PHYSICAL ACTIVITY, SCREEN-BASED SEDENTARY BEHAVIOUR, DIETARY HABITS AND ADIPOSITY OF 9 TO 11 YEAR OLD SCHOOL CHILDREN IN NAIROBI COUNTY, KENYA

BY

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DECLARATION

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

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This work is dedicated to God for His grace, provision and favour, to my parents for finding it worthwhile to educate and support their daughter and to all Kenyan children in the pursuit of healthy active living.

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DEFINITION OF TERMS

Accelerometry: measurement of body movement using a motion sensor called an accelerometer (Actigraph, 2011).

Anthropometry: measurement of body size and proportions including stature, weight, circumferences, bony width and lengths, and skin fold thicknesses (Heyward, 2006).

Epoch: term used in accelerometry and refers to the amount of time over which activity counts are summed and stored (Actigraph, 2011).

Sedentarism: lengthy periods of time spent in sedentary behaviours characterised by minimal movement, low energy expenditure and rest (Canadian Society for Exercise Physiology (CSEP), 2011).

Sedentary: a class of behaviours such as sitting, watching television, playing video games that cause little physical movement and low energy expenditure (CSEP, 2011)

Operational Definitions of Terms

Adiposity: a general term used for indices of body weight and fatness in the assessment of physical status (e.g. bio-impedance measures, body fat levels, BMI categorizations, etc.) of 9 to 11 year old school children in Nairobi County, Kenya.

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

Dietary habits: that which is routinely ingested or consumed by 9 to 11 year old school children in Nairobi County through foods and drinks in terms of type and frequency.

Overweight: BMI of children in Nairobi County between 86^{th} and 95^{th} percentile for their sex and age (9 to11 years) on the WHO 2007 Standards growth chart percentile ranks.

Obesity: BMI of school children in Nairobi County above the 95^{th} percentile for their sex and age (9 to 11 years) on the WHO 2007 Standards growth chart percentile ranks.

Physical activity: bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level that includes general play, PE activities, games and sports of 9 to 11 year old school children in Nairobi County.

Physical activity level: classifications of energy expenditure as vigorous (>7 METS), moderate (>4 METS) or low (<4 METS) derived from estimates of physical activities expressed in MET (metabolic equivalents) of 9 to 11 year old children in Nairobi County.

Sedentary screen time: time spent by 9 to 11 year old school children in Nairobi County, viewing TV or movies, playing video games, and using mobile phones and computers or any other gadgets that have a screen and is operated in a sedentary fashion.

ABREVIATIONS AND ACRONYMS

AAHPERD	-	American Alliance for Health, Physical Education, Recreation and Dance
AHKC	-	Active Healthy Kids Canada
ANOVA	-	Analysis Of Variance
BF	-	Body Fat
BMI	-	Body Mass Index
CDC	-	Centers for Disease Control and Prevention
CSEP	-	Canadian Society for Exercise Physiology
DHHS	-	Department of Health and Human Services
FFQ	-	Food Frequency Questionnaire
HAKK	-	Healthy Active Kids Kenya
ICAD	-	International children's accelerometry database
IOTF	-	International Obesity Task Force
ISCOLE	-	International Study of Childhood Obesity, Lifestyle and the Environment
LPA	-	Light Physical Activity
KIDS-CAN	-	Kenyan International Development Study – Canadian Activity Needs
MET	-	Metabolic Equivalents
MPA	-	Moderate Physical Activity
MUAC	-	Mid Upper Arm Circumference
MVPA	-	Moderate- to Vigorous Physical Activity
NCD	-	Non-Communicable Diseases

PA	-	Physical Activity
PE	-	Physical Education
SBRN	-	Sedentary Behaviour Research Network
SES	-	Socioeconomic Status
SPSS	-	Statistical Package for Social Sciences
ST	-	Screen Time
TRB	-	Transportation Research Board
TV	-	Television
VPA	-	Vigorous Physical Activity
WC	-	Waist Circumference
WHO	-	World Health Organization

ABSTRACT

Lifestyle related chronic diseases in adulthood are potential health consequences of failing to regulate body weight issues and lifestyle behaviors such as physical activity (PA), sedentariness, and dietary intake in childhood. The purpose of the study was to assess the PA, diet, sedentarism (screen-time - ST) and adiposity of 9 to 11 year-old primary school children in Nairobi County. The study used a cross-sectional analytical design and engaged a total of 563 children from primary schools in Nairobi County. PA levels and patterns were objectively measured using an Actigraph GT3X+ accelerometer for 7 consecutive days. Sedentary ST and dietary habits were assessed by self-report using a questionnaire. Adiposity of the children was classified using BMI (WHO Standards) and percent body fat. Data were analyzed using SPSS, Version 17.0. Independent T-tests and one way ANOVA were used to compare differences in the means of variables. Chi-square test and binary logistic regression was used to establish the relationship between categorical variables. Multinomial logistic regression was used to identify the predictors of adiposity. A p-value of <0.05 was considered significant. Most of the respondents (73%) were of normal body weight and there were significant differences in adiposity by SES **(**$p < 0.001$). About 14.3% were sufficiently active with more males (20.2%) meeting the WHO recommended PA levels than females (9.3%). A higher percentage of participants from public schools (26.5%) met the recommended PA levels than those from private schools (0.8%) and were found to be 42.6 times more likely to be sufficiently active than private school participants (p=0.001). Participants from private schools were 5.1 times more likely to be overweight/obese (OR=5.1; 95% CI: 3.14 - 8.145; p <0.001) than those from public schools. Majority (95.5%) of the overweight, and all the overfat and obese respondents were 9.8 times more likely to be insufficiently active than those who were not (OR=9.8; 95% CI: 2.357 - 40.674; p=0.002). Most of the participants that achieved the set PA guidelines were from low SES. Overall, 15.5% of the participants had high ST and spent 4.25 hours in screen-based sedentary activities on a weekend day (higher than the CSEP recommendation of not more than 2 hours of ST daily). ST was significantly associated to adiposity status ($\chi^2 = 18.057$, $p = 0.035$). The most frequently consumed foods on a weekly basis were vegetables (5.3) and fruits (5.1). Those who consumed cakes/pastries (χ^2=14.679, p=0.023), potato crisps (χ^2=21.626, p=0.003) and fast foods (χ^2=13.462, p=0.036) more frequently were significantly less likely to be overweight/obese. The strongest predictors of adiposity status were PA and type of school attended (p<0.001 for both). All the null hypotheses were rejected. The study recommends that further studies and intervention plans should focus on those who are overweight/obese, those with insufficient PA and high ST levels. More focus should also be directed towards factors identified to greatly influence lifestyle behaviours and adiposity (type of school and PA). Policies should also be formulated to promote and further enhance the current efforts on healthy active living among children.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Both developed and developing countries are grappling with a heavy burden of Non-Communicable Diseases (NCDs) (WHO, 2009). Overweight and obesity are recognized risk factors for various NCDs and chronic health problems like cardiovascular diseases, hypertension, stroke, type 2 diabetes mellitus and osteoarthritis (Cappuccio et al., 2008; Asfaw, 2006). The World Health Organization [WHO] (2010) defines obesity as a disease in which excess body fat accumulates to such an extent that one’s health may be adversely affected. Studies have shown that central, upper body, or visceral distribution of fat, independent of total adiposity, are risk factors for poor health in both adults and children as excess abdominal fat is associated with hyperlipidemia which is a risk factor for cardiovascular disease, type II diabetes among other morbidities (Fernandez et al., 2004; Lurbe et al., 2001; Okosun et al., 2000).

About 20-50% of urban populations in Africa are classified as overweight or obese (Sodjinou et al., 2008; Kamadjeu et al., 2006). It is also estimated that by 2025, three quarters of the obese population globally would be in non-industrialised countries such as those in Sub-Sahara Africa (WHO, 2005). It has been reported that in some developing countries, especially in the continent of Africa, the state of being overweight coexists with under-nutrition (Petersen & Kruger, 2004). There are also reports indicating that in some African countries such as South Africa, increased weight and fatness affects more children than malnutrition (International Obesity Task Force [IOTF], 2010).

Whitaker et al. (1997) stated that the risk of being an obese adult from being obese as a child increases significantly at age 10 years. This suggests that age 10 may be a critical period to address and prevent both childhood and adulthood obesity. It has also been found that between 25% and 40% of the variability in population body weight can be explained by genetics, leaving at least 60% of the influence attributed to the environment (Brownell & Horgen, 2004). Therefore, this signified that a person's lifestyle largely influences their body weight and fatness status.

A rise in national economic prosperity and resulting changes in environmental settings as a result of urbanisation affect people's lifestyles, especially in relation to physical activity (PA) and dietary habits (Yamauchi et al., 2001). Kenya, like many developing countries is facing a rapid epidemiological transition as a result of technological advancements that are changing lifestyle behaviours (Onywera et al., 2012; Tremblay et al., 2010; Onywera et al., 2010). Typical urban lifestyles, technological advances, and better economic status come with increased access to and consumption of energy-dense foods and sedentary activities such as motorized transport, electronic media and mechanization/automation of chores (Unwin et al., 2010; Christensen et al., 2008). These have resulted in many people, especially children, having a positive energy balance and increased adiposity (Ojiambo et al., 2012; WHO, 2005). Increased adiposity among children manifests from interactions of such factors as daily PA, diet and sedentarism. When energy intake is higher than energy output, the result is weight gain over time (Maziak et al., 2008).

Physical activity (a means for energy expenditure) helps in maintaining energy balance and good health. Understanding the strength of the associations between PA and health is limited by complexities in precisely quantifying PA, which is a multi-dimensional and highly erratic behaviour (Sherar et al., 2011). It had been noted that despite common perceptions that children are ‘naturally' active and that PA is a normal part of childhood, studies in developing countries reported that children are often inactive (Trippe, 1996; Heath et al., 1994). They noted that the children spent only a small proportion of their awake time (~20%) in any form of PA while the remainder of the time was spent in light activity or sedentary behaviours (Hesketh, 2010**; Mc**Veigh et al., 2004a**)**. Sallis (2000) also noted that although children obtain reasonable amounts of PA at a younger age, the levels decline throughout childhood to well below recommended levels. Active children are also more likely to continue being active into adulthood (Corbin, 2001; Vanreusel et al., 1997). Again, factors which may promote or discourage children from PA are quite different from those that influence adults (Bauman et al., 2012). Therefore, understanding the factors that may encourage the attainment of active lifestyles during childhood is crucial in establishing life-long patterns of PA (McVeigh et al., 2004a).

In **school, PA largely entails** sports, games and activities in Physical Education (PE) (Summerfield, 2011). Physical educators incorporate a variety of physical activities into the curricula to enhance pupils’ PA (Murray et al., 2009). Previously, it has been noted that unstructured PA and active play may be equally good if not a better way of increasing PA compared to organized sports and physical activities (Active Healthy Kids Canada [AHKC], 2011). It has also been noted that the school setting represents a good location for studies on childhood lifestyle given the amount of time children spend in school (Fox et al., 2004). To attain a complete picture of lifestyle behaviours, the assessments should take an approach of segmenting the week (weekdays verses weekends), day (during and after school program) and time (time of day) as well as assess activity levels within and outside the school to shed light on the places and times when school-aged children are most active (Nilsson, 2008; Fairclough et al., 2007; Jago et al., 2005).

There is also strong evidence indicating that physical inactivity contributes to weight gain and the obesity pathogenesis (Tremblay et al., 2008; WHO, 2004_b). Evidence suggests that the amount of time one spends in sedentary behaviour (e.g. sitting) is strongly associated with an elevated health risk, independent of their level of PA (Tremblay et al., 2010b). An important factor in understanding sedentarism in children is recognizing the many hours they engage in screen-based activities such as watching television, playing video games and operating a computer (Must & Tybor, 2005). The growth of electronic media has dramatically increased TV viewership amongst children, and the advent of video games, computer, internet and cell phone ownership has similarly increased sedentary behaviour, taking up time that children would have otherwise used in active PA (Must & Tybor, 2005). Therefore, assessment of screen-based sedentary behaviour with Screen Time (ST) as the indicator could serve as a valuable index of sedentarism.

Patterns of inactivity often begin early in life and can persist throughout a lifetime, leading to a loss of health and productivity. This has made the encouragement of PA among children imperative (Healthy Active Kids Kenya [HAKK], 2011). According to a study by Onywera et al. (2010), most of the urban children in Kenya spent more time watching TV, playing video games and on computers, than their rural counterparts. A report by HAKK (2011) also showed that urban Kenyan children were more sedentary and were being exposed to obeseogenic lifestyles and environments (those that promote the consumption of energy dense foods and discourage PA participation). There was therefore need to conduct a follow-up assessment on urban children to study this further.

Childhood adiposity is also greatly influenced by dietary intake **(**Spurrier **et al., 2008)**. An excessive energy intake in comparison to total daily energy expenditure over time may result in adverse accumulation of body fat and related co-morbidities (DeLany et al., 2013). Unhealthy food is increasingly available in developing countries, including Kenya, in multiple settings including schools. Additionally, processed and fast foods are locally available in larger portion sizes at relatively low prices (Daniels, 2009[a]). A study by Adamo et al. (2011) reported that urban Kenyan children appeared to be showing signs of a nutrition-transition. This transition is characterized by changes in dietary habits on intake of fat, intake of starch, sugar, protein, fruits and vegetables. Nevertheless, this has not been conclusively investigated. A study conducted elsewhere by Nago et al. (2010) reported that the main change was that diets were mostly based on ready-to-eat purchased foods with excessive amounts of saturated and trans-fatty acids, sugars and salt. These foods affected children more since they are particularly prone to bad food choices.

Based on the foregoing issues, there seems to be an elevated risk of energy imbalance from transitions in PA, sedentarism and dietary habits – and this requires further investigation. In research, drifts towards increasing childhood weight, fatness and related co-morbidities are still precipitating an increased level of interest in examining trends and patterns in PA, sedentary lifestyles and multimedia based activities. These factors appear to progressively erode the potentially active time of children (Onywera, 2010; Tremblay et al., 2008), thus provoking an energy imbalance. Little is known about these trends in Kenya's urban children.

A report by HAKK (2011) entitled 'Kenya's 2011 Report Card on the PA and Body Weight of Children and Youth' found that there was insufficient information on PA trends and practices in Kenyan schools. The report recommended that there be more studies to increase knowledge and understanding of the relationship between PA, healthy eating and other health determinants that contribute to or inhibit optimal health. A study by Kamau et al. (2008) found that overweight and obesity had a cumulative prevalence of 11.9% among 10 to 15 year old primary school children in Nairobi, Kenya. A study by Adamo et al. (2011) also reported that urban Kenyan children appeared to be showing signs of PA - transition, mainly shifting from high energy consuming activities towards more sedentary activities even at school. The present study intended to conduct a follow-up on these studies.

The study was part of a large multi-national study of lifestyle and obesity in children. The International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) was a cross-sectional study that aimed at determining the relationship between lifestyle characteristics and obesity amongst 9 to 11 year-old children. It also investigated the influence of higher-order characteristics such as behavioral settings and the physical, social and policy environments, on the observed relationships within and between countries. The study was conducted in twelve countries (Australia, Brazil, Canada, China, Colombia, Finland, India, Kenya, Portugal, South Africa, United Kingdom and United States) from five major geographical regions of the world (Europe, Africa, The Americas, South-East Asia and Western Pacific). The ISCOLE team and Coordinating Center at Pennington Biomedical Research Center in Baton Rouge, Louisiana USA, was responsible for protocol development, regulatory oversight, training of personnel and quality control. The ISCOLE protocol included data collected from several objective and subjective sources, including pupils, their parents, school administrators, as well as direct observations of the school environment by the ISCOLE staff (Katzmarzyk et al., 2013). Data on physical characteristics of the children to classify their body weight and fatness status, data on PA (measured with the most objective techniques available at the time) as well as data on child’s dietary and sedentary lifestyle, provided the necessary information for addressing the objectives set forth in this thesis.

1.2 Problem Statement

Physical activity is a multi-dimensional exposure variable, occurring with varying frequencies, durations and intensities, and constitutes a challenge to assess in free-living populations (Sherar et al., 2011). Knowledge on levels, patterns and adequacy of PA in children in Kenya just like other low income countries is limited due to the difficulty of measuring this complex behaviour in normal daily living and limitations in the methods used (Basterfield et al., 2008). Quantification of structured, unstructured, incidental and lifestyle embedded physical activities requires objective monitoring (Tremblay et al., 2008), and such monitoring is required to accurately quantify individual energy expenditure (Maria et al., 2010). This study addressed this gap using accelerometry (Actigraph accelerometer), a validated objective method for assessing PA.

According to the Kenya 2011 report card by HAKK (2011), there was a need for surveillance data on daily PA profiles of Kenyan urban children. The urban children's habitual and structured PA levels remained to be determined as no study had measured this in the required depth and extent to warrant conclusive findings. While there were a few studies that had used objective measures of PA of Kenyan children (e.g., Ojiambo et al., 2012), there was still very little research on objective measurement of PA in Kenyan children. Previous studies had been conducted in rural and suburban areas with a restricted population using different methods, monitors and analysis and had presented conflicting findings. It was clearly evident that information on the evidence of the urban children population from diverse backgrounds was very limited. In addition, important new information on levels and patterns of activity among children in comparison to set international recommendations (on PA levels) was required to help classify children appropriately as well as to inform interventions for promotion of PA and reduction in sedentary behaviour.

Information on the status and trends of PA, sedentary behaviours and dietary habits and their contribution to body weight and fatness is required to assess, understand and monitor the threat of increased childhood adiposity. Therefore apart from PA, dietary habits and sedentary screen–based behaviour were also assessed for comparative purposes as valuable indices of energy intake and energy balance in the energy equation. Although findings of studies conducted elsewhere showed significant associations between PA, sedentary ST, diet and adiposity (Davis et al., 2007; Janssen et al., 2006; Guillaume & Lambert, 1998), accurate estimates of the strength of associations among Kenyan children were not available as few epidemiological studies examined the relationships between these lifestyle habits and adiposity levels. Mechanisms behind the associations between TV viewing and adiposity in children found elsewhere were also not clear, and the interactions between ST and PA had not been fully delineated in Kenya. Many of the studies also showed inconsistent findings, perhaps because virtually all studies have environmental variability, unique factors and methodological differences, hence the need to assess the local situation.

The potential adverse effects of daily lifestyle on body weight and fatness of urban Kenyan children were not well known (Adamo et al., 2011) due to paucity of data on the issue. Thus, an in-depth study to assess and report on lifestyle factors focusing on both sides of the energy balance equation; PA, dietary habits, and screen-based sedentary behaviour patterns and an examination of their correlation to body weight and fatness, was conducted to improve on the knowledge of the healthy lifestyle behaviours of urban Kenyan children.

1.3 Purpose of the Study

The purpose of this study was to assess and describe the PA level and patterns, dietary habits and screen-based sedentary behaviour in relation to gender, type of school attended and socio-economic status (SES) of school children aged 9 to 11 years in Nairobi County, Kenya. Further the study aimed at assessing the associations between objectively measured PA, sedentary ST, dietary habits and adiposity status (body weight and fatness status) of 9 to 11 year old Kenyan urban children.

1.4 Study Objectives

This study was guided by the following objectives:

1. To assess the adiposity status (body weight and fatness status), PA level and patterns, dietary habits, and screen-based sedentary behaviour patterns of 9 to 11 year old school children in light of recommendations set by the WHO.
2. To assess selected factors that promote PA (active transport, outdoor play time, school opportunities and facilities for PA and school PA policies) among 9 to 11 year old school children in Nairobi County.
3. To determine the relationship between PA levels and body weight, and fatness status of 9 to 11 year old school children in Nairobi County.
4. To determine the association between sedentary ST habits and body weight, and fatness status of 9 to 11 year old school children in Nairobi County.
5. To determine the relationship between dietary habits and body weight, and fatness status of 9 to 11 year old school children in Nairobi County.
6. To examine differences in the relationships between PA, dietary habits and ST to adiposity status of 9 to 11 year old school children by sex, school type and SES.
7. To compare the associations of PA, diet and ST to adiposity status of 9 to 11 year old school children in Nairobi County.

1.5 Research Hypotheses

The following hypotheses guided the study;

$H0_1$ There is no significant relationship between PA levels and body weight, and fatness status of 9 to 11 year old school children in Nairobi County.

$H0_2$ There is no significant association between sedentary ST habits of 9 to 11 year old school children in Nairobi County and body weight, and fatness status.

$H0_3$ There is no significant relationship between dietary habits of 9 to 11 year old school children in Nairobi County and body weight, and fatness status.

$H0_4$ There is no significant difference in the relationships between PA, dietary habits and ST of 9 to 11 year old school children by sex, type of school and SES.

$H0_5$ There is no significant difference in the comparison of associations of PA, diet and ST to adiposity status among 9 to 11 year old children in Nairobi County.

1.6 Significance of the Study

It is anticipated that this study may provide important new information on the increasing public health challenge of childhood adiposity in Kenya. The study has provided foundational information upon which measures and interventions could be designed and conducted. Further, the study has introduced the use of objective assessment of PA by accelerometry for a large population of Kenyan schoolchildren and has increased the knowledge of its use locally. The use of objective assessment of PA has also revealed the sources of variability in PA behaviour among children which is important for future studies and interventions. In addition, data on objectively measured PA patterns are important in formulating appropriate recommendations on PA. The study outcomes are likely to influence policy making leading to the development of new policies and/or improving existing ones. For instance, policies in the Ministries of Health and Education particularly on school programs, curriculum and teacher training can be reviewed to promote PA among children at high-risk of increased adiposity, at specific time frames and in school programs. In addition, child health disparities that have an impact on daily lifestyle may be addressed and may lead to initiatives that promote healthy, active living.

1.7 Delimitations of the Study

The study was delimited to school-going children aged 9 to 11 years (9.0 to 11.9, mean age = 10 years) attending private and public mixed day primary schools in Nairobi County.

1.8 Limitations of the Study

The study was conducted under the following limitations:

1. The study did not investigate genetic determinants for childhood adiposity.

2. The study only involved schools, children and parents who provided consent to participate. Therefore, the possibility of selection bias to achieving representativeness of the sample cannot be ruled out.

3. Foreign studies and research instruments were used to strengthen the conceptual basis of the study due to a paucity of local information. Nevertheless, the instruments were adapted, as much as possible, to suit the local situation.

4. The use of accelerometry had the following limitations a) only dynamic muscular work could be detected with any reasonable reliability (Chen & Basset, 2005), thus static work or work against external forces remain largely undetected and b) the monitors were not to be used in water therefore findings excluded water-based physical activities such as swimming c) the accelerometers were worn on the hip so upper-body specific movements may not have been accurately captured.

1.9 Assumptions of the Study

The study was carried out based on the assumption that the large and varied sample size lessened the effects of influence of genetic factors. The larger the sample size, the more the variability in a population sample thus making it highly unlikely to have all the sampled children with the obesity-causing genes.

1.10 Conceptual Framework

Socio-ecological models provide the most widely supported conceptual frameworks for the study of childhood lifestyle (Glanz et al., 2002). The ecological approach recognizes that human behaviour is a result of interactions among multiple levels of influence with interdependency among these levels (Stokols, 1996). Socio-ecological model-based investigations look at the multiple effects and interrelatedness of social elements in an environment, connected through networking relationships (McLeroy et al., 1988).

Various individual, family, community, policy, physical, social and environmental factors collectively contribute to an ‘obeseogenic environment’; the actual context in which children are developing (Sallis et al., 2006). The development of high body weight and fatness status involves interactions among these multiple levels that shape daily diet and PA, which operate in conjunction with one another to trigger changes in the body (Sallis et al., 2006).

Ecological frameworks describe 'obesogenic' environments in terms of macro and micro environments over which individuals have more or less control (Grzywacz, 2000; Swinburn et al., **1999**). Characteristics of such environments are said to be direct determinants of children's active healthy lifestyles. Such lifestyle behaviours are complex and are affected by multiple levels of influence such as intrapersonal characteristics, higher-order factors that include local and national policies, the physical environment, behavioral settings and local cultures (Story et al., 2008; Sallis et al., 2006). Micro-environments include the school, home and the neighborhood which largely determine the child's lifestyle, food availability and opportunities for PA (Booth et al., 2001). Macro-environments include transport, food supplies, the built environment, school programs, government services and policies (Spurrier **et al., 2008)** which may support or obstruct healthy childhood. The study was anchored in such an ecological framework. The conceptual model that guided this thesis is illustrated in Figure 1.1.

Basically, children spend most of their day**s either at school engaging in programs or at** home attending to duties which are either active or inactive and form their lifestyle. Physical activities in these endeavors promote energy expenditure while sedentarism reduces it (Must & Tybor, 2005). Long-term energy balance can be estimated by assessing body weight and fat status. The study therefore assessed childhood lifestyle in relation to habitual PA, dietary habits and sedentary ST patterns and their body fatness and body weight status as indicators of healthy active living.

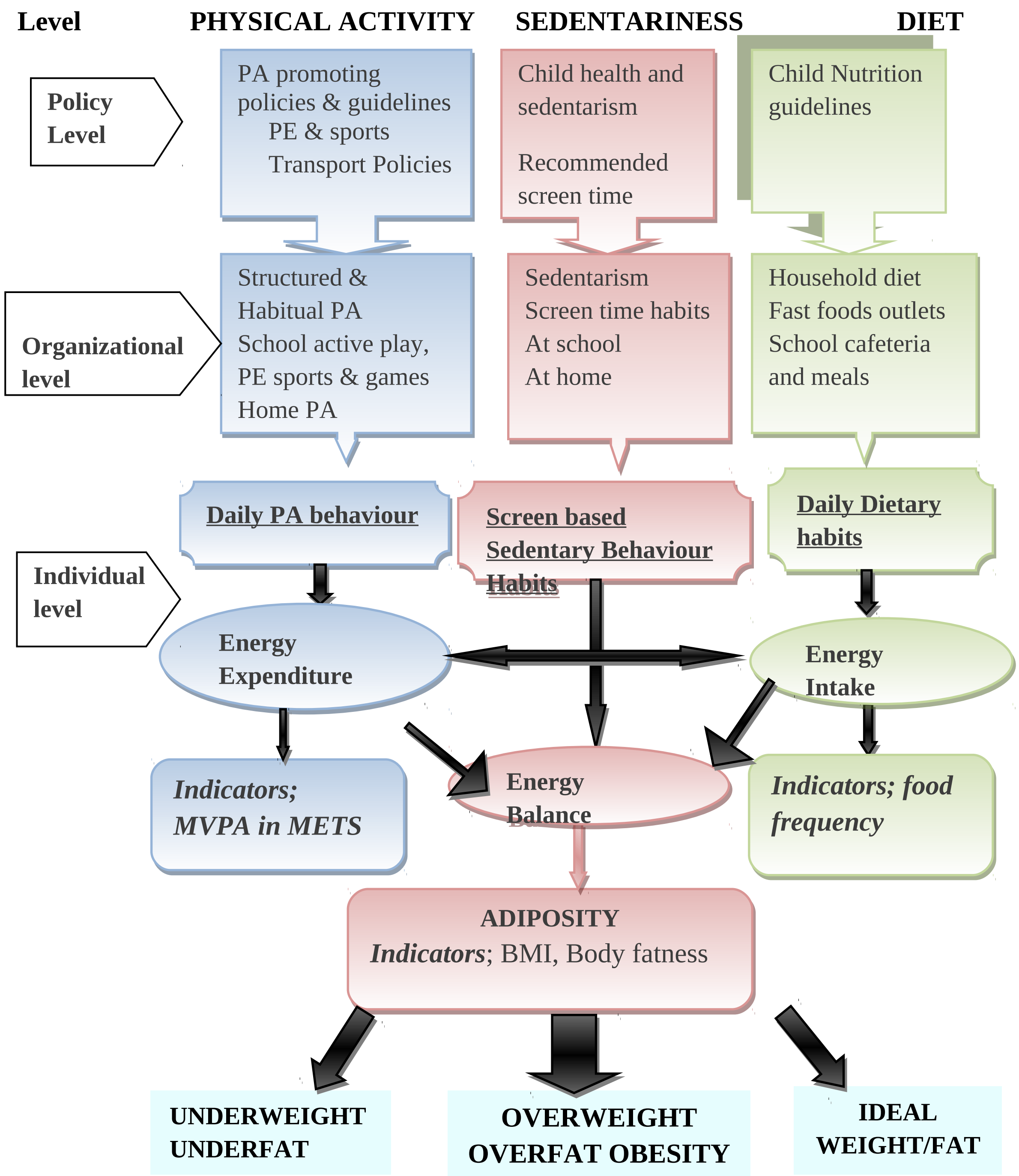


Figure 1.1: Conceptual framework of Childhood Healthy Active Lifestyle
SOURCE: Developed by the researcher based on insights from literature and the socio-ecological model by Sallis et al. (2006).

CHAPTER TWO: LITERATURE REVIEW

2.1 Adiposity among Children

In children, obesity occurs when there is an increase in the number and size of fat cells whereas in adults, fat loss or gain is as a result of decrease or increase, respectively, in the size of fat cells with no change in the number of fat cells (Kuk et al., 2009). Continued storage of fats in the body leads to increased adiposity which is mainly expressed as fatness and is also seen to contribute to body weight (Willhite, 2011). On the other hand, too little body fat is also a health risk as the body also needs a certain amount of fat to support normal physiological functions (Heyward, 2006). Understanding the distinction between overweight (mainly expressed as relative weight for height) and overfat (that includes relative body fat (%BF) and aspects of fat distribution) is essential (Laurson et al., 2011; Freedman & Sherry, 2009) when studying adiposity.

2.1.1 Assessment of Adiposity

It is widely recognized that measuring childhood obesity is a complex process (Share & Strain, 2008). An ideal measure of obesity should be accurate in its estimate of body fat. The measure should be easy to obtain in terms of time, cost and acceptance by the child and should use well-documented and published reference values (Wells & Fewtrell, 2006; Power, Lake & Cole, 1997). To classify level of body fatness (under or overfatness) the relative body fat (%BF) is used and there are recommended % BF standards for children where values vary with age, gender and activity status (Heyward, 2006). For weight status, the definition and determination of levels (underweight, overweight and obese) in children and adolescents is different from that of adults (Patrick et al., 2009). Body Mass Index (BMI) classifications in children are age and sex specific to account for changes in body weight and fat that occur as they grow and mature (WHO, 2013; Patrick et al., 2009; Ogden et al., 2002). For instance, a BMI-for-age and sex at or above the 95^{th} percentile indicates obesity and a BMI between the 85^{th} and 95^{th} percentiles for their age and sex is considered overweight (WHO, 2013). BMI-for-age and sex between 85^{th} and 5^{th} percentiles indicates normal/ideal weight while below 5^{th} percentile signifies underweight status. A good correlation exists between BMI and percentage body fat for all ages and both sexes (WHO, 2000). However, given that BMI does not measure body fat directly (Ponder & Anderson, 2007), the percent body fat should be determined separately for reliability purposes to further categorize individuals according to weight and fatness status. Many studies use BMI as a proxy for body fat because it is more easily assessed, despite its limitations of being correlated with both lean and fat mass (Wells, 2000) which may lead to misclassification of mesomorphic individuals.

Anthropometry is an inexpensive and non-invasive measure of the general nutritional status of a person or population group (Cogill, 2001). It is the measure of the size and proportion of the human body segments (Heyward, 2006). The measurements include standing height (stature) and weight (used to calculate BMI), measures for sitting height to standing height ratio (Cormic Index), measures of bony width and lengths, skin fold measures and circumferences such as waist, hip circumferences and mid-upper-arm circumference (MUAC) (Heyward, 2006; Cogill, 2001). MUAC is commonly used to indicate nutrition status, including malnutrition.

It is well known that waist to hip ratio and waist circumference measurements assess total abdominal fat accumulation, but they do not provide a quantitative measurement of abdominal fat distribution, i.e. visceral and subcutaneous fat (Christensen et al., 2008).

The gold standards for the quantitative assessment of visceral fat tissue are computed tomography (CT) and magnetic resonance imaging (MRI) (Shuster et al., 2012). However, due to equipment size, costs and radiation exposure, these methods are not practicable for epidemiological research purposes (Christensen et al., 2008). There was a consensus that waist circumference alone may be a more useful index in both adults and children (Taylor et al., 2000; Harris et al., 2000; Savva et al., 2000). Although it cannot discriminate between subcutaneous and visceral fat, research supports waist circumference as a better predictor of risks of cardiovascular disease (Zhu et al., 2002) than body mass index (Fernandez et al., 2004). In addition, studies that used more precise measures of adiposity have supported associations between intra-abdominal fat and a variety of metabolic disorders, which becomes evident at early stages of life (Goran & Gower, 1999; Owens et al., 1998).

It is also well recognized that body composition is a key component and indicator of nutritional health, mainly in the determination of an individual's body fat mass and fat-free mass ratio (Wells & Fewtrell, 2006). The gold standards for the determination of body composition include isotope dilution, densitometry and dual X-ray absorptiometry. These techniques provide accurate information but are expensive, require sophisticated technical expertise, and may not be suited for use in many settings (Wells & Fewtrell, 2006). Bio-electrical Impedance Analysis (BIA) is an inexpensive, simple to perform, non-invasive method and uses a portable machine which is a useful alternative for predicting body composition and has been validated even in child populations in field settings (Heyward, 2006). With this method, a low-level current is passed through the subject's body and the impedance which is seen as the resistance to flow of current, is determined using a BIA analyzer. This is based on the notion that resistance of current flow is greater in subjects with larger amounts of fat since adipose tissue (that has low water content) is a poor conductor of electrical current (Heyward, 2006).

2.1.2 Causes and Factors Influencing Childhood Obesity

Obesity is not a single disease but is instead a condition with a multi-factorial etiology that includes metabolic, genetic, environmental, social and cultural interactions (Carvalhal et al., 2006). Obesity is thought to be associated with children's increased exposure to calorie-dense foods and sedentary lifestyle choices (Kumanyika et al., 2002). Although some genetic predispositions contribute to childhood obesity, its rapid increase in genetically stable populations indicates the importance of social and environmental factors in causing obesity (Maziak et al., 2008). Strong associations between childhood obesity and daily lifestyle factors are reported, suggesting that many of the causes are environmental (Ebbeling et al., 2002).

As stated earlier, Kenyan urban children appear to be showing signs of a nutrition - PA transition that may exacerbate an obesity crisis in Kenya. Evidence supporting this was reported in a study by Adamo et al. (2011) on 179 Kenyan children (9 – 13 years) living in urban and rural environments. The nutrition transition was defined as a series of dietary changes in favor of those practiced by the Western culture (Popkin, 2004). On the other hand, PA transition referred to a shift towards more sedentary activities, less active modes of transportation and reduced PA patterns (Onywera, 2010).

2.1.3 Consequences of Childhood Overweight and Obesity

Obesity contributes to serious physical, social, and psychological health complications in children and adolescents (WHO, 2000). Overweight and obese children are at an increased risk for Type 2 diabetes, hypertension, respiratory disorders, cardiovascular disease and psychological problems during childhood and later in life (Canadian Pediatric Society [CPS], 2002). Juvenile obesity and overweight is also associated with poor self-esteem, depression, social discrimination and teasing (Carr & Friedman, 2005).

Overweight and obesity problems in childhood usually continue into adulthood and can result in higher rates of morbidity and mortality from chronic diseases (Maffeis & Tatò, 2001). Therefore, chronic diseases in adulthood are potential health consequences of failing to prevent and control overweight and obesity conditions by promoting PA, healthy eating, and healthy weight in children (Raine, 2004).

2.2 Physical Activity in Children

WHO (2013) defines physical activity as any bodily movements produced by skeletal muscles that require energy expenditure. For children, PA includes play, games, sports, transportation, chores, recreation, PE, or planned exercise, in the context of family, school, and community activities (WHO, 2013). Frequency, duration, intensity and mode of activities are four dimensions that are usually determined when assessing patterns of PA. Frequency relates to how often the activity occurs over time, duration denotes how long the activity is sustained, intensity denotes how strenuous the activity is (McArdle et al., 2006) and mode represents the type of activity. Another frequently used measure of intensity is the metabolic equivalent (MET) for a specific activity. A MET value represents multiples of energy expenditure during rest. One MET is defined as the amount of oxygen consumed at rest which is equivalent to 3.5ml/min/kg. Approximate MET-values from many different activities have been proposed (Ainsworth et al., 2000).

An important function of PA is to help maintain energy balance. Weight gain occurs when energy intake (calories consumed) exceeds total daily energy expenditure for a prolonged period (Maziak et al., 2008; DHHS, 1996). In childhood, total energy expenditure represents the sum of four factors: (a) resting energy expenditure to maintain basic body functions (approximately 60 percent of total energy requirements); (b) processing of food, which includes the thermic effect of digestion, absorption, transport, and deposition of nutrients (about 10 percent of total energy requirements); (c) non-resting energy expenditure, primarily in the form of PA (about 30 percent of total energy requirements) (Müller, & Bosy-Westphal, 2003) and (d) the energy required for growth.

The WHO Global guidelines on PA for health recommend that children and youth aged 5-17 years should accumulate at least 60 minutes of moderate to vigorous intensity PA daily. Most of the daily PA should be aerobic and vigorous-intensity activities should also be incorporated, including those that strengthen muscle and bone, at least 3 times per week (WHO, 2011). Extended periods of inactivity (≥2 hours) are also discouraged for children, especially during daytime (American Alliance for Health, Physical Education, Recreation and Dance [AAHPERD], 2010). Regular PA is important due to its great variability and potential for positive health outcomes (Bénéfice & Cames, 1999).

2.2.1 Assessment of Physical Activity

Physical activity has complex dimensions and its assessment in free-living populations may present challenges (Sherar et al., 2011) if the method of assessment is not properly selected. An ideal method of assessment should be able to assess both the total volume of PA and the nature of the pattern of the activity in a valid and reliable way. The method needs to be well-designed for use in field settings (e.g. non-obtrusive), make little interference with normal living and require low burden to the individuals, especially for use in younger age groups (McClain & Tudor-Locke, 2008; Livingstone et al., 2003; Lamonte & Ainsworth, 2001; Montoye et al., 1996). PA assessment methods can broadly be divided into two groups; subjective (self-report) and objective methods.

Subjective methods include self-administered or interview-administered recall questionnaires, activity logs (also called diaries) and proxy-reports (Lagerros & Lagiou, 2007; Sallis & Saelens, 2000). Data from subjective methods rely on the validity of the reported response by the respondent or from a spokesperson of the respondent. It has been noted that considerable cognitive demands are placed on the respondent when asked to recall specific past events and that children's activity behaviour is sporadic and intermittent (Sherar et al., 2011; Welk et al., 2000; Baily et al., 1995), making it difficult to accurately recall. It has been noted that studies which use self report methods in general tend to report higher levels of physical activity compared to studies using direct measures (Saunders et al., 2011). This discrepancy has been observed and reported by many authors who explain that children tend to over-estimate actual time spent in physical activity and this should be taken into account when interpreting self-report data (Saunders et al., 2011; Adamo et al., 2009; Nilsson, 2008). Due to this, it has been stated that self-report methods should be used with caution in ages 10 to 15 years, and should be avoided in children under the age of 10 years (Kohl et al., 2000; Sallis & Owen, 1999). However, it should be noted that other pieces of information (such as type of activity) from self-report may provide important contextual data to supplement objective measures of PA behaviour (Nilsson, 2008).

