THE POTENTIAL ROLE OF NUTRITION EDUCATION IN REDUCTION OF OVERWEIGHT AND THE ASSOCIATED RISK FACTORS AMONG SCHOOL CHILDREN (9-14 YEARS) IN NAIROBI, KENYA

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A thesis submitted in fulfilment of the requirement for the Degree of Doctor of Philosophy in Applied Human Nutrition in the Department of Food Science, Nutrition and Technology, University of Nairobi

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DECLARATION

I, Florence Mumbi Muthiani Kyallo, hereby declare that this thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

To my lovely baby boy, the late **Kyalli** (1999-2001) and my beloved father, the late **Joseph Kwinga** (1939-2006), I treasure all the memories.

To my loving sons, **Kyalle and Kito.** only you could give that unique support.

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ABBREVIATIONS AND ACRONYMS

BAZ:	BMI-for-Age z-Score
BMI:	Body Mass Index
CG:	Control Group
CVD:	Cardiovascular Diseases
DVD:	Digital Versatile Disk
GOK:	Government of Kenya
HDL-C:	High Density Lipoprotein Cholesterol
HPA:	Heavy Physical Activities
IASO:	The International Association for the Study of Obesity
IDF:	International Diabetic Federation
IEC:	Information Education Communication
IG:	Intervention Group
IOTF:	International Obesity Task Force
KDHS:	Kenya Demographic and Health Survey
KNH:	Kenyatta National Hospital
LDL:	Low Density Lipoprotein cholesterol
MIPA:	Moderate Intensity Physical Activities
MUAC:	Mid Upper Arm Circumference
NCD:	Non Communicable Diseases
NCHS:	National Center for Health Statistics
Overweight:	BMI-for-age ≥+1SD (Combined overweight and obesity)
PA:	Physical Activity

SA:	Sedentary Activities
SCN:	Standing Committee on Nutrition
SD:	Standard Deviation
SPSS:	Statistical Package for Social Scientists
TB:	Tuberculosis
TSFT:	Triceps Skinfold Thickness
TV:	Television
VIPA:	Vigorous Intensity Physical Activity
WC:	Waist Circumference
WHO:	World Health Organization

DEFINITION OF TERMS

Bhajia:	Deep fried spiced potato chips
Githeri:	A mixture of boiled maize and beans
Maandazi:	Dough pastries (deep fried)
Mala:	Fermented milk
Overweight:	BMI-for-age Z-score (BAZ) ≥+1SD (overweight plus obesity)
Ugali:	A thick gruel made from cereal flour and water
Thinness:	BAZ<-2SD

ABSTRACT

Obesity among children is increasing at an alarming rate worldwide. With research linking both childhood malnutrition and obesity to increased risk of morbidity and mortality in adulthood, more attention is now shifting to addressing the pandemic among children so as to alleviate the generational calamity in the future. This study investigated the prevalence of overweight, the associated risk factors and the potential of nutrition education as an intervention among school children aged 9-14 years attending private and public schools in Nairobi. From two randomly selected divisions, four schools, two public and two private, were randomly selected for inclusion in the study. At baseline, nutrition status of the children was determined using anthropometric indices. Dietary practices were assessed using the 24 hour dietary intake recall method. Socio-demographic characteristics and physical activity were collected using a pre-tested questionnaire. One public and one public school were randomly allocated into two study groups, an intervention (IG) and a control group (CG). Pupils in the IG received a nutrition education package while those in the CG did not receive the intervention. The children were followed up for eleven months (3 school terms) and assessments were carried out at the end of every school term. Data were analysed using WHO AnthroPlus, OpenEpi and SPSS version 17.0. Descriptive statistics were used to describe characteristics of the study children while inferential statistics were used to establish differences in various variables between the control and intervention groups, and relationships between selected variables and overweight. Chi-square tests and Odds Ratio (OR), were used to test relationships between categorical variables. T-tests and Mann-Whitney U tests were used to compare continuous variables with normal distribution and those without normal distribution, respectively. The Wilcoxon test was used to compare trends in anthropometric characteristics throughout the study. A p value <0.05 was considered significant. Out of 344 study children, 40.4% were from private schools and 52.3% were female. The mean age of the children was 12.0±0.84 years, with 79.9% within age 11-12 years. The prevalence of obesity was 5.9%, while combined overweight and obesity was 19.0%, with prevalence in private schools significantly higher (29.0%) than public schools (11.5%). Prevalence was highest among girls in private schools (30.9%), followed by boys in private schools (27.1%). Socio-demographic and economic factors found to be positively associated with overweight included being in a private school, not having siblings, mother's occupation, type of residence, access to a family computer with computer games, having a personal cell phone, number of cell phones, use of motorised transport to and from school and time spent on sedentary activities after school. Dietary factors included consumption of margarine, white bread, *githeri* and sugar sweetened black tea/coffee. On the other hand, factors found to be negatively associated with overweight included having physical education (PE) scheduled in the class timetable, participation in physical education, active commuting to and from school, having family meals and receiving food rewards, consumption of vegetables, cake, *maandazi* and eggs. The predictors of overweight included being in a private school, having a self-employed mother, being a single child, having access to a family mobile phone and not having family meals. The intervention resulted in significant increase in participation in physical education (PE) and swimming, decrease in consumption of white bread, *maandazi* and crisps and an increase in consumption of wholemeal bread and fruits

($p<0.05$), but no significant decrease in overweight. In conclusion, the overweight rate in the study group is of public health concern. The school curriculum should be revised to include compulsory participation of all children in physical education. Advocacy among parents is needed so that the benefits of increased physical activity in school are complimented by active lifestyles and healthy diets at home.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Food and nutrition-related issues in developing countries have for a long time focussed on inadequate food intake, specific nutrient deficiencies and food insecurity. Once regarded as unique to developed countries, overweight and obesity are now prevalent in both developed and developing countries. In 2006, the World Health Organization (WHO) estimated that worldwide, over 1.6 billion adults were overweight and 400 million were obese (WHO, 2006), raising concern about the associated health risks, especially chronic diseases. Chronic diseases account for approximately 60% of all deaths worldwide, with nearly 70% of these occurring in developing countries (WHO, 2003b). Over 155 million school-aged children are overweight (Lobstein *et al.*, 2004) and more than 22 million pre-school children (17 million of them in developing countries) are overweight or obese, (WHO and IDF, 2004; WHO, 2006).

Although undernutrition, micronutrient deficiencies and infectious diseases continue to challenge public health in developing countries, there is increasing concern about diet and lifestyle related chronic diseases, especially among urban populations and in countries undergoing the nutrition transition. Developing countries now have overweight and underweight co-existing in the same country, community or even household (Garrett and Ruel, 2005; James, 2005; Caballero, 2005; Mendez *et al.*, 2005; Barquera *et al.*, 2007). They are now confronted with the double burden of malnutrition (undernutrition and overnutrition) and related diseases (WHO, 2000b; SCN, 2005; SCN, 2006).

In 1994, Popkin raised concerns about the nutrition transition in developing countries (Popkin, 1994). This transition is characterised by a shift from traditional diets and lifestyles to Western diets (high in saturated fats, sugar and refined cereal foods), combined with reduced levels of physical activity and increased stress, particularly in the rapidly growing urban populations In 2002, WHO attributed the sudden rise in obesity to changes in environmental factors that include dietary changes such as increased consumption of fat, especially saturated fat, and refined carbohydrate rich foods (WHO, 2002). This shift to energy dense foods is combined with decreased energy expenditure resulting from sedentary lifestyles (less labour intensive tasks both at home and at the work place, motorized transport, and physically undemanding recreation), to dispose one to overweight.

Worldwide, the rise in obesity among children is equally alarming. It is estimated that 10% of the children aged 5-19 years have excess body fat (are either overweight or obese). Of these, 2.5% are obese (Lobstein *et al.*, 2004). While prevalence of excess body fat among children (as in other population groups) is notably higher in developed countries, the increase in some developing countries is almost at par with some developed nations. For example, while an extra 1% of children and adolescents in some European countries, Canada and Australia became overweight or obese annually in the 1990s, the increase in Brazil (a developing country) was 0.5% in the same period. This rate of increase was similar to that of USA, a developed country (Lobstein *et al.*, 2004).

Overweight and obesity increase the risk of chronic diseases such as cardiovascular diseases, cancer and Type 2 diabetes. They also generally increase the risk of morbidity and mortality (Loke, 2002; Weiss *et al.*, 2004; Labbok, 2005; Stein *et al.*, 2005; Wayne, 2006; McMillan *et al.*, 2006; Vona-Davis *et al.*, 2007). Non-communicable Diseases (NCDs), majority of them nutrition related, account for 60% of all premature deaths worldwide, 66% of which occur in developing countries. In the latter, they account for 47% of all deaths (WHO, 2002; WHO, 2005). In 2004, WHO estimated that 2.6 million people died annually as a result of obesity and overweight-related complications, while an additional 4.4 million and 7.1 million died as a result of raised total cholesterol levels and high blood pressure, respectively (WHO, 2005). Both conditions are associated with excess body fat. Thus together, overweight, high cholesterol and high blood pressure (all diet-related conditions) accounted for 14.1 million deaths. This is exclusive of deaths due to other diet-related condition such as Type 2 diabetes. As part of the international response to this growing threat, the International Diabetes Federation, Africa Region, launched the Diabetes Declaration and Strategy for Africa, in December 2006 at the 19th World Diabetes Congress in Cape Town, whose purpose was to increase awareness about diabetes and improve care.

Overweight during childhood increases the risk of early onset of obesity-related chronic diseases and complications. For instance, there is evidence that 10% of young people with Type 2 diabetes develop renal failure in early adulthood (Dean and Flett, 2002). This reduces the productivity of these individuals at their prime years, increases hospitalizations, may imply lifelong dialysis and a significant fall in life expectancy. In

addition to health complications associated with obesity, obese individuals experience stigmatization and prejudice from the rest of the population (Puhl and Brownell, 2003).

It is therefore evident that overweight and obesity impose an additional economic and health burden on households, communities and societies in general, further straining already struggling economies of low income countries.

There is inadequate reporting on obesity in developing countries, leading to inadequate data for comparison purposes (Nishida and Mucavele, 2005; Lobstein *et al.*, 2004). Inadequate data on overweight in children may wrongly be interpreted to mean that overweight is not a problem in sub-Saharan Africa. The fact that national demographic and health surveys (DHS) in Africa rarely include data on obesity in children has contributed to this misconception.

Like other countries in sub-Saharan Africa, data on prevalence of overweight in Kenya, especially among children, is scarce. Nationwide and smaller surveys carried out in the past have mainly focused on under nutrition and micronutrient deficiencies (GOK, 1994; GOK, 1998; Mwaniki *et al.*, 2001; GOK, 2004; GOK, 2010), possibly because these are viewed as more pressing issues. However, changing lifestyles in urban areas, coupled with the rapid proliferation of supermarkets (especially in residential neighbourhoods), fast food outlets, adaptation of western lifestyles including consumption of refined foods and deep fried foods in place of traditional complex carbohydrate foods, and the increased participation of women in the workforce has posed a new challenge, namely

over-nutrition. Alongside this is the adaptation of sedentary lifestyles, fuelled by increased use of motorised transport, and access to sedentary recreation gadgets and equipment.

1.2 Problem Statement

Chronic and diet-related diseases are on the increase in Kenya (Jablonski-Cohen *et al.*, 2003; Daily Nation, 2007). A cardiologists' conference held in Nairobi in 2007 drew attention to increase in obesity, heart disease and other lifestyle diseases in the general population in Kenya. According to the Ministry of Health in Kenya, an estimated 1.2 million Kenyans live with diabetes, and if the trend continues, by 2025 that number is expected to rise to 1.5 million (4.5% of the population) (Daily Nation, 2007).

Children in Kenya have not been spared by this problem. In 1993, 10.2% of under-fives (12-59 months) in Kenya were overweight and an additional 2.0% were obese (Martorell *et al.*, 2002a). By 2003, the rate of overweight (BMI-for Age Z-score>+2SD) among under-fives had increased to18% (Gewa, 2009). According to the 2008-2009 Kenya Demographic Health Survey (KDHS), the prevalence of overweight (Weight-for-height Z-score SD>+2) was 4.7% (GOK, 2010). Similarly, obesity rates among women increased from 13.8% in 1993 (GOK, 1994) to 23.4% in 2003 (GOK, 2004) and to 25.1% in 2008 (GOK, 2010). While overweight and obesity among women and under-fives in Kenya is documented, data on school-aged children is scarce. However, at health facilities like the Kenyatta National Hospital Diabetes Clinic, more and more children are seeking treatment for diabetes, some as young as three years (KNH Diabetic Clinic,

November 2007: personal communication). This suggests that the consequences of obesity and overweight may already be present in children, despite the lack of data on the same.

There are no known deliberate efforts in Kenya to intervene on overweight among school children and in the general population. Under the Ministries of Health (Public Health and Sanitation and Medical Services), nutrition education is routinely availed to pregnant and lactating mothers during pre- and post-natal clinics. However, such education focuses almost exclusively on adequate feeding of pregnant/lactating mothers and young children. In the case of obesity, nutrition maybe provided at the clinical level only to patients presenting with chronic conditions such as diabetes and hypertension.

This study therefore investigated the extent of overweight and obesity among school children, associated risk factors and the potential of school based nutrition education interventions in reducing the prevalence and risk factors.

1.3 Justification

Overweight and obesity in childhood are known to have significant impact on both physical and psychosocial health. *Hyperlipidaemia*, hypertension and abnormal glucose tolerance are more frequent among obese children and adolescents (Freedman *et al.*, 1999a; Dhuper *et al.*, 2011).

Despite the serious health and social consequences of childhood obesity and the overwhelming evidence that it is becoming a public health problem worldwide, there is inadequate reporting on it in Kenya. Overweight has serious health, social, emotional consequences and increases a child's risk of disability and premature death (Must *et al.*, 1992; WHO, 2003; Lobstein *et al.*, 2004).

The factors that promote development of obesity are present in Nairobi. Residents are exposed to motorised transport, increased sedentary recreation (televisions, computers, video and computer and mobile games), supermarkets, pocket money, mothers engaged in full time income earning activities, advertising of energy dense foods and more use of restaurants and fast food outlets, all of which are obesity related environmental factors (Ebbeling *et al.*, 2002; Lobstein *et al.*, 2004). Residents are also more exposed to western diets and lifestyles. It is therefore important to investigate the nutritional status of children in Nairobi in relation to this 'obesogenic' exposure.

Halting the rising prevalence of obesity in children is considered to be a public health priority and it is acknowledged that prevention must rely on modification of diet and activity patterns. Schools are a reliable setting for implementing interventions to prevent and manage overweight in children (Lobstein *et al.*, 2004; Anderson, 2005; Doak *et al.*, 2006; Brown *et al.*, 2007), given that children spend a lot of time in school. The school also allows for utilization of existing organizational, community and social structures to even reach mothers and the community at large. In addition a large proportion of children in the population are reached (Lobstein *et al.*, 2004). Because of the challenges in treating

overweight, the International Obesity Task Force (IOTF) considers prevention of excessive weight gain as the only feasible solution (Lobstein *et al.*, 2004). Preventing overweight requires understanding and addressing the 'obesogenic environment' in which children live. Environmental factors take precedence in prevention efforts because they are the most modifiable (Kelishadi *et al.*, 2003). Interventions should aim to modify risk behaviours in non-overweight or obese children as well as those who are already overweight or obese. Thus, the identification of factors that are associated with overweight in adolescents is important, because it could help prioritize areas for intervention, including developing educational messages and preventive programmes targeting such factors, to potentially reduce overweight and associated health concerns in young persons.

The results of this study will be useful to government and other stakeholders in designing interventions and strategies to address the challenge of overweight among school children.

1.4 Objectives

1.4.1 Main objective

The main objective of study was to assess the potential role of effect of nutrition education in reduction of overweight and the associated risk factors among school children in Nairobi.

1.4.2 Specific objectives

1.4.2.1 To determine the prevalence of overweight among school-going children in Nairobi

1.4.2.2 To determine the socio-demographic and economic indices of the study children

1.4.2.3 To determine the dietary practices and food consumption patterns of the study children

1.4.2.4 To determine the physical activity patterns of the study children

1.4.2.5 To determine the potential of school based nutrition education on the prevalence of and the risk factors for overweight among school-going children in Nairobi

1.5 Hypotheses

1.5.1 Prevalence of overweight among school children in Nairobi is too low to be of public health concern.

1.5.2 Socio-demographic and economic factors, physical activity patterns and diet are not significant risk factors for overweight among school children in Nairobi.

1.5.3 School-based nutrition education has no significant effect on prevalence of and risk factors for overweight among school children in Nairobi.

CHAPTER TWO: LITERATURE REVIEW

2.1 Definition of obesity

WHO defines overweight and obesity as abnormal or excessive fat accumulation that may impair health (WHO, 2006). Among adults, overweight is defined as a BMI greater than 24.9 kg/m^2 while obesity is defined as BMI >30 kg/m^2. Among children and adolescents (5-19 years), overweight is defined as BMI-for age Z-score >+1SD above the WHO growth standard median (equivalent to BMI 25 kg/m^2 at 19 years) while obesity is defined as BMI-for age Z-score >+2SD above the WHO growth standard median (equivalent to BMI 30 kg/m^2 at 19 years) (www.who.int/growthref/en/)

2.2 Prevalence and Trends of Overweight and Obesity

2.2.1 Adult Overweight

Over 1.6 billion adults are overweight and at least 400 million of them are clinically obese worldwide (WHO, 2006). WHO further estimates that by the year 2015, 2.3 billion adults will be overweight and another 700 million will be obese. Trend studies have shown that overweight are on the increase worldwide (Lee *et al.,* 2009; Rguibi and Belahsen, 2007; Lobstein *et al.,* 2004). Although previously assumed to be a problem only in developed countries, developing countries have not been spared by adult overweight and obesity. According to the WHO and researchers, obesity has been reported in developing countries (WHO, 1997; Martorell *et al.,* 2000b; Prentice, 2006; van der Merwe and Pepper, 2006; Villamor *et al.,* 2006), even among low-income communities (Hawkes *et al.,* 2005). In Africa, obesity prevalence rates range from 0.6% among Ghanaian males to 33% among Egyptian female population (Nishida and Mucavele, 2005). The prevalence of obesity among women in Egypt (33%) is higher than

that of women in the US (20.7%) (Martorell *et al.*, 2000b). Mendez *et al.* (2005) analysed nationally representative data from 36 developing countries collected between 1992 and 2000 and reported that the prevalence of overweight (BMI >25kg/m²) among urban women ranged from 10.3% in Madagascar to 70% in Egypt.

Like in developed countries, obesity in developing countries has increased dramatically in the recent past. In Tanzania, obesity among women increased from 3.6% in 1995 to 9.1% in 2004 (Villamor *et al.*, 2006), while in Morocco, the prevalence increased from 4.1% in 1984/85 to 10.3% in 1998/1999 (Rguibi and Blahsen, 2007). In rural Mexico, the prevalence increased by 78% between 1980 and 1998. This is mainly attributed to increased adaptation of western diets and increased sedentary lifestyle, factors that are more prevalent in urban areas.

2.2.2 Childhood Overweight

Worldwide, at least 20 million children under the age of five years are overweight (WHO, 2006). According to the IOTF, at least 155 million school children worldwide are overweight or obese (Lobstein *et al.*, 2004). It is evident that overweight and obesity among children in Africa is also high as shown in Table 1. In a recent review by Wang and Lobstein (2006), it was found that children in developing countries living in urban areas, and exposed to the Western lifestyle, face a significant and rapidly growing epidemic of obesity. There is also evidence that some developing countries have higher prevalence rates of childhood obesity than developed countries.

Table 1: Prevalence of childhood overweight in selected African countries

Country	Age (years)	Criteria	Sex	Prevalence of overweight (%)	Source
Kenya	12-18	Normalised NCHS	Female	0.6	Leenstra *et al.* 2005
Kenya	3-5 years	WHO	All	18.0	Gewa (2009)
Kenya	9-13 years	IOTF	Male	6.8	Adamo *et al.* (2010)
			Female	16.7	
South Africa	13-19 years	IOTF	All	17.0	Medical Research Council (2002)
Nigeria	12-18 years	IOTF	All	3.6	Ben-Bassey *et al.* (2007)
Mozambique	6-18 years	WHO	Male	4.8	Prista *et al.* (2003)
			Females	7.7	
Morocco	<5 years	NCHS	All	9.2	Rguibi and Belahsen (2007)

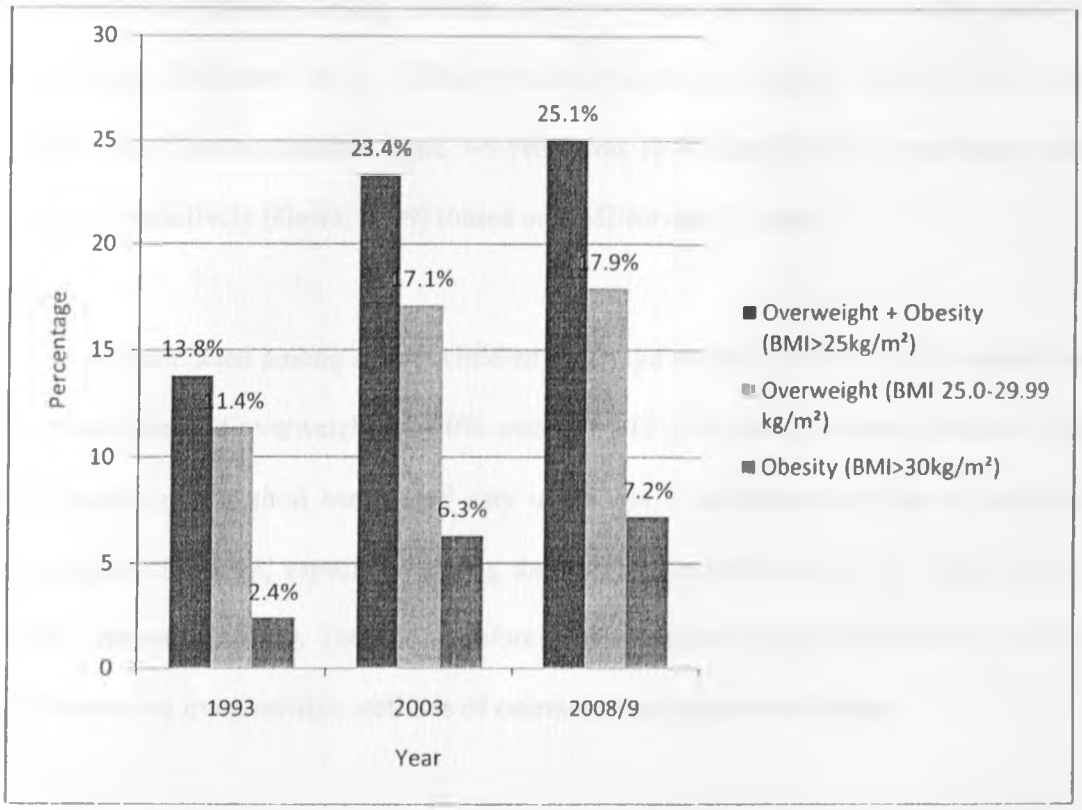
In 1995, the prevalence of childhood obesity (>5 years) in the U.S.A (4.5%) was almost at par with that of Zimbabwe (4.2%), but lower than in some other African countries such as Egypt (8.6%), Algeria (9.2%), Malawi (6.7%) and South Africa (6.7%), (Lobstein *et al.*, 2004). Martorell *et al.* (2000a) reported a prevalence of childhood obesity >20% among children in Egypt, Morocco, Peru and Uzbekistan in 1998, compared to 16% among children in United States.

Prevalence of childhood obesity is on the increase in developing countries. According to data analyzed in 2000 based on the WHO Global Data Base on Child Growth and Malnutrition, out of a total of 94 developing countries, twenty one had preschool (<5 years) overweight (defined as weight-for-height >+2SD) prevalence of more than 5% and sixteen countries showed a rising trend between 1985 and 1998 (de Onis and Blössner,

2000). In Thailand, the prevalence of obesity among 5-12 year old children rose from 12.2% to 15.6% in just over two years.

2.2.3 Overweight in Kenya

In Kenya, prevalence of obesity (BMI>30kg/m²) among women tripled between 1993 (2.4%) and 2008-9 (7.2%), while overweight (BMI 25.0-29.99kg/m²) increased from 11.4% to 17.9% in the same period (Figure 1) (GOK, 1994; GOK, 2004; GOK, 2010). Among urban women, the prevalence of obesity increased from 5.4% to 12.1% during this period, with 40% of them being overweight or obese (BMI>25kg/m²) in 2008-9



Source: GOK, 1994; Martorell et al., 2000b; GOK, 2004; GOK, 2010
Figure 1: Trends in maternal overweight and obesity in Kenya 1993-2009

(GOK, 2010). It is thus evident that maternal overweight is increasing in Kenya. Given that parental obesity is the most important risk factor for childhood obesity (Treuth *et al.*, 2003; Bogaert *et al.*, 2003; Benton, 2004; Li *et al.*, 2007), prevalence rates among other vulnerable groups, including children and adolescents, should be investigated.

Data on prevalence of overweight among school children in Kenya is scarce, with national nutrition surveys traditionally excluding data on school children. The main focus has been wasting, stunting, and underweight levels among 0-5 year olds, probably because it was assumed that over-nutrition was non-existent. In 1993, prevalence of overweight and obesity among children aged 1-5 years in Kenya was 10.2% and 2.05 respectively (Martorell *et al.*, 2000a) (NCHS weight for height) while in 2003, the prevalence of among children aged 3-5 years was 18.0% and 4.0% for overweight and obesity, respectively (Gewa, 2009) (based on BMI-for-age Z score).

A survey conducted among school children in Kenya in 2003 (WHO, 2003a) reported a prevalence rate of overweight of 9.0% among 13-15 year olds. However, this data was self-reporting, a method considered very unreliable in anthropometry due to incorrect perception of weight, especially among the overweight (Genovesi *et al.*, 2005; WHO, 2000b; Sweeting, 2007). There is therefore need to assess the prevalence among school children using more reliable methods of assessment and current indicators.

2.3 Consequences of Overweight and Obesity in Childhood

Childhood overweight has serious consequences on health and psychosocial well being. Various studies have reported that childhood obesity is likely to persist into adolescence and adulthood (Freedman *et al.*, 2001; Shumei *et al.*, 2002; Loke, 2002). Overweight and obese children are also at increased risk of chronic diseases (Freedman *et al.*, 1999a; Dhuper *et al.*, 2011) including elevated lipid profile, insulin resistance and hyperinsulinemia. In the long term, overweight/obese children have increased risk of cardiovascular disease, diabetes Type 2, gall bladder disease, hypertension and osteoarthritis in adulthood. Sinha *et al.*, (2002) found a high prevalence of impaired glucose tolerance among obese children and adolescents. Among Chinese children aged 7-15 years, the relative risk of hypertension was 2.96 and 4.85 for overweight and obesity, respectively (Chen, 2008). In addition, childhood obesity tends to predict adult obesity. Overweight children are likely to become obese adults (Whitaker *et al.*,1997; Wright *et al.*, 2001; Guo *et al.*, 2002) facing increased risk of morbidity in later life. Interventions during childhood are therefore preventive of both childhood obesity and adult obesity. In addition, obese children and adolescents may encounter prejudice and discrimination, which often begins from an early age (Loke, 2002). Body image dissatisfaction is also common among obese adolescents, as is depressive disorder.

The economic consequences of childhood obesity are significant, and include the high cost of treatment of co-morbidities associated with obesity and loss of employment among others. In a literature review of medical care burden of obesity, Thomson and Wolf (2001) found that the percentage of national health expenditures attributable to

obesity ranged from 2.0% in Australia to 7.0% in the USA. The WHO (2000a) lists the following as the costs of obesity:

(a) Direct costs: health care resources for the management of obesity and related illness

(b) Indirect costs: loss of economic activity due to illness and premature deaths associated with obesity

(c) Intangible costs: social and personal loss associated with obesity and its related illnesses.

2.4 Methods of Measuring Overweight and Obesity in Children

Body Mass Index (BMI): The consensus among obesity researchers is that BMI is significantly related to relative fatness in childhood and adolescence, and is the most convenient way of measuring relative adiposity. BMI, which is a measure of body mass relative to height, has emerged as the most practical, universally applicable, inexpensive and non-invasive anthropometric indicator for classifying overweight and obesity. However, BMI in children varies with age, rising during the first year of life, then falling during the second and sixth year and rising again after the sixth year. The BMI z-score is therefore an essential adjustment made for both age and sex in order to allow valid comparison between individual time points or between studies. Increased BMI-for-age in childhood and adolescence is associated with higher percentages of body fat (Neovious *et al.*, 2004; Zimmermann *et al,* 2004; Freedman *et al.*, 2005) and known risk factors for cardiovascular disease (Williams *et al., 1992*). Earlier studies have used the age and sex specific cut-offs that were recommended by the IOTF (Cole *et al.*, 2000). In 2007, the

WHO released BMI-for-age Z-scores (BAZ) for use among children aged 5-19 years. Children are categorised as severely thin (BAZ <-3SD), thin (-3SD>BAZ<-2SD), normal (-2SD>BAZ<1SD), overweight (1SD>BAZ<2SD) and obese (BAZ>2SD). In this study, nutrition status was determined using the WHO reference 2007 for school-age children and adolescents, which provide a suitable reference for the 5 to 19 years age group and is recommended by the WHO for both clinical and epidemiological use (Lobstein *et al.*, 2004; de Onis and Lobstein, 2010). These curves are closely aligned with the WHO Child Growth Standards at 5 years, and the recommended adult cut-offs for overweight and obesity at 19 years (BMI of 25 and 30, respectively).

Waist circumference: Waist circumference is a measure of central or visceral obesity. It is useful in predicting health risks in children just as it is among adults (Wang, 2006). In addition, waist circumference and serum triacylglycerol concentrations are highly correlated in children of homogeneous background (Freedman *et al.*, 1999b; Wang, 2006). Waist circumference is also a convenient, non- intrusive and simple measure which is unrelated to height, correlates closely with BMI and is an approximate index of intra-abdominal fat mass and total body fat (WHO, 2004). The measurement of waist circumference therefore further informs on health risks in children.

