DIETARY PRACTICES, PHYSICAL ACTIVITY, AND OVERNUTRITION AMONG SCHOOL-GOING CHILDREN AGED 8 - 11 YEARS IN THIKA TOWN, KIAMBU COUNTY, KENYA

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DECLARATION

Declaration by Candidate:

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

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ABSTRACT

Introduction: Childhood overnutrition is a growing public health issue. It is a significant risk factor for non-communicable diseases and is becoming increasingly prevalent in low- and middle-income countries. This study aimed to determine the influence of dietary practices and physical activity levels on overnutrition among school-going children aged 8–11.

Methods: A cross-sectional design with multistage sampling was employed. A total of 281 children were recruited from five schools. A food frequency questionnaire was used to assess dietary intake. Physical activity was evaluated using the physical activity questionnaire for older children. Body mass index (BMI for age and sex) z-score was used to indicate nutrition status. Univariate, bivariate, and multivariate analysis was applied to determine associations between the independent variables and overnutrition.

Results: The median age of the respondents was 10 years, and over half (55%) were girls. Most (66.6%) of the children had adequate nutrition status, while 22.4% and 11% were underweight and overweight, respectively. There was a notably high frequency of consumption of foods from grains, plantains, white roots, and tubers (19.2%), as well as the deep-fried and salty (12%) food groups. About 11.7% of the children consumed caffeinated drinks. Nearly half (45.2%) of the children were inactive. Overnutrition was significantly higher among private than public school children (aOR 2.641; 95% CI = 1.013-6.887, p = 0.0047). There was a significantly higher prevalence of overnutrition amongst children who didn't walk to school than those who walked, though it was not statistically significant (aOR 2.017; 95% CI = 0.875-4.650, p = 0.1).

Conclusion: Overnutrition is prevalent among school-going children, particularly in private schools and those who don't walk to school. The study recommends investing in nutrition surveillance to understand trends and risk factors and promoting healthy, active living efforts, including physical activity, sedentary behaviors, and dietary practices, to enhance school-going children's overall health.

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ABBREVIATIONS AND ACRONYMS

AMIU - AMREF International University

APHRC - African Population and Health Research Center

BMI - Body Mass Index

CDAE - Capacity Development of Applied Epidemiologists in Eastern Africa Region

DBM – Double burden of malnutrition

DM – Diabetes Mellitus

EDCTP2 - European and Developing Countries Clinical Trials Partnership II

FFQ – Food Frequency Questionnaire

GDP - Gross Domestic Product

GERD – Gastroesophageal reflux disease

GNR - Global Nutrition Report

GSHS - Global School-based Student Health Survey

HTN - Hypertension

IDF – International Diabetes Federation

KDHS - Kenya Demographic and Health Survey

KNNAP – Kenya National Nutrition Action Plan

LMICs - Low- and middle-income countries

MDD-W – Minimum dietary diversity for women

MIYCN - Maternal, infant, and young child nutrition

MNCS - Multinational companies/corporations

MVPA – Moderate to vigorous physical activity

NCDs – Non-communicable diseases

OB - Obesity

OW - Overweight

PA – Physical Activity

SB – Sedentary Behavior

SSB – Sugar sweetened beverages

SDGs - Sustainable Development Goals

SGC – School Going Children

SSA – Sub-Saharan Africa

UN – United Nations

US – United States of America

WHO - World Health Organization

WHR – Waist Hip Ratio

OPERATIONAL DEFINITION OF TERMS

Childhood: is a stage in the lifespan when one is considered a child, usually during infancy, adolescence, and before age 18 (UNICEF, 1989).

Dietary practices: are an individual's food consumption choices and preferences as influenced by factors such as physiologic state, age, disease/condition, culture and taboos, food advertisement, and household food security.

Non-communicable diseases: are non-contagious chronic diseases that occur due to a complex interaction between various factors, such as genetics, behavior, environment, and physiological processes. They include cancers, cardiovascular diseases, dyslipidemias, kidney diseases, respiratory diseases, such as asthma, musculoskeletal disorders, and mental disorders.

Overnutrition: is a physiologic state resulting from excessive energy intake and inadequate energy expenditure over a long period of time. It can lead to either overweight or obesity.

Physical activity: is all bodily movement that expends energy. This includes walking to and from places, running, doing house chores, and playing.

Sedentary behavior: is any waking moment an individual spends sitting or reclining.

CHAPTER 1: INTRODUCTION

1.1. Background of the Study

Overnutrition, resulting in overweight (OW) and obesity (OB) poses a significant and multifaceted public health crisis that impacts populations worldwide. Over the last forty years, the occurrence of OB has consistently increased across all nations. None of the countries has successfully reversed the trends of obesity (Swinburn et al., 2019). It manifests in a disproportionate accumulation of body fat that poses risk to health. It is the fifth leading cause of mortality worldwide (Smith & Smith, 2016). In 2018, the obesity society categorized OB as a disease due to the numerous biological changes that occur because of obesity (Jastreboff et al., 2019). For children and adolescents aged 5–19 years, the World Health Organization (WHO) 2007 Growth Reference standards recommend classification for those whose body mass index (BMI Z-score) ≥1SD and BMI ≥2SD of the median for age and sex as either OW or obese respectively (Amamilo et al., 2020; Moore et al., 2015).

Childhood overnutrition, once thought to be a concern for high-income countries, is increasingly becoming a problem in sub-Saharan Africa. Recent studies across various sub-Saharan African countries suggest an upward trajectory in childhood overweight and obesity (Danquah et al., 2017). Middle childhood, i.e., children between 6-11 years, is an important developmental stage since the foundations for health and well-being are being set (Williams et al., 2012). Children in this stage are usually enrolled in primary school, which provides opportunities to develop their foundational skills for higher education as

well as economic, interpersonal, social, and civic responsibilities later in life (Dhimal et al., 2021).

Individuals from all population groups are at increased risk of OW and OB. The Global Nutrition Report (2021) highlights that about 2.2 billion people are overweight globally, of which 772 million are obese. In children 5 - 9yrs, the prevalence of OW (including obesity has increased i.e., from 17.0% among boys and 15.5% among girls in 2010 to 24.5% (male) and 21.4% (female), respectively in 2019. An increase has also been observed among adolescents (aged 10–19 years, i.e., from 14.4% and 13.8% in 2010 to 20.2% (male) and 18.4% (female), respectively, in 2019. Furthermore, 38.9 million children (5.7% of all children <5 years) are overweight. In Kenya, 33% and 4% of women 15 – 49 years and children <5 years are overweight, respectively (Kenya National Bureau of Statistics (KNBS), 2014). The Global Burden of Disease data further points to approximately 206 million children (5-19 years) being overweight by 2025.

In children, OW and OB are particularly harmful as they contribute to the development of chronic non-communicable diseases (NCDs), which were once thought of as adult problems such as hypertension (HTN), dyslipidemias, type 2 diabetes (DM), breathing difficulties such as asthma and sleep apnea, and joint problems. This is in part due to the pro-inflammatory and pro-oxidative state resulting from the accrual of visceral fat. Fat tissue is an endocrine organ whose functionality will be dysregulated by the excessive accumulation of fat cells seen in overweight/obesity, which contributes significantly to metabolic disease (Garvey et al., 2016). Additionally, it contributes to impaired psychosocial health, premature death, and reduced quality of life. For instance, children

have reported that the most frequent reason for bullying, teasing, and stigmatization is their body weight. This could result in impaired social development and education as well as predispose the children to mental health problems such as eating disorders, suicidal ideation, and depression. Exposure to weight stigma also impedes one's willingness to access health care (Danquah et al., 2020; Jebeile et al., 2022).

In very simplistic terms, OW and OB result from an imbalance between caloric intake and caloric utilization (Smith & Smith, 2016). This results from a complicated interaction between genetic, metabolic, and behavioral practices, cultural and environmental factors, life events marketing, mental health, sleep, and stigma (Blüher, 2019; Sahoo et al., 2015; Bray et al., 2017). Currently, the global food system is laden with a surplus of cheap, micronutrient-poor, palatable, and energy-dense food that mostly targets children as key consumers. Studies have found that advertisement significantly influences children's preferences, purchases, and consumption of these foods (Folkvord et al., 2013; Tan et al., 2018). Furthermore, despite the known benefits of regular physical activity in increasing energy expenditure, hence reducing adiposity, globally, about 80% of the children and adolescents in school are not meeting the requirements (Eyler, 2011; WHO, 2022).

