RELATIONSHIP BETWEEN INTAKE OF ENERGY-DENSE DIETS AND NUTRITIONAL STATUS OF ADOLESCENTS IN PRIMARY SCHOOLS IN NAIROBI CITY COUNTY, KENYA

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Q57/30654/2015

A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF PUBLIC HEALTH (MONITORING AND EVALUATION) IN THE SCHOOL OF HEALTH SCIENCES OF KENYATTA UNIVERSITY

JUNE, 2024

DECLARATIONS

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

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DEDICATION

I dedicate this thesis to my parents, Mr and Mrs Muinga, my siblings, and everyone who gave me their support and encouragement throughout this study.

ACKNOWLEDGEMENT

Firstly, I thank the Almighty God for the grace, protection, wisdom, and good health He accorded me throughout the research period. I extend my earnest appreciation to my supervisors Prof. Judith Waudo and Prof. Joachim Osur of Kenyatta University and Amref International University, for their tireless efforts in providing me with their support, encouragement, guidance, and dedicated supervision.

I appreciate the Ministry of Education, Alice Musili, Lucia Mwongeli, Headteachers, Deputy Headteachers, and senior teachers of Embakasi South primary schools (Fair Oak Pri. School, Kwa Njenga Pri. School, Reuben AEF Primary School, St James Academy, MCC Primary School, Gatoto Community Centre Primary School, and Swammirayawan Primary School) who supported me during data collection. Special thanks to Dr Paul Oyore, Rael Jepchumba, Beatrice Koki, and Christopher Chege for their help during thesis development, data analysis, and thesis writing. I would also like to thank Dr Mwanzo, Dr Justus Osero, Dr Mary Muiruri, the Dean School of Health Sciences, and the Dean of Graduate School Kenyatta University for their assistance and guidance during the thesis presentation. Finally, I thank my family and friends for their encouragement and support in ensuring the success of my master's programme.

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ABBREVIATIONS AND ACRONYMS

CWW: Concern Worldwide

DALYs: A disability-adjusted life years (DALYs)

FSRFR: Food Security Research Findings and Recommendations Nairobi County

KDHS: Kenya Demographic and Health Survey

MoE: Ministry of Education

MoH: Ministry of Health

NCD: Non-Communicable Diseases

NCIDP: Nairobi County Integrated Development Plan

NFNPS: National Food and Nutrition Policy for Schools

NSHSIP: National School Health Strategy Implementation Plan

SNMSK: School Nutrition and Meal Strategy for Kenya

UNICEF: United Nations International Children's Emergency Fund

WHO: World Health Organization

DEFINITION OF OPERATIONAL TERMS

Adolescent: refers to any person aged between 10 and 14 years.

Malnutrition: is defined as the deficiencies, excesses, or inequities in one's ingestion of nutrients**.**

Underweight: refers to body weight, which is considered too low for one to be healthy, having a BMI of less than 18.5.

Non-communicable diseases: refer to diseases that develop over a prolonged time and are caused by lifestyle and genetics.

Energy density: is the quantity of energy or calories in a gram of food.

Fast foods: refer to convenient foods generally sold in retail outlets, such as fast-food restaurants and rich in great amounts of calories, sugar, saturated fat, and salt.

Irritable bowel syndrome: refers to a disorder that affects the large intestines whose signs and symptoms include cramps, bloating, constipation, abdominal pains, and diarrhoea.

ABSTRACT

Energy-dense diets are of low nutrient quality but high energy content and this may have adverse health outcomes. There is limited information regarding the relationship between the intake of energy-dense foods and adolescents' nutritional status. The study aimed to establish how the intake of energy-dense diets relates to the nutritional status of adolescents in Nairobi County. The study was a mixed-method research design combining qualitative and quantitative techniques of data collection. Cluster sampling was utilized to select schools in Embakasi South Sub-County. Simple random sampling was utilized to select adolescents in classes 5, 6 and 7; and 161 adolescents (87 females and 74 males) aged 10-14 years participated in the study. Structured questionnaires, 24-hour recall, and food frequency questionnaires were used to collect quantitative data. Anthropometric measurements were taken using calibrated standometers, weighing balance and MUAC tape to determine the nutritional status of the adolescents. The key informant interviews were conducted with 7 headteachers/ class teachers to collect qualitative data. Analysis of quantitative data was done using SPSS software version 23.0. Dietary and anthropometric data were analyzed using Nutrisurvey and ENA for SMART software. Pearson correlation was utilized to determine the relationship between the nutritional status and intake of energy-dense foods. The school heads consented on behalf of the parents of the adolescent. The study established a burden of malnutrition among adolescents in Nairobi County (13%) who are underweight, (5.7%) overweight, (4.3%) severely underweight, and (2.5%) obese. The average energy taken was 1610.4±686.4 kcal. The energy-dense foods which had a significant relationship with the nutritional status of the adolescents were: potato chips (r=0.044, p=0.045), doughnuts (r= -0.02, p = <0.001), pancakes (r= -0.001, p= 0.762), cheese (r= -0.107, p-value= 0.660), and Regular soft drink (r= -0.147, p= 0.101). Qualitative findings indicated that doughnuts were frequently brought to school as snacks. In conclusion, a quarter of the adolescents interviewed were malnourished. The adolescents' nutritional status was influenced by the intake of some energy-dense diets and sociodemographic characteristics. There is a need to have nutrition education forums in schools and communities on the importance of nutrition to adolescents for better health

CHAPTER ONE: INTRODUCTION

1.1. Background to the study

Dietary energy density is the total energy found in a certain weight of food (Kcal/gram) (Rolls, 2017). Most fatty, highly refined foods and sugar-sweetened foods and beverages are high in energy density but poor in other essential nutrients. The availability of high-energy-dense diets among urban dwellers is a key contributor to malnutrition (over-nutrition and under-nutrition) among adolescents (Robinson *et al*., 2022; Rouhani *et al*., 2016). The adolescents are presumed to be wise enough to make their own food choices, which predisposes them to consume fast foods and junk food rich in high energy density, which lack all the essential nutrients (Vos *et al*., 2017; Banfield *et al*., 2016). Inadequate nutrients in these foods predispose them to various forms of malnutrition and other nutritional-related disorders (Osano *et al*., 2017). Malnutrition in adolescents can result in lifelong health complications, and in girls, it can cause delayed puberty and small pelvis development. Malnourished teenage girls who conceive during adolescence have a high probability of experiencing complications in their gestation and giving birth to babies of low birth weight (Ministry of Health, 2016; Lillie *et al*., 2019; Ahmad, Rahman, & Nadia, 2020). Overreliance on energy-dense diets also contributes to micronutrient deficiencies including iodine, iron, and zinc deficiencies that have been found to influence school performance, and impaired cognitive and motor development (Zerga *et al*., 2022).

Globally, approximately 10.4% and 7% of adolescents are underweight and obese, respectively (Christian & Smith, 2018; WHO, 2018). In Africa, undernutrition and obesity among adolescents are estimated to range between 5-60% and 15%, respectively (UNICEF, 2017; Akseer *et al*., 2017). In Sub-Saharan Africa, 30% of

adolescents are stunted, 27% are underweight, 49% are anaemic, and 16% are overweight (Akombi *et al*., 2017). The estimate of iodine deficiency is 4.6 % among adolescents in developing nations, while the percentage of adolescent girls with a deficiency of vitamin A is 20% (Christian & Smith, 2018). In Kenya, approximately 8% of adolescents are stunted, 15.6% are underweight, and 22% are obese (National Food and Nutritional Policy for Schools (NFNPS), 2016; Christian & Smith, 2018).

Intake of refined and sugar-sweetened foods and drinks among adolescents has increased in the recent past. Approximately a third (30.3%) of adolescents in schools do not consume fruits, vegetables, or legumes, but 43.7% consume soft sugary drinks and beverages and highly refined foods regularly (M'mbaya, 2021). Also, 69% of more than 23,000 food products analyzed were found to be of low nutrient quality, especially in developing countries (Global Nutrition Report (GNR), 2018). A study conducted in Kenya and Ghana indicates that consumption of sugar-sweetened beverages has increased among adolescent*s* in urban setups (Holdsworth *et al*., 2020). Changes in economic development in developing countries have led to increased sales of high energy-density foods at lower prices which increase access among adolescents (Osei-Kwasi *et al.,* 2020). Also, increased food insecurity and food unaffordability contribute to access to unhealthy diets including high-energy-dense foods which predispose adolescents to various forms of malnutrition among city dwellers (WHO, 2020). In Nairobi, urbanization has led to increased production of highly processed foods hence the increased consumption of high-density foods among adolescents (Wachira *et al*., 2021). A study by Kigaru *et al.,* 2015, also indicated that there is a versed growth of fast food restaurants in Nairobi County which predisposes adolescents to sugar-sweetened beverages and high energy-dense diets. The accessibility of cheap and highly refined foods in Nairobi increases access to high-energy-dense foods among

adolescents. However, there is a scarcity of information on the energy-dense diet intake and the relationship between these foods intake and adolescents' nutritional status. Increased intake of high energy-dense diets and other essential nutrients is a fundamental predisposing factor for chronic diseases (WHO, 2020; WHO, 2015).

1.2. Problem statement

The intake of energy-dense diets among adolescents has increased in the recent past globally, elevating the burden of malnutrition and nutritional-related diseases. The situation is not different in Kenya, with increased urbanization and limited food sources in urban areas (Kathoka *et al*., 2022). In Nairobi, there has been a fast growth of fast food restaurants and outlets recently, which has led to increased access to fatty and high-energy-dense foods among adolescents (Kigaru *et al*., 2015; Wambui, Kibe, & Macharia, 2019). Increased intake of energy-dense diets among adolescents could be associated with the increased levels of malnutrition in Nairobi County. Approximately 11.1% of adolescents are underweight, 11% are stunted, and 8.6% are obese in Nairobi County (Kigaru *et al*., 2015). The high levels of malnutrition among adolescents could have been attributed to the diet the adolescents consume, including high energy-dense diets. Excessive intake of energy-dense diets and excess adiposity significantly contribute to non-communicable diseases and malnutrition among adolescents (Guyenet, 2019). However, little information is available on the intake patterns of energy-dense diets and how they contribute to malnutrition among adolescents in the Embakasi South Sub-County. A lower and middle socioeconomic class, with many food outlets and street foods that supply fatty and cheap foods that are easily accessible by adolescents, characterizes Embakasi South Sub-County. According to Obinda *et al*., (2021), the Embakasi South sub-county has many street food vendors who sell street foods, which could not be safe for consumption due to poor food handling practices.

The nutritional content of the street food sold is not controlled and thus could expose the consumers to various forms of malnutrition.

Additionally, there is a nutritional data gap of adolescents in this area, which limits the generation of evidence-based actions for support of programmes, which enhance optimal health for adolescents. As a result, this could have an adverse effect on their health during adulthood and underpin the nation's efforts to achieve sustainable development goals. This study, therefore, aimed to determine the relationship between energy-dense food intake and the nutritional status of teenagers aged 10-14 years in the Embakasi South Sub-County.

1.3. Justification of the Study

Good health is a crucial fundamental human right in an adolescent's life. The National Food and Nutrition Policy for Schools dictates that adolescents should be provided with healthy diets that meet healthy diet guidelines (NFNPS, 2016). Nairobi County has a challenge of food production and thus relies on food from rural and peri-urban counties. Thus, food security, safety and accessibility are a big challenge due to the vast growth of the population in the city (Mwasi, 2020). An increased number of fast-food restaurants and street foods, which provide cheap, readily available, refined foods and sweetened drinks, also characterizes Nairobi County. These foods and beverages have high sugar and fat contents characterized by high energy (Wambui, Kibe, & Macharia, 2019). Additionally, Embakasi South Sub-county being a peri-urban area, has little or no space for agriculture to provide diverse food varieties for consumption. There is also an increased population due to the availability of cheap housing with no guarantee of food security. There are also increased street food vendors in the sub-county. Thus, its residents are pushed to rely on fast/ junk foods high in energy density but low nutritional value (Obinda, 2020).

Moreover, the relationship between energy-dense diets and adolescents' nutritional status has not been documented in this area. Lack of such vital information can lead to an increased intake of energy-dense foods, which contributes to malnutrition among adolescents, thus affecting their school performance and health. In addition, this hinders the effective implementation of nutritional programmes in this area. Therefore, this study provides information that informs school nutritional policies and school feeding programmes to formulate strategies that improve food intake patterns among adolescents in schools to prevent overreliance on high-energy-dense foods. It also helps to inform parents and teachers about the dangers of overreliance on energy-dense foods.

1.4. Research questions

The study questions were:

i. What is the nutritional status of adolescents in primary schools in Nairobi County?

ii. What are the intake patterns of energy-dense foods among adolescents in Nairobi County?

iii. What is the relationship between the intake patterns of energy-dense foods relate and malnutrition among adolescents in Nairobi County?

iv. How do sociodemographic characteristics relate to the intake of energy-dense foods among adolescents in primary schools in Nairobi County?

1.5. Null hypotheses

1. There is no relationship between the intake of energy-dense diets and the nutritional status of adolescents in selected primary schools in Nairobi County.
2. There is no association between sociodemographic characteristics and the intake of energy-dense foods amongst adolescents in selected primary schools in Nairobi County.

1.6. Broad objective

The study's main objective was to establish the relationship between the intake of energy-dense diets and the nutritional status of adolescents in selected primary schools in Nairobi County.

1.7. Specific objectives

The specific objectives that guided this study were:

i. To assess the nutritional status of adolescents in primary schools in Nairobi County
ii. To determine the intake patterns of energy-dense foods among adolescents in primary schools in Nairobi County
iii. To determine the relationship between the intake of energy-dense foods and the nutritional status of the adolescents in primary schools in Nairobi County.
iv. To determine the relationship between sociodemographic characteristics and energy-dense food intake among adolescents in Nairobi County primary schools.

1.8. Significance of the study

This study provides insight into the intake patterns of energy-dense foods and their relationship with the nutritional status of adolescents in Nairobi County. The study's findings inform the teachers and parents of the effects of overreliance on energy-dense foods in their adolescents' diets. Additionally, the results provide the teachers with knowledge of energy-dense diets; thus, they can give adolescents guidance on the significance of consuming quality diets. The information generated from this study may enable the education stakeholders to come up with better nutritional strategies to improve the nutritional status of adolescents as well as their academic performance. Moreover, the study findings provide information which can be used to implement national school nutrition policy. Lastly, the information may be used by MoH, MoE,

and other NGOs to implement school feeding programmes to enhance adolescents' nutritional and health status.

1.9. Delimitations of the study

The study was conducted in primary schools among adolescents (10-14 years) in Embakasi South Sub-county, of which results can be applied to areas with comparable characteristics. The results of other peri-urban setups can produce similar results.

1.10. Limitations of the study

The study took place in schools that might affect adolescents' consumption patterns of energy-dense foods through the food that was provided in schools. Additionally, the presence of coexisting diseases was not tested during the study, which could have influenced the adolescents' nutritional status. The research assistants with the assistance of the class teachers ensured that they followed the study procedures, especially in selection criteria to avoid selecting adolescents who were sick during the time of the study. Also, the study was done during the COVID-19 pandemic, which could have influenced the nutritional status of adolescents because the schools had been closed for more than six months. Additionally, the presence of school feeding programmes in all the schools where the study was conducted, limited access to fast foods, which are highly energy-dense among the adolescents; hence the high percentage of normal nutritional status was noted among the adolescents.

1.11. Conceptual framework

Figure 1.1 is a conceptual framework which illustrates the relationship between food consumption patterns, level of energy density, and nutritional status among adolescents. The sociodemographic characteristics influence the affordability and accessibility of food in a household. The sociodemographic characteristics determine the food intake

frequency, the type of food consumed, and the number of meals consumed in a day. The frequency of food consumption and the type of foods consumed, the amount of nutrients consumed, and the amount of meals/ beverages taken in a day influence the amount of energy contribution of food. The higher the frequency of consumption of foods high in energy leads to high energy density. Intake of foods that are rich in high energy density, the higher the likelihood of increased level of adiposity tissues. High energy density in the food also results in either over-nutrition or under-nutrition. Also, it can affect an individual's nutritional status by exposing them to micronutrient or macronutrient deficiencies, which may affect the health of adolescents. Low energy density in diets contributes to normal nutrition and healthy bodies.