Doubly labeled water technique, measurements based on heart rate recording, respiratory gas analysis (indirect calorimetry), behavioural observation, use of pedometers and accelerometry are objective methods of assessing PA. Accelerometry has been used to assess habitual PA in children for many years (Sherar et al., 2011) as it is an accurate, objective, non-invasive, valid, reliable and cheaper method (compared to many of the other objective methods) for epidemiological purposes (Bénéfice & Cames, 1999). Accelerometers are also well tolerated by children (Actigraph, 2011).

2.2.2 Accelerometry

The accelerometer measures body accelerations. It is said to be the most widely used objective PA assessment method (Cain et al., 2013). The theoretical basis of measuring accelerations in the context of PA assessment is that changes in body accelerations reflect changes in energy cost during locomotion (Sherar et al., 2011). Since the accelerometer measures both the magnitude and frequency of body movement, quantification of the intensity and duration of PA is achievable. The monitor is usually placed either at the hip or the back of the body to assess accelerations of the body during locomotion (Ekelund et al., 2001; Ekelund et al., 2000).

Chen and Bassett (2005) fully described the principle and properties of accelerometer technology. In short, the outer shell of the monitor protects the piezoelectric sensor inside which is sensitive to single or multiple plane accelerations. The monitor samples voltage signals in proportion to detected accelerations. The signals first become filtered to discriminate human movement from vibration and other artifacts before they are converted into a digital set of numbers, called ‘counts’. Finally, all counts sampled are summarized over a user-specified time frame (epoch) (Sherar et al., 2011). The intermittent nature of children’s physical activity requires very short epoch settings for detecting high intensity PA (Nilsson, 2008). A shorter epoch (e.g. 1 second) setting is strongly recommended when detailed analysis of PA patterns is required (Chen & Bassett, 2005). For example, when assessing time spent at higher intensity PA during school recess, higher resolution of PA assessment is required in order to capture even short bursts of high intensity PA (Nilsson, 2008).

The monitor is initialized for sampling by connecting it to a computer program via an interface, and after measurement, data from the monitor are downloaded via the interface onto a computer. The raw outcome from the monitor (i.e. counts) reflects the total volume of physical activity performed during the given measurement period. Total counts over registered time ($cnts \cdot min^{-1}$) provide an estimate of the average intensity of PA over a day (Sherar et al., 2011). Thresholds for activity counts corresponding to specific intensities of physical activity are useful when analyzing time spent at different intensity levels of physical activity (e.g. sedentary, light, moderate, vigorous, very vigorous) or when examining proportions of children who reach recommended levels of physical activity (Sherar et al., 2011).

One limitation with most accelerometers, regardless of type, is that only dynamic muscular work can be detected with any reasonable reliability (Chen & Basset, 2005) thus, static work or work against external forces will remain largely undetected. Fortunately, a majority of daily activities have dynamic characteristics and studies show that there is a direct association between body acceleration and energy expenditure (Bénéfice & Cames, 1999). In addition, the monitors are not supposed to get in to contact with water hence the assessment of PA excludes water activities such as swimming.

To date, a large number of studies that included accelerometer-assessed PA, have been published, though most are from samples in developed countries. The following summary presents only those that examined PA profiles and variables of Kenyan children with a highlight of the gaps left and that were addressed by this study.

To begin with, a recent review of Kenyan studies in a report card by HAKK (2011), noted that there was very limited information on the proportion of Kenyan children that are physically active, and more surveillance on PA was needed to determine the overall activity patterns and levels among Kenyan children.

A study by Ojiambo et al. (2012) compared objectively measured habitual PA, sedentary time, and indices of adiposity among adolescents from rural and urban areas of Kenya. PA and sedentary time were assessed by uniaxial accelerometry for 4 consecutive weekdays and 1 weekend day in 97 rural and 103 urban adolescents aged 13 ± 1 years. BMI z-scores were used to assess adiposity. The study concluded that rural Kenyan adolescents are significantly more physically active (and less sedentary) and have lower indices of adiposity compared to urban adolescents. That study examined adolescents of

12-16 years whose adiposity would have likely been influenced by the adolescence growth spurt. The urban population was drawn from a smaller urban town (Eldoret) which may not present the diversity and complete urbanized lifestyle compared to a city like Nairobi. The study used the Actitrainer uniaxial accelerometer which only filters movement in one axis compared to the triaxial monitor being used in the current study to present more detailed findings. That study also only used BMI to assess adiposity which may not adequately present body fatness. Dietary intake was also not measured which was necessary as authors have suggested that differences in energy intake and not physical activity levels may primarily explain observed differences in adiposity (Westerterp & Speakman, 2008), though the two variables should be assessed.

Onywera et al. (2010) assessed the PA levels of Kenyan children from urban and rural environments. The study involved 179 children aged 9-12 years from both rural and urban Kenya schools. Pedometers were used to estimate daily PA in participating children. Findings from the study indicated that children from rural areas were more physically active than their urban counterparts taking more steps per day (18008±594 vs. 13945±527). That study concluded that further research is needed to get more data on the PA patterns of Kenyan children. The study also used pedometers which when compared to accelerometers, present inadequate PA outcomes for conclusive analysis of PA levels and patterns, since pedometers only measure total accumulated ambulatory PA.

Another study (Croteau et al., 2011) examined pedometer-measured PA levels of western Kenyan youth then compared the results to those of children in developed countries. Participants (n = 72, age range = 8–12 years) wore a sealed Yamax pedometer for 4 weekdays. Results showed that the total sample averaged 14558 ± 3993 daily steps. There was a significant effect with regard to gender [$F (1, 68) = 4.791$, $P = .033$], with boys (16262 ± 4698) being significantly more active than girls (13463 ± 3051). Accelerometers could have assessed patterns and varying intensities, and could capture other types of physical activities that are not ambulatory in nature much better than pedometers. They could also present more detailed findings. The studies should have employed larger sample sizes to capture the variability and habitual PA patterns of diverse lifestyles. This study examined rural children only whilst children in urban settings may have different levels of PA. This study also assessed PA during the week only excluding activities over the weekend. It has been proposed that weekend activities be investigated as studies have shown differences in children's PA levels during the week and on the weekend (Treuth et al., 2007; Jago et al., 2005; Trost et al., 2000).

In reviewing some related studies conducted elsewhere in developed countries on objectively measured PA in children, it was noted that there was a lifestyle characterized by a low volume and low intensity level of PA (Ekelund et al., 2012; Basterfield et al., 2011a, 2011b; Troiano et al., 2008;). However a similar current study in South Africa presented a low intensity, high volume of PA in rural South African children and adolescents (Craig, Bland, & Reilly, 2013). Such details about the Kenyan urban child are yet to be determined and were addressed in the current study as well as the gaps presented in the analyses above.

2.2.3 Determinants and Variability in Physical Activity Patterns in Children

To understand PA and sedentary behaviours, studies need to identify the determinants of PA and variability that affects PA patterns. Age, gender, ethnicity and SES are examples of non-modifiable determinants for PA that also help in identifying special categories/groups at risk of being inactive (Sallis & Owen, 1999). There are several modifiable determinants for PA among children that include active play, household chores, sport participation, PE and active transportation to and from school (HAKK, 2011). Active transportation to and from school is one important factor that is generally associated with higher levels of daily PA (Sirard et al., 2005). Other factors associated with active transportation include individual characteristics, the social environment, public policies (e.g., in urban planning) and the built environment (e.g., greater walkability and cycling lanes) (AHKC, 2011).

For children, time spent outdoors compared to time spent indoors is also strongly associated with PA in those who are younger than 13 years (Ferreira et al., 2006; Sallis et al., 2000). Different types of leisure time activities, for instance organized sports, are also seen to influence the overall daily PA levels (Fairclough et al., 2007; Spinks et al., 2006). Additionally, school days and weekend days also present differences in types of PA as well as opportunities for activity while different time blocks of a day have also previously been shown to significantly vary patterns of PA (Jago et al., 2005).

2.2.4 Physical Education and Physical Activity

Lessons in PE are one of the five most strongly recommended interventions for increasing the PA of children and adolescents (Maria et al., 2010). PE provided at school is an ideal way to encourage activity and develop fitness among children and for many children, this may be their only preparation for an active lifestyle. School PE and recess/break times are great opportunities for the child to be physically active, although school time is likely to be more restricted compared to free time after school or over the weekends (Fairclough & Stratton, 2005; Ridgers et al., 2005; Mota et al., 2005). Even though the Ministry of Education in Kenya has a policy that states that children and youth are required to engage in 40 minutes of PE 3 times per week (Kenya Institute of Education, 2002), the teaching of PE is often not taken seriously. In many schools, PE lessons are often used to teach other examinable subjects (HAKK, 2011). This is probably a problem of attitude towards the subject as there are adequate human resources in primary schools. All teachers who graduate from teacher training colleges in Kenya, who form the bulk of primary school teachers, take PE as a compulsory subject (Kenya Institute of Education, 2002). There is need for further studies geared to examine opportunity for PA through PE lessons in Kenya.

The Center for Disease Control and Prevention (CDC) recommends comprehensive daily PE for children (CDC, 2013) with ‘Healthy People 2010’ (CDC, 2010) guidelines stating that 50% of every PE lesson should have Moderate to Vigorous Physical Activity (MVPA). A study by Nettlefold et al. (2011) that used accelerometers to measure PA in 8 to 11 year olds in British Columbia, found that girls spent 13% and boys spent 11% of their PE class in MVPA. In fact, only 2% of girls and 3% of boys spent at least 50% of PE class in MVPA. In their meta-analysis, Maria et al. (2010) found that children, especially boys, were more active outside of PE lessons than during the lessons. One study in the U.S. found an average child to be vigorously active for only two minutes during thirty-minute classes (Sarkin et al., 1997). In another study conducted in the U.S., researchers found that PE lessons conducted by classroom teachers consisted mainly of games in which a few children were active, while the remainder waited for a turn, and only 5% of these classes had fitness activities as their major focus (Faucette et al., 1999). An observational study of third-grade children during PE lessons in 95 schools in the U.S. showed that children accrued only 5−10 minutes of MVPA in classes of 32 minutes (McKenzie et al., 1995). A study of children enrolled in grades 1 to 8 (Rowe et al., 1997) found that MVPA represented 37% of the total time during PE classes, substantially below the 50% suggested in ‘Healthy People 2010’ (CDC, 2010). Another longitudinal intervention study showed that PA levels during PE lessons could be improved through curriculum changes, teacher training and longitudinal follow-ups (Sallis et al., 1997).

Considering the amount of time children spend in school, the school set-up provides an excellent opportunity to positively influence children to lead a more active lifestyle (HAKK, 2011). Sports serve as an excellent opportunity for PA and schools should provide an all-inclusive sports culture and infrastructure to promote PA (HAKK, 2011). Schools should therefore have ample space and allocate adequate time to allow participation in various sporting activities.

2.3 Sedentary Behaviour among Children

Public health agencies have given little attention to the increasing evidence that supports sedentary behaviour as a distinct health concern and have concentrated on getting populations to meet PA recommendations (AHKC, 2011). Despite the perception that children are ‘naturally' active, they have been found to spend quite a significant amount of time in sedentary activities **(**Hesketh, 2010). Advances in modern technology may have contributed to this problem by reducing children's PA engagement (Bassett et al., 2007). Inactivity resulting from excessive sedentarism is widely recognized as a major factor in obesity development (Lanningham-Foster et al., 2006) and also leads to decreased fitness, self-esteem and academic performance, and increased aggression in children (AHKC, 2011). The Canadian Sedentary Behaviour Guidelines recommend that children (age 5 to 11) should reduce sedentary time each day by 1) reducing recreational ST to no more than 2 hours per day and 2) reducing motorized transport, long periods of sedentary sitting and time spent indoors throughout the day for there to be health benefits (CSEP, 2011).

Sedentary behaviour is conveniently categorized as sedentary screen time behaviours (TV-viewing, video games, and computer use) and sedentary (usually sitting) non-screen time behaviours (e.g. sitting at school or in a car) (Sedentary Behaviour Research Network [SBRN], 2012). Screen-based sedentary activity is an important factor in understanding sedentarism by assessing the number of hours each day spent in such activities. This study sought to assess this factor only.

2.3.1 Sedentary Screen Time

Screen time, which refers to time spent watching television or videos, playing video games, using computers and mobile phones (Carson et al., 2010; Lanningham-Foster et al., 2006), represents a major source of inactivity in childhood. With the boom of the technology age, it has been observed that sedentary time has increased dramatically with children participating in many activities that require little energy expenditure (Rinderknecht & Smith, 2004). The growing saturation of cell phones with built-in games, multi-player networks and computers in the lives of children as documented in developing countries is quickly taking up time that children would have otherwise used in more physically active pursuits (Must & Tybor, 2005).

Professional pediatric organizations recommend that children should not engage in more than 2 hours of ST daily (Carson et al., 2010; CSEP, 2011). Studies have also concluded that children with the most number of hours of sedentary ST per day have the highest prevalence of overweight and obesity regardless of age, race/ethnicity, or family income (WHO, 2010; HAKK, 2011) and that they are less likely to engage in PA (CDC, 2007). Other studies do not agree that increased ST affects engagement in PA and have found no effects and **non-significant associations between the two factors (Taveras et al., 2007; Marshall et al., 2006; Vandewater et al., 2006; Marshall et al., 2004; Sallis et al., 2000).**

A study by Carvalhal et al. (2006) on 7–9 year old Portuguese children explored associations amongst PA, TV, videogames, and obesity. The results showed that the BMI data were only significantly associated with time for playing electronic games. The study had limitations in its methodology as the BMI cut-points used in the study were for adults and not for children. Further, parents completing questionnaires on children's PA could have reported inaccurate results as they had not accompanied the children throughout. In a review of studies by Nilsson (2008) on the notion that TV-viewing affects time spent in active PA, there was a study on 9 to 12 year old children that reported a possible association especially in the afternoon time after school (Hager, 2006), while another study reported no association in the same age group (Vandewater et al., 2006). A large-scale (n=7982) cross-sectional study by Koezuka et al. (2006) amongst 15 year olds found out that TV-viewing was associated with physical inactivity.

Studies in Kenya by Onywera et al. (2012) and Adamo et al. (2011) showed that rural Kenyan children accumulated less time in sedentary behaviours (555 +/- 67 minutes per day) than their urban counterparts (678 +/- 95 minutes per day). Onywera et al. (2012) also reported that 13.1% of urban Kenyan children spent more than 11 hours per week playing screen games while 62.5% of rural children spent 0 hours per week playing screen games. These results may appear better compared to other nations but with the emerging PA transition in Kenya, there is urgent need to address this situation before it resembles that of high income countries (HAKK, 2011). Based on the gaps left in the above studies and for further review on the issue, more studies are needed on screen-based sedentary behaviours in larger, diverse and more urban populations in Kenya. Studies should ascertain the extent of screen-based sedentariness among children as they are more vulnerable since they may not be able to monitor and control their ST.

2.4 Dietary Intake and Adiposity among Children

Dietary intake in children is meant to provide appropriate calorie intake, provide optimum nutrition for the maintenance of health and normal growth, and develop healthy eating habits (Daniels et al., 2005). It is observed that as incomes rise and populations become more urban, diets that are high in complex carbohydrates give way to more varied diets with a higher proportion of fats and sugars (WHO, 2004a). Increased consumption of more energy-dense, nutrient-poor foods, combined with reduced PA, has led to high obesity rates in many countries (WHO, 2004a). Research also indicates that uptake of large portions of food may contribute to excess weight by promoting excessive energy intake (Davis et al., 2007).

Caloric needs may vary for children of the same age due to normal differences among children (Daniels et al., 2005). Although there are no Dietary Reference Intake guidelines for the Kenyan child, general references from studies recommend a fat intake of 25% to 35% of daily caloric intake in children 4 to 18 years old; a carbohydrate intake of 45% to 65%; and protein intakes of 10% to 30% (Daniels et al., 2005). Additional dietary recommendations include providing adequate nutrition-promoting age-appropriate serving sizes of fruit and vegetables, milk or dairy products, and whole-grain and grain products per day and consumption of adequate amounts of dietary fiber. Dietary recommendations also emphasize low-calorie foods and structuring of meal times (Daniels et al., 2005).

Davis et al. (2007) conducted an analysis of studies targeting different populations on dietary intake and adiposity. They particularly focused on how adiposity was associated with consumption of different food types. None of the 17 studies reviewed showed evidence that increased fruit and vegetable intake related to decreased adiposity. The review also concluded that there was no evidence in the literature to support suggestions that low dietary fat intake is associated with increased childhood adiposity. The review also reported that there was evidence strongly supporting a positive association between intake of calorically sweetened beverages and adiposity in children. With respect to snack food, the Growing Up Today study (Field et al., 2004), of 9 to 14 year old girls and boys, found no relationship between intake of snack food and subsequent changes in BMI among boys and that there was a weak inverse association with weight change among girls. In another study of 196 non-obese, pre-menarcheal, 8 to 12 year old girls, energy-dense snack food intake did not influence subsequent weight status or fatness changes (Phillips et al., 2004). In contrast, the Bogalusa Heart Study found that, among 1562 10 year-old children, the total amount of food from snacks was associated positively with overweight status (Nicklas et al., 2003). Collectively, these analyses show that consumption of different food types is differentially associated to adiposity. It is important to note that many other factors influence different studies leading to conflicting findings, some of which appears to be contrary to what is expected.

As part of the Health Behaviour in School-aged Children (HBSC) study, an international WHO collaborative survey on lifestyle factors and health behaviour in young people, Vereecken et al. (2008) compared food group intakes and dietary indices estimated from a 14-item food frequency questionnaire (FFQ) with a seven day diet record. 112 Belgian and 114 Italian children (11–12 years) completed the FFQ followed by a seven-day diary and a retest one week later. The FFQ (Vereecken et al., 2005; Vereecken & Maes, 2003) had similar indices to that of the current study. It assessed the consumption frequency of fruit, vegetables, dietary fibre (breakfast cereals, white bread, brown bread) and calcium (skimmed milk, whole fat milk, cheese, other milk products (for example yogurt)) and items typical of the youth food culture (crisps, chips, sweets or chocolates, sugared soft drinks and diet soft drinks). That comparative study concluded that when FFQs are used for estimating consumption frequencies, the ability to rank individuals varies considerably between food items.

A study similar to the present study by Janssen et al. (2004) examined overweight and obesity and their associations with dietary habits and PA patterns and adiposity level in 11 to 16 year old Canadian youth. In assessing dietary habits, the subjects were asked to indicate the number of times in a typical week that they consumed the following food items: fruits, vegetables, sweets (candy or chocolate), non-diet soft drinks, cake or pastries and potato chips. The subjects were also asked to indicate the number of days in a typical week that they were physically active for 60 minutes or more and the number of hours they watched television (including videos) and used a computer in their free time. The findings showed high prevalence rates of sedentary behaviours with a strong trend in increased overweight and obesity with increased television viewing time in boys and girls. They also observed some significant associations among dietary habits, overweight and obesity. There was however no consistency in the pattern for these observations and the researchers explained that this could have been due to misreporting which is more often observed among overweight and obese subjects compared to normal weight subjects. Again, a major limitation of this study was that the heights and body mass values used to calculate BMI were derived from self-reports as well as information on diet, leisure-time activities and PA.

2.5 Summary of Literature Review

The search through the available literature revealed that, there was no clear evidence of an association between dietary habits, PA, sedentary ST and childhood adiposity among Kenyan urban children. Some literature suggested associations among some variables, but comprehensive reviews of several studies conducted elsewhere indicate conflicting results. Perhaps the associations were only true for some populations and the inconsistency in findings may be related to measurement limitations and differences. Existing studies in Kenya concentrated only on some of the energy balance determining factors, leaving gaps that may have led to inconsistency of study findings even across similar populations under study. In addition, many of these studies assessed PA using subjective methods. Given the fact that children's activity patterns have sporadic episodes of PA with short durations and varying intensities (Armstrong & Welshman, 2006; Epstein et al., 2001; Bailey et al., 1995), it is unlikely to be captured accurately by self-report. Therefore, investigating the influence of a possible association of PA and time spent in sedentary activities using objective assessment techniques is much more likely to detect existing relationships and its actual strength. Many of the studies reviewed also used adolescent children whose adiposity status may have been greatly influenced by puberty. Some reviewed studies presented inadequately assessed adiposity status while others used adult cut-off points for children. The current study sought to address the above gaps.

The main strength of this study was the assessment of PA levels and patterns using the Actigraph GT3X+ accelerometer (which is highly recommended for scientific purposes and is superior to many devices used in the reviewed studies). The study therefore assessed PA levels and patterns, as well as screen-based sedentary behaviour and dietary habits (for comparative purposes), with an attempt to clarify the associations between them and adiposity status and with demographic characteristics. The study also investigated if PA and ST and their status were in line with international recommendations and guidelines by WHO and CSEP.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Research Design

The study used a cross-sectional analytical design in which both the prevalence of underweight, overweight and obesity and the factors influencing the condition were determined. Cross sectional designs are usually used to determine the prevalence of a condition at a given point in time and any associated factors, and also to quantify the presence and magnitude of associations between variables (Mann, 2003). The study also used the design to examine relationships between selected variables by comparing respondents that had their characteristics to those who did not, at a given point in time.

3.2 Measurement of Variables

The dependent variable was adiposity status (indicated by BMI and percent body fat measured using anthropometry). The primary independent variables were physical activity (accelerometry), sedentary ST and dietary habits (self report) while the secondary independent variables were sex, SES and type of school attended (self report).

3.3 Study Area

The study was conducted in Nairobi County, Kenya (Appendix Q). Nairobi was purposively selected since it is a metropolitan area and the capital city of Kenya with people from diverse backgrounds and standards of living (United Nations University, 2011). In an effort to maximize comparisons in the larger study across ISCOLE sites, the sampling frame included students from urban areas, but not from rural areas. Several studies in Kenya have shown that urban children have higher prevalence of overweight and obesity compared to their rural peers (Onywera, 2010; Adamo et al., 2011; Labros et al., 2007) thus the choice of the study location. This location also captured children of varying lifestyle, environmental exposure, feeding patterns and opportunities for PA and provided a more heterogeneous sample in terms of ethnicity, culture and SES. For this study, data collection facilitated through the school was ideal in accessing the participants and their parents as well as examining the children's lifestyles, given the amount of time they spend in school (Fox et al., 2004).

3.4 Target Population

The target population was children aged between 9 to 11 years attending primary day schools in Nairobi County. The target of the larger ISCOLE research project was to recruit at least 500 children with a mean age of 10 years. Due to an anticipated difficulty in obtaining a school-based sample of children who would be exactly 10 years of age, the study planned to ensure a final sample of children with minimal variability around a mean age of 10 years i.e. 9.0 to 11.9. This age was also ideal as WHO standards of weight-for-age beyond this age group may not distinguish between height and body mass, where children are experiencing the pubertal growth spurt and may appear as having excess weight for their age when in actual fact, they are just tall (WHO, 2010). The age was therefore appropriate to give findings that largely result from the variables under investigation. The size of the population from which participants were drawn was approximately 160,879 children aged 9 to 11years in Nairobi County, Kenya (Kenya National Bureau of Statistics, 2010).

3.4.1 Inclusion Criteria

The study included a population of urban children, males and females, aged 9 to 11 years attending primary day schools in Nairobi County. Age was determined from the date of birth reported by parent/guardian and the age as of the date the consent was signed.

3.4.2 Exclusion Criteria

Participants were excluded from the study if they were sick or injured at the time of assessment, or had conditions likely to limit PA such as those in a wheelchair. Individuals with a pacemaker or another internal medical device were also to be excluded as the body composition analyzer SC-240 sends a weak electrical current through the body during measurement. Individuals who have such internally implanted medical devices, such as pacemakers, should not use this equipment due to the risk of malfunction to the device that may be caused by the weak electrical current. In addition, those already recruited but whose data did not contain the primary study endpoints (age, sex, weight, height and adequate accelerometer data) were also excluded from the list at the data analysis stage.

3.5 Sample Size and Sampling Procedure

3.5.1 Sample Size

The primary objective of sampling in this study was to obtain an adequate sample that predicted adiposity as a function of dietary behaviour and PA, taking into account other lifestyle behaviours. According to the ISCOLE protocol (Katzmarzyk et al., 2013), the estimation of the sample size was guided by the development of a regression model to predict BMI from objectively monitored PA (accelerometer-determined activity counts/day) and self-reported caloric consumption (kcal/day) among 10 year olds in the 2005/2006 U.S. National Health and Nutrition Examination Survey. Based on estimates gathered from the regression model, the sample size was determined under the following assumptions: a) 10 year old students would be sampled in school clusters with an average of 25 students per school, b) the 5% significance level was desirable and c) at least 90% power was required to detect a significant predictor that explains 3% of the variability in BMI (Katzmarzyk et al., 2013). It was determined that a minimum of 350 students from each of the ISCOLE study site would achieve a minimum power of 91%. As the students were to be sampled in clusters by schools, a design effect of 1.3, estimated from Williamson et al. (2012), was applied to produce a required sample size of 455. To further accommodate an estimated 20% of students who may fail to provide valid accelerometer data, drop-outs, missing data or equipment malfunctions, the enrollment target was set higher at 570 with an actual target sample size of 500 participants within a target of at least 20 schools.

The ISCOLE study was not designed to provide representative data from each participating country or region; rather, the sampling strategy was designed to maximize variation in SES and environmental characteristics at each site. However for the Kenya site and for purposes of writing this thesis, further calculations were done to check the local representativeness of the target sample size. The Kenya 2009 census (Kenya National Bureau of Statistics, 2010) reported that there were approximately 160,879 children aged 9 to 11 years old in Nairobi County.

The researcher used the Yamane (Glenn, 2009) formula to estimate the sample size. A 95% confidence level and p=0.5 (maximum variability) was considered in formulating the following equation:

$$n = \frac{N}{1+N(e)^2} \qquad n = \frac{160879}{1+160879\ (0.5)^2} = 400$$

Where: N (population size) was 160,879, e was the margin of error (level of precision) set at 0.5, the confidence level at 0.95, proportion (response distribution) at 0.5 to get a minimum sample size for 2 tailed tests as 400. This sample size was further subjected to power analysis using the G Power 3.0.3 calculator engaging a large effect size of 0.50 because the subjects had much variability and were likely to cluster in different aspects. It was established that the lowest power possible for this sample was at 95.2% and highest power at 99.6% confidence levels. An actual target sample size of 500 participants was therefore much better to provide excellent power for detecting meaningful significant contributors to the hypothesized study.

3.5.2 Sampling Procedure

The study used a multi-stage sampling technique that involves working from a large to progressively smaller sampling frames (William, 2006). The primary sampling unit was schools and the secondary sampling unit was classes in the school that best corresponded to 10 year old students. The primary sampling frame entailed a list of all mixed day primary schools in Nairobi County. This sampling frame of schools was typically stratified by indicators of SES in order to maximize variability. Hence, the schools were categorized as either private or public, which mostly represent various economic classes of schools in terms of schooling costs and incurred expenses. This ensured that pupils sampled represented the diverse socio-economic classes. The schools were then classified in three SES groups; low (LSES), middle (MSES) and high (HSES) to capture a range of economic classes.

The recruitment of schools was also planned by the location of schools to avoid clustering in one jurisdiction of Nairobi County. It was set to be conducted in all the eight regions (the old divisions/constituencies) of Nairobi County namely; Dagoretti, Embakasi, Kasarani, Kibera, Makadara, Pumwani, Starehe and Westlands (map presented in Appendix Q) to ensure regional representation. It is from these categories/strata that schools were identified and approached.

For each selected school, the process began with a visit to the schools to introduce the study and present necessary documents in seeking approval and permission to recruit the school. Only schools whose administration agreed to take part in the study were recruited in the primary sampling frame. A total of 29 schools were recruited; 9 (31.0%) low cost schools, 17 (58.6%) middle cost schools and 3 (10.3%) high cost schools. This categorization was determined by proxy indicator from school fees and expenses incurred in different public and private schools thus indicating the school's SES.

The secondary sampling framework consisted of 9 to 11 year-olds in a single stream from a sampled school. This mainly entailed pupils from grade/class 4 or 5 (whichever that had most of the pupils of these ages in class). Due to the nature of data collection procedures which entailed interaction with the pupils during class time, it was important to work with a single stream or class (depending on the class size). The study preferred a class-based sample which ensured that learning was not disrupted and that the children were of a similar learning level. In each school, fifty (50) pupils of this age group were randomly selected using the simple random sampling technique and given the consent and assent forms to be completed by the parent and pupil respectively. Since the researcher did not expect 100 percent returns and consent by the set dates, the study was set to recruit the first 30 consenting children with completely filled forms in each school. Figure 3.1 illustrates the primary and secondary sampling frames.

All mixed day primary schools in Nairobi County

Private mixed day primary schools

Maximum of 30 consenting 9 – 11 year old pupils in each of the recruited schools

Public mixed day primary schools

Maximum of 30 consenting 9 – 11 year old pupils in each of the recruited schools

Figure 3.1: Sampling procedure

In order to appropriately sample the pupils in private and public schools, the study used the target proportion estimation below to ensure that the sampling was proportional to the number of pupils attending the two types of schools. This is because there are more private schools than public schools in Nairobi but majority of the pupils attend public schools. The sampling was therefore not dependent on the number of schools recruited but was geared to meet the targeted number of consenting valid (with complete study endpoints) 500 participants in the appropriate proportions as presented in the Table 3.1.

Table 3.1 Participant recruitment by type of school

	Participants' school		**Total**
	Public Schools	**Private Schools**	
Target Proportion	0.6	0.4	1
Target Number of Valid Participants	300	200	500
Actual Number of Valid Participants	295	268	563

The distribution by location of the schools that agreed to participate in the various divisions within Nairobi County and their SES is presented in Table 3.2 and Figure 3.2.

None of the schools contacted in Madaraka and Pumwani divisions agreed to participate in the study.

Table 3.2 Number of recruited schools per division and socio-economic classes

	Divisions in Nairobi	Low-SES	Middle-SES	High-SES	Totals
1	Dagoretti	1	1	0	**2**
2	Embakasi	0	2	0	**2**
3	Kasarani	5	3	0	**8**
4	Kibera	0	5	1	**6**
5	Makadara	0	0	0	**0**
6	Pumwani	0	0	0	**0**
7	Starehe (Central)	2	0	0	**2**
8	Westlands	1	6	2	**9**
	Totals	**9 (31.0%)**	**17 (58.6%)**	**3 (10.3%)**	**29 (100%)**

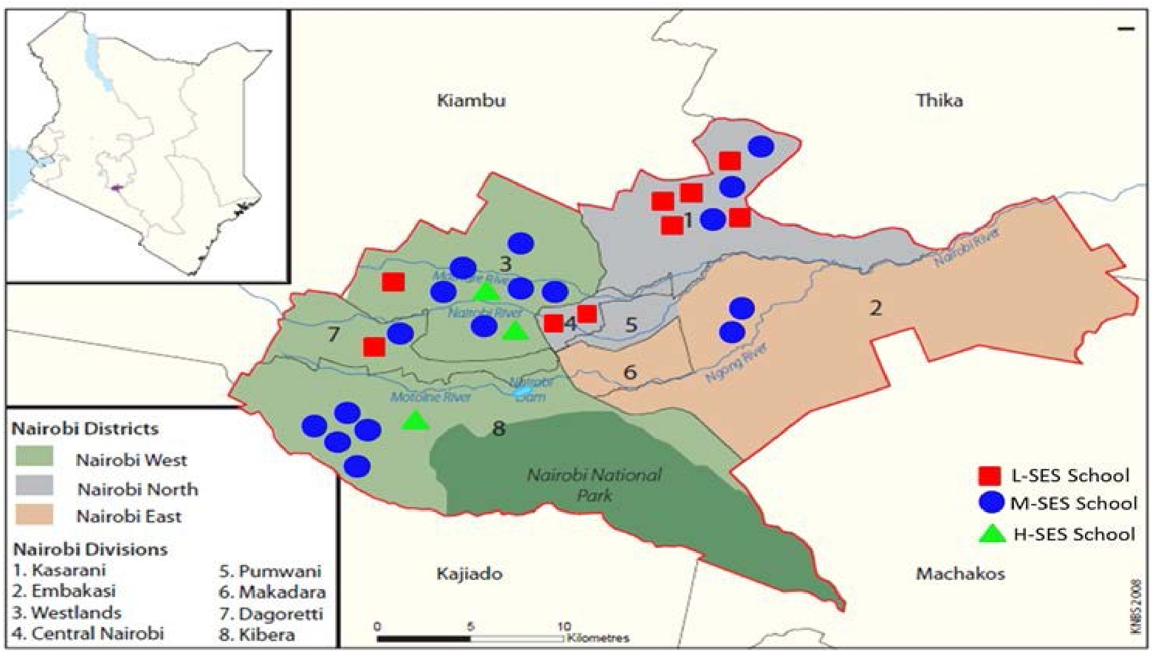


Figure 3.2 School Recruitment by location in Nairobi County and SES

Out of a total of 1278 consent forms distributed, 632 pupils obtained the parents' consent to participant in the study resulting in a response rate of 49.5%. Out of the 632 recruited, 563 children met all primary endpoints (age, sex, weight, height, and adequate accelerometer data) and formed the final sample.

3.6 Research Instruments

3.6.1 Actigraph GT3X-plus Accelerometer (ActiGraph, Pensacola, FL)

The Actigraph accelerometer is the most commonly used accelerometer for scientific purposes and the U.S. National Health and Nutrition Examination Survey (NHANES) adopted it as part of its regular surveillance strategy since 2003 (Tudor-Locke, Camhi, & Troiano, 2012). The study used the Actigraph GT3X+ accelerometer which provides raw data that can be manipulated in a number of ways to provide extensive information on time in various intensities of activity, activity counts, vector magnitude, and MET's (Actigraph, 2011) which can be organized as activity level (volume), intensity, as well as daily, weekly and seasonal activity patterns (Esliger & Tremblay, 2007).

The Actigraph GT3X+ is a tri-axial accelerometer with an accurate movement filter to differentiate actual steps from background noise movements (Actigraph, 2010; Daniels, 2009b). The GT3X+ rechargeable Lithium Polymer battery is capable of providing power for up to 10 days without recharging and instrument calibration is not required (Actigraph, 2011). It is worn on a belt, simplifying attachment and removal, and it is well tolerated by children. The unit can be worn either outside or beneath clothing, and it is not necessary for the device to make contact with the skin. However, the device must be held snugly against the body to prevent erroneous readings (Actigraph, 2011). The monitor should also not be in contact with water therefore participants were asked to take it off when bathing, showering and in water activities such as swimming.

While collecting day-to-day energy expenditure data, the device should be affixed securely to the body's center-of-mass to ensure the most accurate measurements

(Actigraph, 2011). Studies have shown that levels of PA and time spent at different intensities seem comparable, regardless of the placement of the monitor (hip or back placement) during free living conditions. Placement at the hip may be recommended as it is likely to be more comfortable for the subjects compared to the back placement (Nilsson, 2008). For this study, the monitor was positioned securely over the right hip so that the device lay upright and flat against the participant's body.

Since other studies have reported problems with achieving minimal wearing time with a waking hours protocol (i.e., allowing daily instrument removal), the children were encouraged to wear the device for 24 hours per day for at least 7 full days (plus an initial familiarization day and the morning of the final day), including 2 weekend days. The study aimed for 7 days in order to maximize the number of participants providing the analysis requirement of at least 4 valid days with at least 10 hours of wear per day including at least one weekend day. Previous studies have shown that four days of measurement provide a reliable picture of habitual PA in children (Trost et al., 2000; Janz et al., 1995). Although 10 hours does not cover all waking hours, it was considered to provide a sufficient picture of daily PA. A study has also shown that reliability in assessing daily habitual PA increases with increased monitored time, but only up to 600 min per day (Penpraze et al., 2006). Overall instructions for wearing the waist monitor are presented in Appendix I.

Device Initialization and Data Collection

The monitors require charging and initializing before they are sent out for data collection. The monitor was initialized for sampling by connecting it to a computer program via an interface, and after measurement, data from the monitor were downloaded via the interface onto a computer. The ActiLife analysis software package supports the GT3X-plus activity monitor and provides a means to configure these activity monitors (initialize) as well as download and analyze the data collected by the devices (Actigraph, 2011). The initialization process helped to verify that the epoch/sampling rate (raw data sample frequency) was set at 80 Hz, the subject name shows the correct device's serial number, and that the start date and time were correctly set (by selecting start date for the day and time following the day that the accelerometer will be given to the participant) (Katzmarzyk et al., 2013).

The process of collecting the raw data is such that the filtered acceleration signal is first of all filtered to discriminate human movement from vibration and other artifacts before they are converted into a digital set of numbers, called 'counts' which are summarized over a user specified time frame (epoch interval) (Chen & Basset, 2005). For each epoch interval, the summed value is stored in the memory and the numerical integrator reset (Ojiambo et al., 2012). The nature of children's PA requires very short epoch settings for detecting high intensity PA due to their irregular pattern of short bursts of activity, thus a shorter epoch setting is strongly recommended for detailed analysis of PA patterns (Nilsson, 2008). The study used a 1 second epoch time frame in data collection to offer the greatest flexibility in terms of later reintegration into longer epochs during analysis.

Accelerometers also contain voltage regulators that measure acceleration in uniaxial, biaxial or triaxial axes/planes or a combination of all these (Ojiambo et al., 2012). The GT3X+ collects data from all on-board sensors in raw data format from all three axes regardless of configuration. Three-axis data collection refers to acceleration data parallel to Axis 1, Axis 2 and Axis 3 of a device (Actigraph, 2011). Data recorded includes vertical axis activity acceleration data (Axis 1), horizontal axis activity acceleration data (Axis 2) and perpendicular axis activity acceleration data (Axis 3). Although steps and inclinometer are not directly measured during data collection, these values can be derived from the 3-axis data collected. The inclinometer feature helps users identify the orientation of the device and, more importantly, when the device itself was taken off (Actigraph, 2011).

3.6.2 Seca 214 Portable Stadiometer (Hamburg, Germany)

Participant's standing height (stature) was measured using the Seca 214 portable stadiometer (Hamburg, Germany). This instrument was placed on a hard and level floor next to a wall to ensure the subject was aligned vertically and in the appropriate manner. It uses an attached sliding head board which is lowered to the vertex of the head with the participant's head in the Frankfort Plane. Stature was measured with the participant's weight evenly distributed over both feet after a deep inhalation and the reading was obtained from the indicator scale. The reading was rounded to the nearest 0.1 centimeter. The measurement is repeated and the average is calculated and used for analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart and the average of the two closest measurements is used for analysis).