The WHO recommends about 1 hour of moderate to vigorous intensity PA (MVPA) per day as well as limiting sedentary activities for children and adolescents aged between 5 and 17 years (WHO, 2021). The Sustainable Development Goals (SDGs), particularly goal (2.2), propose to end all forms of malnutrition. The World Health Assembly in 2010 also recommended limiting children's exposure to advertisements of unhealthy foods and beverages (WHO, 2010). However, many low- and middle-income countries (LMICs) are

up till now not giving obesity and its consequences the attention it deserves, yet evidence points to the existence of a double burden of malnutrition (DBM) (Swinburn et al., 2019).

A systematic review conducted by Danquah et al., (2020) highlighted a scarcity of literature on evidence of the burden of childhood overnutrition from sub-Saharan Africa. Additionally, various studies employ different criteria in defining childhood OW and OB. This research aimed to employ the WHO-recommended assessment criterion for childhood overweight and obesity to allow for easy interpretation and comparability with other studies. This establishes an initial benchmark that will facilitate tracking trends over time and enable ongoing monitoring of risk factors contributing to childhood OW and OB in the future.

1.2. Statement of the Problem

Middle childhood, i.e., children between 6 - 11 years, marks a critical developmental stage since the foundations for health and well-being are being set (Williams et al., 2012). However, they are usually underrepresented in the research and developmental agenda. The Global Nutrition Report (2021) highlights that the global nutrition targets for 2025 do not capture the Children and adolescents aged between 5 and 19 years despite their being particularly burdened by inadequate diets and, consequently, all forms of malnutrition.

Childhood overnutrition is rapidly developing into a critical threat to global health in the 21st century. About 42 million children aged 5-19 years are obese. Several studies demonstrate an upward trend in the proportion of overnourished school-going children in Sub-Saharan Africa (Adom et al., 2019; Danquah et al., 2020; Muthuri et al., 2014). For

instance, a study conducted in 29 Nairobi city schools found a prevalence of 20.8% of OW and OB among school-going children (SGC) aged 9-11 years (Wachira et al., 2020). Another conducted among SGC aged between 8.45 to 14 years in both Kisumu and Nairobi cities found that 21% were either overweight or obese (Gewa et al., 2022).

Childhood OW and OB, a disease in and of itself, is particularly harmful as it increases risk of developing chronic NCDs (De Lorenzo et al., 2019; Powell-Wiley et al., 2021). Furthermore, physical inactivity and unhealthy diets are also highlighted as notable risk factors for the occurrence of NCDs in children (Guariguata & Jeyaseelan, 2019). Exposure to weight stigma also impedes one's willingness to access health care (Danquah et at., 2020; Jebeile et al., 2022).

Very few studies have evaluated dietary practices, PA, and overnutrition in many parts of Kenya, particularly among children aged 8 - 11. This study assessed sociodemographic and behavioral factors and their influence on the occurrence of overnutrition among SGC between 8 and 11 years old in Thika town, Kiambu County, Kenya.

1.3. Research Questions

The study was guided by the following questions:

i. What is the socio-demographic characteristics of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya? This should be the first question.
ii. What are the dietary practices of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya?

iii. What is the physical activity level of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya?

iv. What is the nutrition status of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya?

v. What is the association between socio-demographic characteristics, dietary practices, physical activity level and overnutrition amongst SGC aged 8 - 11 years in Thika town, Kiambu County Kenya?

1.4. Research Objectives

1.4.1. Main Objective

The main objective of the study was to determine the dietary practices, physical activity, and overnutrition amongst school-going children (SGC) aged 8- 11 years in Thika town, Kiambu County Kenya

1.4.2. Specific Objectives

The specific objectives were to:

i. To determine the socio-demographic characteristics of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya.

ii. To assess the dietary practices of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya

iii. To assess the physical activity level of SGC aged 8 - 11 years in Thika town, Kiambu County Kenya

iv. To determine nutrition status amongst SGC aged 8 - 11 years in Thika town, Kiambu County Kenya

v. To assess the association between socio-demographic characteristics, dietary practices, physical activity level and overnutrition amongst SGC aged 8 - 11 years Thika town, Kiambu County, Kenya.

1.5 Justification of the Study

Prevention and management of childhood OW and OB is important in preventing adult obesity and the myriads of health, economic, social, and psychological implications associated with it. Among the global nutrition targets for 2025, WHO member states target a 'no increase in childhood overweight' as one of the key priority areas of action and catalyzing global change. The Sustainable Development Goals (SDGs) set by the United Nations (UN) in 2015 also identify protecting children, adolescents and adults against obesity and diet-related NCDs as a key objective. Furthermore, the Kenya National Nutrition Action Plan (KNNAP) 2017-2022, in key result area twelve (KRA 12), recognizes the need to position nutrition in the policies, guidelines, strategies, and action plans within the education sector. The key outputs highlighted to achieve this include conducting nutrition assessments, promoting nutrition, reinforcing physical activity, and promoting healthy and safe food environments in schools and other learning institutions.

This study investigated the prevalence of overnutrition and its associated factors among SGC aged 8-11 years residing in Thika Town, Kiambu County.

1.6 Significance of the study

This research investigated the factors associated with childhood OW and OB, which are critical in the fight against the rising tide of NCDs globally. By mapping out and identifying the root causes, such as dietary practices, PA levels, and sociodemographic factors, we gain the power to prevent harmful weight gain in children in the first place. This not only helps enhance children's immediate health and well-being but also reduces their risk of developing chronic NCDs later in life.

This data informs the development of targeted preventative strategies by policymakers, healthcare professionals, and educators. For example, a link between high sugar intake and obesity might lead to school nutrition policies promoting healthier choices, while a connection between screen time and weight gain could inform physical activity programs. Ultimately, this research paves the way for evidence-based interventions that create a healthier future for our younger generations, helping to curb the alarming rise of NCDs and their associated burdens.

1.7 Assumptions of the study

This study posits that sampling from both public and private schools will strengthen the generalizability of the findings to the target population by achieving a more representative sample.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Childhood OW and OB are considered one of the greatest epidemiological challenges to global health systems in the 21st century. The WHO (2007) Growth Reference standards for Children and adolescents aged 5–19 years recommends classification for those whose BMI Z score of ≥1SD and ≥2SD of the median for age and sex as either overweight or obese, respectively. The phenomenon has reached pandemic proportions (Dabas & Seth, 2018; Memedi et al., 2013; Smith et al., 2020), gaining attention from researchers, policymakers, health workers, and other health agencies. OW and OB result from a disproportionate accumulation of body fat that may impair one's health (Omer, 2020). This could be due to a complicated interaction between genetic, metabolic, behavioral e.g. dietary practices, physical activity, alcohol and substance abuse and sedentary behavior, cultural e.g. viewing overweight children as healthy, environmental factors e.g. access to healthcare, life events e.g. pregnancy and illness, marketing, mental health, sleep, and stigma (Blüher, 2019; Sahoo et al., 2015; Bray et al., 2017).

Various forms of malnutrition, such as OB, OW, wasting, underweight, and stunting, collectively contribute to adverse health outcomes across all stages of life. Overnutrition is one of the most important risk factors to the occurrence of NCDs which not only increases households' income expenditure but also contributes to the increased risk of reduced quality of life and mortality (Cusumano et al., 2021; X. Fang et al., 2020; Garvey et al., 2016; Sahoo et al., 2015b). Several studies have recommended conducting additional anthropometric assessments to determine central obesity using WHR, as it is an invaluable

predictor of metabolic syndrome in children. The International Diabetes Federation (IDF) describes metabolic syndrome as a series of abnormalities, i.e., DM and pre-DM, abdominal OB, hyperlipidemia, and hypertension, which increase the risk of impaired cardiovascular health (Saif-Ali et al., 2020).

This literature review discusses empirical evidence pertaining to socioeconomic and demographic characteristics, dietary practices, PA, and their relationship with the occurrence of OW and OB, particularly amongst children. It also describes available evidence on comorbidities associated with overnutrition. The content discussed is drawn from individual studies, expert opinions, policy documents, narrative reviews, and systematic reviews of evidence. Featured articles were selected based on their coverage of OW and OB, related socioeconomic and demographic, dietary practices, PA, and related comorbidities.