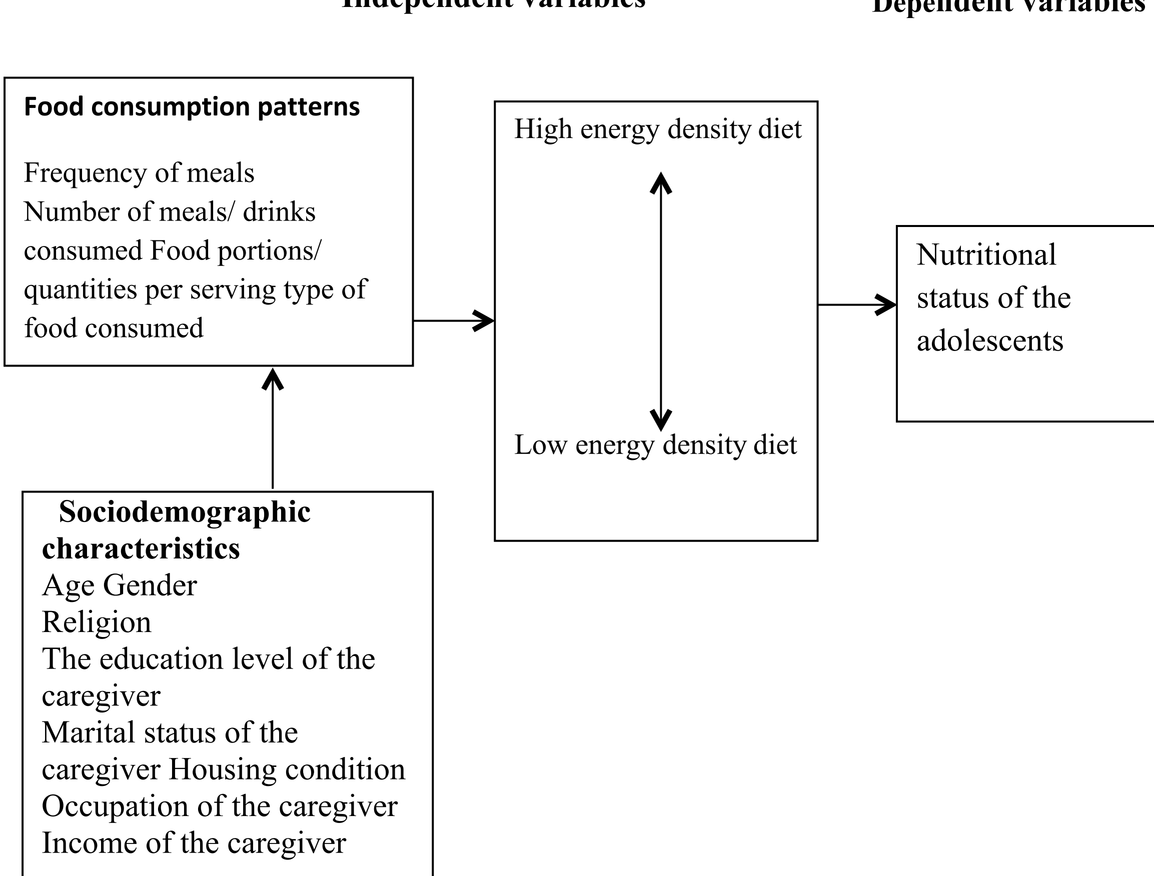

Figure 1.1: Conceptual framework

Source: Adopted and modified from Rono, 2017; Githinji *et al*., 2016

CHAPTER TWO: LITERATURE REVIEW

2.1. Nutritional status of adolescents

Adolescence is an important age in one's life because it is the stage in which physical growth, psychosocial changes, cognition, brain development, maturity, and physical changes occur (Tandon *et al*., 2016). During this growth phase, energy, proteins, and micronutrients are required to enhance development and optimal growth (Grech *et al.,* 2017; Rono, 2017). When the nutritional requirements for adolescents are not met, nutritional deficiencies and growth retardation may result.

Studies show that malnutrition among adolescents has risen in the past years. There are high levels of undernutrition and overnutrition in low and middle-income countries (LMIC) among adolescents. The burden of malnutrition in the LMIC is higher among female adolescents as compared to male adolescents. Malnutrition among adolescents is manifested in various forms, which include; micronutrient deficiencies, height-for-age, overweight, wasting, obesity, and chronic nutrition-related sicknesses like diabetes, increased blood pressure, and metabolic syndrome (Zárate-Ortiz *et al*., 2019). More than 30% of adolescents in Mexico were estimated to be obese or overweight (Hernandez-Cordero *et al*., 2017). A survey done in Bangladesh showed that adolescent girls and boys were undernourished and had low consumption of essential micronutrients as a result of intake of energy-dense diets (IFPRI, 2018). A study done in Ghana shows that 2.1-50.3%, 7-19.4%, 6.9-19.8%, and 24% of adolescents were stunted, underweight, overweight/obese, and anaemic respectively (Agaba *et al*., 2022). A study done in Ethiopia showed that 15.3% and 26.6% of adolescents were wasted and stunted respectively (Hadush *et al*., 2021). In Tanzania, 23.1%, 25%, and 6.1% of adolescents were anaemic, overweight, and obese respectively (Nicholaus *et al*., 2020). A study done in Kenya showed that 15.6%, 8%, and 22% of adolescents were

underweight, stunted and obese respectively (National Food and Nutritional Policy for Schools (NFNPS), 2016; Christian & Smith, 2018)

2.2. Consumption patterns of dietary energy-dense foods

Dietary energy density may be defined as the quantity of calories in a specific weight of foodstuff or beverage (Rolls, 2017). Water in a diet provides a substantial weight without increasing the amount of energy, contributing to variations in energy density. Dietary fibre adds weight to the diet while adding low energy (Grech *et al.,* 2017). Density can be calculated by taking food only without including any drink or use of food plus other drinks. Therefore, water and fibre in foods usually make them have lower energy density. Dietary fats, contrary, provide high amounts of energy per gram and, hence are high in energy density. Dietary energy drinks, excluding non-energy beverages, contribute to the high energy density in foods (Horgan *et al*., 2022).

Thus, the food's energy density is very critical in determining the overall energy intake in the body. High-energy-density foods may cause inert overconsumption (Grech *et al*., 2017). Hence, with an increased energy density of food eaten, the higher the overall energy consumed (Rolls, 2017). High energy density foods generally are highly refined and contain high energy to other nutrient contents. Besides, a high-energy-density diet may involve the intake of high sugar-sweetened beverages (Guyenet, 2019; Fernando, 2018). Intake patterns of energy-density food have a substantial impact on health. Thus, dietary energy intake with lower energy density is recommended for adolescents to reduce nutrition-associated health problems such as dental caries and malnutrition (Grech *et al*., 2017).

Dietary patterns have changed in all age groups in the current societies due to high industrialization and urbanization. Most people tend to incline so much to Westernized

dietary habits (intake of highly processed foods with large amounts of sugar, fats, salt, and inadequate amounts of dietary fibre while reducing consumption of a balanced diet (Rathi *et al*., 2017; Majabadi *et al*., 2016). The changes in dietary habits cause a reduction in water in the diet of adolescents, being replaced by sugar-sweetened drinks, which are high in energy density. Moreover, the intake of diets rich in proteins, carbohydrates, and micronutrients, which provide essential nutrients for optimal growth has declined over time (Mendes *et al*., 2016). Studies also show that frequent consumption of high-energy-density diets increases energy intake and weight gain. Low energy density dietary, on the other hand, assists in weight maintenance in the body (Centers for Disease Control and Prevention, 2015). Consumption patterns of dietary density foods are determined by the adolescents' eating habits, availability, and affordability of the food, and the knowledge level of the caregiver on nutrition (Aballa, 2013). The types of food frequently consumed by adolescents in towns are snacks and fast food, which influence the energy intake of foods. Most of the snacks eaten are high in fats, sugar, salt, fats, and carbohydrates (Kigaru *et al*., 2015; Rathi *et al*., 2017). Frequent snacking among young adolescents has been associated with weight gain and micronutrient deficiencies (WHO, 2015). However, few studies have been done to show the outcomes of consuming foods with high energy densities among adolescents.

2.3. Relationship between the intake of diets with high energy-dense and nutritional status of adolescents

Studies indicate a relationship between the intake of energy-dense foods and body composition. A diversified diet provides all the essential nutrients needed to enhance the adolescents' nutritional status. Studies have established a positive association between the frequency of dietary intake and nutritional status. Intake of a balanced diet with a high intake of fruits and vegetables has been found to contribute to better

nutritional status of adolescents. Diets with the poor nutrient quality especially oily, highly refined and salted foods, and sugar-sweetened beverages contribute to malnutrition (Do Amaral e Melo *et al*., 2020; Nicholaus *et al*., 2020). High intake of energy-dense diet has been attributed to poor nutrient quality, which contributes to the increased level of undernutrition or overnutrition. Adolescents' diets in most developing nations have limited intake of animal products, vegetables, and fruits but frequently consume foods high in energy density, especially in urban setups. Notably, there has been an increase in iron, zinc, and calcium deficiencies, vitamin C and overweight among adolescents who frequently consume high energy-dense diets (Ochola & Masibo, 2014; Nicholaus *et al*., 2020). A study done in East African countries to determine intake patterns of different levels of processed foods and their association with health outcomes showed that, intake of highly processed foods contributed to obesity among women (Sarfo *et al*., 2021). Excess intake of diets which are high energy-dense has been identified as the primary cause of obesity amongst adolescents, contributing to the emergence of public health problems of occurrence of chronic disorders such as diabetes, cardiac diseases, hypertension, cancer, arthritis (Anilkumar *et al*., 2017; Rono, 2017; Dyson *et al*., 2018; Cohen *et al*., 2017)). De Amicis *et al*., (2022) established a positive relationship between the intake of ultra-processed foods (high in energy density) and the prevalence of obesity among adolescents. Intake of energy-dense diets predisposes adolescents to the risk of acquiring cardiovascular diseases, dental caries, cancers related to obesity, and hypertension (Vos *et al*., 2017). They may also expose the adolescents to constipation, haemorrhoids, and other gastrointestinal infections, such as diarrhoea, that could affect nutrient absorption in the body, leading to undernutrition. Consumption of foods with high fat content causes irritable bowel syndrome (Torres *et al.,* 2018). Moreover, micronutrient inadequacy

could expose adolescents to micronutrient deficiencies such as night blindness, scurvy, anaemia, and poor mental development (Singh, 2014). Consumption of deep-fried foods has been associated with irritable bowel syndromes that affect the absorption of other nutrients, thus contributing to nutritional deficiencies (Adeniyi *et al.*, 2017).

2.4. The relationship between intake of energy-dense foods and sociodemographic characteristics

Sociodemographic characteristics of people are key determinants of the dietary intake of the population. The age, gender, religion, education level of the caregiver, occupation, income level, number of children in a family, and food affordability, in some studies done, show that they influence the dietary intake of adolescents (Yau *et al*., 2020; Githinji *et al*., 2016). Most households with low income cannot afford food in adequate amounts and of high quality that meets their nutritional needs (School Nutrition & Meal Strategy for Kenya (SNMSK), 2016). Adolescents from low socioeconomic classes tend to skip some meals, which affects their feeding habits, hence the energy intake in a day (Konttinen *et al*., 2021; Yau *et al*., 2020). These foods contain high energy-density and may include fast foods, jumble foods, and highly sugar-sweetened, or carbonated drinks (Food Security Research Findings and Recommendations Nairobi County, 2014). However, for the high-income social class, the parents are busy with their working schedule. This contributes to the adolescents being left to choose the type of food to feed, which exposes them to high-energy diets since they are quick and easy to prepare (Verstraeten e*t al*., 2014).

Age and gender play a very important role in dietary intake. According to Gewa *et al*., (2022), most adolescents in Kenya preferred to consume confectionaries, sugar-sweetened beverages, and street foods like french fries/ crips that have high levels of

energy density compared to intake of other healthy diets including intake of fruits and vegetables. The adolescence age is presumed to be an age when adolescents are wise enough to make wise food choices compared to young children who are given more attention when it comes to dietary monitoring (Vos *et al*., 2017).

The education level of the caregivers determines nutrition knowledge which influences the type of diet the caregivers provide to the adolescents (M'mbaya, 2021). These fast foods are associated with high energy intake, sugar, salty and fatty, with low levels of vitamins and other essential nutrients (Boylan *et al*., 2017; Vos *et al*., 2017). These foods are cheap and readily available but contain high energy density, which could lead to various nutritional-related illnesses such as malnutrition and dental caries (UNICEF, 2017). However, for the high-income social class, the parents are busy with their working schedule. This contributes to the adolescents being left to choose the type of food to feed, which exposes them to high-energy diets since they are quick and easy to prepare (Verstraeten e*t al*., 2014). The caregiver's education level also affects the food the adolescents consume. Educated caregivers tend to have a high knowledge of the benefits of proper nutrition on adolescents, contrary to those with low levels of education (SNMSK, 2016).

Food accessibility and affordability influence the dietary choices of an individual. Most people in low- and middle-income countries opt to purchase readily and cheap types of food. Most cheap and readily available foods in urban set-ups are foods that are highly processed, fatty, salty and poor in other essential nutrients (high energy-dense diets); which leads to unhealthy dietary habits (Pradeilles *et al.,* 2021). In Kenya, and specifically Nairobi there is high growth of fast food restaurants and street food vendors, which sell cheap and readily accessible foods. The food sold by the food vendors in Nairobi County has been found to be compromised in dietary quality and

safety. This exposes consumers to poor nutrition which contributes to malnutrition, especially among adolescents, especially in primary schools (Obinda *et al*., 2021).

Different religions have different specifications or instructions on dietary choices. Some religions have restrictive food intake patterns which are likely to affect the energy density of a particular food. A restrictive diet may impact the nutritional status of an adolescent either positively or negatively. For example, in the Seventh-day Adventist Church, religious leaders encourage their followers to consume lots of vegetables, food with less fat, whole grains or fruits, which have lower energy density. Thus, promoting healthy lifestyles while other religions do not educate their believers on dietary intake patterns (Saintila *et al*., 2022). Also, a study by Bauer *et al*., (2019) showed that faith beliefs were associated with intake of high energy-density.

2.5. Summary and gaps in the reviewed literature

Literature review shows that malnutrition among adolescents is a serious public health issue affecting both the developed and developing world. Malnutrition predisposes adolescents to poor health, premature deaths, and low productivity (Hadush, Seid, & Wuneh, 2021). Malnutrition among adolescents is caused by food insecurity, poor food intake patterns, and sociodemographic characteristics (Kimani-Murage *et al*., 2014). Moreover, intake of energy-dense foods has been identified as a causal factor of malnutrition among adolescents due to their preference for sugar-sweetened beverages and highly refined foods which are high in energy density.

The literature reviewed shows that the intake of energy-dense diets affects adolescent's health due to their insufficiency in nutrients. However, with studies carried out, there is scanty information on adolescents' consumption patterns of energy-dense foods especially in LMIC. Furthermore, there is a need to evaluate dietary patterns, the

existence of malnutrition and diseases associated with the various forms of malnutrition among young adolescents (WHO, 2018). Also, from the literature, there are gaps in the association of intake patterns of high energy-dense foods intake and nutritional status and socio-demographic characteristics (Gewa *et al*., 2022)

CHAPTER THREE: MATERIALS AND METHODS

3.1. Introduction

This chapter provides an overview of the materials and methods which were used to collect data, variables, study population, techniques which were used for sampling, determination of sample size, study instruments, data collection techniques, analysis, pretesting, validity, reliability, and ethical and logistic considerations.

3.2. Research Design

The research design used during the study was a cross-sectional survey, which applied a mixed-method approach of data collection. The mixed method combined both the qualitative and quantitative methods of data collection to facilitate data triangulation (Creswell, 2017). It was descriptive because it helped in the determination of adolescents' energy-dense diet intake patterns, and the level of malnutrition. The study design was appropriate for this study because it helped to determine the association between energy-dense diet intake and the nutritional status of adolescents.

3.3. Variables

3.3.1. Dependent variables

The dependent variable was the nutritional status of adolescents aged 10-14 years.

3.3.2. Independent variables

Independent variables were the energy-dense food consumption patterns (Frequency of meals, number of meals/ drinks consumed, food portions/quantities, type of food consumed), and the level of energy density provided by the diet (high or low energy density).

3.4. Location of study

The study was carried out in Nairobi City County in Kenya, which is approximately

696.1 square kilometres. Nairobi County is bordered by Kajiado, Machakos, and Kiambu Counties to the South, East, and North West, respectively. It lies between 36˚45'E and 1˚18'S and has an altitude of 1798m above sea level. It is subdivided into nine sub-counties, 27 divisions, 64 locations, and 135 sub-locations and is a cosmopolitan city with people of varied ethnic, cultural, and religious backgrounds. Embakasi South Sub-county is approximately 12.0 Km^2 with five wards. Embakasi South Sub-county has a population of 80,440 adolescents aged 10-14 years old (KNBS, 2019). Most of the adolescents reside within non-formal settlements. In these settlements, access to education and proper diet is quite a big problem. The primary school net enrolment rates are 77.8%, while the drop-out rates are 3.6%. This study was, therefore, conducted in chosen private and public primary schools in Kware, Pipeline, Imara Daima, Mukuru Kwa Njenga, and Mukuru Kwa Reuben Wards in Embakasi South Sub-county because the area comprises both planned and unplanned settlements. Representing a population of both medium and low social classes; characterized by insufficient supply of clean water; poor sanitation; poor housing conditions; and low income (NCIDP, 2017).

3.5. Study population

The adolescents aged between 10-14 years old in primary schools were the study population. Adolescents of this age group were appropriate for this study because this age group is transitioning from childhood to the youthful stage. Adolescence is characterized by rapid growth, puberty changes, mental development, and increased nutrient requirements. Therefore, failure to meet nutritional needs during this stage may result in impaired growth, malnutrition, impaired mental development, and cognition ability of adolescents (Christian & Smith, 2018). In addition, dietary habits and patterns developed during adolescence may be transferred to adulthood, hence might have a

health impact on later days of life. Moreover, studies show that a high-energy-dense diet adopted during adolescence contributes to obesity, depression, micronutrient deficiencies, and other metabolic risks (Zárate-Ortiz *et al*., 2019).

3.6. Target population

The target population for this study were pupils in classes 5, 6 and 7 in private and public primary schools in Embakasi South Sub County, Nairobi County. Even though some pupils in class 4 had reached the age bracket required for the study, they were excluded from the study because they did not understand the research tools used. Also, class 8 pupils were not included in the study because they had completed their exams when the study was done. Therefore, the pupils ideal for the study were pupils in classes 5, 6 and 7. The class teachers, senior teachers and head teachers were conveniently selected as key informants as they related closely with the adolescents and understood their dietary intake much better.

3.7. Inclusion and exclusion criteria

3.7.1. Inclusion criteria

The study included adolescents whose parents or guardians gave consent to their participation. The adolescents selected had lived with their parents in the study area for at least six months. The class teachers of the streams that were selected.