3.6.3 TANITA SC-240 Body Composition Analyzer (Arlington Heights, IL)

The participant's weight, impedance and percentage body fat were measured using a portable Tanita SC-240 Body Composition Analyzer (Arlington Heights, IL) connected to a laptop with an installed software.

The TANITA Body Composition Analyzer (SC-240) is indicated for use in the measurement of weight and impedance, and the estimation of BMI, total body fat percentage, total body water percentage and weight, muscle mass (skeletal and smooth), physique rating, bone mass, visceral fat rating with healthy range, basal metabolic rate (BMR), metabolic age and target body fat percentage with predicated weight and fat mass using BIA (Bioelectrical Impedance Analysis) (TANITA Corporation, 2010). This device measures body composition using a constant current source with a high frequency current (50 kHz, 90 μA) that sends a weak electrical current through the body during measurement. The 8 electrodes are positioned so that electric current is supplied from the electrodes on the tips of the toes of both feet, and voltage is measured on the heel of both feet (TANITA Corporation, 2010). The device is indicated for use for healthy children 5-17 years old and healthy adults with active, moderately active, to inactive lifestyles. This equipment is simple to use, and requires no specialized facilities or expertise to take measurements. Measurements can be taken quickly and easily, causing minimal inconvenience to the participant during measurement (TANITA Corporation, 2010).

The participant's weight and impedance are measured after all outer clothing, heavy pocket items, shoes and socks are removed. After the unit has been initialized (flashes "step on"), the participant steps onto the middle of the body composition analyzer, with their bare feet situated such that the heels are placed on the posterior electrodes and the front part of the feet are in contact with the anterior electrodes. The participant stands on the unit in a stable position without bending their knees as the measurements are taken. Two measurements are obtained, and the average is used in analysis (a third measurement is obtained if the first two measurements are more than 0.5 kg or 2.0% apart, for weight and percentage fat, respectively, and the closest two are averaged for analysis).

3.6.4 Non-Elastic Anthropometric Tape

Waist circumference was measured using a non-elastic anthropometric tape. According to Nago et al. (2010), waist circumference has been found to be a simple and effective measure of truncal adiposity in children and adolescents. The non-elastic anthropometric tape is non-extensible, flexible and is enclosed in a case with automatic retraction. It is calibrated in centimeters with millimeter graduations. First, a fine tip washable marker is used to mark the floating rib and top of iliac crest landmarks, then the anthropometric tape is used to measure the distance between them to establish the midpoint. At the midpoint, the tape is wrapped horizontally around the waist using the cross-over technique and the measure is read at the end of gentle expiration from the bottom of the tape, to the nearest 0.1 cm.

Mid-upper-arm circumference was also measured using the non-elastic anthropometric tape wrapped horizontally around the relaxed arm (with arm hanging loosely at the side of the body) at the marked midpoint. The anthropometric tape is used to measure the distance between the bare acromion and olecranon processes and the midpoint of the humerus/elbow is marked using the washable marker on the dorsal/back surface of the arm. The circumference of the upper arm is measured at this location, to the nearest 0.1 cm. Each of the above measurements are repeated, and the average used for analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart and the average of the two closest measurements is used for analysis).

3.6.5 Diet and Lifestyle Questionnaire

The Diet and Lifestyle Questionnaire (Appendix O) administered to all student participants, included questions related to dietary intake, PA, sedentary behaviour and sleep. For purposes of this thesis, the researcher only used data on PA, dietary habits and sedentary ST behaviour. This questionnaire was prepared by the ISCOLE research group and was a compilation of previously validated items obtained from several different self-report instruments as well as new questions designed by ISCOLE investigators where no suitable previous alternatives were found.

Several of the questions related to PA and sedentary behaviour were obtained from the U.S. Youth Risk Behaviour Surveillance System (CDC, 2009). These questions relate to issues regarding obtaining adequate amounts of PA (question 12), and the amount of time spent watching television (questions 1 and 5) or playing video games (questions 2 and 6), as well as the number of PE classes attended per week (question 8). Questions related to active transport to school were adapted from the Canadian component of the 2009/10 Health Behaviour in School-aged Children Study.

A food frequency questionnaire (FFQ) was also included in the Diet and Lifestyle Questionnaire (question 33), which was adapted from the Health Behaviour in School-aged Children Survey (Currie et al., 2008). This FFQ asked the child about several different types of food consumed in a "usual" week. The food items included in the FFQ were standardized as much as possible across ISCOLE sites. However, regional variation in food consumption patterns necessitated some cultural and regional adaptations of some of the items by changing the food names and giving examples to the equivalent locally.

The Diet and Lifestyle Questionnaire was completed in a face-to-face session with research assistants present to answer any questions and ensure quality and completeness.

3.6.6 Assessment of Maturity of Participants

The larger ISCOLE research project checked for maturation factors that could influence childhood adiposity. All participants in ISCOLE were between 9 and 11 years (10 years of age on average) and may have differed in their stage of biological maturity. Several methods exist to assess biological maturity, including the assessment of secondary sex characteristics (Tanner Stages), skeletal age, dental maturation or somatic maturation. All options were considered for inclusion in the ISCOLE protocol (Katzmarzyk et al., 2013). However, the only method that was deemed feasible across all countries (being a multinational study) was to use estimates of somatic maturation. There are two methods of assessing somatic maturation that were used in ISCOLE: 1) percentage of predicted adult height attained, using the Khamis-Roche method (Khamis & Roche, 1994) to predict adult height and 2) the maturity offset (Mirwald et al., 2002).

In the Khamis Roche Method, the rationale for using percentage of adult height attained is that two children of the same age can be the same height, but one may be closer to their final adult height, and hence is more advanced in somatic maturation (Katzmarzyk et al., 2013). Given that the final adult stature of the children was not known, it was predicted using their chronological age, stature, weight and mid-parent stature (average of father's and mother's stature). The intercepts and regression coefficients used in the prediction models for males and females in ISCOLE study are presented in Appendix P.

In the Maturity Offset method, an important indicator of somatic maturation is the age at peak height velocity (PHV), which can only be directly assessed from serial measurements of the child throughout adolescence (Katzmarzyk et al., 2013). Age at PHV is a commonly used indicator of somatic maturity and is an accurate benchmark of maximum velocity of growth during adolescence. Given that ISCOLE is a cross-sectional study, the method of Mirwald and colleagues (2002) was used to predict years from peak height velocity, or the “maturity offset” (Katzmarzyk et al., 2013). The prediction equations used in the prediction models for males and females in ISCOLE study are presented in Appendix P.

3.7 Recruitment and Training of Research Assistants

The researcher, who was the ISCOLE Kenya site coordinator, was certified as competent to make the required measurements by trained experts. This involved the completion of on-line training modules, viewing protocol videos and successfully completing on-line exams prior to the hands-on training session at a regional training meeting. The training sessions were conducted by the ISCOLE Coordinating Center (Pennington Biomedical Research Center) in Brazil prior to recruitment and training of research assistants.

Research assistants were screened through initial interviews to ensure they possessed basic knowledge and were available for the study. Those that were recruited had necessary competencies in the area of PA and healthy lifestyle. Seventeen research assistants were selected and subjected to a three-day local training facilitated by the ISCOLE Kenyan Site study staff (who had previously been trained in England and Brazil on the ISCOLE study protocol). The training covered the required procedures on administration of questionnaires, accelerometry, anthropometric measurements as well as data management and quality control techniques and professionalism. The trained assistants were examined, certified and assigned duties and responsibilities.

3.8 Pre-testing

A pre-test was conducted to test all study procedures, equipment and instruments. The purpose of the pre-test was to familiarize the research team with the administrative procedures, assess feasibility and logistics, use of instruments, execution, data collection, data management, quality control, data entry and examine the length of time required for the processes. Pre-testing was conducted in one school in Nairobi that was not recruited for the actual data collection. A 4% sample (of the secondary sampling frame) of 20 children, both male and female was recruited for the pre-test and a total of 17 consented children were enrolled for the exercise.

3.8.1 Validity and Reliability

Reliability refers to the likelihood that a data measuring or survey instrument will provide the same result when it is used by a different researcher or in a repeated test. Validity refers to an assessment of whether the data collected is accurate, relative to some objective standard or measure (Kimberlin & Winterstein, 2008). The Actigraph GT3X-plus is a widely used monitor that had been tested for reliability and validity and was found to be suitable and well tolerated by children from any population (Actigraph, 2010). Actigraph models have shown acceptable levels of technical reliability (Esliger & Tremblay, 2006; Brage et al., 2003), and have been shown to be valid in both children and adolescents (Sirard et al., 2000). Ekelund et al. (2001) also assessed their validity in free-living children using doubly labelled water as the criterion measure and found that the output (counts/min) was related to energy expenditure level ($r = 0.58$, $P < 0.01$). This can be compared with correlations of self-report versus gold standard measurements, usually in the range of r = 0.0-0.2. The Tanita Body Composition Analyzer and anthropometric equipment are also widely used and had been previously tested and found suitable. In addition, the main researchers of the larger ISCOLE project conducted a pilot study and also found the instruments suitable for use in the research project.

The equipment used in the ISCOLE study, including the Actigraph GT3X-plus monitor and the Tanita Body Composition Analyzer did not require calibration. The standardization of all instruments and equipments was made across all ISCOLE study locations (Katzmarzyk et al., 2013). However, the accuracy of the Tanita scale was tested periodically by weighing a volunteer on both the Tanita and a physician's balance beam scale to ensure that the instrument remained accurate over time.

The Diet and Lifestyle Questionnaire questions were adopted from widely used and accepted international instruments (U.S. Youth Risk Behaviour Surveillance System and Health Behaviour in School-aged Children Survey). These instrument's validity and reliability had previously been established. The ISCOLE group did not conduct further tests in the individual countries, due to the variability of the 12 Country sites, for purposes of standardization of all tools. However, representatives from each Country were involved in a rigorous review process of each item to confirm validity and therefore the questionnaire was approved based on expert consensus.

All instruments used in this study had previously been tested and had been found to be highly suitable. In addition, the instruments were also pre-tested locally to ensure proper functioning and suitability to the local situation.

3.9 Data Collection Techniques

Table 3.3 presents an outline of the ISCOLE data collection tools and methods from which data for analysis in this study was obtained. For questionnaires, the study mainly used data from the Diet & Lifestyle questionnaire (presented in Appendix O).

Table 3.3: **ISCOLE data collection questionnaires and methods from ISCOLE procedures manual (Katzmarzyk et al., 2013)**

ISCOLE Questionnaires used for data collection	• Diet & Lifestyle (filled by child) • Demographic & Family Health (by parent/guardian) • Neighborhood & Home Environment (by parent/guardian) • School Environment (school administrator)
Direct Measures	• Anthropometry of child (measurement of height, weight, % BF, bioelectric impedance, circumferences) • Accelerometry of child (physical activity monitoring)

Abbreviations: % BF = percent body fat**;** ISCOLE = International Study of Childhood Obesity, Lifestyle and the Environment (Katzmarzyk et al., 2013).

Data collection took place between February 2012 to November 2012 during the regular school terms and school hours at the selected schools and consisted of about six visits to each selected school. The study targeted to work with 9 to 11 year olds and these were recruited from class 4 or 5, depending on the school since the study used a class-based sample. Subjects' age was determined from their date of birth as reported by parent/guardian and as of the date the consent was signed by the parent/guardian. Informed consent forms (Appendix G), and the questionnaires to be completed by the parent/guardian were given to the sampled children to take home for their parent/guardian to complete. After a week, the research team went back to the school and collected all the forms from the children. Only those whose consent forms were fully filled were recruited for the study. The recruited pupils were then issued with the assent form (Appendix H) and were asked to sign if they wished to participate in the study. Those who assented were then registered as participants.

The research team then visited the school for the third meeting with the participants, which was for completion of the child's diet and lifestyle questionnaire (Appendix O) and anthropometric measurements, which took about two hours. The participants began by filling in the questionnaire. All children completed the questionnaire individually and research assistants were on standby in case the participants had any questions, made errors or needed guidance while filling the questionnaire. The research team however was instructed not to interfere during the completion of the questionnaire. Upon completion, the questionnaires were handed back and participants proceeded to the anthropometric measurement stations where weight, height, sitting height, percent body fat, waist and mid-upper arm circumference measurements were taken. A detailed procedure of each measurement is presented in Appendix J and the data collection forms in Appendix K. Thorough checking of all data forms and questionnaires throughout data-collection was implemented to ensure accurate and complete data sets before departing from the school.

Upon completion of anthropometrics, participants were gathered by the researcher and given instructions about the accelerometer (Appendix I). The children were shown an Actigraph monitor and instructed that it was to be worn for the next 7 full (24 hours) days (plus an initial familiarization day and the morning of the final day) including 2 weekend days. Fully charged and initialized monitors attached to elastic belts were then distributed to the children. Research staff showed the children how to wear the monitor using the belt, making sure the belt fit snugly against the body. The monitor was to be positioned securely over the right hip so that the device lay upright and flat against the body.

The team supervised the children as they practiced and put on their own devices and reminded them that they were to wear them all the time and would only remove them when taking a bath, swimming or when it was likely to get in contact with water. The class teachers also received the instructions as they were to be present at school to; ensure compliance during school days, remind the participants about the wearing rules on a daily basis and remind participants to take care of their devices. In the case of accelerometer malfunction or non-adherence by a participant, the accelerometer procedure, from giving of instructions to the wearing process was to be repeated for an extra 7 days.

A day after the final day of wear, participants returned the accelerometers to the research team at the school. Upon retrieval, data was downloaded from monitors on to a computer using the manufacturer's interface (Actilife software version 6; ActiGraph, Pensacola, FL) and the data was checked to see if it had valid wear time and completeness. A fifth visit to the school was made to collect any remaining forms or monitors in instances where some of the participants had forgotten their devises at home or were absent during the collection day. The researcher then made a final visit to the school to thank the administration and participants.

3.10 Data Analysis and Presentation

Data coding, entry, cleaning and checks were done by ISCOLE Kenya research team at Kenyatta University and the ISCOLE project Coordinating Centre at Pennington Biomedical Research Centre in Baton Rouge, Louisiana USA using a secure web-based data entry and management system. Data quality control for consistency, range checks and to ensure completeness was thoroughly conducted by the team. Data were later entered and managed using Statistical Package for Social Sciences (SPSS) version 17.

3.10.1 Data organization and scoring

Body mass index (BMI)

BMI is calculated from weight and height 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). This thesis used the WHO 2007 reference (WHO, 2010) of BMI-for-age and sex (Appendix L & M) to interpret the BMI results and the following percentiles were used as cutoff points; 5th percentile and below = underweight; from the 5th percentile up to and including the 85th percentile = normal weight; from the 85th percentile up to and including the 95th percentile = overweight; above the 95th percentile = obese.

Body fat (BF) percentage (%)

The study used the Tanita SC-240 Body Composition Analyzer to measure the % BF and then used the TANITA Corporation (2004) cut off points for body fat for specific ages and sex (Appendix N) to interpret the results. The categories are; underfat (below the healthy body fat range), healthy fat (within the healthy body fat percentage range for one’s age/sex), overfat (above the healthy range) and obese.

Waist Circumference (WC)

For waist circumference, Fernández and colleagues (2004) used the NHANES III data set to determine 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles by ethnic background. Estimated value for percentile regression according to participant’s sex and age for African-American children and adolescents, which presented the closest association compared to the other available distributions in terms of race, were used in this study as there were no reference data for the Kenyan population. The average WC measurement for each study participant was located in the respective percentile. Those in the75th and 90th percentiles are at risk and may need lifestyle adjustments.

Socio-economic status (SES) of participants

The SES data were obtained from the Demographic and Family Health questionnaires completed by a parent or guardian. The SES was assessed as a combination of the highest income of both parents per month from which the annual household income was calculated. Given the tax rates that the Government of Kenya charges for each of the ranges and the proportion of the sample for each SES group, the classification presented in Table 3.4 was used. This categorization was determined by proxy indicators from tax brackets in Kenya (Institute of Economic Affairs, 2012) and via a consultative process.

Table 3.4: Socio-economic status of households

Category	**Annual Household Income Range**	**Tax Rate**	**N (563)**	**Quartile**	
1	Less than Ksh.121,980	10	126	1	**LSES (N = 264)**
2	Ksh. 121,992 - Ksh. 236,892	15	68	1	
3	Ksh. 236,904 - Ksh. 351,804	20	36	1	
4	Ksh. 351,816 - Ksh. 466,716	25	34	1	
5	Ksh. 466,728 - Ksh. 599,988	30	31	2	**MSES (N = 177)**
6	Ksh. 600,000 - Ksh. 1,199,988	30	92	2	
7	Ksh. 1,200,000 - Ksh. 1,799,988	30	54	2	
8	Ksh. 1,800,000 - Ksh. 3,599,988	30	54	3	**HSES (N= 102)**
9	Ksh. 3,600,000 - Ksh. 5,999,988	30	29	3	
10	Ksh. 6,000,000 and above	30	19	3	
No Response			20		

Adopted from: Institute of Economic Affairs (2012) A Citizen's Handbook on Taxation in Kenya
Abbreviations: Ksh = Kenya shilling; LSES = Low Socio Economic Status; MSES = Middle Socio Economic Status; HSES = High Socio Economic Status

Objectively monitored Physical Activity (Accelerometry)

Only data from participants aged 9 to 11 years old at the time anthropometric measurements were taken, were included in accelerometry analyses. Actilife version 5.6 software was used to manage the initial accelerometer data parameters such as initialization, wear time validation and download (immediately upon retrieval of each accelerometer). The downloading process produced an .AGD file with the following settings: 1 second epoch, 3 axes of orientation, steps, lux (ambient light), inclinometer, and low frequency extension.

A maximum of 7 days from each accelerometer file were screened for possible inclusion in the summary datasets. A rigorous process of data checks and cleaning was conducted by the ISCOLE coordinating center team using specialized software to ensure the final dataset contained valid data as per the protocol. For example, if the first day of data for any accelerometer files indicated an initialization time other than midnight or that the device was initialized prior to being placed on the child, then all data prior to the first recorded midnight were deleted. In addition, the last day of data were also deleted (as the last day was not a complete wear day up to midnight). Any minutes with an intensity >20,000 counts were considered invalid and changed to non-wear time after all of the sleep and non-wear algorithms were completed.

The accelerometer datasets were summarized into a week's worth of minute-by-minute data downloaded from the accelerometer into one record per person. The weekly PA averages were based on days defined as 24 hours from midnight-to-midnight. The weekly PA averages were calculated using only minutes for which the participant was awake and wearing the device on valid days (at least 10 hours of wake/wear time in a 24-hour period) and only for participants with at least 4 valid days (including one weekend day). One weekend day was required because of the known differences in activity levels between weekdays and weekend days in children (Rowlands et al., 2008; Treuth, et al., 2007). The dataset used for analysis contained information regarding time spent in various intensities and also contained separate averages for weekdays and weekend days.

The study used two different cut points to group the data therefore the dataset contained two sets of PA summaries. The following activity count cut points were chosen and used to create activity levels based on intensity counts:

From Treuth, et al. (2004) (data were processed using 1 minute epochs)

- Sedentary < 100
- 100 ≤ Light<3000
- 3000 ≤ Moderate ≤ 5200
- Vigorous > 5200

From Evenson, et al. (2008) (data were processed using 15 second epochs)

- Sedentary ≤ 25
- 26 ≤ Light < 574
- 574 ≤ Moderate <1003
- Vigorous ≥ 1003

This theses presented results from the two cut points. Treuth’s cut points are age appropriate while Evenson’ cut points were derived from newer data and used shorter epochs though based on slightly younger participants. Evenson’ cut points have also shown to maximize activity intensity classification accuracy when compared to other pediatric activity count cut points (Trost et al., 2011). Data from the datasets were later transferred and managed using SPSS version 17.

Screen Based Sedentary Behaviours

Four questions from the Diet and Lifestyle questionnaire (Appendix O) were used for analysis. This presented ST variables of two types of data (a) continuous data; average ST on a school day, average ST on a weekend day, average daily ST and the total number of hours in a week on screen based activities, and (b) grouped/categorized data; overall ST levels, ST levels for watching TV on school days, ST levels for watching TV on weekend days, ST levels for playing video/computer games/use computer not school work on school days and ST levels for playing video/computer games/use computer not school work on weekend days.

The subjects were asked how many hours they watched television in a typical school day as well as on a weekend day. They were also to indicate the number of hours they played video or computer games or used a computer for something that was not school work on both a school day and a weekend day. For the four questions, the possible responses were "I do not watch TV/play video/computer games or use a computer other than for school work on school days", "< 1 hour", "1 hour", "2 hours", "3 hours", "4 hour", and "5 or more hours". Each response was then assigned a score 0 – 6 respectively. The scores for each of the four questions were then used to classify the participant in levels of ST for each question. In order to classify the children's ST volumes (obtained from the four questions) into levels of engagement, it was necessary to obtain a score which would be used for classification. A total score of all questions for each participant was then obtained. Equal quartiles were formed and were used to categorize the participants' scores into ST levels as follows: “low,” (1st quartile) “low-moderate,” (2nd quartile) “moderate-high,” (3rd quartile) and “high” (4th quartile). A similar scoring process was used by Janssen and Katzmarzyk et al. (2004) in analyzing ST in leisure-time activities, in their study on overweight and obesity of Canadian adolescents and their associations with dietary habits and PA patterns.

The children were asked how many hours they watched television on a school day and on a weekend day and how many hours they played video or computer games or used a computer for something that was not school work on a school day and on a weekend. These questions were used to assess the participant’s ST habits and a similar scoring process as presented above was used to classify the responses for each question into four quartiles; “low’’, low-moderate’’, “moderate-high’’ and “high’’.

Dietary Habits

The study was set to assess the frequency of consumption of various foods using a food frequency questionnaire which was adapted from the Health Behaviour in School-aged Children Survey (Currie et al., 2008) by the ISCOLE research team. One question (from the Diet and Lifestyle questionnaire, Appendix O) with a total of 23 food and drink variables was used to collect this information. The subjects were asked how many times in a typical week they usually eat each of the following food items: fruits, vegetables, sweets (candy or chocolate), regular soft drinks that contain sugar, cake or pastries, potato chips, French fries, etc. The possible responses were “never,” “less than once a week,” “once a week,” “2–4 days a week,” “5–6 days a week,” “once a day, every day” and “every day more than once.”

The responses were first assigned a value 0 to 6 (0 for “never” 1 for “less than once a week,” 2 for “once a week,” 3 for “2–4 days a week,” 4 for “5–6 days a week,” 5 for “once a day, every day” and 6 for “every day, more than once”). For each food item the value was recorded to represent the frequency of consumption for each food or drink. A similar scoring process was also used by Janssen and Katzmarzyk et al. (2004) in their study on overweight and obesity of Canadian adolescents and their associations with dietary habits and PA patterns.

3.10.2 Data Analysis and Presentation

The coded data were entered into Statistical Package for Social Sciences (SPSS) version 17 for analysis. Descriptive statistics such as frequencies, percentages, means and standard deviations (SD) were used to describe the demographic characteristics of the participants, study schools as well as the variables of the study. Tables and charts were used to present the results. Independent T-tests were used to compare means of two variables of continuous data and one way ANOVA was used in cases where there were more than two means being compared. A follow up test for ANOVA (Duncan post hoc tests) was used to establish where exactly the observed differences were, by identifying the categories different from each other. Chi-square tests were used to find the relationship between the categorical variables. Binary (binomial) logistic regression was used to determine the odds ratio between study variables and multinomial logistic regression test was used to determine the key significant predictors of adiposity in the study population. A p-value <0.05 was considered significant in the testing of hypotheses.

3.11 Logistical and Ethical Considerations

Kenyatta University's Graduate School approved the research proposal and gave the authorization to conduct the study (Appendices A and B respectively). Authorization to conduct research was granted by National Council for Science and Technology (Appendix D) while authority to conduct the research and contact the schools in Nairobi was obtained from the City Education Department of Nairobi City Council (Appendix E). Ethical review of the study protocol was sought and approval granted by Kenyatta University Ethics Review Committee (Appendix C). All data collection and management procedures were also guided and approved by the ISCOLE project Pennington Biomedical Coordinating Centre for standardization purposes. With regard to school recruitment, those selected were approached and issued with a letter of request (Appendix F) to participate, which had information about the study. A detailed explanation of the study was also presented to parents who gave consent for their children to participate by signing the English or Swahili version of the Informed Consent form (Appendix G). The participating children also received an explanation of the study and assented to take part by signing the assent forms (Appendix H). Participants were assured of confidentiality in handling of the information they had given.

CHAPTER FOUR: RESULTS

4.1 Introduction

Findings of the study that include data analysis and results are presented in this chapter. Data analyses were done using SPSS version 17.0 and the analyzed data are presented using tables, graphs and charts.

The hypotheses were tested using the various analytical tests described above (chapter three; data analysis). Demographic information and descriptive statistics for the key variables (adiposity, PA, ST and dietary habits) preceded testing of the hypotheses in each of the sections.

4.2 Characteristics of the Study Schools and Participants

This study was part of the ISCOLE project that examined the lifestyle characteristics of 9 to 11 year-old children. A total of 29 schools participated in the study; 9 (31.0%) low cost schools, 17 (58.6%) middle cost schools and 3 (10.3%) high cost schools. This categorization was determined by proxy indicators from school fees and expenses incurred in different public and private schools thus indicating the schools SES. Of the 29 schools, 16 (55.2%) were public schools (run by the government) and 13 (44.8%) were private schools (owned and run by private entities).

There were more respondents from public schools (52.4%) than from private schools (47.6%) and more females (53.5%) than males (46.5%). Most of the children were 10 years of age (49.4%), of LSES (46.9%) and attended middle income schools (63.6%). Details are presented in Table 4.1.

Table 4.1: **Demographic information of Study Participants**

Study Participants N (563)	**n**	**%**
Age Range (9.0 to 11.9 years)		
9 years	207	36.8
10 years	278	49.4
11 years	78	13.9
Sex of the participants		
Males	262	46.5
Females	301	53.5
Participants' SES		
LSES	264	46.9
MSES	177	31.4
HSES	102	18.1
No response	20	3.6
Frequency by Type of School		
Public	295	52.4
Private	268	47.6
Frequency by School SES groups		
LSES school	158	28.1
MSES school	358	63.6
HSES school	47	8.3

Abbreviations: n= total; SES Socio Economic Status**; LSES = Low Socio Economic Status; MSES = Middle Socio Economic Status; HSES = High Socioeconomic Status.**

4.3 Anthropometric **characteristics of study participants**

The means and standard deviations of the anthropometric measurements are presented in Table 4.2. These results are stratified by age (9, 10 and 11 years) and sex (male/female) to capture differences in growth and development at different ages and sex. For all study participants, the mean weight was 33.8 kg ranging from 19.1 kg to 74.8 kg while the mean height was 139.0 cm ranging from 116.9 cm to 162.9 cm. The mean WC for all participants was 62.3 cm and that of Mid-Upper Arm Circumference (MUAC) was 20.6 cm while the mean of percent body fat was 16.0% and that of impedance was 628.4 ohms (Table 4.2).

Table 4.2: **Anthropometric m**easures stratified by age and sex

Variables	**Age of participating children**			**ANOVA**
	9 years (*n*= 207)	**10 years (*n*=278)**	**11 years (*n*=78)**	***p*-values**
Weight (kg); ***Mean (33.8); Range (19.1 - 74.8)***				
Male	30.9^a (6.8)	35.2^b (8.5)	33.4^{ab} (6.4)	< 0.001**
Female	31.9^a (7.7)	35.2^b (8.6)	35.9^b (10.1)	0.003*
Height (cm); ***Mean (139.0); Range (116.9 -162.9)***				
Male	135.5^a (6.9)	140.4^b (6.8)	140.5^b (6.9)	< 0.001**
Female	136.9^a (7.2)	140.5^b (7.6)	142.5^b (7.4)	< 0.001**
WC (cm); ***Mean (62.3); Range (47.9 -108.1)***				
Male	60.5 (6.9)^a	63.4 (8.4)^{ab}	60. 8 (6.4)^a	0.026*
Female	61.2 (7.2)	63.3 (7.9)	63.3 (10.1)	0.150
MUAC (cm); ***Mean (20.6); Range (14.7 -36.2)***				
Male	19.3 (2.7)^a	20.9 (3.5)^b	20.2 (2.5)^{ab}	0.001*
Female	20.4 (3.4)	21.4 (3.8)	21.2 (4.1)	0.257
% BF; ***Mean (16.0); Range (5 - 44)***				
Male	15.0 (6.7)^{ab}	16.7 (7.9)^b	12.6 (5.8)^a	0.017*
Female	15.8 (8.0)	17.3 (9.4)	14.9 (9.1)	0.237
Impedance (ohms); ***Mean (628.4); Range (477.3 - 873.5)***				
Male	617.9 (66.1)	611.6 (60.5)	591.5 (71.6)	0.181
Female	654.2 (68.8)	639.5 (66.6)	646.4 (89.6)	0.567
Maturity offset; ***Mean (-2.51); Range (-4.86-0.30)***				
Male	-3.83 (0.4)^a	-3.22 (0.5)^b	-2.84 (0.5)^c	<0.001**
Female	-2.23 (0.5)^a	-1.57 (0.6)^b	-1.08 (0.5)^c	<0.001**

Notes: All data are mean values and (SD). * p< 0.05 and ** p< 0.001.
ANOVA; ^{ab} Values within a row with different superscript letters are significantly different.
Abbreviations: n = total; SD= Standard Deviation; BMI = Body Mass Index; WC = Waist **circumference; MUAC = Mid Upper Arm Circumference; % BF = percent body fat; St ht = sitting height**

One way ANOVA revealed that there were significant differences in the means of weight, height, WC, MUAC and % BF among the males of different ages. There was a 99.9% confidence that 10 and 11 year olds were significantly taller than the 9 year olds in both sexes, which is expected due to growth. Surprisingly, there was no linear increase in the means with age as the means in weight, WC, MUAC and % BF of 10 year old male participants were significantly higher than that of 11 year old participants (Table 4.2). In fact, 10 year old males were significantly heavier (p<0.001) than the 11 year old males which is usually not expected in growth. There was linear increase in the means for weight and height with age of female participants with results showing significant differences in the means where 9 year olds were significantly lighter and shorter than their older female counterparts.

Although results from the comparison of means across the ages and sexes indicate that the females were heavier, taller, had a larger waist and mid-upper arm circumferences, higher percent body fat and impedance compared to their male counterparts across all ages, one way ANOVA results (Table 4.2) revealed that the differences between the sexes were only significant for MUAC ($F= 7.878$; $p=0.005$) impedance ($F= 24.621$; $p<0.001$) and maturity offset ($F= 996.724$; $p<0.001$).

To obtain the maturity offset value, the ISCOLE study used Mirwald et al. (2002) method that is used to predict years from peak height velocity (PHV), or the maturity offset and the Khamis-Roche method that predicts adult height from the participant's chronological age, height, weight and their mid-parent stature to compute the percentage of adult height already obtained (Khamis & Roche, 1994). The explanations, prediction equations, intercepts and regression coefficients used in the prediction models for males and females in ISCOLE are presented in Appendix P. Results presented in Table 4.2 indicate that the maturity offset of the study participants ranged from -4.86 to 0.30 with a mean of -2.51. This, together with the mean values for the three ages across the sexes show that the study participants were majorly pre-mature (pre-adolescent) and the values linearly progressed with age towards full maturation. There was a significant linear progression ($p<0.001$) in both sexes in the means between the ages where participants drew closer to maturity with increasing age, which is expected.

4.3.1. Characteristics of study participants by body weight and fatness status

Body mass index (BMI) for age

The findings showed that the majority (73%) of the participants were of normal weight with 73.8% females and 72.1% males being of normal weight (Table 4.3). Those categorized as overweight were 9.4% with 8.8% being male and 10% females. About one tenth (10.8%) of the participants were obese. There were no significant differences in weight status between the females and males. When the study participants were categorized into two groups of those who were overweight/obese and those who were not, 20.2% were classified as being overweight/obese. **This group may require further investigation and intervention to minimize the health risks involved.**

Body fat (BF) percentage (%)

The results showed that the 44.9% of the participants were in the healthy (fat) category with 50.6% males and 49.4% females in this category (Table 4.3). There was no significant association between body fatness between the females and males. When the participants were categorized into two groups; those who are overfat/obese (fat) and those who are not, 13.9% were overfat/obese (fat) while 86% were not overfat/obese (fat).

Waist Circumference (WC)

The findings (Table 4.3) showed that 12.4% of the participants were in the 75th percentile while 6.0% were in the 90th percentile with more males in these categories than **fe**males though the difference **was not significant (**Chi-square test; p = 0.110).

Table 4.3: **Adiposity** variables stratified by sex

Variables	**Male N=262**		**Female N=301**		**Total N=563**		**Chi-square test**
	n	**%**	**n**	**%**	**n**	**%**	**P value**
BMI for age (n=563)							

Underw**eight**	19	7.3	19	6.3	38	6.7	0.827
Normal (ideal) Weight	189	72.1	222	73.8	411	73.0	
Overweight	23	8.8	30	10.0	53	9.4	
Obese	31	11.8	30	10.0	61	10.8	
Body fatness (%BF) (n=543)							
Underfat	91	34.7	123	40.9	214	38.0	0.090
Healthy (fat)	128	48.9	125	41.5	253	44.9	
Overfat	11	4.2	23	7.6	34	6.0	
Obese (fat)	24	9.2	18	6.0	42	7.5	
Waist Circumference (n=562)							
Below 10th percentile	36	13.8	30	10.0	66	11.7	0.110
10th percentile	40	15.3	61	20.3	101	18.0	
25th percentile	67	25.7	94	31.2	161	28.6	
50th percentile	60	23.0	70	23.3	130	23.1	
75th percentile	38	14.6	32	10.6	70	12.5	
90th percentile	20	7.7	14	4.7	34	6.0	

Notes: **all data are** frequency and (%). Significance by Pearson Chi-Square ($p<0.05$) Abbreviations: n = total; BMI = Body Mass Index; % BF = percent body fat; **WC = Waist circumference**

4.**4 Adiposity Status**

The study used **body** weight status and fatness status from BMI and % BF **respectively as indices of adiposity. Table 4.3 also presents the proportions for** BMI and %BF categories.

Though a good correlation is said to exist between BMI and percentage of body fat for all ages and both sexes (WHO, 2000), the findings of this study indicate that there were some differences when comparing the categorization **in BMI and that of % BF of study participants. Some participants appear in one BMI category and a different fat category. For instance,** 173 participants had normal weight but were classified as underfat, 21 were overweight but in the healthy fat category while 10 participants who were obese appeared to have healthy fat levels (Table 4.4). The two measures may therefore not be used to represent each other and it is thus important to report on both variables.

Table 4.**4: Comparison of body weight status and body fat status**

Variables		Body fatness status (%BF) **N =543**				**Chi-square test P value**
		Underfat n =214	**Healthy (fat) n =253**	**Overfat n =34**	**Obese (fat) n =42**	
BMI status	Underw**eight (n =37)**	34	3	0	0	< 0.001
	Normal Weight (n =**395)**	173	219	3	0	
	Overweight (n =5**1)**	7	21	19	4	
	Obese (n =6**0)**	0	10	12	38	

Cross-tabulations of **adiposity variables, all data are** frequency and (%). Abbreviations: n = total; BMI = Body Mass Index; % BF = percent body fat

Although there **are these notable differences, Chi square analysis revealed a significant relationship (**$\chi^2 = 487.878$, $p < 0.001$). The study used both the weight status and fatness status to classify each participant and the two variables were used henceforth in assessing associations with other variables.

4.4.1 Association of body weight and fatness status and waist circumference

Chi-**square analysis revealed that there was** a highly significant relationship between **the participants in the 75th percentiles and their body weight status and body fatness status which had a highly significant linear** progression **(**$\chi^2 = 34.345$, $p < 0.001$).

4.4.2 Association of body weight and fatness status by SES of study participants

The findings on the a**ssociation of body weight and body fatness status by SES (Figure 4.1) show that** 59% of participants of LSES **were largely underfat and** 52% were of normal weight while majority of those of MSES and HSES **had normal weight and had healthy fat levels. Only 8% of the HSES were underweight and** 13.6% were underfat**.**

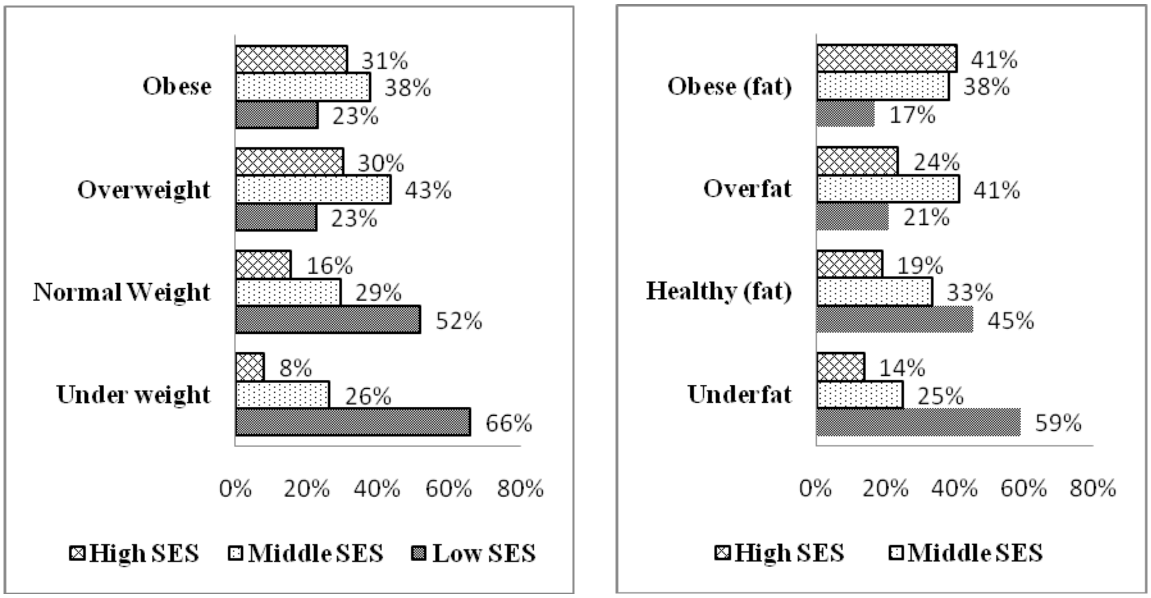


Figure: 4.**1 Body weight and fatness status by SES**

Chi-square analysis revealed that there was **highly significant association between body weight status by SES (**$\chi^2 = 42.019$, $p < 0.001$) as well as for body fat**ness status by SES (**$\chi^2 = 58.963$, $p < 0.001$).