Skinfold thickness: Just like waist circumference, skinfold thickness is a relatively easy and fast measure which estimates both subcutaneous fat and total body fat. Subcutaneous fat may be taken as an indicator of total fat (Sweeting, 2007) and therefore of overweight. Both waist circumference and triceps skinfolds are useful measurements in identifying

pre-pubertal children with higher cardiovascular risk (Maffesis *et al.*, 2001). In addition, measurement of skinfold thickness is useful in monitoring effectiveness of interventions (Lobstein *et al.*, 2004). In this study, triceps skinfold thickness was used to estimate subcutaneous fat.

2.5 Risk Factors for Overweight and Obesity

The primary cause of overweight is related to energy imbalance, where energy intake exceeds energy expenditure. However, environmental factors also play a big role in adiposity. Family factors, including environmental and genetic factors, are also known to contribute to the development of obesity (Li *et al.*, 2007; Vandewater and Huang, 2006; Veugelers and Fitzgerald, 2005; Bogaert *et al.*, 2003; Benton, 2004; Treuth *et al.*, 2003). Parents confer both genetic makeup and environmental influence to their children. In a study in China, Li *et al.* (2007) showed a prevalence rate of childhood overweight of 6.9% among children with at least one overweight parent and a prevalence of 39.1% among those with two obese parents, with the prevalence increasing with parental weight. Similarly, Treuth *et al.*, (2003) found that fat mass and percent body fat increased with parental body weight status among non-obese girls. While there is a strong genetic similarity between members of the same family (Jacobson and Rowe, 1999) which accounts for 45-70% of the variations in body mass index, the shared family environment also contributes to the similarities in weight status among family members. Family circumstances influence the diet, sedentary activities and physical activity of the individuals. These include the number of siblings, birth order, the marital status and the socio-economic status of parent(s) among others.

2.5.1 Genetic factors

Familial genetic makeup is an important factor in the aetiology of obesity. There is evidence that adiposity in preadolescent children born since the onset of the obesity epidemic is highly heritable. Twins tend to show similar weight gain patterns, including accumulating fat in the same body parts (Wardlaw and Kessel, 2002). Studies of adopted children have shown that despite separation, children show closer similarity in body composition to their biological parents compared to the adoptive parents. It is thought that genetic heritability of obesity approximates 25-40 % (Williams, 2005) and may be as high as 77% in twin studies (Wardle, 2005).

Parental obesity is the most important risk factor for childhood obesity (Treuth *et al.*, 2003; Bogaert *et al.*, 2003; Benton, 2004; Li *et al.*, 2007). In a study done in China, prevalence of overweight among children with one overweight parent was 3.9% compared with 39.1% among those with both parents being obese (Li *et al.*, 2007). In the USA, Vandewater and Huang (2006) found that having at least one obese parent increased the risk of child overweight among children aged 6-19 years. Similar findings were reported by Treuth *et al.* (2003) among non-obese pre-pubertal girls who were followed up for two years. Weight gain among girls with two obese parents was double that among girls with two lean parents.

However, there is a consensus that the period over which the global prevalence of obesity has increased substantially is too short for there to have been significant genetic changes

within populations (WHO, 2000b; Peters, 2002; Lobstein *et al.*, 2004; Williams, 2005). There is a general consensus that the marked increase in obesity worldwide appears to be attributable to changing environmental and lifestyle factors. It is in this view that this study focuses on environmental factors rather than genetic factors.

2.5.2 Socio-economic status

Indicators used to estimate socio-economic status include education level, occupation and income of one or more parent and in some cases residence (Law *et al.*, 2007). In developed countries, obesity prevalence decreases with improved socio-economic status (Strauss and Knight, 1999; Lobstein and Frelut, 2003; Lobstein *et al.*, 2004), while in developing countries, it increases with improvement in socio-economic status. Martorell *et al.*, (2000a) showed that obesity among pre-school children is more prevalent among pre-school children whose mothers have higher education status. Several KDHSs have also reported higher rates of overweight among women of higher wealth quartile compared to those in the lower quartile (GOK, 2004; GOK, 2010). Higher socio-economic status may be associated with consumption of energy dense foods including refined foods, foods high in fat, soft drinks, and reduced intake of fruits and vegetables, increased sedentary transportation and recreation (Lobstein and Frelut, 2003). Education and occupation of parents have also been investigated in relation to overweight.

2.5.3 Family factors

The family environment and parental influence have a bearing on factors related to diet and physical activity, and subsequently to obesity. Family food patterns influence quality

of food. Increased frequency of consumption of restaurant and fast foods is associated with increased weight gain mainly because restaurant foods are more energy dense and their portions tend to be larger than home meals (Pereira *et al.*, 2005; Stender *et al.*, 2007). Children consume more energy when more meals are eaten in restaurants than at home (Binkley *et al.*, 2000). Presence of a television set in a bed room increases viewing by 38 minutes per day, a scenario attributed to the increased inactivity and the possibility of taking snacks while watching television (Wiecha *et al.*, 2001). Similarly, recreational eating patterns encourage consumption of high fat and high calorie foods. In addition, social support from parents correlates strongly with participation of children and adolescents in physical activity (Fereirra *et al.*, 2006).

2.5.4 Cultural factors

Historically, a fat individual was considered healthy and able to survive food shortages and infection (Haslam, 2007). Adult studies show cross-cultural differences in attitudes towards weight, body shape and attractiveness, with studies showing African and Latin Americans having less preference for thinness and more acceptance for larger body proportions (Swami *et al.*, 2007). This may also apply to children, where some parents may perceive otherwise overweight/obese children as being healthy.

2.5.5 Dietary factors

Energy-dense diets can undermine appetite regulation in humans (Prentice and Jebb, 2003). In their study on healthy lean young men, Prentice and Jebb reported that subjects spontaneously ingested more energy and deposited more fat in adipose tissue (65g per

day) when consuming a more energy dense diet. In contrast, body fat was shed when the subjects were put on a low-energy diet.

Over consumption of fat in the diet is believed to be an important predictor of weight gain, mainly because fat is metabolised efficiently (upto 96%) and its storage capacity in the body is unlimited. It is also thought to suppress satiety signals, thus leading to excess overall intake (WHO, 1997). Other studies show that obesity prevalence is positively associated with the proportion of energy intake from fat (Bray and Popkin, 1998). Several studies as reviewed by Mozaffarian *et al.* (2006) showed that consumption of trans-fatty acids raises levels of LDL-cholesterol, lowers levels of HDL-cholesterol and raises the ratio of total cholesterol to HDL-cholesterol. Guallar-Castillón *et al.* (2007) found that the prevalence of general and central obesity increased with increasing intake of energy from fried food, which are generally high in fat.

High glycemic index carbohydrate dense diets have also been linked to weight gain and obesity (Ludwig, 2000), though evidence is inadequate.

Portion size affects energy intake by up to 30% (Rolls *et al.*, 2002; Rolls, 2003). Increased portion sizes (combo meals) are often advertised in fast food outlets in Nairobi, a good example being the 'Bottomless Coke' promotion in Galitos in which for every one combo meal, a customer gets as many refills of coke as they wish. Others include the 'Wacky Wednesday' in Steers and 'Terrific Tuesday' in Pizza Inn. This aggressive advertisement implies availability of a ready market. Other dietary factors that are

associated with overweight in children include lunch pattern, frequency of eating family meals together at home and frequency of eating in front of the television (Veugelers and Fitzgerald, 2005).

2.5.6 Physical inactivity and sedentary recreation

When an individual's energy expenditure is less than energy intake, there is energy imbalance and ultimately weight gain. Physical activity has several health benefits in children, including bone health (Janz *et al.*, 2001). Studies have reported an association between increased physical activity and the development of obesity, with moderate to high levels of physical activity being associated with a reduced risk of overweight (van Baak, 1999; Saris *et al.*, 2003). In the review by Saris *et al.* (2003), decreased physical activity was associated with weight gain, while in China, Li *et al.* (2007) reported that overweight children spent less time on moderate/rigorous physical activity compared to normal weight children. In children, physical activity and inactivity is related to environmental and family factors including age, sex, maternal education, parental support, television/video viewing, participation in physical education (PE) in school and family income (Gordon-Larsen *et al.*, 2000). Studies have shown that time spent watching television is an indicator of an overall inactive lifestyle (Evenson & McGinn, 2005). Adult men and women watching more than 3 hours of television per day are twice as likely to be obese as those who watch less than 1 hour of television per day (Tucker & Friedman, 1989; Tucker & Bagwell, 1991).

2.6 Nutrition Education in the Prevention and Management of Overweight

Due to the increasing problem of overweight and the accompanying health complications, there are urgent calls for interventions to prevent and manage obesity and the related health complications. Schools are an important avenue for delivery of programmes targeted at children. This is because children spend many hours in school and the environment is already conducive to learning. In addition, such programmes utilize the existing infrastructure and are therefore cost effective. School-based interventions also have the potential for establishing healthy dietary and exercise patterns that may persist in adulthood and reduce risk of chronic disease.

Educational messages are effective in preventing and reducing prevalence of overweight (Doak *et al.,* 2006). School-based health and nutrition education involves the delivery of specific messages to children within the school. In obesity studies, such messages are aimed at reduced energy intake, increased intake of fibre and micronutrients mainly from fruits and vegetables and increased physical activity. These messages may be delivered in form of posters, pamphlets, classroom lectures, demonstrations and essay competitions. In most cases several of these maybe combined in the course of delivering the intervention. Research has shown that most school-based interventions aimed at obesity prevention and management are effective in achieving behaviour change, with the most modifiable behaviours being television watching and dietary habits (Kelishadi *et al.,* 2003; Sharma, 2006; Doak *et al.,* 2006). Despite this well documented success of school based interventions, schools in Kenya have not been adequately utilised as avenues for delivery of simple interventions to prevent development of obesity among children.

2.7 Theoretical Framework

Because overweight in childhood has been associated with stigmatization, bias and self-consciousness (Dietz, 1998; Loke, 2002; Puhl and Brownell, 2003; Lobstein *et al.*, 2004; Holm, 2007), a 'whole population approach' as recommended by Holm (2007) was used in the current study. This is a public health approach that seeks to reduce stigmatization of the overweight/obese in the community. Overweight/obese individuals usually experience stigmatization and may harbour feelings of low self-esteem and body dissatisfaction (Robinson *et al.*, 2001; Ozmen *et al.*, 2007; Maclean *et al.*, 2009). This intervention approach avoids targeting overweight and obese individuals only as this is likely to lead to more stigma. To avoid this, the intervention is delivered to all persons in a population irrespective of whether they are considered at risk or not. The approach aims to reduce intervention related stigma. In addition, this approach is preferred as opposed to a targeted approach because it aims to cultivate a culture of healthy lifestyle behaviours at a stage when children are developing their health-care habits (Greening *et al.*, 2011). Another advantage of this approach is that a reduction in prevalence of overweight will be preceded by behaviour change in the whole group, and not only the obese members.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study was conducted in Nairobi Province. At the time of the study, Nairobi was divided into eight (8) administrative divisions, namely: Dagoreti, Westlands, Langata, Embakasi, Kasarani, Kamukunji and Starehe. Nairobi was selected because it is an urban area, and more significantly, it represents the two extremes of socio-economic status, with abject poverty and opulence occurring almost in the same neighbourhoods. The factors favourable to increased intake of processed foods and energy dense foods (such as affinity to many fast food outlets, supermarkets), as well as factors contributing to sedentary lifestyles such as access to television, computer and motor vehicle transportation, are common. In addition, children from both low-socio-economic and high socio-economic backgrounds in Nairobi have exposure to these factors.

3.2 Study Design

The study was a controlled trial designed to test the effects of a nutrition education intervention on overweight and the associated risk factors among school going children in Nairobi. There was an intervention group consisting of children in two schools (one private and one public school) and a control group consisting of children in another two schools (one private and one public school). The study was conducted in two phases. In the first phase, a cross-sectional study was conducted to assess the socio-demographic factors, nutritional status, physical activity level, dietary practices and food consumption factors associated with overweight and obesity among the target group of children. This phase of the study also provided baseline data.

In the second phase, an intervention study comprising two study groups; an intervention group (IG) and a control group (CG) was conducted. The first group received an education package with specific messages targeted at the pupils. The second group was the control group and received no intervention. The children were followed up for one academic year (three school terms). The data collected during the follow-up study included anthropometry, dietary practices, food consumption and physical activity. Data was collected at the end of every school term (first after 3 months, then every 4 months).

3.3 Study Population

The study population consisted of 344 children aged 9-14 years (classes 5&6) attending primary schools in Nairobi. To ensure the study population was representative of this age group, the children were drawn from both private and public primary schools.

Inclusion criteria

Only children who met the following criteria were included in the study:

(a) pupils in schools whose management gave consent for participation

(b) pupils within the age range 9-14 years attending primary school in Nairobi

(c) pupils in classes 5 and 6

(d) pupils whose parents gave informed written consent

(e) pupils who gave assent to the study

Exclusion criteria

The following were excluded from the study:

a) pupils with a known chronic medical condition such as diabetes or hypertension
b) pupils known to be on routine medication that may influence metabolic profile viz epileptic drugs, antidepressants
c) pupils with physical disability or obvious movement disturbance, example movement aided by crutches, wheelchair
d) pupils whose parents did not give consent
e) pupils who did not give assent
f) pupils below 9 years and above 14 years
g) pupils not in classes 5 and 6

3.4 Sampling

3.4.1 Sample size determination

The desired sample size was 330 (165 per study group). This was based on a 95% Confidence Interval, and a power of 80%, 17.2% non-intervention prevalence rate (Medical Research Council, 2002), an expected post intervention prevalence rate of 15.2% and 5% significance level. Using EpiInfo 3.3.2, (Feb, 9. 2005) calculator, this formula gave a sample size of 165 per study group (Figure 2). By assuming an attrition rate of 10%, the calculated sample size was 364 (182 per study group).

3.4.2 Sampling procedure

Figure 2 shows the sampling procedure. Of the eight (8) administrative divisions in Nairobi, two divisions were randomly selected. This was based on the assumption that the distribution of public and private schools does not vary from division to division. One

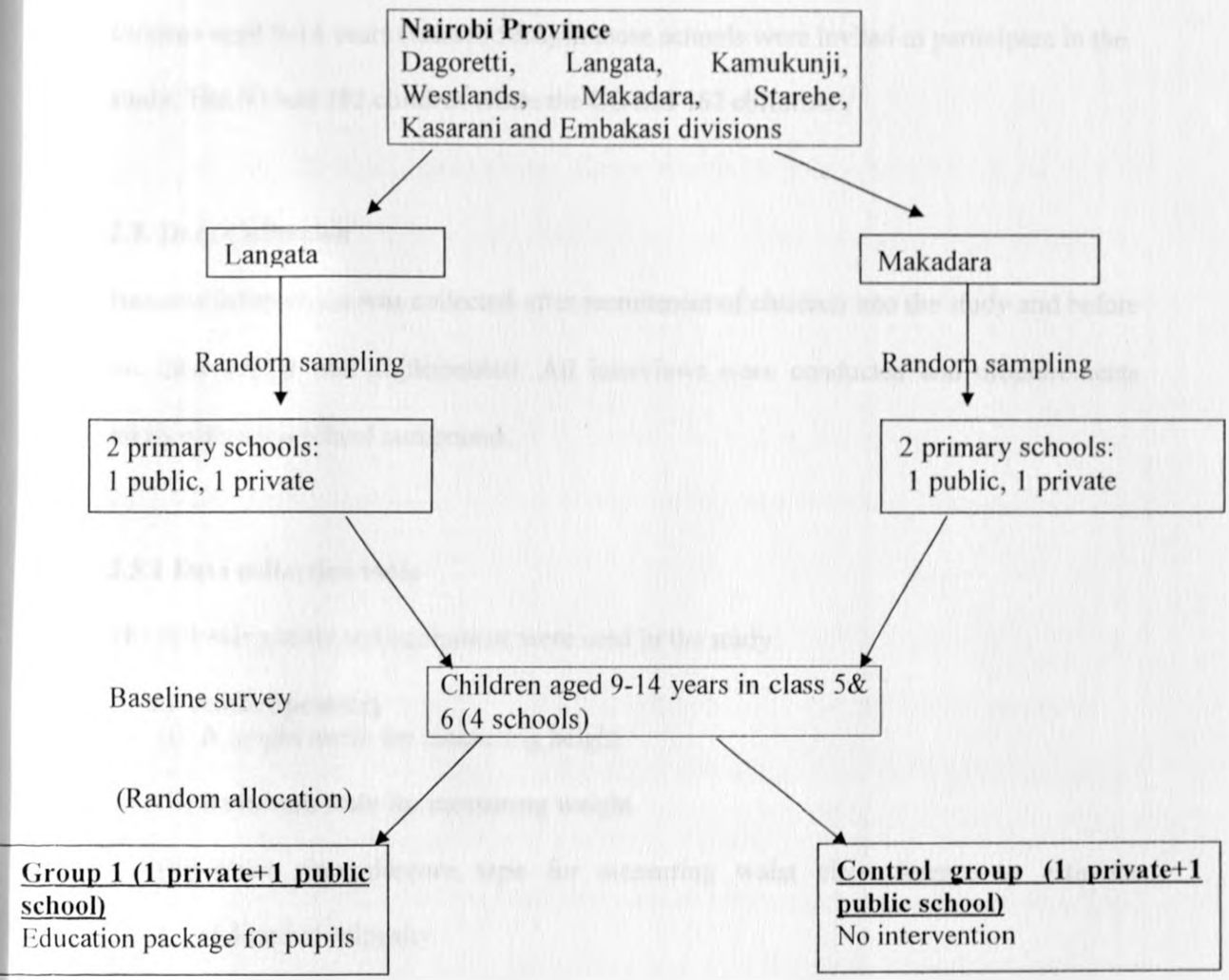


Figure 2: Schematic presentation of sampling procedure

public and one private primary school were randomly selected from each division, to make a total of four (4) schools representing 3.4% and 1% of private and public schools in Nairobi respectively (City Council of Nairobi, 2007). Schools, rather than children, were randomised. From the two public schools, one was randomly selected to be included in the intervention group. The same procedure was followed to select one private school. The intervention group therefore consisted of two schools, one private and one public, while the control group also had two schools, one public and one private school. All the

children aged 9-14 years (classes 5&6) in those schools were invited to participate in the study. The IG had 182 children while the CG had 162 children.

3.5. Data Collection

Baseline information was collected after recruitment of children into the study and before the intervention was implemented. All interviews were conducted and measurements taken within the school compound.

3.5.1 Data collection tools

The following tools and equipment were used in the study.

a) Anthropometry

(i) A height metre for measuring height

(ii) Bathroom scale for measuring weight

(iii) Waist circumference tape for measuring waist circumference to estimate abdominal adiposity

(iv) Skin fold callipers to measure triceps skinfold thicknesss (subcutaneous fat)

b) Questionnaire

The questionnaire had several sections including:

(i) Socio-demographic characteristics

(ii) Dietary practices and food consumption

(iii) Physical activity and sedentary recreation

(iv) Family based characteristics

3.5.2 Recruitment and training of research assistants

Five research assistants with a minimum of secondary level education and a good command of written and spoken English and Kiswahili were selected to assist in data collection. Two of them were nutritionists, and were charged with taking the anthropometric measurements. The group were trained by the principal investigator for two days. The training covered the objectives of the study and the methodology. They were also advised on how to conduct themselves within the school compounds and handle pupils during the study period. The training also included basic interviewing skills, as well as practical skills in interviewing, recording responses and taking anthropometric measurements during the pre-testing of the questionnaire and equipment. Their competency was tested by the accuracy, consistency and logical recording of responses. Role plays were used to test their interviewing skills. During the role plays, the principal investigator recorded the responses and later compared them to those of the research assistants. For purposes of standardization, the other research assistants also listened to the role interviews and recorded responses. These were then compared by the principal investigator for consistency and corrections made. This process was repeated until the investigator was satisfied with their competence.

3.5.3 Pre-testing questionnaire

Prior to the study, questionnaires were pre-tested by administering them to children aged 9-14 years in schools with similar characteristics as the study schools (one private and one public primary school) outside the study zones. The aim of the pre-test was to establish level of understanding of questions/wording by respondents, ease of

understanding the language used, the ease with which the questionnaire was administered, adequacy of instructions for the interviewer, adequacy of recording space and length of time required to administer each questionnaire. After pre-testing, the questionnaire was adjusted accordingly.

3.5.4 Data Collection Procedures

3.5.4.1 Anthropometric measurements

The anthropometric measurements included weight, height, waist circumference and triceps skin-fold thickness and were taken as described by Gibson (2005). Measurements were taken by two of the research assistants who were nutritionists (university level). All measurements were taken in triplicate for each child. Weight was taken using a calibrated SECA balance (Seca gmbh &co.kg, Hamburg, Germany) and recorded to the nearest 0.5 kg. The children were dressed in light clothing and without shoes in order to avoid extra weight from clothing. Height was measured to the nearest 0.1 cm with a height meter with the child standing upright with feet together (without shoes), and head, back, and buttocks vertical against the wall.

Waist circumference was measured using a non-elastic waist tape with the child standing upright with arms hanging loosely on the sides. The tape was placed horizontally mid-way between the bottom floating rib and the iliac crest. Measurements were taken in triplicate and recorded to the nearest 0.5 cm.

Triceps skinfold thickness was measured using Holtain Tanners skinfold callipers. Measurement was made by pinching the skin at the triceps to raise a double layer of skin and the underlying adipose tissue, but not the muscle. The callipers was then applied 1 cm below and at right angles to the pinch, and a reading in millimetres (mm) taken two seconds later and recorded to the nearest 0.1 mm. The mean of two measurements were taken. If the two measurements differed by more than 0.2mm, a third measure was done, then the median value taken.

3.5.4.2 Administering questionnaire

The questionnaire was administered to the study children by the trained research assistants. The questionnaire collected data on:

a) Socio-demographic characteristics of the children and their families. Children's characteristics of interest included sex, age, religion, birth order, the persons they lived with, number of siblings and the type of school attended. Family characteristics of interest included type of housing and parents' (or guardian) occupation and level of education.

b) Dietary practices. These were assessed using a 24 hour intake recall. Children were asked to recall the foods and drinks they had consumed in the previous 24 hours at each evaluation.

c) Physical activity and sedentary recreation. Children were asked questions related to:

(i) Access to sedentary recreation gadgets and games including television, computer (in a family room and/or in child's room), and cell phones (own or other family member's)

(ii) Access to physical activity enhancing equipment including bicycles, football, basket ball and roller skates

(iii) Mode of transportation to and from school (either motorised or non-motorised)

(iv) Participation in scheduled physical activities in school including swimming, Physical Education (PE) and games

(v) Participation in and amount of time spent on various activities after school, during weekends and during school holidays. The activities included sedentary activities (homework/private study, computer/mobile games, television viewing), moderate-intensity physical activities (housework and taking care of younger siblings) and vigorous-intensity physical activities (outdoor play and riding bicycles).

d) Family based practices. These included instrumental feeding (receiving food/drinks as reward for work well done or good behaviour), having family meals, eating while watching TV, eating out (in hotels/restaurants or take away foods), type of cooking oil/fat commonly used at home and cooking methods commonly used at home.

3.6 Nutrition Education

The intervention was a controlled trial which included one intervention group (IG) and one control group (CG), each consisting of a public and a private school. The IG received a nutrition and health education package for pupils. While the intervention was delivered to all children in the intervention schools that were included in phase 1, follow-up data were collected for only the sampled children. The intervention combined both direct and indirect methods of delivering the messages. Direct methods included fortnightly classroom interactions between the researcher and the pupils, involving direct delivery of lessons as well as question answer sessions. These took place in the classroom during the afternoon break (after lunch) and before the afternoon lessons and lasted 45 minutes. Because of time constraints, these interactions took place every two weeks. All the topics were covered during the first school term. In subsequent terms, children participated in development of messages, which were then discussed in class to enhance understanding of the topics. Discussions also included the posters posted in the school notice boards, with the aim of ensuring children read the messages and monitoring their understanding of the messages. The messages were designed to reduce hours of television/ video viewing and to increase consumption of fruits and vegetables, unprocessed cereal products, reduced consumption of sugary soft drinks and high fat foods. Themes selected for this intervention (Appendix 1) were based on identified gaps in the curriculum (which covers only balanced diets), as well WHO recommendations for preventing excess weight gain and obesity among children and adolescents (WHO, 2003b). Hence the themes of the messages included: causes, health implications and prevention of overweight and obesity, constituents and importance of a well balanced diet, making correct food choice

and importance of physical activity. The detailed content was based on WHO recommendations for preventing excess weight gain among children and adolescents (WHO, 2003b). Teaching aids used during the intervention included food models and a poster of the Eat Well Plate (Appendix 2). The later were posted on classroom and school notice boards. The children were also involved in developing the materials and messages. For each topic covered, students developed messages conveying what they understood about the topic. These were discussed in class to enhance understanding. These were then discussed during the classroom interactions. On the other hand, the CG received only one nutrition lecture on recommendations for healthy living. This talk was delivered at the end of the third school term.

Anthropometric data, dietary habits and physical activity patterns were monitored at the end of three school terms (April, August and December 2009) in both study groups.

3.7 Data Quality Assurance

3.7.1 Reliability and accuracy

Research assistants were trained on how to administer the questionnaire and take anthropometric measurements. The questionnaire was pre-tested to establish sensitivity, clarity and length of questions, as well as the duration of the interview. The investigator randomly recorded answers alongside the interviewers and compared them to ensure similarity in recording.

To ensure consistency in answers given, the investigator randomly interviewed children who had been interviewed earlier to cross-check consistency and/or veracity of answers. In order to enhance reliability and accuracy, anthropometric equipment were well maintained throughout the study. Calibration was done regularly and each measurement was taken three times. Data cleaning was carried out daily by the investigator.

3.7.2 Internal validity

Internal validity was achieved through the following strategies as recommended by Thompson and Panacek (2006) and Martin (2005):

a) Allocation to intervention groups was random for all schools.

b) All study children remained in their usual environment and geographical setting.

c) A control group with characteristics similar to study group was included.

d) All study children were homogenous in age and setting.

e) Length of follow-up was the same (11 months).

f) Follow-up measurements were taken at the same intervals (after 3, 7 and 11 months).

3.7.3 External validity

In order to achieve external validity, the study sample had the same characteristics as the population from which it was drawn (Martin, 2005).

3.8 Data Management and Analysis

Data was cleaned and verified, then entered using the Excel 2007 software package. Data analysis was done using SPSS version 17.0, AnthroPlus and OpenEpi. Characteristics of the study population were described using descriptive statistics such as frequencies, means, medians and standard deviations. Inferential statistics were used to establish differences in various variables between the control and intervention groups, and relationships between selected variables and overweight. Non-parametric tests, Chi-square tests and Odds Ratio (OR), were used to test relationships between categorical variables such as socio-demographic and economic characteristics. For continuous variables with normal distribution, t-tests were done to compare the Control Group (CG) and the Intervention Group (IG). Where continuous variables were not normally distributed, Mann-Whitney U test was used to compare the two study groups. Mean waist circumference and skinfold thickness were used as part of the monitoring of nutrition status. The Wilcoxon test was used to compare trends in anthropometric characteristics (weight, height, BMI, waist circumference and waist circumference) from baseline to the final evaluation. A significant level of ($p<0.05$) was used in all statistical tests.

Activities that children engaged in while at home were categorised according to recommendations by WHO (2010) into sedentary activities (SA), moderate-intensity physical activities (MIPA) and vigorous intensity physical activities (VIPA). SA included television viewing, private study/homework and computer/mobile games while MIPA included housework and taking care of younger siblings while. VIPA included outdoor play and riding bicycles.

Children's weight and height measurements were transformed into sex- and age-specific BMI-for-age Z-scores using AnthroPlus, with BMI calculated as weight in kilograms divided by the height in metres squared. The children were classified into normal, thin, overweight or obese based on the WHO sex specific BMI-for-age z-scores (BAZ) for children 5-19 years (de Onis *et al.*,2007). A child with a BAZ below -2SD was considered thin (moderate malnutrition). A BAZ between +1SD and +2SD indicated that the child was overweight while a BAZ $\geq$ +2SD indicated that a child was obese.

In order to investigate the factors that affect overweight among the study children, characteristics of normal weight children were compared to those of overweight children. Malnourished children were excluded from the comparison. In the multivariate stepwise logistic regression analysis, only variables with significant associations (i.e. p-value <0.05) with children's weight status in the Chi-square tests were considered. The Odds Ratio (OR) and its 95% confidence interval (CI) were calculated for each categorical variable using OpenEpi.

Table 2 summarises the type of data collected, the analysis and the statistical tests conducted to address the study objectives.

Table 2: Data analysis matrix

Objective	Data collected	Analysis
Prevalence of overweight	Age, weight, height Waist circumference, Triceps skin fold thickness	Age and sex specific BMI-for-age z-scores were calculated using AnthroPlus and children classified as severely thin, thin, normal weight, overweight and obese (de Onis *et al.*, 2007) z-scores, waist circumference and skinfold thickness were categorised as described by Gibson (2005). Chi-square test was used to compare categorical data, t-test used to compare continuous data in the two groups
Risk factors for overweight	Individual factors: Age, sex, mode of transport to school, Physical activity patterns, dietary habits; school factors: type of school, scheduled activities in school; Family factors: parents' education and occupation, residence, family status, religion, access to recreation equipment/ gadgets	Cross tabulation summaries & chi square tests for association between nutrition status and selected factors; t-tests used to compare normally distributed continuous data; Mann Whitney U test used to compare non-normally distributed continuous data, regression analysis to determine associations; Summary tables for frequency of food intakes; Physical Activity (PA) patterns were classified as Sedentary Moderate/heavy intensity PA cut off set at 45h/day (Saris *et al* ., 2003)
Determine effect of health and nutrition education on overweight and obesity, and the risk factors	Weight, Height, Waist circumference, Triceps skin fold thickness, BMI, commuting, physical activity, sedentary recreation and diet	Cross tabulations; Wilcoxon test to compare pre-and post tests and χ^2 test for associations; t-test for continuous data

3.9 Ethical Considerations

Research permits

Permits to conduct the study were obtained from the Ministry of Education, Science and Technology (MES&T) and the Nairobi City Council (NCC).

Ethical review committee

The research protocol was approved by the Kenya Medical Research Institute National Ethical Review Committee (KEMRI-NERC) (Appendix 10). In addition, school administrators in the sampled schools also gave written consent for the study.