3.7.2. Exclusion criteria

Adolescents who were absent from school during the study, sick, mentally, or physically challenged, were excluded from the study. The study involved body measurements; hence, physically challenged adolescents were not eligible to participate. Teachers assisted in identifying any cases of mentally challenged adolescents and, if any, were excluded, as they could not answer interview questions well. The presence of any sickness would act as a confounding factor for nutritional

status because the study aimed to establish whether there was any relationship between the intake of energy-dense foods and nutritional status.

3.8. Sampling Techniques and Sample Size

3.8.1. Sampling Techniques

Nairobi County, specifically Embakasi South Sub-county, was purposively selected because it is a cosmopolitan city with low, middle, and high social classes. Cluster sampling was utilized to select the schools in Embakasi South Sub-county wards in terms of private and public, with seven schools being selected. Out of the seven schools selected three were public schools while four were private schools. Simple random sampling was used to pick one stream in classes 5, 6 and 7. Simple random sampling was appropriate as it helped to reduce the bias in sample selection. Proportional-to-size sampling was used to select the number of adolescents studied from the selected streams.

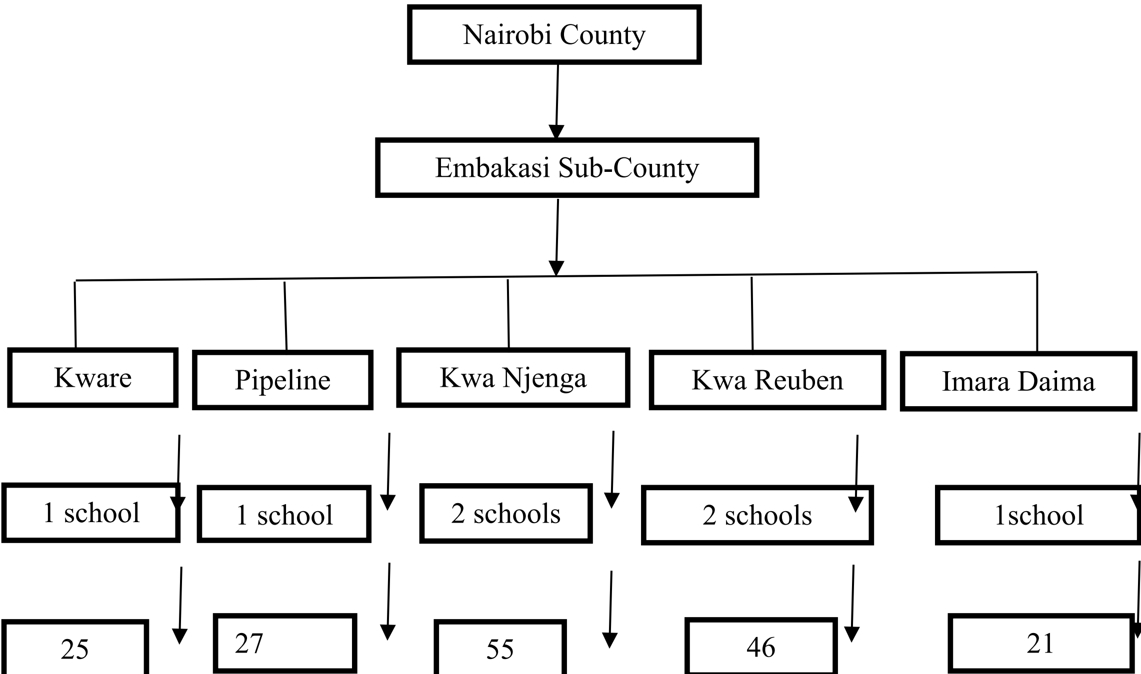

Figure 3.1: sampling frame

3.8.2. Sample Size determination

The sample size was determined using Cochran's (1963:75) formula for a population above 10,000 to represent the total population.

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

e = is the desired level of precision= 5% (i.e. the margin error),

p = is the projected percentage of undernourished adolescents

q = (1 – p) i.e. the proportion of adolescents not undernourished Z^2= normal distribution at 95% confidence interval

n= is the desired sample size

$n0 = ((1.96)^2 (0.111) (1-0.111)) / (0.05)^2 = 152$

To account for the attrition rate, 10% was added to the initial sample size to bring it to 166 adolescents.

Seven key informant interviews were conducted with the class teachers the senior teachers or the headteachers selected from each school. The class teachers/ head teachers were purposively sampled because they are the people who interact closely with the adolescents. They also monitor class attendance and ensure the well-being of the adolescents in the schools.

3.9. Construction of Research Instruments

A self-administered questionnaire was utilized to collect the sociodemographic characteristics information of the adolescents. Energy-dense diet intake was assessed using a 24-hour recall questionnaire. Standard measuring dishes, cups, and spoons were utilized to make demonstrations to assist the adolescents in estimating their food intake. A food frequency questionnaire was utilized to give the frequency of intake of different

food groups. Anthropometry measurements (weight, height, and mid-upper arm circumference) were measured using a well-calibrated weighing scale, height board, and MUAC tape to determine body mass index (BMI). The adolescents' nutritional status was established using BMI. The age and gender of the adolescent were also recorded. Key informant interviews were conducted with the class teachers/ head teachers to gather information on the type of meals available in the school feeding programmes.

3.10. Pretesting

Pretesting of the research tools was done in two selected schools (Thawabu Primary School and St Peters Academy) in Embakasi Central Sub-county and involved 20 adolescents. The purpose of pretesting the research tools was to check for any anomaly in the questionnaire wording and if there was any lack of clarity in the order of the questions. The data collection tools were corrected and adjusted according to the observations made during pretesting before the actual study was carried out.

3.11. Validity

The study tools were standardized using FAO/WHO-approved dietary practices. The study questionnaires were pretested to ensure that there were no repeated questions. Also, the questions were based on research objectives. Also, subjecting the questionnaire to the supervisors' review helped validate the research instruments. Standardization of the research tools including calibration of the measuring tool ensured validity. The Research Assistants took part in pretesting the data collection instruments in Embakasi Central Sub County; to enable them to familiarize themselves with the tools. Any errors detected during pretesting were corrected before the main research was carried out to establish methodological coherence and thus enhance the study's validity.

3.12. Reliability

The test-rest method was utilized to assess the reliability of research tools. Two schools were used in the pre-test, and a reliability coefficient of greater than 0.7 was achieved, which complied with the recommended reliability coefficient in the literature (Simões *et al.*, 2018). Using the Bland-Altman plot, the test-retest analysis indicated that the second findings were consistent with the first findings; thus, the tools were reliable.

3.13. Data Collection Tools and Techniques

The study preliminaries involved training Research Assistants to familiarize themselves with the research tools and visiting the study area (Embakasi South Sub-county) to meet and brief the school headteachers about the study. Also, contacts were made with the sub-county nutrition and dietetics department to seek assistance with research tools such as weight scales, height boards, and MUAC tapes. The school headteachers gave consent for the adolescents to be interviewed and signed the informed consent on behalf of the adolescents' parent. The adolescents were randomly selected using class registers proportionally to the class sizes from each stream. The adolescents were given a chance to ascent to participate or not. During the data collection period, the Research Assistants explained the content of the questionnaire to the selected adolescents; then, they gave them structured questionnaires on sociodemographic characteristics to fill. The height board and weighing balance were calibrated before taking the measurements. The Research Assistants took the adolescents' weight, height, and MUAC measurements. The adolescents were asked to remember the foods they had taken within 24 hours, and then the foods they had carried to school were estimated using WHO/FAO standardized measuring dishes, spoons, and cups. The adolescents were asked to estimate if the food they had taken within the 24 hours before the study would be equivalent to the measurements taken, and their responses were recorded. The

Research Assistants further probed to ensure that no food was forgotten. According to Arsenault *et al*., 2020, the capability of children to recall the food they consumed increases with age. Probing and proper guidance of adolescents aged between 12-14 years helps to reduce errors in 24-hr recall. A 7-day food frequency questionnaire was used to assess the food intake frequencies for a different energy-dense group of foods. The number of times the food was consumed per day and the number of days the energy-dense foods had been consumed in a week was recorded for each adolescent.

Key Informant Interviews were conducted with the school headteachers or class teachers for each school to give information on the types of meals the adolescents bring to school or available meals in the school feeding programmes, their food consumption patterns, and their influence on nutritional status.

3.14. Data analysis

Data collection was preceded by data labelling, cleaning, and coding. It was then entered into the computer for analysis. Quantitative data was fed into SPSS software version 23.0 for analysis. Descriptive statistics were presented in the form of frequencies and percentages. Nutrisurvey software was used to evaluate the caloric contribution of the meals and analyze dietary data. The amount of calories in the food determined the level of the energy density of the foods frequently consumed by adolescents, hence the magnitude of intake of energy-dense foods. ENA for SMART software was utilized to analyze anthropometric data to establish the nutritional status of adolescents. Inferential statistics were used for hypothesis testing. Pearson correlation was used to establish the relationship between the consumption of energy-dense foods and adolescents' nutritional status. Data from key informant interviews were transcribed using data transcription software (Transcribe Express), and then the information obtained was further grouped into themes which provided evidence to

complement quantitative data.

3.15. Logistical and ethical considerations

Authority to conduct the study was provided by the graduate school Kenyatta University, while ethical approval was obtained from the Kenyatta University Ethical Review Committee (KUERC). A research permit was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI). Also, approval was obtained from the Nairobi City Council and the Ministry of Education because the primary schools are under their custody. Authorization for conducting the research was requested from school headteachers. The headteachers gave and signed the informed consent letter on behalf of the adolescents' caregivers so that the adolescents could participate in the study and the participants gave informed assent. Anonymity was ensured by not disclosing the names of the participants. Confidentiality was maintained by ensuring the information collected in hard copies was stored in a locked place and accessed only by the data analysts, while the soft copies and KII recordings were secured with a password.

CHAPTER FOUR: RESULTS

4.1. Introduction

This chapter presents the study's results on the energy-dense diet intake patterns and the nutritional status of adolescents in Nairobi City County.

4.2. Sociodemographic characteristics of the adolescents in selected primary schools in Embakasi South Sub-County

The expected study sample size was 166 respondents. Out of 166 questionnaires, 5 questionnaires were incomplete and were discarded, while 161 questionnaires were complete and were used for data analysis giving a 97% response rate.

4.2.1. Gender, age, class, and religion distribution of the adolescents

Table 4.1: Sociodemographic characteristics of the adolescents in Embakasi South Sub-County

	Frequency N=161	Percentage (%)
Gender		
Male	74	46
Female	87	**54**
Age		
10 years	5	3.1
11 years	21	16.8
12 years	57	**35.4**
13 years	50	31.1
14 years	22	13.7
Class		
Std 5	54	33.5
Std 6	60	**37.3**
Std 7	47	29.2
Religion		
Christianity	156	**96.9**
Islam	3	1.9
Hindu	2	1.2
Total	**161**	**100**

The total number of adolescents interviewed was 161 aged between 10 and 14 years, out of which 87(54%) were female, and 74(46%) were males. Among the adolescents interviewed, 3.1% were aged 10 years, 16.8% were aged 11 years, 35.4% were 12 years, 31.1% were aged 13 years, and 13.7% were aged 14 years. The majority of the adolescents 60(37.3%) were in class six, 54(33.5%) were in class five, and 47(29.2%) were in class seven. Most of the adolescents interviewed were Christians 156(96.9%), 3(1.9%) were Islam, and 2(1.2%) were Hindu.

4.2.2. Education level of the adolescents' caregivers in Embakasi South Sub-County

The education level of the caregivers of the adolescents interviewed was estimated to be 46.8% (college/ university education), 37.3% (secondary education), and 24.9% (primary school), while 1.2% of the caregivers were reported to have never gone to school (figure 4.1).

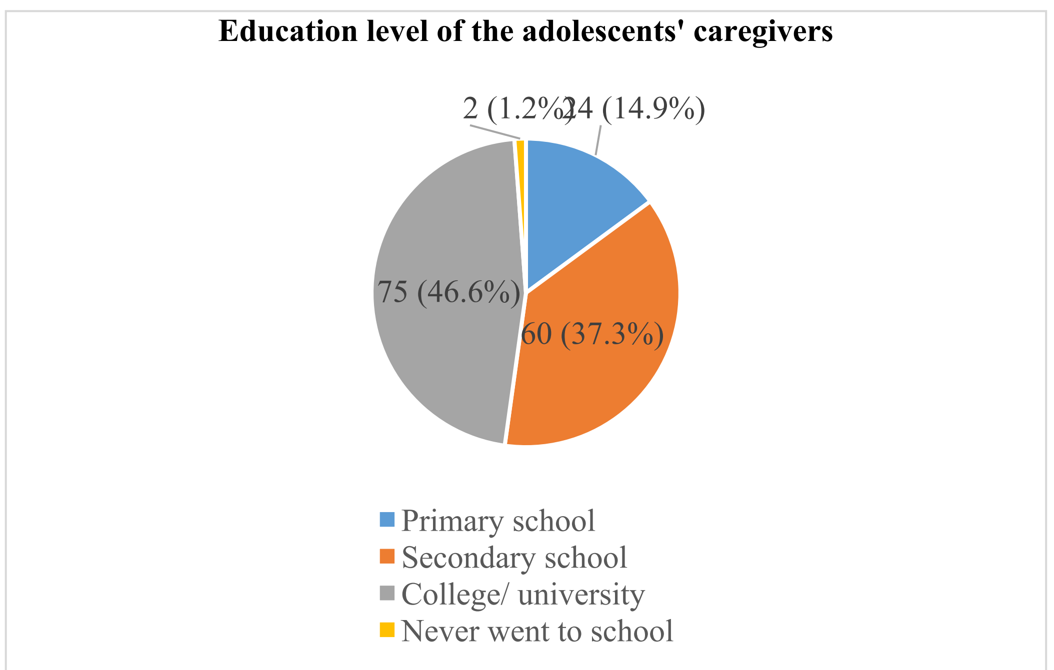

Figure 4.1: Education level of the adolescents' caregivers

4.2.3. Occupation of the respondents' caregivers in Embakasi South Sub-County

Most of the adolescents' caregivers were employed in the private sector (37.9%) and self-employed (37.3%), 14.9% were unemployed, 9.3% were employed by the government/county government, and 0.6% were employed in the community sector (figure 4.2.)

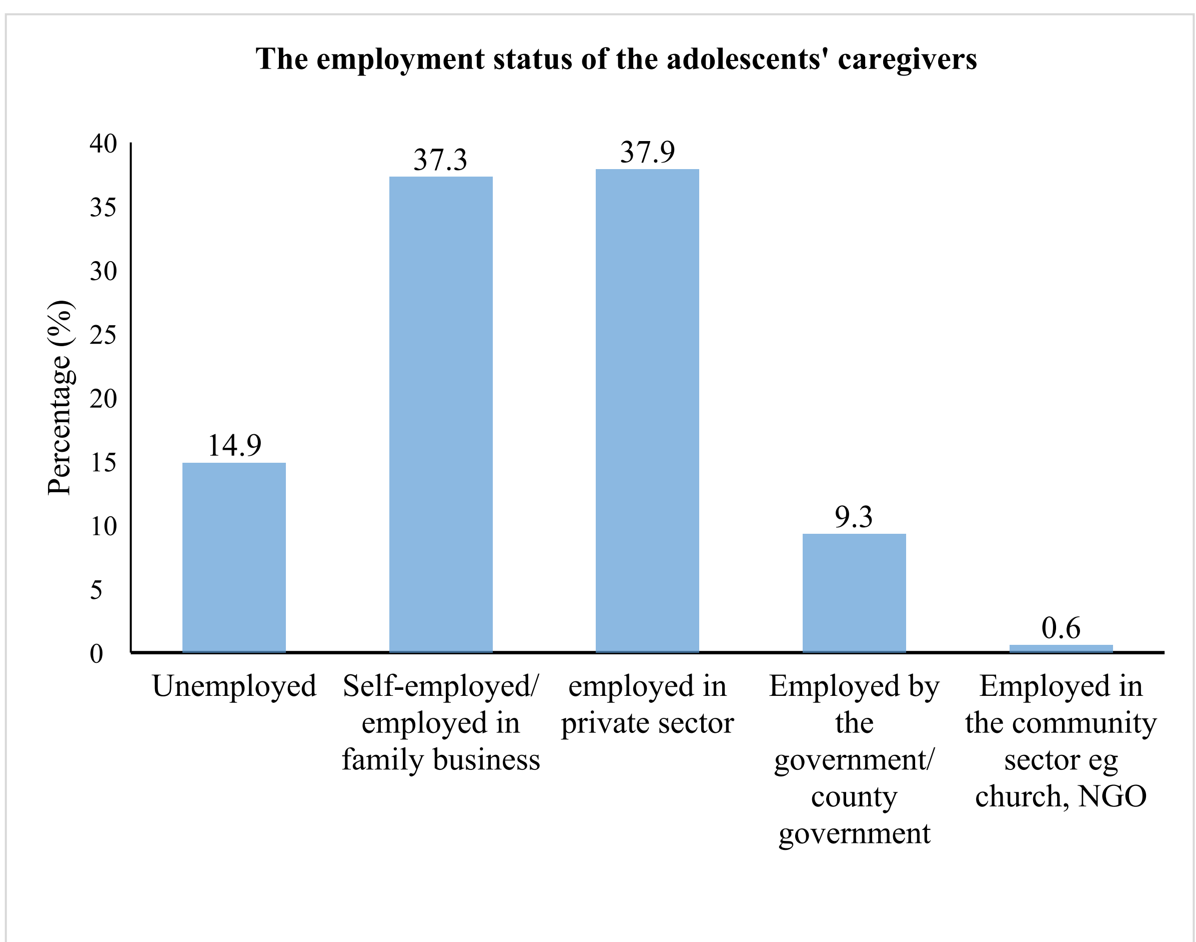

Figure 4.2: Employment status of the adolescents' caregivers

4.2.4. Marital status of the caregivers

The results indicate that 82% of the adolescents' caregivers were married, 12% were single, and 8% were divorced/separated (figure 4.3).