4.4.3 Association **of body weight and fatness status by school type and school SES**

In the examination of the a**ssociation of body weight and SES of school, results (Figure 4.2) revealed that majority of participants were of normal weight for both private and public types of schools classified by school SES. In the low cost public schools, only 3**% **of participants were overweight and** 1% **of participants were obese. In the middle cost private schools,** 15% **of participants were overweight and** 19% of **participants were obese while in the high cost private schools an equal proportion with 15**% of participants **being overweight and also obese. Chi-square analysis indicate that the associations were only significant for the public schools (**$\chi^2 = 11.452$, $p = 0.010$).

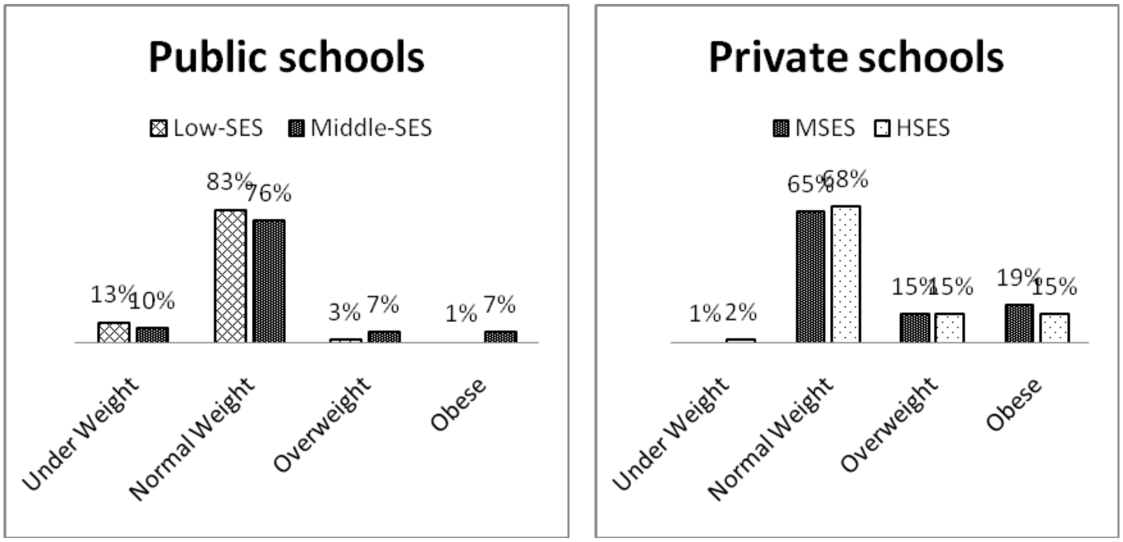


Figure 4.**2: Body weight status by type of school and school SES level**

Findings on the a**ssociation of body fatness levels by type of school and SES of the school (Figure 4.3) revealed that** 49.8% of all participants in public schools were underfat (most of whom were in the low cost schools) and a significant number (40.3%) had healthy fat levels (most of whom were in the middle cost schools). Very few participants were overfat (2%) or obese (fat) (1%) in the LSES categories of public schools. Majority (50.0%) of participants in private schools had healthy fat levels while fewer were in overfat and obese (fat) categories especially in high cost schools with 4 % being overfat and 15% obese (fat) participants. Most (73.5%), of the overall overfat participants and most (73.8%) of the overall obese (fat) participants came from middle cost private schools. **Chi-square analysis revealed that the associations were only significant for the public schools (**$\chi^2 = 34.007$, $p < 0.001$).

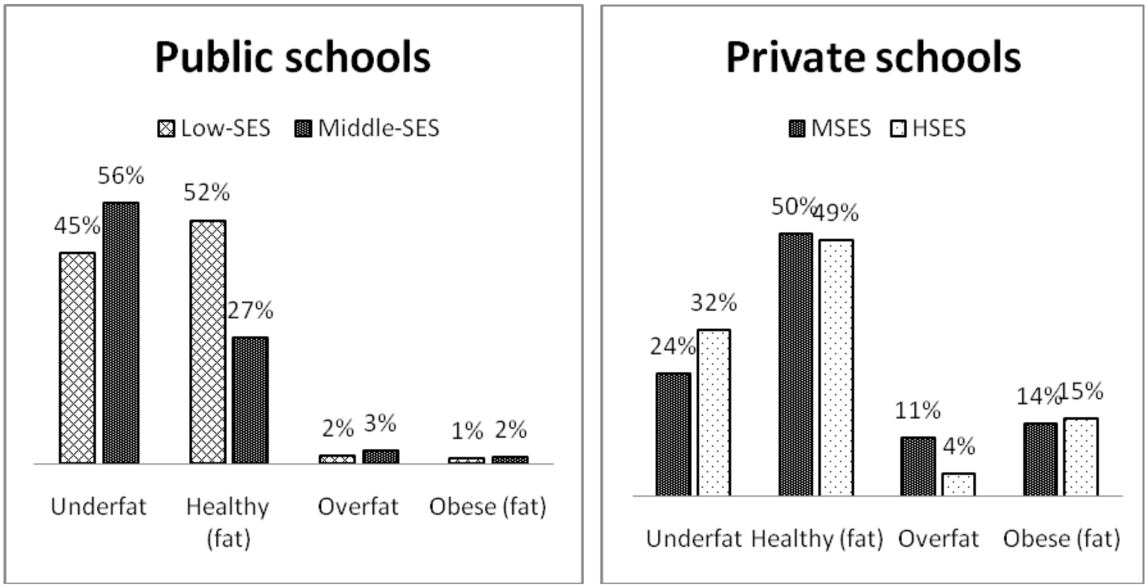


Figure 4.3: Body fatness levels by type of school and school SES level

4.5 Physical Activity

The main objective of this part of the study was to use both objective and subjective methods to assess and describe the PA level and patterns of the study participants in light of set international recommendations. The study was to determine the association between PA variables and age, sex, type of school attended and SES of the study participants as well as their body weight, and fatness status.

4.5.1 Key direct measure physical activity variables

Direct (objective) measurement of PA was done using the Actigraph GT3X+ tri-axial accelerometer and the scoring by the Actilife version 6 software. Out of the many PA variables that can be derived from the accelerometer data, the study chose to report on PA levels in relation to activity counts for the various intensity levels as well as time spent in the levels of PA. The two intensity cut points used to classify participants activity counts into PA levels, Treuth et al. (2004) and Evenson et al. (2008) (presented in chapter 3 under data scoring) were used for all analysis as they have different classification margins which are important for comparative purposes.

Out of the 563 participants, 553 had complete accelerometer data but only 502 had valid data i.e. at least 4 days with 10+ hours of wake/wear time, including 1 valid weekend day. The mean wake/wear time (minutes) per day (from all valid days) was 896 daily, 914 on a weekday and 856 on a weekend day.

Descriptive results (means) of the PA variables are presented in Table 4.5. The results are organized according to the average means of time (minutes) spent in the levels of PA and the number of intensity counts for the various intensity levels.

Table 4.5: Average means of physical activity variables (N=502)

		Daily		**Weekday**		**Weekend day**	
PA levels		**Treuth**	**Evenson**	**Treuth**	**Evenson**	**Treuth**	**Evenson**
MVPA	Duration (mins) per day	35.45	71.65	36.05	70.32	34.17	74.66
	Daily total intensity counts	145382	271352	146613	266857	143614	282451
Vigorous PA	Duration (mins) per day	3.98	22.57	3.89	22.72	4.34	22.36
	Daily total intensity counts	26573	123719	24820	123329	31549	125859
Moderate PA	Duration (mins) per day	31.46	49.08	32.18	47.60	29.83	52.31
	Daily total intensity counts	118809	147633	121793	143527	112064	156591
Light PA	Duration (mins) per day	463.08	329.95	458.74	329.31	472.40	331.10
	Daily total intensity counts	369345	245459	355804	237922	399677	262289
Sedentary PA	Duration (mins) per day	397.81	494.73	419.54	514.69	349.44	450.24
	Daily total intensity counts	8674	6590	9432	7071	6944	5494

Notes: A**ll data are** means. Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs)
Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity; mins: minutes

These variables have average means for daily, weekdays and weekend days for both Treuth and Evenson cut points. Generally, the participants spent more time in sedentary and light activities compared to moderate and vigorous activities. Participants spent the least time in vigorous PA.

4.5.2 Study Participant's sex and direct measure physical activity variables

The study assessed the average time spent in the various PA levels for both cut points across the two sexes. The means (Table 4.6) represent the duration (minutes) in PA levels per day by sex. Independent t-test analysis was used to determine whether there were any significant differences in the means between the sexes within the various PA levels.

Table 4.6: Mean duration (minutes) of PA levels per day by sex according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		All N=502	Male N=233	Female N=269	T-test P value
MVPA	Treuth	35.45	41.79	29.96	<0.001**
	Evenson	71.65	80.59	63.91	<0.001**
Vigorous PA	Treuth	3.98	3.99	3.97	0.935
	Evenson	22.57	25.88	19.69	<0.001**
Moderate PA	Treuth	31.46	37.79	25.99	<0.001**
	Evenson	49.08	54.71	44.21	<0.001**
Light PA	Treuth	463.08	464.71	461.67	0.627
	Evenson	329.95	329.99	329.92	0.988
Sedentary PA	Treuth	397.81	390.51	404.13	0.033*
	Evenson	494.73	486.42	501.94	0.008*

Independent T test analysis * represents the *p* values that are significant (* p< 0.05 and ** p< 0.001) Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs). Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity

Results indicate that there were significant differences between the sexes in all PA levels except for LPA (Light Physical Activity) and the Treuth cut points of VPA (Table 4.6). From the results, males spent significantly more time in MVPA, VPA and MPA compared to females while females spent significantly more time in sedentary activity than males. In fact, males spent significantly (p<0.001) more time in moderate and vigorous PA than females.

4.5.3 Study Participant's age and direct measure physical activity variables

The results of the average time spent by study participants in the various PA levels for both cut points by age are presented in Table 4.7. To determine if there was significance in the differences among the means of the various ages, one way ANOVA was used.

Table 4.7: Mean duration in minutes of PA levels per day by age according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		All N= 502	9.0-9.99yrs N= 186	10.0-10.99yrs N= 243	11.0-11.99yrs N= 73	ANOVA P value
MVPA	Treuth	35.45	35.57[a]	33.39[a]	41.98[b]	0.022*
	Evenson	71.65	73.87[ab]	67.67[a]	79.27[b]	0.010*
Vigorous PA	Treuth	3.98	3.74[a]	3.83[a]	5.09[b]	0.058
	Evenson	22.57	22.69[a]	21.340[a]	26.34[b]	0.024*
Moderate PA	Treuth	31.46	31.82[a]	29.57[a]	36.86[b]	0.025*
	Evenson	49.08	51.17[b]	46.33[a]	52.93[b]	0.008*
Light PA	Treuth	463.08	480.44[b]	452.11[a]	455.38[a]	<0.001**
	Evenson	329.95	343.11[b]	322.31[a]	321.89[a]	<0.001**
Sedentary PA	Treuth	397.81	376.54[a]	413.25[b]	400.62[b]	<0.001**
	Evenson	494.73	475.57[a]	508.79[b]	496.79[b]	<0.001**

Notes: All data are mean values**.** Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs). ANOVA: [ab] Values within a row with different superscript letters are significantly different. * p< 0.05 and ** p< 0.001. Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity

Results (Table 4.7) show that there were significant differences among the ages in all PA levels. Participants who were 11 year old spent significantly more time in moderate and vigorous PA than their counterparts. Notably, the trend was not linear as the 10 year old participants seem to have spent less time in moderate and vigorous PA than the 9 year olds. Nine year old participants spent highly significantly more time in light activity and the least time in sedentary activity compared to the older counterparts ($p<0.001$).

4.5.4 Type of school and direct measure of physical activity variables

The study set to find out how participants from the two types of schools were distributed across the PA levels. Results of the average time spent by participants from the two types of schools across the PA levels for both cut points by age are presented in Table 4.8. The means indicate that public school participants spent more time in MVPA, VPA, MPA and LPA than the participants from private schools.

Table 4.8: Mean duration in minutes of PA levels per day by type of school attended according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		All	Private school	Public school	T-test P value
MVPA	Treuth	35.45	23.69	46.04	<0.001**
	Evenson	71.65	54.76	86.88	<0.001**
Vigorous PA	Treuth	3.98	2.65	5.18	<0.001**
	Evenson	22.57	16.18	28.33	<0.001**
Moderate PA	Treuth	31.46	21.04	40.86	<0.001**
	Evenson	49.08	38.58	58.55	<0.001**
Light PA	Treuth	463.08	446.66	477.89	<0.001**
	Evenson	329.95	320.32	338.64	<0.001**
Sedentary PA	Treuth	397.81	416.05	381.37	<0.001**
	Evenson	494.73	511.31	479.79	<0.001**

Independent T test analysis (** p< 0.001) Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs).
Abbreviations: PA: Physical Activity, MVPA: Moderate-to-Vigorous Physical Activity

Independent t-test analysis was used to determine whether there were any significant differences in the means between these two types of schools. From the results presented in Table 4.8, it is clear that there were highly significant difference ($p<0.001$) between private and public schools participants in all levels of PA. This is to say that public school participants spent significantly more time in MVPA, VPA, MPA and LPA than the participants from private schools while private school participants spent significantly more time in sedentary activity than their public school counterparts.

4.5.5 SES and direct measure physical activity variables

The study also sought to assess the association between the distributions of the means for participant of different SES groups across the various levels of PA. The means are presented in the Table 4.9.

Table 4.9: Mean duration in minutes of PA levels per day by SES of participant according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		Low SES N=236	Middle SES N=158	High SES N=91	ANOVA P value
MVPA	Treuth	46.11[b]	27.04[a]	24.30[a]	<0.001**
	Evenson	87.39[b]	58.09[a]	57.07[a]	<0.001**
Vigorous PA	Treuth	5.19[b]	3.05[a]	2.70[a]	<0.001**
	Evenson	28.19[b]	18.00[a]	17.03[a]	<0.001**
Moderate PA	Treuth	40.91[b]	23.99[a]	21.59[a]	<0.001**
	Evenson	59.19[b]	40.09[a]	40.04[a]	<0.001**
Light PA	Treuth	471.13[b]	453.56[ab]	462.98[ab]	0.048*
	Evenson	331.78	326.80	333.75	0.380
Sedentary PA	Treuth	386.68	412.79	397.63	0.003*
	Evenson	484.74	508.49	494.09	0.004*

Notes: All data are mean values**.** Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs). ANOVA: [ab] Values within a row with different superscript letters are significantly different. * p< 0.05 and ** p< 0.001. Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity

By observation of these means there was a clear pattern or trend in the higher levels of PA where there was a less time spent in activity with rising SES. The results indicate that there were significant differences in all PA levels. Notably, the higher PA levels (MVPA, MPA and VPA) recorded highly significant differences ($p<0.001$) with those from LSES spending significantly more time in these levels than their counterparts.

4.5.6 Achievement of recommended physical activity level (direct measure)

The WHO (2011) PA guidelines recommend that children and youth (5-17 years) should accumulate at least 60 minutes of MVPA daily. Based on these guidelines, the study sought to assess the participants' PA levels by direct measure using accelerometry to check if they met the set guidelines. The time spent on MVPA per day was used to classify the participants as 'sufficiently active' (those that accumulated at least 60 minutes of MVPA daily) or 'insufficiently active' (those who did not accumulate at least 60 minutes of MVPA daily).

The two cut points were used since they have different classification margins which are important for comparative purposes. For instance, according to Treuth's cut points, majority of the participants (85.7%) were insufficiently active while Evenson's cut points indicated that majority (57.4%) of the participants were sufficiently active. The results are presented in Table 4.10 indicating the compliance as per the various study variables.

Generally, more males met the recommended PA levels than females and more participants from public schools met the recommended PA levels than those from private schools. For SES, most of the participants that achieved the set PA guidelines were from low SES. According to Treuth's cut points, 95.5% of those who were overweight, all the obese participants and all overfat and obese (fat) participants were insufficiently active. This indicates that participants who have excessive weight and fat levels did not engage in much PA in a day as recommended hence insufficient energy expenditure.

Table 4.10: Classification by achievement of recommended PA according to WHO (2011) (N=502)

Variables	Recommended daily PA Treuth's cut points			Recommended daily PA Evenson's cut points		
	Sufficiently active N=72(14.3%)	Insufficiently active 430(85.7%)	x^2 and (P value)	Sufficiently active 288(57.4%)	Insufficiently active 214(42.6%)	x^2 and (P value)
Childs sex						
Male n=233	47(20.2%)	186(79.8%)	12.026 (0.001)	166(71.2%)	67(28.8%)	34.223 (< 0.001)
Female n=269	25(9.3%)	244(90.7%)		122(45.4%)	147(54.6%)	
Age						
9 years n=186	33(17.7%)	153(82.3%)	4.076 (0.130)	113(60.8%)	73(39.2%)	5.559 (0.062)
10years n=243	27(11.1%)	216(88.9%)		127(52.3%)	116(47.7%)	
11years n=73	12(16.4%)	61(83.6%)		48(65.8%)	25(34.2%)	
School type						
Private n=238	2(0.8%)	236(99.2%)	67.158 (< 0.001)	83(34.9%)	155(65.1%)	93.651 (< 0.001)
Public n=264	70(26.5%)	194(73.5%)		205(77.7%)	59(22.3%)	
Socioeconomic Status (SES)						
Low SES n=236	60(25.4%)	176(74.6%)	45.618 (< 0.001)	184(78.0%)	52(22.0%)	77.294 (< 0.001)
Middle SES =158	10(6.3%)	148(93.7%)		62(39.2%)	96(60.8%)	
High SES n=91	2(2.2%)	89(97.8%)		35(38.5%)	56(61.5%)	
Body Weight Status						
Underweight n=36	9(25.0%)	27(75.0%)	16.857 (0.001)	28(77.8%)	8(22.2%)	46.706 (< 0.001)
Normal n=370	61(16.5%)	309(83.5%)		233(63.0%)	137(37.0%)	
Overweight n=44	2(4.5%)	42(95.5%)		16(36.4%)	28(63.6%)	
Obese n=52	0(0.0%)	52(100.0%)		11(21.2%)	41(78.8%)	
Body fat status						
Underfat n=201	35(17.4%)	166(82.6%)	12.570 (0.014)	145(72.1%)	56(27.9%)	52.995 (< 0.001)
Healthy n=218	34(15.6%)	184(84.4%)		120(55.0%)	98(45.0%)	
Overfat n=29	0(0.0%)	29(100.0%)		10(34.5%)	19(65.5%)	
Obese (fat) n=35	0(0.0%)	35(100.0%)		5(14.3%)	30(85.7%)	

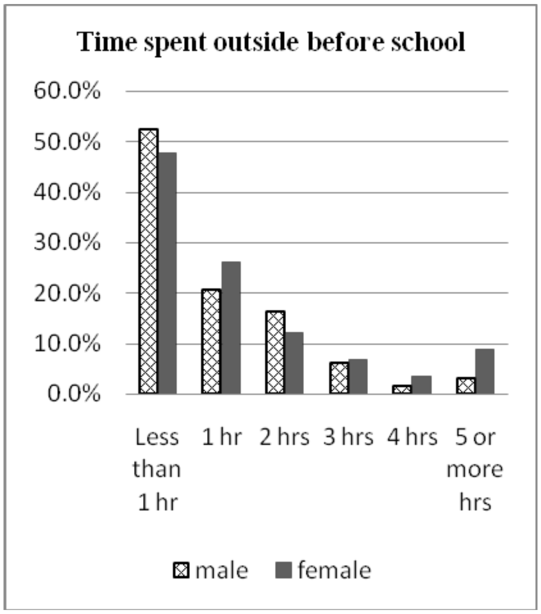
WHO (2011) and guidelines recommend that children and youth (5-17 years) should accumulate at least 60 minutes of moderate to vigorous physical activity daily (6-7days per week).

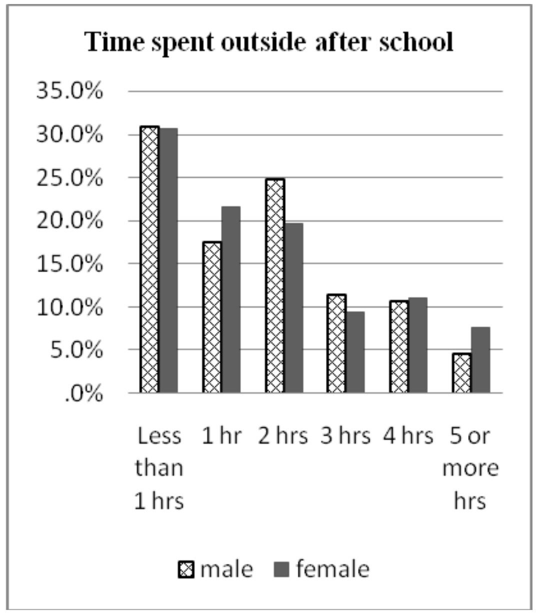
4.5.7 Results of various factors that influence physical activity

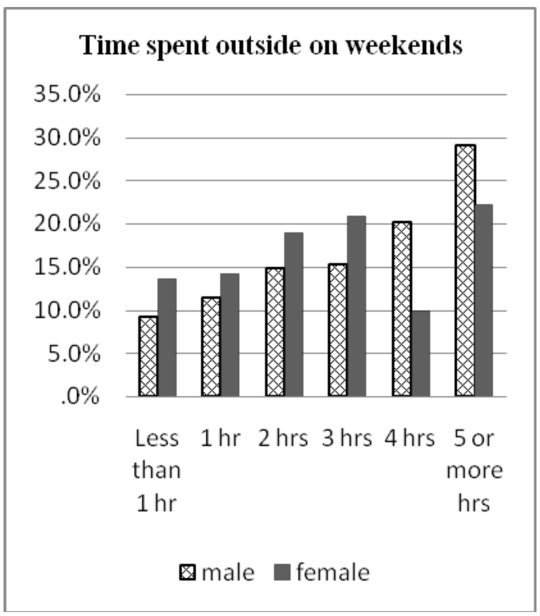
A description of various determinants and contributors to total PA in children is presented. Some of such factors include outdoor play, active transport, school opportunities (co-curricular activities) and facilities for PA and school PA policies. There was also a question on frequency of MVPA in past 7 days for at least 60 minutes.

4.5.7.1 Outdoor play (available time for PA outside school time)

For all the study participants, the average time per week for outdoor play outside school time i.e. before and after school and on a weekend day was about 6.0 hours. Figure 4.4 show the distribution of males and females across this time blocks. Generally, participants spent less time outside before school and a little bit more time after school with females spending less time than males. On weekends, the participants spent a lot more time outside and chi-square analysis revealed that the as**sociation was only significant for time spent outside on weekends (**$\chi^2 = 19.605$, $p = 0.001$).



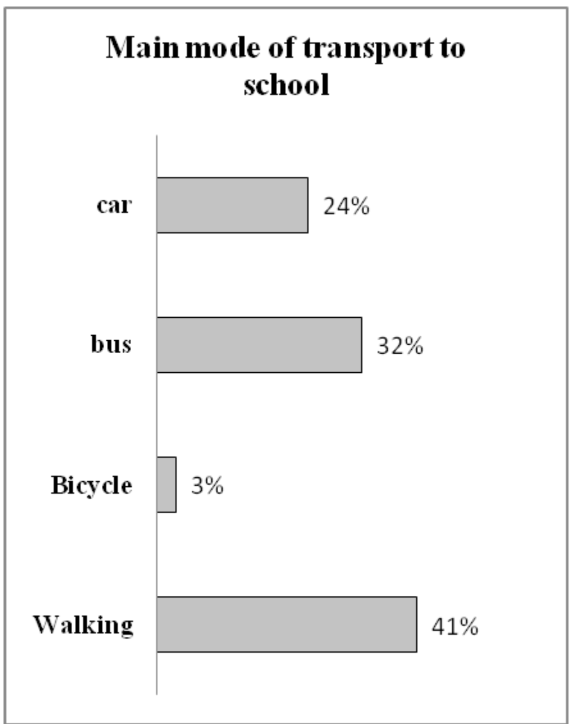


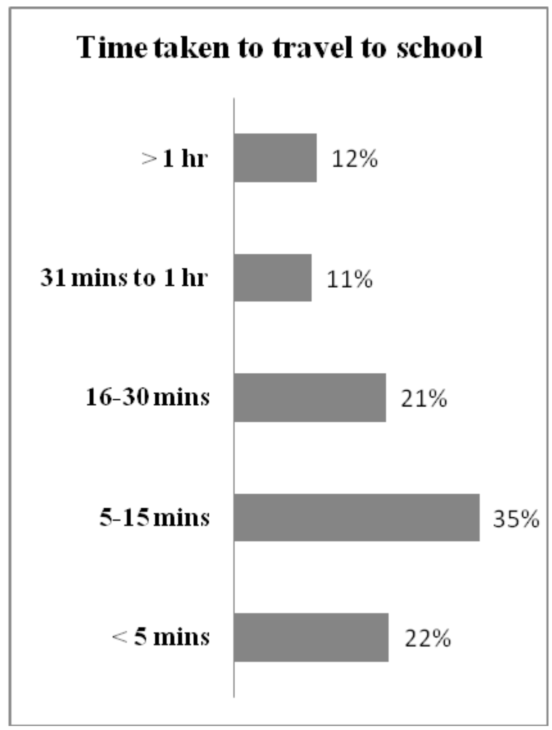


Figures 4.4 Frequency of self-reported time spent outside during different times of the day and week

4.5.7.2 Active transportation

This variable was assessed by looking at the main mode of transportation to school and average time of travel to school. Mode of travel to school was a closed question with four possible answers representing categories of like modes of transport (walking, bicycle/rollerblade/skateboard/scooter, bus/train and car/motorcycle). Length of time for travel had five possible answers ('less than 5 minutes', '5 to 15 minutes', '16 to 30 minutes', '31 minutes to 1 hour' and 'more than 1 hour'). The charts (Figure 4.5) present the percentages of the two transport variables. The highest percentage (41%) of the study participants walked to school followed by 32% that used the bus (*matatu*). Only 3% cycled to school. A majority (35%) took 5 to 15 minutes to travel to school while 11% took 31 minutes to 1 hour and 12% took more than 1 hour to travel to school.





Figures 4.5 Proportional distribution of mode of transportation and time taken to travel as reported by study participants

4.5.7.3 School Opportunities for PA

Breaks (recess) time

This is the time period between classroom lessons that allow children to go out for a bathroom break, for refreshment and meals as well as play. In assessing recess time, the study gave two responses ('15-29 minutes' and '30+ minutes') to assess the proportions of both private and public schools that offer each. Only 75.0% of private schools offered two 15-29 minute break sessions while 38.5% of public schools offered two 15-29 minute break sessions. Two schools, one public and one private, did not offer 15-29 minutes break sessions. Equal number of private and public schools offered 1 and 2, 30+ minutes break sessions while 4 private schools offered 3 or more 30+ minutes break sessions (Table 4.11). Multiple and longer recess times provide more opportunity for PA.

Table 4.11: School Opportunities for PA

			Private schools	Public schools
Recess time	**15-29 minutes**	1	1(6.3%)	4(30.8%)
		2	12(75.0%)	5(38.5%)
		3 or more	2(12.5%)	3(23.1%)
		Zero	1(6.3%)	1(7.7%)
		1	6(37.5%)	6(46.2%)
		2	6(37.5%)	6(46.2%)
	30+ minutes	3 or more	4(25.0%)	1(7.7%)
No. of PE classes attended in past 7 days by participants (n, %)		0 days	37(13.8%)	39(13.2%)
		1 day	69(25.7%)	68(23.1%)
		2 days	66(24.6%)	67(22.7%)
		3 days	54(20.1%)	64(21.7%)
		4 days	30(11.2%)	18(6.1%)
		5 days	12(4.5%)	39(13.2%)

A**ll data are** frequency and (percentage)

4.5.7.4 Physical Education

PE in school provides an ideal opportunity for promoting PA among school going children (CDC, 2013; CDC, 2010). Study participants were asked to indicate the number of days they participated in a PE class in the past week. The responses and results for both participants in public and private schools are presented in the Table 4.11. Only 13.8% of participants from private school and 13.2% of participants from public school reported not to have attended a PE class in the past week. Most of the participants clustered around 1 to 3 days while 13.2% reported to have attended PE classes on five days in the past week. This shows that there were different opportunities for children in different schools for attending PE classes, which is mandatory for primary school education especially for public schools.

Still, there seems to be differences in the scheduling of PE classes in these schools perhaps indicating that the schools have made local adjustments with regard to time allocated for PE. For instance five schools reported to have 35 minutes of PE per week while seven schools reported to have 105 minutes per week which is equivalent to 35 minutes on three days of a week. The rest of the four public schools reported to have 35, 70, 100 and 140 minutes of PE per week. For private schools, two schools reported to have 35 minutes of PE per day and two other had 140 minutes per week. The remaining private schools reported to have 40, 45, 90, 120 and 180 minutes of PE per week.

4.5.7.5 Co-curricular activities (Sports)

The study only assessed sports related co-curricular activities. It sought to examine the sports offered by schools and the competitions (Intermurals, Intramural or both) engaged in. It is evident from the results (Table 4.12) that many of the schools offer the sports and allow participation within the schools. None of the schools offered wrestling and very few (6.9%) offered rugby. One quarter of the schools (24.1%) did not offer soccer and almost half of the schools offered volleyball, track and field and swimming.

Table 4.12: Total number of schools and percentage that offered selected sports

Sports	Not offered	Intermurals	Intramural	Both
Basketball	20(69.0)	5(17.2)	2(6.9)	2(6.9)
Volleyball	13(44.8)	8(27.6)	2(6.9)	6(20.7)

Soccer	7(24.1)	14(48.3)	2(6.9)	6(20.7)
Baseball or softball	24(82.8)	2(6.9)	1(3.4)	2(6.9)
Rugby	27(93.1)	-	2(6.9)	-
Gymnastics	19(65.5)	6(20.7)	3(10.3)	1(3.4)
Wrestling	29(100)	-	-	-
Track and field	13(44.8)	10(34.5)	2(6.9)	4(13.8)
Badminton	27(93.1)	-	2(6.9)	-
Swimming	13(44.8)	9(31.0)	1(3.4)	6(20.7)

A**ll data are** frequency and (percentage)

4.5.7.6 School facilities for PA

The study assessed the 29 schools using a questionnaire to find out the school facilities in each school that are supportive to PA.

Table 4.13: School facilities for PA as reported by school administrators (N = 29).

Facilities for PA	***Not available***	***Yes, on school grounds only***	***Yes, off school grounds only***	***Yes, both on and off school grounds***
Gymnasium	27(93.1)	1(3.4)	-	1(3.4)
Large room for PA	22(75.9)	6(20.7)	-	1(3.4)
Fitness room	25(86.2)	3(10.3)	1(3.4)	-
Running track	6(20.7)	18(62.1)	-	5(17.2)
Outdoor sports field	-	19(65.5)	2(6.9)	8(27.6)
an outdoor paved area	10(34.5)	14(48.3)	-	7(17.2)
Swimming pool	14(48.3)	13(44.8)	1(3.4)	1(3.4)

A**ll data are** frequency and (percentage)

Majority of the schools did not have access to a gymnasium (93.1%), large room for PA (dance studio, auditorium) (75.9%), or a fitness room (86.2%) during school hours. Almost half (48.3%) of the schools could not access a swimming pool and a fifth of the schools (20.7%) did not access a running track. All schools could access an outdoor sports field with 65.5% of schools having an outdoor sports field within the school grounds. The Table 4.13 provides more details.

4.5.7.7 Physical activity policies in schools

The study sought to find out the proportion of schools that had existing written policies or practices concerning healthy eating and PA and/or a committee to oversee development of such polices. About 69.0% of schools reported to have existing policies and/or practices concerning PA and 51.7% had committees to oversee development of PA and healthy eating policies.

4.6 Screen Based Sedentary Behaviours

The main objective of this part of the study was to assess and describe the screen-based sedentary activity patterns and present the amount of time spent on screen based sedentary behaviors in the light of set international recommendations. It was also to determine the association of sedentary ST levels and sex, type of school attended and SES as well as body weight, and fatness status of study participants. The study also sought to find out the types of screen based electronic devices that participants had access to and find out if presence of these devices influenced their overall ST levels. The results on associations of ST levels with adiposity were later compared to similar associations of other major study variables to check for significance.

4.6.1 Overall Time spent in screen based sedentary activities

Professional pediatric organizations recommend that children should not engage in more than 2 hours of ST daily (CSEP, 2011; Carson, et al., 2010) as part of a healthy lifestyle. The results indicated that on average, participants spent about 1.75 hours engaging in screen based sedentary activities on a school day which is within the acceptable levels and about 4.25 hours on a weekend day which is excessive according to the recommendations. Data on screen activities on a school day and on a weekend day were summarized and combined into two outcomes ('less than 2 hours per day' or '2 hours or more per day'). Results (Table 4.14) indicated that on a school day, majority (67.9%) of the participants spent less than 2 hours in screen based sedentary activities while on a weekend day, most (74.2 %) of the participants spent more than 2 hours in screen based sedentary activities.

Table 4.14: Time spent on screen-based activities as per recommendations N= 563

Time (Recommended < 2 hours daily)	School Days	Weekend Days
2 hours or less of Screen Time	382 (67.9%)	145 (25.8%)
More than 2 hours of Screen Time	181 (32.1%)	418 (74.2 %)

Recommendation: American Academy of Pediatrics (2001) and Canadian Society for Exercise Physiology (2011) 5 to 11 year old children should not engage in more than 2 hours of screen time daily

4.6.2 Screen Time Levels

As explained earlier (under data scoring), equal quartiles were formed and were used to categorize the participants' scores into ST levels as follows: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile). The overall ST levels for participants indicate that 283 (50.3%) were of low levels, 193 (34.3%) were of low-moderate level, 84 (14.9%) were of moderate to high level and only 3 (0.5%) were of high level. Figure 4.6 presents the proportions.

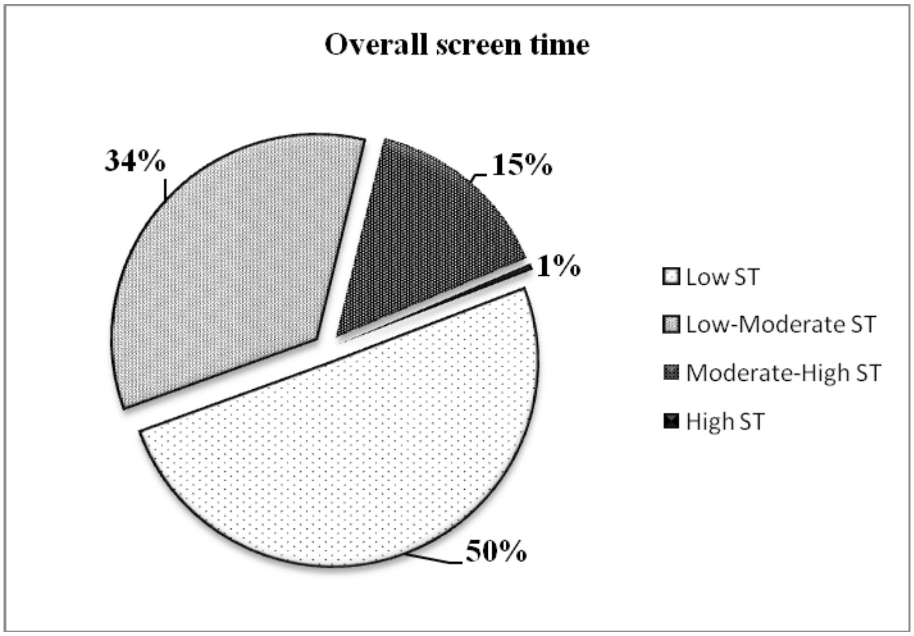


Figure 4.6: Overall screen time levels

The study participants were also categorized into two major groups: low ST and high ST. The results showed that 84.5% had low ST while 15.5% had high ST.

4.6.3 Screen Time Levels and access to electronic devices

The study sought to investigate whether the availability/access to selected electronic devices affected the participant's ST levels. Given that 46.9% of the participants in this study were of LSES, it is clear that many of the participants did not have access to these electronic devices. Among those that had moderate-high levels of ST, 78.6% had a TV in their bedrooms, 13.1% had access to a computer, 23.8% had access to hand-held video game device, 32.1% had access to a cell phone and 16.7% had a non-hand held video game system (Play station, Xbox). More details of the results are presented in Table 4.15.

Table 4.15: Association of ST level and access of electronic devices

Electronic devices	response	Screen time categories			
		Low	**Low-moderate**	**Moderate high**	**High**
TV in participant bedroom	Yes	245(86.6%)	148(76.7%)	66(78.6%)	0(.0%)
	No	38(13.4%)	45(23.3%)	18(21.4%)	3(100.0%)
Computer	Yes	25(8.8%)	28(14.5%)	11(13.1%)	1(33.3%)
	No	253(89.4%)	164(85.0%)	70(83.3%)	2(66.7%)
Hand-held video game system	Yes	37(13.1%)	39(20.2%)	20(23.8%)	2(66.7%)
	No	240(84.8%)	153(79.3%)	61(72.6%)	1(33.3%)
Cell phone	Yes	47(16.6%)	45(23.3%)	27(32.1%)	2(66.7%)
	No	229(80.9%)	147(76.2%)	54(64.3%)	1(33.3%)
Video game system (non-hand held; Play station, Xbox,	Yes	20(7.1%)	24(12.4%)	14(16.7%)	3(100.0%)
	No	257(90.8%)	168(87.0%)	67(79.8%)	0(.0%)

Cross-tabulations of **variables, all data are** frequency and (%).Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile)

4.6.4 TV viewing and playing video/computer games and use of computer during school days and weekend days

From the results, it was evident that children are spending a lot more time on screen activities on weekend days than on school days. For instance 41.4% of participants had high levels of TV watching and 35.2% were of moderate-high levels while 24.5% of participants were placed in the moderate-high levels in their use of computer and video games and 13.0% were in the high category. This is supported by findings presented earlier that revealed that 74.2% participants had more than 2 hours of ST on weekend days. Although it is obvious that children are engaged in school work during school days and should therefore have low levels of ST on school days, 23.1% were in the moderate-high category and 8.3% were in the high category of TV viewing during school days. More details are presented in Table 4.16.

Table 4.16: Level of TV viewing and playing video/computer games/use computer during school days and weekend days

	ST level	School day n	(%)	Weekend day n	(%)
TV viewing	Low	310	(55.1%)	86	(15.3%)
	Low-moderate	76	(13.5%)	45	(8.0%)
	Moderate high	130	(23.1%)	198	(35.2 %)
	High	47	(8.3%)	233	(41.4%)
Computer use, playing video/computer games/use	Low	421	(74.8%)	292	(51.9%)
	Low-moderate	68	(12.1%)	60	(10.7%)
	Moderate high	51	(9.1%)	138	(24.5%)
	High	23	(4.1%)	73	(13.0%)

Cross-tabulations of variables, **all data are** frequency and (%). Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile)

4.6.5 Screen time variables and sex of study participants

The study first assessed the ST levels of males and females in the specific ages to establish any tendencies that may be related to ST. The distribution of ST levels by age and sex of participants as presented in the Figure 4.7 shows that generally, there were more participants with low ST levels followed by those in low-moderate levels in each sex across all ages except for 11 year old males where the number of those in the low and moderate-high were the same (11). There were no 10 and 11 year old female participants and no 9 year old males with high levels of ST.