2.2 Consequences of Childhood Overnutrition

The global economic burden due to obesity is also particularly high not only due to the loss in economic productivity but it is also estimated to account for approximately 2.8% of the world's Gross Domestic Product (GDP) or approximately 2 trillion US dollars expenditure (Swinburn et al., 2019). In children, OW and OB are particularly harmful as they increase the risk of developing NCDs. This is in part due to the pro-inflammatory and pro-oxidative state resulting from visceral fat accumulation. Adipose tissue is an endocrine organ whose functionality will be dysregulated by the excessive accumulation of fat cells seen in OW and OB, which contributes greatly to metabolic disease (Garvey et al., 2016). Hypertension in children is particularly destructive as it increases risk of other cardiovascular diseases in

adulthood (Amamilo et al., 2020; Moore et al., 2015). Additionally, it contributes to impaired psychosocial health, premature death and reduced quality of life. For instance, children have reported that the most frequent reason for bullying, teasing and stigmatization is their body weight. This could result in impaired social development and education as well as predispose the children to mental health problems, e.g., eating disorders, suicidal ideation, depression, etc. Exposure to weight stigma also impedes one's willingness to access health care (Danquah et al., 2020; Jebeile et al., 2022).

2.3 Socio-Economic and Demographic Factors

Since overweight and obesity are considered a 'lifestyle disease', it goes without saying that an individual's social life will influence its occurrence. Children from affluent backgrounds are more prone to being OW or O compared to children from low socio-economic (SE) groups in LMICs. This is partially because families from a higher SE background have succumbed to the nutrition transition where they have more access to an abundance of calorie-dense foods and a decrease in physical activity, e.g., through motorized transport (Gewa et al., 2022; Fruhstorfer et al., 2016a). Studies have pointed to the prevalence of OW and OB being higher in children from private schools compared to their counterparts in public schools (Mekonnen et al., 2018; Sadoh et al., 2017). For instance, a study conducted in Tanzania showed that the risk of developing overnutrition was 4.08 times higher in children in private schools compared to those in public schools (Mosha et al., 2021).

Children in boarding schools tend to be undernourished because of the poor diet quality and quantity. These tend to be low in energy and nutrients and high in anti-nutrients such

as phytates (Nicholaus et al., 2020; Serrem et al., 2020). Children from urban areas are at a higher risk of becoming OW or OB than those from rural areas (Adom et al., 2019). This is due to the increased access to calorie-dense, nutrient-deficient foods, increasing scarcity of open spaces for recreation, over-reliance on motorized transport e.g., using buses and motorbikes to get to schools, increased sedentary behavior exacerbated by improved access to technological advancements e.g. televisions, play stations and computers for entertainment (Danquah et al., 2020). Furthermore, video games and social media applications are presenting an unprecedented challenge to the occurrence of childhood obesity since they provide a platform through which targeted and unregulated advertising is driven (Staiano & Calvert, 2012; Tan et al., 2018). They serve as an important influencer in children's food preferences and consumption patterns.

2.4 Dietary Practices

Research has demonstrated that a diet lacking fruits and vegetables yet having high saturated fat, refined carbohydrates, salt, and total calories per meal is associated with an increased prevalence of OB (Grace et al., 2021). Furthermore, children are reporting an increased dependence on food prepared away from home (Wachira et al., 2020). Most countries in SSA are experiencing a nutrition transition. This is giving rise to an upsurge in NCDs amongst all population groups (Abrahams et al., 2011).

The WHO, through its report on 'time to deliver', made recommendations for the food system to create an environment free of persuasive and pervasive food marketing to children (*WHO NCDs Final Report*, n.d.). However, multinational companies (MNCs) are still finding innovative and efficient ways to push for these adverts e.g., through

advergaming. The advergames are paving the way for MNCs to circumvent the 'no aiming adverts at young children' legislation that is in place in some Western countries. There are no obligations to feature health warnings in advergames as they were not foreseen when the laws on food advertisement were being laid out (Dhimal et al., 2021; Staiano & Calvert, 2012; Truman & Elliott, 2019). Furthermore, governments' attempts to regulate commercial activities, such as imposing taxation on sugar-sweetened beverages or regulating subsidies on agriculture, are challenged and quashed by multinational food and beverage companies that have the resources and powers to do so (Swinburn et al., 2019).

Consumption of a high-fiber diet consisting of unrefined grains and pulses, fruits, and vegetables is linked to a decreased risk of developing OB (Abrahams et al., 2011). A case-control study conducted amongst adolescents showed that increased intake of fast foods and chocolates/sweets and decreased intake of fruits are associated with the occurrence of OB (Grace et al., 2021). In contrast, a study conducted amongst Children and adolescents in Kenya found that children who consume less healthy diets containing fast foods, potato crisps, and cakes/pastries are at a decreased risk of OW and OB (Wachira et al., 2020). Another study conducted among primary school students found that a reduction in the consumption of vegetables was significantly associated with childhood OW and OB, while there was no relationship with fruit consumption (Ali et al., 2020).

Practices that interfere with meal patterns and the quality of meals affect the nutritional intake, causing detrimental effects on body composition. A cross-sectional study seeking to determine risk factors for excess body fat found that dietary practices are a factor in the development of OW and OB (Telleria-Aramburu & Arroyo-Izaga, 2022). In the study,

university students exhibited unhealthy meal patterns, including skipping meals, irregular intervals between meals, and inadequate time spent on meals. Their findings demonstrated that these practices increased the likelihood of having excess body fat.

These data clearly show that dietary practices influence the body fat composition that predisposes individuals to overweight and obesity.

2.5 Physical Activity

Several international expert societies and health organizations, including WHO, the European Association for the Study of Obesity (EASO), and the National Institute for Health and Clinical Excellence (NICE), recommend at least 1 hour each day of MVPA for school-aged children (Weihrauch-Blüher et al., 2018). Inadequate levels of PA among children contribute to higher levels of overnutrition. Researchers have found that there is a decline in total PA at the age of 6 years (Schwarzfischer et al., 2019). The widespread use of advanced technology in various aspects of life has significantly contributed to a decrease in PA and increased SB, i.e., spending much time in a sitting, reclining, or lying position characterized by an energy consumption of ≤1.5 metabolic equivalents. In addition to using smartphones and computers to play video games and access their social media applications and television viewing, SGC is now relying on motorized transport to get them to and from schools (Adom et al., 2019; Vandoni et al., 2021). The increased screen exposure serves as a double-edged sword as it provides a platform for the pervasive marketing of junk foods and sugar-sweetened beverages (SSBs) that are dense in calories and poor in other nutrients. Furthermore, it also promotes mindless eating as well as a reduction in sleep

time, further aggravating the growing challenge of higher BMI (Jebeile et al., 2022; Schwarzfischer et al., 2019).

Rapid urbanization, coupled with poor urban planning, inadequate road safety, and perceived insecurity in new urban centers, has also resulted in the loss of recreational spaces, resulting in decreased physical activity (Jebeile et al., 2022). Despite cycling, walking, and public transport being cheaper modes of active transport, there has been a steady decline in their use. Furthermore, pupils spend most of their time seated in classrooms on weekdays with short breaks in between (Muthuri, et al., 2014). Increased sedentary behavior has been shown to increase the risk of CVDs and DM and worsen pro-social and behavioral behaviors (Mazur et al., 2022).

2.6 Identification of the Knowledge Gap

Adequate nutrition status is recognized as a critical contributor to the optimal cognitive, social, and physical development of the children in the target age group. However, data on the prevalence of the various forms of malnutrition in SGC are sparse (Lelijveld et al., 2023). Very few studies have assessed the dietary practices, PA, OW, and OB in many parts of Kenya, particularly amongst children aged 8 - 11 years. This study sought to assess the sociodemographic factors, dietary practices, and PA and their influence on the occurrence of OW and OB among SGC aged 8 - 11 years in Thika town, Kiambu County, Kenya.

2.7 Theoretical Framework

Understanding the root causes of childhood obesity demands a multifaceted approach that considers both individual and environmental factors. The Socio-Ecological Model (SEM) provides a valuable framework, highlighting the interplay between these levels (Sallis et al., 2006). On the individual level, the SEM acknowledges the role of genetics, metabolic variations, and even psychological factors that can influence a child's susceptibility to weight gain (Wang et al., 2016). For example, some children may be genetically predisposed to store calories more efficiently, making them more vulnerable to obesity in obesogenic environments.

The SEM doesn't stop at individual biology; it delves into the surrounding environment. Factors like access to healthy and affordable food options, opportunities for PA in schools and neighborhoods, and cultural attitudes toward food and body image all play a significant role (Story et al., 2009). Research suggests that children living in food deserts with limited access to fresh fruits and vegetables, coupled with a culture emphasizing processed foods and sedentary leisure, are at an increased risk of developing obesity (Powell et al., 2007).

However, the SEM doesn't fully explain individual differences in response to these environmental influences. Here, the behavioral susceptibility theory offers additional insights. This theory proposes that some children are inherently more susceptible to weight gain due to their behavioral responses to environmental cues (Carnell & Wardle, 2008). For example, a child with high behavioral susceptibility might find it harder to resist readily available sugary snacks compared to a child with lower susceptibility. Additionally, the

theory suggests that certain parenting styles or emotional states can influence a child's susceptibility.