4.2.5. Type of housing and number of rooms

The type of housing in which most adolescents lived was stone houses (72.7%), while 27.3% lived in iron sheet-made houses. There were no adolescents who reported to be

living in mud or grass-thatched houses. A majority of the adolescents reported that their houses were single rooms (49.1%), 12.4% lived in a bedsitter, 14.9% lived in 1 bedroom, 18.6% lived in 2 bedrooms, and 5% lived in 4 rooms or more (table 4.2).

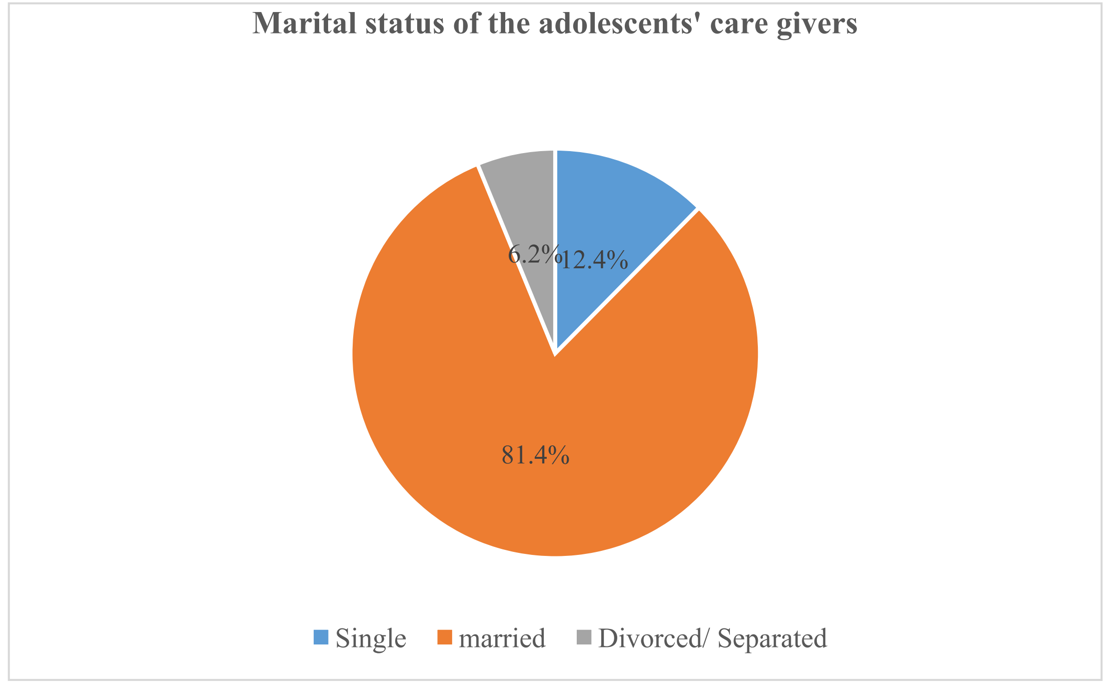

Figure 4.3: Marital Status of the adolescents' caregivers

Table 4.2: Type of housing and number of rooms

Type of housing and number of rooms		**Frequency**	**Per cent**
Type of the house	Stone house	117	**72.7**
	Iron sheet house	43	27.3
Number of rooms	Single room	79	**49.1**
	Bedsitter	20	12.4
	1 bedroom	24	14.9
	2 bedroom	30	18.6
	4 rooms and more	8	5.0

4.4. Number of children in a household

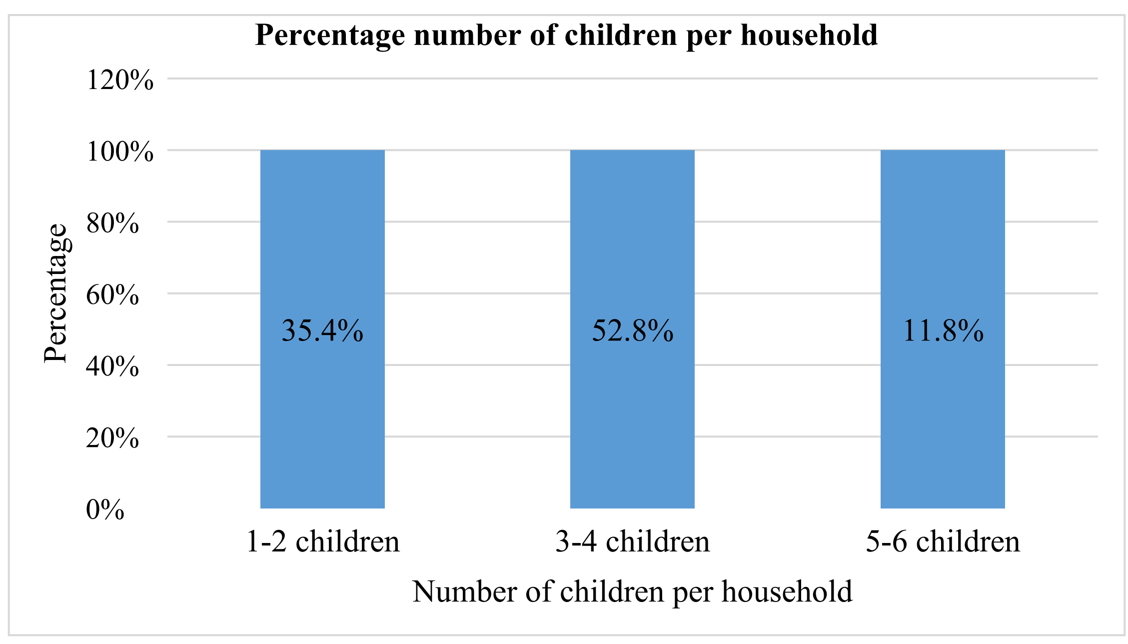

Figure 4.4: Percentage of number of children in a household

The findings show that most of the households where the adolescents come from had 3-4 children (52.8%), 35.4% of the households had 1-2 children, and 11.8% had 5-6 children, as shown in figure 4.4.

4.4.1. Affordability of the food in the market

Out of 161 adolescents interviewed, 57.8% reported that the food in the market was expensive, 29.8% indicated that the food in the market was cheap, 9.9% said that the food in the market was very expensive, and 2.5% indicated that the food in the market was very cheap as shown in figure 4.5.

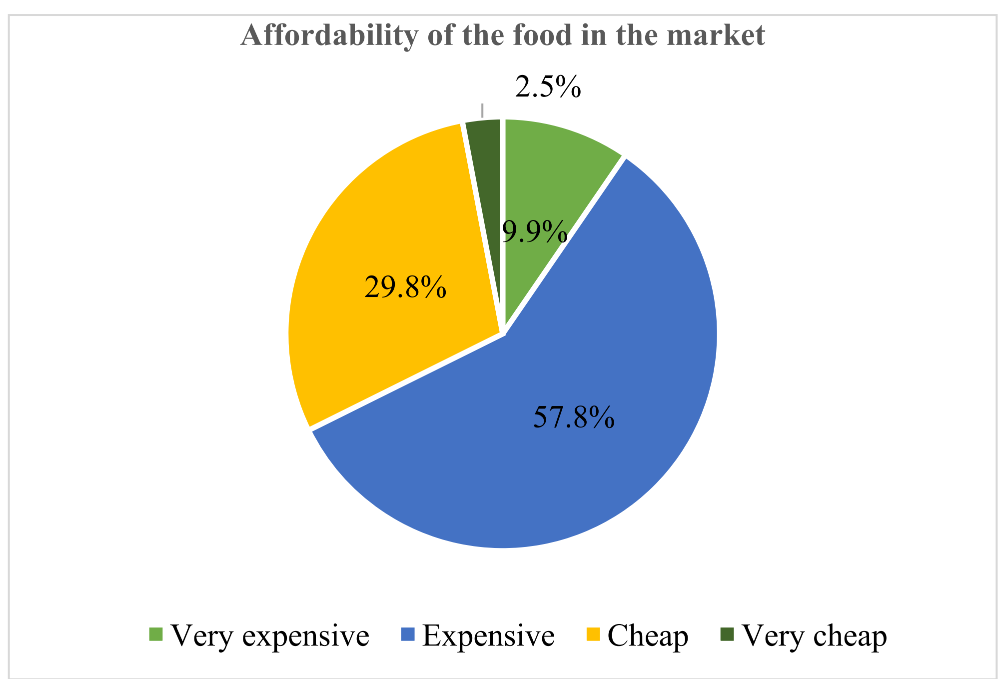

Figure 4.5: Affordability of the food in the market

4.5. The nutritional status of the adolescents in Embakasi South Sub-County

The adolescents' nutritional status was determined using BMI[1]. Three-quarters (74.5%) of the adolescents had normal nutrition (-1 SD- 1 SD), 13% of the adolescents were underweight (≤ -2 SD), 4.3% were severely underweight (≤ -3 SD), 5.7% of the adolescents were overweight (≥ 2SD), and 2% were obese (≥ 3 SD) (figure 4.6). The nutritional status was further segregated by gender and the results show that more male adolescents (78.4%) had normal nutritional status as compared to female adolescents (71.3%). More females (9.2%) were overweight than male adolescents (1.4%). A high percentage of male adolescents (14.9%) were underweight as compared to female adolescents (11.5%). A higher percentage of female adolescents (4.6%) were severely underweight compared to male adolescents (4.1%). A high proportion of female adolescents were obese (3.4%) as compared to male adolescents (1.4%) as shown in figure 4.7.[2]

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[1] BMI- Body Mass Index
[2] SD -standard deviation

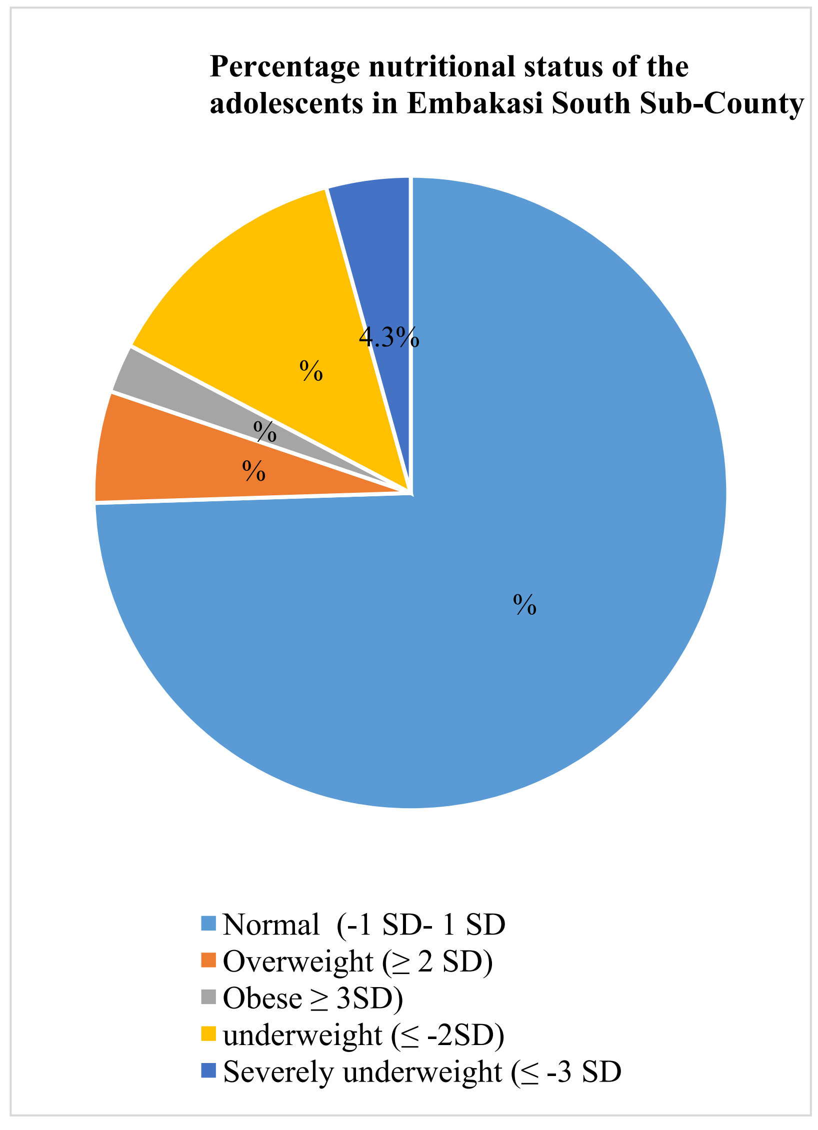

Figure 4.6: Nutritional status of the adolescents in Embakasi South Sub-County

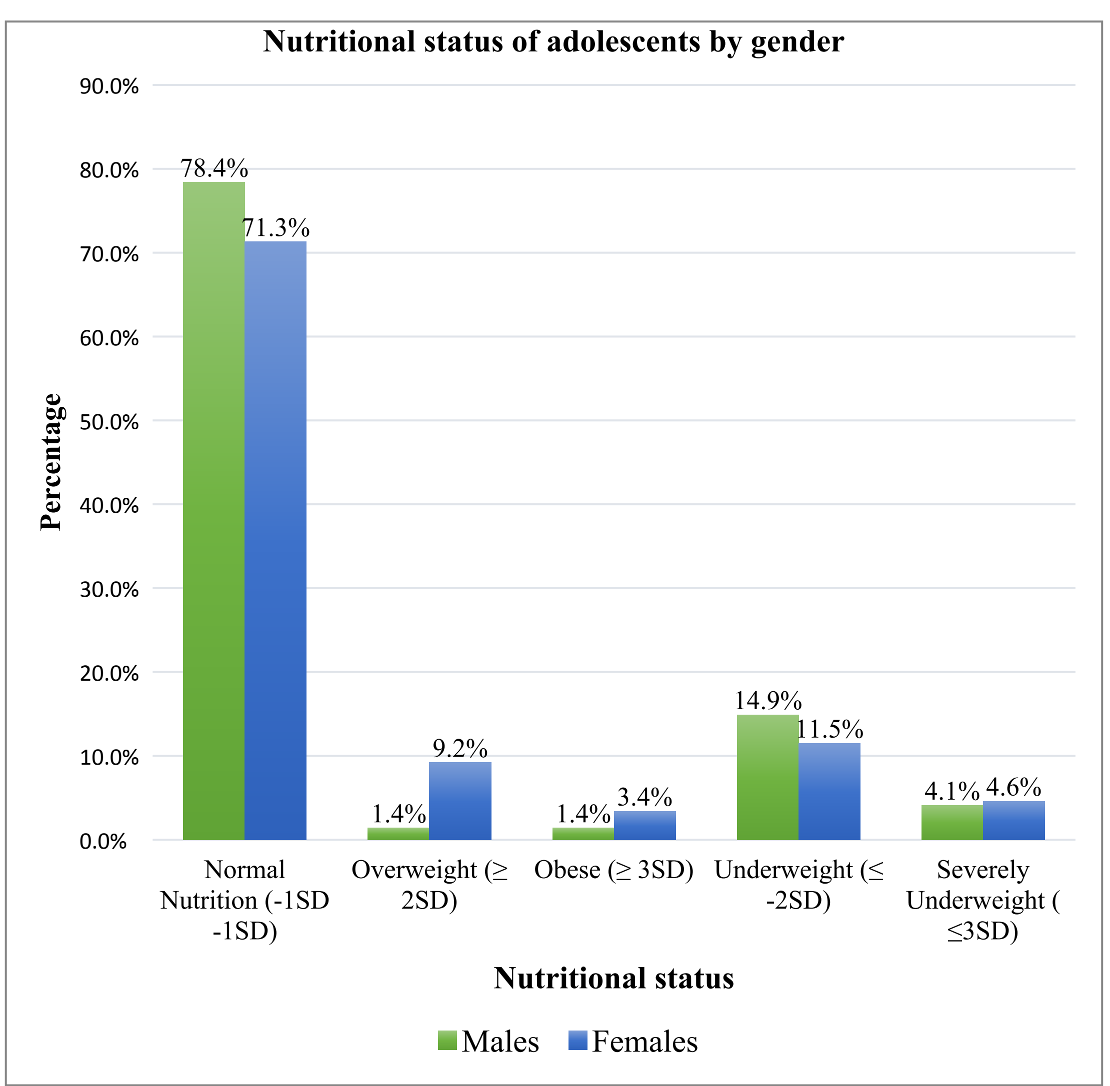

Figure 4.7: Nutritional status of adolescents by gender

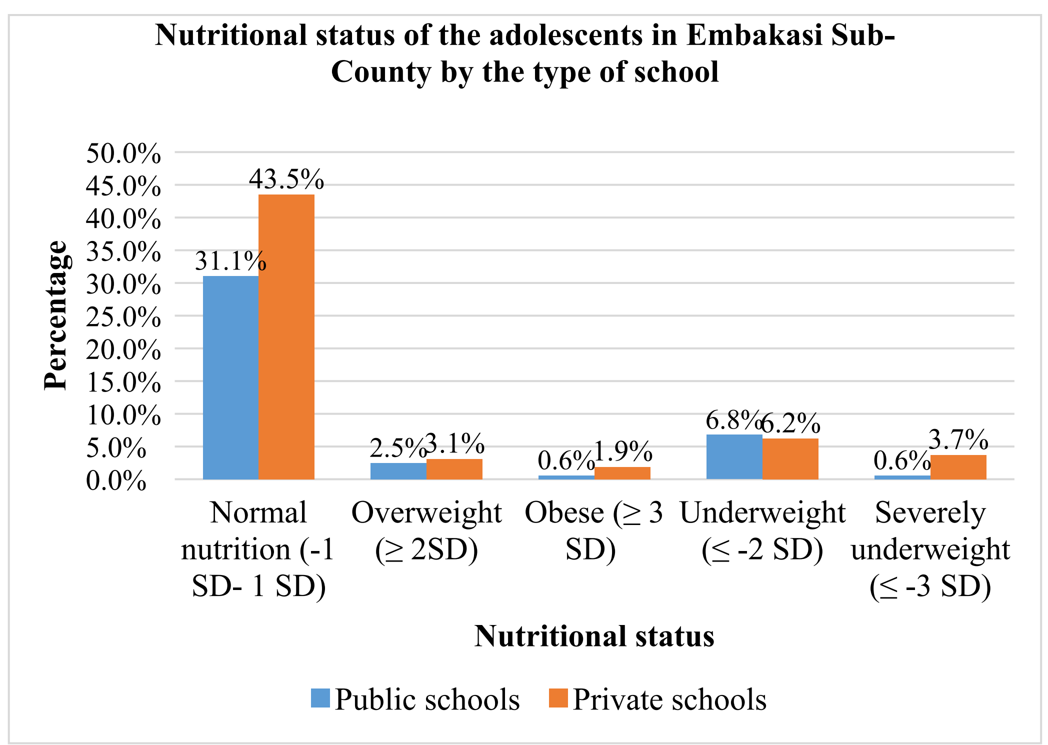

Figure 4.8: Nutritional status of the adolescents in Embakasi Sub-County by the type of school

The nutritional data was further analyzed by the type of school. More adolescents in private schools were overweight (3.1%) and obese (1.9%), compared to adolescents in public schools overweight (2.5%) and obese (0.6%). Amongst adolescents who were underweight majority were from public schools (6.8%). The majority of adolescents who were severely underweight were from private schools (3.7%) compared to public schools (figure 4.8).