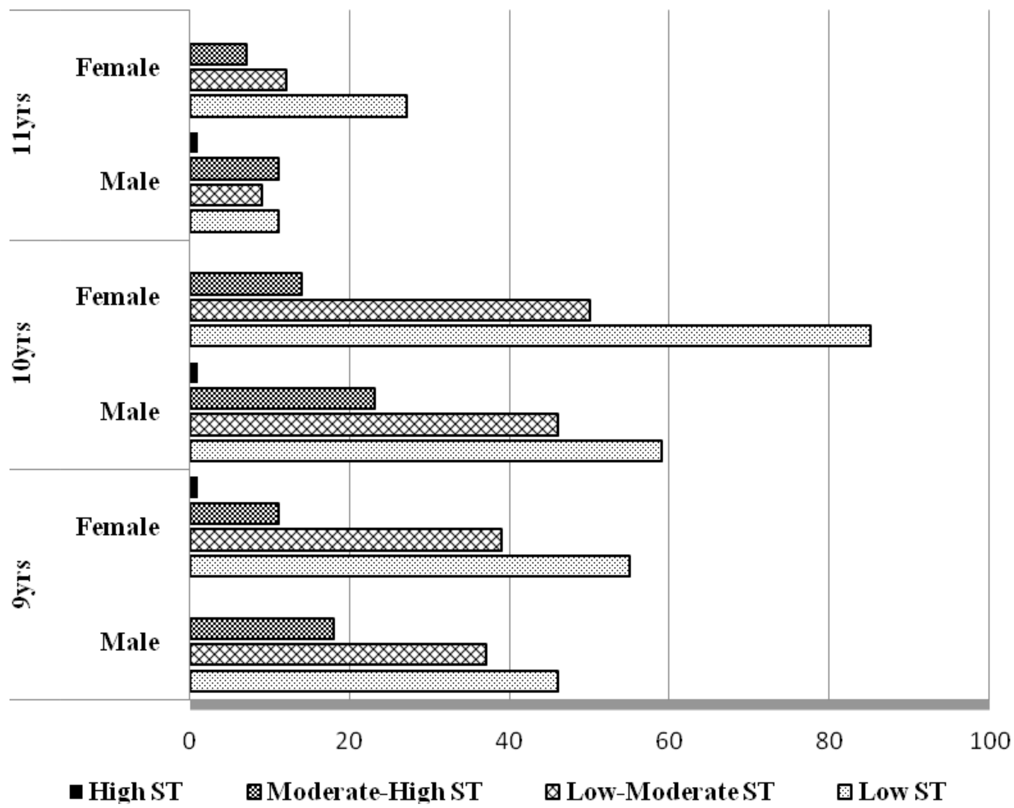


Figure 4.7: Distribution of screen time levels by age and sex of study participants

Chi-square analysis was used to test if there was any significant relationship in the distribution of the ST levels by sex. Results indicated that there was a significant relationship between the sexes and overall ST levels $\chi^2 = 12.062$, $p = 0.007$. There was a significant trend such that there were fewer participants with increase in ST levels in both sexes. More details are presented in Table 4.17.

Table 4.17: Study participant's sex and overall screen time level

Child's sex	Low ST	Low-Moderate ST	Moderate-High ST	High ST	Chi-square (P value)
Male	116(44.3%)	92(35.1%)	52(19.8%)	2(0.8%)	12.062 (0.007)
Female	167(55.5%)	101(33.6%)	32(10.6%)	1(0.3%)	
Total	283(50.3%)	193(34.3%)	84(14.9%)	3(0.5%)	

Cross-tabulations of variables, **all data are** frequency and (%).Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile)

The study also used independent t-test analysis to determine whether there were any significant differences in the distribution of participants across the two sexes within the other ST determinants of continuous data. Results indicate that there was only a significant difference in the means of average ST on a weekend day (Sig. (2-tailed) of <0.001 and t=3.912) and average daily screen-time (Sig. (2-tailed) of <0.001 and t=3.527). Details are presented in Table 4.18. Indeed, the differences observed in the means where there were higher ST means for males than females in the two variables were significant. Therefore, males have a significantly higher ST over the weekend and daily average ST than females.

Table 4.18: Differences in selected ST variables by sex of participant

	Child's Sex	**Mean**	**Std. Deviation**	***t***	**Significance (2-tailed)**
Average screen time on a school day	Male	1.9	1.9	1.646	0.100
	Female	1.6	1.8		
Average screen time on a weekend day	Male	4.7	2.7	3.912	<0.001**
	Female	3.9	2.4		
Average daily screen-time	Male	1.7	0.9	3.527	<0.001**
	Female	1.4	0.9		

T test analysis * represents the *p* values that are significant (* $p < 0.05$ and ** $p < 0.001$)

4.6.6 Screen time variables and school type

The frequencies and percentages of the cross-tabulation between school type and overall ST levels are presented in the Table 4.19. Chi-square analysis used to check for any associations revealed that there was significant linear relationship $\chi^2 = 10.717$, p = 0.013. In both types of schools there was a significant linear progression such that there were fewer participants with increase in ST.

Table 4.19: Screen time variables and school type

School Type	Overall Screen Time Level				Total
	Low	Low-Moderate	Moderate-High	High	
Private School	118(44.0%)	101(37.7%)	46(17.2%)	3(1.1%)	268(100.0%)
Public School	165(55.9%)	92(31.2%)	38(12.9%)	0(0.0%)	295(100.0%)
Total	283(50.3%)	193(34.3%)	84(14.9%)	3(0.5%)	563(100.0%)

Cross-tabulations of variables, **all data are** frequency and (%).Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile)

In further analysis involving school type and ST variables with continuous data, t-test results presented in Table 4.20 indicate that there was only significant difference in the means of average ST on a weekend day (Sig. (2-tailed) of <0.001 and t=4.467) and average daily screen-time (Sig. (2-tailed) of <0.001 and t=3.580) for the two types of schools, indicating that private schools participants had a higher mean in ST than those in public schools over the weekend and daily.

Table 4.20: Differences in selected ST variables by school type

	School Type	**Mean**	**Std. Deviation**	***t***	**Significance (2-tailed)**
Average screen time on a school day	Private School	1.8	1.8	1.014	0.311
	Public School	1.7	1.9		
Average screen time on a weekend day	Private School	4.8	2.5	4.467	<0.001**
	Public School	3.8	2.6		
Average daily screen-time	Private School	1.7	0.9	3.580	<0.001**
	Public School	1.4	0.9		

T test analysis * represents the *p* values that are significant (* p< 0.05 and ** p< 0.001)

4.6.7 Screen time levels and SES of study participants

The overall ST levels were compared to the participants' SES to check for any associations. Generally the largest group of participants was of low SES. Noteworthy, the majority of those in moderate-high ST levels were of low SES and most (49.0%) of the high SES participants had low levels of ST. Evidently, many of those who can afford the various screen-based electronic devices may not necessarily spend much of their time using them. By observation of the frequencies in the Table 4.21, there appears to be a linear relationship between SES and ST levels but Chi-square analysis confirmed that this was not a significant relationship ($\chi^2 = 12.289$, $p = 0.198$).

Table 4.21: Association of **screen time levels and SES of study participants**

Screen time levels	SES Categories			Chi-square (P value)
	LSES	MSES	HSES	
Low	145(54.9%)	82(46.3%)	50(49.0%)	12.289 (0.198)
Low-moderate	80(30.3%)	69(39.0%)	36(35.3%)	
Moderate high	39(14.8%)	24(13.6%)	15(14.7%)	
High	0(0.0%)	2(1.1%)	1(1.0%)	

Cross-tabulations of variables, all data are frequency and (%).Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile). Abbreviations: LSES = Low Socio Economic Status; MSES = Middle Socio Economic Status; HSES = High Socioeconomic Status.

4.7 Dietary Habits

The study sought to assess and describe the dietary habits in relation to the frequency of consumption of various foods and drinks. The study also determined the relationship between the frequency of consumption of various foods by sex, type of school and SES of the participants as well as their body weight, and fatness status.

Overall, the most frequently consumed foods/drinks were vegetables, fruits, dark green vegetables whereas the least consumed were cheese, energy drinks, ice-cream and sport drinks (Table 4.22). The frequency in consumption of foods that are high risk for obesity such as French fries, soft drinks (contain sugar), potato crisps, cake/pastries, fast food, fried food and sweets was average compared to the rest of the foods.

4.7.1 Frequency of consumption of foods and drinks by sex

Table 4.22 presents the means for the frequency of consumption of foods/drinks by sex.

Table 4.22: Mean frequency of consumption of foods and drinks by participants' sex

Foods consumed	**All N=563 Means(sd)**	**Male N=262 Mean (sd)**	**Female N= 301 Mean (sd)**	***p* value T test**
Cake, pastries, or doughnuts	3.5 (1.8)	3.3 (1.8)	3.6(1.8)	0.105
Potato Crisps	3.6 (1.8)	3.5(1.7)	3.8(1.8)	0.043*
Regular cola or soft drinks (contain sugar)	3.2 (1.7)	3.1(1.7)	3.4(1.8)	0.050
French fries	3.3 (1.7)	3.2 (1.8)	3.5(1.7)	0.088
Whole grain bread or cereal (weetabix, etc.)	4.4 (2.2)	4.2 (2.2)	4.6 (2.1)	0.027*
Energy drinks (Red Bull, Shark, etc.)	2.3 (1.8)	2.3 (1.9)	2.4(1.7)	0.760
Sports drinks (lucozade, Gatorade, Powerade)	2.9 (1.9)	3.0(2.0)	3.0(1.9)	0.663
Fast food such as hotdog, pizza, hamburgers,	3.2 (1.9)	3.1(1.9)	3.4(1.8)	0.079
Fruits	5.1 (1.8)	4.9 (1.9)	5.3 (1.7)	0.017*
Vegetables	5.3 (1.7)	5.3(1.7)	5.4(1.7)	0.526
Diet cola or diet soft drinks	3.1 (1.9)	3.1 (1.9)	3.1 (1.9)	0.887
Dark green vegetables(*sukuma wiki*, spinach)	4.9 (1.9)	4.9 (1.9)	4.9 (1.9)	0.732
Other vegetables (carrots, cucumber, sweet potato, etc.)	4.8 (2.0)	4.7(1.9)	4.9 (1.9)	0.088
Fruit juice	3.9 (1.9)	3.8(1.9)	4.1 (1.9)	0.041*
Low fat milk (1%,2%,skim)	3.7 (2.2)	3.6 (2.2)	3.8(2.2)	0.373
Whole milk (homogenized)	4.2 (2.2)	4.0 (2.3)	4.3(2.2)	0.228
Other milk products (yogurt, chocolate milk,)	3.7 (1.9)	3.5(1.8)	3.9 (1.9)	0.004*
Meat alternatives (beans, green grams (*ndengu*), lentils, eggs, peanut butter, etc.)	4.3 (1.8)	4.4(1.8)	4.3(1.8)	0.634
Fish	3.3 (1.8)	3.3 (1.8)	3.2 (1.7)	0.505
Cheese	2.2 (1.7)	2.2 (1.8)	2.1 (1.6)	0.468
Ice Cream	2.9 (1.7)	2.9(1.7)	3.1(1.7)	0.141
Fried food such as chicken wings, etc.	3.3 (1.8)	3.3(1.9)	3.3 (1.8)	0.780
Sweets	3.0 (1.6)	2.9(1.6)	3.1 (1.7)	0.059

Note: All data are means and (SD), unless otherwise indicated. Definitions: *sukuma wiki* = kales; *ndengu* = green grams. * Significant (2-tailed) difference ($p<0.05$)

There was significant difference between males and females in the frequency of consumption of potato crisps (p=0.043), whole grain bread or cereal (p=0.027), fruits (p=0.017), fruit juice (p=0.041) and other milk products (p=0.004). The females consumed these foods significantly more frequently than the males. There was no significant difference in the consumption of the other foods between the sexes.

4.7.2 Frequency of consumption of foods and drinks by type of school

Table 4.23 presents the frequency of consumption of foods/drinks by school type.

Table 4.23: Frequency of consumption of foods/drinks by type of school

Foods consumed	**Private sch N=268 Mean (sd)**	**Public sch N= 295 Mean (sd)**	***p* value T test**
Cake, pastries, or donuts	3.1(1.5)	3.8(1.9)	<0.001**
Potato Crisps	3.6(1.8)	3.7(1.8)	0.581
Regular cola or soft drinks (contain sugar)	3.3(1.6)	3.2(1.8)	0.339
French fries	3.2(1.4)	3.5(1.9)	0.006*
Whole grain bread or cereal (weetabix, oatmeal, etc.)	4.7(2.1)	4.1(2.2)	0.001*
Energy drinks (Red Bull, Shark, etc.)	2.1(1.6)	2.6(1.9)	<0.001**
Sports drinks (lucozade, Gatorade, Powerade)	2.8(1.8)	3.1(2.1)	0.156
Fast food such as hotdog, pizza, hamburgers,	3.1(1.5)	3.4(2.1)	0.056
Fruits	5.3(1.7)	5.0(1.9)	0.100
Vegetables	5.5(1.5)	5.1(1.9)	0.017*
Diet cola or diet soft drinks	2.8(1.8)	3.4(1.9)	0.001*
Dark green vegetables(*sukuma wiki*, spinach,	4.9(1.8)	5.0(1.9)	0.387
Other vegetables (carrots, cucumber, sweet potato, etc.)	4.9(1.9)	4.8(2.0)	0.857
Fruit juice	3.9(1.8)	3.9(2.1)	0.851
Low fat milk (1%,2%,skim)	3.6(2.2)	3.8(2.2)	0.456
Whole milk (homogenized)	4.3(2.2)	4.1(2.2)	0.274
Other milk products (yogurt, chocolate milk,)	3.7(1.7)	3.8(2.0)	0.323
Meat alternatives (beans, green grams (*ndengu*) lentils, eggs, peanut butter, etc.)	4.4(1.7)	4.3(1.9)	0.393
Fish	2.9(1.5)	3.5(1.9)	<0.001**
Cheese	1.9(1.4)	2.5(1.9)	<0.001**

Ice Cream	2.8(1.5)	3.2(1.9)	0.003*
Fried foods such as chicken wings, etc.	3.1(1.6)	3.5(1.9)	0.036*
Sweets	3.2(1.6)	2.8(1.6)	0.001*

Note: All data are means and (SD), unless otherwise indicated. Definitions: *sukuma wiki* = kales; *ndengu* = green grams. * Significant (2-tailed) difference ($p<0.05$); **Significant difference ($p<0.001$)

The results indicate that pupils from the private schools significantly consumed whole grain or cereals, vegetables and sweets more frequently than their counterparts in the public schools (Table 4.23). In contrast, pupils from the public schools significantly consumed more cake, pastries or doughnuts, energy drinks, diet cola or soft drinks, fish, cheese, ice-cream and chicken wings more frequently than those in the private schools. The findings indicate that participants from public school consumed more frequently foods/drinks that promote overweight and obesity specifically cake/pastries, energy drinks, French fries, cheese, ice-cream and fried food.

4.7.3 Frequency of consumption of foods/drinks by SES of participants

Since the participants' SES may influence their lifestyle in relation to food intake due to availability, abundance and affordability of the foods, it was important to study the association of these variables before drawing further conclusions. Table 4.24 presents the means of the frequency of consumption of the various foods/drinks by SES.

The results (Table 4.24) show that, there was significant difference in the consumption of cakes/pastries ($p<0.001$), whole grain bread/cereal ($p=0.036$), energy drinks ($p=0.001$), fruits ($p=0.002$), diet soft drinks ($p=0.007$) and fish ($p<0.001$) by SES. Participants from LSES consumed cakes/pastries, energy drinks and fish more frequently than those from MSES and HSES. The high consumption of energy drinks among those from LSES may be a case of over-reporting. Participants from HSES consumed whole grain bread/cereal and fruits more frequently than those from LSES and MSES.

Table 4.24: Frequency of consumption of foods/drinks by SES of participants

Foods consumed	**LSES N=264 Mean (sd)**	**MSES N= 177 Mean (sd)**	**HSES N=102 Mean (sd)**	***p* value ANOVA**
Cake, pastries, or donuts	3.9(1.9)^{b}	3.2(1.6)^{a}	2.9(1.5)^{a}	<0.001**
Potato Crisps	3.7(1.8)	3.5(1.7)	3.6(1.8)	0.511
Regular cola or soft drinks (contain sugar)	3.2(1.9)	3.1(1.5)	3.4(1.6)	0.192
French fries	3.5(1.9)	3.2(1.6)	3.1(1.3)	0.191
Whole grain bread or cereal (weetabix, oatmeal, etc.)	4.2(2.3) ^{a}	4.5(2.0) ^{a}	4.8(2.1) ^{b}	0.036*
Energy drinks (Red Bull, Shark, etc.)	2.6(1.9) ^{b}	2.3(1.7) ^{ab}	1.8(1.3) ^{a}	0.001*
Sports drinks (lucozade, Gatorade, Powerade)	3.0(2.0)	2.9(1.9)	2.7(1.8)	0.539
Fast food such as hotdog, pizza, hamburgers,	3.5(2.2)	3.1(1.5)	2.9(1.4)	0.065
Fruits	4.9(1.9) ^{a}	5.2(1.7) ^{ab}	5.7(1.5) ^{b}	0.002*
Vegetables	5.2(1.9)	5.4(1.6)	5.5(1.6)	0.233
Diet cola or diet soft drinks	3.4(2.1) ^{b}	2.9(1.7) ^{ab}	2.8(1.9) ^{ab}	0.007*
Dark green vegetables(*sukuma wiki*, spinach,	4.9(1.9)	5.1(1.7)	4.8(1.9)	0.394
Other vegetables (carrots, cucumber, sweet potato, etc.)	4.7(2.0)	4.9(1.9)	5.1(1.8)	0.234
Fruit juice	3.8(2.0)	3.8(1.8)	4.3(1.8)	0.071
Low fat milk (1%,2%,skim)	3.9(2.2)	3.5(2.2)	3.6(2.3)	0.253
Whole milk (homogenized)	4.2(2.2)	3.9(2.3)	4.4(2.2)	0.376
Other milk products (yogurt, chocolate milk,)	3.8(1.9)	3.7(1.8)	3.8(1.8)	0.993
Meat alternatives (beans, green grams (*ndengu*) lentils, eggs, peanut butter, etc.)	4.3(1.9)	4.3(1.9)	4.4(1.7)	0.833
Fish	3.6(1.9) ^{b}	2.9(1.6) ^{a}	3.0(1.4) ^{ab}	<0.001**
Cheese	2.4(1.9)	2.1(1.6)	1.9(1.3)	0.076
Ice Cream	3.2(1.9)	2.7(1.5)	2.9(1.5)	0.051
Fried food such as chicken wings, etc.	3.4(1.9)	3.2(1.7)	3.2(1.5)	0.455
Sweets	2.9(1.8)	3.0(1.5)	3.2(1.5)	0.416

Note: All data are means and (SD). ^{ab} Values within a row with different superscript letters are significantly different. * Significant (2-tailed) difference ($p<0.05$); **Significant difference ($p<0.001$). Abbreviation: SES = Socio Economic Status. Definitions: *sukuma wiki* = kales; ndengu = green grams.

4.8 Association between adiposity (weight and fatness status) and primary independent variables (Physical Activity, Screen Time and dietary habits)

4.8.1 Body weight status and direct measure of physical activity variables

The findings show a relationship between duration of time spent in activity and weight status. Results for light and sedentary activity levels were not significant. For the higher levels of PA, it appears that the higher the weight status, the less the time spent on PA and vice-versa. These results were highly significant (p<0.001) to show that there is a significant meaning for the linear progression observed (which is expected), indicating that the higher the body weight status the lower the time of engagement in PA.

Table 4.25: Mean duration in minutes of PA levels per day by body weight status according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		All N=502	Under weight N=36	Normal weight N=370	Over weight N=44	Obese N=52	ANOVA P value
MVPA	Treuth	35.45	50.79^{c}	38.08^{b}	22.24^{a}	17.28^{a}	<0.001**
	Evenson	71.65	92.88^{c}	74.60^{b}	55.97^{a}	49.25^{a}	<0.001**
Vigorous PA	Treuth	3.98	5.47^{b}	4.39^{b}	2.19^{a}	1.51^{a}	<0.001**
	Evenson	22.57	30.85^{c}	24.24^{b}	14.39^{a}	11.87^{a}	<0.001**
Moderate PA	Treuth	31.46	45.33^{b}	33.68^{b}	20.04^{a}	15.77^{a}	<0.001**
	Evenson	49.08	62.03^{c}	50.36^{b}	41.57^{a}	37.37^{a}	<0.001**
Light PA	Treuth	463.08	471.29	462.03	476.46	453.55	0.367
	Evenson	329.95	332.47	328.34	343.57	328.22	0.313
Sedentary time	Treuth	397.81	387.44	397.24	400.59	406.72	0.648
	Evenson	494.73	484.19	494.41	499.75	500.09	0.676

Notes: All data are mean values**.** Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs).
ANOVA: [ab] Values within a row with different superscript letters are significantly different. * p< 0.05 and ** p< 0.001. Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity

The null hypothesis ($H0_1$) that there is no significant association between the PA levels and body weight status among 9 - 11 years old in Nairobi County, was therefore rejected.

4.8.2 Body fatness status and direct measure of PA variables

The study also assessed the association between the distributions of participants of different body fatness status across the various levels of PA. By observation of the means presented in Table 4.26, there was also a clear pattern in the higher levels of PA where there was less time spent in activity with rising body fat levels. Findings indicate that just like in the body weight status results, there were highly significant differences (p<0.001) in MVPA, MPA and VPA levels across the body fat levels. The results (Table 4.26) show that those who are classified as obese (fat) and overfat spent significantly less time in the higher level PA (MVPA, MPA and VPA) than those classified to have healthy fat and the underfat. Results for light and sedentary time were not significant.

Table 4.26: Mean duration in minutes of PA levels per day by body fat status according to Treuth et al.'s and Evenson et al.'s cut points

PA levels		All N=483	Underfat N=201	Healthy fat N=218	Overfat N=29	Obese (fat) N=35	ANOVA P value
MVPA	Treuth	35.57	42.31[b]	34.72[b]	19.36[a]	15.51[a]	<0.001**
	Evenson	72.01	81.23[c]	70.04[b]	52.00[a]	47.92[a]	<0.001**
Vigorous PA	Treuth	3.96	4.89[c]	3.74[bc]	2.63[ab]	1.05[a]	<0.001**
	Evenson	22.62	26.73[b]	21.93[b]	13.79[a]	10.67[a]	<0.001**
Moderate PA	Treuth	31.61	37.43[b]	30.98[b]	16.73[a]	14.46[a]	<0.001**
	Evenson	49.39	54.50[b]	48.11[b]	38.27[a]	37.25[a]	<0.001**
Light PA	Treuth	463.16	468.84	458.17	473.64	452.96	0.287
	Evenson	329.69	332.61	325.82	341.45	327.25	0.337
Sedentary time	Treuth	396.64	389.36	402.02	389.45	410.94	0.167
	Evenson	493.67	486.68	499.05	488.99	504.24	0.183

Notes: All data are mean values**.** Treuth, et al. (2004) cut points results (data processed using 1 minute epochs), Evenson, et al. (2008) cut points results (data processed using 15 second epochs).

ANOVA: [ab] Values within a row with different superscript letters are significantly different. * $p < 0.05$ and ** $p < 0.001$. Abbreviations: PA: Physical Activity, MVPA, Moderate-to-Vigorous Physical Activity

These findings show that there is a significant meaning behind the linear progression (which was expected) where the higher the body fatness status/levels the less the amount of time spent in the higher levels of PA. On account of the significance noted above, the null hypothesis ($H0_1$) that there is no significant association between the PA levels and body fatness status among 9 to 11 year olds in Nairobi County, was rejected.

4.8.3 Screen time variables and body weight and fatness status

The screen time levels of the participants were compared to their body weight and body fatness status to check for any associations especially among those who are overweight/obese and those classified as overfat and obese fat. The categories did not result in a good distribution (for instance the high category had very few participants) (Table 4.27). However, majority of those who were overweight and obese and those classified as overfat and obese fat had low levels of ST. This may indicate that for this population, there may be other factors other than screen-based sedentary behaviour that promote increase in body weight at a greater capacity.

Table 4.**27: Association of Screen time levels and** body weight and body fat status

Variables		Screen time categories				
		Low	**Low-moderate**	**Moderate high**	**High**	**Total**
BMI status	Underw**eight**	24(8.5%)	9(4.7%)	5(6.0%)	0(0.0%)	38(6.7%)
	Normal	205(72.4%)	149(77.2%)	56(66.7%)	1(33.3%)	411(73.0%)
	Overweight	25(8.8%)	15(7.8%)	11(13.1%)	2(66.7%)	53(9.4%)
	Obese	29(10.2%)	20(10.4%)	12(14.3%)	0(0.0%)	61(10.8%)
Body fatness status (%BF)	Underfat	113(39.9%)	64(33.2%)	37(44.0%)	0(.0%)	214(38.0%)
	Healthy (fat)	129(45.6%)	94(48.7%)	28(33.3%)	2(66.7%)	253(44.9%)
	Overfat	14(4.9%)	11(5.7%)	8(9.5%)	1(33.3%)	34(6.0%)

Obese (fat)	21(7.4%)	14(7.3%)	7(8.3%)	0(.0%)	42(7.5%)

Cross-tabulations of **variables, all data are** frequency and (%).Categorization of ST score: "low," (1st quartile) "low-moderate," (2nd quartile) "moderate-high," (3rd quartile) and "high" (4th quartile)

Chi-square tests for the categorized variables above revealed a significant association ($\chi^2 = 18.057$, $p = 0.035$) with a linear relationship between weight status and overall ST levels. The linear relationship was such that there were fewer participants with an increase in ST across all weight levels. However, one way ANOVA revealed no significant difference between the body weight levels and the continuous variables (average ST on a school day, average ST on a weekend day, average daily ST and total number of hours in a week) on screen activities even among the sexes and school types.

In the analysis of ST vs. body fatness, Chi-square analysis revealed no significant linear relationship between body fatness and all categorical indicators of ST. However, one way ANOVA found significant differences between the means of the total number of hours in a week on screen based activities $p = 0.045$, average ST on a weekend day $p = 0.024$, and average daily ST the $p = 0.045$. For all these, the differences were observed between those who were underfat and healthy with those in the overfat and obese fat groups. This means that although there somewhat seemed to be an increase in ST with increase in fat levels in these variables, significance differences in means only existed between those who were underfat/healthy and not those in the overfat and obese fat groups (Table 4.28).

Table 4.**28: Association of continuous screen time variables and** body fatness status

Fatness status	**Total no. of hours/week in screen activities**	**Average screen time on school day**	**Average screen time on weekend day**	**Average daily screen time**
Under fat	5.7^{a}	1.7^{ab}	4.1^{a}	1.4^{b}
Healthy fat	5.9^{a}	1.7^{ab}	4.1^{a}	1.5^{b}
Overfat	6.3^{ab}	2.4^{b}	4.8^{ab}	1.8^{ab}
Obese (fat)	7.2^{ab}	1.4^{a}	4.9^{ab}	1.6^{ab}

***p* values**	0.045*	0.108	0.024*	0.045*

Notes: [ab] letters represent homogeneous subsets and means with the same superscript letter in the same column are not significantly different and those with different letters are significantly different ANOVA analysis * represents the *p* values that are significant (* $p < 0.05$)

These results led to the rejection of the hypothesis ($H0_2$) that there is no significant association between sedentary ST habits and body weight and fatness status.

4.8.4 Association between BMI and frequency of consumption of foods/drinks

The results (Table 4.29) show that, those who were underweight reported eating vegetables less frequently than the rest (p=0.003). There was also a significant difference in the consumption of ice cream (p=0.038) with the mean for the normal weight category being significantly higher than the rest.

Table 4.29: Association between BMI and frequency of consumption of foods/drinks

Foods consumed	**Under weight N=38**	**Normal weight N=411**	**Over weight N=53**	**Obese (weight) N= 61**	***p* value ANOVA**
Cake, pastries, or donuts	3.5(1.9)	3.6(1.9)	3.3(1.9)	2.9(1.1)	0.089
Potato Crisps	3.3(1.6)	3.7(1.8)	3.7(2.0)	3.2(1.5)	0.127
Regular cola or soft drinks (contain sugar)	2.9(1.5)	3.2(1.7)	3.7(2.0)	3.2(1.6)	0.104
French fries	3.6(1.9)	3.3(1.7)	3.7(1.9)	3.1(1.5)	0.232
Whole grain bread or cereal (weetabix, etc.)	4.1 (2.1)	4.4(2.2)	4.5(2.2)	4.4(2.3)	0.763
Energy drinks (Red Bull, Shark, etc.)	2.1(1.7)	2.4(1.8)	2.4(2.0)	1.9(1.3)	0.151
Sports drinks (lucozade, Gatorade)	2.8(2.1)	3.0(2.0)	2.9(1.8)	2.5(1.5)	0.189
Fast food such as hotdog, pizza, hamburgers,	2.9(1.9)	3.3(1.9)	3.4(1.8)	2.9(1.4)	0.195
Fruits	5.2(2.0)	5.1(1.8)	5.3(1.9)	5.3(1.8)	0.626
Vegetables	4.4(2.1)[a]	5.4(1.7)[b]	5.1(1.8)[b]	5.6(1.6)[b]	0.003*
Diet cola or diet soft drinks	3.1(1.9)	3.2(1.9)	2.9(2.0)	2.9(1.8)	0.712
Dark green vegetables(*sukuma wiki*, spinach,	4.8(1.9)	4.9(1.9)	4.7(1.8)	5.2(1.9)	0.441
Other vegetables (carrots, sweet potato, etc.)	4.6(1.9)	4.9(1.9)	4.5(2.2)	4.9(2.0)	0.427
Fruit juice	3.5(1.9)	3.9(1.9)	4.4(1.9)	3.9(1.8)	0.111
Low fat milk (1%,2%,skim)	4.1(2.1)	3.7(2.2)	3.9(2.3)	3.3(2.2)	0.203
Whole milk (homogenized)	4.2(2.1)	4.2(2.2)	4.3(2.3)	4.0(2.2)	0.904
Other milk products (yogurt, chocolate milk,)	3.6(1.7)	3.8(1.9)	3.7(1.7)	3.2(1.6)	0.079

Meat alternatives (beans, green grams (etc.)	4.2(1.9)	4.4(1.8)	4.1(1.8)	4.2(1.7)	0.719
Fish	3.0(1.7)	3.3(1.8)	3.2(1.5)	2.9(1.5)	0.216
Cheese	2.5(1.6)	2.2(1.7)	2.3(1.7)	1.9(1.5)	0.539
Ice Cream	2.9(1.8)[ab]	3.1(1.8)[b]	2.9(1.8)[ab]	2.4(1.3)[a]	0.038*
Fried food such as chicken wings, etc.	3.4(1.7)	3.3(1.8)	3.5(1.6)	3.2(1.8)	0.800
Sweets	2.7(1.6)	3.0(1.6)	3.3(1.9)	2.9(1.6)	0.296

Note: All data expressed as means and (SD), unless otherwise indicated. [ab] Values within a row with different superscript letters are significantly different. * Significant (2-tailed) difference ($p<0.05$).

Chi-square analysis was also conducted to check for associations between BMI and consumption of foods. BMI levels were categorized into two groups; those who were overweight/obese and those who were not overweight/obese. The overweight/obese group consumed the following less frequently than the normal/underweight group: cakes/pastries ($\chi^2 = 14.679$, $p = 0.023$), potato crisps ($\chi^2 = 21.626$, $p = 0.003$), fast foods ($\chi^2 = 13.462$, $p = 0.036$) and other milk products ($\chi^2 = 13.471$, $p = 0.036$).

These results led to the rejection of the hypothesis ($H0_3$) that there is no significant relationship between dietary habits and body weight.

4.8.5 Association between body fatness and frequency of consumption of food/drink

The results (Table 4.30) revealed that, there were no significant differences in the means of frequency of consumption for all foods/drinks by body fatness status.

Table 4.30: Association between fatness status and frequency of consumption of foods/drinks

Foods consumed	**Underfat N=214 Mean (sd)**	**Healthy (fat) N=253 Mean (sd)**	**Overfat N=34 Mean (sd)**	**Obese fat N= 42 Mean (sd)**	***p* value ANOVA**
Cake, pastries, or donuts	3.6(1.9)	3.6(1.8)	3.1(1.7)	2.9(1.2)	0.159
Potato Crisps	3.5(1.7)	3.8(1.9)	3.4(1.9)	3.4(1.5)	0.492
Regular cola or soft drinks (contain sugar)	3.2(1.7)	3.3(1.7)	3.2(1.9)	3.3(1.6)	0.237
French fries	3.3(1.7)	3.4(1.7)	3.2(1.8)	3.1(1.4)	0.722
Whole grain bread or cereal (weetabix, etc.)	4.4(2.2)	4.4(2.2)	4.9(1.9)	4.1(2.3)	0.499
Energy drinks (Red Bull, Shark, etc.)	2.4(1.8)	2.4(1.8)	2.2(1.6)	1.7(1.2)	0.201

Sports drinks (lucozade, Gatorade)	2.9(1.9)	3.0(2.0)	3.1(1.7)	2.3(1.4)	0.159
Fast food such as hotdog, pizza, hamburgers,	3.3(1.9)	3.2(1.9)	3.3(1.5)	2.7(1.1)	0.247
Fruits	5.0(1.9)	5.1(1.8)	5.5(1.7)	5.3(1.9)	0.291
Vegetables	5.2(1.8)	5.3(1.7)	5.7(1.8)	5.3(1.7)	0.430
Diet cola or diet soft drinks	3.0(1.9)	3.2(1.9)	3.3(1.9)	2.9(1.9)	0.776
Dark green vegetables(*sukuma wiki*, spinach,	4.9(1.9)	4.9(1.9)	5.4(1.9)	5.1(1.8)	0.736
Other vegetables (carrots, sweet potato, etc.)	4.8(1.9)	4.8(1.9)	4.8(2.0)	5.2(1.9)	0.250
Fruit juice	3.8(1.9)	4.0(1.9)	4.2(2.0)	3.8(1.8)	0.620
Low fat milk (1%,2%,skim)	3.6(2.2)	3.8(2.2)	3.9(2.4)	3.4(2.2)	0.672
Whole milk (homogenized)	4.2(2.3)	4.2(2.1)	3.9(2.2)	4.3(2.2)	0.975
Other milk products (yogurt, chocolate milk,)	3.8(1.9)	3.8(1.9)	3.8(1.7)	3.1(1.5)	0.076
Meat alternatives (beans, green grams etc.)	4.3(1.8)	4.3(1.8)	4.4(1.5)	4.1(1.9)	0.926
Fish	3.3(1.8)	3.3(1.8)	3.5(1.7)	2.7(1.3)	0.276
Cheese	2.3(1.7)	2.2(1.7)	2.3(1.8)	2.0(1.5)	0.928
Ice Cream	2.9(1.7)	3.1(1.8)	2.7(1.7)	2.5(1.1)	0.293
Fried food such as chicken wings, etc.	3.4(1.9)	3.3(1.8)	3.4(1.9)	3.0(1.5)	0.761
Sweets	2.9(1.6)	3.1(1.7)	3.2(1.7)	2.9(1.5)	0.379

Note: All data expressed as means and (SD), unless otherwise indicated. Definitions: *sukuma wiki* = kales.
* Significant (2-tailed) difference ($p<0.05$)

Chi-square analysis was also conducted to check for associations between body fatness (% BF) and consumption of foods. The body fatness levels were also categorized into two groups; those who were not overfat/obese fat and those who were overfat/obese fat. Chi-square test results showed that those who were overfat/obese (fat) consumed fast foods less frequently than those who were not (χ^2 = 23.181, p = 0.026) which is unexpected.

On account of the noted significance in these results, the null hypothesis ($H0_3$) that there is no significant relationship between dietary habits of 9 to 11 year old school children in Nairobi County and body fatness status was rejected.

4.9 Associations among key study variables

Binomial logistic regression analysis was used to examine the associations among key study variables, especially for those that had shown significant relationship or differences. For these analyses, the data in all variables had to be dichotomized into two categories to enable calculation of odds ratio. The categories and codes were as follows; body weight (not overweight/obese =0, overweight/obese=1), body fatness (not overfat/obese (fat) =0, overfat/obese (fat) =1), sex (male=0, female=1), school type (private=1, public=0), PA (sufficiently active =0, insufficiently active =1), ST (low ST=0, high ST=1) and foods with significant relationship (cakes/pastries, potato crisps, cheese and fast foods) (low consumption=0, high consumption=1). Only the results that showed significant ($p<0.05$) association are reported.

Male participants were 2.1 times significantly likely to have high ST levels than female participants (OR=2.1; 95% CI: 1.32-3.37; p=0.002). In addition, the PA variables showed very highly significant odds for the two sexes. Females were 2.5 times (according to Treuth's cut points) and 3 times (according to Evenson cut points) significantly more likely to be insufficiently active than males (OR=2.5; 95% CI: 1.46 - 4.15; p=0.001 and OR=3; 95% CI: 2.06 - 4.33; $p<0.001$ respectively). Female participants were also 1.4 times significantly more likely to have high consumption of potato crisps than males (OR=1.4; 95% CI: 1.02 - 1.99; p=0.041).

Notably, pupils from private school were 5.1 times significantly more likely to be overweight/obese (OR=5.1; 95% CI: 3.14 - 8.15; $p<0.001$). Pupils from public school were also 42.6 times (according to Treuth's cut points) and 6.5 times (according to

Evenson's cut points) significantly more likely to be sufficiently active than private school participants (OR=42.6; 95% CI: 10.31 - 175.86; p<0.001 and OR=6.5; 95% CI: 4.38 - 9.62; p<0.001 respectively). Public school participants were 2 times more likely to have high consumption of cakes/pastries and 2.1 times significantly more likely to have high consumption of cheese than participants from private schools (OR=2; 95% CI: 1.44 - 2.87; p<0.001 and OR=2.1; 95% CI: 1.37 - 3.29; p=0.001 respectively).

None of the variables; sex, ST, dietary habits, PA and socio-economic status were predictors of adiposity judged by percentage body fat. Those who were overweight/obese were 3.6 times significantly more likely to be overfat/obese (fat) than those who were not (OR=3.6; 95% CI: 2.49 - 5.19; p <0.001). Those who were overweight/obese were 1.8 times likely to have high ST than those who were not (OR=1.8; 95% CI: 1.04 - 2.94; p =0.034). Children who were active (according to Treuth's cut points) were about 10 times (OR: 9.8 [95% CI: 2.36 - 40.67]) less likely to be overweight whereas those who were active based on Evenson cut off points were about five times (OR: 4.6 [95% CI: 2.82]). Those who had high ST were 2 times more likely to have high consumption of cakes/pastries and fast foods, and 1.8 times more likely to have high consumption of potato crisps (OR=2; 95% CI: 1.24 - 3.11; p=0.004 and OR=1.8; 95% CI: 1.16 - 2.92; p=0.009 respectively).