By combining these frameworks, we gain a more comprehensive picture of childhood obesity. The SEM identifies the broader environmental influences, while the behavioral susceptibility theory refines our understanding of individual differences in response to these influences. This knowledge is crucial for designing effective interventions. We can address environmental factors through policy changes and community initiatives while recognizing that some children might require additional support to make healthy choices within those environments.

2.8 Conceptual Framework

The following conceptual framework demonstrates the factors of interest that contribute to childhood overnutrition.

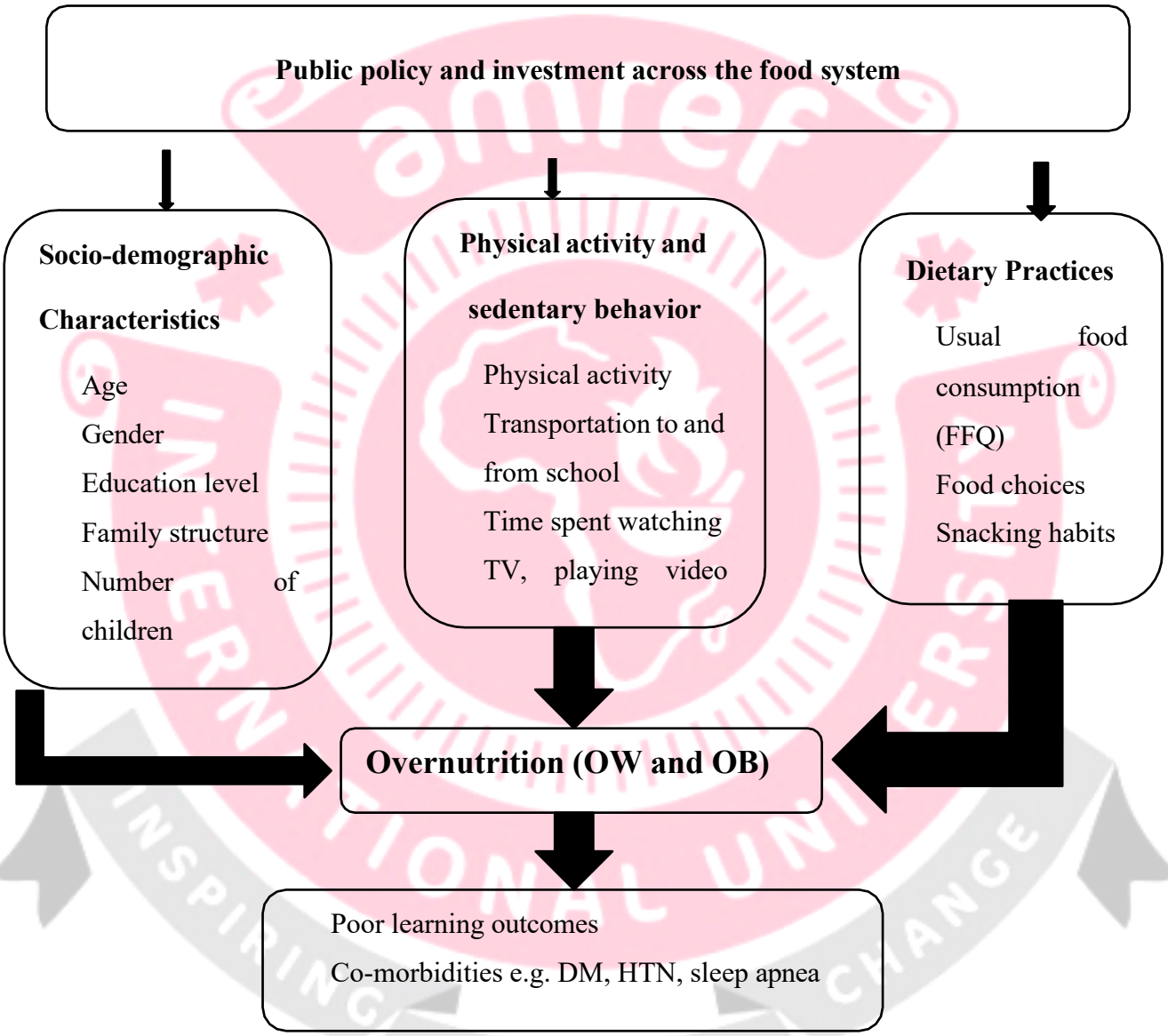

Figure 2.1 Conceptual Framework on the Causes of Overnutrition

CHAPTER 3: METHODOLOGY

3.1 Introduction

This section discusses the materials and methods that were used in the study. It outlines the research methods, including the study population, site, variables examined, and tools used for data gathering. It covers the sampling techniques and processes, analytical approaches for the collected data, and ethical principles guiding the survey.

3.2 Research Design

The study applied a cross-sectional quantitative study design. Both descriptive and analytical methods were employed to describe and investigate relationships between the occurrence of overnutrition and sociodemographic characteristics, physical activity, and dietary practice. The cross-sectional approach worked well for this study since it allowed gathering data on numerous factors simultaneously for analysis. Descriptive methods were useful in the assessment of frequency and distribution of the variables, while analytical methods were used to examine associations between the variables.

3.3 Variables Description

The study aimed at investigating the dietary practices, PA and overnutrition among SGC. The dependent variable for the study was overnutrition (OW/OB). It was assessed using the weight and height of the children and interpreted using WHO's BMI for age and sex z-scores for individuals aged 5-19 years. The independent variables for the study were socio-demographic factors, PA level and dietary practices. National and facility health policies

were considered intervening variables in this study. Socio-demographic variables investigated included age, gender, and the type of school the pupils attend. Dietary practices were assessed through a seven-day food frequency questionnaire. A validated PA questionnaire for older children (PAQ-C) was used to assess PA (Kowalski et al., 2004). The amount of time spent watching TV, or playing video games, computer games, or browsing the internet or playing hand-held games was used to assess sedentary behavior.

3.4 Study Setting

The study was conducted in the Thika Town Constituency of Kiambu County, which has over 2.4 million people, according to Kenya's 2019 census. Thika West Subcounty is an urban setting and one of the most populous in the county, with 79,125 children over 3 years old recorded in school. The Constituency has 110 primary schools: 86 private and 24 public. The study was also conducted in 5 primary schools in the Thika West sub-county.

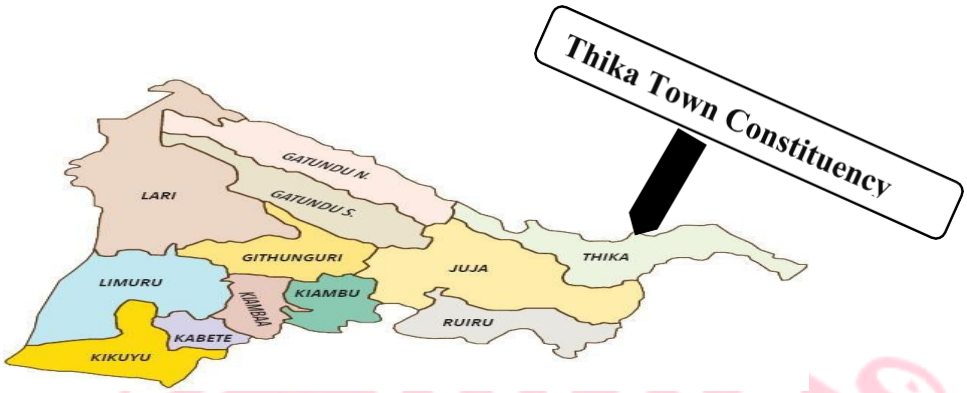

Figure 3.1 Map of Kiambu County

Source: Kiambu County Government https://kiambu.go.ke/about-us/#3

3.5 Target Population

The study targeted SGC 8 - 11 years of age old in Thika West Subcounty. The respondents included both the pupils and their parents. The children included were those whose parents live in Thika Town Constituency and provided written consent for their involvement in the study. They were also obliged to assent to being involved in the study. The study excluded boarding schools as their dietary choices are restricted to that which is provided by the institution, sick or injured during the study period or those with conditions that impede PA e.g., those on a wheelchair or requiring assisted walking. Children whose home residence was not Thika town constituency were also excluded since their predisposition to various food items varies by geographical region. The participants' place of residence was determined from the school records.