Informed consent

The objectives and benefits of the study were explained to parents during their class meetings and through written explanations. Before enlisting the children into the study, their parents/guardians gave informed written consent by signature or thumb mark on the consent form provided by the researcher (Appendix 4).

Assent by the pupils

The study objectives and methodology were also explained to the pupils. All the children involved assented to the study.

Participant Confidentiality

Confidentiality was maintained throughout the study. All anthropometric measurements and interviews were conducted individually and were not disclosed to other participants.

Overweight children were not singled out at any stage of the study, but were instead sampled alongside thin and normal weight children in order to avoid stigmatization. The intervention was delivered to all pupils meeting the inclusion criteria irrespective of their nutrition status. The information collected during the study has been used for research only and identities of participants have not been disclosed.

Procedure to ensure safety and comfort of children

All procedures were conducted within the school compound and in privacy, with other children waiting at a distance or in another room where available. No disclosure was made about individual children's weights or other measurements. All efforts were made to ensure each child was made as comfortable as possible and high standards of hygiene and safety were observed during the whole process.

3.10 Limitations of the Study

The study only included school-going children aged 9-14 years (classes 5&6) and may have excluded any children in this age group who were not attending school or were in a class below or above the selected classes.

Because of the sensitivity and stigma associated with obesity, it is possible some parents of overweight children failed to give consent for participation, implying that an eligible number of children may have been excluded on this basis.

CHAPTER FOUR: RESULTS

4.1 Introduction

The findings of this study are presented as follows:

(a) baseline data presented according to school status (private vs public schools)

(b) prevalence of overweight according to school status and sex of the children

(c) risk factors for overweight

(d) comparison of the study groups at baseline

(e) the effect of nutrition education intervention on overweight

4.2 Enrolled Subjects in the Study

The minimum sample size was 330 (165 per study group) while the calculated sample size was 364. Written consent by parents/guardians allowing their children to participate was obtained for 344 of them (182 in the IG and 162 in the CG). Complete anthropometric data was obtained for 321 children representing 97.6% and 99.4% of the calculated minimum sample in the IG and CG, respectively. It was still possible to carry out statistical analysis on this data.

4.3 Baseline Findings

Baseline data was collected before the schools were randomised.

4.3.1 Demographic and socio-economic characteristics

These included characteristics of the study children as well as those of their families.

4.3.1.1 Demographic characteristics of study children

Table 3 shows the distribution of the study children by selected socio-demographic characteristics. About two fifths of the children were from private schools. The ratio of male to females was about 1:1. Over three quarters of the children were 11-12 years old.

Table 3: Socio-demographic characteristics of study children (%)

Socio-demographic factors	Total N=344	Private school n=139	Public school n=205	*p-value*
Sex				0.298
Male	47.7	51.4	45.1	
Female	52.3	48.6	54. 9	
Age (years)				
9-10	9.6	5.8	12.1	
11 – 12	79.9	92.8	71.4	
13 – 14	10.5	1.4	16.5	
Person child lives with				***0.011***
Both parents	74.7	83.4	68.9	
Mother only	17.2	10.1	21.8	
Father only	5.5	5.8	5.3	
Guardian	2.6	0.7	3.9	
Birth order				***0.044***
Only child	8.7	9.4	8.3	
First born	36.0	39.9	33.5	
Last born	25.0	29.0	22.3	
Other birth positions	30.0	21.7	35.4	
Number of siblings				0.161
No siblings	8.7	9.4	8.3	
1-2 siblings	51.5	56.5	48.2	
3-5 siblings	34.3	31.2	35.4	
≥6 siblings	5.5	2.9	7.3	
Religion				0.431
Protestant	61.2	56.9	64.1	
Catholic	33.8	37.2	31.6	
Muslim	2.6	3.6	1.9	
Seventh Day Adventist	2.3	2.2	2.4	
No religion	0.3	0.7	0.0	

p-values in bold represent significant differences

The mean and median ages were 12.0±0.84 and 11.92 years, respectively. However, boys had a slightly higher mean age (12.04±0.88 years) compared to girls (11.89±0.80 years) but the difference was not significant. There was also no significant difference in mean ages of children in private schools (11.8±0.58 years) and those in public schools (12.0±0.95 years) ($p>0.05$).

Nearly all the children (97.4%) lived with at least one parent (either father or mother or both parents) and only 2.6% lived with guardians. About 75% lived with both parents. A higher proportion of children in private schools lived with both parents (83.4%), compared to 68.9% of those in public schools. 25% of the children were last borns in their families, and 36% were first borns, 8.7% were single children (no siblings) and another one third consisted of the other birth positions. The number of siblings (brothers and sisters) ranged from none to 9 siblings per child. About 50% of the children had one or two siblings, one third had 3-5 siblings and the rest had six or more siblings.

The predominant religion was Christianity (96%), with the majority being Protestants, followed by Catholics and a few Seventh Day Adventists (SDAs). Only 2.6% of the children were Muslims and one child reported having no religion.

4.3.1.2 Family socio-economic and demographic characteristics

Table 4 shows the family characteristics of the study children. One third of the children lived in a bungalow or maisonette (within a residential court), while another one third lived in flats (in storey buildings). The rest lived either in homesteads with own

Table 4: Socio-economic and demographic characteristics of families of study children

Socio-demographic characteristics	All N=344	Private school n=139	Public school n=205	*p-value*
Type of housing				***0.000***
Bungalow/ maisonette	33.4	51.4	21.4	
Apartment/flat	32.0	33.3	31.6	
House with own compound	22.4	14.5	27.2	
Single room (informal settlement)	12.2	0.7	19.9	
Mother's highest level of education				-
Tertiary	72.0	92.7	56.8	
Secondary	17.7	7.3	25.4	
Primary	9.6	0.0	16.6	
Not attended school	0.7	0.0	1.2	
Father's highest level of education				-
Tertiary	83.8	95.9	73.4	
Secondary	13.5	4.1	21.6	
Primary	2.7	0.0	5.0	
Mother's occupation				***0.000***
Employed	59.6	75.2	48.7	
Self-employed	23.8	21.8	25.1	
Unemployed/Casual labour	16.7	3.0	26.2	
Father's occupation				0.192
Employed	74.3	79.1	70.3	
Self-employed	24.3	20.2	27.2	
Unemployed/Casual labour	1.4	0.8	1.9	

p-values in bold represent significant differences

compound or in a single room in an informal settlement. There was a significant difference in residence of the study children, with over half of those in private schools living in bungalows or maisonettes compared to about 20% of the children in public schools ($p<0.001$). Almost equal proportions of children from both types of schools lived in apartments. On the other hand, more children in public schools lived in houses which had compounds (detached houses) and single rooms compared to those in private schools.

Education levels of parents of the study children were high. 72% of the mothers and 84% of the fathers had tertiary level education (college and above). About 10% and only 2.7%% of the mothers and fathers, respectively, had primary school education. Only 1.2% of the mothers lacked formal education and these had their children in public schools.

When achievement of tertiary education was compared between parents of children in both types of schools, a significantly higher proportion of mothers (92.7%, $p<0.001$) and fathers (95.9%, $p<0.001$) of children in private schools had achieved tertiary education compared to 56.8% of mothers and 73.4% of fathers from public schools. Unemployment among mothers of the study children was higher than among fathers. At 3.0%, unemployment was low among mothers of children in private schools compared to 26.2% among their counterparts from public schools.

Nearly three quarters of the fathers and about 60% of the mothers had formal employment (either in the public or private sectors) while an almost equal proportion (about 24%) of mothers and fathers were engaged in self-employment. Overall, there was a significant difference in employment levels of mothers of children in private and public schools ($p<0.001$), but not among fathers.

4.3.2 Physical activity and sedentary recreation characteristics

The physical activities considered were those scheduled in the school timetable while sedentary recreation was related to access to gadgets and games, and activities at home after school, on weekends and during school holidays.

4.3.2.1 Children's access to leisure, sedentary recreation, and physical activity gadgets

Overall access to sedentary recreation gadgets and the associated games was high among the study children (Table 5). Nearly all the children (95.9%) had access to a television set, 85% had access to at least one cell phone and half had access to a computer. In addition, a small proportion had access to these items in their rooms; 12 % and 8% had a television set and a computer, respectively, in their rooms.

Access to all the sedentary recreation gadgets assessed in this study was significantly higher among children in private schools than among those in public schools ($p<0.05$). These included television, family computer and personal cell phone (Table 5). In addition, children in private schools were also more likely to have a video games in a family room, a computer in their rooms ($p<0.001$) and computer games in their rooms ($p<0.001$), when compared to those in public schools. When access to the sedentary recreation gadgets was compared according to sex, significantly more boys than girls ($p<0.001$) reported having access to a television set in their rooms, television games in the family television set ($p<0.05$) and in their rooms ($p<0.01$), a computer ($p<0.05$) and computer games in their rooms ($p<0.001$) (Table 5). However, there was no significant

Table 5:Children's access to leisure and activity equipment by type of school and sex (%)

Gadget/equipment	All	Type of school			Sex		
	N=344	Private school n=139	Public school n=205	*p-value*	Male n=164	Female n=180	*p-value*
Sedentary recreation gadget							
Television set							
Family television set	95.9	100.0	93.2	***0.002***	96.3	95.6	0.713
Television set in child's room	11.9	14.5	10.2	0.244	16.5	7.8	***0.013***
Video/VCD games							
Video games in family room	69.2	77.5	63.6	***0.005***	74.4	64.4	***0.046***
Video games in child's room	4.4	5.8	3.4	0.297	7.3	1.7	***0.010***
Computer							
Family computer	49.7	76.1	32.0	***0.000***	49.4	50.0	0.910
Computer in child's room	7.8	15.2	2.9	***0.000***	11.0	5.0	***0.040***
Family computer has games	40.4	65.2	23.8	***0.000***	45.1	36.1	0.089
Child's computer has games	9.0	18.8	2.4	***0.000***	15.3	3.3	***0.000***
Cell phone							
Child's cell phone with games	37.8	51.4	28.6	***0.000***	37.2	38.3	0.828
Other cell phone with games	84.9	88.4	82.5	0.124	84.8	85.0	0.950
Physical activity equipment							
Bicycle	55.0	72.1	43.7	***0.000***	62.8	47.8	***0.005***
Football	53.5	58.0	50.0	0.143	62.8	45.0	***0.001***
Basket ball	19.8	28.3	14.1	***0.001***	21.3	18.3	0.484
Roller skates	7.3	9.4	5.8	0.220	6.1	8.3	0.425

p-values in bold represent significant differences

difference between boys' and girls' access to a family television set, family computer and computer games, and cell phones ($p>0.05$).

Bicycles and footballs were the most common physical activity enhancing equipment with over half (55.0% and 53.5%, respectively) of the children having access to them in their homes (Table 5). Basketballs and roller skates were less common. There was

variation in access to these equipment between children in private schools and those in public schools.

Although more children in private schools reported having access to footballs and roller skates than those in public schools, the difference was not significant ($p>0.05$). On the other hand, significantly more children in private schools had access to bicycles and basketballs compared to those in public schools ($p<0.001$). Access to the physical activity equipment was higher among boys than girls (Table 5). However, the difference was significant for bicycles and footballs ($p<0.001$), but not for roller skates and basketballs ($p>0.05$).

The number of cell phones accessible to children differed significantly across schools ($p<0.001$) (Figure 3). Nearly half of the children in private schools (48.2%) had access to two cell phones, compared to only one quarter (25.9%) of those in public schools. Similarly, 15.1% of the children in public schools did not have access to a cell phone compared to only 7.9% of those in private schools.

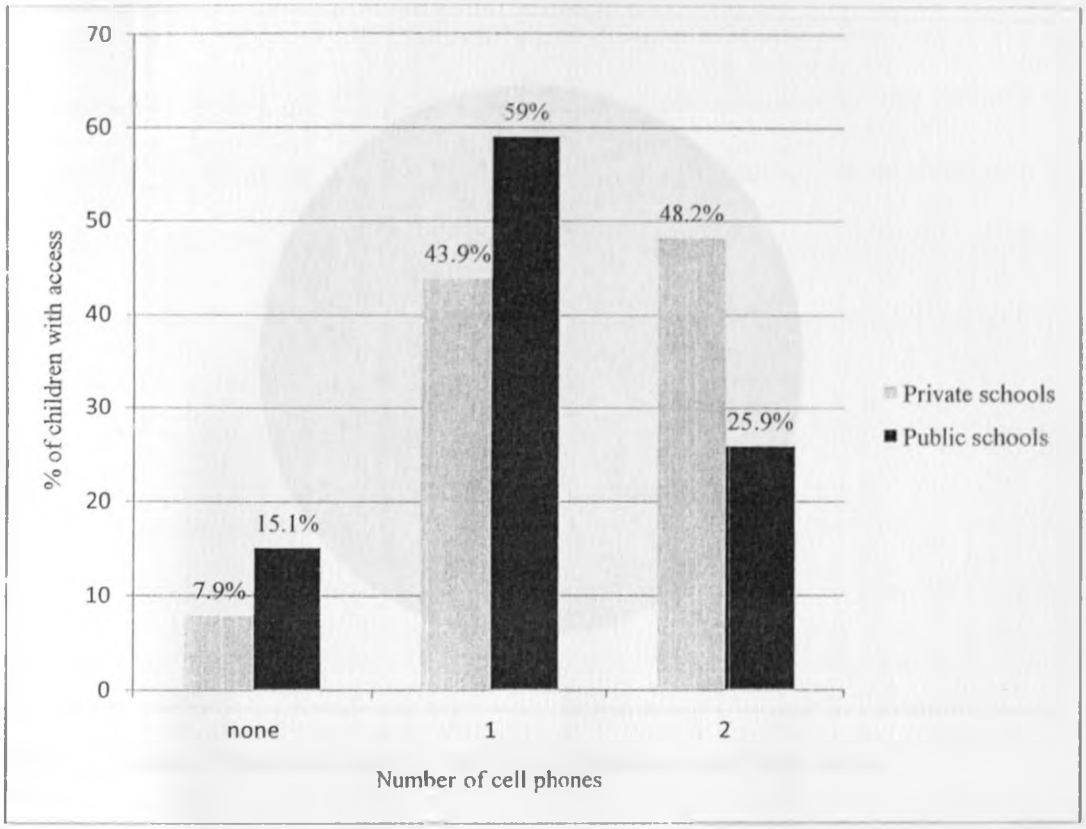


Figure 3: Access of study children to cell phones by school type

4.3.2.2 Means of transport to and from school

Nearly half of the children (47.6%) used motorised transport to and from school (Figure 4). This included school buses, family car and public transport - *matatu* or bus. Active mode of transport, namely walking to and from school, was used by 40.7% while the rest of the children walked and used public transport interchangeably. The use of motorised transport to and from school was significantly higher among children in private schools than among those in public schools ($p<0.001$) (Figure 5). More than half of the children in public schools walked to and from school (active transport), compared to less than one quarter of those in private schools. In contrast, nearly three quarters of children in private

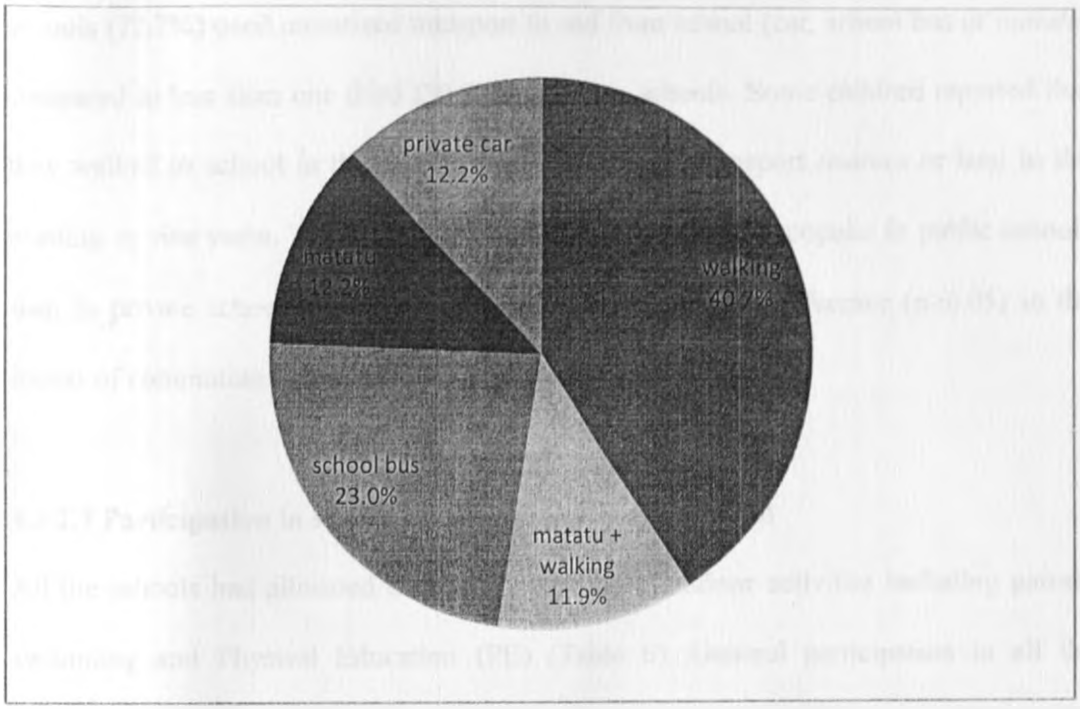
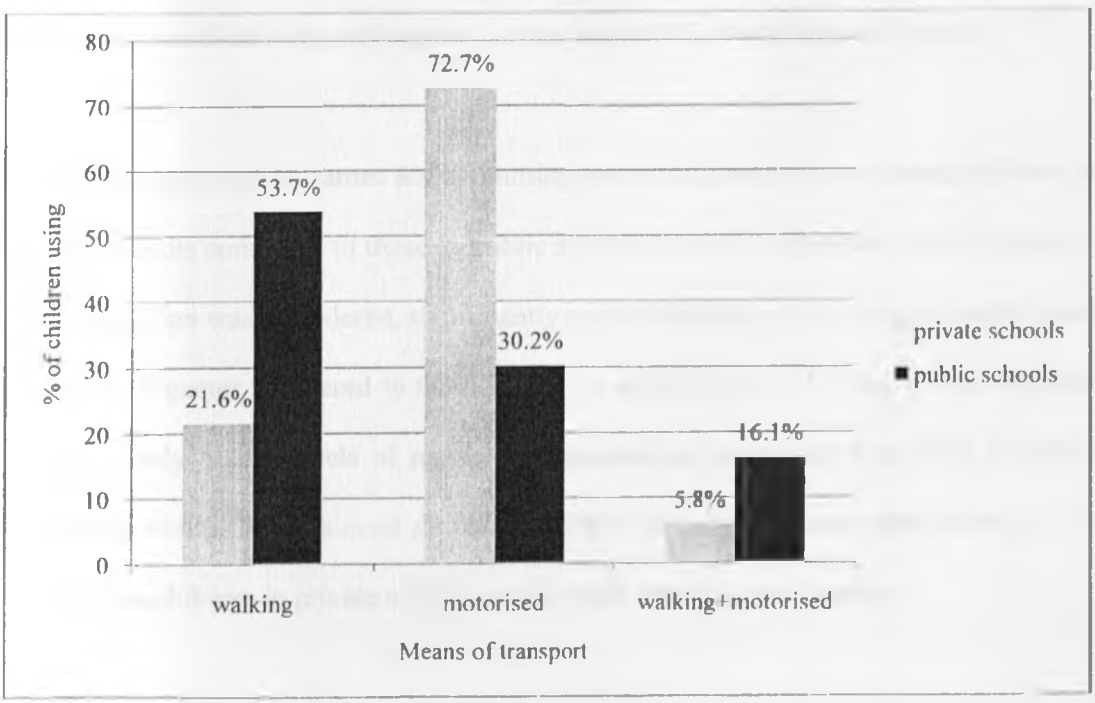


Figure 4: Means of transport used by the study children to and from school



Motorised=car, school bus or *matatu*

Figure 5: Means of transport to and from school by type of school

schools (72.7%) used motorised transport to and from school (car, school bus or *matatu*) compared to less than one third (30.2%) in public schools. Some children reported that they walked to school in the morning and used public transport *(matatu* or bus*)* in the evening or vice versa. This mixed mode of transport was more popular in public schools than in private schools. There was, however, no significant difference ($p>0.05$) in the means of commuting to and from school across sex.

4.3.2.3 Participation in scheduled physical activity in school

All the schools had allocated time for one or more outdoor activities including games, swimming and Physical Education (PE) (Table 6). General participation in all the scheduled physical activities was high with over 90% of the children participating in PE, games and swimming. When asked how frequently they participated in these activities, only about two thirds reported regular participation in PE, swimming and games.

General participation in games and swimming was significantly higher among children in private schools compared to those in public schools ($p<0.01$). However, when frequency of participation was considered, significantly more children in public schools participated regularly in games compared to those in private schools ($p<0.01$), who in turn reported insignificantly higher levels of regular participation in swimming than those in public schools ($p>0.05$). While almost all children (98%) in public schools participated in PE, none of the children in private schools in this study reported participation.

Table 6: Participation in scheduled physical activities in school

Activity	Type of school				Sex		
	All (%) N=344	Private school (%)n=139	Public school (%) n=205	*p-value*	Male (%) n=164	Female (%) n=180	*p-value*
Activities scheduled in school timetable							
Games	100.0	100.0	100.0	-	100.0	100.0	-
Swimming	72.4	100.0	53.7	***0.000***	75.6	69.4	0.201
PE	59.6	0.0	100.0	***0.000***	56.7	62.2	0.298
Participation in activities							
Games	94.5	99.3	91.7	***0.002***	95.7	93.9	0.443
Swimming	91.2	95.7	85.5	***0.005***	92.7	89.6	0.382
PE	98.0	0.0	98.0	-	100.0	96.4	-
Regular participation in physical activities							
Games	72.3	64.5	78.1	***0.009***	74.5	69.8	0.345
Swimming	68.7	73.7	61.7	0.055	68.7	68.8	0.993
PE	68.2	0.0	68.2	-	79.6	58.3	***0.001***

p-values in bold represent significant differences

When participation according to sex was considered, there was no significant difference between boys' and girls' general participation in the three activities (Table 6). Although over two thirds of both boys and girls reported regular participation in swimming and games, there was no significant difference in frequency of participation ($p>0.05$). However, a significantly higher proportion of boys reported regular participation in PE compared to girls ($p<0.001$).

4.3.2.4 Activities outside school

Table 7 shows the percentage of children viewing television for more than two hours per day. School for all the children interviewed ended between four and five o'clock. To get the average television viewing per day, the average time spent watching television after school per day was multiplied by five and added to time spent on Saturday and Sunday,

Table 7: Proportion of children watching television for more than two hours per day

Period	All (%) N=344	Private school (%) n=139	Public school (%) n=205	*p-value*	Male n=164	Female n=180	*p-value*
After school	40.2	38.1	41.6	0.520	39.1	41.1	0.707
Saturday	85.4	91.4	81.2	***0.009***	83.9	86.9	0.435
Sunday	67.9	73.4	64.0	0.069	65.8	69.7	0.447
Holiday	88.1	92.8	84.8	***0.025***	87.0	89.1	0.536

p-values in bold represent significant differences

then divided by seven. On average, 45% of the study children watched television for more than two hours per day. This proportion varied from 40.2% after school, to 70% - 80% on weekends and reached nearly 90% during school holidays (Table 7). While there was no difference in proportion of children from private and public schools watching television for more than two hours after school and on Sundays, a significantly higher proportion of children in private schools watched television for more than two hours on Saturday ($p<0.01$) and during school holidays ($p<0.05$). There were, however, no significant differences when sex of the children was considered ($p>0.05$).

Apart from television viewing, other home based activities that were assessed were homework/private study, playing computer/mobile games, outdoor play, light household chores, taking care of siblings and riding bicycles. These activities were categorised into sedentary activities (SA), moderate-intensity physical activities (MIPA) and vigorous-intensity physical activities (VIPA) (WHO, 2010). SA included television viewing, homework /private study and computer/mobile games while MIPA included housework and taking care of younger siblings. VIPA included outdoor play and riding bicycles. The mean time spent on each of these categories after school, on weekends and during school

Table 8: Mean time (hours) spent by study children on selected activities while away from school

Activity	Mean time in hours (±SD) All N=344	Private school n=139	Public school n=205	*p-value*
After school				
SA	3.01 (1.26)	3.26 (1.33)	2.84 (1.19)	***0.003***
MIPA	0.43 (0.58)	0.38 (0.70)	0.47 (0.49)	***0.000***
VIPA	0.50 (0.85)	0.37 (0.90)	0.58 (0.82)	***0.001***
Saturdays				
SA[b]	5.76 (2.8)	6.82 (2.81)	5.05 (2.49)	***0.000***
MIPA[a]	1.16 (1.46)	1.15 (1.69)	1.17 (1.28)	0.152
VIPA[b]	3.06 (2.42)	3.36 (2.68)	2.85 (2.21)	0.125
Sundays				
SA	3.79 (2.45)	4.21 (2.41)	3.51 (2.45)	***0.003***
MIPA	0.82 (1.30)	0.78 (1.47)	0.84 (1.16)	0.143
VIPA[b]	1.98 (1.95)	1.81 (1.82)	2.10 (2.00)	0.152
School holidays				
SA[b]	7.14 (3.68)	8.67 (3.68)	6.10 (3.31)	***0.000***
MIPA[a]	1.55 (1.89)	1.41 (1.91)	1.65 (1.87)	0.063
VIPA[b]	4.14 (2.92)	4.45 (3.20)	3.94 (2.78)	0.312

[a]significantly higher in females than males ($p<0.05$); [b]significantly higher in males than females; SA=sedentary activities; MIPA=moderate intensity physical activities; VIPA=Vigorous intensity physical activities; p-values in bold represent significant differences

holidays is presented in Table 8 and Appendix 5. Overall, the study children spent more time on sedentary activities than on MIPA and VIPA. SA were more popular after school than MIPA and VIPA, with children spending more than two and a half hours more on SA after school than on MIPA and VIPA. Children in private schools spent significantly more time on SA after school compared to those in public schools ($p<0.01$). In contrast, children in public schools spent significantly more time on MIPA and VIPA after school than those in private schools ($p<0.001$).

During weekends, the time spent on all the activities increased compared to school days. The time spent on SA by children in private schools doubled from about 3 hours per day on week days to nearly 7 hours per day on Saturdays, while for children in public schools, it increased by over two hours. Just like during the week, children in private schools spent significantly more time on SA on Saturdays ($p<0.001$) and Sundays ($p<0.01$) than their counterparts in public schools. There was no significant difference in time spent by children in the two types of schools on MIPA and VIPA on weekends.

During school holidays, the study children spent more than seven hours per day on SA compared to 1-2 hours spent on MIPA and 4 - 4.5 hours spent on VIPA. Children in private schools spent over eight hours per day on SA (over two hours more than those in public schools), a difference which was significant ($p<0.001$).

On Saturdays, male children tended to spend significantly more time on SA than their female counterparts ($p<0.05$), who in turn spent significantly more time on MIPA ($p<0.001$) than the males. In addition, boys spent more time on Saturdays and Sundays on VIPA such as cycling and other outdoor play ($p<0.0001$). The same trend was reflected during school holidays, when boys spent significantly more time outdoors on VIPA ($p<0.001$) as compared to girls who spent significantly more time during school holidays on MIPA (housework and taking care of younger siblings) compared to boys ($p<0.001$).

4.3.3 Family characteristics

A comparison of selected family characteristics known to have an association with overweight/ obesity is shown in Table 9. Children in public schools were more 4.3 times more likely to have family meals and had a threefold preference for home-made food (as opposed to eating out) compared to children in private schools ($p<0.001$). However, they were also 1.7 times more likely to receive food as reward for work well done or good behaviour than those in private schools ($p<0.05$). In addition, their families were 3.8 times more likely to use fat shortenings as opposed to oil for cooking and 82% increased likelihood of applying healthier options of cooking such as stewing, boiling or steaming food as opposed to unhealthier options such as deep frying ($p<0.05$).

Table 9: Selected family characteristics

Family characteristic	All (%) N=344	Private school (%) n=139	Public school (%) n=205	Odds Ratio (Confidence Intervals)	*p-value*
Eat meals together					
Yes	90.7	83.5	95.6	4.32 (1.93-9.65)	***0.000***
No	9.3	16.5	4.4		
Preferred food					
Home food	83.1	74.1	89.3	2.91 (1.62-5.21)	**0.000**
Eating out	16.9	25.9	10.7		
Watch TV at meal times					
Yes	81.2	82.7	80.1	1.19 (0.68-2.08)	0.638
No	18.8	17.3	19.9		
Food rewards					
Yes	72.7	66.2	77.1	1.72 (1.06-2.77)	***0.026***
No	27.3	33.8	22.9		
Cooking fat/oil					
Oil	57.1	75.5	44.6	3.84 (2.39-6.17)	***0.000***
Fat	42.9	24.5	55.4		
Cooking method					
Healthy†	80.5	74.8	84.4	1.82 (1.06-3.11)	***0.028***
Unhealthy‡	19.5	25.2	15.6		

p-values in bold represent significant differences

†: defined as stewing/boiling/steaming; ‡: defined as frying/deep frying, TV=Television

4.3.4 Food consumption patterns

Majority of the children reported taking three meals per day. Skipping meals was not very common, with only 4.7%, 3.2% and 1.2% skipping breakfast, lunch and supper, respectively. Consumption of snacks was highly prevalent among the study children. About two thirds of the study children reported taking a morning snack (35.8%) and an afternoon snack (33.4%), and only 17.7% took an additional snack after supper.

Table 10 and Appendix 6 show the foods, snacks and beverages consumed by the study children during the previous 24 hours. The carbohydrate rich cereal based foods were classified into refined and unrefined because of the differences in energy density, a factor of great interest in development of obesity. The consumption of refined carbohydrate rich foods was very popular among the study children, ranging from 40% for *maandazi* to nearly 80% for white bread. This is in contrast to wholemeal foods, whose consumption was relatively low. While consumption of white bread was significantly higher among children in private schools ($p<0.001$), the opposite was true for other refined foods such as refined flour chapatti, refined flour *ugali*, *maandazi* and rice, whose consumption was significantly higher among children in public schools ($p<0.001$).

Consumption of foods rich in animal proteins (meat, chicken, sausages/hotdogs, and milk/milk products) was significantly higher among children in private schools ($p<0.01$) except for fish, whose consumption was significantly higher among children in public schools ($p<0.05$). On the other hand, consumption of foods rich in plant proteins (beans and green grams) was significantly higher among children in public schools ($p<0.05$).