A crosstabulation analysis was done to evaluate the nutritional status data and sociodemographic characteristics of the adolescents. The results were as follows; adolescents aged 11 and 13 years had the highest percentage of overweight adolescents, 1.9 % of adolescents were obese, 4.3% of adolescents were underweight, and 1.9% of adolescents aged 11 years were severely underweight. The adolescents' age did not have a significant association with their nutritional status (p=0.273).

Table 4.3.1: Nutritional status by sociodemographic characteristics of the

adolescents in Embakasi South Sub-County

Sociodemographic characteristics		Normal nutrition (%)	Overweight (%)	Obese (%)	Underweight (%)	Severely underweight (%)	Significance level
		Nutritional Status					
Age	10 years	3.1	0.0	0.0	0.0	0.0	
	11 years	11.2	**1.9**	0.0	1.9	**1.9**	0.273
	12 years	**28.0**	1.2	**1.9**	3.7	0.6	
	13 years	24.2	**1.9**	0.6	3.1	1.2	
	14 years	8.1	0.6	0.0	**4.3**	0.6	
Class	Std 5	23.6	**3.1**	0.6	**4.3**	1.9	
	Std 6	**31.7**	1.9	**1.2**	**4.3**	**2.5**	0.840
	Std 7	19.3	0.6	0.6	**4.3**	**2.5**	
The education level of the caregiver	Primary school	11.8	0.6	0.6	1.2	0.6	
	Secondary school	27.3	1.9	**1.2**	5.6	1.2	
	University/college	**34.8**	**2.5**	0.6	**6.2**	**2.5**	0.730
	Never gone to school	0.6	0.6	0.0	0.0	0.0	
Occupation of the caregivers	Unemployed	18.8	0.6	0.0	**5.6**	**1.9**	
	Self-employed	25.5	**3.1**	**1.2**	1.9	0.6	
	Employed in the private sector	**32.3**	1.2	0.0	3.7	0.6	
	Employed by the government	4.3	0.6	**1.2**	1.9	1.2	0.616
	Employed in the community sector	0.6	0.0	0.0	0.0	0.0	

Table 4.3.2: Nutritional status by sociodemographic characteristics of the

adolescents in Embakasi South Sub-County

Sociodemographic characteristics		**Nutritional Status** Normal nutrition (%)	Overweight (%)	Obese (%)	Underweight (%)	Severely underweight (%)	**Significance level**
Marital status of the caregivers	Single	9.9	0.6	0	**9.9**	**4.3**	0.78
	Married	**59.6**	**5**	**2.5**	1.9	0	
	Separated	5	0	0	1.2	0	
Type of housing	Stone house	**54**	2.5	**2.5**	**9.9**	**4.3**	0.176
	Iron sheet house	20.5	**3.1**	0	3.1	0	
Size of the house	Single room	**37.9**	**3.7**	**1.2**	**4.3**	**1.9**	0.253
	Bedsitter	8.7	0	0	2.5	1.2	
	1 bedroom	11.8	0	0.6	2.5	0	
	2 bedroom	13.7	1.2	0.6	2.5	1.2	
	4 rooms and above	2.5	0.6	0	1.2	0.6	
No. of children in your home	1 to 2	26.7	1.9	0.6	3.1	**3.1**	**0.028***
	3 to 4	**40.4**	1.2	**1.9**	**8.1**	1.2	
	5 to 6	7.5	**2.5**	0	1.9	0	

The adolescents in class 5 had the highest percentage of malnutrition (1.2%) obese, (4.3%) underweight, and (2.5%) severely underweight as compared to adolescents in the other classes. However, there were no observed significant differences between the adolescents' nutritional status and the classes they were in ($p<0.05$). The adolescents whose caregivers had attained university/ college education level were found to be more malnourished; (2.5%) overweight, (6.2%) were underweight, and (2.5%) severely underweight, as compared to the caregivers who had attained the different levels of education. There was no significant difference between the education level of the adolescents' caregivers and the nutritional status of the adolescents ($p< 0.05$).

Adolescents whose caregivers were unemployed had the highest percentage of underweight (5.6%) and severely underweight (1.9%) cases. Nevertheless, there was no significant difference noted between the employment status of the caregivers and the nutritional status of the caregivers ($p<0.05$). The married caregivers had the highest proportion of adolescents who were overweight (5%) and obese (2.5%), while adolescents from single caregivers had the highest proportion of underweight (9.9%) and severely underweight (4.3%) adolescents. Nevertheless, there was no significant difference in the nutritional status of the adolescent by the marital status of their caregivers ($p<0.05$). The adolescents who reported living in stone houses had more cases of malnutrition; (2.5%) obese, (9.9%) underweight, and (4.3%) severely underweight. Adolescents who lived in single rooms were found to have a high percentage of malnutrition; 3.7% were overweight, 1.2% obese, 4.3% underweight, and 1.9% were severely underweight. Adolescents who came from a family with 3-4 children had a high level of malnutrition 1.9% obese and 8.1% underweight, while those with 1-2 children had a high number of adolescents severely underweight (3.1%). There was a significant difference between the number of children in a family and the nutritional status of the adolescents ($p<0.05$) (Table 4.3).

Nutritional status of the adolescents (MUAC measurement results)

The MUAC measurement results indicated that 86% of adolescents had normal nutrition, 12% had moderate acute malnutrition, and 2% had severe acute malnutrition (figure 4.9).

Body Mass Index data

The mean BMI of the male adolescents was 18.1 and the mean BMI of the female adolescents was 18.7. The results found that the BMI of male adolescents did not have any significant difference from the BMI of female adolescents ($P< 0.05$) as shown in

table 4.4.

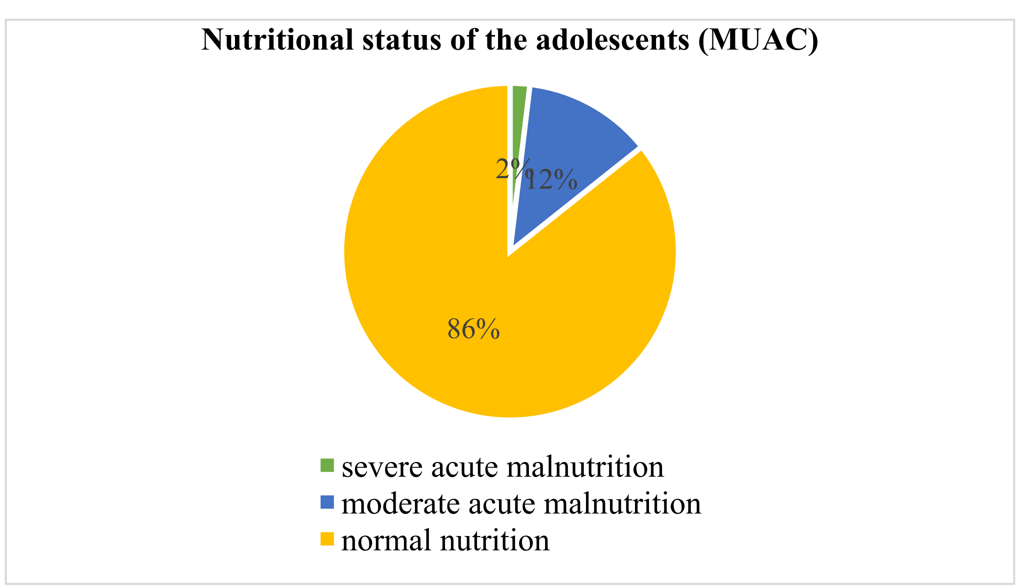

Figure 4.9: Nutritional status of the adolescents (MUAC measurement results)

Table 4.4: Mean Anthropometric Characteristics

Variable	**Male n 74**		**Female n=87**		
	Mean	**95% Conf Interval**	**Mean**	**95% Conf Interval**	**P value**
Age	12.5	12.3-12.5	12.2	12.0-12.5	0.08
Height	1.5	1.49-1.54	1.52	1.51-1.54	0.53
Weight	41.2	39.1-43.4	43.7	41.6-45.8	0.10
BMI	18.1	17.6-18.7	18.7	18-19.4	**0.04***

4.6. Intake patterns of energy-dense foods among adolescents

4.3.1 Adolescents' dietary intake pattern based on 24-hour recall

The adolescent's dietary intake pattern was determined using 24-hour recall. The average energy intake was 1610.4 ±686.4 Kcal. The average energy intake among female adolescents was 1673.3± 737, with 20.7% of the adolescents meeting the recommended daily intake (RDI), 69% consuming energy below the RDI, and 10.3%

consuming energy greater than the RDI for energy. The average energy intake among male adolescents was 1554.2±172, with 16.2% meeting the required RDI, 73% less than the recommended RDI and 10.8% consumed more than the recommended dietary intake. A high percentage of female adolescents (69%) consumed a higher amount of proteins than the recommended dietary intake as compared to male adolescents (68.9%). The average intake of proteins for both male and female adolescents was higher ((69.1± 7.4) for male adolescents and (124± 5.2) for female adolescents) than the recommended dietary allowances (45g) for male adolescents and (46g) for female adolescents. The Carbohydrate and fat intake were high among both male and female adolescents. The male adolescents' mean carbohydrate and fat intake was 229.4± 24.6 and 51.5± 7.8, respectively. Female adolescents consumed high amounts of carbohydrates and fats compared to male adolescents.

Table 4.5: Mean dietary intake of the adolescents

	Males n=74					Females n=87				
	Mean	**RDI**	**Below RDI (%)**	**Met RDI (%)**	**above RDI (%)**	**mean**	**RDI**	**Below RDI (%)**	**Met RDI (%)**	**above RDI (%)**
Energy (Kcal)	1673.3± 737	2500	**73**	16.2	10.8	1554.2±172	2200	**69.0**	20.7	10.3
proteins (g)	69.1± 7.4	45	18.9	12.2	**68.9**	124± 5.2	46	21.8	9.2	**69**
Fats (g)	51.5± 7.8	30	20.3	24.3	**55.4**	97.6± 7	30	24.1	27.6	**48.3**
CHO (g)	229.4± 24.6	130	10.8	9.5	**79.7**	233.6± 17.6	130	9.2	16.4	**74.7**
Dietary fibre (g)	34.5± 4.3	28	25.7	31.1	**43.2**	31.9± 2.8	26	18.4	33.3	**48.3**
PUFA (g)	13.7± 8	10	25.7	**41.9**	32.4	13.8± 12	10	27.6	**40.2**	32.2
Vitamin A (µg)	1016.2±126.2	900	**39.2**	23	37.8	1008± 96.1	700	24.1	27.6	**48.3**
Folic acid (µg)	215.3± 22.3	150	18.9	13.5	**67.6**	203.5± 17.7	150	21.8	18.4	**59.8**
Vitamin C (mg)	113.5± 14.8	40	8.1	16.2	**75.7**	196.7± 12.7	40	8.1	21.8	**70.1**
Iron (mg)	13.1±1.4	11	16.2	**55.4**	28.4	12.5± 1.1	15	29.9	**62.1**	8
Zinc (mg)	12.1± 3.5	13	29.7	**55.4**	14.9	11.1± 1.0	7	5.7	31.1	**63.2**

RDI-Recommended Dietary Intake; PUFA- Polyunsaturated Fatty Acids; CHO- Carbohydrates

The female adolescents' consumption of vitamin A was slightly higher than the recommended daily intake (1008± 96.1), with 48.3% taking higher than the recommended RDI and 24.1% consuming less than the recommended RDI. The consumption of vitamin C was slightly higher compared with the recommended dietary intake for both male and female adolescents (93.1% males and 92.8% females not meeting the RDI). The adolescents met the RDI for zinc and iron, with their means lying within the acceptable range (table 4.5).

4.3.2. Intake of energy-dense food based on 7-day food frequency questionnaire

A 7-day food frequency intake of selected foods was used to determine the patterns of energy-dense food intake of the adolescents. The findings reveal that most starchy foods are consumed 1-2 days a week. The starchy food frequently consumed was rice, with 40.7% of the adolescents consuming it 3-4 days a week and 44.7% of the adolescents consuming it 1-2 days. Chips (44.1%) and bhajia (43.5%) which are classified as energy-dense food, were also frequently consumed at least 1-2 days a week by the adolescents. Pizza and cookies were infrequently consumed, with 82% and 59% of the adolescents not consuming them at all.

Among the street foods consumed, eggs were frequently consumed, with 46.6% and 20.5% of the adolescents consuming them 1-2 days and 3-4 days on average in a week. Fried chicken and sausages/smokies were not consumed regularly with 47.8% and 46% of the adolescents not consuming them at all. The confectionaries/sweets consumed regularly are sweet cakes (44.1%) on an average of 1-2 days and 12.1% on an average of 3-4 days, and sweets (38.5%) on an average of 1-2 days in a week. The sugar-sweetened beverages frequently consumed are tea, with 43.5% of the adolescents consuming it daily, and soft drinks, with 54% consuming it between 1-2 days a week, as shown in Table 4.6.

The results from the KII indicate that most schools had school feeding programs, but the adolescents brought mandazi (doughnuts) to school as break-time snacks. The doughnuts are deep-fried wheat food which is rich in high energy density. The findings are consistent with the increased frequency of intake from the 7-day food frequency questionnaires. Also, the teachers mentioned that they did not have concerns about the diet the adolescents fed at home and the snacks they brought to school.

"*We have a feeding programme, the children bring snacks like mandazi from home purposely for break time they carry for break time but the lunch is provided in the school*." ~ **KII headteacher AEF Reuben Primary School.**

Table 4.6: Energy-dense food intake based on 7-day food frequency

Food	**0 Days**		**Daily**		**1-2 Days**		**3-4 Days**		**5-6 Days**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Bread	12	7.5	28	17.4	50	**31.1**	50	**31.1**	28	17.4
Rice	5	3.1	5	3.1	72	**44.7**	65	40.4	14	8.7
Doughnuts/ mandazi	36	22.4	11	6.8	63	**39.1**	36	22.4	15	9.3
Cakes	56	34.8	4	2.5	65	**40.4**	26	16.1	10	6.2
fried rice	45	28	5	3.1	70	**43.5**	30	18.6	11	6.8
Chips	39	24.2	8	5	71	**44.1**	29	18	14	8.7
Bhajia	57	35.4	3	1.9	66	**41**	26	16.1	9	5.6
Roasted/ boiled maize	89	**55.3**	3	1.9	53	32.9	14	8.7	2	1.2
Samosa	63	39.1	3	1.9	68	**42.2**	19	11.8	8	5
Biscuits	58	36	6	3.7	62	**38.5**	25	15.5	10	6.2
Cookies	95	**59**	4	2.5	37	23	20	12.4	5	3.1
Pizza	132	**82**	1	0.6	21	13	6	3.7	1	0.6
Porridge	43	26.7	13	8.1	56	**34.8**	34	21.1	15	9.3
Breakfast cereals	128	**79.5**	3	1.9	22	13.7	4	2.5	3	1.9
Fried chicken	77	**47.8**	3	1.9	58	36	18	11.2	5	3.1
Sausage	74	**46**	6	3.7	58	36	12	7.5	11	6.8

Eggs	38	23.6	5	3.1	75	**46.6**	33	20.5	10	6.2
Sweet cakes	57	35.4	5	3.1	71	**44.1**	20	12.4	8	5
Sweets	63	**39.1**	6	3.7	62	38.5	18	11.2	12	7.5
Honey	95	**59**	6	3.7	42	26.1	16	9.9	2	1.2
Candy	103	**64**	5	3.1	31	19.3	18	11.2	4	2.5
Chocolate	103	**64**	3	1.9	38	23.6	13	8.1	4	2.5
Soda	38	23.6	4	2.5	87	**54**	28	17.4	4	2.5
Homemade juice	88	**54.7**	8	5	41	25.5	19	11.8	5	3.1
Coffee	104	**64.6**	3	1.9	36	22.4	13	8.1	5	3.1
Tea	6	3.7	70	**43.5**	26	16.1	34	21.1	25	15.5

Yes, we have had some cases of malnutrition, and we have had some cases of overweight because of the kind of feeding habits at home. I mean the kind of food they eat at home. I have never had such concerns about the food they take at home. We do not monitor the snacks they bring to school either." ~ **KII Class teacher Fair Oak Primary School**

On the usage of the blue band on bread, 53% of the adolescents reported having used the blue band on bread, 28% did not use the blue band on bread, and 19% used the blue band on bread, (figure 4.10). Usage of the blue band on food was used because it contributes to a higher amount of caloric value in food.