Those who were sufficiently active (according to Evenson's cut points) were 2 times significantly more likely to have high consumption of cakes/pastries (OR=2; 95% CI: 1.36 - 2.87; p <0.001) and 1.6 times more likely to have high consumption of fast foods (OR=1.6; 95% CI: 1.07 - 2.32; p = 0.023) than those who were not. Those children who ate pastries/cakes were less likely to be obese based on the BMI Index. This means that participants who were underweight/normal weight had sufficient activity levels and had a higher frequency of consuming cakes/pastries.

Based on these findings that show associations between the variables, the null hypothesis ($H0_4$) that there is no significant difference in the relationships between PA, dietary habits and ST by sex, type of school and SES was rejected.

4.10 Key predictors of adiposity

The study sought to identify the variables that had the strongest relationship to adiposity as predictors of energy balance in this sample. Only the variables that had significant associations in the binomial analyses (Table 4.31) were considered for further analyses. The following are the results of the binomial logistic regression results based on BMI that were thereafter used in multinomial logistical regression analysis.

Table 4.31: Predictors of adiposity

Independent Variables		**β**	**BMI OR (CI 95%) p value**
Child's sex			NS
Type of school		1.62	5.1(3.14 - 8.15) p <0.001
ST		0.56	1.8 (1.04 - 2.94) p =0.034
SES			NS
PA	Evenson	1.53	4.6 (2.82 - 7.50) p<0.001
	Treuth	2.28	9.8 (2.36 - 40.67) p=0.002

Diet	-0.60	1.8(1.17 - 2.87)
Cakes/pastries		p =0.008

Definitions: NS = Not Significant (p<0.05), BMI = Body Mass Index, *OR* = Odds Ratio, CI = Confidence Interval, ST = Screen Time, PA = Physical activity, SES = Socio Economic Status

Multinomial logistic regression analysis was then conducted to determine the contribution of each of the independent variables to predicting adiposity. The findings of the study showed that the type of school and PA was the strongest predictor of adiposity among the children. School type and PA were highly associated to BMI (both at p <0.001) as well as for fatness level (school type at p <0.001 and PA at p=0.004).

The null hypothesis that there is no significant difference in the associations of PA, diet and ST to adiposity status was thus rejected.

CHAPTER FIVE: DISCUSSION

5.1 Adiposity Status

5.1.1 Growth and maturation

Bénéfice et al. (2004) posit that it is not advisable to identify overweight and adiposity during pre-adolescence and adolescence stages simply on the basis of a composite index such as the BMI. They affirm that to interpret this index accurately, puberty maturation stage should first be taken into account. In the current study, an assessment of the respondents' maturation progress was conducted. Results indicated that the participants were predominantly pre-pubertal. There was a linear progression in both sexes with highly significant differences ($p<0.001$) between the ages where participants drew closer to full maturation with increasing age.

This was an important finding for the study to ascertain that the sampled participants were not yet fully in puberty which influences weight and fatness outcome. Therefore, the adiposity status of the participants was predominantly dictated by active interaction with the wider environment and the study findings could largely be as a result of the variables under examination. Sometimes the adolescent growth spurt occurs at an early age, leading to quicker maturation and increased adiposity (Kruger et al., 2006). Research also states that children experiencing the adolescent growth spurt earlier are more likely to have a higher BMI in early adulthood or to become heavier adults (Elrick et al., 2002).

A recent systematic review of school-aged children in Sub-Saharan Africa found that body composition measures were higher in females than in males, higher in urban compared to rural populations, and higher in those with higher SES (Muthuri et al., 2014a). Generally, females tend to grow and mature faster than males at pre-pubertal age and such differences, also witnessed in the present study, are expected. Ten and 11 year olds were significantly taller than the 9 year olds in both sexes ($p < 0.001$) which is expected due to growth. Surprisingly, there was no linear increase with age in the means of weight, WC, MUAC and percent BF as 10 year old male participants had significantly higher means than those of 11 year old participants. In fact, 10 year old males were highly significantly heavier than the 11 year old males ($p < 0.001$), which would normally be unexpected. This observation needs further investigation especially since the trend was observed mainly among the males. However, there is evidence stating that age 10 may present potential increase in adiposity (Whitaker et al., 1997). Whitaker et al. (1997) further stated that the risk of being an obese adult from being obese as a child increases enormously at age 10. This clearly signifies that 10 years of age is a critical period to assess and prevent both childhood and adulthood obesity.

5.1.2 Prevalence of adiposity based on BMI, Percent Body Fat and WC

Majority (73%) of the participants were of normal weight **while** 6.7% were underweight. About 20.2% were overweight/obese. These are encouraging results considering that such a large percentage are healthy. On body fatness, majority of the participants had healthy (fat) **levels** with 38.0% being categorized as underfat. About 13.9% were overfat/obese (fat). As Petersen & Kruger (2004) stated, it is apparent that in developing countries, especially in Africa, the state of being overweight coexists with under-nutrition.

Being overweight during growth years has been known to increase risk of adverse health effects and premature death in adulthood (Field et al., 2005; Maffeis & Tato, 2001; Dietz, 1998). In addition, overweight in childhood greatly increases the risk of overweight in adulthood (Deshmukh Taskar et al., 2006; Field et al., 2005; Whitaker et al., 1997). A recent systematic review by Muthuri and colleagues (2014a) revealed a trend towards increasing proportions of overweight/obesity in school-aged children in Sub-Saharan African children over time. Such findings highlight the need to carefully monitor such trends and initiate interventions in high risk groups.

The study chose to use two variables; BMI and body fatness as indices of adiposity. Many studies use BMI as a proxy for body fat because it is more easily assessed, despite its limitations of being correlated with both lean and fat mass (Wells, 2000). There is a high correlation between BMI and percent body fat for all ages and both sexes (WHO, 2000). However, given that BMI does not measure body fat directly (Ponder & Anderson, 2007; Krebs et al., 2007), the percentage body fat should be determined separately as one may not be used to represent the other. If this is done, there may be no issues of invalidity where **some participants** are misclassified using BMI because they are mesomorphic. For instance, when comparing the **BMI and the fatness status of** study participants, 43.8% who had normal weight were classified as underfat, 41.2% who were overweight were classified in the healthy fat category while 16.6% of obese participants appeared to have healthy fat levels. Thus when assessing adiposity, it is important to report on both variables since they measure somewhat different characteristics.

Waist circumference is also an important factor in the assessment of adiposity. Research has supported that both the trends in studies on WC and cut-off points differ according to race (Fernandez et al., 2004). In assessing WC, the study used estimated values for percentile regression according to the participants' sex and age for African-American children and adolescents, which presented the closest association since there were no reference data for the Kenyan population. In addition, authors had stated that these data merely describe observed WC percentiles and do not establish safe or healthy norms. However, Fernandez et al. (2004) state that it would certainly be accurate to consider those children whose WC values fall on the 75^{th} and 90^{th} percentile, according to their ethnic classification, age and sex, at significant risk for obesity related co-morbidities. This criterion becomes important in the identification and prevention of such risks among children. The study found that 12.4% of the participants were at the 75^{th} **percentile while** 6.0% were at the 90^{th} **percentile. There was a highly significant relationship between the participants in the 75^{th} percentiles and their BMI status and fatness status, which also had a significant positive linear trend. This confirms that WC is associated with adiposity status, and children at or beyond these percentiles should be targeted in interventions.**

5.2 Physical Activity

Establishing an active lifestyle in early years is reported to increase the likelihood of being physically active as an adult (McVeigh et al., 2004a; Corbin, 2001; Vanreusel et al., 1997). Although many children seem to have adequate amounts of PA, these levels tend to decline throughout childhood (Sallis et al., 2000), and are seen to drop to well below recommended levels (Troiano et al., 2008; Molnar et al., 2004; Baranowski et al., 1993). The measurement of PA among children is challenging especially when using self report, as the ability to understand and to recall the concepts of time, duration, and intensity of past activity is associated inversely with age (Davis et al., 2007). In addition, the nature, context, and practice of PA vary with age among other factors (Davis et al., 2007). Objective measures of PA which are commonly used in recent studies, such as accelerometry, represent an important improvement in PA measurement and therefore this was a major strength of this study.

5.2.1 Directly Measured PA

School days and weekends are likely to provide different opportunities for being active and exhibiting differences in PA behaviour (Rowlands et al., 2008; Treuth et al., 2007). Although weekend days are likely to offer more free time than school days, there was surprisingly not much difference in the amount of time spent in MVPA (between weekdays and weekends). These findings are not in agreement with those of other studies. Kruger et al. (2006) for example, reported that children's PA levels were higher over weekends than on weekdays, and that both sexes were least active on weekdays due to low involvement in school activities. The possible reasons in the Kenyan situation were that, although children had more free time over weekends, they spent more of this time in light and sedentary activities as evident in the high screen-based sedentary activity reported over the weekend.

Thresholds for activity counts were useful in analyzing the time spent at different intensity levels of PA (e.g. light, moderate, vigorous) and in examining proportions of children who reach recommended PA levels (Treuth et al., 2004). The study used the two cut-points for comparative purposes since they had different cut off margins and tended to give a different classification for some participants. Notably, Treuth et al.'s cut points were age appropriate while Evenson et al.'s cut points were from newer data and used shorter epochs (more precise) though were based on slightly younger participants.

The study results indicate that participants spent more time in sedentary and light activities compared to moderate and vigorous activities. These findings may be explained by what researchers have expressed as a consequence of modern-day lifestyles that tend to shift the habitual and occupational PA from high-energy expenditure activities (e.g., active transport, manual labour) to low-energy expenditure activities or sedentary behaviours (e.g., motorized transport, desk work) (Katzmarzyk & Mason, 2009). Study findings also indicate that participants spent the least time in vigorous PA while they had an overall mean of 35.45 minutes of MVPA daily (Treuth's cut points). We can therefore say that the urban Kenyan children aged 9 to 11 years have an average volume and intensity of PA compared to other related studies conducted in developed countries where findings indicate low volume and low intensity levels of PA (Ekelund et al., 2012; Basterfield et al., 2011a, 2011b; Troiano et al., 2008). However a similar recent study in South Africa reported a low intensity, high volume of PA in rural South African children and adolescents (Craig, Bland, & Reilly, 2013).

5.2.1.1 Child Sex and PA

Boys and girls differ substantially in their PA preferences (Aaron et al., 2002; Mota, 2002) and in their patterns of PA involvement (Jago et al., 2005; Mota et al., 2003). From the results, males spent significantly more time in MVPA, VPA and MPA compared to females, while females spent significantly more time in sedentary activity than males. Males spent significantly more time in moderate and vigorous PA than females ($p < 0.001$). Several other studies with similar results concluded that males were more active than girls in all age groups (Kruger et al., 2006; Riddoch et al., 2004; Trost et al., 2002) with other studies confirming that girls report less PA than boys, both before (Simons-Morton et al., 1997) and during (Higgins et al., 2003) adolescence. A recent systematic review by Muthuri and colleagues (2014b) of school-aged children in Sub-Saharan Africa also reported that studies using directly measured PA (by both accelerometry and pedometer data) found that males were significantly more active than females (Craig et al., 2012; Croteau et al., 2011). This review concluded that perhaps, the superior physical and functional ability of males and their higher motivation to participate in PA may explain the findings. Girls **may need further intervention to raise PA levels to prevent the adverse health effects of sedentariness, which is implicated in weight gain.**

5.2.1.2 Type of school and PA

The study found that public school participants spent significantly more time in MVPA, VPA, MPA and LPA than the participants from private schools, while private school participants spent significantly more time in sedentary activity than their public school counterparts. In fact, public schools participants were 42.6 times significantly more likely to be sufficiently active than private school participants. Public schools participants in Kenya (who are mainly of low SES) are highly likely to use active transport (such as walking and running) to and from school which contributes greatly to directly measured PA compared to private schools. However, a study by Okoth (2013) on adolescents in Western Kenya found that participants from private schools were more physically active than their counterparts in public schools because sports/games were compulsory in the private schools. Private schools (middle and high cost) can afford various expensive sports facilities which offer a greater variety of PA. These facilities however are accessible only on school days, a time when children are more engaged in school work.

5.2.1.3 SES and PA

The results revealed a clear trend in the higher levels of PA where there was less time spent in activity with rising SES ($p<0.001$), with those from LSES spending significantly more time in higher PA levels than their counterparts. Many studies support these findings. A recent review of 11 studies found that lower SES children had higher levels of PA compared to higher SES, while 3 more studies found contradicting evidence or no SES differences (Dapi et al., 2011; Ansa et al., 2010; McVeigh et al., 2004b). The explanation to these findings, which was also the interpretation given by the authors of the studies is that LSES children engaged in higher levels of active transportation (e.g. walking and running to school) (Micklesfield et al., 2012; Bovet et al., 2012; Onywera et al., 2012; Aandstad et al., 2006; Lennox et al., 2008), spent more time in activities of daily living (e.g. house chores, habitual activity) (Larsen et al., 2004; Prista et al., 2003; Proctor et al., 1996), but spent less time engaged in organized sports or formal activities compared to their HSES (or urban) peers (Micklesfield et al., 2012; Bovet et al., 2012).

To fully understand PA and sedentary behaviours, studies need to identify the determinants of PA and variability that affect PA patterns. Factors such as gender and age, are determinants for PA that help in identifying special categories/groups at risk of being inactive (Sallis & Owen, 1999), though these factors are not modifiable. Additionally, school days and weekend days present differences in duration and opportunities for activity. Previously, different time blocks in a day have been shown to significantly vary the patterns of PA, (Jago et al., 2005). In Kenya, there is almost no knowledge about the actual amount of time spent physically active during different time blocks within a day, as well as its contribution to the total amount of daily and total PA.

5.2.1.4 Compliance to recommended PA (direct measure)

One important factor that determines if a participant is sufficiently active is the achievement of the required PA volume and intensity as per set PA guidelines. There are no local guidelines for PA hence the study was guided by international recommendations. The WHO (2011) recommends that children and youth (5-17 years) accumulate at least 60 minutes of MVPA daily.

Treuth's cut points indicated that 14.3% of the participants were sufficiently active. More males met the recommended PA levels than females and more participants from public schools met the recommended PA levels than those from private schools. In addition, most of the participants that achieved the set PA guidelines were from low SES. A study by Ojiambo et al. (2012) of 12 - 16 year old Kenyans that used direct measures reported compliance with guidelines (accumulating 60 minutes MVPA daily) for rural males as: 60%; rural females: 50%; urban males: 21%; urban females: 12%. There is no improvement in the achievement of the set guidelines by the present study compared to the study by Ojiambo et al. (2012) where 16.5% of urban participants in their study met the recommendations, while 14.3% in the present study met the recommendations. The differences observed may be attributed to methodological differences. If not so, this may mean that less children are active than in the recent past. The difference may be attributed to the differences in the participants' age between the two studies although this is in contrast with the fact that younger participants are known to be more active than their counterpart (Sallis, 2000). It may also be due to differences in study location presenting different opportunities for PA.

It has been observed that although children may accumulate a substantial amount of time in PA, rarely do they engage in continuous bouts of activity lasting for more than a few minutes at a time (Epstein et al., 2001; Bailey et al., 1995). It has also been concluded that children's activity patterns can best be described as irregular, as they seem to engage in MVPA in very brief periods rather than in continuous bouts (Bailey et al., 1995). Therefore, the number of participants classified as achieving sufficient amounts of PA will vary, depending on whether recommendations describe continuous bouts of PA or accumulated time in PA per day (Nilsson, 2008). It is difficult to compare the findings of this study with other previous studies that used direct measures (even with the same population, methods and devices) as many articles do not indicate the approach taken in their analysis. Accumulated time rather than continuous time in PA has recently been emphasized as the appropriate measure when evaluating levels of activity in youth (Strong et al., 2005). Self report approaches pose even greater challenges, especially in children, due to the difficulty in estimating the volumes (accumulated time), specific intensities and frequency which is also further complicated by the recall accuracy.

5.2.2 Factors associated with PA among children

In their report, HAKK (2011) concluded that the key sources of PA were active play, household chores, sport participation, physical education and active transportation to and from school. In this study, the various factors were investigated using self report method.

It is important to note that there are weaknesses in the findings of such studies that use subjective assessment due to recall accuracy issues.

(a) Outdoor play (Leisure time and recess time): For children, time spent outdoors is strongly associated with PA in children younger than 13 years and play in the outdoors incorporates more health-related PA compared to indoor activities at home (Ferreira et al., 2006; Sallis et al., 2000). Outdoor play (whether as part of the school program or at leisure time) is an important determinant of the overall PA among school-going children (AAHPERD, 2010). Additionally, school days and weekend days present differences in types of PA as well as opportunities for activity, while different time blocks of a day have previously been shown to significantly vary the patterns of PA, (Jago et al., 2005).

Results of the current study indicate that for all the study participants, the average time for outdoor play outside school time i.e. before and after school and on a weekend day was about 6.0 hours. Generally, participants spent less time outside before school, which is expected, and a little bit more time after school which is usually a longer time block for various activities at home before darkness sets in. Females spent less time than males and socio-cultural roles of the female may explain this finding. On weekends, the participants spent a lot more time outside which is expected due to the amount of time available for leisure activity. There was significant association in the time spent outside on weekends **which shows that inventions should focus on this time block to raise activity levels of children especially those at risk.**

At school, opportunities for outdoor play are mainly given in the afternoon and early evening. Nilsson (2008) indicated that outdoor play after school on most days is a significant correlation for increased PA level, especially in regard to time spent in MVPA among 9 year-old children. Afternoon time and weekends therefore become key time blocks for accumulation of time spent at MVPA, and subsequently a target when promoting PA in younger children. Since not much can be done to increase the available time for active play especially during school days, there should be more focus on promoting sufficiently active play within the available time.

Recess time is the period between classroom lessons which allow children to go out for bathroom break, refreshment and meals as well as for play. The study found that all schools had recess time but private schools offered more and longer (3 or more 30+ minutes) sessions compared to public schools. However little, recess time is important and should be encouraged since it creates an opportunity for PA as bouts of PA lasting 15 minutes or more each day benefits the child (AAHPERD, 2010). Recess time however is likely to be more restricted compared with leisure time. It is expected that leisure time could be a better contributor to time spent at MVPA, given the relatively low levels of PA recorded during recess as previously reported by studies (Ridgers et al., 2005; Mota et al., 2005). Different types of leisure activities, for instance structured and unstructured sports, are also seen to influence the overall daily levels of PA (Spinks et al., 2006).

(b) Active transportation: Three previous studies (Onywera et al., 2012; Ojiambo et al., 2012; Croteau et al., 2011) on Kenyan children and youth reported that the majority of the participants from the rural area walked to and from school. These participants had a higher involvement in both walking and running compared to the urban participants who were reported to use either a car or a bus to school. There is not much difference in the results of the current study. The present study results indicate that the highest percentage

(41%) of the study participants walked to school followed by 32% that used the bus. Only 3% cycled to school. It s evident that a good number of the urban Kenyan children walk to school though this percentage is likely to decrease with increased urbanization that promotes motorized transportation. In addition, other factors such as increased crime rates in urban areas may discourage active transport, while an improved economy which raises the SES of people may promote motorized transportation and decrease travel time to school. Regardless, it is evident that active transport is a potential mediator of PA among youth (Tudor-Locke et al., 2002). Active transportation to and from school is associated with higher levels of daily PA (Sirard et al., 2005). In fact, the study by Tudor-Locke et al. (2002) presented a significant decrease in proportions of 10-year-old children achieving recommendations of daily PA when active commuting was omitted from the analysis. This indicated that the mode of transportation is an important contributor to daily amount of PA and should therefore be a key factor in future research and PA surveillance as well as intervention programs.

(c) Physical Education: Results show that there were different opportunities for children in different schools for attending PE classes. All schools reported having scheduled PE classes but the frequency and duration differed among the schools, which should not be the case since there is the mandated time and frequency, especially for public schools.

Private schools in Kenya show greater flexibility in decisions on the stipulated times for PE since this is at the discretion of the management personnel. For instance, two private schools, reported to have 35 minutes of PE per day and two other had 140 minutes per week while the rest had different duration of PE classes per week. On the other hand, public schools which are mostly owned and run by the government have clear guidelines as per the syllabus, in regard to the time allocated for PE. The findings of the study however show that not all public schools adhered to the guidelines as five schools reported to have 35 minutes of PE per week. In recent years, PE has been reduced in many schools, resulting in long periods of inactivity during the school day without opportunities for PA. Increased competition for classroom time has put pressure on PE classes in schools in many countries, even in developed countries such as Australia and the United Kingdom (Dollman et al., 2005). As much as the Ministry of Education in Kenya has a policy that provides for up to 40 minutes of PE lessons 3 times per week, the teaching of PE is not taken seriously. In many schools, PE lessons may be scheduled but are often used to teach other examinable subjects (HAKK, 2011).

The problems of PE in Kenyan schools are perhaps not as a result of the curriculum, teacher training or scheduling in time tables, but an attitude problem whose result is PE being given less attention compared to other subjects since it is not examinable. Quality/improved PE programs are needed to increase the physical competence; health related fitness, self-esteem and enjoyment of PA for all learners (Sarradel et al., 2011).

(d) Sports and School facilities for PA: School facilities that support PA are quite important for providing opportunities for PA among all school going children. Access and use of such facilities, whether the facility is within the school grounds, off the school grounds or both, provides the opportunity for PA. Different facilities support different activities which yields a variety of needed skills. Private schools which were mainly middle and high cost had a wider variety of facilities that support PA, although such schools had less pupil population compared to the public schools. Schools should have various facilities to allow a wider variety of physical activities.

Co-curricular activities such as sports, dance and other arts also offer great opportunities for PA. The study only assessed sports-related co-curricular activities. Sports serve as an excellent opportunity for PA and schools should provide an all-inclusive sports culture and infrastructure to promote PA (HAKK, 2011). However, they rely heavily on facilities for the specific sport and such activities are competitive, therefore involve a lot of seriousness in practice sessions and performance. The study found that many of the schools offered the sports activities. These sports offer a good variety of sport skills but some, such as volleyball and soccer may only allow a small number of players at a time. The study did not assess the proportion of the participants that engaged in sports, but studies have shown that many children in schools that have sporting facilities engage in active sports. Nilsson (2008) found that participation in sports clubs significantly contributes to increased levels of PA among 15-year-olds. Therefore, schools should have ample space and allocate adequate time for sports-related activities.

(e) Physical activity policies: Policies on PA may offer support to enhance opportunities for PA in a school in many ways by directing attention and finances to its development. Relevant authorities, especially the government and stakeholders in education, should ensure that school policies support the provision of opportunities and programs for PA. One approach includes providing schools with safe and appropriate spaces and facilities so that students can spend their time actively creating social networks that encourage PA in schools (WHO, 2009). The study sought to find out the proportion of schools that had documented policies or practices concerning healthy eating and PA and/or a committee to oversee development of such polices. About 69.0% of schools reported to have existing policies and/or practices concerning PA and 51.7% reported to have committees to oversee development of PA and health eating policies. Although quite a number of schools acknowledged having such policies, it is evident that there is need for implementation of the policies through proper practice. For instance, although PE lessons are scheduled as required by government policy, school administrators and teachers revealed that PE sessions were in some cases used to teach other examinable subjects.

5.3 Screen Based Sedentary Behaviour

The study focused on inactive screen-based activities through assessment of time spent watching television or videos, playing video games and using computers, which is reported to represent a major source of inactivity in childhood. The study results indicate that majority (84.5%) of the children had low ST while 15.5% had high ST levels. Too much ST is associated with poor dietary habits and an increase in ill health (Robinson, 2001), poor fitness, increased childhood obesity, increased caloric intake possibly caused by the outcome of advertising, and reduced resting metabolism (Crespo et al., 2001). The 15.5% may therefore be at danger of these consequences of excessive ST.

In Kenya, unlike developed nations, there is no recommended limit for ST even as exposure to and opportunities for screen-based activities are increasing (Onywera, 2012). Organizations such as the American Academy of Pediatrics and Canadian Society for Exercise Physiology have sedentary behaviour guidelines which recommend that children (age 5 to 11) should not engage in more than 2 hours of recreational ST daily.

The results of this study indicate that on average, these urban children spent about 1.75 hours engaging in screen-based sedentary activities on a school day, which is within the acceptable levels and about 4.25 hours on a weekend day which is excessive according to the recommendations. A previous study conducted in Kenya by Onywera et al. (2012) also reported that 13.1% of urban Kenyan children spent more than 11 hours per week playing screen games while 62.5% of rural children spent 0 hours per week playing screen games. That study concluded that children residing in urban areas participate in more sedentary behaviour (i.e., screen time) and are less active than children from rural areas, providing supporting evidence of a PA transition. Onywera et al. (2012) and Adamo et al. (2011) also indicated that rural Kenyan children accumulated less time in sedentary behaviours than their urban counterparts.

The current study examined urban children and found that indeed, the children are spending a lot of time on screen activities more than the recommended thresholds particularly on weekend days. For children with ST levels in excess of 2 hours per day, experts (CSEP, 2011) recommend that they should start to progressively reduce their ST as a stepping stone to meeting the guidelines.

Results on overall ST levels indicate that majority of the participants were of low and low-moderate ST levels. These results may appear better compared to other populations and nations. However, HAKK (2011) advices that with the emerging PA transition in Kenya resulting from urbanization and increased access to media and sedentary leisure-time pursuits, there is a need to attend to the situation before it deteriorates.

Among those that had moderate-high levels of ST, 78.6% had a TV in their bedroom. The large number of participants who reported to having a TV in their bedroom could be for reasons that many children from low SES groups (46.9%) spend the night in the family living room where the TV is located and may therefore have extended time of TV viewing. The American Academy of Pediatrics (2001) also reported findings which showed that 32% of 2 to 7-year-olds and 65% of 8 to 18-year-olds had television sets in their bedrooms. Children are not entirely in charge of their ST usage and the more time parents/guardians spend watching television and using other media, the more likely the children are to engage in similar activities (Rideout and Hamel, 2006).

5.3.1 Sex of the child and ST

Study findings indicate that males have a significantly higher ST over the weekend and daily average ST than females. Contrary, recent investigations of self reported studies on TV viewing found that more girls (19%) than boys (16%) watched TV for more than 3 hours daily (Toriola & Monyeki, 2012). However, for this population, more studies are needed to further investigate the male child and confirm the reasons for such finding. Studies on the factors influencing both males and females in the engagement in screen-based sedentary behaviour are also needed. Perhaps the female children in this population have more household and social responsibilities compared to the male counterpart that takes up much of their time. Results also indicated that there was a significant linear progression with there being less numbers of participants with increase in ST levels. This is a positive trend that should be encouraged gearing towards minimizing high ST levels.

5.3.2 School Type and ST

There were some significant differences observed between private school and public school participants. Private school participants had a significantly higher mean daily ST and over the weekend than those in public schools. In fact, private school participants were found to be 1.5 times more likely to have high ST than public school participants. Private schools (especially the middle and high cost schools) can afford wide-ranging facilities, equipment and programs for various activities and tend to target more affluent persons. This may be explained by the fact that private schools (especially the middle-high cost schools) may be providing an environment with more exposure to electronic devices and encourages the engagement in screen-based activities for educational, information technology and entertainment purposes. More studies are needed to further investigate the situation and explore the reasons for this trend and caution private school administrators about the potential health consequences of excessive ST.

5.3.3 SES and ST

In the current study, many of those in moderate-high ST levels were of low SES. Such findings have also been reported in other studies. For instance, Carson et al. (2010) noted that it is possible that children of LSES living in low income neighborhoods may engage in more ST compared to children living in higher income neighborhoods because they have fewer resources for after-school programs and recreational facilities in their neighborhoods. In addition, perceived lack of safety in low income neighbourhoods may limit children's outdoor play and increase ST through sedentary indoor activity (Carson, et al., 2010). About half of the participants from the HSES in this study had low levels of ST. Perhaps these participants have the electronic devices but may not necessarily spend much of their time using them and may opt for other leisure pursuits such as outdoor activities. This needs further investigations to ascertain the reasons for the findings.

5.4 Dietary Habits

Studies have shown that dietary intake assessment is difficult in children since they tend to under-report (Kruger, Kruger & Macintyre, 2006) or over-report their usual food intake (especially adolescents and obese persons). Additionally, they have difficulty in quantifying foods eaten away from home (Livingstone, 2001). In addition, Vereecken, et al. (2008) also concluded that when a FFQ is used for estimating consumption frequencies, the ability to rank individuals varies considerably between food items. Consequently the findings discussed here should be interpreted with caution.

It is important to note that the distribution of the frequency of consumption of various foods and drinks may be due to availability, abundance and affordability of the foods or the level of knowledge on the nutritive values of foods. For instance, some vegetables are readily available, abundant and very affordable in Kenya compared to the developed countries, and even families from LSES (who were the majority in this study) can afford to eat these foods. Probably, this explains the findings of this study that indicated a high frequency of consumption of vegetables, fruits, dark green vegetables and other vegetables (carrots, cucumber, sweet potato, etc) compared to other foods such as cheese, energy drinks and sports drinks. However, we cannot rule out under-reporting or over reporting given the method of assessment. Contrary to this study's results, the THUSA study in South Africa by Kruger et al. (2006) reported that the eating patterns of the children in their study indicated high consumption of cereal or starch-based staple foods (maize meal, bread, rice), empty-kilojoules snack foods and cold drinks, and low consumption of nutrient-dense foods (milk, meat, fruit, vegetables).

In the present study, the frequency in consumption of food/drinks that are high risk for overweight and obesity such as French fries, soft drinks (containing sugar), potato crisps, cakes/pastries, fast food, fried food and sweets was average compared to the rest. Such foods are readily available to urban children, and food vendors (traders, especially near the school compounds) find children an easy market for such foods. About a quarter of the youth in a study in Canada by Janssen et al. (2004) reported eating sweets (candy, chocolate) and non-diet soft drinks more than once per day. It is recommended that these unhealthy foods should make up a very small portion of the total diet (Health Canada, 1997). Brown et al. (2000) also reports that fast food options were gaining popularity among adolescents, possibly because of their taste, convenience and the influence of peers. Similarly in Kenya, these foods are very popular among urban children who may use their lunch money on school days to purchase such foods compared to other healthier foods such as fruits and vegetables. High consumption of such foods, especially cakes/pastries as well as sugar-sweetened soft drinks, increases energy intake and replaces intake of nutrient dense foods in the diet, causing a high glycaemic index that may stimulate overeating and contribute to weight gain (Ebbeling et al., 2002). In this study the consumption of cakes/pastries and sugar-sweetened soft drinks was high.

5.4.1 Child sex and diet

Females were found to have reported significantly higher frequency of consumption of potato crisps, whole grain bread or cereal, fruits, fruit juice and other milk products than the males. Such findings have not been reported in any of the studies reviewed and may be a unique characteristic to this population. However a study by Okoth (2013) on adolescents in Western Kenya found that female adolescents ate chips, beans, sweets and kale significanlty more frequently than their male counterparts. The male adolescents on the other hand drank whole fat milk more frequently. These findings depict the differences in food choices between the sexes. Further investigation is needed to ascertain the reason(s) for the differences observed in the frequency of consumption of various foods between males and females.

5.4.2 School type and diet

Participants from public school consumed most of the foods/drinks that are high risk for overweight and obesity, specifically cakes/pastries, energy drinks, French fries, cheese, ice-cream, fish and fried food at significantly higher frequency than those from the private schools. This may also be explained by the fact that most of these foods are available, abundant, affordable, and popular to all urban school going children. The public school children are however an easy target and market for such foods compared to private schools which offer meals and have stringent measures to control food intake from other sources during school days. Contrary to this results, the study by Okoth (2013) conducted in western Kenya reported that the adolescents from the private schools ate white bread, maize, chips and *mandazi* significantly more times than those from the public schools and that the mean frequency of consumption of dairy products (yoghurt and ice-cream) was also significantly higher among the adolescents in private schools compared to those from the public schools. The differences observed may be attributed to differences in lifestyle, age and SES differences of the two study populations.

5.4.3 SES and diet

The participants' SES is also a major factor that may influence food-related lifestyles as the types of foods consumed by those from LSES may differ from those consumed by those from HSES. A study by Carson et al. (2010) reported that poorer diets among adults were associated with living in lower income neighborhoods, and this may also be the case for children in the family setup. Participants from LSES consumed cakes/pastries more frequently than those from MSES and HSES. Simple small cakes and pastries such as *mandazis* are cheap, affordable and readily available in the lives of urban Kenyan children. Participants from HSES had consumed whole grain bread/cereal and fruits more frequently than those from LSES and MSES. Those from higher income families seem to consume more of the healthier foods while most of the poor may not have adequate resources to buy adequate **healthy food.** However, the findings that participants from HSES consumed energy drinks, diet soft drinks and fish less frequently than those of lower SES may be a case of over reporting from the lower SES which is a weakness of self report assessment, as these are expensive foods/drinks.

5.5 Factors associated with adiposity

5.5.1 Child sex and adiposity

There were no significant differences in weight and fatness status among the sexes in the present study results. However, more females (56.6%) were overweight than males which may be explained by the high levels of sedentariness observed among females. These results are consistent with those from other studies where the trend in overweight and obesity is higher among female than male. For instance, the study by Adamo et al (2010) on children aged 9 to 13 years in western Kenya found that 6.8% of the boys and 16.7%

of the girls in the urban school setting were considered overweight/obese while a study by Ojiambo et al (2013) also found that the mean BMI was significantly higher in female than in male subjects. The findings may be explained by the fact that females tend to store more fat and naturally have a lower metabolic rate as compared to their male counterparts. Males are also reported to be more physically active hence the lower prevalence in overweight/obesity compared to females.

5.5.2 School type and adiposity

The type of school a child attends and its economic and social standing may influence his/her lifestyle. For instance, high cost schools can afford wide-ranging feeding programs and facilities, equipment and programs for a variety of physical activities, and tend to target more affluent persons. Results on associations between the SES of the school and body weight and fatness revealed that the **incidences of overweight and obesity are more common in the middle and high cost private schools. In fact, private school participants were found to be 5.1 times significantly more likely to be overweight/obese than private school participants. Public (low cost) schools had majority of the normal weight participants but also exhibited a problem of underweight/underfat, which may be due to under-nutrition.** A study by Okoth (2013) in western Kenya also reported that BMI showed a higher prevalence of overweight/obesity among the participants from private schools compared to their counterparts from the public schools. These findings are consistent to the notion that higher prevalence of overweight and obesity **exist** among the affluent (Ziraba et al., 2009). However, there is growing evidence that should not be ignored regarding variation in the relationship between income and obesity due to other factors such as gender, age, race/ethnicity and time.

5.5.3 SES and adiposity

The results revealed that majority of the participants of LSES were largely found to be underfat **perhaps due to under-nutrition, while majority of the MSES and HSES were of normal weight and had healthy fat levels which is explained by the fact that they can afford adequate food to stay healthy.** Low SES therefore presents a greater risk for wasting than obesity. **There was also a highly significant association between body weight and body fatness status by SES where majority of those classified as overweight/obese/overfat were of MSES and HSES.** The findings are comparable to those that have demonstrated higher prevalence of overweight and obesity among the wealthier sub-population groups in urban Africa (Ziraba et al., 2009). For instance a study by Griffiths et al. (2008) found that body composition indices consistently increased with SES. That study concluded that those findings highlight the role of SES in influencing fat acquisition throughout childhood and provides evidence for the need to address the problem especially in higher SES groups. These findings are however different from those found in western countries such as America and Canada where higher SES is associated with lower incidences of overweight and obesity.

5.5.4 Physical activity and adiposity

It has been reported that lower PA levels may lead to reduced lean and increased fat mass, which may symbolize pathways of increased risk of childhood and adult disease (Wells, 2003). The results of the present study indicate a clear significant trend in the higher levels of PA characterized by less time spent in activity with rising weight and fatness levels. Those who were obese/overweight/overfat spent significantly less time in the higher PA levels than those with normal weight, healthy fat levels and the underweight/underfat levels. In fact, overweight/obese participants were 9.8 times significantly more likely to be insufficiently active than those who were not. The reverse trend was observed for sedentary activity level as there was more time spent in sedentary activity with rising weight as well as fatness levels. This is an expected trend as those who are sedentary tend to have greater energy balance leading to overweight/obese. Similarly, Odhiambo et al. (2012) also found that BMI z-score was positively correlated with % sedentary time in Kenyan adolescents ($P < .001$) and negatively correlated with % MVPA time ($P < .001$). These findings also concur with those of studies conducted in developed countries. For example, the study by Janssen and colleagues (2004) found that there was a trend for increased overweight and obesity with decreasing PA participation in males and females. Their study was similar in many ways to this study and also found that PA levels were lower in overweight/obese participants than normal-weight youth.

Looking at the adiposity status and compliance to recommended PA, 95.5% (according to Treuth's cut points) of those who were overweight and all the obese participants and all respondents who were overfat and obese (fat) were insufficiently active. This indicates that participants who have excessive weight and fat levels did not engage in much PA in a day as recommended hence insufficient energy expenditure. These results reflect the increasing worldwide trend towards sedentary lifestyles that leads to increased overweight prevalence among children and possibly tracking to adulthood.

The link between low levels of PA and an associated increase in the risk of developing obesity emphasizes the need for these problems to be addressed in childhood (McVeigh et al., 2004a). Those already overweight/overfat or obese would benefit from PA as the evidence is strong that daily moderate/vigorous PA helps reduce adiposity in overweight/obese youths (Davis et al., 2007). Conversely, those who were underweight spent significantly more time in higher PA levels than the normal as well as all other weight categories. This may perhaps implicate excessive energy expenditure or under-nutrition or both, which is expected though not assessed by this study.

The presence of significant associations between PA and adiposity in the study findings led to the rejection of the first null hypothesis. PA was highly ($p<0.001$) negatively associated with the adiposity status of 9 to 11 years old children in Nairobi County.

5.5.5 Screen-Time and Adiposity

It is well known that sedentariness contributes to energy imbalance and weight gain which influence the adiposity status of a person (Tremblay et al., 2008). Studies have also concluded that children with the most number of hours of sedentary ST per day have the highest prevalence of overweight and obesity regardless of age, race/ethnicity, or family income (HAKK, 2011; WHO, 2010). Some studies had reported that the used of screen based electronic devices are positively related to overweight in youth (Andersen et al., 2005; Janssen et al., 2004; Marshall et al., 2004; Robinson, 1999; Gortmaker et al., 1996; Dietz & Gortmaker, 1985) and concluded that limiting screen based activity among youth to less than two hours per day may prevent overweight/obesity among youth. However, the systematic review by Marshall et al. (2004) also concluded that although television and video/computer games have a positive relationship with BMI, the effects are small and are unlikely to be of clinical relevance. The results of these studies generally support the growing evidence implicating screen based activities as a leading factor in childhood obesity and the findings of the present study concur with these studies.