Table 10: Foods and drinks consumed by study children in the previous 24 hours

Food/Drink	All (%) N=344	Private School (%) n=139	Public school (%) n=205	Odds Ratio (Confidence Intervals)	*p-value*
Cereal based refined foods					
White chapatti	25.6	11.5	35.1	4.16 (2.30-7.54)	***0.000***
White bread [a]	79.4	99.4	65.4	73.12 (10.02-533.8)	***0.000***
White *ugali*	63.1	45.3	75.1	3.64 (2.30-5.77)	***0.000***
Maandazi[b]	39.8	10.8	59.5	12.1 5 (6.64-23.23)	***0.000***
White rice	67.7	51.8	78.5	3.41 (2.13-5.45)	***0.000***
Cereal based unrefined foods					
Githeri	29.1	54.0	12.2	8.44 (4.94-14.41)	***0.000***
Meat, dairy and eggs					
Beef	53.8	63.3	47.3	1.92 (1.24-2.99)	***0.005***
Chicken	11.6	23.0	8.8	3.11 (1.66-5.80)	***0.000***
Sausage/hotdog	20.6	32.4	12.7	3.30 (1.91-5.58)	***0.000***
Milk/ milk products	26.7	38.1	19.0	2.62 (1.61-4.27)	***0.000***
Fish	5.2	1.4	7.8	5.80 (1.31-25.63)	***0.018***
Legumes grains and nuts					
Beans	12.2	7.2	15.6	2.39 (1.13-5.03)	***0.030***
Green grams	14.5	6.5	20.0	9.11 (4.26-19.5)	***0.000***
Vegetables and fruits					
Vegetables [a]	89.8	82.0	95.1	0.01 (0.01-0.02)	***0.000***
Fruits	62.5	84.2	47.8	5.81 (3.41-9.88)	***0.000***
Roots/tubers					
Chips/bhajia	14.5	23.3	9.3	2.81 (1.51-5.22)	***0.001***
Crisps	9.3	4.3	12.7	3.22 (1.29-8.04)	***0.015***
Drinks					
Soda	24.4	36.7	16.1	3.02 (1.82-5.02)	***0.000***
Bread spread					
Margarine [a]	63.1	79.9	51.7	3.70 (2.25-6.06)	***0.000***
Jam/ Marmalade	15.4	20.9	11.7	1.99 (1.10-3.59)	***0.031***

[a]Significantly higher in males than females; [b]Significantly higher in females than males
p-values in bold represent significant differences

except for *githeri,* whose consumption was significantly higher among children in private schools than among those in public schools ($p<0.001$). The consumption of vegetables was significantly higher among children in public schools ($p<0.001$) while fruit consumption was significantly higher among those in private schools ($p<0.001$).

Potatoes were the only root crops consumed by the study children. Significantly more children in private schools consumed French fries (chips) and/or bhajia than their counterparts in public schools ($p<0.001$). On the contrary, consumption of crisps was significantly higher among children in public schools ($p<0.05$).

Ready to drink juices were popular among children in both private and public schools, with over 40% reporting consuming them. While sodas were consumed by only one quarter of the study children they were significantly more popular among children in private schools than those in public schools ($p<0.001$). Similarly, children in private schools consumed significantly more margarine ($p<0.001$) and marmalade ($p<0.05$), which were used as bread spread, compared to their counterparts in public schools.

A comparison of food consumption based on sex showed that significantly more male children consumed white bread, vegetables and margarine ($p<0.05$). On the other hand, female children were more likely to consume *maandazi* than male children ($p<0.05$). There was no significant difference across sex in consumption of other foods ($p>0.05$).

Comparison of different foods and drinks consumed at different meals and snack times is shown in Table 11 and Appendix 7. Over half of the study children consumed white bread for breakfast, mainly spread with margarine or jam/marmalade. Brown bread was less consumed at breakfast, followed by *maandazi* and cake in reducing order. Few children consumed protein-rich foods at breakfast. Such foods were mainly eggs, sausages/ hotdogs and peanuts. Only about 5% of the study children ate fruits at

Table 11: Foods and drinks consumed by study children at different meal and snack times at home and in school

Food / Drink	% consuming			
	All N=344	Private school n=139	Public school n=205	*p- value*
Breakfast				
Maandazi	15.5	1.4	23.9	***0.000***
Cake	10.1	15.8	5.4	**0.001**
Hotdog/sausage	9.8	18.0	3.4	**0.000**
Snacks				
White bread	42.8	68.8	24.1	***0.000***
Fruits	35.8	44.8	29.3	***0.002***
Margarine	30.1	47.2	17.2	***0.000***
Maandazi	28.4	10.4	41.4	***0.000***
Crisps	10.8	4.5	13.6	***0.009***
Chapatti	6.4	0.8	10.3	***0.001***
Lunch				
Rice	37.8	20.1	49.7	***0.000***
Githeri	21.3	44.8	5.5	***0.000***
Fruit	19.2	33.6	9.5	***0.000***
Chapatti	7.5	3.0	10.6	***0.010***
Green grams	6.3	0.0	10.6	***0.000***
Supper				
Githeri	5.9	9.6	3.4	***0.021***
White *ugali*	40.0	27.4	48.8	***0.000***
Beef stew	30.6	37.8	25.9	***0.032***
Drinks				
Milk/milk products	26.7	38.1	19.0	***0.000***
Soda	24.4	36.7	16.1	***0.000***

p-values in bold represent significant differences

breakfast. Children in public schools were 21 times more likely to consume *maandazi* at breakfast than those in private schools ($p<0.001$) while those in private schools consumed significantly more cake and sausages/hotdogs at breakfast ($p<0.001$). There was no significant difference in consumption of other foods for breakfast between children in the two types of schools (Appendix 7).

Overall, the most popular snacks among the study children were predominantly made from refined cereal flours. These included cakes and white bread (consumed by over 40% of the study children), *maandazi* (28%) and chapatti (6%). Other less popular snacks were brown bread and crisps which were consumed by 11% of the children. Just like at breakfast, bread consumed at snack time was spread with margarine or jam, and was mainly white. Fruits were popular as a snack for about 36% of the study children. Significantly more children in private schools consumed white bread ($p<0.000$), margarine ($p<0.001$) and fruits ($p<0.01$) as snacks compared to those in public schools.

On the other hand, *Maandazi,* crisps and chapatti were significantly more popular as snacks among children in public schools than in private schools ($p<0.01$).

All children in this study took lunch within the school compound. The most common foods consumed at lunch were rice, refined flour *ugali* and *githeri*, in that order. Beef was the most common protein-rich food consumed at lunch followed by beans and *ndengu* in that order. Vegetable consumption at lunch was low. Other foods consumed were legume grains and potatoes. A significantly higher proportion of children in public schools consumed rice, chapatti and green grammes for lunch as compared to those in private schools ($p<0.001$). However, consumption of *githeri* and fruits at lunchtime was significantly higher among children in private schools compared to those in public schools ($p<0.001$). There was no significant difference in consumption of other foods consumed at lunch (Appendix 7).

The most commonly consumed food at supper was refined flour *ugali* followed by rice and chapatti in that order. Vegetable consumption was higher at supper (60%) compared to lunch (39%), indicating that the children consumed more vegetables at home than in school. Consumption of beef was also higher at supper than at lunch. Children in public schools were more likely to consume white flour *ugali* for supper compared to those in private schools ($p<0.001$), who in turn, were more likely to consume *githeri* and beef ($p<0.05$).

Consumption of wholemeal foods and fruits for supper among the study children was low. Only 5.0% and 2.1% of the children reported consuming wholemeal *ugali* and wholemeal chapatti, respectively, at supper. Consumption of fruits at supper was below 5% for all the children compared to 19% at lunch and 36% at snack time.

The most popular beverages were sugar sweetened tea, coffee and cocoa/chocolate. Consumption of sweetened ready-to-drink juices and cordials was very common among the study children. Over 40% of the children had taken these juices and nearly one quarter had consumed soda, compared to less than 10% who had taken fresh fruit juice. Milk was mainly consumed in tea or coffee, and only about one quarter (27%) reported consuming fresh milk, yoghurt or *mala*. Children in private schools were significantly more likely to consume fresh milk and/or milk products, and soda compared to those in public schools ($p<0.001$).

4.3.5 Nutritional situation

Nutrition status of the study children was determined using anthropometric indices, namely BMI-for-age Z-scores (BAZ), mean waist circumference and triceps skinfold thickness.

4.3.5.1 Nutrition status of study children

The prevalence of thinness (BAZ <-2SD) was 4.0%, overweight (BAZ>+1SD) was 19.0%, while obesity (BAZ>+2SD) was 5.9%. Overall, there was no significant difference in nutrition status of boys and girls. Although the prevalence of thinness (3.9% among males and 4.2% among females) and obesity (5.8% among males and 6.0% among females) did not differ much between the sexes, it is noted that malnutrition (defined as thinness plus overweight) was higher among females (25.2%) than among males (20.8%). The difference was, however, not significant ($p>0.05$). Similarly, the difference between the prevalence of overweight among female (15.0%) and male (11.0%) pupils was not significant ($p>0.05$).

Table 12 shows the nutrition status of the study children according to school type and sex. A significantly higher proportion of children in public schools had normal body weight compared to those in private schools ($p<0.01$). Combined malnutrition (defined as BAZ< -2SD plus BAZ>+1SD) was therefore significantly higher in private than in public schools. It was also significantly higher among girls in private schools than among girls in public schools (OR 2.455, 95% CI 1.203-5.007; p=0.012), but not among boys (OR 2.035, 95% CI 0.92-4.49; p=0.076). Prevalence of thinness in public schools was more

Table 12: Nutrition status of study children by sex and type of school

Nutritional status	All children (%)			Private school (%)			Public school (%)		
	Private (n=138)	Public (n=183)	*p-value*	Male n=70	Female n=68	*p-value*	Male n=84	Female n=99	*p-value*
Thinness	2.2	5.5	0.139	0.0	4.4	0.763	7.1	4.0	0.551
Normal	68.8	83.1	***0.003***	72.9	64.7	0.301	84.5	81.8	0.627
Overweight	29.0	11.5	***0.000***	27.1	30.9	0.628	8.3	14.1	0.219
Obese	10.9	2.2	***0.001***	11.4	10.3	0.831	1.2	3.0	0.749

p-values in bold represent significant differences
Thinness = BMI-for-age z-score <-2SD; Overweight= BMI-for-age z-score >+1SD, obesity= BMI-for-age z-score >+2SD;

than double that in private schools. However, children in private schools were 3.2 times more likely to be overweight (OR 3.15, 95% CI 1.755-5.65; p=0.000) and 5.5 times more likely to be obese (BAZ>+2SD) (OR 5.457; 95% CI 1.769-16 83; p=0.001) compared to those in public schools. In both private and public schools, the prevalence of overweight was higher than that of thinness.

4.3.5.2 Anthropometric characteristics of study population

The anthropometric characteristics of the study children are shown in Table 13. The children had a mean BMI and BAZ of 18.2±3.37 kg/m^2 and -0.08, respectively. Means of anthropometric parameters of males and females were compared using the Students t-test for data that was normally distributed and Mann-Whitney-U for non-normally distributed data. All parameters were significantly higher in girls than in boys except for BAZ. A similar trend was observed when anthropometric characteristics were compared according to the type of school. They were all significantly higher among children in private than among those in public schools (p<0.05).

Table 13: Anthropometric characteristics of study children by sex

Anthropometric Characteristic	Mean (±SD) All N=321	Boys n=154	Girls n=167	*p-value*
Weight (kg)[a]	40.1 (9.28)	38.5 (8.08)	41.6 (10.07)	***0.007***
Height (cm)[a]	148.0 (0.08)	147.0 (0.08)	149.0 (0.08)	***0.006***
WC (cm)[a]	65.5 (8.90)	64.2 (8.15)	66.7 (9.44)	***0.011***
TSFT(mm)[a]	18.8 (5.99)	10.5 (5.60)	13.1 (6.10)	***0.000***
BMI(kg/m²)[a]	18.2 (3.37)	17.8 (2.87)	18.5 (3.70)	***0.012***
BAZ[a]	-0.08 (1.24)	-0.15 (1.18)	-0.02 (1.30)	0.365

p-values in bold represent significant differences
BMI: Body Mass Index; BAZ: BMI-for-age z –score; WC: Waist Circumference; TSFT: Triceps Skinfold Thickness; [a] significantly higher private than public schools ($p<0.05$)

Boys in private schools were significantly heavier, had significantly higher BMI, BAZ, waist circumference (WC) and triceps skinfold thickness (TSFT) than boys in public schools ($p<0.05$) (Table 14). Similarly, girls in private schools were significantly heavier and had significantly higher waist circumference and triceps skinfold thickness compared to girls in public schools ($p<0.05$). While there was no significant difference in mean height between boys in private schools and those in public schools ($p>0.05$), girls in private schools were significantly taller than those in public schools ($p<0.05$). However, girls in private schools had a insignificantly higher mean BMI than girls in public schools ($p>0.05$).

Comparison of anthropometric characteristics within schools is also shown in Table 14. While girls in public schools were significantly heavier than boys in the same schools ($p<0.05$), there was no significant difference in weight between boys and girls in private schools ($p>0.05$).

Table 14: Anthropometric characteristics of study children by sex and school type

Within sex comparison of anthropometric characteristics						
Anthropometric characteristic	Male Mean (SD)			Female Mean (SD)		
	Private school n=70	Public school n=84	*p-value*	Private school n=68	Public school n=99	*p-value*
Weight (kg)	40.6 (8.80)	36.7 (6.96)	***0.007***	43.6 (10.68)	40.2 (9.43)	***0.050***
Height (cm)	147.0 (0.08)	146.0 (0.08)	0.285	151.0 (0.08)	148.0 (0.08)	***0.030***
BMI (kg/m^2)	18.6 (3.43)	17.1 (2.02)	***0.003***	19.2 (4.30)	18.2 (3.29)	0.341
BAZ	0.23 (1.21)	-0.46 (1.06)	***0.000***	0.15 (1.45)	-0.14 (1.18)	0.169
WC (cm)	68.4 (8.48)	60.6 (5.86)	***0.000***	70.7 (9.45)	63.9 (8.40)	***0.000***
TSFT (mm)	12.4 (6.46)	8.9 (4.16)	***0.000***	14.7 (6.54)	12.0 (5.57)	***0.007***

Within school comparison of anthropometric characteristics						
	Private Schools			Public Schools		
	Male n=70	Female n=68		Male n=84	Female n=99	
Weight (kg)	40.6 (8.80)	43.6 (10.69)	0.084	36.7 (6.96)	40.2 (9.43)	***0.009***
Height (cm)	147.0 (0.08)	151.0 (0.08)	***0.018***	146.0 (0.08)	148.0 (0.08)	0.085
BMI (kg/m^2)	18.6 (3.43)	19.2 (4.30)	0.757	17.1 (2.02)	18.2 (3.29)	***0.018***
BAZ	0.23 (1.21)	0.16 (1.45)	0.659	-0.46 (1.06)	-0.14 (1.18)	0.054
WC (cm)	68.4 (8.48)	70.7 (9.45)	0.136	60.6 (5.86)	63.9 (8.40)	***0.005***
TSFT (mm)	12.4 (6.46)	14.7 (6.54)	***0.010***	8.9 (4.16)	12.0 (5.57)	***0.000***

p-values in bold represent significant differences

BMI-Body Mass Index; BAZ-BMI-for-age z-score; TSFT-Triceps Skinfold Thickness; WC-Waist Circumference

However, in private schools, girls were significantly taller than boys ($p<0.05$), as opposed to public schools, where there was no significant difference in height between girls and boys ($p>0.05$). While girls in public schools had significantly higher BMI, WC and TSFT compared to boys in the same schools ($p<0.05$), the difference was only significant for TSF in private schools ($p<0.05$).

When the anthropometric characteristics were compared according to age, there was no significant difference between boys and girls aged 9-10 years for all the parameters (Table 15). However, for children aged 11-12 years, all parameters except BMI were

Table 15: Anthropometric characteristics of school children in Nairobi by age and sex

Age range (years)	Anthropometric characteristic	Mean (SD)		*p-value*
		Males (n=12)	Females (n=17)	
9-10	Weight(kg)	33.3 (5.69)	38.2 (14.78)	0.226
	Height (cm)	1.4 (0.06)	1.43 (0.07)	0.167
	BMI(kg/m²)	17.1 (2.63)	18.4 (5.53)	0.402
	WC (cm)	61.7 (7.69)	63.9 (11.36)	0.149
	TSFT(mm)	10.7 (5.6)	14.4 (7.83)	0.541
		Males (n=126)	Females (n=137)	
11-12	Weight(kg)	38.6 (8.20)	41.6 (9.37)	***0.006***
	Height(cm)	147.0 (0.08)	149.0 (0.07)	***0.004***
	BMI(kg/m²)	17.9 (3.00)	18.5 (3.57)	0.080
	WC(cm)	64.5 (8.42)	66.8 (9.26)	***0.037***
	TSFT(mm)	10.8 (5.81)	12.7 (5.65)	***0.006***
		Males (n=16)	Females (n=13)	
13-14	Weight(kg)	40.9 (7.32)	45.0 (9.33)	0.208
	Height(cm)	151.0 (0.08)	153.0 (0.09)	0.701
	BMI(kg/m²)	17.8 (1.73)	19.2 (2.81)	0.124
	WC(cm)	62.9 (5.97)	68.6 (8.13)	***0.051***
	TSFT(mm)	8.4 (2.94)	14.7 (8.13)	***0.018***

BMI: Body Mass Index; BAZ: BMI-for-age z –score; WC: Waist Circumference; TSFT: Triceps Skinfold Thickness

significantly higher for girls than for boys ($p<0.05$). Among the 13-14 year old children, all parameters were higher for girls than boys but the difference was significant only for WC and TSFT ($p<0.05$).

4.4 Factors Associated with Overweight

The factors investigated included demographic and socio-economic factors, access to selected sedentary recreation and physical activity enhancing gadgets and equipment, means of transport to and from school, participation in physical activity, sedentary recreation, dietary practices and food consumption.

4.4.1 Overweight by socio-demographic and economic characteristics

Table 16 shows the prevalence of overweight based on children's characteristics. The characteristics included type of school, sex, age, number of siblings, birth order and which parent the child lived with. Prevalence of overweight was significantly higher in private than in public schools ($p<0.001$). When each gender was considered separately, the prevalence of overweight among boys in private schools was three times higher than among those in public schools, and the difference was significant ($p<0.01$). Similarly, girls in private schools were nearly three times more likely to be overweight compared to those in public schools ($p<0.01$). However, within the schools, there were no significant differences in overweight status between boys and girls ($p>0.05$).

Overweight was highest among children aged 9-10 years and lowest among 13-14 year olds. Living with both parents (father and mother) increased the risk of being overweight by 81%.

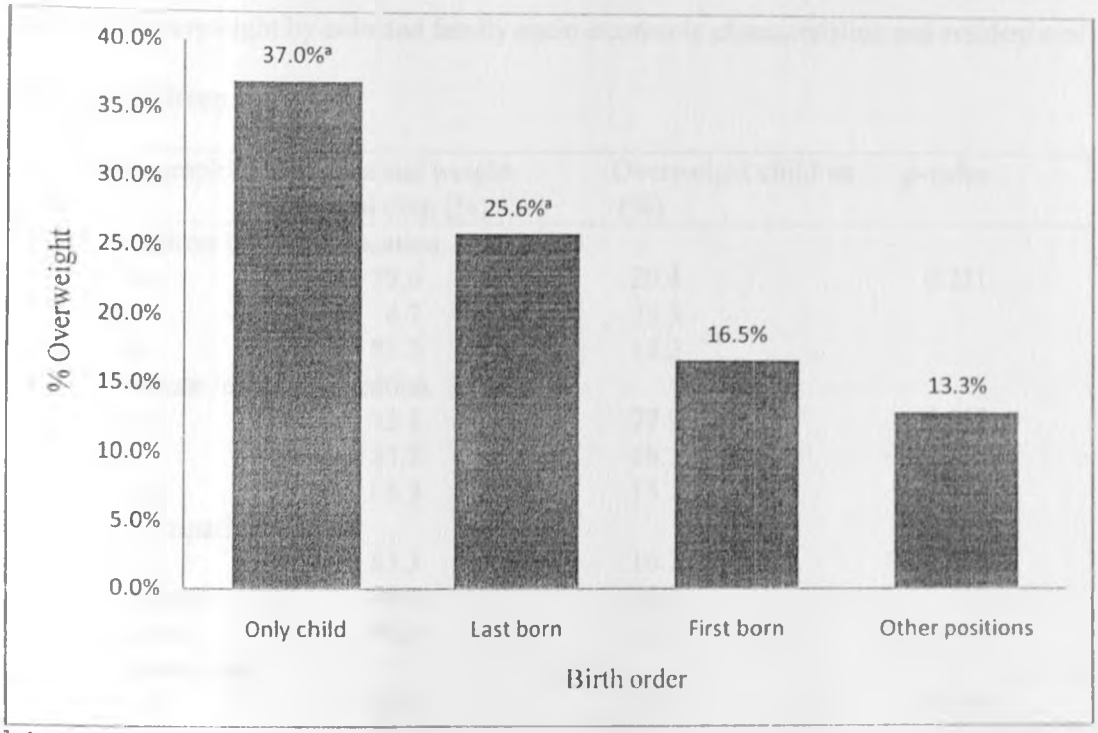
On average, the study children had 2 siblings, with an overall range of none to nine (9) siblings. There was a trend of decreasing prevalence of overweight with increasing number of siblings. Children who had no siblings were 2.6 times more likely to be overweight compared to those with one or more siblings ($p<0.05$).

Table 16: Overweight by socio-demographic characteristics of the study children

Socio-demographic factors	Normal Children (%)	Overweight children (%)	Odds Ratio (95% CI)	*p-value*
Type of school				
Private	70.1	29.9	3.1 (1.72-5.58)	***0.000***
Public	87.9	12.1		
Sex				
Male	82.4	17.6	0.76 (0.43-1.34)	0.343
Female	78.1	21.9		
Male				
Private	72.9	27.1	3.78(1.48-9.66)	***0.004***
Public	91.0	9.0		
Female				
Private	67.2	32.8	2.86 (1.32-6.18)	***0.006***
Public	85.4	14.6		
Age				
9-10	75.0	25.0	-	0.411
11-12	79.8	20.2		
13-14	98.9	1.1		
Having siblings or not				
No sibling	63.0	37.0	2.65 (1.15-6.13)	***0.020***
≥1 siblings	81.9	18.1		
Number of siblings				
No sibling	63.0	37.0	2.86 (1.15-7.11)	***0.020***
1-2 siblings	81.0	19.0	2.51 (1.05-6.03)	***0.030***
≥ 3 siblings	82.9	17.1	1.00	
Parent child lives with				
Both parents	78.7	21.3	1.81 (0.84-3.89)	0.128
One parent	87.0	13.0		

p-values in bold represent significant differences

When overweight was compared according to the birth order, there was a significant difference ($p<0.05$) in overweight based on the birth order, with the highest prevalence being among those children who had no siblings, followed by last born and first born (Figure 6).



[a] significantly higher than other birth positions

Figure 6: Overweight by child's birth order

The prevalence of overweight was also compared based on highest levels of education attained by parents of the children (Table 17). The mothers' and fathers' level of education did not make a significant difference in rates of overweight ($p>0.05$). However, the prevalence of overweight was highest among children whose fathers had university level education, followed by those whose mothers had college and university education. The prevalence was lowest among children whose mothers and fathers had achieved secondary school level of education.

There was a significant difference in overweight rates based on the occupation of mothers of the children ($p<0.05$), but not that of fathers. For both parents, the rate was highest

Table 17: Overweight by selected family socio-economic characteristics and residence of the study children

Socio-demographic factors	Normal weight Children (%)	Overweight children (%)	*p-value*
Mother's highest level of education			
University	79.6	20.4	0.221
College	74.7	25.3	
Secondary	85.3	14.3	
Father's highest level of education			
University	72.1	27.9	0.058
College	83.7	16.3	
Secondary	86.8	13.2	
Mother's occupation			
Employed	83.3	16.7	**0.023**
Self-employed	68.6	31.4	
Unemployed	84.8	15.2	
Father's occupation			
Employed	80.2	19.8	0.636
Self-employed	77.4	22.6	
Type of housing			
Apartment	84.5	16.3	***0.028***
Bungalow	70.9	29.1	
Detached house	86.8	13.1	
Single room	82.4	17.6	

p-values in bold represent significant differences

among children whose parents were self-employed, and lowest among children of unemployed mothers. When the type of residence was considered, there was a significant difference in overweight ($p<0.05$). Overweight was lowest among children who lived in residences with own compounds and highest among those who lived in residential courts (bungalows/maisonettes). Prevalence was similar among children who lived in apartment blocks and single rooms.

4.4.2 Overweight by access to selected sedentary recreation and physical activity enhancing equipment

Access to television (TV) sets was very high among the study children. Among the 9 children who did not have access to a television set at home, only one was overweight. There was a two-fold risk of overweight among children with access to a family television, while video games in the family television set increased the risk of being overweight by 64% (Table 18). Similarly, a family computer increased the risk of overweight two fold, while having games in the family computer increased the risk by 79%. Similarly, having a computer and computer games in the child's room increased the risk of overweight by 24% and 54% respectively. In addition, children with access to cell phones (either parents' or own) were twice as likely to be overweight when compared to those without access.

Overweight was significantly higher among children with access to a family computer ($p<0.05$), computer games in the family computer ($p<0.05$) and a personal cell phone ($p<0.01$). Further, overweight was lowest among children with no access to cell phones and highest among those with access to at least two cell phones, a difference which was significant ($p=0.013$) (Figure 7).

Table 18: Overweight by access to selected recreation equipment promoting sedentary lifestyles

Gadget/ equipment	Normal BMI (%)	Overweight/ obesity (%)	Odds Ratio (Confidence Intervals)	*p-value*
Family Television set				
Yes	79.9	20.1	2.01 (0.25-16.37)	0.507
No	88.9	11.1		
Television set in child's room				
Yes	82.1	17.9	0.87 (0.37-2.08)	0.756
No	79.9	20.1		
Video games in living room				
Yes	78.1	21.9	1.64 (0.84-3.21)	0.145
No	85.4	14.6		
Video games in child's room				
Yes	93.3	6.7	0.27 (0.01-1.90)	0.329
No	79.5	20.5		
Family computer				
Yes	75.0	25.0	2.02 (1.12-3.62)	***0.017***
No	85.8	14.2		
Computer in child's room				
Yes	76.9	23.1	1.24 (0.48-3.23)	0.662
No	80.5	19.5		
Computer games in family computer				
Yes	74.8	25.2	1.79 (1.02-3.15)	***0.041***
No	84.2	15.8		
Computer games in child's room				
Yes	73.3	26.8	1.54 (0.65-3.66)	0.321
No	80.9	19.1		
Personal cell phone with games				
Yes	73.0	27.0	2.09 (1.19-3.69)	***0.010***
No	84.9	15.1		
Parent's cell phone with games				
Yes	78.6	21.4	2.23 (0.84-5.91)	0.099
No	89.1	10.9		

p-values in bold represent significant differences

Table 19 shows the prevalence of overweight by access to physical activity enhancing equipment at home. There was no significant association between access to these equipment and overweight.

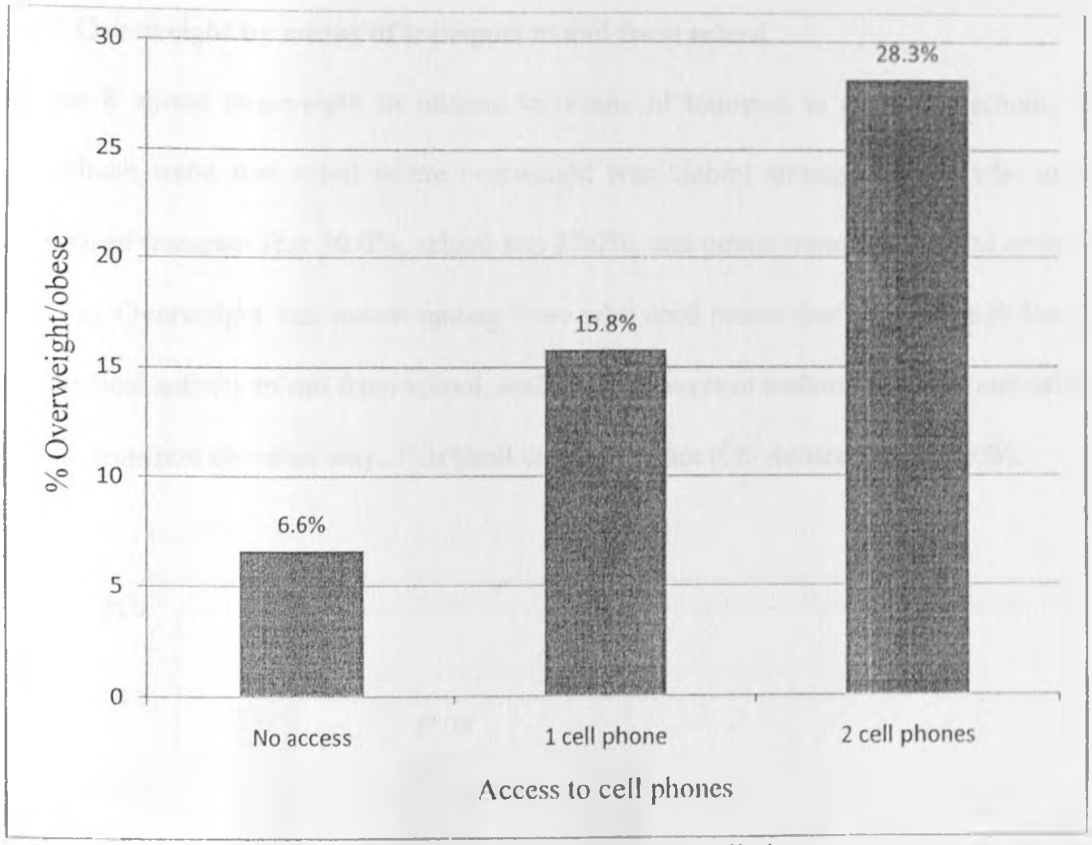


Figure 7: Relationship between overweight and access to cell phones

Table 19: Overweight by access to physical activity enhancing equipment

Gadget/ equipment	Normal Children (%)	Overweight Children (%)	Odds Ratio (CI)	*p-value*
Bicycle				
Yes	79.1	20.9	0.85 (0.48-1.50)	0.574
No	81.7	18.3		
Roller skates				
Yes	65.2	34.8	0.43 (0.17-1.06)	0.121
No	81.4	18.6		
Foot ball				
Yes	80.0	20.0	0.97 (0.55-1.71)	0.924
No	80.4	19.6		
Basket ball				
Yes	77.4	22.6	0.81 (0.41-1.59)	0.539
No	80.9	19.1		

4.4.3 Overweight by means of transport to and from school

Figure 8 shows overweight in relation to means of transport to and from school. A significant trend was noted where overweight was highest among children who used motorised transport (car 30.0%, school bus 27.0%, and public transport -*matatu or* bus- 24.2%). Overweight was lowest among those who used means that required high levels of physical activity to and from school: walking both ways or walking one way and using public transport the other way. This trend was significant (Chi-square test $p=0.039$).