The findings indicate that most adolescents did not use the blue band on baked potatoes and other vegetables (64%), 29% of the adolescents used the blue band on baked potatoes, and 7% used the blue band on baked potatoes infrequently (Figure 4.11).

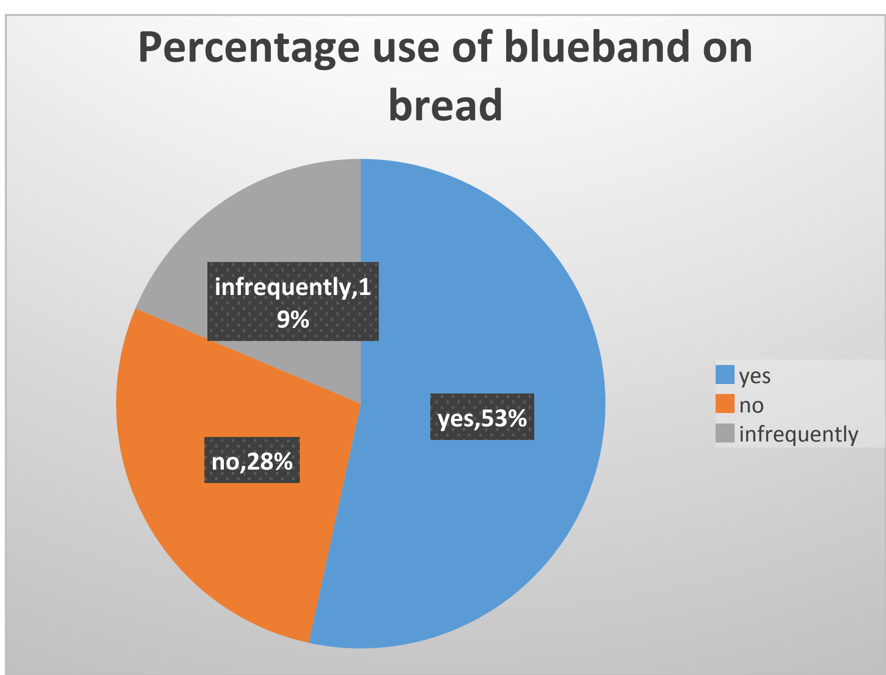

Figure 4.10: Usage of the blue band on bread

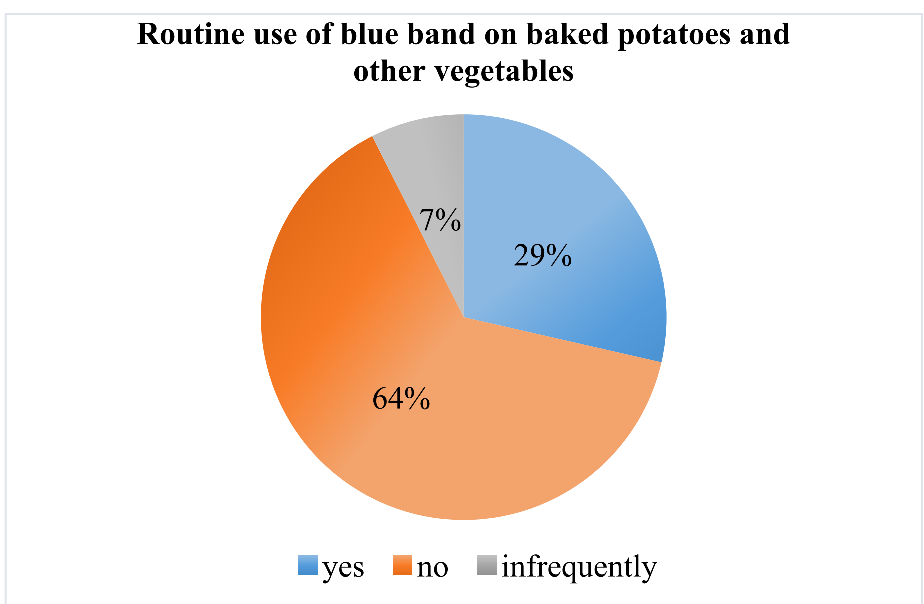

Figure 4.11: Blue band use on baked potatoes and other vegetables

Vegetable consumption by adolescents

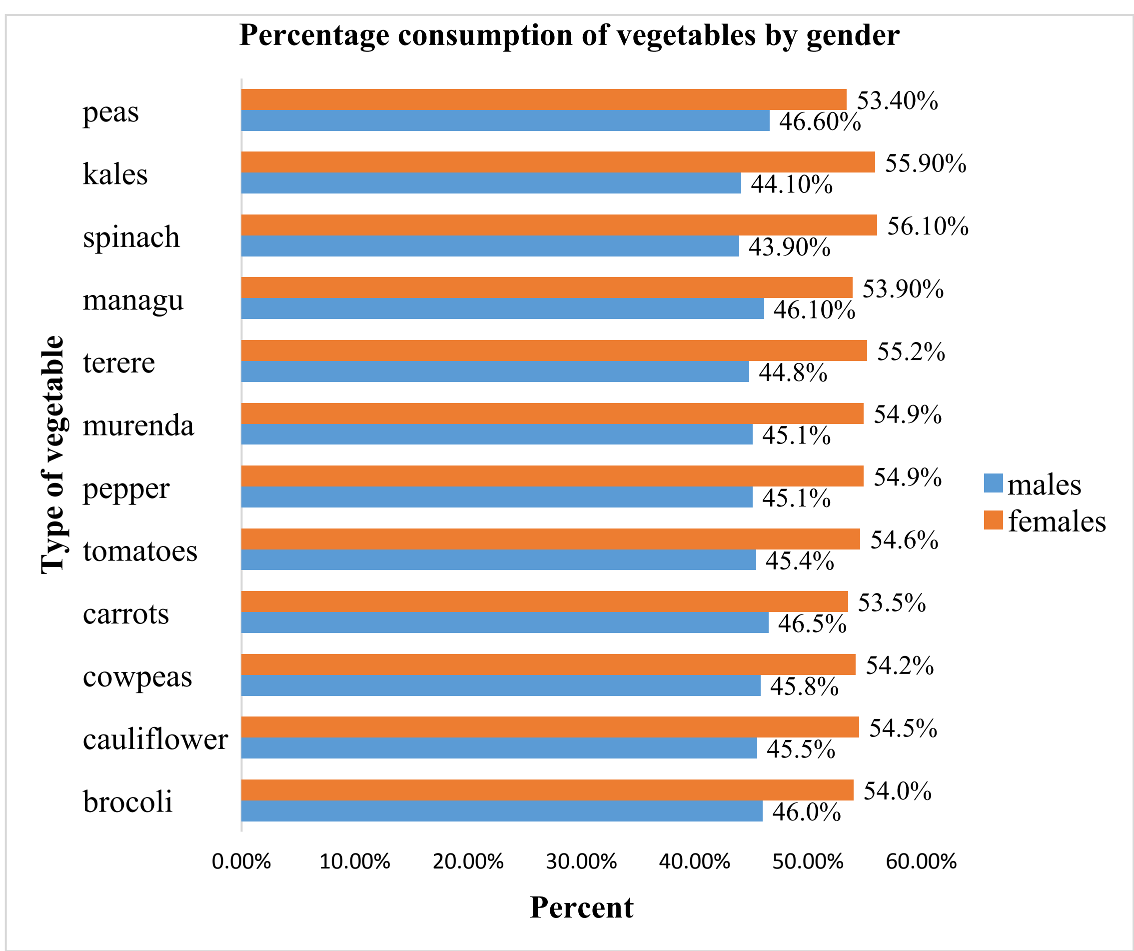

Figure 4.12: Percentage consumption of vegetables

The female adolescents were consuming more different types of vegetables compared to male adolescents (figure 4.12). Both males and females consumed 3 servings of vegetables on average in a day. The KII results indicated that the schools had school feeding programmes, and the adolescents were fed a balanced diet, with vegetables being part of the servings, as illustrated by the senior teacher in Gatoto Community Primary School. Similar feedback was given by a class teacher at Fair Oak Primary School.

"*There is a feeding programme we have here for porridge and githeri. Porridge for breakfast and githeri plus cabbages for lunch but sometimes we give them fruits twice or thrice per week but not every day Mon, Wed, and Friday. The fruits given are oranges and watermelons. We give a quarter melon or half an orange per serving.*" ~KII senior teacher Gatoto primary school|

"We have different varieties, on Mon and Wed we have rice and beans, and some greens like cabbage, other times we have kales, and manage. We usually change, on

Fridays we usually have ugali, beans, and cabbage or greens, on Tuesdays and Thursdays we usually have rice and green grams and greens." ~KII class teacher Fair Oak Primary School**.**

4.4. The relationship between intake of energy-dense foods and the nutritional status of the adolescents

Table 4.7 shows that there was a non-significant negative relationship between the use of blue band on bread and the nutritional status of the adolescents (r= -0.11, p-value=0.888). However, the use of blue band on vegetables did not have any relationship with the adolescents' nutritional status (r=0.213, p-value=0.23), smashed potatoes had a non-significant positive relationship with the BMI of the adolescents (r=0.069, p-value=0.764). There was a significant positive relationship (r=0.044, p-value=0.045) between the intake of chips and the BMI, which means the more the students consumed chips, the higher the chances of increasing the BMI. Intake of mandazi did not have a significant association with the BMI of the adolescents. There was a highly significant negative relationship (r= -0.02, p-value= <0.001) between the intake of doughnuts (ngumu/KDF) and the BMI of the adolescents. A non-significant negative relationship (r= -0.001, p-value= 0.762) was observed between the intake of pancakes and the BMI of the adolescents, implying that the intake of pancakes influenced the nutritional status of the adolescents. A negative non-significant relationship (r= -0.014, p-value=0.897) between the intake of bhajia and the BMI was established, indicating that the higher the intake of bhajia, the higher the BMI.

The results show that intake of cheese had a negative non-significant association with the BMI (r= -0.107, p-value= 0.660), thus as the intake level of cheese increases, the BMI of the adolescents increases (levels of obesity increases). Regular soft drink intake had a negative non-significant association with the BMI of the adolescents (r= -0.147, p-value= 0.101). Increased intake of regular soft drinks increased the BMI. Intake of

fruit juice had a positive non-significant relationship (r=0.105, p-value= 0.227) with the BMI of adolescents. Thus, the intake of fruit juice did not influence the nutritional status of the adolescents. Moreover, the consumption of chocolates had a negative association with the BMI (r= -0.248, p-value- 0.567). Intake of fried chicken had a negative non-significant relationship with the BMI (r= -0.040, p-value= 0.614) (table 4.7).

Table 4.7: Relationships between intake of energy-dense foods and the BMI using Pearson Correlation test among adolescents in Nairobi County

Relationship	N	R	p-value
Blue band on bread and BMI	161	-0.11	0.888
Blue band in vegetables and BMI	161	0.213	0.23
Smashed potatoes and BMI	161	0.069	0.764
Chips and BMI	161	0.044	**0.045***
Mandazi and BMI	161	0.132	0.184
Dough nuts (ngumu/KDF)	161	-0.02	**0.001****
Pancakes and BMI	161	0.001	0.762
Bhajia and BMI	161	-0.014	0.897
Cheese and BMI	161	-0.107	0.660
Regular soft drinks and BMI	161	-0.147	**0.101**
Fruit juice and BMI	161	0.105	0.227
Chocolate and BMI	161	-0.248	0.567
Fried chicken and BMI	161	0.040	0.614

4.5. The relationship between sociodemographic characteristics and intake of energy-dense foods among adolescents in primary schools in Nairobi County.

Table 4.8: Relationship between sociodemographic characteristics and intake of energy-dense foods using Pearson correlation

Relationships	N	R	P-value
Energy dense food and gender	161	0.056	0.404
Energy-dense food and age	161	0.072	0.484
Energy-dense food and religion	161	0.024	0.764
Energy-dense food and education level of the caregiver	161	-0.089	**0.0262***
Energy-dense food and occupation of the caregiver	161	-0.109	**0.17**
Energy-dense foods and income	161	0.125	0.114
Energy-dense food and marital status	161	-0.031	0.696
Energy-dense food and food affordability	161	0.029	**0.002***
Energy-dense food and the size of the house	161	-0.054	0.499
Energy-dense food and the number of children in a household	161	-0.003	0.973

The association between intake of energy-dense food and sociodemographic characteristics was analyzed using the Pearson correlation. There was no significant relationship between gender and intake of energy-dense diets (r= 0.056, p-value= 0.404), gender did not influence the intake of energy-dense diets; thus, the energy-dense diet was independent of gender. There was a positive non-significant relationship between energy-dense food intake and age (r= 0.072, P=0.484), indicating that age did not influence the intake of energy-dense diets. A weak positive non-significant association between religion and intake of energy-dense diets was found (r= 0.024, p-value= 0.764). The weak positive association between religion and intake of energy-dense food shows that religion influences the intake of energy-dense foods, but the influence is so low. The caregiver's education level had a significant negative relationship (r= -0.089, p-value= 0.0262) with the intake of energy-dense diets, which

means the lower the education level, the higher the intake of energy-dense foods and vice versa. The results indicate a negative non-significant association (r= -0.109, p-value= 0.170) between energy-dense food intake and the caregivers' occupation, implying that adolescents whose caregivers were unemployed were likely to consume more energy-dense foods. There was a non-significant positive relationship (r= 0.125, p-value= 0.114) between the intake of energy-dense foods and the income level of the caregivers. The higher the income of the adolescent's caregivers, the less intake of high energy-dense diets. The marital status had a non-significant negative relationship (r= -0.031, p-value= 0.696) with the intake of energy-dense foods. The marital status of the adolescent's caregivers determines the type of food the adolescents consume and whether it meets dietary requirements. A non-significant negative relationship was found (r= -0.003, p-value= 0.973) between the number of children in a household and the intake of energy-dense diets. The more the number of children in a household, the higher the chances of an increased level of intake of energy-dense foods. There was a highly significant positive relationship between the intake of energy-dense foods and food affordability in the market, meaning the more expensive the food was in the market, the higher the chances of the adolescents consuming high energy-dense foods (table 4.8). One of the class teachers reported that some adolescents are given money by their parents to buy cheap readily available snacks within the school surrounding. The cheap snacks mentioned were cakes which contain high sugars and high energy-dense diets.

"*They carry some cash to buy their meals from around, like peanuts, and cakes, they also buy these simple and cheap snacks, but they get their lunch from the school.*" ~**KII Class teacher Kwa Njenga Primary School.**

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Discussion

5.1.1 Nutritional status of the adolescents

Most of the adolescents (74.5%) were found to have normal nutritional status. The normal nutrition was attributed to the school feeding programmes in all the sampled schools. These results were consistent with the study findings obtained from a study done by Githinji *et al.,* (2016), which found that (84%) of adolescents in primary schools in Nairobi County had normal nutrition. The KIIs indicated that the schools provide a balanced diet to the pupils. Some of the schools also offered adolescents fruits at least thrice a week. This contributed to the well-being of the adolescents. Gwelo *et al*., (2023) established a positive association between school feeding programmes, the living environments, and normal nutrition among adolescents in primary schools in South Africa, which aligns with the findings of the study. Normal nutrition helps to improve the health outcomes and school performance of adolescents in primary schools. A study done in England showed that nutritious school meals provided through school feeding programmes; help to reduce the rate of underweight, overweight, and obesity among adolescents and school-going children compared to home-made meals (Holford & Rabe, 2022). According to the National School Meals and Nutrition Strategy (2017-2022), the meals provided in schools contribute to adolescents' improved nutritional status in Nairobi County City slums and marginalized areas of Kenya. However, 13% of the adolescents were underweight, 5.7% were overweight, 4.3% were severely underweight and 2% were obese. The findings were related to studies done by Githinji *et al*., (2016), Kimani (2014) and KDHS (2014) which indicated there was a burden of underweight and over-nutrition in adolescents in

primary schools. The KII results revealed that the adolescents' malnutrition is attributed to the diet they take at home and the snacks they bring to school, as the teachers have fewer concerns about what the adolescents feed on when they go home or monitor the type of snacks brought to school. Feeding habits including the intake of too many snacks contribute to underweight, overweight, obesity, and micronutrient deficiencies among adolescents in primary schools (Wilcox & Wilcox, 2021). Also, a study conducted in South Africa among adolescent and school-going children showed that the economic status of the caregivers influenced their nutritional status (Gwelo *et al*., 2023)

The MUAC measurements showed that 86% of adolescents had normal nutritional status, while a few (2%) were malnourished. These results were consistent with MUAC findings from studies by Roy & Sekher, (2022) which showed that 98.4% of adolescents in India had normal nutrition while 1.6% were malnourished. Similarly, a study by Bhattacharya *et al*., (2019) indicated that 96.2% had normal nutrition and 3.8% were malnourished. Also, a research by Lillie *et al.,* (2019), had similar findings of nutritional status by MUAC measurements, that 75% of adolescents in Tanzania had normal nutrition.