The findings of the present study revealed that there was significant relationship between the body weight levels and overall ST but no significant difference with the means of continuous ST variables. In fact, those who were overweight/obese were 1.8 times likely to have high ST. For body fatness, significance in the differences in ST means only existed between those who are underfat and healthy versus those in the overfat and obese fat groups. The ST means of the overfat and obese fat were significantly higher than those of the underfat and healthy fat participants.

Findings indicate that majority of those who were overweight had a longer duration of time **spent in sedentary activity.** Findings also reported significant associations between time spent in sedentary activity level and body fat. Th**e high sedentariness, which is also characterized by increased screen-based activity, is known to trigger weight gain.** Studies also report that children who watch more television consume higher fat foods and more fast food and soft drinks while watching TV compared to eating fruits and vegetables **(**Minnesota Dept of Health, 2010**).** Therefore the relationship between television and poor diets in this context should be studied in this population.

The significant associations found between ST and adiposity in the current study findings led to the rejection of the second null hypothesis. ST had significant positive relationship with the adiposity status of 9 to 11 years old children in Nairobi County.

5.5.6 Diet and Adiposity

Changes in dietary patterns over the years to increased consumption of high fat and sugar foods have been implicated in the increase in obesity (Janssen et al., 2004). Some authors have reported that several dietary components and behaviours consistently predict adverse weight outcomes including greater fat intake, higher consumption of fast foods, and lower intake of fiber and/or whole grain foods (Bethesda, 2004). In addition, increased consumption of more energy-dense, nutrient-poor foods, combined with reduced PA, has been reported to lead to high obesity rates (WHO, 2004a).

In the current study, there was a significant negative relationship for fast foods among those categorized as overfat/obese fat. This is an unexpected result as most fast foods are calorie-dense (in terms of sugar content or fat saturation) and may influence increased body fatness. This may be a case of under-reporting among those who were overfat/obese fat and there is need for further investigation to ascertain the relationship. This is also important as fast foods options are gaining popularity possibly because of their taste, convenience and the influence of peers (Brown et al., 2000).

Those who consumed cakes/pastries, potato crisps, fast foods and milk products more frequently were less likely to be overweight/obese than those who did not. In fact, those who were not overweight/obese were reported to be 1.8 times more likely to have high consumption of cakes/pastries. **This may be a case of under-reporting by the overweight/obese participants since these outcomes should not be reversed from what is expected about foods that promote energy balance. Cases of under-reporting in food intake have also been noted in other studies. A similar study by Janssen et al. (2004) also found a negative relationship between sweets, potato chips and**

cake/pastries intake, and BMI which was also attributed to under reporting. Some studies (Field et al., 2004; Phillips et al., 2004) also found non-significance between snacks and BMI.

Interestingly, the findings of the current study found that those who were classified as being sufficiently active were more likely to have high consumption of cakes/pastries (2 times) and fast foods (1.6 times) than those who were not. Perhaps due to increased hunger as a result of increased energy expenditure, there was increased consumption of such readily available snacks among these participants. **This may be a good example of a case of energy expenditure exceeding energy intake hence the unexpected findings of high consumption of cakes/pastries with low adiposity levels. The study however cannot confirm this reason considering the weaknesses of self report assessments.**

Kruger et al. (2002) found a weak correlation between dietary fat intake and BMI in the THUSA study, while the study by Kruger et al. (2006) reported poor association of dietary intake and BMI, confirming other findings from several other studies such as that by Janssen et al (2006) that found no significant association. These studies concluded that diet (energy and fat intake) does not seem to be the main cause for overweight/obesity. The findings of the present study are consistent with such conclusions.

The present study's findings also show that the frequency of consumption of vegetables was significantly lower for the underweight participants compared to the rest which may be attributed to the underweight participants (who were of low SES) not affording adequate food. However, a **Kenyan study by Okoth (2013) on adolescents in western Kenya, found that** female adolescents with normal weight consumed fruits and vegetables significantly more times than those who were overweight. An analysis of 17 studies on dietary intake and adiposity by Davis et al. (2007) also reported that several studies found no association between fruit and vegetable intake and childhood adiposity.

The present study findings are not clear whether dietary fat are associated with BMI in this sample since many of the foods that are high in fat had non-significant associations. Evidence supports an unclear association between dietary fat and obesity in children (ADA, 2006) where some studies had mixed results and found both positive associations and non-significant associations between dietary fat intake and adiposity.

Though the findings of this study reported non-significant associations with sweetened drinks, evidence strongly supports a positive association between intake of calorically sweetened beverages and adiposity in children (ADA, 2006). The ADA analysis of studies for evidence concluded that the larger, more strongly designed, and higher-quality studies reported that sweetened beverage intake is related to obesity among children.

It is notable from the findings of the present study that majority of the participants were on healthier diets that are rich in vegetables and generally low on energy dense foods. As a result, the majority were falling under healthy weight and fatness status. The observation from the findings **(which are a bit unclear) also indicates that participants' weight or fatness status is generally not significantly associated with the frequency of consumption of the various foods, especially some of those that are known to influence weight gain. It is possible, therefore, that there could be other factors involved.** In addition, because this study obtained information only on the frequency of food consumption, it is possible that the portion sizes of unhealthy foods were greater in the overweight and obese youth. This was not reflected in their questionnaire responses.

On account of the noted significance in the current study's results, the third null hypothesis was rejected. It is evident that some of the foods, especially those that are known to influence weight gain, were negatively associated with the adiposity status of 9 to 11 years old children in Nairobi County.

5.**6 Predictors of adiposity**

Of all the study variables, type of school **(public/private) and PA were the strongest predictors to the adiposity levels of children (**$p<0.001$). **Those children with high level of activity and those in public schools were less likely to be overweight and obese.** A similar **study by Okoth (2013) however found that t**he most significant predictors of overweight and obesity based on BMI were consumption of carbohydrates, meats and eggs, fruits and vegetables, fats and the amount of proteins. A low frequency of consumption of carbohydrates and fruits and vegetables predicted overweight and obesity among that study's participants which was attributed to gross underreporting among the obese adolescents especially in the consumption of carbohydrates.

In the present study, PA is more paramount in determining weight status than ST and diet. This could be because PA is a major source of energy expenditure among children to bring about energy balance and those found to be highly active have low adiposity levels. It would therefore be more useful to promote PA among children and especially in meeting the recommended dosage of at least 60 minutes of MVPA daily for both preventive and corrective measures of overweight/obesity. This is **especially important**

since the negative consequences of inactivity are carried forward to adulthood (McVeigh et al., 2004a). This does not mean that diet and sedentary screen-based activities are not important factors to be considered at all but there should be a greater research attention directed at issues related to PA. In fact, some studies (Kruger et al., 2006; Janssen et al., 2006; Kruger et al., 2002; Blundell & Cooling, 2000) concluded that diet does not seem to be the main cause for overweight/obesity, and that low activity levels seem to be a more important determinant of obesity in their study settings.

In addition, the school environment and practices may influence healthy active living. For instance, the type of school a child attends in Nairobi, which was a strong predictor of adiposity, may be of concern. Middle **to high cost private school participants were highly likely to be overweight/obese. This may be attributed to the lower PA levels recorded compared to those in low cost schools which are mainly public schools.**

The null hypothesis that there is no significant difference in the associations of PA, diet and ST to adiposity status was rejected since significant differences were found among the three, and PA was **found to have the strongest association with adiposity.**

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of the Findings

The study was based on an ecological conceptual framework that explained the interrelationships of children's lifestyle behaviours in influencing childhood adiposity. The lifestyle behaviours assessed in this study were; PA, dietary habits and screen-based sedentary behaviour. All the null hypotheses of the study were rejected.

Adiposity status

Majority of the study participants were of normal weight. More females were overweight than males while there were more males in the obese (fat) **category than fe**males. Overall**, most of the participants who were overfat and most of the obese (fat) participants came from middle cost private schools whereas the majority of the underweight were from public (low cost) schools. Public schools had majority of the normal weight participants but also exhibited another problem of underweight/underfat.** Majority of participants of LSES were largely underfat while majority of those of MSES and HSES were of normal weight and had healthy fat levels.

Physical Activity

Generally, participant spent more time in sedentary and light activities compared to moderate and vigorous activities. More time on weekdays was spent in sedentary activities and there was no clear difference between weekdays and weekend days in the duration of time spent at MVPA. Males spent significantly more time in higher levels of PA compared to females while females spent significantly more time in sedentary activity than males. Public school participants spent significantly more time in higher levels of

PA than the participants from private schools who spent significantly more time in sedentary activity. There was less time spent in higher levels of PA with rising SES with those from LSES spending significantly more time in these levels than their counterparts.

As per PA recommendations, only 14.3% of the participants were sufficiently active with more males meeting the recommended PA levels than females. More participants from public schools met the recommended PA levels than those from private schools. In addition, most of the participants that achieved the set PA guidelines were from low SES. Majority of those who were overweight, all the obese participants and all participants who were overfat and obese (fat) were insufficiently active. There was less time spent in higher levels of PA with rising weight as well as fatness levels and the trend was reverse for sedentary activity level. Those who were obese and overweight/overfat spent significantly less time in the higher levels of PA than those with normal weight, healthy fat levels and the underweight/underfat levels. Conversely, those who were underweight spent significantly more time in higher levels of PA than all other weight categories.

Screen Time

Majority of the participants had low ST while 15.5% had high ST levels. Participants spent about 1.75 hours engaging in screen based sedentary activities on a school day which was within the acceptable levels and about 4.25 hours on a weekend day which is excessive according to the recommendations. Males have a significantly higher ST over the weekend and daily average ST than females. Private schools participants had significantly higher means in daily ST and over the weekend than those in public schools. High SES participants exhibited low levels of ST. For this population, increase in ST may influence an increase in fat levels but not weight (BMI) levels as statistical significance was found in the differences but only between those who are underfat and healthy versus those in the overfat and obese fat groups.

Dietary Habits

There was a high frequency of consumption of vegetables, fruits, dark green vegetables and other vegetables (carrots, cucumber, sweet potato, etc) compared to other foods and drinks. The frequency in consumption of foods/drinks that can trigger overweight and obesity was average. Public school participants had significantly higher means in the consumption of foods/drinks that promote overweight and obesity than private school participants. The consumption of cakes/pastries was found to be negatively associated with those who were overweight/obese but positively associated with participants from LSES compared to the other SES groups.

Factors associated with and predictors of Adiposity

Overweight/obese participants were 9.8 times significantly more likely to be insufficiently active. Males were more likely to have high ST levels than female participants. Participants from private schools were more likely to be overweight/obese and 1.5 times more likely to have high ST than public school participants. Their counterparts in public schools were seen to lead a healthier lifestyle and were also 42.6 times significantly more likely to be sufficiently active than private school participants.

Those who were overweight/obese were 1.8 times likely to have high ST and low consumption of cakes/pastries. Participants from public schools were more likely to have high consumption of cakes/pastries than participants from private schools. The study did not find any significant association between ST and PA. Those who had high ST were 2 times more likely to have high consumption of cakes/pastries and fast foods, and 1.8 times more likely to have high consumption of potato crisps. Participants who were under/normal weight had highly significant sufficient activity and had a higher frequency of consuming cakes/pastries and fast foods. However, the predictors of adiposity status in the study population were low levels of PA and being in a private school.

6.2 Conclusions

The prevalence of overweight/obesity was not high as majority were of normal weight and had healthy fat levels. Participant spent more time in sedentary and light activities compared to the recommended MVPA. The results are broadly consistent with findings of many studies on the association between PA, sedentary time, diet and adiposity in children. PA was found to be highly negatively associated with the adiposity status while ST had significant positive relationship with the adiposity status. Some of the foods, especially those that are known to influence weight gain, were negatively associated with the adiposity status. Factors associated with adiposity status were type of school, ST, PA and diet but the strongest predictors of the status were PA and type of school attended.

6.3 Implication of Findings

The study had major and very important strength in that it was the first study to use directly monitored PA using accelerometry in this population and to this magnitude. This presents high quality and highly reliable information in PA assessment in Kenya.

Although the prevalence of overweight and obesity in this study were lower than those reported elsewhere, there is still an imminent danger because the trend of the conditions is rising swiftly with urbanization and socio-economic transition. Kenya is at the beginning of the PA-nutrition transition and countries already past the transition show evidence of adverse effects on the health of children (Onywera et al., 2012).

Since this was a cross-sectional study, the directions of the associations under study for this population have been identified but not causality. Further, it is possible that unmeasured intervening factors other than age, gender, school type and SES may affect the observed relations between the assessed variables and adiposity status.

In addition, the lack of agreement in the results observed in this study and those from local studies on PA levels among Kenyan children raises some fundamental questions about the appropriateness of the PA cut-off points used in this study and the others. In addition, this raises the concern about the appropriateness of current PA recommendations for the local population. This point has also been raised by previous authors (Odhiambo et al., 2012) who have advocated for development and adoption of cut points for the local population for consistency. Notably, some variables (ST and diet) were assessed by self-report and misclassification of exposures may be present and the magnitude of associations between such variables may be present. Furthermore, since the study obtained information only on the frequency of food consumption, it is possible that the portion sizes of unhealthy foods were greater in the overweight and obese youth, which would not have been reflected in their questionnaire responses.

Despite these limitations inherent in using self-reported data (which the study tried to address by employing measures to raise accuracy and check for ambiguity), the study still found associations among adiposity level, PA, ST and diet that were consistent, strong, and in the expected direction. Moreover, the study had major strengths especially in the use of validated objective methods for measurement of adiposity, monitoring of PA (accelerometry), and the large sample of randomly selected children representing the diverse backgrounds of Kenyan urban children living in Nairobi. Therefore the findings that lifestyle factors such as PA, screen-based activities and diet together with the secondary independent variables are strongly associated with adiposity in the study population as well as findings on the various determinants and variability, can be used to aid future research and formulation of intervention programs.

6.4 General Recommendations

Given that children spend most of their childhood lives in school, school programs should minimize the extended periods of inactivity by including episodes of PA, however brief.

Based on the findings, weekend days and leisure time during weekdays seem appropriate targets when promoting PA in order to increase the proportion of children achieving current recommendations on health enhancing PA.

It is important to monitor PA patterns regularly among Kenyans so as to initiate necessary interventions and monitor trends. The findings of this study should also be considered when planning PA interventions in school-age youth.

The findings on screen activity and time may appear better compared to other studies conducted in developed countries but researchers (Onywera et al., 2012) advise that with the emerging transition in Kenya resulting from urbanization and increased access to media and sedentary leisure-time pursuits, there is need to attend to the situation before it worsens as witnessed in countries that have completed the transition.

The findings provide a rationale for the need of prevention efforts, and promotion of active living in early ages especially for the groups at risk. The recommendation is to primarily promote an active lifestyle in early age as the effects are seen to be carried forward into adulthood and persist throughout the lifespan, for healthy future populations.

6.5 Recommendations for Policy

This study recommends that reference norms for the various anthropometric measurements as well as national guidelines for PA and ST for health, for the Kenyan population and Sub-Saharan Africa at large, should be developed by researchers and implemented for use by educationists, health workers and policy makers. References and cut-off points developed should be determined objectively and address all ages and sexes for purposes of use in population studies especially for free living populations.

Developed countries have placed the promotion of PA in childhood high on their agenda yet developing countries have not paid as much attention to the problem as they ought to. The Ministries of Health and Education in Kenya together with other stake holders should implement policies on health of children with greater attention to promoting healthy active living directed at reversing the trend towards obeseogenic lifestyles due to rapid urbanization and the noted emerging PA and nutrition transition.

6.6 Recommendations for Further Studies and intervention

The following are study recommendations for future research and intervention:

- Future studies using a longitudinal design and direct measures following individuals from an early age throughout school years and into adulthood are warranted, as these studies may inform on causality.
- Future research should use more precise measurements of food intake such as weighed food records.
- Larger studies of national representative samples are needed to help formulate reference norms, cut-off points and guidelines for anthropometry, PA and ST for the local population groups.
- Studies should focus on assessment of actual energy expenditure among Kenyan children to include total energy expenditure and energy expenditure in PA levels for different activities, time blocks, type of days, PE and recess time in school, active transport and activities such as swimming which was not assessed in this study.
- Studies should also include potential modifiable determinants of PA not assessed in the thesis, e.g. PA in different time blocks, type of days and seasonal differences.
- Further studies should address problems of overweight and obesity in middle and high cost private schools and should report on the reasons for the observed trend(s).
- Strategies for reducing the high screen activities over the weekend should focus on replacing time spent on screen activity with other activities of healthy living.
- Studies and interventions targeting the girl child need raise activity levels to prevent the adverse health effects of sedentariness and high adiposity. For the male child, interventions should target at reducing the high screen-based sedentary time to prevent the potential healthy consequences of excessive ST.

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APPENDIX A: Approval of Research Proposal by Kenyatta University Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

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

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 810901 Ext. 57530

Internal Memo

FROM: Dean, Graduate School **DATE:** 3rd October, 2011

TO: **Wachira Lucy Joy Muthoni** **REF:** H87/20079/10
C/o Physical & Health Education Dept.

SUBJECT: APPROVAL OF RESEARCH PROPOSAL
=======================================

This is to inform you that Graduate School Board, at its meeting of **28th September 2011**, approved your Research Proposal for the Ph.D Degree, **subject to clarifying the title and including Kenya on the title.**

Thank you.

JOHN M. ODONGI
FOR: DEAN, GRADUATE SCHOOL

c.c. Chairman, Physical and Health Education Department

Supervisors:

1. Dr. Vincent Ochieng Onywera
   C/o Department of recreation Management and Exercise Science
2. Dr. Sophie Ochola
   C/o Department of Foods, Nutrition & Dietetics
3. Mark Stephen Tremblay, PhD, D.Litt.(Hon),CSEP-CEP
   Healthy Active Living and Obesity Research Group
   Children's Hospital of Eastern Ontario Research Institute – Canada
   C/o Department of Physical & Health Sciences

JMO/bwk

Committed to Creativity, Excellence & Self-Reliance

APPENDIX B: Research Authorisation Letter by Kenyatta University Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

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

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: H87/20079/10

Date: 27th October, 2010

The Permanent Secretary,
Ministry of Higher Education, Science & Technology,
P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR LUCY JOY MUTHONI WACHIRA REG.NO H87/20079/10

I write to introduce Lucy Joy Muthoni Wachira who is a Postgraduate Student of this University. She is registered for a Ph.d degree programme in the Department of Physical and Health Education in the School of Applied Human Sciences.

Ms. Wachira intends to conduct research for a Thesis entitled, **"Assessment of Physical Activity Patterns, Dietary Habits. Sedentary Screen Time and Adiposity of 10 Year Old School Children in Nairobi County of Kenya."**

Any assistance given will be highly appreciated.

Yours faithfully,

JOHN M. ODONGI
FOR: DEAN, GRADUATE SCHOOL

JMO/rwm

APPENDIX C: Ethics Review Approval Letter for ISCOLE Kenya study site by Kenyatta University Ethics Review Committee

KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: director-crd@ku.ac.ke
Website: www.ku.ac.ke

P. O. Box 43844
Nairobi, 00100
Tel: 8710901/12

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/I04 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 repo 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, PhD.
CHAIRMAN ETHICS REVIEW COMMITTEE

I ...Dr. Vincent Onywera.... accept the advice given and will fulfill the conditions therein.

Signature..................................... Dated this day of ...March 8th........ 2011.

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

AT/

APPENDIX D: Research Authorisation Letter for ISCOLE Kenya study site by National Council for Science and Technology

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123.
Fax: 254-020-2213215, 318245, 318249
When replying please quote

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

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.

Hussein.

SAID HUSSEIN
FOR: SECRETARY/CEO

Copy to:

The Provincial Commissioner
Nairobi Province

The Provincial Director of Education
Nairobi Province

APPENDIX E: Research Authorisation Letter for ISCOLE Kenya study site by City Education Department, City Council of Nairobi

CITY COUNCIL OF NAIROBI

TELEGRAM "SCHOOLING"
TELEPHONE: 221166/224281
EXT: 2426 /2590

CITY HALL ANNEXE
P. O. BOX 30298 GPO
NAIROBI

CITY EDUCATION DEPARTMENT

GL/NC/141VOL IV/162

7th October, 2011

HEADTEACHERS
PRIMARY SCHOOLS
NAIROBI.

RE: RESEARCH AUTHORIZATION

This is to certify that **VINCENT OCHIENG ONYERA**, 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 F: ISCOLE Kenya Request and Information Letter to the School

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

SCHOOL ADMINISTRATOR INFORMATION

Dear School Administrator,

I am writing to you from Kenyatta University, where we are currently conducting a study to examine the influence of behavioral, physical, social, and policy environments on the relationship between lifestyle characteristics and weight gain in school aged children. This study, called the **International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE),** will collect data from 500 children in each of 12 countries representing five major regions of the world – including Kenya in Africa.

The participating children, their parents, and a school contact will be requested to complete questionnaires related to diet, lifestyle, neighbourhood, the home and school environment. Physical attributes of the children such as their body weight, physical activity, and dietary patterns, will also be directly measured using standardized procedures and questionnaires. This being a minimal risk study, there are no aspects of the procedures that are anticipated to present any risk of injury to the children.

Your school was methodologically and randomly selected to represent other schools in the Nairobi County. Please note that data collection in your school may take up to 5 research visits in a span of 4 weeks. We are seeking to recruit up to 30 pupils from the classes in the participating schools that best correspond to 10 year olds. Your participation is therefore very important to us and we hope that you will positively consider this request.

The results of this study will provide important new information that will help in the development of lifestyle interventions to address childhood obesity that will be culturally relevant for populations across these countries.

Sincerely,

Dr. Vincent Onywera

Senior Lecturer, Kenyatta University

APPENDIX G: Parent's Informed Consent Form

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

CONSENT TO PARTICIPATE IN THE ISCOLE STUDY

FOR A MINOR

Title of Study: International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) **KENYA SITE**

What you should know about the research study

- We give you this consent form so that you may read about the purpose, risks and benefits of this research study.
- The main goal of research studies is to gain knowledge that may help current and future populations.
- You have the right to refuse to take part, or agree to take part now and change your mind later on.
- Please review this consent form carefully and ask any questions before you make a decision.
- Your participation is voluntary.
- By signing this consent form, you agree to participate in the study as it is described.

1- Who is doing the study?

Investigators Information:

Kenya Investigators: Vincent Onywera, Ph.D., & Mark Tremblay, Ph.D.

Study staff and graduate students: Joy Lucy Wachira, M.Sc. and Stella Muthuri, M.Sc.

Researchers Dr. Vincent Onywera and Dr. Mark Tremblay will direct this study in Kenya. We expect about 500 children per site from 12 countries will be in this study. The study will take place over the 2012 school year. The expected time for the assessment of your child in this study will be 8 days. Some of the children may be asked to return for follow-up for another 8 days to wear the waist monitor for a second time. This study is a multi-national sponsored study.

2- Where is the study being conducted? The Kenya investigators are from Kenyatta University. This study takes place in Nairobi County. Data collection will be conducted in your child's school with some questionnaires completed by you in your home.

3- What is the purpose of this study? The purpose of this study is to learn more about the role of lifestyle and environment on obesity and weight gain in children approximately 10 years of age.

4- Who is eligible to participate in the study? Who is ineligible?

Your child is eligible for the study if:

- Your child is enrolled in a school from Nairobi County that participates in the study.
- Your child is 10-10.9 years old at the time of study enrollment.
- You (the parent or legal guardian) and your child agree (by signing this form) to participate in the study.
- The child signs the separate assent form indicating that he/she wishes to volunteer for the study.

Your child will not be eligible for the study if:

- You (the parent or legal guardian) do not sign this consent form, or your child does not sign the assent form indicating that they wish to volunteer for the study.
- Your child is unable to walk or unable to wear an waist monitor to detect physical activity.

5- What will happen to you if you take part in the study?

You (the parent or guardian) will be asked to complete demographic and family health questionnaires, including your perception of your child's home, neighborhood, and school environments. You will also be asked to supply information to allow us to follow-up with the child in the future. The questionnaires will be sent home with your child. The parent or guardian will complete the questionnaires at home. It will take about 15 minutes to complete the questionnaire. You should give your child the questionnaires so as to return them to school where the researchers will pick them up

All children enrolled in the study will have the same measurements. All measurements will be confidential and will not be shown to anyone other than researchers involved in the study. School personnel will not be allowed to see your child's measurements.

Taking the children's measurements will be coordinated with school administrators so as to not conflict with important school activities or tests. Your child's measurements will be obtained by trained personnel in a private area at the school determined by the school principal.

The measurements will include:

1. Weight
2. Height (standing and sitting)
3. Body fat – this number is calculated while your child is standing on a weight scale
4. Waist and arm circumferences
5. Questionnaire about diet and exercise

In addition your child will wear a physical activity monitor for 8 days, 24 hours a day, to measure his/her normal physical activity. It should be removed only for bathing. The monitor is on a flexible belt that will be worn around the waist. A research staff member will call you twice during the monitoring time to answer questions you might have. There is a possibility that your child will be asked to wear the monitor for 8 additional days.

6- What are the possible risks and discomforts?

This is a minimal risk study. There are no aspects of the study that are anticipated to increase the risk of injury to your child.

7- What are the possible benefits?

We cannot promise any benefits from your child being in the study.

8- If you do not want to take part in the study, are there other choices?

You can either choose to participate in the study by signing this form and returning it to the study staff in the envelope provided, or you can choose not to participate in the study by not signing the form. You have the choice at any time not to participate in this research study. Therefore, if you and your child decide to participate in the study at this time, and later decide to not participate, you are allowed to withdraw from the study.

9- If you have any questions or problems, whom can you call?

If you have any questions about your rights as a research volunteer, you should call Dr. Vincent Onywera on 0788291696 or, Ms. Joy Lucy Wachira on 0723842543. If you have any questions about the research study, contact Dr.Vincent Onywera on 0788291696 or Ms. Joy Lucy Wachira on 0723842543. If you think you have a research-related injury or medical illness, you should call Dr. Vincent Onywera during regular working hours or on weekends.

10- What information will be kept private?

All data will be collected in a confidential manner. Every effort will be made to maintain the confidentiality of your study records and those of your child's. However, someone from the international team may inspect and/or copy the medical records related to the study. However, your child will be assigned a unique identity number and names will not appear on questionnaires or data collection forms. A separate secure list held at the international office will be used only to identify participants for re-contacting in the future. Results of the study may be published; however, we will keep your name and other identifying information private. Other than as set forth above, your identity will remain confidential unless disclosure is required by law.

11- Can your taking part in the study end early?

Dr. Vincent Onywera can withdraw you and your child from the study for any reason or for no reason. You and your child may withdraw from the study at any time without penalty. Possible reasons for withdrawal include failure to wear the activity monitor or disruptive behavior related to the conduct of the study. The sponsor of the study may end the study early.

12- What if information becomes available that might affect your decision to stay in the study?

During the course of this study there may be new findings from this or other research which may affect your willingness to continue participation. Information concerning any such new findings will be provided to you.

13- What charges will you have to pay?

None

14- What payment will you receive?

No payment will be received for participating in this study. Your child's school may receive gifts, such as balls, Frisbees etc. These gifts will be determined by coordination between school administration and the research team.

15- Will you be compensated for a study-related injury or medical illness?

No form of compensation for medical treatment or for other damages is available from the research team.

16- Confidentiality

Records that you give us permission to keep, and identify you, will be kept confidential as required by law. Except when required by law, you will not be identified by name, identity card number, address, telephone number, or any other direct personal identifier in records disclosed outside of the research. For records disclosed outside of the research, you will be assigned a unique code number.

17- Signatures

The study has been discussed with me and all my questions have been answered. If there is anything I don't understand, I can ask the investigators or anyone from the ISCOLE study team. I have been given a copy of the signed consent form.

With my signature, I also acknowledge that I have been given either today or in the past a copy of the Notice of Privacy Practices for Protected Health Information.

The study volunteer is a child and I certify that I am his/her guardian.

Printed Name of Parent/Guardian Relationship to Child Date

________________________________ _______________ _____________

Parent/Guardian Signature Date Date of Birth of Child

________________________________ _______________ ___________

Name of Site Staff Member Receiving the Signed Informed Consent

____ Date ___________

Kenya Investigators: Vincent Onywera, Ph.D., & Mark Tremblay, Ph.D.

Study staff and graduate students: Stella Muthuri, M.Sc. and Joy Lucy Wachira, M.Sc.

IDHINI YA MTOTO KUSHIRIKI KWENYE UTAFITI WA ISCOLE

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

Anwani ya Utafiti: Utafiti wa Kimataifa kuhusu Unene, Mtindo wa Maisha na Mazingira ya Utotoni (ISCOLE) **ENEO LA KENYA**

Unayopaswa kujua kuhusu utafiti chunguzi

- Tunakupatia fomu hii ya idhini ili uweze kusoma kuhusu lengo, hatari na manufaa ya utafiti huu chunguzi.
- Lengo kuu la tafiti chunguzi ni kupata maarifa ambayo yanaweza kusaidia wakazi wa sasa na wa baadaye maeneo mbalimbali.
- Una haki ya kukataa kushiriki, au ukakubali kushiriki sasa na kisha kubadili nia yako baadaye.
- Tafadhali durusu fomu hii ya idhini kwa makini kisha uulize maswali yoyote kabla hujafanya uamuzi.
- Kushiriki kwako ni kwa hiari.
- Kwa kutia sahihi fomu hii, unakubali kushiriki katika utafiti kama ulivyofafanuliwa.

1- Akina nani wanafanya utafiti?

Taarifa kuhusu watafiti:

Watafiti kutoka Kenya: Vincent Onywera, Ph.D., na Mark Tremblay, Ph.D.

Wafanyi kazi kwenye utafiti na wanafunzi wa shahada za juu: Joy Lucy Wachira, M.Sc. na Stella Muthuri, M.Sc.

Watafiti Dkt. Vincent Onywera na Dkt. Mark Tremblay wataongoza utafiti huu nchini Kenya. Tunatarajia kuwa na watoto 500 kutoka kila eneo katika mataifa 12 yatakayoshiriki katika utafiti huu. Utafiti utafanyika katika kipindi kizima cha masomo mwaka wa 2012. Muda unaotarajiwa kutumika kutathmini mtoto wako katika utafiti huu ni siku 8. Baadhi ya watoto huenda wakaulizwa kurudi kwa tathmini zaidi kwa muda wa siku zingine 8 na kuvaa kiangalizi kwa mara ya pili. Huu ni utafiti uliodhaminiwa na mataifa mengi.

2- Utafiti unafanyiwa wapi? Watafiti kutoka Kenya ni wa Chuo Kikuu cha Kenyatta. Utafiti huu utafanyiwa Kaunti ya Nairobi. Ukusanyanji wa data utafanyiwa katika shule anayosomea mwanao huku hojaji fulani zikijazwa nawe mwako nyumbani.

3- Lengo la utafiti huu ni lipi? Lengo la utafiti huu ni kujua mengi zaidi kuhusu athari ya mtindo wa maisha na mazingira katika unene na kuongeza uzani kwa watoto ambao wana takribani miaka 10.

4- Ni nani anaweza kushiriki kwenye utafiti huu? Nani hawezi kushiriki?

Mwanao anaweza kushiriki katika utafiti huu iwapo:

- Anasomea katika shule mojawapo kutoka Kaunti ya Nairobi zinazoshiriki katika utafiti huu.
- Mwanao ana kati ya miaka 10-10.9 wakati wa usajili wa utafiti.
- Wewe (mzazi au mlezi halali) na mwanao mnakubali kushiriki kwenye utafiti (kwa kutia fomu hii sahihi).
- Mwanao ametia sahihi kwenye fomu ya kukubali iliyo kando kuonyesha kuwa amejitolea kwa hiari kushiriki kwenye utafiti.

Mwanao hawezi kushiriki kwenye utafiti iwapo:

- Wewe (mzazi au mlezi halali) hujatia sahihi kwenye fomu hii, au mtoto wako hajatia fomu ya kukubali iliyo kando kuonyesha kuwa amejitolea kwa hiari kushiriki kwenye utafiti.
- Mwanao hawezi kutembea wala kuvaa kiangalizi cha kiunoni cha kubaini shughuli za uchezaji.

5- Itakuwaje kwako ukishiriki kwenye utafiti huu?

Wewe (mzazi au mlezi) utaulizwa kujaza hojaji ya demografia na afya ya familia, ikiwa pamoja na hisia zako kuhusu nyumbani mwa mwanao, maeneo jirani na mazingira ya shuleni. Utaulizwa pia kutoa taarifa kuturuhusu kufuatilia mwanao baadaye. Hojaji zitatumwa nyumbani na mwanao. Mzazi au mlezi atajaza hojaji akiwa nyumbani. Itachukua kama dakika 10 kuijaza. Unapaswa kumpatia mwanao hojaji zile arudi nazo shuleni ambapo watafiti watazichukua.

Watoto wote watakaosajiliwa kwenye utafiti watakuwa na vipimo vinavyofanana. Vipimo vyote vitakuwa siri na havitaonyeshwa yeyote isipokuwa wachunguzi wanaoshiriki kwenye utafiti. Wafanyi kazi wa shule hawataonyeshwa vipimo vya mwanao.

Kupimwa kwa watoto kutasimamiwa na wakuu shuleni ili kusiingilie shughuli muhimu za shule na mitihani. Vipimo vya mwanao vitachukuliwa na maofisa walio na ujuzi katika eneo la faragha humo shuleni ambalo litabainishwa na mwalimu mkuu.

Vipimo hivi ni pamoja na:

6. Uzani
7. Kimo (akiwa amesimama na pia kuketi)
8. Vipimo vya mafuta mwilini – hiki hukadirwa mwanao akiwa amesimama kwenye kipima uzani.
9. Mduara wa kiuno na mkono
10. Hojaji kuhusu malaji na mazoezi

Pia, mwanao atavaa kiangalizi cha mazoezi ya mwili kwa siku 8, masaa 24 kwa siku ili kupima kiwango chake cha kawaida cha mazoezi yanayohusisha viungo. Kinapaswa kutolewa tu wakati akioga. Kimewekwa kwenye ukanda legevu utakaovaliwa kiunoni. Mfanyi kazi kwenye utafiti atakupigia simu mara mbili wakati wa kuangalia ili kujibu maswali ambayo huenda ukataka kuuliza. Kuna uwezekano kuwa mwanao ataulizwa kukivaa kwa siku 8 zaidi.

6- Ni hatari zipi au usumbufu upi ambao huenda ukatokea?

Huu ni utafiti wenye kiwango finyu sana cha hatari. Hakuna vipengee vyovyote vya utafiti ambao vinatarajiwa kuongezea hatari ya kuumizwa kwa mwanao.

7- Ni manufaa yepi yanayotarajiwa?

Hatuwezi kuahidi manufaa yoyote kwa mwanao kutokana na utafiti huu.

8- Kama hutaki kushiriki katika uchunguzi, kuna mapendekezo mengine?

Unaweza kuamua kushiriki katika utafiti kwa kutia sahihi fomu hii na kuirudisha kwa wafanyi kazi wa utafiti katika bahasha iliyotolewa, au ukaamua kutoshiriki kwenye utafiti. Una haki wakati wowote ya kutoshiriki katika utafiti. Hivyo basi, ikiwa wewe na mwanao mtaamua kushiriki sasa kisha baadaye mkaamua kutoshiriki, mnaruhusiwa kujiondoa kwenye utafiti.

9- Iwapo una maswali yoyote, utaweza kumpigia nani simu?

Iwapo una maswali kuhusu haki zako kama mhusika aliyejitolea kushiriki katika utafiti, unapaswa kumpigia simu Dkt. Vincent Onywera kwa simu nambari 0788291696 au, Bi. Joy Lucy Wachira kwa nambari 0723842543 . Iwapo una maswali kuhusu utafiti huu chunguzi, wasiliana naye Dkt.Vincent Onywera kupitia 0788291696 au Bi. Joy Lucy Wachira kupitia 0723842543. Iwapo unadhani una jeraha au ugonjwa unaohusiana na utafiti, unapaswa kumpigia simu Dkt. Vincent Onywera wakati wa masaa ya kawaida ya kufanya kazi au hata mwishoni mwa juma.

10- Ni taarifa zipi zitahifadhiwa kwa siri?

Data zote zitakusanywa kwa usiri. Hatua zozote zitachukuliwa kuhakikisha kuwa usiri wa rekodi zako na zile za mwanao umedumishwa. Hata hivyo, mtu kutoka kundi la kimataifa anaweza kupitia au kurudufu rekodi za kiafya zinazohusishwa na utafiti. Mwanao atapewa nambari ya kipekee ya utambulisho na majina hayatokea kwenye hojaji au fomu za kukusanya data. Orodha nyingine kando iliyohifadhiwa kwenye ofisi ya kimataifa itatumika kuwatambulisha washiriki ambao huenda wakatafuatiliwa baadaye. Matokeo ya utafiti yanaweza kuchapishwa; lakini jina lako pamoja na taarifa nyingine za kibinafsi zinazoweza kukutambulisha zitabanwa. Isipokuwa katika hali zilizobainishwa awali, utambulisho wako utawekwa siri isipokuwa iwapo itahitajika kubainishwa kupitia sheria.

11- Kushiriki kwako kunaweza kufikia kikomo kabla ya uchunguzi kukamilika?

Dkt. Vincent Onywera anaweza kukuondoa kwenye utafiti kwa sababu fulani au bila sababu yoyote. Wewe na mwanao mnaweza kujitoa kwenye utafiti wakati wowote bila lawama zozote. Sababu za kujitoa ni kama vile ukosefu wa kufaa kiangalizi au tabia zinazovuruga zinazohusishwa na utafiti. Mdhamini wa utafiti anaweza kusitisha utafiti kabla ya wakati wake.

12- Na iwapo taarifa zitatokeza ambazo zinaweza kuathiri uamuzi wako wa kuendelea kushiriki?

Wakati utafiti huu ukiendelea kunaweza kuwa na matokeo mageni kutoka kwa utafiti huu au mwingine yanayoweza kuathiri uamuzi kwako wa kuendelea kuhusika. Taarifa kuhusu matokeo kama haya zitatolewa kwako.

13- Utalipa malipo gani?

Hutalipa chochote.

14- Utalipwa malipo yepi?

Hamna malipo yoyote yatakayotolewa kwa ajili ya kushiriki katika utafiti huu. Shule anayosomea mwanao inaweza kupata tunu kama vile mipira, visahani vya kucheza Frisbees n.k. Hizi tunu zitaamuliwa na uratibu baina ya uongozi wa shule na kundi la watafiti.

15- Utafidiwa kwa ajili ya jeraha au ugonjwa unaohusishwa na utafiti?

Hakuna fidia yoyote itakayotolewa kwa sababu ya matibabu au aina yoyote nyingine ya uharibifu (kutoka kwa kundi la watafiti).