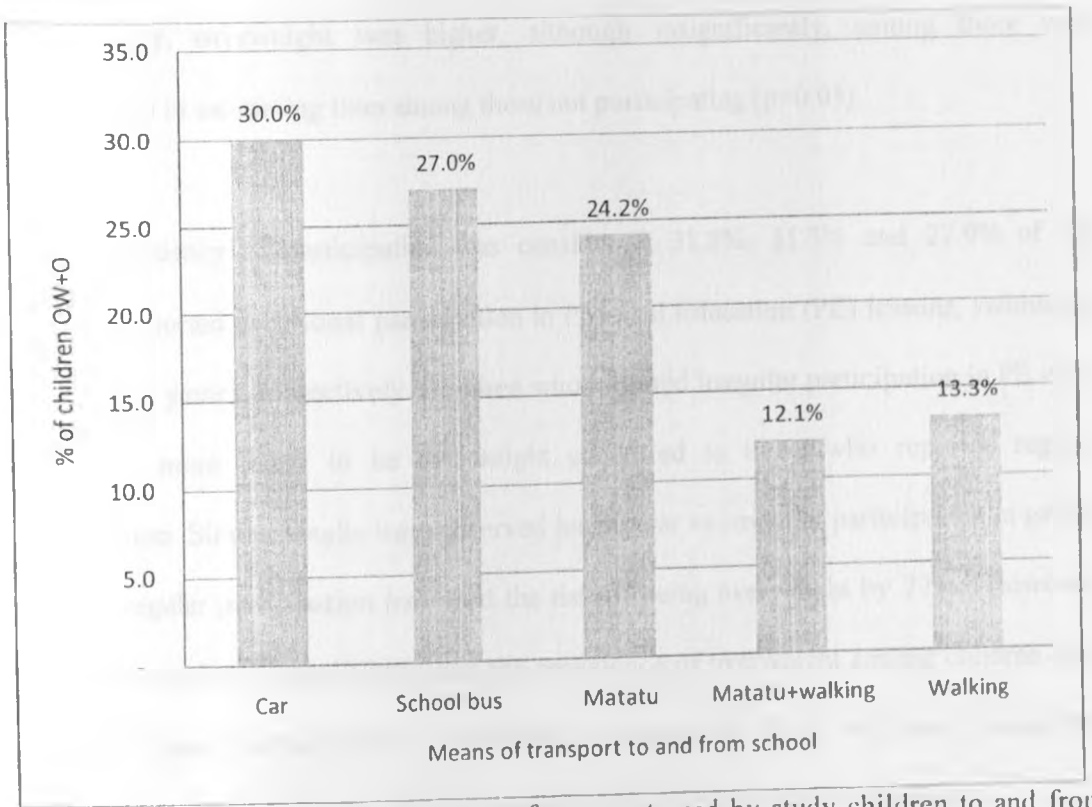


Figure 8: Overweight based on means of transport used by study children to and from school

4.4.4 Overweight by participation in physical activity in school

Table 20 shows the prevalence of overweight by participation in physical activities in school. The activities considered here included Physical Education (PE), swimming and games. Prevalence of overweight was significantly higher among children who did not have scheduled PE lessons compared to those whose schools scheduled PE lessons ($p<0.001$). Among those with PE in the school timetable, overweight was significantly higher among those not participating ($p<0.001$). Children not participating in PE were 3.2 times more likely to be overweight compared to those who participated ($p<0.001$). Interestingly, overweight was higher, although insignificantly, among those who participated in swimming than among those not participating ($p>0.05$).

When frequency of participation was considered, 31.8%, 31.3% and 27.9% of the children reported occasional participation in Physical Education (PE) lessons, swimming lessons and games, respectively. Children who reported irregular participation in PE were 2.4 times more likely to be overweight compared to those who reported regular participation. Similar results were observed for regular vs irregular participation in games where irregular participation increased the risk of being overweight by 77%. However, there was no significant difference in the prevalence of overweight among children who reported regular participation in swimming compared to those with only occasional participation ($p>0.05$). In fact, the prevalence rate was higher among the former.

Table 20: Overweight by participation in physical activity in school

Physical activity	Normal weight (%)	Overweight (%)	Odds Ratio (CI)	*p-value*
PE scheduled in school timetable				
Yes	87.9	12.1	0.33 (0.18-0.59)	***0.000***
No	70.4	29.6		
Swimming scheduled in school timetable				
Yes	77.6	22.4	0.54 (0.27-1.07)	0.076
No	86.5	13.5		
Games scheduled in school timetable				
Yes	80.2	19.0	-	-
No	0.0	0.0		
Participation in Activity				
PE				
Yes	88.3	11.7	3.22 (1.78-5.83)	***0.000***
No	70.1	29.9		
Swimming				
Yes	77.5	22.5	0.60 (0.32-1.12)	0.106
No	85.2	14.8		
Games				
Yes	80.9	19.1	2.11(0.54-7.10)	0.308
No	66.7	33.3		
Frequency of participation				
PE				
Regular	91.5	8.5	2.43 (0.95-6.25)	0.059
Irregular	81.5	18.5		
Swimming				
Regular	75.3	24.3	0.72 (0.34-1.51)	0.384
Irregular	81.3	18.8		
Games				
Regular	83.5	16.5	1.77 (0.96-3.27)	0.067
Irregular	74.1	25.9		

p-values in bold represent significant differences

4.4.5 Overweight by participation in activities away from school

A comparison of overweight by activities in which the study children were involved in away from school is shown in Table 21 and Appendix 8. Overall, overweight children spent more time on sedentary activities (SA) than normal weight children on all weekdays except on Sundays. After school, overweight children spent significantly

Table 21: Overweight by time spent by school children in Nairobi on various activities after school

Period	Time (hours) Mean(±SD)		*p-value*
	Normal weight children	Overweight children	
	Sedentary Activities (SA)		
After school	2.97 (1.19)	3.29 (1.34)	***0.044***
Saturdays	5.81 (2.88)	5.95 (2.67)	0.630
Sundays	3.83 (2.39)	3.65 (2.39)	0.614
Holidays	7.03 (3.68)	7.84 (3.72)	0.104
	Moderate-Intensity Physical Activities MIPA)		
After school	0.43 (0.58)	0.41 (0.66)	0.314
Saturdays	1.15 (1.15)	0.98 (0.96)	0.931
Sundays	0.80 (1.32)	0.59 (0.65)	0.868
Holidays	5.15 (2.96)	5.05 (2.99)	0.576
	Vigorous-Intensity Physical Activities (VIPA)		
After school	0.51(0.89)	0.41 (0.67)	0.549
Saturdays	3.09 (2.43)	2.86 (2.52)	0.351
Sundays	2.03 (1.99)	1.57 (1.76)	0.087
Holidays	4.15 (2.96)	4.05 (2.89)	0.876

more time on SA compared to normal weight children. During holidays, overweight children spent nearly 50 minutes more on SA than normal weight children, although the difference was not significant ($p>0.05$).

Overweight children generally spent less time on moderate intensity physical activities (MIPA) and vigorous intensity physical activities (VIPA) compared to normal weight children, although the differences were not significant ($p>0.05$).

4.4.6 Overweight based on selected family factors

Among family factors investigated were: family meals, television viewing at meal times, cooking methods and cooking oils/fats commonly used at home and whether children received food rewards (Table 22). Among these, overweight was significantly higher among children who did not have family meals compared to those who reported having family meals ($p<0.01$). Children from public schools were 4.4 more likely to have family meals compared to children from private schools (OR 4.38; 95% CI 1.96-9.78 $p=0.000$). The prevalence of overweight was significantly higher among children who did not receive foods and/or drinks as rewards for work well done or good behaviour compared to those who received food rewards (Table 22).

Table 22: Overweight by selected family characteristics

Family characteristic	Normal weight children (%)	Overweight children %)	Odds Ratio (CI)	p-value
Eat meals together				
Yes	82.8	17.2	0.26 (0.12-0.57)	***0.001***
No	55.2	44.8		
Preferred food				
Home food	82.0	18.0	1.79 (0.91-3.53)	0.088
Eating out	71.7	28.3		
Watch TV at meal times				
Yes	80.3	19.7	0.92 (0.45-1.87)	0.960
No	78.9	21.1		
Food rewards				
Yes	83.0	17.0	0.54 (0.99-0.98)	***0.041***
No	72.6	27.4		
Cooking fat/oil				
Oil	79.2	20.8	1.12 (0.63-1.97)	0.822
Fat	81.5	18.5		
Cooking method				
Healthy†	80.5	19.5	1.09 (0.55-2.18)	0.937
Unhealthy‡	79.0	21.0		

†: defined as stewing/boiling/steaming; ‡: defined as frying/deep frying

Children from public schools were more likely to receive food rewards compared to those from private schools ($p<0.05$; Table 9). In addition, children who had no siblings (among whom overweight was significantly higher than the rest) were more likely to eat while watching television compared to the rest ($p<0.0001$). Overweight was higher among children who preferred eating out compared to those who preferred home food, although the difference was not significant ($p>0.05$). Other factors that did not have a significant effect on overweight were the type of cooking oil/fat commonly used at home and the predominant methods of cooking used at home.

4.4.7 Predictors of Overweight

Upon regression analysis, the predicting variables for overweight were found to be being in a private school, having a mother who is in self-employment, being an only child (having no siblings), having access to a cell phone and not having family meals (Table 23).

Table 23: Regression analysis for predictors of overweight

Predicting variable	Wald statistics	*p-value*	Exp (ß)	Odds Ratio (95% CI)
Child in a private school	4.661	***0.031***	2.984	1.09 (1.11-8.05)
Self employed mother	6.665	***0.010***	3.167	1.15 (1.32-7.60)
Child has no siblings	4.927	***0.026***	6.277	1.84 (1.24-31.78)
Access to family cell phone	4.231	***0.040***	8.765	2.17 (1.11-69.36)
No family meals	3.938	***0.047***	2.773	3.91 (1.77-8.66)

p-values in bold represent significant differences

4.4.8 Overweight based on dietary practices

Table 24 and Appendix 9 compare food consumption between overweight children and normal weight children. Overall, refined carbohydrate rich cereal foods were more popular among the study children than wholemeal cereal foods. Consumption of white bread and *githeri* was significantly higher among overweight children compared to children with normal weight ($p<0.01$). On the other hand, normal weight children consumed significantly more cake, *maandazi*, eggs and vegetables than overweight children ($p<0.01$). Also, more normal weight children tended to consume wholemeal cereal foods than overweight children, although the differences were not significant ($p<0.05$) (Appendix 9).

Consumption of vegetables was significantly higher among normal weight children compared to overweight children ($p<0.0001$). Although fruit consumption was higher among overweight children, the difference was not significant ($p>0.05$). Similarly consumption of crisps, and fried potatoes (chips/bhajia) was higher among overweight children, but the difference was not significant ($p>0.05$). However, overweight children consumed significantly more fat as bread spread and sweetened beverages compared to normal weight children ($p<0.0001$ and $p<0.05$, respectively). Other foods whose consumption did not differ between normal weight and overweight children are shown in Appendix 9.

Table 24: Overweight by food and drinks consumed by study children in the previous 24 hours

Food /drink	Percent of children consuming			Odds Ratio (95% CI)	*p-value*
	All N=308	Normal weight (n=247)	Overweight (n=61)		
White bread	89.3	85.0	98.4	10.57 (1.42-78.64)	***0.009***
White *ugali*	60.4	64.4	44.3	0.44 (0.25-0.78)	***0.004***
Cake	48.8	51.8	36.1	0.52 (0.29-0.94)	***0.027***
Maandazi	37.3	42.1	18.0	0.30 (0.15-0.61)	***0.000***
Githeri	30.2	25.5	49.2	2.83 (1.59-5.04)	***0.000***
Eggs	14.9	17.4	4.9	0.25 (0.07-0.82)	***0.014***
Green grams	13.3	15.4	4.9	0.28 (0.08-0.95)	***0.030***
Vegetables	88.0	93.5	65.6	0.13 (0.06-0.27)	***0.000***
Margarine	64.3	57.9	90.2	6.67 (2.77-16.07)	***0.000***
Sweetened black tea/coffee/cocoa	14.6	12.6	23.0	2.08 (1.03-4.20)	***0.050***

p-values in bold represent significant differences

4.5 Comparison of Control and Intervention Groups at Baseline

The baseline characteristics of the study children were determined before implementation of the intervention.

4.5.1 Comparison of baseline characteristics by study groups

The two study groups were similar in most demographic and socio-economic characteristics except for type of housing, levels of education of mothers and fathers and means of transport to and from school (Tables 25 and 26). A significantly higher proportion of children in the intervention group (IG) lived in single rooms compared to those living in detached (own compound) homes (Chi-square test, $p<0.05$) (Table 25). There was also a significantly higher number of children in the control group (CG) whose mothers had college level education ($p<0.0001$), while in the IG, there was a higher

Table 25: Baseline comparison of key socio-economic characteristics by study groups

Characteristic	IG (n=182) n (%)	CG (n=162) n (%)	*p-value*
Sex			
Male	45.5	50.3	0.440
Female	54.5	49.7	
School status			
Private	41.8	38.1	0.482
Public	58.2	61.9	
Child living with parents			
Yes	97.4	97.4	0.621
No	2.6	2.6	
Parent child lives with			
One parent	21.3	25.2	0.405
Both parents	78.7	74.8	
Type of housing			
Apartment/flat	27.0	38.7	***0.009***
Bungalow/maisonette	32.8	34.2	
Detached house	23.3	20.6	
Single room	16.9	6.5	
Mother's highest level of education			
Secondary level	38.8	18.4	***0.000***
College	24.3	48.2	
University	38.8	33.3	
Father's highest level of education			
Secondary level	20.4	11.0	***0.000***
College	30.3	54.2	
University	49.3	34.7	
Mother's occupation			
Employed	58.3	61.1	***0.036***
Self-employed	20.6	27.8	
Unemployed	21.1	11.1	
Father's occupation			
Employed	73.9	77.2	0.613
Self-employed	26.1	22.8	

p-values in bold represent significant differences

proportion of fathers who had completed secondary level education and university level education. The proportion of children in the CG walking to and from school was also significantly higher in the CG than in the intervention group (IG) (Table 26) ($p<0.01$).

Table 26: Baseline characteristics of the children by study group

Characteristic	IG (n=182) n (%)	CG (n=162) n (%)	*p-value*
Means of transport to and from school			
Walking	25.4	59.4	***0.000***
School bus	32.3	11.6	
Car	11.6	12.9	
Matatu	15.9	7.7	
Matatu+walking	14.8	8.4	
Participation in activity			
PE	96.4	100.0	0.061
Swimming	89.9	95.0	0.230
Games	92.6	96.8	0.127
Access to sedentary recreation gadget			
Television set			
Family television set	94.2	98.1	0.070
Television set in child's room	11.1	12.9	0.610
Video/VCD games			
Video games in family room	66.1	72.9	0.176
Video games in child's room	4.2	4.5	0.898
Computer			
Family computer	48.7	51.0	0.672
Computer in child's room	8.5	7.1	0.639
Computer games in family room	39.7	41.3	0.762
Computer games in child's room	8.5	9.7	0.696
Cell phone			
Personal cell phone with games	36	40	0.444
Other cell phone with games	83.1	87.1	0.299
Access to physical activity equipment			
Bicycle	53.4	56.1	0.527
Roller skates	8.5	5.8	0.345
Football	53.4	53.5	0.984
Basket ball	19.6	20.0	0.922

p-values in bold represent significant differences

There was no significant difference in access to sedentary recreation gadgets and physical activity enhancing equipment ($p>0.05$).

The Mean Body Mass Index (BMI) of children in the IG was higher than for those in the CG, though the difference was not significant (Table 27). However, weight, height and

Table 27: Comparison of baseline anthropometric characteristics by study group

Measurement	Mean(SD)		Median(range)	
	IG (n=168)	CG (n=153)	IG (n=168)	CG (n=153)
Weight (kg) *	41.8 (10.17)	38.2 (7.81)	40.0 (23.0-89.0)	36.2 (25.0-61.2)
Height (cm) *	149.6 (0.08)	146.1 (0.08)	149.6 (130-173)	146.2 (129-172)
WC (cm) *	67.3 (9.47)	63.4 (7.76)	66.1 (51.5-101.2)	62.3 (50.2-93.8)
TSFT (mm) *	12.0 (5.92)	11.7 (6.08)	10.7 (3.5-36.1)	10.07 (3.3-38.0)
BMI	18.5 (3.56)	17.9 (3.11)	17.5 (11.6-36.4)	17.0 (13.3-28.9)

IG= Intervention group; CG= Control group; WC=Waist circumference; TSFT=Triceps Skinfold Thickness; BMI=Body Mass Index. * Significant difference p<0.05

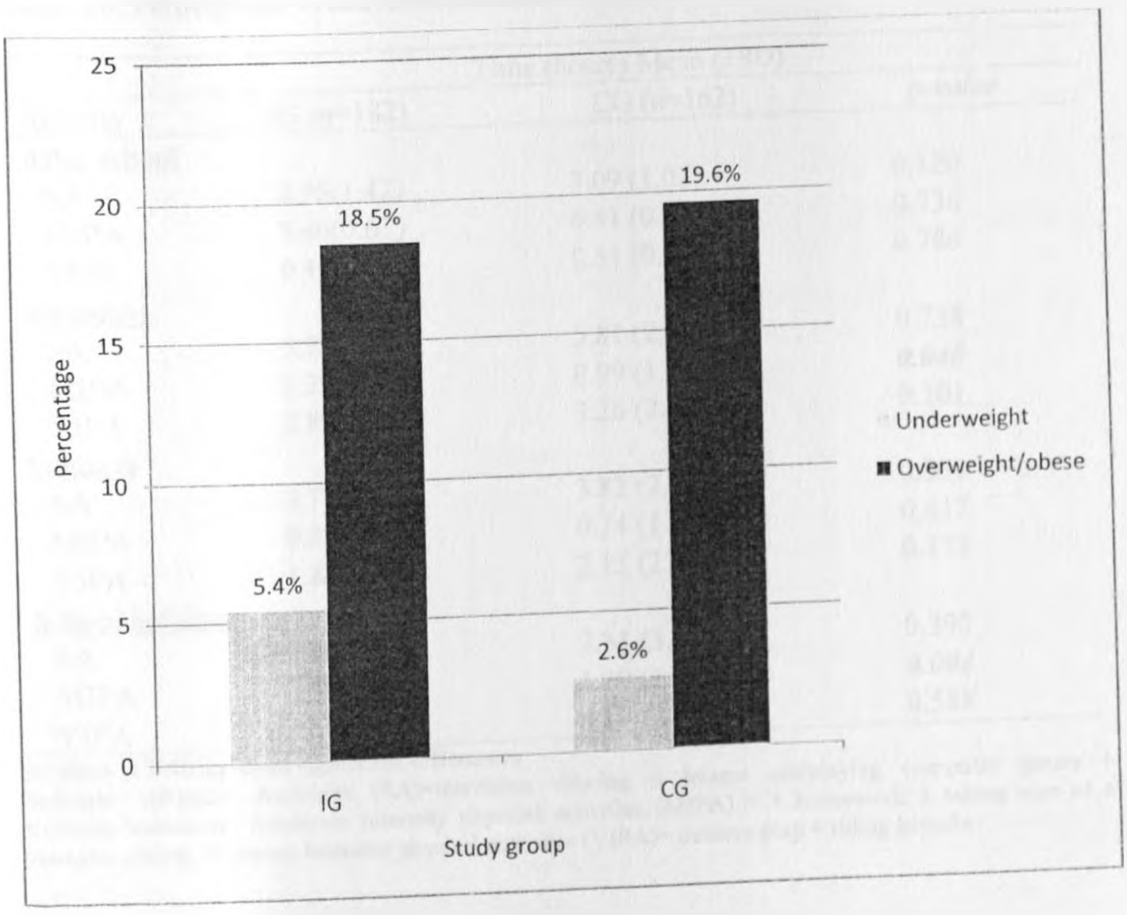


Figure 9: Nutrition status of the study children by study group at baseline

waist circumferences were significantly higher in the IG than in the CG ($p<0.05$). There was no significant difference in overweight between children in the two study groups (Figure 9).

When the level of participation in activities away from school (after school, during weekends and school holidays) was considered, there was no significant variation in time spent by the study children in the various activities except for moderate intensity physical activity (MIPA) on Saturdays and school holidays (Table 28).

Table 28: Participation in activities after school at baseline by study status

	Time (hours) Mean (±SD)		
Activity	IG (n=182)	CG (n=162)	*p-value*
After school			
SA	2.95(1.42)	3.09 (1.02)	0.120
MIPA	0.46(0.63)	0.41 (0.52)	0.736
VIPA	0.49(0.91)	0.51 (0.79)	0.786
Saturdays			
SA	5.73(2.84)	5.81 (2.67)	0.738
MIPA	1.29(1.66)	0.99 (1.14)	***0.048***
VIPA	2.89(2.41)	3.26 (2.43)	0.101
Sundays			
SA	3.77(2.40)	3.82 (2.53)	0.931
MIPA	0.88(1.46)	0.74 (1.05)	0.617
VIPA	1.84(1.87)	2.15 (2.05)	0.175
School holidays			
SA	7.00(3.79)	7.31 (3.55)	0.395
MIPA	1.77(1.98)	1.29 (1.74)	***0.004***
VIPA	4.10(3.03)	4.19 (2.79)	0.588

p-values in bold represent significant differences
Sedentary physical Activities (SA)=television viewing + leisure use/playing computer games + studying/homework; Moderate Intensity physical activities (MIPA) = + housework + taking care of a younger sibling; Vigorous Intensity physical activities (VIPA)= outdoor play + riding bicycle

A comparison of dietary practices of the two study groups is shown in Table 29. Children in the IG consumed significantly more white (refined) flour *ugali*, chicken and vegetables ($p<0.05$).

Table 29: Foods and drinks consumed by study children at baseline

Food /drink	Percent of children consuming		Odds Ratio (95% Confidence Interval)	*p-value*
	IG (n=182)	CG (n=162)		
Cereal based refined foods				
White bread	66.1	99.4	78.85 (10.79-576.3)	***0.000***
Rice	69.8	65.2	1.48 (0.77-2.85)	0.313
Cake	50.3	43.2	1.28 (0.84-1.96)	0.340
Maandazi	39.2	40.6	0.94 (0.61-1.45)	0.865
White *ugali*	75.1	48.4	3.14 (1.99-4.96)	***0.000***
Chapatti/spaghetti	29.6	20.6	1.33 (0.86-2.07)	0.238
Cereal based unrefined foods				
Brown bread	27.5	32.9	1.29 (0.81-2.05)	0.333
Wholemeal *ugali*	5.3	4.5	0.85 (0.35-2.28)	0.936
Githeri	12.7	49.0	155.1 (36.36-66.90)	***0.000***
Meat, dairy and eggs				
Beef stew	50.3	58.1	1.37 (0.89-2.10)	0.182
Hotdog/sausage	16.9	25.2	1.65 (0.98-2.79)	0.081
Eggs	14.8	15.5	0.95 (0.53-1.72)	0.983
Chicken	19.0	9.0	2.37 (1.23-4.58)	***0.014***
Fish	4.2	2.6	3.02 (0.97-9.37)	0.079
Legumes and grains				
Beans stew	13.8	10.3	1.39 (0.71-2.69)	0.422
Green grams	14.3	14.8	1.05 (0.57-1.91)	0.993
Peanuts	7.4	9.7	1.34 (0.63-2.87)	0.576
Vegetables and fruits				
Vegetables	99.5	77.4	54.83 (7.42-405.5)	***0.000***
Fruits	50.8	82.6	4.59 (2.78-7.56)	***0.000***
Roots and tubers				
Boiled potato	24.3	23.2	0.99 (0.60-1.62)	0.930
Chips/bhajia	17.5	12.9	0.59 (0.32-1.09)	0.089
Crisps	11.6	6.5	1.91 (0.88-4.17)	0.144
Fats and oils				
Margarine	43.9	86.5	8.15 (4.74-14.02)	***0.000***

p-values in bold represent significant differences

On the other hand, children in the CG consumed significantly more white bread, *githeri*, fruits and margarine ($p<0.05$). There was no significant difference in consumption of all the other foods.

4.6 Effect of the Intervention on Overweight and the Risk Factors

The effect of the intervention was established by following up the study children for 11 months.

4.6.1 Anthropometric characteristics

Table 30 shows the changes in anthropometric parameters during the study period. Wilcoxon test was used to compare trends in anthropometric characteristics from baseline to the final evaluation.

4.6.1.1 Changes in anthropometric measurements after three months

After three months, children in both groups were significantly heavier and taller than at baseline ($p<0.05$) (Table 30). Children in the IG remained significantly heavier, taller, with higher waist circumferences and triceps skinfold thickness than those in the CG, just as at baseline. While average waist circumference decreased by -0.4cm in the IG, it increased by +0.4cm in the CG. The changes in both groups were however not significant ($p>0.05$). Similarly, triceps skinfold thickness dropped in the IG by -0.2 mm (although insignificantly, $p>0.05$) but increased significantly in the CG by +0.3 mm ($p<0.05$) after three months. The difference in triceps skinfold thickness between the IG and the CG at three months was not significant either. Although the mean BMI of children in the IG

Table 30: Trend in mean anthropometric measurements by time and study group

Measure-ment	Base-line	3 mths	Change	*p-value*	7 mths	Change	*p-value*	11 mths	Change	*p-value*
Intervention group										
Weight (kg)	41.4	43.7	+2.3	***0.000***	45.2	+3.8	***0.000***	46.2	+4.8	***0.000***
Height (m)	149.6	152.3	+2.7	***0.000***	154.9	+5.3	***0.000***	157.1	+7.5	***0.000***
WC (cm)	67.3	66.9	-0.4	0.801	66.9	-0.4	0.929	65.6	-1.7	***0.005***
TSF (mm)	12.0	11.8	-0.2	0.785	11.9	-0.1	0.298	11.7	-0.3	0.369
BMI (kg/m^2)	18.5	18.7	+0.2	***0.002***	18.7	+0.2	***0.008***	18.5	0.00	0.058
BAZ	-0.04	-0.17	-0.13	***0.022***	-0.27	-0.23	***0.000***	-0.18	-0.14	***0.000***
Control Group										
Weight (kg)	38.2	39.9	+1.7	***0.000***	41.5	+3.3	***0.000***	43.7	+5.5	***0.000***
Height (m)	146.1	148.3	+2.2	***0.000***	150.6	+4.5	***0.000***	152.0	+5.9	***0.000***
WC (cm)	63.4	63.8	+0.4	0.634	64.2	+0.8	0.054	64.4	+1.0	***0.034***
TSF (mm)	11.7	12.0	+0.3	***0.052***	12.4	+0.7	***0.001***	12.8	+1.1	***0.000***
BMI (kg/m^2)	17.9	18.1	+0.2	***0.000***	18.2	+0.3	***0.000***	18.7	+0.8	***0.000***
BAZ	-0.13	-0.15	-0.02	0.925	-0.23	-0.10	***0.027***	-0.18	-0.05	***0.038***

p-values in bold represent significant differences; mths=months; TSFT=Triceps Skinfold thickness; WC=Waist Circumference; BMI=Body Mass Index; BAZ=BMI-for-age z-scores

remained higher than that in the CG, the difference was not significant (Table 30). There was however a significant increase in BMI between baseline and three months in both study groups ($p<0.01$). While BAZ had decreased in both groups at three months, the decrease was only significant in the IG ($p<0.05$).

4.6.1.2 Changes in anthropometric measurements after seven months

Children in both study groups continued to put on weight and grow in height, and the increments were significant compared to baseline ($p<0.05$) (Table 30). While there was no change in mean BMI in the IG between three and seven months, the difference in mean BMI was significant when compared to baseline ($p<0.05$), as was the case in the CG also. After 7 months, waist circumference had decreased in the IG by -0.2cm but increased in the CG by +0.8cm, although the changes were not significant ($p>0.05$). Similarly, TSFT decreased insignificantly in the IG group, but increased significantly in

the CG ($p<0.05$). BAZ had decreased significantly in both groups by seven months ($p<0.05$), but the decrease was greater in the IG than the CG (-0.23 and -0.01, respectively).

4.6.1.3 Changes in anthropometric measurements after 11 months

The trend of increasing weight and height continued until the end of the study, with the measurements being significantly higher after 11 months than at baseline in both study groups ($p<0.01$). However, on average, children in the CG added more weight (mean increase of +5.5kg) compared to a mean increment of 4.8kg in the IG. On the contrary, mean increase in height was higher in the IG (7.5m) compared to 5.9m in the CG. While WC decreased significantly in the IG compared to baseline (-1.7cm, $p<0.01$), it increased significantly in the CG (+1.0cm, $p<0.05$). TSFT decreased (-0.3mm), although not significantly ($p>0.05$), in the IG, but increased significantly ($p<0.05$) by +1.1mm in the CG after 11 months. Mean BMI of children in the IG remained unchanged at 11 months, but had increased significantly ($p<0.001$) by a mean of 0.8kg/m^2 in the CG in the same period. BAZ decreased significantly in both groups ($p<0.05$), and the decrease was greater in the IG (-0.14) than in the CG (-0.05).

At the end of the third school term, the difference in weight, waist circumference and BMI was not significant between the two groups. Children in the IG remained significantly taller, while those in the CG had significantly higher triceps skinfold thickness when compared to those in the IG at the end of the intervention ($p<0.05$).