5.1.2 Adolescents' dietary intake patterns

The adolescent's dietary intake pattern was determined using 24-hour recall and 7-day food frequency. The mean energy intake was 1610.4 ±686.4 Kcal/day. The results differed from the findings of a study by Keats *et al*., (2018), which indicated that adolescents in urban areas, on average, consumed 1906 ± 507Kcal/day. The average intake of energy was lower than the recommended dietary intake which should be 2500Kcal for male adolescents and 2200Kcal for female adolescents. Low energy intake in adolescents results in suppression of reproductive hormones (Luteinising hormone in females), as well as exposing the adolescents to protein-energy

malnutrition (Melin *et al,* 2016). The findings also indicated that the mean fat (51.5± 7.8 (male adolescents) and 97.6± 7 (female adolescents)) and carbohydrate (229.4± 24.6(male adolescents) and 233.6± 17.6 (female adolescents)) consumption were higher than the recommended dietary intake (fats (30g for both male and female adolescents) and carbohydrates (130g for both male and female adolescents). Diets high in fats and carbohydrates contribute to the accumulation of fats in adipose tissues that lead to obesity and associated disorders (Yki-Järvinen *et al*., 2021).

Moreover, the intake of dietary fibre was higher (34.5± 4.3 (male adolescents) and 31.9± 2.8 (Female adolescents) than the recommended dietary intake (28g for male adolescents and 26g for female adolescents). Intake of dietary fibre helps in gut motility and digestion of food. However, intake of excess dietary fibre predisposes adolescents to gastrointestinal disorders such as cramping, accumulation of intestinal gas, and bloating (Gill *et al*., 2021; Barber *et al*., 2020). Thus, intake of excess dietary fibre would expose adolescents to gastrointestinal disorders.

Most adolescents consumed bread, mandazi and tea as their main breakfast and break time snacks. These results were similar to the findings of a study by Githinji (2016), which showed that most adolescents in Nairobi county took bread and tea as their main breakfast. The adolescents had good consumption of vegetables as revealed in the results of the study. The schools sampled had school feeding programmes that ensured the provision of a balanced diet to the adolescents and other school-going children. These findings concur with the national school meals and nutritional strategy (2017-2022), which indicates that the meals provided in schools account for a third of recommended dietary allowances of energy, iron, vitamins, proteins and iodine. However, the deviations noted in the RDI of some nutrients consumed could be

associated with the meals the adolescents consumed at home or carried for break-time snacks. However, the results in-consisted with Citrakesumasari, Kurniati, & Virani, (2020) findings which showed that the dietary intake in adolescents does not meet the recommended daily intake.

5.1.3. Energy-dense diet intake patterns

The adolescents frequently consumed starchy and fatty foods in a 7-day food frequency assessment. The starchy foods frequently consumed by adolescents were rice, potato chips and bhajia. Potato chips and bhajia are starchy and, in addition, are fatty foods which are energy-dense. Food intake with high fat content has been associated with high energy density (Bazshahi *et al*., 2021). Thus, adolescents' intake of starchy and fatty foods could contribute to their energy-dense diet intake. These results were consistent with the findings of a study done by Radhi, Riddell, & Worsley (2017), which showed that most adolescents in Kolkata consumed one or more types of energy-dense foods or drinks in their meal servings.

Intake of eggs was also noted to be frequent among adolescents. Adolescents also frequently consumed sweet cakes and sweets. Tea was a sugar-sweetened drink frequently drank together with soft drinks. Soft drinks contribute to the energy density in the diet and, if consumed in plenty, could lead to reduced intake of a healthy diet (Guyenet, 2019). Mandazi/ doughnuts were frequently consumed, which contributed to the energy density.

5.1.4 The association between sociodemographic characteristics and intake of energy-dense diets

Sociodemographic characteristics of people are key determinants of the dietary intake of the population (Dong *et al*., 2019). Age, gender, religion, education level of the caregiver, employment status, income level, number of children in a household, and

food affordability, in some studies, show that they influence the dietary intakes of adolescents (Yau *et al*., 2020; Abudayya *et al*., 2009). These results show that gender did not influence the intake of energy-dense foods among adolescents. Contrary to a study by Sun, Li, & Rahut, (2021), gender was found to influence energy intake, where females were likely to consume more macronutrients than male adolescents, which contributed to more energy density of the meals.

There was no association between age and an energy-dense diet. These findings were consistent with other studies which have shown a relationship between age and intake of energy foods. The body's energy demands increase with age, especially during puberty, when there is increased growth (Christian & Smith, 2018). A positive relationship was established between religion and the intake of energy-dense foods. The adolescents came from different religions, influencing their dietary intake and energy. According to Potts *et al*., (2019), religion influenced food intake in a population, which was similar to the findings of this study.

The education level of the caregivers was found to influence the intake of energy-dense foods negatively. According to Kell *et al*. (2015) and Konttinen *et al*., (2021), the education level of the guardians was found to influence the dietary intake of their adolescents, with most educated guardians embracing healthy feeding habits for their children/adolescents. The low education level of the caregivers was likely to influence the intake of energy-dense foods negatively as the education level also contributes to the diet the caregivers provide to their adolescents (Kebede *et al*., 2022).

The findings indicated that the caregivers' employment status influenced the energy intake, with the adolescents whose caregivers were unemployed consumed high energy-dense foods. The findings indicate that most of the adolescent caregivers were

either self-employed, employed by the government, or employed in the private sector. In contrast, a low percentage of adolescent caregivers were unemployed. The affordability of the food in the market was mentioned to be a challenge as most of the adolescents reported that the food in the market was expensive. Therefore, the preference for cheap and affordable foods is poor in nutrient composition. These findings were consistent with the study by Konttinen *et al*., 2021 which indicated that the level of income would influence food choices in the market due to their affordability. This relates to the positive association between the intake of energy-dense foods and the income of the caregivers.

The cost of food influences the nutrient density consumed. The results found a highly significant positive relationship between the intake of energy-dense foods and food affordability in the market. when the food in the market is expensive, people are inclined to cheaper food which is deficient in all the nutrients and high in energy density. The majority of the adolescents reported that the food was expensive in the market, which implied their dietary intake. With the low income levels of the parents, it was likely that the adolescents' nutrient was affected. As a result, their nutritional status was affected by the dietary intake of the adolescents. The results from a study conducted among adolescent girls in low-middle-income countries produced similar results to the study's findings. Adolescents who come from low economic social classes are inclined to cheap and readily high-energy-dense foods; thus they don't meet the recommended dietary intake. Intake of foods that have high energy density cause malnutrition or nutritional-related disorders such as blood pressure, and heart diseases (Bose *et al.,* 2021). Intake of deep-fried foods which are high in energy density may also lead to constipation and irritable bowel movement disorders (Rollet *et al.,* 2021). According to Konttinen *et al*., (2021), dietary diversity is greatly influenced by the

socioeconomic status of the people; people of high socioeconomic class adopt healthy balanced diets, while people of the low socioeconomic class place higher importance on food prices and lower importance on health outcomes of consumptions of a particular food.

The findings indicate that most of the adolescents' caregivers were married, with few single and divorced/separated parents. The marital status of the adolescent's caregivers was found to have a negative relationship with the intake of energy-dense foods, meaning, adolescents from single parents were more likely to take high energy-dense foods due to their easy access and affordability. Similarly, according to Sun *et al*., (2021), households headed by women are likely to experience food insecurity at one point compared with households headed by men; thus, the offspring are likely to suffer from malnutrition. Households led by both the father and mother are associated with healthy dietary practices which reduce the reliance on high energy-dense foods. Households led by a single parent, either father or mother related to the intake of foods high in energy density (Chen *et al.,* 2019).

Male adolescents were found to consume more energy compared to female adolescents. The mean energy intake for female adolescents was below the recommended daily intake (RDI) (2000-2100 Kcal/day for girls aged 10-14 years), while for male adolescents, the energy intake was below the RDI (2200-2500 Kcal/day). Also, the carbohydrates, proteins, fibre, fats, and micronutrient intakes were higher among female adolescents and lower among male adolescents. However, they either exceeded or were lower than the RDI. These results were consistent with Citrakesumasari *et al.,* (2020) findings which showed that the dietary intake in adolescents does not meet the recommended daily intake.Religion has been found to influence the dietary intake of

people, which as a result affects the health outcomes of adolescents. The results found that religion did influence the intake of energy-dense foods. The different religious groups did not affect the level of intake of energy-dense foods. Major-smith *et al*., 2023 found that religious beliefs promoted intake of micronutrients which limit intake of energy-dense diets. This study was limited to the intake of energy-dense foods and the micronutrient intake was not investigated. However, from the findings religion did not have a relationship with the intake of energy-dense foods and that could be attributed to the balanced diet which limits the intake of energy-dense diets.

5.1.5 Relationship between energy-dense Food Intake and Nutritional Status of Adolescents

The findings indicate that the use of the blue band on vegetables and bread negatively influenced the nutritional status of the adolescents, meaning adolescents who frequently consumed the blue band on food were more likely to become overweight and obese as compared to those who used it infrequently. These results were consistent with the findings of a study conducted by Kamanu (2019), which indicated that intake of fatty and oily foods predisposed adolescents to over-nutrition.

Intake of fried potatoes, mashed potatoes, mandazi, doughnuts and bhajias influenced the BMI of the adolescents. The more the adolescents consumed these foods, the more likely they were to get overweight and obese. There was a positive association between the intake of sugar-sweetened beverages and soft drinks. These results were similar to the findings of a study conducted by Huang et al. (2019) which showed that the intake of sugar-sweetened beverages led to overnutrition in adolescents.

The results showed that the nutritional status of the adolescents was influenced by intake patterns of high energy-dense diets. This is because the intake of high energy-

dense diets had a significant positive and negative relationship with the nutritional status of the adolescents. Therefore, the study failed to reject null hypothesis one and concluded that intake of high energy-dense diets had an effect on the nutritional status of the adolescents.

Also, most of the sociodemographic characteristics of the adolescents except age and gender had a negative relationship with the intake of energy-dense foods. Thus, we fail to reject the null hypothesis two and conclude that the intake of high energy-dense diets is influenced by the sociodemographic characteristics of the population.

5.2. Conclusion

Objective 1: To assess the nutritional status of adolescents in primary schools in Nairobi County

Three quarter (74.5%) of the adolescents interviewed in Nairobi county had normal nutrition. 13% were underweight, 5.7% were overweight, 4.3% were severely underweight, and 2.5% were obese. The normal nutrition in most adolescents was contributed by the school feeding programme in most of the schools in the study area, which provided a balanced diet to the adolescents and other pupils. The cases of malnutrition identified were associated with overreliance on energy-dense foods. There was no significant difference that was observed between the social demographic characteristics and the nutritional status of the adolescent. However, there was a significant difference between the number of children in a household and the nutritional status of the adolescents ($P<0.05$).

Objective 2: To determine how patterns of consumption of energy-dense foods relate to malnutrition among adolescents in primary schools in Nairobi County.

Intake of high energy-dense foods was found to have a significant association with the nutritional status of adolescents. High energy-dense foods included potato chips,

mandazi, ngumu, and pancakes. Adolescents who were overweight and obese were found to consume these energy-dense foods more frequently. Frequent intake of sugar-sweetened beverages including sodas was found to influence the nutritional status of adolescents negatively. Intake of cheese was also found to have a negative association with the nutritional status of adolescents.

Objective 3: To find out if there is an association between sociodemographic characteristics and intake of energy-dense foods among adolescents in primary schools in Nairobi County.

Sociodemographic characteristics of the adolescents were found to be key determinants of their dietary intake. Gender, age, employment status, marital status and income level of the adolescent's caregivers were found to influence the adolescent's dietary intake. The socioeconomic status of the adolescent's guardians had a significant association intake of energy-dense foods since it influences food affordability. Most adolescents indicated that the food in the market was very expensive, which led to overreliance on cheap energy-dense diets. The education level of the adolescents' caregivers was found to have a significant association with the intake of energy-dense diets and the nutritional status of the adolescents. For most adolescents who were found to be malnourished, their caregivers were found to have reached the secondary education level and below. The income level of the caregiver had a significant association with dietary intake as it influences food choice in the market based on the affordability of the food. Marital status was also associated with the nutritional status of the adolescents, with adolescents from single parents being most affected by malnutrition. There is no association between sociodemographic characteristics and consumption of energy-dense foods amongst adolescents in selected primary schools in Nairobi County.

5.3. Recommendation

5.3.1 Recommendations from the study

Recommendations for parents

Create awareness with the parents and community on the right nutrition; educate the parents about the amounts and quality of food they feed to their children. The churches, chief's barazas and community nutrition forums can be used in the creation of awareness it would reach the parents easily and effectively. The nutritionist can use these forums to educate the population on diet quality, and its implication on the health of the adolescents and young children. These forums could be useful in identifying nutritional needs in the community and informing policymakers on nutritional programme implementation gaps.

Recommendations for the schools

Schools were found to be implementing the school feeding programme effectively. However, there was a need to control the snacks brought to school by adolescents. From the findings, most snacks brought to school for break time were high energy-dense diets and, thus, the need to regulate the snacks brought to school. The school heads together with the parent's teachers association chair, ought to inform the parents of the right snacks which are low in energy density to be brought to schools.

Recommendations for the Ministry of Education

The findings show that adolescents in Nairobi County are still faced with the burden of over- and under-nutrition, which could affect school performance and growth.

Therefore, the Ministry of Education in collaboration with the Nairobi City County Government should ensure that there is a professional nutritionist allocated for each Sub-County to carry out a nutritional assessment in school as well as conduct frequent nutrition education forums for adolescents, teachers and parents. The ministry can also

assist in the design of a community nutrition policy which focuses on mothers' nutritional education and through the Ministry of Health and Agriculture help mobilize resources to enable caregivers to provide quality and healthy diets that prevent malnutrition among adolescents.

5.3.2 Suggestions for further research

1. Further studies can be conducted to investigate the effects of the consumption of energy-dense foods on adolescents’ school performance.

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APPENDIXES

Appendix I: Study area map

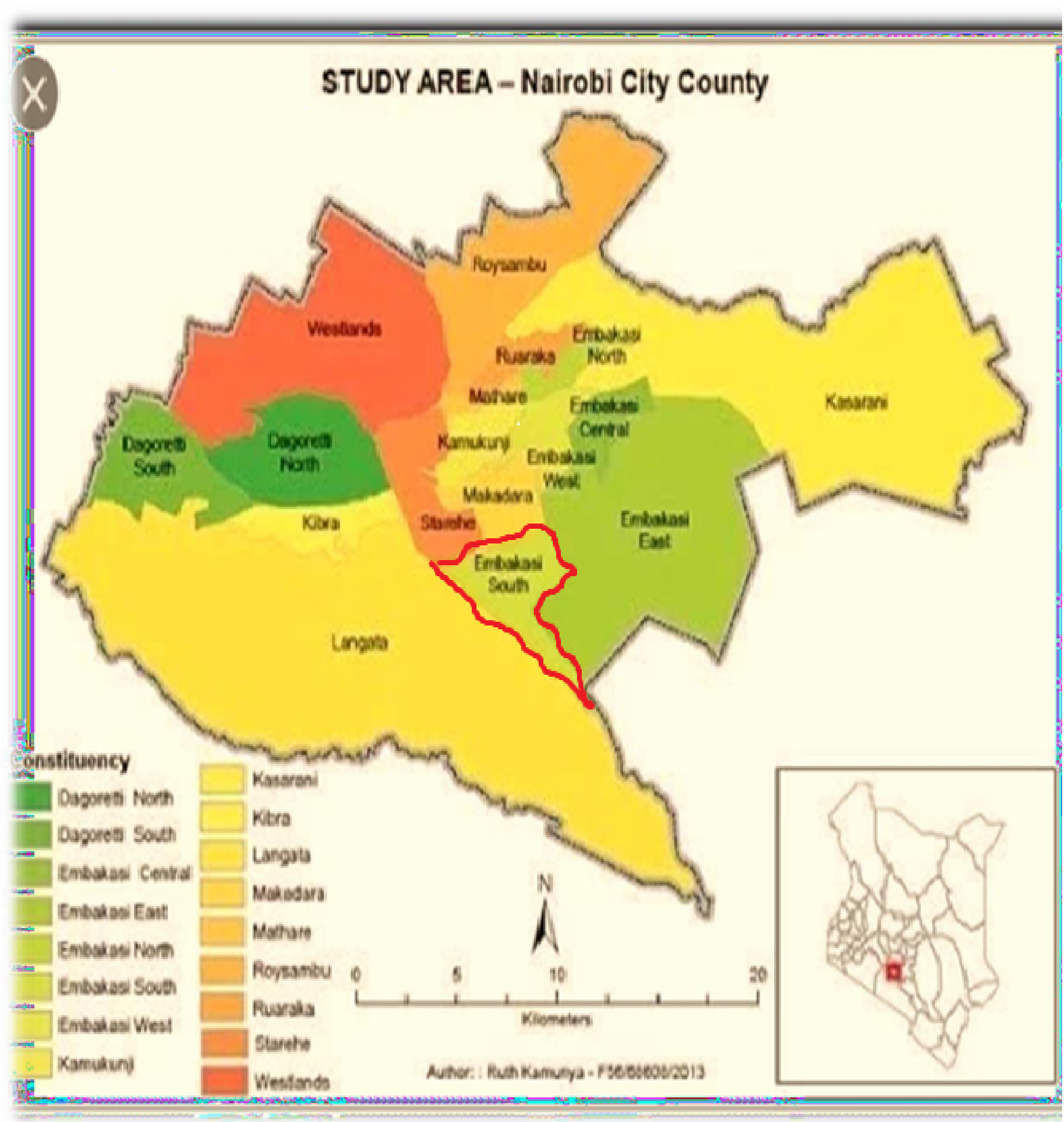

Figure 2.1: Study area map

Appendix II: Consent Form/ Assent form

Introduction

Hello, my name is Evelyne Ndunge of the School of Public Health from Kenyatta University, conducting a study on "Nutritional status and intake of energy-dense foods among adolescents aged 10-14 years in Nairobi City County, Kenya." I am requesting that the school you represent to be involved in the study. The aim of this consent form is to explain to you about the information required to assist you decide whether to participate in the study or not. Kindly take time and read the consent form carefully, or if you have any difficulties, I can assist you to go over it. In case you might be having any question about the study, possible risks, and benefits, your rights as a volunteer, and anything else feel free to ask. After going through the consent form, you will make your decision to participate or not. The process is known as the 'informed consent' and you are going to be left with a copy of consent for your reference.