3.6 Sample Size

The Open-Epi version 3.01 (Open Epidemiological Statistics for Public Health) statistical programme was used to calculate the sample size under the following presumptions: Pupil

population in Thika Town Constituency 41793 as of July 2022 according to the Thika Sub-county education office; with a 21% frequency of OW and OB derived from study finding by Gewa et al., 2022; a 95% level of confidence, a margin of error of 5% and a design effect of 1.0. This brought the estimated sample size to 253 participants. To increase statistical power and account for non-response from the parents and incomplete responses by the children, an additional 10% was included, making the final sample size of 281 participants.

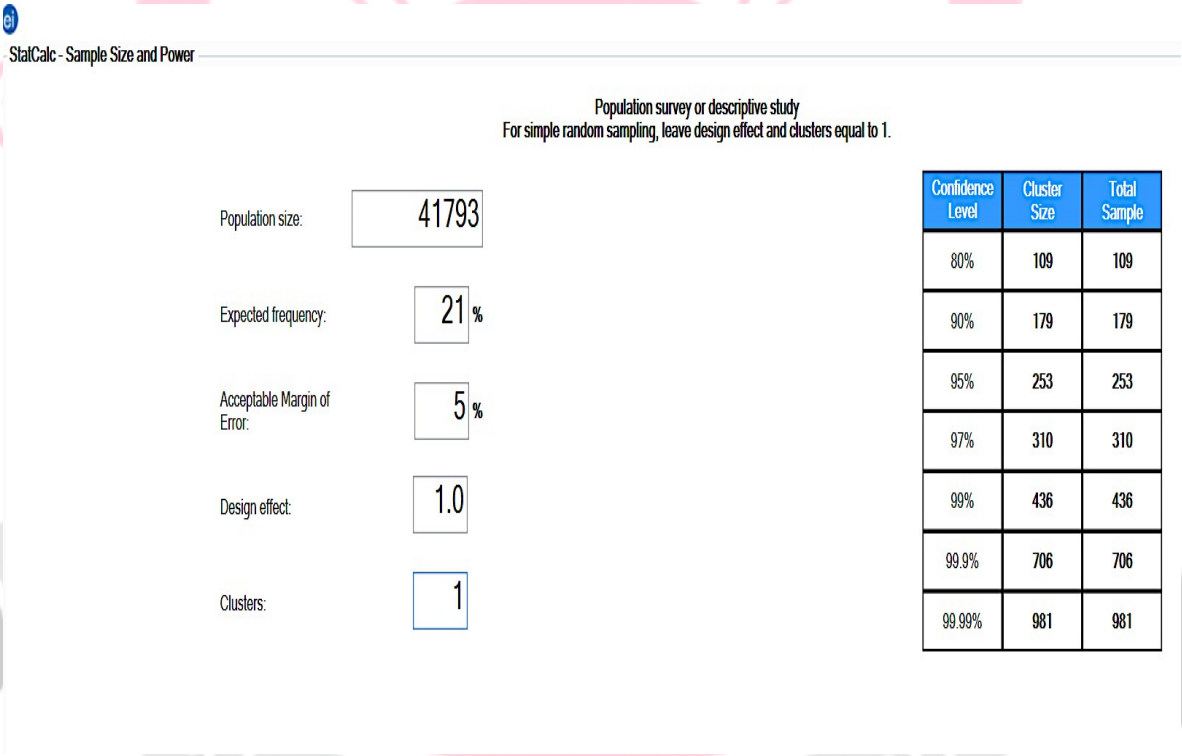

Figure 3.2 Sample Size Calculation Using Epi Info

3.7 Sampling Procedures

The study used multistage sampling. According to the information provided by the Sub-County Directorate of Education, Thika West Subcounty, there are 50 private primary

schools with a population of 19672 pupils and 24 public primary schools with a population of 22865 pupils.

Table 3.1: Pupils Population in Primary School in Thika West Sub-County

School category	Student population	% of the total population
Private	19672	46
Public	22865	54
Total	**42537**	**100**

Source: (Sub- County directorate of education, Thika west subcounty, 2023)

The specific number of participants in each stratum were as follows:

Neyman's equation was used to determine stratum specific sample sizes:

$$n_h = (Nh / N) * n$$

Where, n_h (sample size for stratum h), Nh (population size for stratum h), N is the total population size, and n is the total sample size.

$n_{(private)}$= (19672/42537) 279=129

=129 pupils

$n_{(public)}$= (22865/42537) 279=149.97

=150 pupils

Table 3.2: Sampling of Pupils from Private and Public Primary Schools

School category	Student population	% of the total population	Sample	
Private	19672	46	129	148 (115%)
Public	22865	54	150	135 (90%)
Total	**42537**	**100**	**279**	**281**

Five schools (2 public and 3 private) were selected at random for inclusion in the study to enable the computation of an adequate sample size from the two strata. The names of the schools were entered in Microsoft Excel 2021 stratifying into either public or private. With the assistance of the school headmasters, classes with children aged 8-11 were identified and consent forms were randomly issued to them through balloting.

3.8 Validity and Reliability of Data Collection Instruments

To ascertain the reliability of the data collection tools, a pre-test study was carried out with thirty pupils from Thika East sub-county. The results were analyzed, and internal consistency tests were performed to determine the reliability. Face and content validity were also adopted to establish the validity of the research tools. To establish face validity, the researcher examined the instruments to determine whether they measured the variables appropriately. The researcher engaged expert biostatistics and epidemiological researchers to establish content validity. Three experts evaluated the instruments and verified their ability to measure the variables under study.

3.9 Data Collection Procedures

The study employed researcher-administered electronic-based questionnaires using the Kobo toolbox and Kobo collect mobile application. The researcher was assisted in conducting structured interviews by research assistants who were trained in the data collection procedures. The researchers obtained assent from the pupils whose parents consented for them to participate after obtaining authorization from the school's administration and written consent from the guardians/parents.

The questionnaire was structured into various sections to obtain information on sociodemographic characteristics, dietary practices, PA, and nutrition status among the respondents. The first section constituted questions about the respondents' socio-demographic factors. The subsequent sections were structured to collect data on the children's sedentary behaviors, PA, and dietary practices. The last section was used for nutrition assessment.

3.9.1 Dietary Practices

Dietary practices were assessed using a 7-day FFQ comprising of 108 food items categorized under various food groups. The questionnaire adopted the ten food groups outlined in the minimum dietary diversity for women (MDDW) (i.e., grains, white roots, and tubers and plantains, pulses, nuts and seeds, milk and milk products, meat, poultry and fish, eggs, dark green leafy vegetables, other vitamin A rich fruits and vegetables, other vegetables and other fruits) and an additional three food groups (fried and salty foods, sweet foods, and sugar-sweetened beverages) to take into consideration consumption of

unhealthy foods that increase risk of OW, OB and diet-related NCDs. The scales for frequencies of consumption included; once/day, ≥twice/day, 1-3 times/week, 4-6 times/week, and never. A table was used to show the frequency of intake for each food. The food frequency data of food items within the food groups was summed up to produce a frequency of consumption per food group to allow for comparisons. This was achieved through summing up the counts of consumption of each food in the group. The denominator was the total counts of consumption for the 101 food items by all the respondents.

Additionally, dietary diversity score was also used as an indicator to interpret the results. For this, the study adopted the ten food groups and a cut-off point of 5 used in the MDDW. Consumption of any food item within a food group earned a score of 1 and if not consumed, scored 0.

3.9.2 Sedentary Behaviors, Moderate and Vigorous PA

Sedentary behaviors were assessed by asking questions related to the frequency and average time spent watching TV, using computers to play video games or for non-school activities and time spent sitting alone or with friends e.g., to read, both on weekdays and weekends. The WHO has not set a precise cut-off for sedentary or recreational screen time due to low certainty evidence (Chaput et al., 2020). However, the Australian Institute of Family Studies (AIFS) and the PA and sedentary behavior guidelines for Chinese people recommend that children 5 – 17 years should limit screen-based sedentary activities to less than 2 hours each day (Joshi & Hinkley, 2021; Chen et al., 2022). Most SSA countries do not have national plans or strategies to limit screen time SBs in the population (Ojedoyin et al., 2022). Therefore, we used this (2 hours) as the cut-off for the sedentary activities.

Assessment of PA was completed subjectively by adopting the PAQ-C questionnaire (Kowalski et al., 2004). It is an appropriate tool for assessing the overall levels of PA throughout the earlier school years for students in grades 4 to 8 and approximately in children 8 to 14 years of age. It consists of ten questions each assessing different aspects of physical activity. It was completed by assessing the children's, frequency of participation in various activities in their spare/leisure time (e.g., jogging, walking for exercise, skipping rope, playing tag, '*bladder'*, '*kati'*, table tennis, football, hop, step and jump, hide and seek, cycling, volleyball, handball, netball), perceived level of PA during physical education (PE) classes, activities they participated in during break time and on lunch breaks (other than eating), number of days in the past week they had engaged in PA in the evenings, and immediately after school as well as the number of times they engaged in PA on weekends. We adopted activities that reflect the actual situation for a typical Kenyan child. They were also asked to describe their perception on their level of PA.