Table 31: Change in mean BMI by time and study group

	Mean BMI (kg/m^2)						
Nutrition status	Baseline	3 months	*p-value*	7 months	*p-value*	11 months	*p-value*
Intervention Group							
Normal weight	17.5	17.6	0.114	17.5	0.185	17.5	0.500
Overweight	24.2	24.7	0.230	25.0	0.212	25.0	*0.133*
Control Group							
Normal weight	16.8	17.0	***0.000***	17.3	***0.000***	17.3	***0.000***
Overweight	22.9	23.4	0.290	23.6	0.200	23.9	***0.044***

p-values in bold represent significant differences

Changes in BMI among normal and overweight children, compared to baseline, are shown in Table 31. *P-values* were determined by comparing the mean BMI at the different evaluation periods with baseline mean BMI. While BMI among normal weight children in the IG remained unchanged, it increased significantly ($p<0.05$) among normal weight children in the CG throughout the study period. Mean BMI increased among overweight in both the IG and the CG during the study period, but the increase was only significant ($p<0.05$) after 11 months in the CG.

4.6.2 Effect of the intervention on the prevalence of overweight

At baseline, overweight /obesity in the IG was 18.5% while the rate in the CG was 19.6% (Table 32). At the end of the first school term, the prevalence of overweight in the CG had increased by +2.0% to 21.6% and decreased by 3.2% to 15.3% in the IG. The changes in prevalence in both study groups were, however, not significant ($p>0.05$). At seven months, overweight remained almost constant in the IG, while in the CG, the prevalence was 18.8%, representing an insignificant change ($p>0.05$) compared to baseline. After 11 months, the prevalence in the IG was 15.6% compared to 19.7% in the

Table 32: Nutrition status of the children by study group and time

Nutrition status	Baseline (%)	3 months (%)	*p-value*	7 months (%)	*p-value*	11 months (%)	*p-value*
Intervention Group (IG)							
Thinness	5.4	7.3	0.570	6.6	0.589	4.9	0.629
Normal weight	76.2	77.4		77.9		79.5	
Overweight	18.5	15.3		15.4		15.6	
Control Group (CG)							
Thinness	2.6	7.2	0.786	7.5	0.982	7.1	0.893
Normal weight	77.8	71.2		73.7		73.2	
Overweight	19.6	21.6		18.8		19.7	

p-values in bold represent significant differences

CG, representing a change of -2.9% and +0.1% in the IG and CG, respectively, between baseline and final evaluation. These changes in prevalence between baseline and 11 months were not significant ($p>0.05$). After three months, thinness had increased in both study groups by 1.9% and 4.6% in the IG and CG, respectively. While the proportion of thin children in the IG decreased between three months and 11 months (from 7.3% to 4.9%), the proportion of the same in the CG increased from 7.2% at three months to 7.5% after seven months, then back to 7.1% at 11 months. An increasing trend in proportion of normal weight children was observed in the IG (from 76.2% at baseline to 79.5% after 11 months) compared to a decreasing trend in the CG (from 77.8% at baseline to 73.2% at the end of the study). Overall, the differences in nutrition status between children in both study groups, were, however, insignificant throughout the study period ($p>0.05$).

4.6.3 Effect of the intervention on level of participation in physical activity in school

At baseline, participation in scheduled school activities was higher among children in the CG compared to those in the IG, although the differences were not significant (p>0.05) (Table 33).

Table 33: Participation in scheduled school activities

Nutrition status	Baseline (%)	3 months (%)	*p-value*	7 months (%)	*p-value*	11 months (%)	*p-value*
Intervention Group							
Participation							
PE	96.4	96.8	0.785	97.2	0.949	98.4	0.475
Swimming	89.9	90.0	0.891	91.2	0.856	95.9	0.088
Games	93.1	92.1	0.859	88.2	0.185	97.5	0.144
Frequency of participation							
PE							
Regular	66.0	67.0	0.942	68.1	0.795	85.7	***0.003***
Irregular	34.0	33.0		31.9		14.3	
Swimming							
Regular	71.2	71.0	0.999	60.5	***0.047***	84.6	***0.012***
Irregular	28.8	29.0		39.5		15.4	
Games							
Regular	73.7	74.0	0.927	60.8	***0.023***	79.0	0.370
Irregular	26.3	26.0		39.2		21.0	
Control Group							
Participation							
PE	99.4	96.4	***0.053***	94.8	***0.012***	94.6	***0.035***
Swimming	95.0	92.0	0.471	89.1	0.091	88.7	0.105
Games	93.8	90.2	0.358	85.0	***0.029***	85.0	***0.030***
Frequency of participation							
PE							
Regular	70.5	66.2	0.525	61.6	0.154	67.6	0.699
Irregular	29.5	33.8		38.4		32.4	
Swimming							
Regular	61.4	60.1	0.875	55.1	0.328	59.6	0.965
Irregular	38.6	39.9		44.9		40.4	
Games							
Regular	70.7	68.1	0.810	65.5	0.445	66.9	0.965
Irregular	29.3	31.9		34.5		33.1	

p-values in bold represent significant differences

Throughout the study period, there was an increasing trend in proportion of children participating in PE in the IG, although not significantly. On the contrary, PE participation decreased significantly in the CG during the study period, dropping from 99.4% at baseline to 94.6% after 11 months. Participation in swimming increased steadily, although insignificantly, in the IG, as opposed to a decreasing trend in the CG. Participation in games in the CG decreased significantly ($p<0.05$) after seven and eleven months, while in the IG, there was an insignificant decrease ($p<0.05$) in participation upto seven months. Thereafter, participation increased significantly compared to baseline, reaching a high of 97.5% after 11 months.

A steady increase in regular participation in PE was observed in the IG throughout the study period but the increase was only significant after 11 months (compared to baseline) ($p<0.01$). In the CG, there was a decreasing trend in proportion of children reporting regular participation in PE.

Although initially there was a significant decrease in regular participation in swimming in the IG from 70.2% at baseline to 60.5% at seven months, participation increased to a high of 84.6% after 11 months ($p<0.05$). There was, however, no significant change in regular swimming in the CG ($p>0.05$). Similarly, regular participation in games did not differ significantly in the CG at any of the evaluation periods. In the IG, however, regular participation in games dropped significantly at seven months ($p<0.05$), but thereafter showed an increase which was not significant ($p>0.05$).

4.6.4 Effect of the intervention on activities away from school

The means of transport and the proportion of children using them to travel to and from school remained largely unchanged in both the IG and CG throughout the study period.

Mean time spent on television viewing decreased steadily in the IG both during the school term and during school holidays, but increased in the CG, and remained higher in the latter throughout the study period (Figures 10 and 11). While the differences in television viewing between the two study groups were not significant after one and two school terms, there was a significant difference in mean television viewing between the two study groups at the end of the study ($p<0.05$) with children in the CG spending significantly more time on television viewing per week during the school term and during school holidays than their counterparts in the IG ($p<0.05$).

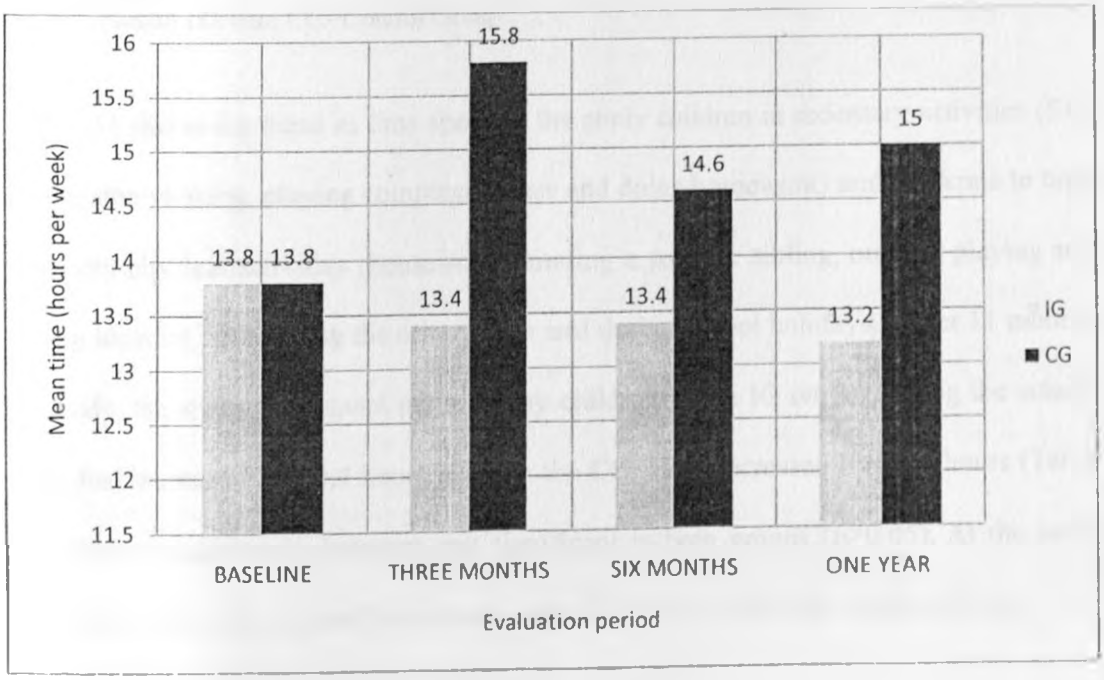


Figure 10: Trend in television viewing in hours per week during school term by study group

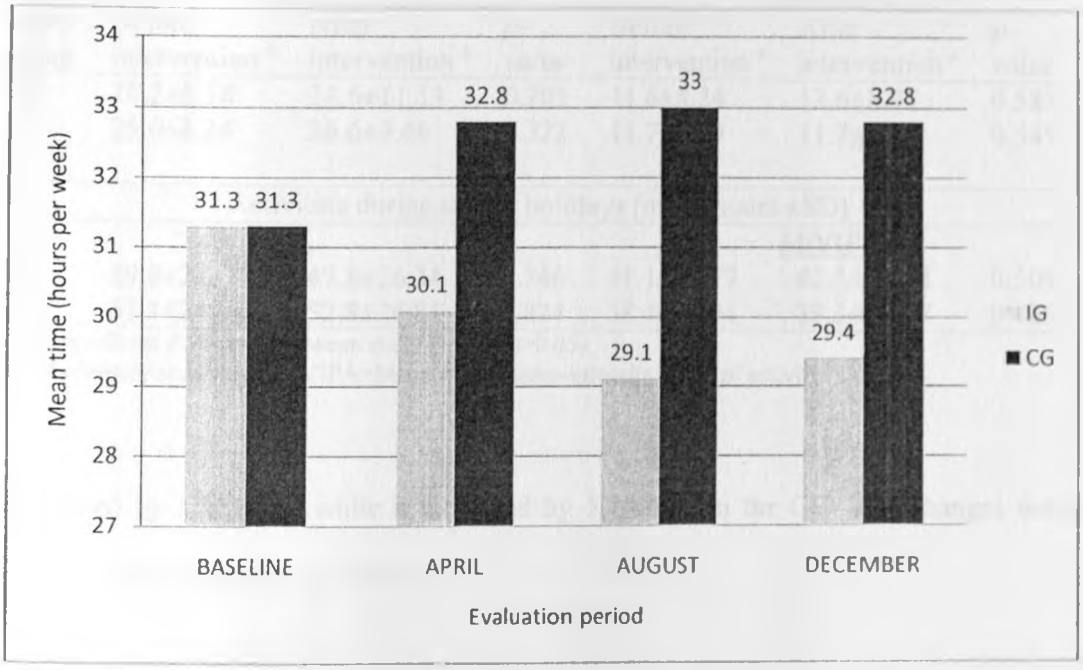


Figure 11: Trend in mean television viewing in hours per week during school holidays by study group
IG=Intervention Group; CG=Control Group

Table 34 shows the trend in time spent by the study children in sedentary activities (SA) (television viewing, playing computer games and doing homework) and moderate to high intensity physical activities (housework, minding a younger sibling, outdoor playing and riding bicycle) both during the school term and during school holidays. After 11 months of study, the mean time spent per week by children in the IG on SA during the school term had increased by +0.4 hours while in the CG it had increased by +1.6 hours (Table 34). The changes were, however, not significant in both groups ($p>0.05$). At the same time, the average time spend by children in the IG on SA during the school holidays

Table 34: Trend in mean time (hours) spent per week on SA and M/VIPA at home

Activities during the school term (mean hours ±SD)						
	SA			M/VIPA:		
Study group	Before intervention [a]	After intervention [a]	*p-value*	Before intervention [a]	After intervention [a]	*p-value*
IG	24.2±8.58	24.6±11.13	0.703	11.6±8.24	12.6±8.95	0.583
CG	25.0±8.34	26.6±9.46	0.322	11.7±7.79	11.7±9.44	0.549
Activities during school holidays (mean hours ±SD)						
	SA			M/VIPA:		
IG	49.0±26.51	47.8±26.34	0.746	41.1±25.77	42.5±21.48	0.509
CG	51.1±24.94	52.8±26.81	0.821	38.4±23.34	39.3±24.27	0.425

[a] no significant difference between study groups (p>0.05)
SA=Sedentary activities; M /VIPA=Moderate/vigorous-intensity physical activity

decreased by 1.2 hours, while it increased by 1.7 hours in the CG. The changes were, however, not significant (p>0.05).

After 11 months, children in the IG reported an increase of 1.0 hours in average time spent at home on moderate to heavy physical activities (M/VIPA) per week during the school term. On the contrary, there was no change in average time spent on the same by children in the CG during the same period.

At the same time, children in both groups reported an increase in mean time spent on M/HIPA during school holidays (+1.4 hours in the IG and +0.9 in the CG). These differences were however not significant (p>0.05). At both baseline and after 11 months, there was no significant difference between the two groups in time spent on SA and M/HIPA, both during the school term or during school holidays (p>0.05).

Table 35 shows the trend in percentage of children watching television for more than two hours per day. In both study groups, there was no significant change in proportion of children viewing television for more than two hours during the period of the study.

Table 35: Proportion of children who watch television for >2 hours per day by time and study group

Study group	Time	Baseline	3 months	*p-value*	7 months	*p-value*	11 months	*p-value*
IG	After school	39.9	41.6	0.846	38.3	0.872	37.9	0.611
	Saturday	83.6	81.8	0.775	84.2	0.991	83.2	0.949
	Sunday	68.3	72.3	0.522	77.4	0.096	77.3	0.117
	Holidays	85.8	90.5	0.271	91.7	0.149	89.1	0.512
CG	After school	40.5	47.5	0.282	41.7	0.937	37.3	0.671
	Saturday	87.6	85.6	0.747	89.4	0.771	84.1	0.513
	Sunday	67.3	74.8	0.201	73.5	0.317	74.6	0.231
	Holidays	90.8	90.6	0.886	89.4	0.832	88.1	0.580

IG=Intervention Group; CG=Control Group

4.6.5 Effect of the intervention on food consumption

Tables 36 and 37 show the patterns of food consumption by time. The refined cereal foods consumed by the study children included white bread, white flour *ugali*, rice, spaghetti and chapatti. The consumption of white flour *ugali* and rice remained high in both groups throughout the study period. White bread remained the most popular snack for children in both groups. At baseline its consumption in the CG was lower than in the IG. It increased significantly by +33.9% ($p<0.05$) in the CG by the end of the study, while consumption decreased gradually and significantly by 15.8% in the IG ($p<0.001$) in the same period. At the end of the study, significantly fewer children in the IG consumed *maandazi* ($p<0.001$) while in the CG, *maandazi* consumption remained largely

unchanged. In the first three months, consumption of cakes decreased significantly ($p<0.05$) in the IG by -9.6%, but not thereafter, while its consumption remained nearly the same in the CG. Wholemeal bread was consumed by 32.9% of the children in the CG at baseline and by 27.5% in the IG.

Table 36: Food consumption in the IG by time

Food /drink	Baseline % consuming) n=*182*	3 months (% consuming) n=*137*	*p-value*	7 months (% consuming) n=*135*	*p-value*	11 months (% consuming) n=*122*	*p-value*
Cereal based refined foods							
White bread	99.4	85.4	***0.000***	88.9	***0.000***	83.6	***0.000***
Rice	65.2	19.0	***0.000***	100	***0.000***	95.1	***0.000***
Cake	43.2	24.1	***0.001***	34.8	0.120	33.6	0.085
Maandazi	40.6	31.4	0.084	39.2	0.788	22.1	***0.000***
White *ugali*	48.4	54.7	0.297	57.0	0.114	54.9	0.244
Chapatti/ spaghetti	20.6	21.2	0.907	29.6	0.063	21.3	0.514
Cereal based unrefined foods							
Wholemeal bread	27.5	25.5	0.692	31.5	0.593	42.6	***0.006***
Wholemeal *ugali*	5.3	5.1	0.942	6.7	0.603	9.0	0.201
Githeri	12.7	2.2	***0.006***	10.4	0.521	9.0	0.318
Meat, dairy and eggs							
Beef stew	50.3	39.4	***0.052***	80.0	***0.000***	36.9	***0.021***
Sausage	16.9	15.3	0.699	12.6	0.284	14.8	0.610
Eggs	14.8	12.4	0.534	6.7	***0.023***	11.5	0.400
Chicken	19.0	51.1	***0.000***	9.6	***0.000***	52.4	***0.000***
Fish	4.2	7.3	0.232	8.9	0.086	5.7	0.545
Milk/milk products	29.0	20.4	0.076	23.7	0.281	29.5	0.938
Legumes, grains and nuts							
Beans stew	13.8	18.2	0.272	23.0	***0.032***	22.1	0.055
Green grams	14.3	10.9	0.375	18.5	0.308	18.9	0.286
Peanuts	7.4	6.6	0.771	12.6	0.118	12.3	0 148
Peas stew	5.8	6.6	0.781	12.6	***0.032***	1.6	0.071
Vegetables and fruits							
Vegetables	100.0	100.0		100.0		100.0	
Fruits	50.8	68.0	***0.002***	92.6	***0.000***	68.0	***0.003***
Roots and tubers							
Boiled potatoes	24.3	6.6	***0.000***	8.9	***0.000***	12.3	***0.009***
Chips/bhajia	11.6	11.7	0.991	14.4	0.516	14.8	0.077
Crisps	17.5	2.9	***0.000***	5.2	***0.001***	4.9	***0.001***
Fat							
Margarine	43.9	30.7	***0.015***	48.9	0.376	41.8	0.713
Drinks							
Diluted juice-cordial	38.1	59.8	***0.000***	41.5	0.539	29.5	0.121
Soda	17.4	25.5	0.076	24.4	0.124	20.5	0.503
Sugar Sweetened black beverage	14.2	14.6	0.937	13.3	0.807	17.2	0 485
Fresh juice	7.1	8.0	0.694	11.8	0.122	16.4	***0.008***

p-values in bold represent significant differences

Table 37: Food consumption in the CG by time

Food /drink	Baseline % consuming) n=*155*	3 months (% consuming) n=*139*	*p-value*	7 months (% consuming) n=*133*	*p-value*	11 months (% consuming) n=*127*	*p-value*
Cereal based refined foods							
White bread	66.1	62.6	0.565	99.2	***0.000***	100.0	***0.000***
Rice	69.8	25.2	***0.000***	99.2	***0.000***	61.4	0.222
Cake	50.3	50.9	0.897	50.1	0.993	52.5	0.684
Maandazi	39.2	36.7	0.727	24.8	***0.009***	37.8	0.789
White *ugali*	75.1	46.0	***0.000***	46.6	***0.000***	89.8	***0.001***
Chapatti/ spaghetti	29.6	27.3	0.018	24.8	0.286	33.8	0.590
Cereal based unrefined foods							
Brown bread	32.9	21.6	***0.041***	3.8	***0.000***	32.3	0.912
Wholemeal *ugali*	4.5	1.4	0.235	1.5	0.143	0.8	0.061
Githeri	49.0	2.2	***0.000***	10.5	***0.000***	11.0	***0.000***
Meat, dairy and eggs							
Beef stew	58.1	54.7	0.640	58.5	0.920	70.1	***0.037***
Sausage	25.2	26.6	0.776	21.1	0.411	23.4	0.314
Eggs	15.5	21.6	0.178	12.0	0.398	13.4	0.619
Chicken	9.0	18.0	***0.024***	10.5	0.670	7.9	0.729
Fish	2.6	5.7	0.170	4.5	0.372	6.3	0.124
Milk/milk products	24.9	26.6	0.680	29.3	0.358	25.2	0.895
Legumes, grains and nuts							
Beans stew	10.3	28.1	***0.000***	18.0	0.059	27.6	***0.000***
Green grams	14.8	16.5	0.686	22.5	0.092	9.4	0.172
Peanuts	9.7	8.6	0.757	14.3	0.227	10.2	0.876
Peas stew	11.0	6.5	0.176	14.3	0.396	9.4	0.676
Vegetables and fruits							
Vegetables	88.4	96.4	***0.011***	85.7	0.499	100.0	***0.000***
Fruits	82.6	64.7	***0.001***	66.2	***0.001***	44.1	***0.000***
Roots and tubers							
Boiled potatoes	23.2	18.7	0.343	18.8	0.359	17.3	0.223
Chips/bhajia	12.9	7.2	0.106	9.8	0.406	6.3	0.065
Crisps	6.5	8.6	0.478	11.3	0.147	13.4	***0.049***
Fat							
Margarine	86.5	80.3	0.174	85.7	0.857	89.8	0.395
Drinks							
Diluted juice-cordial	46.6	60.4	***0.016***	39.1	0.209	51.2	0.429
Soda	30.2	35.2	0.368	30.3	0.964	33.6	0.526
Sugar Sweetened black beverage	16.9	18.6	0.665	21.0	0.354	28.3	***0.019***
Fresh juice	9.5	14.4	0.479	12.8	0.913	11.0	0.877

p-values in bold represent significant differences

While there was no change in consumption of wholemeal bread in the CG after 11 months there was a significant increase in consumption in the IG (+15.1%, $p<0.05$). There was no significant change in consumption of other wholemeal foods in either study groups.

The most popular animal meat was beef (consumed as a stew of beef, tomatoes and onions), which was consumed in main meals by over half of the study children in both groups at baseline. Its consumption varied in the IG, with a significant decrease in consumption noted after 3 months, a significant increase at seven months and a significant decrease after 11 months ($p<0.05$). In the CG, its consumption remained unchanged in the first two evaluations, but had increased significantly by +12.0% after 11 months ($p<0.05$). Other foods rich in animal protein consumed by the study children included hotdogs, sausages, eggs, fish and chicken, which were consumed by less than 20% of the children in both groups at baseline. Their consumption in both groups remained below 20% at follow-up, except for chicken, whose consumption in the IG had increased significantly ($P<0.001$) by 33.4% after 11 months.

There was no significant change in consumption of milk and milk products, whose rate of consumption remained below 30% in both groups throughout the study period. Legume grains consumed at baseline were mainly beans and green grams. Consumption of beans increased gradually in the IG. However, the increase in consumption was only significant at seven months ($p<0.05$). In the CG, significant increases in consumption of beans were recorded after 3 months and 11 months ($p<0.05$). There were no significant changes in consumption of other legumes in either study groups, except for peas whose consumption had increased significantly at seven months in the IG ($p<0.05$).

The consumption of vegetables remained very high (100%) in the IG throughout the study period, while in the CG vegetable consumption fluctuated, showing a significant

decrease after 3 and seven months, and a significant increase after 11 months ($p<0.05$). While the consumption of fruits decreased significantly in the CG, it showed a gradual significant increase in the IG throughout the study period ($p<0.01$).

The consumption of roots and tubers remained low among the study children during the study year. While their consumption remained unchanged in the CG, there was a significant decrease in consumption for both boiled potatoes and crisps in the IG ($p<0.05$). Margarine was the main bread spread used by nearly 90% of the children in the CG throughout the study period. Its use remained lower in the IG, with a significant decrease recorded at four months ($p<0.05$), but not at other evaluation periods.

All children consumed sugar-sweetened tea or coffee mixed with milk (100%). There was no change in this rate in either study group during the study period. Consumption of cordials was high in the IG at baseline (56.6%). This rate increased significantly at four months in both study groups ($p<0.05$), but no significant change was noted thereafter. Consumption of other sugar sweetened beverages remained unchanged in the IG but increased significantly ($p<0.05$) in the CG after 11 months. While there was no significant difference in consumption of soda in both groups, consumption of fresh juice increased significantly in the IG after 11 months, but not at other evaluation periods.

CHAPTER FIVE: DISCUSSION

5.1 Characteristics of the Study Children

The mean age of the study children is 12±0.84 (9.8-14.99) years. The normal school enrolment age in Kenya is 5-6 years, thus most children in classes 5-6 will be within this age range. Majority of the children live with their parents, with the number of siblings ranging from 0-9 siblings. Christianity is the predominant religion. This is in line with the rest of Kenya, where households consist of 1-9 family members and Christians constitute over 90% of the population (GOK, 2010). In Kenya, public schools are currently funded by the government through the free primary education programme and parents are not charged any fees. On the other hand, private schools charge school fees. It therefore follows that only parents who can afford the fees charged opt to enrol their children in private schools. While actual income of the parents has not been determined in this study, the findings indicate that children in private schools are from families of higher socio-economic status as evidenced by their parents' higher literacy and employment levels. Over 90% of fathers and mothers of children in private schools have tertiary education, compared to 57% of mothers and 73% of fathers of children in public schools. Although these rates are higher than those reported in the Kenya Demographic Health Survey (KDHS) 2008-2009 for male and female household heads (GOK, 2010), men in both studies have higher education levels than women. The same is true for unemployment, where unemployment is higher among mothers than among fathers, as was the case in past studies (GOK, 2004; GOK, 2010).

Access to sedentary recreation gadgets such as television, computer and cell phones is

high among the study group, and is significantly higher among children in private schools than among those in public schools. The former are also more likely to have sedentary recreation gadgets in their bedrooms and to have the accompanying games. In this study, majority of the children in private schools have access to more than one cell phone with games. Using the school type and education levels of parents as proxy indicators of socio-economic status, it follows that parents of children in private schools are more likely to have disposable income. The high ownership of cell phones is consistent with other reports in Kenya. According to a study by Pews Research Centre, mobile phone use in Kenya is high, having increased from only 2% in 2002 to 65% in 2010 (Pews Research Centre, 2010). This high subscription rate is collaborated by reports by the Communications Commission of Kenya (CCK) whose annual report 2010/2011 reported that mobile phone subscription in Kenya stood at 25 million Kenyans by June 2011 (CCK, 2011). Another national study conducted in 2009 by the Intermedia Survey Institute showed that ownership of mobile phones increased with education levels (Bowen, 2010).

The higher access to physical activity enhancing equipment among children in private schools is explainable by the higher socio-economic status of their families, who may be able to afford them. On the other hand, cultural practices may explain the higher access by boys to outdoor activity equipment such as bicycles, basketballs and footballs in comparison to girls. Bicycle ridding and ball games are generally viewed as more suitable for boys than girls who in turn, are more likely to be involved in more subdue indoor, than adventurous outdoor, activities.

The high use of motorised transport among the children is consistent with most urban populations the world over. Worldwide, urban populations generally have high access to and use motorised transport as compared to rural populations.

The low participation of school children in Nairobi in physical education (PE) and other outdoor activities in school has been attributed to inadequate infrastructure and inadequate utilization of physical education time (Christian Sports Contact, 2012). As expected, boys in the current study are more involved in PE than girls, possibly because of cultural influences as well as their more adventurous nature.

While at home, children spend more time on indoor rather than outdoor activities, a scenario possibly fuelled by the high access to sedentary recreation gadgets which do not require one to be outdoors. As expected, time spend on sedentary activities increases during weekends and holidays when children have more free time. Possibly because of increasing security concerns and limited options for outdoor activities, children in urban areas may spend more time indoors than outdoors.

The higher employment levels among parents of children in private schools, which may involve longer working hours and more time spend away from home, may be a possible explanation for the significantly lower proportion of children in private schools having regular family meals, as well as the higher preference of these children for hotel food. Higher maternal education level may result in mothers spending more time outside the home, leaving little time to care for the children (including preparing family meals)

(Mamabolo *et al.*, 2005; Hawkins *et al.* 2008). The higher use of cooking oils, which is generally considered healthier than use of cooking fats (predominantly vegetable shortenings), among families of children in private schools would confer some health benefits except that these families seem to mainly frying or deep frying their food. Deep frying food requires large quantities of oil, which the lower socio-economic status families may not be able to afford.

The consumption of cereal based refined foods, and fat and the low consumption of wholemeal cereal based foods is characteristic of populations undergoing the nutrition transition. This transition is characterised by diets low in fiber and high in fat and refined foods (Popkin, 1994). The diet of children in public schools is nutritionally poor as characterised by their high intake of cereal based refined foods (*maandazi*, rice, refined flour *ugali* and chapatti), which are mainly consumed at lunch. Adult studies have shown that long term consumption of whole grains plays a significant role in weight management (Liu *et al.*, 2003; Bazzano *et al.*, 2005) While the private schools in this study provide hot lunch for their pupils, children in public schools are expected to bring packed lunch from home or purchase from authorised vendors within the school compound. It is therefore clear that school lunch in this study is healthier than food purchased from vendors. Mixed findings on the role of school lunch in the obesity epidemic have been reported. While provision of school lunch has been reported to improve dietary habits of school children (Buttriss, 2002) and reduce obesity (Gundersen *et al.*, 2012), studies in the US report increased overweight among children consuming school lunch. A study conducted by the University of Michigan cardiovascular centre

reported that children who consumed school lunches were more likely to be overweight (38.8 percent vs. 24.4 percent) than those who brought lunch from home (American College of Cardiology, 2010), citing the possibility of high fat content and consumption of double portions by students. Similar findings were reported by Millimet *et al.* (2009). For school lunch to be beneficial in weight maintenance and loss, the component of fatty and high sugar foods should be limited to avoid excess calorie intake.

Possibly because of the higher cost of fruits, their consumption is lower than that of vegetables, and higher among children in private than in public schools. In the private schools included in this study, lunch meals include vegetables on all days of the week and fruits on most days of the week, further explaining their higher intake among children in the private schools.

5.2 Prevalence of Overweight

The current study has established a prevalence rate of overweight (including obesity) of 19.0% (13.1% overweight and 5.9% obesity), based on the WHO sex specific BMI-for-age Z-scores (BAZ) (de Onis *et al.*, 2007). Comparison of prevalence of overweight rates among children and adolescents is usually complicated by the variations in definition used in different studies and the different age groups studied (Lobstein *et al.*, 2004). Before the introduction of the WHO BAZ cut-offs for children 5-19 years, most studies used either the NCHS, IOTF cut-offs or CDC BMI growth charts.