Procedures to be followed

The study will involve two questionnaires: one questionnaire will be administered to the pupils and will require you to give us the information on socio-demographic characteristics and health status for the last three months. With your permission, your weight, height, and other body part measurements will be taken to give us information on your nutritional status. The second questionnaire will be a key informant interview guide administered to the headteacher or the class teachers. Kindly note that these activities will take place in the school with approval from the school heads and class teachers. We will endeavor to take the shortest time possible for the whole session to ensure you are comfortable enough. Participation is voluntary, and I hope you can participate in this study as your cooperation is very important.

Risks/ benefits and discomforts

The study involves body measurements that will require the adolescents to either remove their sweaters or heavy clothing or shoes, which might at some point cause discomfort to you. From the findings of the study, the participants may benefit from long term programs that are likely to be rolled out in this region. Please note that there will be no payments for participating in the study.

Confidentiality

Please note that the information which you provide will not be disclosed to anyone who is not part of the research team. Numerical codes will be used to identify you in the research transcripts, while names shall be omitted in the transcription of audio recording. The recorders will be secured using locks to prevent any interference. The information obtained from you shall be kept private and will solely be used for statistical purposes. Any record relating to your identities, such as name, health status, or name of the school, will not be disclosed. The information collected will be erased from the computers after analysis and publications of the results. Researchers will be able to access the information about the research after they have signed the confidentiality agreement.

Liability

Kindly note that to participate in the research is voluntary. Therefore, the participant will not hold the researcher reliable for any issues that arise in connection with the study. If you are not willing to continue with the interviews and you wish to withdraw or refuse to participate in the research, you are free to do so.

Person to contact

In case you have any questions, you can ask anyone from the research team now or later. The principal investigator and other research team members will be available to

answer your questions anytime during the data collection session. If you have questions, later regarding the study, contact the Kenyatta University or me Ethical Review Secretariat on the information given below. Your participation will be highly appreciated.

Evelyne Ndunge Muinga Principal Investigator, Kenyatta University,
P.O. Box 43844-00100, Nairobi.

Tel: 0720063143

Kenyatta University ethical review Committee,

P.O. Box 43844-00100, Nairobi.

Tel: 871090112

Respondent's assent

I have read and understood the information above, everything has been expounded to me well by the chief investigator, and I voluntarily consent to participate in this study (Please indicate by signing your willingness to participate in this study)

Name of the participant: ____

Signature:____Date: _

Investigator's Statement

I, the undersigned, have explained to the volunteer participant in the most understandable way and language, the procedures to be followed, risks and benefits involved in this study. I agree that the participant has been given an opportunity to ask questions about the study, and I have answered all the questions correctly as asked by the participants. I certify that the participant has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of the investigator____

Investigator's signature_____Date: _

Parental permission form

Evelyne Ndunge Muinga, Kenyatta University,

P.O. Box 43844-00100, Nairobi.

Through,

The headteacher,

______Primary School,

P.O. Box_____, Nairobi.

Dear Parents,

I am a student at Kenyatta University, studying a Master's in Public Health. I am carrying out a study on “Nutritional status and intake of energy-dense foods among adolescents aged 10-14 years in Nairobi City County, Kenya." The study will involve pupils of class five to class eight. The information collected will help enhance the understanding of the association between the intake of energy-dense foods and nutritional status and its effects on the adolescent's health. The ethical review committees of Kenyatta University, the school management, and NACOSTI have authorized me to conduct the research. With your approval, I will explain the study to the adolescent and request your consent to participate. I will appreciate it if sign below for approval. Thank you.

Signature of the parent/ guardian____Date__

Appendix III: Questionnaire

Name of the school__

Date of the interview_

Please tick (√) the one that describes your most appropriate answer to the questions

Section A: Socio-demographic

1.1. How old are you? 10 yrs. [ ] 11 yrs. [ ] 12 yrs. [ ] 13 yrs. [ ] 14 yrs.[ ]

1.2. Gender Male [ ] Female [ ]

1.3.Which class are you in?

Std. 5 [] std. 6 [ ] std. 7 [ ]

1.4. What is your religion?

(a) Catholic [ ]

(b) Protestant [ ]

(c) SDA [ ]

(d) Islam [ ]

(e) Hindu [ ]

(f) Others (specify)__

1.5. What is the highest level of education of your caregiver?

(a) Primary school [ ]

(b) Secondary school [ ]

(c) College/ university [ ]

(d) Never went to school [ ]

1.6. What is the occupation/ employment status of your caregiver? [ ]

(a) Unemployed [ ]

(b) Self-employed/ employed in family business [ ]

(c) Employed in the private sector [ ]

(d) Employed by the government/ county government [ ]

[ ]

(e) Employed in the community sector e.g., church, NGO

1.7. What is the marital status of the caregiver?

(a) Single [ ]
(b) Married [ ]
(c) Divorced/ separated [ ]

1.8. What type of house do you live in?

(a) Stone house [ ]
(b) Mud house [ ]
(c) Grass thatched house [ ]
(d) Iron sheet house [ ]

1.9. What is the size of the house you live in?

(a) Single room [ ]
(b) Bedsitter [ ]
(c) I bedroom [ ]
(d) 2 bedrooms [ ]
(e) 4 rooms and more [ ]

1.10. How many children are there in your home? _______

1.11. How affordable are the food commodities in the market?

(a) Very expensive [ ]
(b) Expensive [ ]
(c) Cheap [ ]
(d) Very cheap [ ]

Section B: 24-Hour Recall

Please try to think back and describe the foods (meals and snacks) or drinks which you ate or drank yesterday from the morning to the evening, the time you went to sleep, whether at home or outside the home. Start with the first food eaten in the morning.

(Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned).

	Food/ drink taken (list all foods, beverages or snacks for every meal during the last 24hr. period	Portion size (How many pieces, slices, packets, cups, teaspoons, tablespoons)	How was it prepared? (Baked, deep-fried, fried, steamed, boiled) probe for more details.
Breakfast	including tea, juice,		
Break-time snack			
Lunch			
Afternoon snacks			
Super			

Mark where appropriate

Q1: did you eat any sweets or chocolates yesterday?

(a) Yes [ ]

(b) No [ ]

(c) Can't remember [ ]

Q2. Did you eat any fruit yesterday?

(a) Yes [ ]

(b) No [ ]

(c) Can't remember [ ]

If yes, which fruit did you eat? (Probe for more answers)

Q3. How often do you eat/ drink the food/ beverages you have mentioned above?

(a) Often [ ]

(b) Always [ ]

(c) Once in awhile [ ]

(d) Never [ ]

Section C: Food Frequency

Indicate how often you consume the following types of food by indicating the number of times per day or week

1. once=1 [ ]
2. twice=2 [ ]
3. thrice or more=3 [ ]
4. never=4 [ ]

	No. of times eaten in a day	**No. of days eaten in a week**
Cereals, carbohydrates, starch		
Bread		
Rice		
Spaghetti/ pasta		
Noddles		
Chapatti/pancake		
Corn bread		
Doughnuts/kdf		
Cakes		
Fried rice (mchele-njeri)		
Chips(French fries)		
Bhajia		

boiled/roasted maize		
Samosas		
Biscuits		
Cookies		
Pizza		
Porridge		
Breakfast cereals e.g. corn flax, Weetabix		
Others (specify)		
Street foods		
Fried chicken		
Sausage/ smokies		
Eggs		
Others (specify)		
Confectionaries and sweets		
Sweet cake		
Sweets		
Cookies		
Biscuits		
Honey		
Candy		
Chocolate		
Beverages/ sugar sweetened beverages		
Soda		
Processed juice		
Home made fruit juice		
Coffee		
Tea		
Others (specify)		

Energy-dense foods

1) Do you use milk/cream in your coffee or tea? If yes, how many cups per day do you average? ___ Yes [ ] No [ ]

2) Do you routinely use a blue band on bread products such as toast?

Yes [ ] No [ ] Infrequently [ ]

3) Do you routinely add blue band/ fats to cooked or on baked potatoes or other vegetables?

Yes [ ] No [ ] Infrequently [ ]

4) How often, on average, do you consume any of the following snack foods?

- Potato chips
- Smashed potatoes
- Any type of fried snack (mandazi, ngumu, kdf, pancakes, bajhia)
- Cheeses
- Chocolate bars

a) 7 or more times per week [ ]

b) 4-6 times per week [ ]

c) 2-3 times per week [ ]

d) 0-1 times per week [ ]

5) How often, on average, do you consume any of the following snacks or drinks?

- Regular soft drinks
- Fruit juices

a) 7 or more times per week [ ]

b) 4-6 times per week [ ]

c) 2-3 times per week [ ]

d) 0-1 times per week [ ]

6) On average, how many servings per day do you consume of garden type vegetables (ex. broccoli, cauliflower, peas, carrots, tomatoes, peppers, murenda, terere, managu, spinach, kales)?

a) 5 or more servings per day [ ]

b) 3-4 servings per day [ ]

c) 1-2 servings per day [ ]

d) 0 servings per day [ ]

7) On average, how many servings per day do you consume of any of the following: wheat pasta, brown rice, beans, lentils, peas, corn, barley, oatmeal?

a) 5 or more servings per day [ ]

b) 3-4 servings per day [ ]

c) 1-2 servings per day [ ]

d) 0 servings per day [ ]

Section D: Anthropometry

Anthropometry	**Measurement1**	**Measurement2**	**average**
Weight			
Height			
Mid-Upper Arm Circumference			

Section E: Key Informant Interview guide for school heads/ class teachers

Date __

Name of the school__

School code__

Interviewer's name__

Gender______

The questions below are intended to determine dense food consumption pattern, adolescent's health and their nutritional status.

Consumption of energy dense foods and nutritional status

1) Where do the adolescents of this school get their meals from?
2) Does the school have a school feeding program? If yes, what type of food does the program provide?
3) Do you monitor the type of food the adolescents bring to school?
4) How would describe the types of food the children bring to school?
5) How would you describe the nutritional status of the pupils?
6) What health and nutrition challenges has your school experienced in the past 2 months?
7) What recommendations would you suggest to improve the nutritional status of your pupils?
8) How can other stakeholders assist in improving the nutritional status of adolescents?
9) What programmes does your school have to promote nutrition of your pupils?
10) Any other comment? …………

Appendix IV: Kenyatta University approval of research proposal

KENYATTA UNIVERSITY
GRADUATE SCHOOL

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

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School **DATE:** 2nd February, 2021

TO: **Ms. Evelyne Ndunge Muinga** **REF:** Q57/30654/2015
C/o Department of Community Health & Epidemiology

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on **27th January, 2021**, approved your Research Proposal for the M.P.H. Degree entitled, **"Nutritional Status and Intake of Energy-Dense Diets among Adolescents (10-14 Years) in Selected Primary Schools in Nairobi City County, Kenya."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

KENYATTA UNIVERSITY OFFICE OF DEAN 02 FEB 2021 GRADUATE SCHOOL P.O. BOX 43844-00100 NAIROBI

JULIA GITU
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Community Health & Epidemiology Department
Supervisors:

1. Prof. Judith Waudo
   C/o Department of Food, Nutrition & Dietetics
   Kenyatta University

2. Prof. Joachim Osur
   AMREF International University
   C/o Community Health & Epidemiology Department
   Kenyatta University

Appendix V:

KENYATTA UNIVERSITY
GRADUATE SCHOOL

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

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q57/30654/2015 **DATE: 2nd February, 2021**

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MS. EVELYNE NDUNGE MUINGA REG. NO. Q57/30654/2015

I write to introduce Ms. Evelyne Ndunge Muinga who is a Postgraduate Student of this University. She is registered for M.P.H. degree programme in the **Department of Community Health & Epidemiology.**

Ms. Muinga intends to conduct research for a M.P.H. thesis Proposal entitled, **"Nutritional Status and Intake of Energy-Dense Diets among Adolescents (10-14 Years) in Selected Primary Schools in Nairobi City County, Kenya."**

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF DEAN
02 FEB 2021
GRADUATE SCHOOL
BOX 43844-00100 NAIROBI

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

Appendix VI: Kenyatta University Ethical Review Committee Approval

KENYATTA UNIVERSITY
DIRECTORATE OF ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575 **P. O. Box 43844,**
Email: chairman.kucrc(å)ku.ac.ke
Nairobi, 00100
Tel: 8710901/12
Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.I** Date: 29th March, 2021

Evelyn
Muinga P.O
Box 43844,
00100
Nairobi.

Dear Ms.Muinga,

APPLICATION NUMBER: PKU/2234/11378- NUTRITIONAL STATUS AND INTAKE OF ENERGY-DENSE DIETS AMONG ADOLESCENTS (10 14YEARS)1N SELECTED PRIMARY SCHOOLS IN NAIROBI CITY COUNTY, KENYA

This is to inform you that **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE** has approved version 4 of the study protocol together with the attached consent forms dated 12.09.2020. Your application approval number is **PKU/2234/11378**. The approval period is **29th March, 2021 TO 29th March, 2022.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE**.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported **to KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW**

COMMITTEE within 72 hours

v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to **KENYA TTA UNIVERSITY DIRECTORA TE OF ETHICS REVIEW COMMITTEE**.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online upon completion of data collection found on the following websitelink;(https://docs.google.com/forms/d/1ytWefDwvyz5h10z Vln0xbxg3uGdlDzMX FWNDsMrRPQ/edit?usp=sharing

Yours sincerely

KENYATTA UNIVERSITY OFFICE OF THE CHAIRMAN 29 MAR 2021 ETHICS REVIEW COMMITTEE P.O. BOX 43844 - 00100 NAIROBI

Prof. Judith Kimiywe

DIRECTOR- KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE.

A

KENYATTA UNIVERSITY
OFFICE OF THE EXECUTIVE DEAN, GRADUATE SCHOOL

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

Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Executive Dean, Graduate School — DATE: 27th May, 2024

TO: Evelyne Ndunge Muinga — REF: Q57/30654/2015
C/o Family Medicine, Community Health and Epidemiology Department

SUBJECT: REQUEST FOR THESIS TITLE APPROVAL

The subject matter above refers.

Your request to change your thesis title from **"Nutritional Status and Intake of Energy-Dense Diets among Adolescents (10-14 years) in Selected Primary Schools in Nairobi City County, Kenya"** to **Relationship between Intake of Energy-Dense Diets and Nutritional Status of Adolescents in Primary Schools in Nairobi City County, Kenya: A Mixed-Method Study"** was approved subject to dropping the phrase "A Mixed-Method Study" from the title

Kindly proceed to bind your work using the approved title.

Thank you.

PROF. ELIUD N. M. NJAGI
AG. EXECUTIVE DEAN, GRADUATE SCHOOL

cc. Executive Dean, School of Health Sciences
Chairperson, Department of Family Medicine, Community Health and Epidemiology
Supervisors:
1. Prof. Judith Waudo
2. Prof. Joachim Osur

LC/cw

Transforming Higher Education … Enhancing Lives
Kenyatta University …ISO 9001: 2015 Certified

Appendix VIII: National Commission for Science Technology and Innovation Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **127434**

Date of Issue: **11/May/2021**

RESEARCH LICENSE

This is to Certify that Ms.. Evelyne Ndunge Muinga of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: NUTRITIONAL STATUS AND INTAKE OF ENERGY-DENSE DIETS AMONG ADOLESCENTS (10-14 YEARS) IN SELECTED PRIMARY SCHOOLS IN NAIROBI CITY COUNTY, KENYA for the period ending : 11/May/2022.

License No: **NACOSTI/P/21/10426**

127434

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation
off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke

COUNTY COMMISSIONER
NAIROBI COUNTY
P. O. Box 30124-00100, NBI
TEL: 341666

Appendix IX: Ministry of Education Research Authorization

Republic of Kenya
MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone; Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi@gmail.com

REGIONAL DIRECTOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

When replying please quote

Ref: RDE/NRB/RESEARCH/1/65 Vol.1

DATE: 13th May, 2021

Evelyne Ndunge Muinga
Kenyatta University

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on the topic: *"Nutritional Status and Intake of Energy-Dense Diets among Adolescents (10-14 Years) in Selected Primary Schools in Nairobi City County, Kenya."*

This office has no objection and authority is hereby granted for a period, ending 11th May, 2022 as indicated in the request letter.

Kindly inform the Sub County Director of Education of the County you intend to visit.

REGIONAL DIRECTOR OF EDUCATION NAIROBI 13 MAY 2021 MINISTRY OF EDUCATION P.O. Box 74629, NAIROBI

GLADYS MALONZA
FOR: REGIONAL DIRECTOR OF EDUCATION
NAIROBI.

Copy to: Director General/CEO
National Commission for Science, Technology and Innovation
NAIROBI.