The responses from these questions were used to derive a summary score by calculating the average of the composite score of the nine items assessed. Per the protocol, a PAQ-C score of 1 and 5 was used to denote low and high PA, respectively. The study also adopted the cut-off points of ≥2.75 to discriminate > 60 minutes of MVPA (Lupo et al., 2022). The pupils were also asked questions about having and participating in PE sessions and walking to school.

3.9.3 Nutrition Status

Nutrition status was assessed using weight, height, and standardized indicators and reference cut-off points for interpretation. Height and weight were assessed using a

portable SECA stadiometer and SECA digital weighing scale to the nearest 0.1cm and 0.1kg, respectively. Before conducting the weight measurements, the scale was placed on a level and hard surface and calibrated to zero. Participants were then requested to stand still at the center of the weighing machine with the weight evenly distributed on both feet while looking ahead and their hands hanging loosely at their sides. The stadiometer was positioned on a firm, flat surface so that the participant's body could be properly aligned with the measurement device during the assessment. They were then requested to stand upright on the footboard of the stadiometer with their weight dispersed equally over both feet, take a deep inhalation, and the sliding headboard to the vertex of their head to obtain their height reading. The participants were required to remove any heavy and thick clothing, shoes, and items, e.g., chunky watches, to increase the accuracy of the anthropometric measurements.

Table 3.3: WHO Classification of Nutrition Status According to BMI for Age Z-Scores for Children 5 - 19 Years

BMI-for-age (5-19 years) – WHO interpretation of cut-off points	
BMI for age Z-score	**Interpretation**
<− 3 SD	Severe underweight
<-2 SD	Underweight
>-2 SD to <1 SD	Normal/adequate weight
>+1SD	Overweight
>+2 SD	Obesity

3.10 Training of Research Assistants

The researcher was assisted by research assistants who had a background in nutrition and dietetics and were well versed with the field of nutrition research. A two-day training was conducted to ensure a standardized way of collecting the required data. The training

covered, appropriate procedures on administration of children's assent forms, questionnaires, anthropometric measurements, professionalism, research ethics, as well as data quality assurance and management.

3.11 Data Management and Analysis

To ensure the data quality is controlled, measures were taken at every step starting with training of research assistants, calibrating machines, and standardizing methods. After collection, data was coded, entered, and cleaned then analyzed using Statistical Packages for Social Sciences (SPSS) version 25. Descriptive statistics and inferential statistics were used to describe the data. BMI for age and sex Z-scores were calculated using Epi info version 3.5.4 and interpreted per the WHO reference standards. Measures of central tendency, frequencies, and proportions were used in describing the continuous variables. Inferential statistical tests used included chi-square tests and Fischer's exact tests to assess the association between childhood overnutrition and the independent variables. Multivariate logistic regression analysis to estimate odds ratios for factors that showed statistical association at the bivariate level was used. These methods were used to evaluate relationships between the dependent and independent variables, where a p-value <0.05 was considered significant. This data was presented in tables and figures.

Table 3.4: Summary of Data Collection and Analysis Plan

Objective	Data collected	Analysis Done
Objective 1: To determine the dietary practices	• Frequency of consumption of food items on a scale of not consumed, 1-3 times per week, 4-6 times per week, once/day and ≥2 times/day.	Descriptive analysis: • Proportions, percentages, and ratios. • Cross-tabulations • Measures of central tendency • Measure of association (Chi-square/Fischer's exact test)
Objective 2: To determine the SB and PA levels.	• Number of days and average duration of watching TV, using computers for non-school activities and sitting (reading or with friends/family) on weekdays and average duration of watching TV, using computers for non-school activities and sitting (reading or with friends/family) on weekends. • Ten questions each assessing different aspects of physical activity for the children during leisure time per the PAQ-C protocol.	• Proportions, Percentages, and ratios. • Cross-tabulations • Measures of central tendency • Measure of association (Chi-square/Fischer's exact test)
Objective 3: To determine the study nutrition status	• Physical measurements (height, weight)	Descriptive analysis: • Proportions, Percentages, and ratios. • Cross-tabulations • Measures of central tendency • Measure of association (Chi-square/Fischer's exact test)
Objective 4: To examine the association between OW and OB and sedentary behaviours, physical activity, and dietary practices.	• Relating OW and OB and the risk factors included in the study.	• Measures of association (Chi-square/Fischer's exact test) • Binary logistic regression

3.12 Ethical Considerations

Ethical requirements were adhered to by first obtaining approval from Amref's Ethics and Scientific Review Committee (ESRC), Ref: AMREF-ESRC P1345/2022. A permit to conduct research was granted by the National Commission for Science, Technology, and Innovation (NACOSTI), Ref: NACOSTI/P/23/23280. The researcher also obtained permission and approval from the Thika West Sub-County Government through the Ministry of Education. Further, research approval was also obtained from the ministry of Education through the permanent secretary's office. Approval was also sought from the administrators of the schools sampled to participate in the study.

The parents/guardians authorized through written consent for their children to participate in the study. Comprehensive information relating to the study was provided through the consent forms to the parents of the pupils to enable them to decide whether to participate by signing them. The children whose parents consented were also required to assent to participate in the study. Furthermore, a separate area designated by the school's administrator was used when collecting data from the pupils who assented to participate to ensure their privacy. The data was gathered at times that didn't overlap with crucial school events or examinations. The children were made aware of their option to withdraw from the study at any point., without facing any repercussions.

Confidentiality was maintained by using codes on the questionnaires, and no personal information was collected. During the reporting of the findings, schools were described in a general manner without specifying a particular school. Additionally, access to the data collected was limited to the researchers who signed the data confidentiality agreement

forms. No monetary compensation was accorded to the pupils involved in the study. The Covid-19 guidelines were adhered to during the entirety of conducting the study.

3.13 Limitations of the Study

This study acknowledges several limitations:

i. The study did not explore potential determinants of childhood overnutrition arising from genetics or early life feeding habits.
ii. The study's sample was restricted to schools, children, and caregivers/parents who consented to participate. This introduces the possibility of selection bias, potentially limiting the generalizability of the findings to the broader target population.
iii. The study also relied on self-reported data when assessing physical activity and dietary practices. In this regard, the possibility of recall bias could not be ruled out.

CHAPTER 4: RESULTS

4.1. Introduction

This study investigated the dietary practices, PA, and overnutrition among school-going children aged 8 - 11 years in Thika town, Kiambu County, Kenya. This chapter outlines the study results based on the research objectives.

4.2. Socio-Demographic Characteristics

This section presents the findings regarding the socio-demographic characteristics of the participants that were analyzed. These included age, grade, gender, and type of school and are summarized in Table 4.1. Nearly half, 42.3% (n=119), of the respondents were 10 years old. Over half of the respondents i.e., 55% (n=155) were girls, and 45% (n=126) were boys. Respondents were drawn from both public and private schools. More than half, 52% (n=146) of the respondents attended private schools, while 48% (n=135) from public schools. More than half of the respondents were from grade five, i.e., 51.9% (n=147).

Table 4.1 Social Demographic Characteristics of the Pupils

Social Demographic Characteristic	Response	Frequency	Proportion (%)
School type	Private	146	52.0
	Public	135	48.0
Age in Years	8	5	1.8
	9	90	32.1
	10	119	42.3
	11	67	23.8
Gender	Male	126	44.8
	Female	155	55.2

4.3. Dietary Practices

The appendices (Appendix I) provide a more detailed table on the frequency of consumption of the 108 food items in the week preceding the study. Table 4.2 provides a summary of the frequency of consumption of all food items within food groups to allow for comparison amongst the food groups. Compared to other food groups, the grains, white roots and tubers, and plantains group had the highest consumption frequencies (19.2%). Conversely, the eggs group had the least frequency of consumption (1.7%).