In Kenya, few studies have focussed on overweight among school going children. Studies among under-fives have, however, reported high rates of overweight in rural and urban areas. A study carried out among young children (aged 12-13 months) in rural villages in Western Kenya reported that 70% and 42% of females and males were overweight based on NCHS weight-for-age percentiles (Abdulkadir *et al.*, 2009). Another study among children aged 5-6 years in a rural population in Kenya reported a prevalence rate of overweight of 8-10% based on weight-for-age (Semproli and Gualdi-Russo, 2007). An analysis of the 2003 KDHS data by Gewa (2009) also reported a high prevalence of overweight among children aged 36-59 months (18%) based on BAZ.

In a recent study in Kenya by Adamo *et al.* (2010) among school children aged 9-13 years, a lower prevalence rate of overweight among urban children was reported (16.7% among girls and 6.8% among boys) than the rate in the current study. Children in the current study are older, a possible reason for the observed differences. Differences in cut-offs may also result in some variation since the authors used the IOTF cut-offs to classify overweight and obesity. However, when overweight is considered separately, the rates of overweight /obesity are comparable in both studies.

Overweight rates reported from other African countries range from 3.4% among 10-19 year olds in Nigeria (NCHS classification) (Ben-Bassey *et al.*, 2007) to 25.6% among 14-19 year olds in Egypt (CDC BMI growth charts) (El-Gilany and El-Masry, 2011). Ben-Bassey *et al.* (2007) found that the rate of overweight and obesity in Nigerian children aged 10-19 years was 3.4% and 0.2%, respectively, with all the obese individuals being

from urban areas. A study by Prista *et al.* (2003) in Maputo, Mozambique among children 6-18 years reported that 7.7% of the females were overweight compared to 4.8% of the males. In South Africa, the prevalence among children aged 10-17 years was 15% among girls and 4% among boys using the IOTF cut-offs (Kimani-Murage, 2011).

Obesity rate in this study is comparable to rates in some developed countries (Jebb *et al.*, 2003; Małecka-Tendera *et al.*, 2005; Georgiadis and Nassis, 2007; Waters *et al.*, 2008). A nationwide study in Greece (Georgiadis and Nassis, 2007) reported a rate of overweight (IOTF cut-offs) of 17.3% and 3.6% for obesity among children aged 6-17 years, while in Poland, Małecka-Tendera and colleagues (2005) reported a rate of 11.8% and 3.6% for overweigh and obesity, respectively, among 7-9 year olds (IOTF cut-offs). In 2003, obesity among girls aged 12-14 years in the UK was 5.9% (Jebb *et al.*, 2003). The prevalence of overweight /obesity among girls in private schools is also comparable to rates in some developed countries. In Canada, the prevalence of overweight among girls in Nova Scotia in 2003 was 32.9% (Veugelers and Fitzgerald, 2005). In Australia, Waters *et al.*, (2008), reported that the prevalence of overweight in the City of Moreland was 31.0% among children aged 4-13 years. The prevalence rate of overweight and obesity found by Maddah and Nikooyeh (2010) among urban school girls aged 12-17 years in Iran was 18.6% and 5.9%, respectively. Clearly, the results indicate that urban school girls attending private schools in Nairobi have higher or same rates of overweight as those of children in developed countries.

The gender differences in rates of overweight reported in the current study are comparable to findings from other studies.

The findings that the prevalence of overweight among girls is not significantly different from that among boys, though slightly higher, are comparable to results of other studies that have reported higher rates of overweight among girls than among boys (Monyeki *et al.*, 1999; Prista *et al.*, 2003; Kelishadi *et al.*, 2003; Jinabhai *et al.*, 2003; Kruger *et al.*, 2006; Ng *et al.*, 2011; Adamo *et al.*, 2010). In Maputo, Mozambique, Prista *et al* (2003) reported that overweight was significantly higher (7.7%) among girls than among boys (4.8%). In Iran Kelishadi *et al.* (2003) reported a significantly higher rate of overweight among girls than among boys. In the Arab Gulf region, the rates among boys (12-17 years) ranged from 18.8% in Bahrain to 44.2% in Kuwait, while among girls, the rate was lowest in Saudi Arabia (22.2%) and highest in Kuwait at 46.3% (Ng *et al.*, 2011). In South Africa a study conducted by Kruger and colleagues (2006) among children 10-15 years found that twice as many girls were overweight (10.0%) than boys (5.6%). One possible reason for these consistent findings across studies may be that participation of girls in physical activity is lower than among boys.

In a recent study conducted in Kenya among school children aged 9-13 years by Adamo *et al.* (2010), girls in urban areas had less aerobic fitness than boys. The same study reported that girls in urban areas completed only 26.3 shuttle laps compared with boys who attained 41 laps. Unavailability of public recreation areas may contribute to the low activity of children in urban areas. While community playgrounds may not be available close to residential areas, parents may be more protective of their female children playing in open play grounds, especially when not in school. Increasing levels of criminality in urban areas may also be a contributing factor to this low rate of outdoor play. In addition,

differences in dress code between boys and girls in Kenyan schools may also influence the participation of girls in physical activity, as argued by Adamo *et al.* (2010). All school going children attending formal schools in Kenya wear school uniform, which for boys is a pair of shorts and a shirt, while girls wear dresses or skirts in most schools. The latter may be an impediment to their participation in physical activity. Parents are also more likely to restrict outdoor play for girls than for boys, possibly because of security concerns.

The mean BMI of children in the current study is higher than that reported in another recent study in Nairobi (Adamo, *et al.*, 2010) which reported that the mean BMI of boys and girls in urban Kenya was 17.22±0.42 kg/m² and 18.03±0.39 kg/m², respectively. It is noted that the mean age of the children in the earlier study was 11.0±0.28 years for boys and 10.59±0.25 years for girls, compared to a mean of 12.04±0.88 years and 11.89±0.80 years, for boys and girls, respectively, in the present study. Given that in children, BMI increases with age between ages 6-18 years (Piernas and Popkin, 2010), it is expected that older children have higher BMI as reported in this study in which the children are older.

The mean BMI of girls is significantly higher than of boys, a finding consistent with Monyeki *et al.*'s (1999) finding among children aged 7-8 years in South Africa. However, the mean waist circumference and skin fold thickness of children in the current study are higher than in the study by Adamo and colleagues (2010). Studies have shown that abdominal obesity in children is associated with increased risk for cardiovascular

disease, even in children as young as five years (Freedman *et al.*, 1999a; Lobstein and Frelut, 2003).

5.3 Risk Factors for Overweight

The development of excess body fat is caused by an energy imbalance, where energy intake exceeds energy output. However, many factors contribute to this seemingly simple equation. These factors can be broadly categorised into genetic and environmental factors. Environmental factors are widely recognised as the modifiable factors in the prevention and control of overweight. The factors investigated in this study are physical activity, sedentary activities, diet and socio-demographic characteristics.

5.3.1 Effects of demographic and socio-economic characteristics on overweight

In the current study, demographic and socio-economic factors investigated include the type of school (private or public), mother's and father's occupations and level of education, and type of housing. Factors found to be positively associated with overweight include type of school attended, mother's occupation, being an only child, birth order, the number of siblings and type of housing.

Socio-economic status has widely been reported to be associated with overweight in most population groups (GOK, 2004; GOK 2008-9; Erem *et al.*, 2004; Steyn *et al.*, 2011). While in more developed countries, overweight is higher among groups of lower socio-economic status (do Carmo *et al.*, 2008; Mendez *et al.*, 2005; Fach *et al.*, 2010), most studies in developing countries report the opposite (Martorell *et al.*, 2000a; Monteiro, *et*

al., 2004; Kaneria *et al.*, 2006; Rashidy-Pour *et al.*, 2008). In Kenya, past Kenya Demographic Health Surveys (KDHS) and other studies have shown a consistently higher rate of overweight among women in the higher wealth quartile compared to those in the lower quartile (GOK, 2004; GOK, 2008-9; Steyn *et al.*, 2011).

In the current study, children attending private schools are 3.2 times more likely to be overweight compared to those attending public schools (29.2% vs 11.4% OR 3.2 95% CI 1.783,5.745). Children attending private schools are generally drawn from families of higher socio-economic status compared to those in public schools. The increase in prevalence of overweight as maternal and paternal education levels increase is consistent with findings of other studies (Al-Saeed *et al.*, 2006; Padez *et al.*,2004; Li *et al.*, 2007; Pirinçci *et al.*, 2010). In Saudi Arabia, Al-Saeed *et al.* (2006) also found a low prevalence of overweight (16.8% and 9.8%) among children of mothers with a low education level, compared to 21.3% and 12.0% overweight respectively among children whose mothers had higher education levels. In Turkey, Pirinçci and colleagues (2010) reported that overweight increased with maternal and paternal education. Similar findings were reported by Padez *et al.* (2005) in Portugal and Li *et al.*, (2007) in China. A study in the United Kingdom reported that increasing employment among mothers is linked to childhood obesity (de Moira *et al.*, 2010). When parents have higher income, their children may have more exposure to hotel foods than those from families of lower socio-economic status families. Higher education levels and employment of parents increase purchasing capacity of households. Parents may tend to purchase the more of the 'high status foods', which are often energy dense because of their high fat and sugar content

(Kruger *et al.*, 2004). Indeed, in the current study, families of children in private schools are 1.8 times likely to fry or deep fry foods cooked at home as compared to those in public schools. Consumption of fried foods has been associated with obesity in adult studies (Guallar-Castillón *et al.*, (2007).) Such families are also more likely to afford sedentary recreation gadgets and motorised transport. Other studies have also reported an association between higher socioeconomic status and increased overweight among children (Prista *et al.*, 2003; Kaneria *et al.*, 2006; Maddah and Nikooyeh, 2010), probably implying that parental nutritional knowledge maybe a factor in development of overweight. In this study, maternal but not paternal occupation is associated with overweight, with the highest rate among children whose mothers are in self epmloyment (31.4%). Mothers are the primary food providers, involved in purchasing and preparation of food. They have greater control over important lifestyle characteristics of their children. Mothers with a higher flow of disposable income are likely to spend more on food. Studies among low-income households have demonstrated that maternal education level and income are positively associated with improved nutrition status (Olatidoye *et al.*, 2011). In the 2003 Kenya demographic Health Survey, maternal education was also positively associated with childhood overweight and obesity (Gewa, 2009). Inadequate nutritional knowledge among mothers with higher education levels and/or in employment may partly account for the higher rates of overweight among their children, when these are compared with children of mothers with lower education levels and /or unemployed.

Overweight is relatively high among single children (no siblings), last borns and those living with both parents and decreases as the number of siblings increases. Similar

findings were reported among Turkish and Portuguese children. In Turkish study, the prevalence of overweight among children 6-12 years was 17.3% among children with no siblings and 10.9% among children with four or more siblings (Pirinçci *et al.*, 2010). In Portugal, Padez *et al.* (2005) also found that being a single child was significantly associated with overweight and obesity among children aged 7-9.5 years. Having fewer siblings implies less sharing of available food (as well as other family resources), and may result in excess energy intake. Indeed, Kruger *et al.* (2006) reported that children from smaller families consumed more energy per person compared to children from larger families. Such children may also be getting more attention, implying that the family resources may not be stretched and the child receives the undivided attention of the parents, including gifts. These may include more luxurious foods and more sedentary recreation gadgets and activities. Similarly, last born children may be pampered, probably by having more access to more food, including junk foods, than children in other birth positions. Being the family 'baby' may also exempt them from household chores and other energy expending duties at home. In both cases, the children may engage in less household work and have access to more sedentary recreation gadgets, and hence spend more time in sedentary recreation.

In the current study, children whose families do not have regular family meals are 4 times more likely to be overweight than children whose families take their meals together (OR 3.91, 95% CI 1.77-8.66). Other studies have reported similar findings. Veugelers and Fitzgerald (2005) found that increasing frequencies of eating supper together at home (family supper) was associated with a decreased risk of overweight. In Japan, Yuasa *et*

al., (2008) found that among school children, eating meals as a family every day is associated with a lower rate of obesity as well as getting good lifestyle habits such as eating balanced meals and getting enough sleep. Preference of hotel food vis-a-vis home-made food increases risk of overweight by 79.3% in the current study. Because they are generally higher in calories than home meals (Prentice and Jebb, 2003), and larger in portion hotel foods tend to promote a high rate of weight gain (Pereira *et al.*, 2005; Stender *et al.*, 2007). Binkley *et al.* (2000) also found that energy intake is higher when children consume meals in restaurants than at home.

Overweight in the current study is higher among children who do not receive food as reward (instrumental feeding). Instrumental feeding is assumed to encourage the child to associate eating with cues other than hunger and thereby increase the risk of eating in excess of physiological need. It is notable that children in public schools are 72% more likely to receive food rewards compared to children in private schools. Given that these children are generally drawn from families of lower socio-economic status, it is possible that these rewards are not frequent enough to significantly influence weight gain. In addition, their higher activity levels may even out the extra calories obtained through instrumental feeding. The effects of using food as a reward may, however, not be immediate. A 2009 study by weight loss organisation Slimming World found that adults who were rewarded with food as children were four times as likely to be overweight compared with those who were not given food rewards. Of the 2000 people surveyed, 34 percent of those who were given food rewards were found to be obese, compared with 25 percent of those not rewarded with food (Practical Parenting, 2009).

5.3.2 Effects of physical activity and sedentary recreation on overweight

This study identifies three main modes of transport used by the children to and from school, namely motorised transport (47.4%), walking (40.7%) and combining walking and motorised transport (11.9%). Several studies have found a significant association between use of inactive transport and overweight rates (Gordon-Larsen *et al.*, 2005; Li *et al.*, 2007; Landsberg, *et al.*, 2008). Among US young adults, the proportion of individuals using active transportation was higher among non-overweight compared to overweight ones (to work 9·2% v. 6·8 %; to school 29·7 v. 22·6 %). A study in China by Li *et al.*(2007) among children 6-17 years found a significantly lower prevalence of overweight among children who walked to and from school (5.5%) compared to other means of transport (bus-15.0%, bike-9.0%). In Russia, Landsberg, *et al.* (2008) did not find any association between active and inactive means of commuting to school and overweight based on BMI, but found an association based on triceps skinfold thickness. Comparable results are observed in this study. The prevalence rate of overweight is highest among children who are driven to school by parents/guardians (30.0%), followed by those using a school bus (27.0%), those using public transport (24.2%), and lowest among those walking to and from school (13.3%) or combined public means and walking (11.9%). In this study, children reporting commuting to school actively also have significantly lower mean BMI, waist circumference and triceps skinfold thickness.

It has previously been suggested that frequent walking and cycling, regardless of intensity and distance, expends energy and is therefore important to prevent

overweight (Tudor-Locke *et al.*, 2003). In adult studies, walking has been shown to be beneficial to health and weight control (Hu *et al.*, 2002; Gordon-Larsen *et al.*, 2005).

Among Russian school children, 28.4% of overall physical activity was explained by commuting activity (Landsberg, *et al.*, 2008). A study in China also found that children from higher socio-economic status were more likely to passively commute to school (Cui *et al.*, 2011). In the case of children using inactive means to school in the current study, it is possible that they are from families of higher socio-economic status. In Kenyan schools, school transport is usually provided at an extra cost over and above school fees and other mandatory costs, while driving children to school requires daily expenditure on fuel and other motor vehicle costs. Children using these means are therefore likely to have parents who can afford this extra expenditure.

Passive commuting (inactive modes of travel) to and from school can contribute to decreased regular physical activity among children (Cooper, 2003; Tudor-Locke *et al.*, 2003). In the current study, children using active means to school are significantly more active than those using inactive commuting. The former spend significantly less time on sedentary physical activities (television, computer and homework/studying) and significantly more time in moderate or heavy physical activities than those using inactive means to commute to school. The use of motorised transport is not uncommon in urban areas. However, given the association it has with overweight and the anthropometric parameters, it provides an avenue for public health interventions. Barriers to active commuting that have been advanced elsewhere include distance, school affiliation,

parental concern for their child's safety and the nature of the built environment (Hillman *et al.,* 1990; Kerr *et al.,* 2006; Merom *et al.,* 2006; Center for Disease Control and Prevention, 2002; Timperio *et al.,* 2004).

The assessment of time expenditure at home provides some insights into the importance of the home environment in enhancing regular physical activity. Although boys are more involved in outdoor play than girls, this involvement is overshadowed by their higher access to sedentary recreation gadgets, which probably makes them spend more time on Saturdays and during school holidays on low intensity activities, compared to the girls. The involvement of girls in household chores than boys may not be unusual, considering that in most African cultures, girls are more likely to be tasked with household chores than boys.

In urban areas, sedentary lifestyles are recognised as a major factor in the obesity epidemic (Lobstein *et al.,* 2004). This lifestyle is facilitated by access to electronic gadgets that promote sedentary recreation and take the place of otherwise more active and healthy recreation. The findings of this study indicate that high access to sedentary recreation gadgets is associated with overweight, given the significantly higher prevalence rate among children with access to these gadgets compared to those without access. Availability of media opportunities such as family computers, television and cell phones increases the time spend on sedentary activities and has been associated with overweight (Dennison *et al.,* 2000; Carvalhal *et al.,* 2006).

Presence of a television set in the bedroom has been reported to increase viewing by 38 minutes per day (Wiecha *et al.*, 2001). Watching television for more than two hours has been shown to increase the prevalence of obesity by 5% when children watching television for 0-1 hour were compared with those watching television for more than two hours per day (Dietz and Gortmaker, 1985). The present study has not established that watching television for more than 2 hours per day is related to overweight. Similarly, there is no association found between overweight and mean hours spent on television viewing per week when school is in session. However, overweight children spend significantly more hours per week watching television during school holidays than normal weight children. Furthermore, the risk of being overweight is doubled (OR 2.0, 95% CI 0.25-16.37) among children with access to at least one television set at home compared to those without any television set at home. Mixed findings have been reported on the association between television viewing and adiposity. In a study carried out by Marshall *et al.* (2004), no association was found between obesity and watching television. Other studies have, however, reported that the risk of overweight increased with increased television viewing (Dietz and Gortmaker, 1985; Janz *et al*, 2002). Janz and colleagues (2002) found that television viewing was associated with increased fatness. High television viewing has been linked to poor dietary patterns and decreased vegetable and fruit intake (Coon *et al.*, 2001) and is likely to replace more active, energy expending activities. Many studies have reported that activities that do not promote physical activity such as watching television, using computers, and playing video games during leisure time, are closely related to obesity (Robinson, 1999; O'Loughlin *et al.*, 2000; Riberio *et al.*, 2003). In the current study, access to cell phones is significantly

associated with overweight. Access to a cell phone with games allows children to play games even in private, thus is likely to increase the total time spend in sedentary activity at the expense of physical activity.

The lack of an association between the accessibility of physical activity enhancing equipment at home (bicycle, roller skates, foot ball and basket ball) and overweight could be due to inadequate time to utilize the equipment since school ends between 4 pm and 5 pm for the children in this study. The use of the equipment also requires access to a play ground, which may not be readily available to the children within their residential areas. It is also possible that children whose parents can afford these equipment are also economically endowed, and therefore can also afford the foods and electronic equipment that promote weight gain. For example, in this study 89.1% of the children in private schools (where overweight is significantly higher) have access to at least one of the equipment compared to 70.9% among children in public schools ($p<0.05$). There is also a possibility that ownership of these equipment may be motivated by peer pressure, where a child simply wishes to have the items that his/her friends have, and not the need to use them, leading to inadequate utilization.

All the schools included in this study have scheduled time for several physical activities, including Physical Education (PE), swimming and games. They also have large play grounds. While there is no significant difference in participation in games and swimming between girls and boys, significantly more boys than females participate in Physical Education (PE) in the current study. Similar results were reported among Fillipino

adolescents (Tudor-Locke *et al.*, 2003), where male students were found to be significantly more active than female students.

Having scheduled physical education (PE) in class timetable may ensure that children spent some time on guided outdoor physical activities, a possible explanation for the reduced risk of overweight among children attending schools which have scheduled PE in the class timetable. Children who regularly take part in the PE lessons are also likely to have increased overall physical activity levels compared to those taking part only occasionally. This is, however, dependent on total amount of time spend on physical activity. However, not all scheduled physical activity may be beneficial to weight control as observed in the current study where prevalence of overweight is higher among children attending schools with scheduled swimming lessons and those participating regularly in swimming. Regular participation in swimming is often times depend on other factors such as weather. Easy access to a swimming pool is also necessary, a possible drawback for the schools participating in the current study: only one school had a swimming pool in the school compound, while the rest hired the facility from the neighbourhood. It is also possible that because of the high numbers of pupils involved, swimming is more of a leisure activity than a physically engaging activity.

Children who are not participating in PE are 3.2 times more likely to be overweight compared to those who do not participate in swimming and games (OR 3.2, 95% 1.78-5.83). Swimming in most Kenyan schools is charged as an extra fee over and above the school fees. The lower rate of overweight among children who did not participate in

swimming maybe because such children are probably drawn from families of lower socio-economic status who may not readily afford the extra fee charged for swimming lessons. The length of time allocated to swimming lessons may also be too little to make any significant difference. The negative association between overweight and regular participation in physical education and games maybe attributable to the fact that these activities take place within the school compound and more time is spend on them as opposed to swimming, which is mainly offered at hired facilities away from the school compound. The more frequently one participates in an activity, the more the health benefits. Adult studies have demonstrated that exercise frequency may be more important than intensity in improving the lipid profile of men with CHD (Kim *et al.*, 2001).

5.3.3 Dietary practices and overweight

Skipping of meals among the children in this study is low and taking snacks is highly prevalent (two thirds of the children). Taking snacks has been associated with increased weight gain (Nicklas *et al.*, 2003). In the United States, a recent study by Piernas and Popkin (2010) demonstrated that snacking among children and adolescents has risen in the USA in the last two decades, concurrent with the increase in obesity. A close look at the foods commonly consumed as snacks by the children in this study suggests that high energy foods are the most popular. These included white bread, margarine, *maandazi*, and cake. In a study in the United Kingdom among children aged 7-18 years, it was found that every extra megajoule (MJ) of energy from biscuits, cakes and confectionery (BCC) increased the odds of overweight by 24% (OR 1.24, 95% confidence interval 1.02–1.52) (Gibson *et al.*, 2004).

In addition, refined cereal foods dominate the diet of the study sample, even at meal times. Consumption of white bread is significantly higher among overweight children compared to normal weight children. Refined cereal foods are high in energy and are likely to contribute to excess calorie intake. In the USA, where fat intake has been declining over the last few decades, increased carbohydrate intake, especially of carbohydrates with high glycemic index, is seen as the main dietary factor linked to the increasing prevalence of overweight (Slyper, 2004). A review by Roberts *et al.* (2002) that investigated the influence of dietary factors on energy intake found that consumption of high glycemic index foods resulted in a 29% increase in energy intake compared to low glycemic foods. In Xi'an City in China, researchers found that increased energy intake was associated to overweight (OR: 1.8, 95% CI: 1.1-2.9) (Li *et al.*, 2006).

Interestingly, normal weight children consume significantly more cake, sweets and *maandazi* than overweight children. It is likely that other factors such as physical activity and sedentary recreation may override the extra energy intake that is linked to excess intake of these refined carbohydrate rich foods. In addition, it is likely that these foods are not consumed in large amounts or frequently. It is also noted that children in public schools are not provided with snacks in school. Instead, they are allowed to buy snacks from vendors within and around the school compound. These vendors sell mainly *maandazi*, cake and chapatti, as indicated by the high prevalence of consumption of these high calorie foods among children in public schools. Considering that majority of the normal weight children are in public schools, this may partly explain the higher rate of consumption of *maandazi* and cake among the normal weight

Taking snacks in between meals is likely to increase energy intake over and above that provided by the main meals. However, studies have reported mixed findings on the association of snacking and obesity among children. In China, Waller *et al.* (2003) concluded that snacking was inconsequential to obesity among children aged 6-11 years. However, it is not lost to researchers that snacking frequency has increased concurrently with the prevalence of overweight. A recent study by Piernas and Popkin (2010) links snacking to obesity, attributing the increasing prevalence of obesity among US children to increase in snacking, especially on high energy foods. Experts argue that snacks tend to be higher in energy density and fat content than meals, and high levels of snack consumption have been associated with greater intakes of fat, sugars, and energy (American Dietetic Association, 2011).

Diets rich in fruits and vegetables have protective health benefits (WHO, 2002). The consumption of vegetables in this study is significantly higher among normal weight children compared to overweight children ($p<0.05$) as opposed to fruit consumption which was lower in normal weight children. Li *et al.* (2007) also reported a higher intake of vegetables and lower intake of fruits among normal weight children compared to overweight children among Chinese children aged 7-17 years. Overall, the consumption of fruits among the study children was low, supporting the findings by Mwaniki *et al.* (1999) that Kenyans are not habitual consumers of fruits. This may be attributed to the high cost of fruits in urban areas.

5.4 Effect of School Based Nutrition Education

5.4.1 Effect of nutrition education on overweight and obesity

The school environment was chosen for implementation of the intervention because schools offer continuous, intensive contact with children during their formative years. School infrastructure, personnel and physical environment, have great potential to positively influence child health. In addition, adolescence is a critical period for intervention focusing on physical activity. Behaviours such as dietary habits and levels of physical activity are usually formed in adolescence and tend to persist into adulthood (Gillman, 2004; Flynn *et al.*, 2006).

Indicators of overweight in this study include weight, height, waist circumference, triceps skinfold thickness and Body Mass Index. Weight and BMI increase during the first three months of the study in both groups. While waist circumference increases only in the CG, there was a marginal decrease in the IG. On the other hand, mean triceps skinfold thickness increased in the CG but remained the same in the IG. Moderate reduction in waist circumference has been associated with cardiovascular benefits in adult studies (Han *et al.*, 1997).

The prevalence of overweight decreases significantly in the intervention group compared to the control group. However, it is noted that the loss to follow-up is significantly higher in the intervention group (35.4%) compared to the control group (18.1%, $p<0.001$). The main reason for drop out in both groups is transferring to other schools. Among those lost to follow-up in the intervention group, 32.3% were overweight compared to only 16.0%

in the control group. Although there is no evidence that this high dropout is linked to their weight status, it makes it difficult to link the decrease in overweight prevalence in the intervention group to the intervention.

According to Lobstein *et al.* (2004), changes in triceps skinfold thickness are useful in monitoring intervention studies. On the other hand, abdominal obesity is of great interest in obesity studies, especially because it conveys the highest risk of cardiovascular disease. In the Bogalusa Heart study, abdominal fat was related to adverse concentrations of triacylglycerol, LDL cholesterol, HDL cholesterol, and insulin among children aged 5-17 years (Freedman *et al.,* 1999b). While peripheral fat distribution is characteristic in childhood and early childhood, central adiposity is more common in older children (Małecka-Tendera *et al.*, 2005). In the current study, waist circumference decrease by -1.7 cm in the IG compared to an increase of +2.7 cm in the CG during the course of the study.

Mixed impacts of nutrition education interventions have been reported in different obesity intervention studies. An intervention programme among children by Gortmaker *et al.* (1999) focused on the promotion of physical activity, modification of dietary intake and reduction of sedentary behaviours (with a strong emphasis on reducing television viewing). The researchers reported that obesity declined in boys in both the intervention and control groups. In the Pathways study, Caballero *et al.*, (2003) reported that there was no significant reduction in obesity in the intervention group. In the current study, there is no change in mean BMI in the IG. However, mean BMI in the CG increase by 1.0 kg/m^2.

The failure to record a reduction in overweight is not unusual in intervention studies that utilise the 'whole population approach' (i.e. targeting all children in the target age group, and not just the overweight ones). As explained by Caballero *et al.*, (2003), reduction in energy intake in the normal weight children is not desired.

5.4.2 Effect of nutrition education on physical and sedentary activities

Physical activity and sedentary behaviours are considered to be the most modifiable factors in obesity prevention and control (Kelishadi *et al.*, 2003; Sharma, 2006; Doak *et al.*, 2006). This study investigates both school-based activities and activities at home. While most obesity studies are limited to television viewing only, this study further examines other pastime activities, including amount of time spent playing computer and mobile phone games.

In the current study, there is no significant change in general participation of study children in PE, swimming or games reported in both study groups. However, regular participation in swimming increases significantly in the intervention group while there is no change in the control group. Physical activity is one of the recognised modifiable determinants of overweight (Lobstein *et al.*, 2004). Increased participation in promoted activities has been reported in various obesity intervention studies (Caballero *et al.*, 2003; Sharma, 2006).

Sedentary behaviours, especially screen-based behaviours, increase the risk of overweight among children and teenagers (Dietz and Gortmaker, 1985). While no

significant difference was observed due to the intervention in the current study in television viewing between the IG and the CG during the school term, there was a notable gradual decrease in television viewing in the IG compared to a gradual increase in the CG. When television viewing during school holidays was considered separately, children in the intervention group watched less television than those in the control group during school holidays. Cross-sectional studies among adults show a dose-response effect (linear relationship) of TV viewing on overweight that is independent of physical activity (Hu *et al.,* 2003). It therefore follows that any reduction in television viewing, however small, is bound to have health benefits.

There is moderate improvement in screen time (playing computer and mobile games, television viewing and leisure study) among children in the intervention group compared to those in the control group. In the Pathways study in the US, Caballero *et al.* (2003) also reported no significant difference in physical activity after three consecutive years of a school-based intervention among American Indian school children. Increased screen time has been shown to increase the risk of overweight among girls (Hume *et al.,* 2009. Time spent on sedentary activities provides an enabling environment recipe for energy imbalance. In addition, it may displace other more active leisure pursuits, thus reducing the active time (Dietz and Gortmaker, 1985). For most children, television viewing increases the exposure to unhealthy advertised foods, especially snacks of low nutritional value (Aktas, 2006). Studies have shown that children consume 45% more when exposed to advertising (Harris *et al.,* 2009). Overall, television viewing influences the dietary habits of children negatively, with most advertised foods being high in fat and sugar

(Story and French, 2004). Reducing television viewing, significantly reduced sedentary behaviour and energy intake among children aged 4-7 years (Epstein *et al*., 2008). Another possible explanation for the modest improvements in physical activities at home maybe that decisions regarding time expenditure at home, especially after school, is dictated by the parents and children may have little influence on them. In addition, school homework and private study may take priority once children are at home, irrespective of lessons learnt in schools. Since the intervention did not target the home environment, the factors influencing time spend on SA, MIPA and VIPA remain the same during the study period, thus the minimal improvements recorded.