16- Usiri

Rekodi utakazotupa idhini kuziweka na kukutambulisha zitawekwa siri kwa mujibu wa sheria. Isipokuwa wakati ikihitajika kwa mujibu wa sheria, hutatambulishwa kwa jina, nambari ya kitambulisho, anwani, nambari ya simu au kitambulishi chochote kingine cha kibinafsi katika rekodi zitakazobainishwa kando ya utafiti. Katika rekodi zitazobainishwa nje mwa utafiti, utapewa msimbo mahsusi wa nambari.

17- Sahihi

Utafiti umejadiliwa nikiwepo na maswali yangu yote yakajibiwa. Iwapo kuna suala ambalo silielewi, ninaweza kuuliza watafiti au yeyote kutoka kundi la watafiti kutoka ISCOLE. Nimepewa nakala ya fomu iliyotiwa sahihi.

Kwa sahihi yangu nathibitisha kuwa nimepewa leo au hapo awali nakala ya Notisi ya Mienendo ya Usiri ya Taarifa za Afya Zilizobanwa.

Aliyejitolea kushiriki ni mtoto na ninathibitisha kuwa mimi ndiye mlezi wake halali.

__________________________ __________________ __________

Jina lilioandikwa la mzazi/mlezi Uhusiano na mtoto Tarehe

__________________________ ______________ __________________

Sahihi ya mzazi/mlezi Tarehe Tarehe ya kuzaliwa kwa mtoto

____ __________

Mfanyi kazi wa eneo anayepokea fomu iliyotiwa sahihi Tarehe

Watafiti kutoka Kenya: Vincent Onywera, Ph.D., na Mark Tremblay, Ph.D.

Wafanyi kazi katika utafiti na wanafunzi wa shahada za juu: Stella Muthuri, M.Sc. na Joy Lucy Wachira, M.Sc.

APPENDIX H: Child's Assent Form

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

ASSENT TO BE IN THE ISCOLE STUDY

Name of Study: International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) – KENYA SITE

Kenya's Principal Investigators: Vincent Onywera, Ph.D. & Mark Tremblay, Ph.D.

Study staff and graduate students: Joy Lucy Wachira, M.Sc. and Stella Muthuri, M.Sc.

Telephone Contact: +254-0788291696, +254-0723842543

Why am I here?

The researchers want to tell me about body weight and see if I would be interested to be in the study. Dr. Vincent Onywera from Kenyatta University and some other researchers are doing this study.

Why are they doing this study?

They want to learn more about how lifestyle and the environment affect obesity and weight gain in children 10 years of age.

What will happen to me?

If I want to be in the study, two things will happen:

1. I will fill out some papers assisted by the researchers, be weighed and get my height, waist and arm measured.
2. I will wear a monitor at my waist to measure my normal physical activity.

Will the study hurt?

Being in the study should not hurt me.

What if I have any questions?

I can ask questions any time. I can ask now. I can ask later. I can talk to the researchers or I can talk to someone else.

Do I have to be in the study?

I don't have to be in this study. No one will be mad at me if I don't want to do this. If I **don't want** to be in the study, I just have to tell the researchers. If I **want to** be in the study, I just have to tell the researchers. I can say yes now and change my mind later. It's up to me.

Signature of Volunteer__________________ Age ________ Date _______________

Signature of Witness ____________________ Date ________________

Signature of Person Administering Informed Consent________________

Date ________________

APPENDIX I: ISCOLE Project Accelerometer Instructions

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

We would like to measure your normal physical activity today and over the next 7 full days. We can measure this by having you wear this monitor on your waistband. You wear it on your right side, just over your hip (demonstrate). We would like you to wear it for the full 24 hours. However, since the monitor is NOT waterproof, you will need to remove it while showering or taking a bath. On the last day wear it as normal to school where we will collect it from you. We will call you to see if you have any questions about the monitor. You can also call us if you have any questions (show them the number at the bottom). It is very important that you don't do anything different just because you are wearing the monitor. Just do your normal routine today and over the next 7 days."

Wearing the Waist Monitor

1. Using the belt provided, lock elastic band snugly with the monitor around waist. Position the monitor to rests over your hip bone directly underneath your RIGHT armpit. Refer to the picture for proper placement

2. Keep the monitor on for the full 24 hours a day, including when you sleep.

3. The monitor MUST be removed when bathing (either bath or shower) or when going swimming. DO NOT GET THE MONITOR WET!

4. If you have any problems with attaching the monitors, or think they may not be working, please call the number listed below and we will call you back.

Waist Monitor Instructions

Keep the monitor on for the full 24 hours a day. During this time, please live your life as you normally do.

If you have any questions please call: 0723842543, +254-788291696

APPENDIX J: Anthropometric Measurements

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

ISCOLE PROJECT ANTHROPOMETRIC MEASUREMENTS PROTOCOL

HEIGHT

Equipment

- Seca 214 Portable Stadiometer

Height Measurement

1. The assessor has the participant remove his/her footwear and move or remove hair ornaments, buns and braids from the top of his/her head.
2. The participant is instructed to stand erect, arms hanging at the sides with his/her feet together. The participant is instructed to keep his/her heels, buttocks, back and head in contact with the vertical backboard of the stadiometer. The technician makes sure the body weight was evenly distributed, and that both feet were flat on the floor.
3. The assessor instructs the participant to look straight ahead. The participant's head is aligned in the Frankfort Plane. The head is considered to be in the Frankfort plane when the horizontal line from the ear canal to the lower border of the orbit of the eye is parallel to the floor and perpendicular to the vertical backboard. If required, the technician gently tilts the head up or down until proper alignment was achieved with eyes looking straight ahead.

   Note: If a participant can not keep his/her head in contact with the stadiometer while the head was in the Frankfort plane position, the Frankfort plane position takes precedence over ensuring the rear of the head is in contact with the stadiometer.
4. The participant is instructed to stand as tall as possible, take a deep breath and hold it while the measurement is taken. A deep breath allows the spine to straighten, yielding a more consistent and reproducible height measurement.

5. A second assessor then lowers the slide until it reaches the vertex of the skull and records the reading from the indicator, rounding up to the nearest 0.1 centimeter.
6. This process is repeated, and the average of the two heights is used in analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart).

SITTING HEIGHT

Equipment

- Seca 214 Portable Stadiometer
- Standardized bench or block

Sitting Height Measurement

1. The assessor has the participant move or remove hair ornaments, buns and braids from the top of his/her head.
2. The participant is instructed to sit on the measuring box with hands resting on his/her thighs and to keep his/her back, shoulders and head in contact with the vertical backboard of the stadiometer.
3. The assessor instructs the participant to look straight ahead. The participant's head is aligned in the Frankfort Plane. The head is considered to be in the Frankfort plane when the horizontal line from the ear canal to the lower border of the orbit of the eye is parallel to the floor and perpendicular to the vertical backboard. If required, the technician gently tilts the head up or down until proper alignment is achieved with eyes looking straight ahead.

   Note: If a participant could not keep his/her head in contact with the stadiometer while the head was in the Frankfort plane position, the Frankfort plane position took precedence over ensuring the rear of the head was in contact with the stadiometer.

4. The participant is instructed to sit as tall as possible, take a deep breath and hold it while the measurement is taken. The technician ensures that the participant does not contract the gluteal muscles nor push with the legs.
5. A second assessor then lowers the slide until it reaches the vertex of the skull and records the reading from the indicator, rounding up to the nearest 0.1 centimeter.
6. This process is repeated, and the average of the two sitting heights is used in analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart).

WEIGHT AND BIOELECTRIC IMPEDANCE

Equipment

- Portable Tanita Body Composition Analyzer (SC-240)

The participant's weight and impedance are measured using the portable Tanita Body Composition Analyzer (SC-240) after all outer clothing, heavy pocket items and shoes and socks are removed. After the unit has been initialized (flashes "step on"), the participant steps onto the middle of the body composition analyzer, with their bare feet situated such that the heels are placed on the posterior electrodes and the front part of the feet are in contact with the anterior electrodes. The participant stands on the unit in a stable position without bending their knees.

Weight and Impedance Measurement Procedure

1. The assessor has the participant remove his/her footwear ad socks, any heavy accessories and empty his/her pockets.
2. The participant is asked to step on the middle of the body composition analyzer, with their bare feet situated such that the heels are placed on the posterior electrodes and the front part of the feet are in contact with the anterior electrodes.
3. The participant is instructed to stand on the unit in a stable position without bending their knees.
4. Note - it is important to note that the device will send the output directly to a computer through a USB cable immediately. Ensure that the cable is connected

properly before the measurements take place. Record the weight, % body fat and impedance measures on the data collection form in addition to transferring the complete data output to the computer.

WAIST CIRCUMFERENCE

Equipment

- Non-elastic anthropometric tape
- Fine tip washable marker

Waist Circumference Measurement

1. The assessor has the participant stand erect, in a relaxed manner, with feet shoulder width apart and arms slightly forward (at a 45° angle) with palms facing in. The measure is to be taken directly on the skin.
2. Both sides of the participant were landmarked with a washable marker. The location of the first landmark was at the bottom of the rib cage (last floating rib) and the second landmark was at the top of the iliac crest. Both marks were in the mid-axillary line. If needed, the technician asks the participant for assistance in locating the landmarks or to confirm the location. The mid-point between these two landmarks is measured and landmarked using the measuring tape.
3. Standing on the participant's right side, the technician places the measuring tape around the trunk in a horizontal plane at the level marked on the participant's trunk. A mirror or a second technician can be used to ensure proper level and positioning of tape. If there was a visible difference between the two reference marks, the mark on the right side was used as the guide. The technician applies sufficient tension to the tape to maintain its position without causing indentation of the skin surface.
4. Once the measuring tape is in place, the technician instructs the participant to place both arms along the side of the body in a relaxed manner.
5. The participant is instructed to breathe normally.

6. The assessor keeps his/her eyes at the same level as the measuring tape. The measurement is taken at the end of a normal expiration. The cross-over technique is used, and the measure is read from the bottom of the tape.
7. The assessor records the measurement to the nearest 0.1 cm.
8. The process is repeated and the average of each of the two circumferences is used in analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart).

MID-UPPER-ARM CIRCUMFERENCE

Equipment

- Non-elastic anthropometric tape
- Fine tip washable marker

Mid-upper-arm Circumference Measurement

1. With the participant standing and holding their right forearm horizontal, the distance between the bare acromion and olecranon processes is measured by the assessor and the midpoint of the humerus is marked on the dorsal surface of the arm.
2. The arm circumference is measured with the arm relaxed at the participant’s side and the measuring tape wrapped horizontally around the arm at the marked midpoint. The measurement is recorded to the nearest 0.1 cm.
3. This process is repeated and the average of the two circumferences is used in analysis (a third measurement is obtained if the first two measurements are greater than 0.5 cm apart).

APPENDIX K: ISCOLE Anthropometric Data Collection Form

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

Participant ID: ____________

Child's Age _____years **Gender**: ☐ Male ☐ Female

1. Standing Height

1. ⌴ ⌴ ⌴ . ⌴ cm
2. ⌴ ⌴ ⌴ . ⌴ cm
3. ⌴ ⌴ ⌴ . ⌴ cm

2. Sitting Height

Table/Box Height:

1. ⌴ ⌴ ⌴ . ⌴ cm

Total Sitting Height:

1. ⌴ ⌴ ⌴ . ⌴ cm
2. ⌴ ⌴ ⌴ . ⌴ cm
3. ⌴ ⌴ ⌴ . ⌴ cm

☐ **Check if PT could not remove head attire for height measurements**

3. Mid-Upper-Arm Circumference

1. ⌴ ⌴ . ⌴ cm
2. ⌴ ⌴ . ⌴ cm
3. ⌴ ⌴ . ⌴ cm

4. Waist Circumference

1. ⌴ ⌴ . ⌴ cm
2. ⌴ ⌴ . ⌴ cm
3. ⌴ ⌴ . ⌴ cm

5. Weight

1. ⌴ ⌴ ⌴ . ⌴ kg
2. ⌴ ⌴ ⌴ . ⌴ kg
3. ⌴ ⌴ ⌴ . ⌴ kg

6. Body Fat

1. ⌴ ⌴ . ⌴ %
2. ⌴ ⌴ . ⌴ %
3. ⌴ ⌴ . ⌴ %

7. Impedance

1. ⌴ ⌴ ⌴ . ⌴ Ω
2. ⌴ ⌴ ⌴ . ⌴ Ω
3. ⌴ ⌴ ⌴ . ⌴ Ω

☐ **Check if PT is wearing socks/hosiery for weight and body fat measurements**

APPENDIX L: Body Mass Index-for-Age Percentile rank chart for Girls

BMI-for-age GIRLS

5 to 19 years (percentiles)

World Health Organization

Year: Month	Month	L	M	S	Percentiles (BMI in kg/m²) 1st	3rd	5th	15th	25th	50th	75th	85th	95th	97th	99th
9: 4	112	-1.4780	16.2580	0.11985	12.9	13.4	13.7	14.5	15.1	16.3	17.7	18.7	20.5	21.4	23.3
9: 5	113	-1.4803	16.2999	0.12026	12.9	13.4	13.7	14.5	15.1	16.3	17.8	18.7	20.6	21.5	23.4
9: 6	114	-1.4823	16.3425	0.12067	12.9	13.4	13.7	14.6	15.1	16.3	17.8	18.8	20.7	21.6	23.5
9: 7	115	-1.4838	16.3858	0.12108	13.0	13.5	13.8	14.6	15.2	16.4	17.9	18.8	20.7	21.6	23.6
9: 8	116	-1.4850	16.4298	0.12148	13.0	13.5	13.8	14.6	15.2	16.4	17.9	18.9	20.8	21.7	23.7
9: 9	117	-1.4859	16.4746	0.12188	13.0	13.5	13.8	14.7	15.2	16.5	18.0	18.9	20.9	21.8	23.8
9:10	118	-1.4864	16.5200	0.12228	13.0	13.6	13.9	14.7	15.3	16.5	18.0	19.0	21.0	21.9	23.9
9:11	119	-1.4866	16.5663	0.12268	13.1	13.6	13.9	14.7	15.3	16.6	18.1	19.1	21.1	22.0	24.0
10: 0	120	-1.4864	16.6133	0.12307	13.1	13.6	13.9	14.8	15.4	16.6	18.2	19.1	21.1	22.1	24.1
10: 1	121	-1.4859	16.6612	0.12346	13.1	13.6	14.0	14.8	15.4	16.7	18.2	19.2	21.2	22.2	24.2
10: 2	122	-1.4851	16.7100	0.12384	13.1	13.7	14.0	14.9	15.4	16.7	18.3	19.3	21.3	22.2	24.3
10: 3	123	-1.4839	16.7595	0.12422	13.2	13.7	14.0	14.9	15.5	16.8	18.3	19.3	21.4	22.3	24.4
10: 4	124	-1.4825	16.8100	0.12460	13.2	13.7	14.1	14.9	15.5	16.8	18.4	19.4	21.5	22.4	24.6
10: 5	125	-1.4807	16.8614	0.12497	13.2	13.8	14.1	15.0	15.6	16.9	18.5	19.5	21.5	22.5	24.7
10: 6	126	-1.4787	16.9136	0.12534	13.3	13.8	14.1	15.0	15.6	16.9	18.5	19.5	21.6	22.6	24.8
10: 7	127	-1.4763	16.9667	0.12571	13.3	13.9	14.2	15.1	15.7	17.0	18.6	19.6	21.7	22.7	24.9
10: 8	128	-1.4737	17.0208	0.12607	13.3	13.9	14.2	15.1	15.7	17.0	18.6	19.7	21.8	22.8	25.0
10: 9	129	-1.4708	17.0757	0.12643	13.4	13.9	14.2	15.1	15.8	17.1	18.7	19.8	21.9	22.9	25.1
10:10	130	-1.4677	17.1316	0.12678	13.4	14.0	14.3	15.2	15.8	17.1	18.8	19.8	22.0	23.0	25.2
10:11	131	-1.4642	17.1883	0.12713	13.4	14.0	14.3	15.2	15.9	17.2	18.8	19.9	22.1	23.1	25.3
11: 0	132	-1.4606	17.2459	0.12748	13.5	14.0	14.4	15.3	15.9	17.2	18.9	20.0	22.2	23.2	25.4
11: 1	133	-1.4567	17.3044	0.12782	13.5	14.1	14.4	15.3	16.0	17.3	19.0	20.0	22.2	23.3	25.6
11: 2	134	-1.4526	17.3637	0.12816	13.6	14.1	14.4	15.4	16.0	17.4	19.0	20.1	22.3	23.4	25.7
11: 3	135	-1.4482	17.4238	0.12849	13.6	14.2	14.5	15.4	16.1	17.4	19.1	20.2	22.4	23.5	25.8

2007 WHO Reference

Figure A1: Girls WHO Growth chart
Source: WHO 2007 reference (WHO, 2010)

APPENDIX M: Body Mass Index-for-Age Percentile rank chart for Boys

BMI-for-age BOYS

5 to 19 years (percentiles)

World Health Organization

Year: Month	Month	L	M	S	Percentiles (BMI in kg/m²) 1st	3rd	5th	15th	25th	50th	75th	85th	95th	97th	99th
9: 4	112	-1.6753	16.1692	0.10214	13.2	13.7	13.9	14.7	15.1	16.2	17.4	18.2	19.7	20.4	21.9
9: 5	113	-1.6851	16.2009	0.10259	13.3	13.7	14.0	14.7	15.2	16.2	17.4	18.2	19.8	20.5	22.0
9: 6	114	-1.6944	16.2333	0.10303	13.3	13.7	14.0	14.7	15.2	16.2	17.5	18.3	19.8	20.5	22.1
9: 7	115	-1.7032	16.2665	0.10347	13.3	13.8	14.0	14.7	15.2	16.3	17.5	18.3	19.9	20.6	22.2
9: 8	116	-1.7116	16.3004	0.10391	13.3	13.8	14.0	14.8	15.3	16.3	17.6	18.4	20.0	20.7	22.3
9: 9	117	-1.7196	16.3351	0.10435	13.3	13.8	14.1	14.8	15.3	16.3	17.6	18.4	20.0	20.8	22.4
9:10	118	-1.7271	16.3704	0.10478	13.4	13.8	14.1	14.8	15.3	16.4	17.7	18.5	20.1	20.8	22.5
9:11	119	-1.7341	16.4065	0.10522	13.4	13.8	14.1	14.8	15.3	16.4	17.7	18.5	20.2	20.9	22.6
10: 0	120	-1.7407	16.4433	0.10566	13.4	13.9	14.1	14.9	15.4	16.4	17.7	18.6	20.2	21.0	22.7
10: 1	121	-1.7468	16.4807	0.10609	13.4	13.9	14.2	14.9	15.4	16.5	17.8	18.6	20.3	21.1	22.8
10: 2	122	-1.7525	16.5189	0.10652	13.4	13.9	14.2	14.9	15.4	16.5	17.8	18.7	20.4	21.1	22.9
10: 3	123	-1.7578	16.5578	0.10695	13.5	13.9	14.2	15.0	15.5	16.6	17.9	18.7	20.4	21.2	23.0
10: 4	124	-1.7626	16.5974	0.10738	13.5	14.0	14.2	15.0	15.5	16.6	17.9	18.8	20.5	21.3	23.1
10: 5	125	-1.7670	16.6376	0.10780	13.5	14.0	14.3	15.0	15.5	16.6	18.0	18.8	20.6	21.4	23.2
10: 6	126	-1.7710	16.6786	0.10823	13.5	14.0	14.3	15.1	15.6	16.7	18.0	18.9	20.7	21.5	23.3
10: 7	127	-1.7745	16.7203	0.10865	13.6	14.0	14.3	15.1	15.6	16.7	18.1	19.0	20.7	21.6	23.4
10: 8	128	-1.7777	16.7628	0.10906	13.6	14.1	14.3	15.1	15.6	16.8	18.1	19.0	20.8	21.6	23.5
10: 9	129	-1.7804	16.8059	0.10948	13.6	14.1	14.4	15.2	15.7	16.8	18.2	19.1	20.9	21.7	23.6
10:10	130	-1.7828	16.8497	0.10989	13.6	14.1	14.4	15.2	15.7	16.9	18.2	19.1	21.0	21.8	23.7
10:11	131	-1.7847	16.8941	0.11030	13.7	14.2	14.4	15.2	15.8	16.9	18.3	19.2	21.0	21.9	23.8
11: 0	132	-1.7862	16.9392	0.11070	13.7	14.2	14.5	15.3	15.8	16.9	18.4	19.3	21.1	22.0	23.9
11: 1	133	-1.7873	16.9850	0.11110	13.7	14.2	14.5	15.3	15.8	17.0	18.4	19.3	21.2	22.1	24.0
11: 2	134	-1.7881	17.0314	0.11150	13.8	14.3	14.5	15.3	15.9	17.0	18.5	19.4	21.3	22.2	24.1
11: 3	135	-1.7884	17.0784	0.11189	13.8	14.3	14.6	15.4	15.9	17.1	18.5	19.4	21.4	22.2	24.2

2007 WHO Reference

Figure A2: Boys WHO Growth chart

Source: WHO 2007 reference (WHO, 2010)

APPENDIX N: Body Fat Percentage Health Ranges

Eng

Various criteria

What is body fat percentage? (Applicable age 5 - 99)

Body fat percentage is the amount of body fat as a proportion of your body weight.

Reducing excess levels of body fat has shown to reduce the risk of certain conditions such as high blood pressure, heart disease,diabetes and cancer. The chart below shows the healthy ranges for body fat.

Body Fat Ranges for Standard Children [1]
Body Fat Ranges for Standard Adults [2]

[1] *Susan Jebb et al. Obesity Reseach(o2) 2004;12:A156-157 "New Body Fat Reference Curves for children"*

[2] *Gallagher D et al. Am J Clin Nutr 2000,72:694-701. "Healthy percentage body fat ranges:an approach for developing guidelines based on body mass index."*

Underfat — Healthy — Overfat — Obese

Female Age																																													
5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
9	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
10	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
12	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
13	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
20-39	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
40-59	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
60-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

0% — 10% — 20% — 30% — 40%

Male Age																																													
5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
9	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
10	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
12	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
13	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
20-39	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
40-59	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
60-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

Underfat — Healthy — Overfat — Obese

Underfat : below the healthy body fat range. Increased risk for health problems.
Healthy : within the healthy body fat percentage range for your age/gender.
Overfat : above the healthy range. Increased risk for health problems.
Obese : high above the healthy body fat range.
Greatly increased risk of obesity-related health problems.

Note: Athletes may have a lower body fat range depending on their particular sport or activity.

Figure A3: Body Fat Healthy Ranges Chart.
Source: Tanita Body Composition Analyzer Instruction Manual (TANITA Corporation, 2010). *(From ISCOLE procedures manual (Katzmarzyk et al., 2013)*

APPENDIX O: ISCOLE Diet and Lifestyle Interview Questionnaire

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

SCHOOL____________________________ **GENDER**____________________

SERIAL NO OF PARTICIPANT _____________________

I WILL ASK YOU SOME QUESTIONS ABOUT WHAT YOU EAT AND HOW YOU WATCH TV, VIDEO, PLAY VIDEO GAMES, USE A COMPUTER OR MOBILE PHONE. PLEASE TRY AND ANSWER AS CORRECTLY AS POSSIBLE

1. On a school day, how many hours do you watch TV?

☐ I do not watch TV on school days

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

2. On a school day, how many hours do you play video or computer games or use a computer for something that is not school work?

☐ I do not play video/computer games or use a computer other than for school work on school days ☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

3. On a school day how much time do you spend outside **before** school?

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

4. On a school day how much time do you spend outside **after** school?

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

5. On a weekend day, how many hours do you watch TV?

☐ I do not watch TV on weekend days ☐ < 1 hour ☐ 1 hour ☐ 2 hours

☐ 3 hours ☐ 4 hours ☐ 5 or more hours

6. On a weekend day, how many hours do you play video or computer games or use a computer for something that is not school work?

☐ I do not play video/computer games or use a computer other than for school work on the weekend ☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

7. On a weekend day, how much time do you spend outside?

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 or more hours

8. In the last week you were in school, on how many days did you go to physical education (PE) classes?

☐ 0 days ☐ 1 day ☐ 2 days ☐ 3 days ☐ 4 days ☐ 5 days

9. In the last week you were in school, the **MAIN** part of your journey to school was by:

- ☐ Walking
- ☐ Running
- ☐ bicycle
- ☐ bus, train, tram, underground or boat
- ☐ car, motorcycle or moped
- ☐ other _______________

10. In the last week you were in school, **HOW LONG** did it take you to travel to school?

☐ < 5 minutes ☐ 5 - 15 minutes ☐ 16 - 30 minutes ☐ 31 minutes to 1 hour

☐ >1 hour

11. How far is your home/house from you school?

☐ Less than 1 km ☐ 1-2 km ☐ 3-5 km ☐ 5-10 km ☐ more than 10 km

12. In the last week you were in school, **HOW LONG** did it take you to travel back home?

☐ < 5 minutes ☐ 5 - 15 minutes ☐ 16 - 30 minutes ☐ 31 minutes to 1 hour

☐ >1 hour

13. During the past year (12 months), did you do any of these activities? (Check all that apply)

☐ sports teams ☐ dance / martial arts class ☐ art / music class ☐ none of these

14. During the past week (7 days), on how many days were you physically active for a total of at least 60 minutes per day? (all the time you spent in activities that increased your heart rate and made you breathe hard)

☐ 0 days ☐ 1 day ☐ 2 days ☐ 3 days ☐ 4 days ☐ 5 days ☐ 6 days

☐ 7 days

Please tick the box that most sounds like you:

Agree a Lot **Disagree a Lot** →

	1	**2**	**3**	**4**	**5**
15. I can be physically active during my free time on most days.	☐	☐	☐	☐	☐

16. I can ask my parent or other adult to do physically active things with me. ☐ ☐ ☐ ☐ ☐

17. I can be physically active during my free time on most days even if I could watch TV or play video games instead. ☐ ☐ ☐ ☐ ☐

18. I can be physically active during my free time on most days even if it is very hot or cold outside. ☐ ☐ ☐ ☐ ☐

19. I can ask my best friend to be physically active with me during my free time on most days. ☐ ☐ ☐ ☐ ☐

20. I can be physically active during my free time on most days even if I have to stay at home. ☐ ☐ ☐ ☐ ☐

21. I have the coordination I need to be physically active during my free time on most days. ☐ ☐ ☐ ☐ ☐

22. I can be physically active during my free time on most days no matter how busy my day is. ☐ ☐ ☐ ☐ ☐

There are lots of reasons why people take part in physical activity. Please tick the box to show how much each of the reasons below is true for you:

	never true for me	a little bit true for me	sometimes true for me	true for me	very true for me
23. I take part in exercise because other people say I should	☐	☐	☐	☐	☐

24. It's important to me to exercise regularly ☐ ☐ ☐ ☐ ☐

25. I can't see why I should bother exercising ☐ ☐ ☐ ☐ ☐

26. I feel like a failure when I haven't exercised in a while ☐ ☐ ☐ ☐ ☐

27. I find exercise a pleasurable activity ☐ ☐ ☐ ☐ ☐

28. During the past week, what time have you usually turned out the light and gone to sleep on school days?

☐☐:☐☐ AM / PM (circle AM or PM)

29. During the past week, at what time have you usually woken up in the morning on school days**?**

☐☐:☐☐ AM / PM (circle AM or PM)

30. During the past week, what time have you usually turned out the light and gone to sleep on weekend days?

☐☐:☐☐ AM / PM (circle AM or PM)

31. During the past week, at what time have you usually woken up in the morning on weekend days?

☐☐:☐☐ AM / PM (circle AM or PM)

32. During the past week, how would you rate your sleep **quality** overall (how **well** you sleep)?

☐ very good ☐ fairly good ☐ fairly bad ☐ very bad

33. During the <u>past week,</u> how would you rate your sleep **quantity** overall (how **much** you sleep)?

☐ very good ☐ fairly good ☐ fairly bad ☐ very bad

34. Do you have a television in your bedroom?

☐ Yes ☐ No

35. How many times a week do you usually eat . . . ? (Please mark only one box for each line)

	Never	Less than once a week	Once a week	2-4 days a week	5-6 days a week	Once a day, every day	Every day, more than once
Fruits							
Vegetables							
Sweets (candy/chocolate)							
Regular cola or soft drinks that contain sugar							
Cake, pastries, or donuts							
Diet cola or soft drinks							
Potato crisps							
French fries (chips)							
Dark green vegetables (Kale (sukuma wiki), spinach, etc.)							
Other vegetables (carrots, cucumber, bringales, sweet potato,							

etc.)							
Fruit juice							
Low fat milk (1%,2%, skim)							
Whole milk (homogenized)							
Cheese							
Other milk products (yogurt, chocolate milk, pudding, etc.)							
Whole grain bread or cereal (weetabix, oatmeal, muesli, etc.)							
Meat alternatives (beans, green grams (ndengu), lentils, tofu, eggs, peanut butter, etc.)							
Energy drinks (Red Bull, Shark, Rock Star, Guru, etc.)							
Sports drinks (Gatorade, Lucozade, Powerade, etc.)							
Fish							
Ice cream							
Fried food such as chicken wings, chicken fingers, cheese, etc.							
Fast foods such as hot dog, pizza, hamburgers, etc.							

36. How many times a week do you usually eat the following food items **while watching television**?

	Never	Less than once a week	Once a week	2-4 days a week	5-6 days a week	Once a day, every day	Every day, more than once
Potato crisps, peanuts or groundnuts							
Fried food such as chicken wings, chicken fingers, cheese, etc.							
Cookies, biscuits, chocolate or candy bars							
Ice cream							
Fast foods such as chips, pizza, hamburgers, etc.							

37. How often do you usually have **breakfast** (more than a glass of milk or fruit juice)? Mark one box for <u>weekdays</u> and one box for <u>weekend</u>.

<u>Weekdays</u>

- ☐ I never have breakfast on weekdays
- ☐ One day
- ☐ Two days
- ☐ Three days
- ☐ Four days
- ☐ Five days

<u>Weekend</u>

- ☐ I never have breakfast on the weekend
- ☐ I usually have breakfast on only one day of the weekend (Saturday OR Sunday)
- ☐ I usually have breakfast on both weekend days (Saturday AND Sunday)

38. Does your school serve school lunches?

☐ Yes ☐ No

39. In the last week you were in school, about **how many times a week** did you eat a school lunch?

☐ 0 days ☐ 1 day ☐ 2 days ☐ 3 days ☐ 4 days ☐ 5 days

40. During the past week**,** how many meals (breakfast, lunch or dinner) did you get that were **prepared away from home** in places such as restaurants, fast food places, food stands, grocery stores or vending machines? (please do not include meals provided as part of school breakfast or school lunch)

☐☐ meals

How well do these statements describe you? (Put a mark in the box that best describes how often this happens).

	Never or Almost Never	Sometimes	Usually or Always
41. When I am worried I eat more	☐	☐	☐
42. I eat when I am mad	☐	☐	☐
43. When I do something well I give myself a food treat	☐	☐	☐
44. When I am sad I eat more	☐	☐	☐
45. When I am happy I eat more	☐	☐	☐

46. When I am bored I eat more ☐ ☐ ☐

47. I eat between meals even when I am not hungry ☐ ☐ ☐

Thinking about the last week… (Put a mark in the box that best describes how you felt)

	Not at all	Slightly	Moderately	Very	Extremely
48. Have you felt fit and well?	☐	☐	☐	☐	☐
49. Have you felt full of energy?	☐	☐	☐	☐	☐
50. Have you felt sad?	☐	☐	☐	☐	☐
51. Have you felt lonely?	☐	☐	☐	☐	☐
52. Have you had enough time for yourself?	☐	☐	☐	☐	☐
53. Have you been able to do the things that you want to do in your free time?	☐	☐	☐	☐	☐
54. Have your parent(s) treated you fairly?	☐	☐	☐	☐	☐
55. Have you had fun with your friends?	☐	☐	☐	☐	☐
56. Have you got on well at school?	☐	☐	☐	☐	☐

57. Have you been able to pay attention? ☐ ☐ ☐ ☐ ☐

58. In general, how would you say your health is?

☐ excellent ☐ very good ☐ good ☐ fair ☐ poor

Thank you

APPENDIX P: ISCOLE Project Assessment of Maturity of Participants

(From ISCOLE procedures manual (Katzmarzyk et al., 2013)

1) The Khamis Roche Method

The rationale for using percentage of adult height attained is that two children of the same age can be the same height, but one may be closer to their final adult height, and hence is more advanced in somatic maturation. Given that the final adult height of the ISCOLE participants is not known, it must be predicted in order to compute the percentage of adult height obtained. The Khamis-Roche method predicts adult height from the participant's chronological age, height, weight and their mid-parent stature (Khamis and Roche, 1994).

The following intercepts and regression coefficients will be used in the prediction models for boys and girls in ISCOLE.

Table 1. Regression coefficients for predicting of adult height using the Khamis-Roche method

Chronological Age (y)	Intercept (β○)	Height (in)	Weight (lb)	Mid-parent Stature (in)
Boys				
8.5	-11.1220	1.06572	-0.0046261	0.43171
9.0	-11.1571	1.05166	-0.0045254	0.42776
9.5	-11.1405	1.02174	-0.0043311	0.43593
10.0	-11.0380	0.97135	-0.0039981	0.45932
10.5	-10.8286	0.89589	-0.0034814	0.50101
11.0	-10.4917	0.81239	-0.0029050	0.54781
11.5	-10.0065	0.74134	-0.0024167	0.58409
Girls				
8.5	-2.20728	1.01018	-0.009999	0.32105
9.0	-1.87098	0.96020	-0.009044	0.33291
9.5	-1.06330	0.89989	-0.008171	0.35025
10.0	0.33468	0.82771	-0.007397	0.37312
10.5	1.97366	0.74213	-0.006739	0.40161
11.0	3.50436	0.67173	-0.006136	0.42042
11.5	4.57747	0.64150	-0.005518	0.41686

2) Maturity Offset

An important indicator of somatic maturation is the age at peak height velocity (PHV), which can only be directly assessed from serial measurements of the child throughout adolescence. Age at PHV is a commonly used indicator of somatic maturity and is an accurate benchmark of maximum velocity of growth during adolescence. A method has been developed to predict years from peak height velocity, or the maturity offset (Mirwald et al., 2002).

The following prediction equations will be used in the prediction models for boys and girls in ISCOLE.

Boys:

Maturity Offset = - 9.236
+ 0.0002708 (Leg Length (cm) X Sitting Height (cm))
- 0.001663 (Age (y) and Leg Length (cm))
+ 0.007216 (Age (y) X Sitting Height (cm))
+ 0.02292 (Weight (kg) / Height (cm) X 100)

Girls:

Maturity Offset = -9.376
+ 0.0001882 (Leg Length (cm) X Sitting Height (cm))
+ 0.0022 (Age (y) X Leg Length (cm))
+ 0.005841 (Age (y) X Sitting Height (cm))
- 0.002658 (Age (y) X Weight (kg)
+ 0.07693 (Weight (kg) / Height (cm) X 100)

APPENDIX Q: Map of Nairobi County

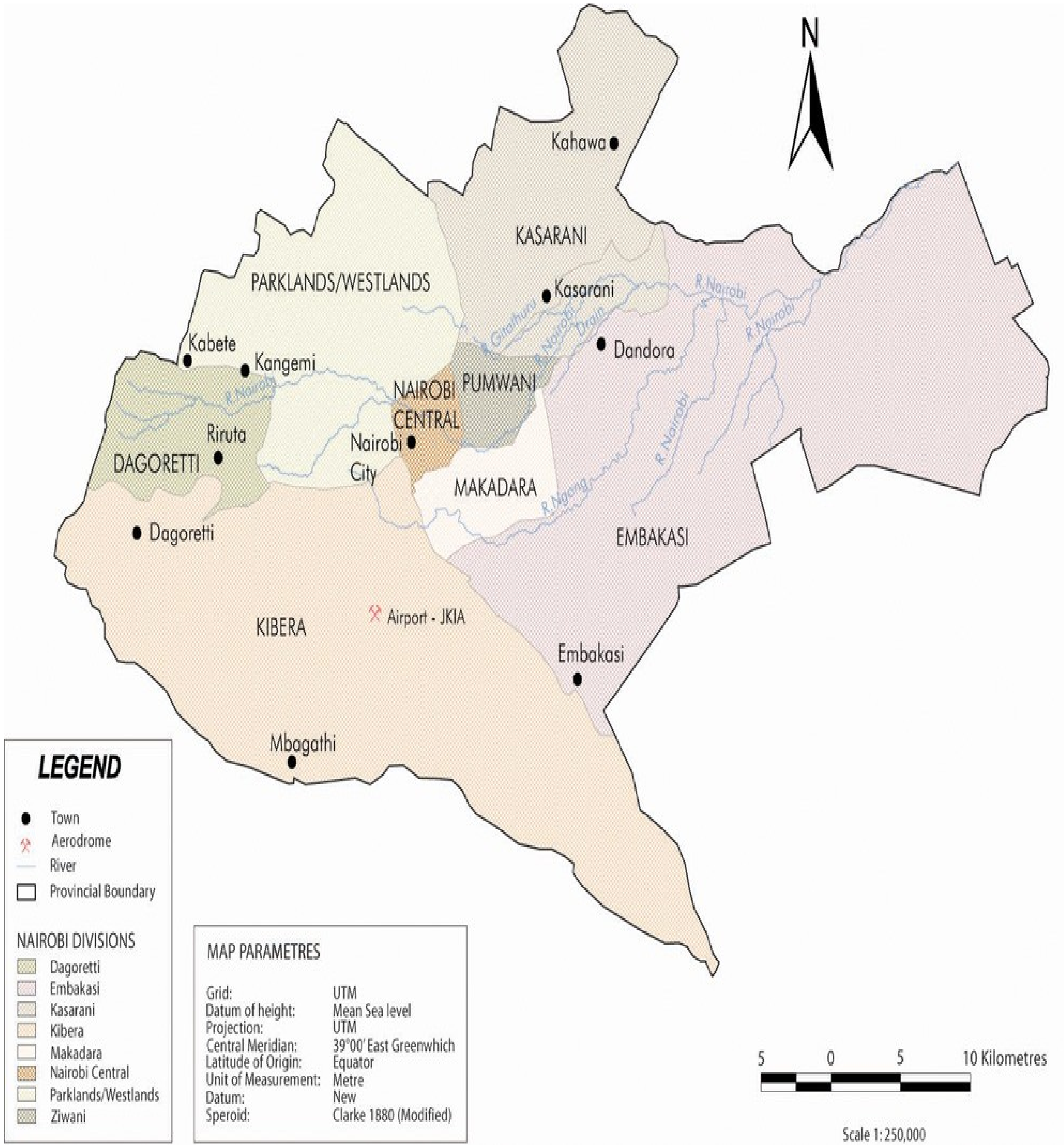

Figure A4: Map of Nairobi County and its eight divisions.
Source: www.unep.org/.../NairobiAdministrative-map.jpg