Table 4.2 Frequency of Food Items Consumption Per Food Group

Food Group	Food items	n	%
Grains, white roots and tubers and plantains	Maize (githeri, muthokoi) and maize meal (*ugali*), porridges, wheat (chapati, bread), arrowroots, cassava, green bananas, pasta, porridge, pasta, breakfast cereal, white-fleshed sweet potato	2482	19.2
Deep fried and salty foods	Kebabs, fried chicken, chips, sausages, burgers, doughnuts, mandazi, samosa, pizza, hotdog, crisps, ringos, corn puffs, popcorn,	1549	12
Sweet foods, sugar sweetened & caffeinated beverages	Table sugar, sugar cane, honey, candies, chocolate, ice cream, yoghurt, soda, Yu Fresh, lemonade and ribena and energy drinks (predator, Power Play, monster, Red Bull)	1358	10.5
Other fruits	Avocado, pineapples, apples, oranges, tangerines, grapes, ripe bananas, watermelon, thorn melon.	1288	10
Dark green leafy vegetables	Spinach, kales (*sukumawiki*), *kunde*, black African nightshade (*managu*), amaranthus, stinging nettle (*thafai*), pumpkin leaves (*matawi ya malenge/riseveve*), broccoli, spider weed (*saget/sagaa)*	1082	8.4
Pulses	Beans, cow peas, dolicos beans (*njahi*), green grams (*ndengu*), lentils (*kamande*),	994	7.7
Vit A fruits and vegetables	Mangoes, pawpaw, passion fruits, Carrots, pumpkins, butternuts, orange-fleshed sweet potato	897	6.9
Meats, poultry and fish	Beef, goat meat, mutton, rabbit, chicken, turkey, quail, ducks, *omena*, tilapia, fish balls, organ meats (liver, kidney, heart)	850	6.6
Other vegetables	French beans (*michiri*), okra, dhania, broccoli, eggplant, cabbages, cauliflower,	778	6
Fats and oils	Vegetable oil, palm oil, margarine, ghee, butter	580	4.5
Nuts and seeds	Groundnuts, macadamia, cashew nuts, sesame	491	3.8
Milk and milk products	Fresh milk, cheese, unsweetened fermented milk (mala), *mursik*	367	2.8
Eggs	Eggs (chicken, quail)	220	1.7
Total		**12936**	**100**

*n=Number of times the items in each food group was consumed in the past 7 days preceding the data collection.

*The denominator (N) is the summation of n for all the food groups.

All the respondents consumed foods drawn from grains, roots and tubers, dairy, and other fruits food groups in the week preceding the survey as shown in Figure 4.1. A high consumption of pulses (93%, n=277), nuts and seeds (93%, n=261), meat, poultry, and fish (98%, n=275), dark green leafy vegetables (99%, n=277) as well as other fruits and vegetables (98%, n=274) was reported among the respondents. Although a substantial proportion reported consuming eggs, it was the least consumed food group, with 83% (n=234) of the respondents stating that they had consumed them in the preceding week.

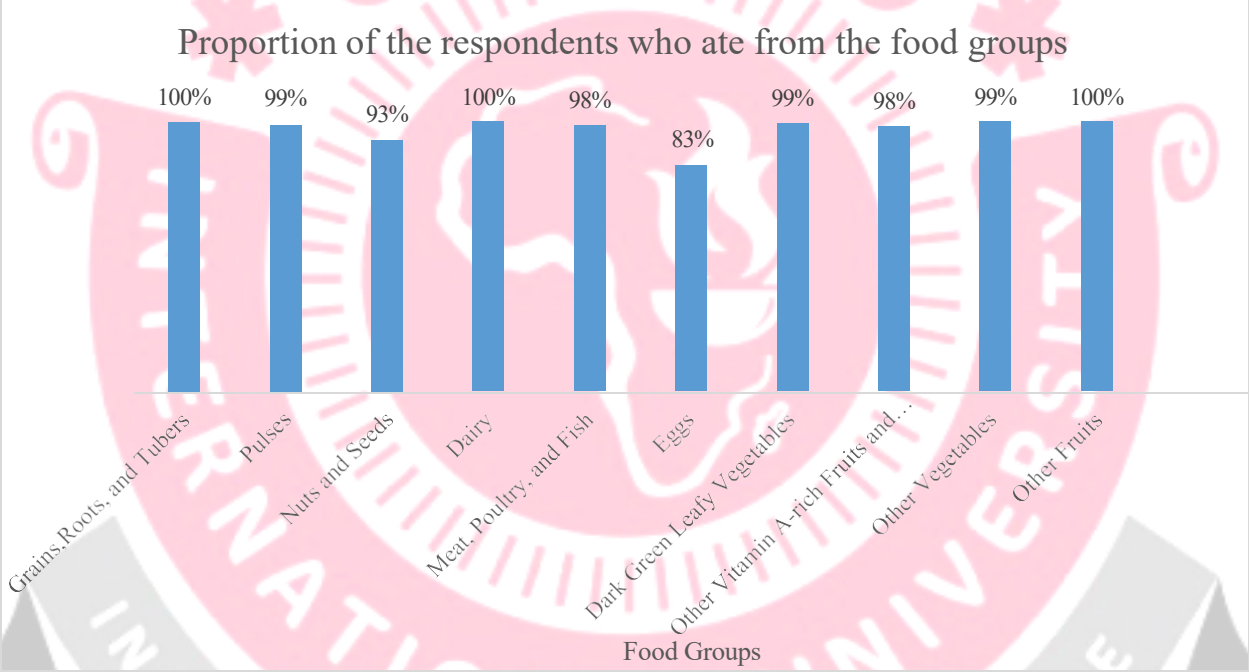

Figure 4.1 Food Group Consumption among Respondents

On further analysis, the results demonstrated that all the respondents had met the minimum dietary diversity score of 5 for the week preceding the survey.

4.4. Sedentary Behaviours

The study assessed the respondents' level of sedentary activity by examining the time spent watching TV and playing video games as well as time spent sitting on weekdays and weekends. The least popular sedentary activity on weekdays was using computers to play video games, as most respondents (63.4%, n=178) indicated that they had not spent any time undertaking the activity in the week preceding the study. The results of each aspect of sedentary activity are outlined below.

4.4.1. Watching TV

The respondents were asked how many days and the average number of hours they spent watching TV after school on weekdays. Over half of the respondents (58.0%, n=163) indicated watching TV every day after school, while 14.6% (n=41) reported not watching TV on any of the weekdays as shown in Table 4.3.

Of those who reported watching TV, 80% (n=192) had spent less than 2 hours watching television.

Table 4.3 Days and Time Spent Watching TV on Weekdays

	Number of days	**Frequency**	**Percent**
Days respondents watched TV.	0	41	14.6
	1	7	2.5
	2	27	9.6
	3	23	8.2
	4	20	7.1
	5	163	58.0
	Total	**281**	**100**
	Number of hours	**Frequency**	**Percent**
Average time spent watching TV.	Less than 2 hours.	192	80
	Spent > 2 hours.	48	20
	Total	**240**	**100**

A majority, 84% (n=110) of the female respondents who watched TV on weekdays on average watched TV for less than 2 hours, as shown in Table 4.3. For most of the male respondents who watch TV on weekdays, 75% (n=82), on average, spend less than 2 hours. Chi-square tests showed no significant association between gender and time spent watching TV (p= 0.92). On average, most of the respondents 88% (n=112) from private schools who watched TV on weekdays spent less than 2 hours. Of the public-school respondents who watch TV on weekdays, 71% (n=80) watch for less than 2 hours. Chi-square tests showed a significant association between school type and time spent watching TV (p= 0.001).

Table 4.4 Association of Time Spent Watching TV on Weekdays with Gender and School Type

Sedentary Activity	Social Demographic Characteristic		Response	n	%	χ2	P Value
Average time spent watching TV on weekdays	Genders	Male	Less than 2 hours.	82	75	2.841	0.092
			Spent >2 hours.	27	25		
		Female	Less than 2 hours.	110	84		
			Spent >2 hours.	21	16		
	School type	Public	Less than 2 hours.	80	71	11.305	**0.001**
			Spent >2 hours.	33	29		
		Private	Less than 2 hours.	112	88		
			Spent >2 hours.	15	12		

4.4.2. Time spent using computers playing video games or for non-school activities.

As Table 4.5 shows, using computers to play video games, watch shows, or do non-school activities was not popular among the respondents since more than half 63.4% (n=178)) indicated that they did not use them. Of those who used them, most 90.3% (n=93) spent 2 hours or less, while the remainder used them for longer.

Table 4.5 Days and Time Spent on Computers to Play Video Games or for Non-School Activities on Weekdays.

	Number of days	Frequency	Percent
Days they used computers to play video games or for non-school activities.	0	178	63.4
	1	33	11.8
	2	26	9.3
	3	19	6.8
	4	5	1.8
	5	20	7.1
	Total	**281**	**100**
	Number of hours	**Frequency**	**Percent**
Average time spent on computers to play video games or for non-school activities.	Less than 2 hours.	93	90.3
	Spent > 2hours.	10	9.7
	Total	**103**	**100**

Most of the female respondents, 89% (n=50), who used computers to play video games, watch shows, or for non-school activities related activities on weekdays used them for less than 2 hours. while 11% (n=6) of them spent more than 2 hours. Of the male respondents who used computers to play video games, watch shows or for non-school activities on weekdays, 91% (n=43) used them for less than 2 hr. while the remainder used them for more than the recommended time. However, a chi-square tests showed no significant association between gender and time spent using computers to play video games, watch shows or for non-school activities (p= 0.707). Furthermore, there was no significant association between school type and period spent on computers playing video games or for other non-school related activities (p= 0.294) as presented in Table 4.6.