5.4.3 Effect of nutrition education on dietary practices

The consumption of refined cereal foods remains popular in both the IG and the CG during the study period. There is a trend of decreased consumption of foods which the children were more likely to choose to consume without the parents direct consent. These include foods such as *maandazi* and cake, which were mainly purchased as snacks in school and whose consumption is significantly decreased in the intervention group compared to the control group.

There is decreased consumption in white bread and increased consumption of wholemeal bread in the intervention group as compared to an increase in the control group. Wholemeal foods are generally high in dietary fibre and low in calories and therefore their increased intake is likely to contribute to weight control. Adult studies have demonstrated that increased consumption of whole grain cereals has an inverse

relationship with weight gain (Koh-Banerjee *et al.,* 2004) and reduces risk of diabetes type 2, cardiovascular disease (Ye *et al.,* 2012). At the end of the study, some children reported mixing white and brown bread in a sandwich or eating white and brown bread alternately, a practice that was absent at baseline. This is made possible by the fact that bread is mainly consumed at breakfast and as a snack, and therefore some children in the intervention group may have a say in the choice of bread, but not in that of main meals. For other refined carbohydrate rich cereal foods like white *ugali*, rice, spaghetti and chapatti, which form the main course in school and home meals, and there is no significant change in consumption, probably because the decision to consume them may not be within the control of the children. On the contrary, parents, who are not targeted in this study, make the decisions regarding the consumption of these foods.

Children in the intervention group report a significantly reduced consumption of chips/bhajia. Considering that these are consumed almost predominantly away from home, it is possible that more children chose alternative hotel foods after undergoing this intervention. Fast foods are high in energy density (Prentice and Jebb, 2003), and can contribute substantially to weight gain (Pereira *et al.,* 2005). It is noted that children in the private schools, who are provided with snacks and hot lunch in school, consumed significantly less of the unhealthy snacks. However, children in the public schools have a higher input in the choice of foods because they purchase lunch and snacks from authorised vendors within the school or brought their own meals from home.

CONCLUSION

This study has determined that the prevalence of overweight among the study children is high and is more than double that of thinness. The rate of overweight was significantly higher among children in private schools compared to those in public schools, with girls in private schools being at the highest risk. This signals a developing public health issue in this group.

Participation in physical activity in school was found to be protective against overweight. The gains can however be lost if the same is not reflected in the family environment, as evidenced by the amount of time spent by study children on sedentary recreation. There is therefore need for advocacy so that families find ways of encouraging continuous physical activity at home.

Provision of school lunch and snacks in schools improves the dietary habits of children as evidenced by the higher consumption of vegetables, fruits and wholemeal foods such as *githeri* in the private schools, as opposed to the high consumption of refined cereal foods (such as chapatti, *maandazi*, and cake) in public schools.

Several socio-demographic, dietary, recreational and physical inactivity factors are positively associated with overweight. These include type of school, being an only child, the number of siblings and being a last born child. Other socio-demographic factors are the mother's occupation and the type of housing the family lives in, as well as access to sedentary recreation gadgets such as a computer with games and cell phones.

School based factors identified include means of transport used to and from school, not having Physical Education in (PE) as a scheduled activity in the school timetable, and not participating in PE in school. The amount of time spent on sedentary activities after school is also significantly associated with overweight. The family factors found to be significantly associated with overweight in this study are not having family meals and not receiving food as a reward for good behaviour or work well done.

However, regression analysis indicates that being in a private school, having a mother who is self-employed, being a single child (child with no siblings) and having access to a cell phone are predictors of overweight.

The current study has demonstrated the potential of school based nutrition intervention in the prevention of overweight and some associated risk factors. The intervention has a positive effect on participation in school based physical activities as evidenced by the increased participation in PE and swimming in the IG. However, the school based intervention is not effective in addressing family based risk factors such as the time spend on sedentary recreation, mode of commuting to and from school and certain dietary factors. Such factors are predominantly influenced by parents. While the intervention is effective in preventing weight gain in non-overweight children, it is not effective in triggering weight loss among the overweight children.

RECOMMENDATIONS

This study recommends the integration of nutrition education into the school curriculum as well as compulsory physical education, as an intervention to reduce the prevalence of overweight among school going children.

There is need for advocacy among parents to identify opportunities to improve physical activity at home, reduce sedentary recreation and provide healthy diets to children at home in order to compliment the increased physical activity in school.

A school meals policy should be developed and implemented in all schools because children receiving school meals have better dietary habits compared to those purchasing food from vendors.

Future research should investigate alternative interventions to address weight loss among school children who are already overweight, as these may not fully benefit from a school based nutrition education intervention alone.

Active commuting to school is a potential source of regular moderate intensity activities. There is need for research on the patterns of commuting (e.g. frequency and regularity) in order to identify viable options for non-motorised transport to and from school in order to reduce the risk of overweight.

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APPENDICES

Appendix 1: Nutrition Education Package for Pupils

Themes consisted of:

(a) Overweight and Obesity

   a. Causes

   b. Health implications

   c. Prevention

(b) Balanced diet

   a. The five main food groups (as they appear in school curriculum)

(c) Importance of fruits and vegetables in the diet

(d) High fat and sugar foods and drinks: their role in health

   a. High calorie foods and obesity

(e) Role of unrefined food products in health

(f) Making correct food choices

   a. The food pyramid for children

(g) Importance of physical activity

(h) Reducing sedentary activity and increasing physical activity

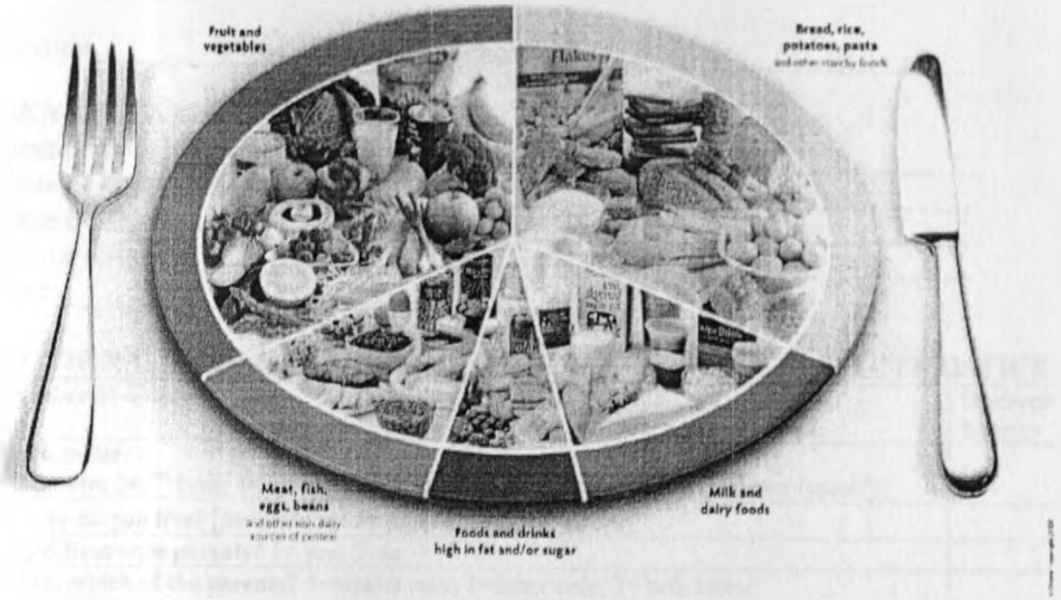
   a. Physical activity in school: Tea break, lunch break, PE and Games

   b. Options for after school recreation

(i) Recommendations for healthy feeding

The content is based on the following references:

Appendix 2: The Eat well plate



Appendix 3: Questionnaire

NUTRITION AND HEALTH STATUS OF SCHOOL CHILDREN (9-14 YEARS) IN NAIROBI AND THE EFFECT OF NUTRITION EDUCATION

SURVEY QUESTIONNAIRE

Division _____ School _____

IDENTIFICATION

Questionnaire No _____ Date of interview _____
Name of Interviewer _____
Name of Child _____
Date of birth _____ Sex _____
Class _____

SECTION 1: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

1	**Number of siblings**	Brothers= Sisters=
2	**Birth order:** 1=1st born; 2=2nd born; 3= 3rd born; 4=4th born; 5=5th born; 6=last born; 7=other (specify)	
3	**Where do you live?** [*indicate estate and region in Nairobi*]	
4a	**Child lives with parents?** 1= yes; 2=no	
4b	**If yes, which of the parents?** 1=mother only; 2=father only; 3= both father and mother	
4c	**If no, who do you live with?** 1=aunt; 2=grandmother; 3=other (specify)	
5	**Type of housing**: 1=apartment/flat; 2= bungalow/maisonette; 3=detached house; 4= single room (in informal settlement); 5=other (specify)	
6	**Religion**: 1=Catholic; 2=Protestant; 3=Seventh Day Adventist; 4=Muslim; 5=Traditionalist; 6=Hindu 7=No religion; 7=None; 8=Others specify.	
7a	**Mother's level of education**: 1=Not attended school; 2= Completed primary; 3= Completed secondary; 4= College; 5=University; 6=Do not know; 7=Not applicable	
7b	**Mothers occupation** 1=Unemployed; 2=Self-employed/business person; 3=employed in private sector; 4=employed in public sector; 5=do not know; 6=Not applicable; 7=other (specify)	
8a	**Father's level of education** 1=Not attended school; 2= Completed primary; 3= Completed secondary; 4= College; 5=University; 6=Do not know; 7=Not applicable	
8b	**Father's occupation** 1=Unemployed; 2=Self-employed/business person; 3=employed in private sector; 4=employed in public sector; 5=do not know; 6=Not applicable; 7=other (specify)	
9a	**Guardian's level of education** 1=Not attended school; 2= Completed primary; 3= Completed secondary; 4= College; 5=University; 6=Do not know; 7=Not applicable	
9b	**Guardian's occupation** 1=Unemployed; 2=Self-employed/business person; 3=employed in private sector; 4=employed in public sector; 5=do not know; 6=Not applicable; 7=other (specify)	
10	**Parent(s) with formal employment** 1=both father and mother; 2=father only; 3=mother only; 4=none of my parents; 5=do not know; 6=guardian; 7=Not applicable	

SECTION 2: PHYSICAL ACTIVITY

11. How do you get to and from school? _____
1=walking; 2= school bus; 3= car; 4=matatu; 5=matatu + walking; 6=others (specify)

_____

12. Please tell us what physical activities are scheduled in your school

Activity	1=yes 2=no	From - (time)	To - (time)	No. of times/week	Do you participate 1=yes; 2=no	If yes, How often? 1=always; 2=sometimes, 3=never
Physical Education (PE)						
Swimming						
Games						
Other (specify)						

13. Do you have access to the following at home? (Please cycle):

Item	1= yes; 2= No; 3=N
TV in sitting room	
TV in your room	
Video games (in room other than child's)	
Video games in your room	
Family computer	
Computer in your room	
Playstation/ Computer games	
Playstation/ Computer games in your room	
Bicycle	
Roller skates	
Football	
Basket ball	
Personal mobile phone with games	
Other (sibling's, parent's etc) mobile phone with games	

14. Please tell us how much time in hours (½, 1, 1½, 2, 2½, 3) you spend (if any) doing each of the following at home:

Activity	After school on week days	On weekends		During school holidays
		Saturday	Sunday	
Watching television				
Doing homework				
Playing with friends outside				
Playing computer/phone/other electronic games				
Riding bicycle				
Housework				
Taking care of younger sibling				

15. Compared with others your age and sex, do you consider yourself to be
1=much more active; 2= somewhat more active; 3= about the same; 4= somewhat less active

SECTION 3: DIETARY PRACTICES

16. What have you carried for break today?
Snack: _____ Lunch _____
Drink: _____ Drink _____

17a. What is your most favourite food? _____
17b. How often do you eat this food? _____

18a. What is your most favourite drink? _____
18b. How often do you take this drik? _____

19. Do you normally eat meals as a family? _____ 1=yes; 2=no

20. Who normally prepares food at home? _____
1=mother; 2=father; 3= house help; 4= elder sister/brother; 5=other

21. What do you prefer, home food or hotel/take away food? _____
1= home food; 2=hotel/takeaway food

22. How many times per week do you eat in a hotel or have food from a hotel brought home? 1 2 3 4 5 6 7

23. Do you normally eat while watching TV? _____ 1=yes; 2=no

24. Which fat/oil is commonly used for cooking at home?
_____

25. What is the preferred method of cooking at home? _____
1= stewing; 2= boiling; 3=frying; 4=deep frying; 5=steaming; 6=other (specify)

26a. Do you sometimes get rewards in form of food for work well done or good behaviour?
_____1=yes; 2=no

26b. If yes, what foods? _____

SECTION 4: FOOD CONSUMPTION

Starting from yesterday morning to evening, please name all the foods and the drinks that you consumed

Meal/time	Foods eaten	Drinks taken
Breakfast		
Snack		
Lunch		
Snack		
Dinner		
Snack		

SECTION 5: ANTHROPOMETRIC ASSESSMENT

Name of child _____

Sex _____ (1= M; 2=F)

School _____

Date of birth of child (d/m/y) _____

(Take the following measurement for each child. Each measurement should be taken 3 times and recorded in corresponding column)

Date		Baseline	1st followup	2nd followup	3rd followup
Weight (kg)	1st				
	2nd				
	3rd				
	Average				
Height (cm)	1st				
	2nd				
	3rd				
	Average				
Triceps skin fold thickness (mm)	1st				
	2nd				
	3rd				
	Average				
Waist circumference (cm)	1st				
	2nd				
	3rd				
	Average				

Appendix 4: Consent Form

Introduction

I, Florence M. Kyallo, of the Applied Nutrition Programme (ANP), Department of Food Science, Nutrition and Technology, University of Nairobi, invite your child to participate in this study entitled:"**Nutrition and health status of School Children (9-14 Years) in Nairobi and the Effect of Nutrition and Health Education".**

Purpose of the study

The study seeks to establish the nutrition and health status of school children in Nairobi, the factors that contribute to high weights among children, and the health complications related to high weights as well as educate children on health and nutrition. Currently, there is no data on prevalence of overweight among school children in Kenya, yet children are being treated for weight related illnesses such as diabetes and many more are at risk of heart disease and other complications. This study will assist parents, teachers and government officials to initiate prevention, including educational and management programmes at home, in school and at national level.

Procedure

The weight, height, under-skin fat and waist of your child will be measured using a bathroom weighing scale, height meter, skin-fold calliper and a non-elastic tape measure respectively (all painless procedures). In addition, the child will be asked simple questions mainly about diet and physical activity. Data from all the children will be analysed and a report prepared and presented as representative of children in Nairobi Province. No mention will be made of individual children or schools involved. However, professional advice will be provided to interested parents. The measurements and questionnaire administration will be done in private (only one child at a time, with other children waiting in an adjacent room).

Confidentiality

All information and data obtained from your child during the course of this study is highly confidential. It will not be disclosed to any third party. A general report descriptive of Nairobi will be made.

Commitment

I, Prof/Dr/Pst/Mrs/Mr/Ms .....

Confirm that my child has been invited to participate in this study which is being undertaken by the Applied Nutrition Programme (ANP), Department of Food Science, Nutrition and Technology, University of Nairobi. I have read and understood the purpose and procedures of the study. I understand that my child may withdraw from the study at any point and that my child will not be disadvantaged in any way and it will not be held against me.

Child's name .....

Parents signature ..... Date.....

Investigator's signature..... Date .....

Dear parent,

Thank you for your child's participation in this study. Should you need any clarifications on the study, please contact **Mrs. Florence Kyallo** at **0722-693523**

Appendix 5: Activities outside school at baseline

Activity	Time (hours) Mean(±SD)	Median (range)
Watching Television		
After school	1.42 (0.94)	1.00 (0-5)
On Saturdays	3.73 (2.31)	3.25 (0-13)
On Sundays	2.74 (2.12)	2.00 (0-11)
School holidays	4.48 (2.77)	4.00 (0-13)
Private study and or homework		
After school	1.40 (0.685)	1.00(0-3)
On Saturdays	1.33(1.20)	1.00(0-6)
On Sundays	0.57(0.90)	0.00(0-6)
School holidays	1.79(1.47)	2.00(0-7)
Playing computer/cell phone games or playstation		
After school	0.21(0.62)	0.00(0-6)
On Saturdays	0.87(1.16)	0.50(0-6)
On Sundays	0.55(0.91)	0.00(0-5)
School holidays	1.09(1.43)	0.50(0-10)
Riding bicycle		
After school	0.15(0.42)	0.00(0-4)
On Saturdays	0.87(1.25)	0.50(0-8)
On Sundays	0.53(0.97)	0.00(0-5)
School holidays	1.30(1.71)	1.00(0-10)
Outdoor playing		
After school	0.38(0.66)	0.00(0-5)
On Saturdays	2.38(1.78)	2.00(0-8)
On Sundays	1.57(1.56)	1.00(0-8)
School holidays	3.14(2.10)	3.00(0-12)
Doing housework		
After school	0.31(0.41)	0.00(0-2)
On Saturdays	0.77(0.72)	0.50(0-4)
On Sundays	0.52(0.68)	0.50(0-6)
School holidays	1.09(1.15)	1.00(0-6)
Taking care of younger sibling(s)		
After school	0.19(0.47)	0.00(0-4)
On Saturdays	0.58(1.34)	0.00(0-12)
On Sundays	0.44(1.23)	0.00(0-12)
School holidays	0.69(1.59)	0.00(0-12)

Appendix 6: Foods and drinks consumed by study children in the previous 24 hours at baseline

Food/Drink	All (%) N=344	Private School (%) n=139	Public school (%) n=205	OR(CI)	*p-value*
Cereal based refined foods					
White chapatti	25.6	11.5	35.1	4.16 (2.30-7.54)	***0.000***
White bread [a]	79.4	99.4	65.4	73.12 (10.02-533.80)	***0.000***
White *ugali*	63.1	45.3	75.1	3.64 (2.30-5.77)	***0.000***
Cakes	47.1	51.8	43.9	1.37 (0.89-2.12)	0.184
Maandazi[b]	39.8	10.8	59.5	12.1 5 (6.64-23.23)	***0.000***
Rice white	67.7	51.8	78.5	3.41 (2.13-5.45)	***0.000***
Cereal based unrefined foods					
Githeri	29.1	54.0	12.2	8.44 (4.94-14.41)	***0.000***
Brown bread	29.9	34.5	26.8	1.44 (0.90-2.29)	0.158
Brown *ugali*	4.9	6.5	3.9	1.71 (0.64-4.53)	0.408
Meat, dairy and eggs					
Beef	53.8	63.3	47.3	1.92 (1.24-2.99)	***0.005***
Chicken	11.6	23.0	8.8	3.11 (1.66-5.80)	***0.000***
Sausage/hotdog	20.6	32.4	12.7	3.30 (1.91-5.58)	***0.000***
Eggs	15.1	16.5	14.1	1.2 (0.66-2.18)	0.648
Milk/ milk products	26.7	38.1	19.0	2.62 (1.61-4.27)	***0.000***
Fish	5.2	1.4	7.8	5.80 (1.31-25.63)	***0.018***
Legumes grains and nuts					
Groundnuts	8.4	11.5	6.3	1.92 (0.89-4.13)	0.135
Beans	12.2	7.2	15.6	2.39 (1.13-5.03)	***0.030***
Ndengu	14.5	6.5	20.0	9.11 (4.26-19.5)	***0.000***
Peas	8.1	10.1	6.8	1.53 (0.70-3.31)	0.380
Vegetables and fruits					
Vegetables [a]	89.8	82.0	95.1	0.01 (0.01-0.02)	***0.000***
Fruits	62.5	84.2	47.8	5.81 (3.41-9.88)	***0.000***
Roots/tubers					
Chips/*bhajia*	14.5	23.3	9.3	2.81 (1.51-5.22)	***0.001***
Boiled potatoes	18.6	14.4	21.5	1.63 (0.91-2.90)	0.130
Crisps	9.3	4.3	12.7	3.22 (1.29-8.04)	***0.015***
Drinks					
Soda	24.4	36.7	16.1	3.02 (1.82-5.02)	***0.000***
Ready To Drink juices	42.7	43.9	42.0	1.08 (0.70-1.67)	0.807
Fresh juice	8.4	11.5	6.3	1.92 (0.89-4.13)	0.135
Bread spread					
Margarine [a]	63.1	79.9	51.7	3.70 (2.25-6.06)	***0.000***
Jam/ Marmalade	15.4	20.9	11.7	1.99 (1.10-3.59)	***0.031***

[a]Significantly higher in males than females; [b]Significantly higher in females than males

Appendix 7: Foods and drinks consumed at different meal and snack times by school types

Food / Drink	All % consuming N=344	Private school % consuming n=139	Public school % consuming n=205	*p- value*
Breakfast				
White bread	50.9	55.4	43.9	0.036
Margarine	38.1	37.4	35.6	0.733
Brown bread	19.5	20.1	17.6	0.546
Maandazi	15.5	1.4	23.9	***0.000***
Jam/marmalade	11.3	14.4	8.3	3.207
Eggs	10.7	12.9	8.3	0.608
Cake	10.1	15.8	5.4	**0.001**
Hotdog/sausage	9.8	18.0	3.4	**0.000**
Peanut/peanut butter	5.5	6.5	4.4	0.689
Fruit	5.2	5.8	4.4	0.566
Snacks				
White bread	42.8	68.8	24.1	***0.000***
Cake	40.9	40.0	43.1	0.907
Fruits	35.8	44.8	29.3	***0.002***
Margarine	30.1	47.2	17.2	***0.000***
Maandazi	28.4	10.4	41.4	***0.000***
Brown bread	11.0	12.9	9.8	0.320
Crisps	10.8	4.5	13.6	***0.009***
Chapatti	6.4	0.8	10.3	***0.001***
Hotdog/sausage	8.4	9.0	7.3	0.534
Jam	5.4	7.2	4.0	0.186
Chips/*bhajia*	4.7	6.4	3.4	0.193
Lunch				
Rice	37.8	20.1	49.7	***0.000***
Refined flour *ugali*	22.5	19.4	24.6	0.253
Beefstew	22.2	25.4	20.1	0.274
Githeri	21.3	44.8	5.5	***0.000***
Fruit	19.2	33.6	9.5	***0.000***
Vegetables	38.7	38.8	38.7	0.977
Bean stew	10.2	6.7	12.6	0.082
Boiled potatoes	9.9	7.5	11.6	0.214
Chips/*bhajia*	7.8	10.4	6.0	0.146
Chapatti	7.5	3.0	10.6	***0.010***
Green grams	6.3	0.0	10.6	***0.000***
Supper				
Githeri	5.9	9.6	3.4	***0.021***
White *ugali*	40.0	27.4	48.8	***0.000***
Rice	28 8	33.3	25.9	0.189
Beef stew	30.6	37.8	25.9	***0.032***
Vegetables	59.1	55.6	61.5	0.166
Chapatti	11.2	8.1	13.2	0.127
Green grammes	8.2	6.7	9.3	0.353
Fruits	7.9	5.9	9.3	0.235
Wholemeal *ugali*	5.0	6.7	3.9	0.281

Boiled potatoes	5.9	7.8	7.1	0.464
Drinks				
Sweetened beverage with milk	100.0	100.0	100.0	-
Ready to drink sweetened drinks	42.7	43.9	42.0	0.722
Milk/milk products	26.7	38.1	19.0	***0.000***
Soda	24.4	36.7	16.1	***0.000***
Sweetened beverage without milk	16.0	18.0	14.6	0.405
Fresh fruit juice	8.4%	11.5	6.3	0.090
Sweetened brown porridge	5.5	5.0	5.9	0.745

Appendix 8: Overweight by participation in activities away from school

Activity and Time	Weight status			
	Normal weight children (Mean±SD)	Overweight children (Mean±SD)	Mann-Whitney U	*p-value*
Television viewing				
Weekday	1.42(09553)	1.47(0.8966)	-0.517	0.605
Saturday	3.71(2.3122)	3.98(2.5177)	-0.777	0.437
Sunday	2.76(2.0577)	2.53(2.1130)	-0.965	0.333
Holiday	4.36(2.6296)	4.90(2.6454)	-1.500	0.133
Homework/private study				
Weekday	1.40(0.7231)	1.44(0.5635)	-1.052	0.293
Saturday	1.35(1.2132)	1.16(1.1716)	-1.148	0.251
Sunday	0.57(0.9385)	0.43(0.7040)	-0.454	0.650
Holiday	1.75(1.4615)	1.83(1.3629)	-0.689	0.491
Computer/mobile phone games				
Weekday	0.19(0.5367)	0.22(0.903)	-0.199	0.843
Saturday	0.88(1.1781)	0.86(0.9775)	-0.469	0.639
Sunday	0.59(0.9343)	0.51(0.8014)	-0.055	0.956
Holiday	1.08(1.3381)	1.24(1.5984)	-1.039	0.299
Outdoor play				
Weekday	0.37(0.6395)	0.30(0.5574)	-0.670	0.503
Saturday	2.35(1.7164)	2.30(1.9349)	-0.581	0.561
Sunday	1.58(1.5657)	1.29(1.4647)	-1.385	0.166
Holiday	3.10(2.0133)	3.04(2.1160)	-0.293	0.770
Bicycle riding				
Weekday	0.20(0.4949)	0.16(0.3743)	-0.277	0.782
Saturday	1.12(1.3693)	0.81(1.0474)	-1.202	0.229
Sunday	0.70(1.0713)	0.42(0.7957)	-1.622	0.105
Holiday	1.62(1.8589)	1.46(1.4457)	-0.009	0.993
Housework				
Weekday	0.30(0.3952)	0.28(0.4235)	-0.680	0.496
Saturday	0.75(0.7282)	0.73(0.6744)	-0.045	0.964
Sunday	0.50(0.7282)	0.42(0.4759)	-0.231	0.817
Holiday	1.01(1.0941)	1.06(1.1109)	-0.208	0.835
Taking care of younger sibling				
Weekday	0.18(0.4509)	0.22(0.5662)	-0.187	0.852
Saturday	0.53(1.2989)	0.42(0.7792)	-0.315	0.753
Sunday	0.40(1.1630)	0.29(0.5654)	-0.0203	0.839
Holiday	0.65(1.5967)	0.54(0.8894)	-0.513	0.608

Appendix 9: Overweight by food and drinks consumed by study children in the previous 24 hours

Food /drink	Percent of children consuming			Odds Ratio (95% CI)	*p-value*
	All N=308	Normal weight (n=247)	Overweight (n=61)		
Cereal based refined foods					
Rice	66.2	64.4	73.8	1.56 (0.83-2.91)	0.216
Chapatti/spaghetti	25.3	27.5	16.4	0.52 (0.25-1.07)	0.073
Cereal based unrefined foods					
Brown bread	30.5	30.0	32.8	1.12 (0.62-2.02)	0.836
Brown chapatti	2.6	3.2	0.0	-	-
Wholemeal *ugali*	5.5	6.5	1.6	0.24 (0.03-1.85)	0.230
Meat, dairy and eggs					
Beef stew	53.6	51.8	60.7	1.43 (0.81-2.54)	0.274
Hotdog/sausage	22.1	21.9	23.0	1.07 (0.55-2.08)	0.991
Chicken	15.2	15.4	4.5	0.77 (0.37-1.63)	0.501
Fish	5.8	6.5	3.3	0.49 (0.11-2.19)	0.132
Milk/milk products	26.6	24.3	36.1	1.76 (0.97-3.20)	0.089
Legumes, grains and nuts					
Beans stew	12.3	13.4	8.2	0.58 (0.22-1.55)	0.273
Peanuts	8.8	8.1	11.5	1.71 (0.72- 4.10)	0.331
Peas stew	8.1	6.5	14.8	1.02 (0.46-2.24)	0.876
Vegetables and fruits					
Fruits	66.6	64.8	73.8	0.65 (0.35-1.23)	0.183
Roots and tubers					
Boiled potatoes	18.5	17.0	24.6	1.59 (0.81-3.11)	0.238
Chips/*bhajia*	15.9	15.4	18.0	1.07 (0.52-2.23)	0.999
Crisps	9.1	8.5	11.5	1.40 (0.56-3.45)	0.635
Fats and oils					
Margarine	64.3	57.9	90.2	6.67 (2.77-16.07)	***0.000***
Drinks					
Sweetened milky tea/coffee/cocoa	100	100.0	100.0		
Diluted juice (cordial)	42.2	40.9	47.5	1.31 (0.75-2.30)	0.425
Soda	25.3	18.2	26.2	1.60 (0.83-3.07)	0.221
Sweetened black tea/coffee/cocoa	14.6	12.6	23.0	2.08 (1.03-4.20)	0.063
Fresh juice	8.8	12.1	11.5	1.067 (0.45-2.56)	0.940

Appendix 10: Ethical clearance

KENYA MEDICAL RESEARCH INSTITUTE

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KEMRI/RES/7/3/1 MARCH 28, 2008

FROM: SECRETARY, KEMRI/National Ethical Review Committee

TO: Florence M Kyallo (University of Nairobi) (Principal Investigator)

RE: NON-SSC No. 067: Overweight and obesity among school children (3-11 years) in Nairobi: Risk factors, health and potential for intervention

Dear Madam,

This is to inform you that during the 152nd meeting of KEMRI/National Ethical Review Committee held on 25th MARCH 2008, the above referenced study was reviewed.

We acknowledge receipt of the following documents:

1. The Study proposal
2. The survey questionnaire in English
3. The Informed Consent Document in English

Thank you for your informative study protocol that aims to determine the:

1. Magnitude of overweight and obesity in children in Nairobi
2. Environmental risk factors associated with number 1
3. The potential for intervention

Due consideration has been given to ethical issues and the study is granted approval from today the 28th MARCH 2008 to MARCH 27th 2009

Please note that any changes to the research study must be reported to the Scientific Steering Committee and to the Ethical Review Committee prior to implementation. This includes changes to research design, equipment, personnel, funding or procedures that could introduce new or more than minimum risk to research participants.

Respectfully,

R. C. Kithinji.
For: Secretary,
KEMRI/NATIONAL ETHICAL REVIEW COMMITTEE