Table 4.6 Association of Time Spent on Computers to Play Video Games, Watch Shows or for Non-School Activities on Weekdays with Gender and School Type.

Sedentary Activity	Demographic Characteristic		Response	n	%	χ2	P Value
Average time spent on computers to play video games or for non-school activities on weekdays.	Gender	Male	Less than 2 hours.	43	91	0.142	0.707
			Spent >2 hours.	4	9		
		Female	Less than 2 hours.	50	89		
			Spent >2 hours.	6	11		
	School type	Public	Less than 2 hours.	31	86	1.103	0.294
			Spent >2 hours.	5	14		
		Private	Less than 2 hours.	62	93		
			Spent >2 hours.	5	7		

4.4.3. Time spent reading or sitting alone or with friends or family.

The respondents were asked to state how much time they spent reading or just sitting with their friends and family, as illustrated in Table 4.7. More than half, 54.5% (n=153), indicated that they spent some time sitting with friends and family every weekday, while 4.63% (n=13) did not spend any time sitting with friends and family. Of those who spent time sitting with friends and family or reading, 85.4% (n=229) on average spent less than 2 hours sitting while 14.6% (n=39) spent more than the recommended time.

Table 4.7 Days and Time Spent Reading or Sitting Alone or With Friends or Family.

	Number of Days	**Frequency**	**Percent**
Days spent reading or sitting alone or with friends or family	0	13	4.6
	1	17	6.1
	2	43	15.3
	3	35	12.5
	4	20	7.1
	5	153	54.5
	Total	**281**	**100**
	Number of Hours	**Frequency**	**Percent**
Average time spent reading or sitting alone or with friends or family	Less than 2 hours.	229	85.4
	Spent > 2hours.	39	14.6
	Total	**268**	**100**

As shown in Table 4.8, the majority of the female respondents, 84% (n=124), who spent time sitting alone or with family or reading on weekdays on average spent less than 2 hours. while 16%(n=24) of them spent more than 2 hours. 88% (n=105). Of the male respondents who spent time sitting alone or with family or reading on weekdays on average spent less than 2 hours. while 13%(n=15) of them spent more than 2 hours. Chi-square tests showed no significant association between gender and time spent reading or sitting alone or with friends or family (p= 0.391). On average, 89% (n=124) of the respondents from private schools who spent time sitting alone or with family or reading on weekdays spent less than 2 hours. Most of the male respondents 82% (n=105) who spent time sitting alone or with family or reading on weekdays spent less than 2 hours. Chi-square tests showed no significant association between school type and time spent reading or sitting alone or with friends or family (p= 0.129).

Table 4.8 Association of Average Time Spent Sitting and Reading with Gender and School Type.

Sedentary Activity	Demographic Characteristic		Response	n	%	X2	P Value
Average time spent reading or sitting alone or with friends or family	Gender	Male	Less than 2 hours.	105	88	0.736	0.391
			Spent >2 hours.	15	13		
		Female	Less than 2 hours.	124	84		
			Spent >2 hours.	24	16		
	School type	Public	Less than 2 hours.	105	82	2.3	0.129
			Spent >2 hours.	23	18		
		Private	Less than 2 hours.	124	89		
			Spent >2 hours.	16	11		

4.4.4. Sedentary Activities on Weekends

Table 4.9 summarizes sedentary activities on the weekends. The respondents were asked to indicate the amount of time they spent doing the sedentary activities of watching TV, using computers to play video games, watch shows or for non-school activities and sitting with friends and family or reading on weekends, i.e., Saturday and Sunday. The majority (63.7%, n=179) on average spent less than 2 hours each day on the weekend while 36.3% (n=102) spent more than 2 hours.

When asked how much time they spent using computers play video games, watch shows or for non-school activities, 179 respondents (63.7%) played video games for less than 2 hours. while 36.3% (n=102) played video games for more than 2 hours. When asked how much time they spent sitting with friends or reading on weekends, 93.6% (n=263) spent less than 2 hours. time while 6.4% (n=18), spent more than 2 hours sitting.

Table 4.9 Sedentary Activity on Weekends

	Time in Hours	**Frequency**	**Percent**
Average duration spent watching TV.	Less than 2 hours.	179	63.7
	Spent >2 hours.	102	36.3
	Total	**281**	**100**
	Number of Hours	**Frequency**	**Percent**
Average duration spent on computers to play video games or for non-school activities.	Less than 2 hours.	265	94.3
	Spent >2 hours.	16	5.7
	Total	**281**	**100**
	Time in Minutes	**Frequency**	**Percent**
Average duration spent reading or sitting alone or with friends or family	Less than 2 hours.	263	93.6
	Spent >2 hours	18	6.4
	Total	**281**	**100**

Chi-square tests on the various sedentary activities on weekends and school type and gender showed a significant association between school type and time spent watching TV on weekends (p= 0.002). The test also showed a significant association between gender and duration spent using computers to play video games, watch shows or for non-school activities (p=0.048). This is presented in Table 4.10.

Table 4.10 Association of Time Spent on Sedentary Behavior with Gender and School Type.

Sedentary Activity	Demographic Characteristic		Response	n	%	χ2	P-Value
Average duration spent sitting or reading on weekends	Gender	Male	Less than 2 hours.	120	95	1.029	0.31
			Spent >2 hours.	6	5		
		Female	Less than 2 hours.	143	92		
			Spent >2 hours.	12	8		
	School type	Public	Less than 2 hours.	129	96	3.056	0.8
			Spent >2 hours.	5	5		
		Private	Less than 2 hours.	134	91		
			Spent >2 hours.	13	9		
Average duration spent watching TV on weekends	Gender	Male	Less than 2 hours.	76	60	1.131	0.288
			Spent >2 hours.	50	40		
		Female	Less than 2 hours.	103	66		
			Spent >2 hours.	52	34		
	School type	Public	Less than 2 hours.	73	54	9.424	**0.002**
			Spent >2 hours.	61	46		
		Private	Less than 2 hours.	106	72		
			Spent >2 hours.	41	28		
Average duration spent on computers to play video games or for non-school activities.	Gender	Male	Less than 2 hours.	115	91	3.922	**0.048**
			Spent >2 hours.	11	9		
		Female	Less than 2 hours.	150	97		
			Spent >2 hours.	5	3		
	School type	Public	Less than 2 hours.	125	93	0.499	0.48
			Spent >2 hours.	9	7		
		Private	Less than 2 hours.	140	95		
			Spent >2 hours.	7	5		

4.5. Moderate to Vigorous Physical Activity

This section summarizes the level of engagement of the respondents in moderate to high PA.

4.5.1. Number of days pupils participated in physical education (PE) classes in school.

Respondents were asked to state how PE classes they participated in PE classes at school in a week. The results are shown in Table 4.11. About 13.5% (n=38) did not participated in PE classes. More than a third of the respondents (37.4%, n=105) participated in PE on one day while 12.8% (n=36) participated in PE classes every day of the school week.

Table 4.11 Number of Days Pupils Engaged in PE.

	Number of days	Frequency	Percent
No. of days respondents participated PE classes in a week	0	38	13.5
	1	105	37.4
	2	45	16.0
	3	43	15.3
	4	14	5.0
	5	36	12.8
	Total	**281**	**100**

4.5.2. Estimated length of the PE sessions

The majority of the respondents who had PE sessions, 79.8% (n=194), reported having the sessions lasting about 35 minutes as shown in Table 4.12. The mean duration of the PE sessions recorded by the respondents was 33.92 (±13.03) minutes, while the mode and the median length were 35 minutes.

Table 4.12 Estimated Duration of each PE Session.

	Duration	Frequency	Percent
Duration of each PE session	35	194	79.8
	≥40 minutes	49	20.2
	Total	**243**	**100**

4.5.3. Walking to School

The participants were asked if they walked to school and the time, they took to reach school and the results are summarized in Table 4.13. More than half (65.5%) walked to school with 38% walking for more than half an hour.

Table 4.13 Estimated Time Spent Walking to School.

	Response	**n**	**%**
Walking to school	Yes	184	65.5
	No	97	34.5
	Total	**281**	**100.**
Duration of walking to school	< 5 mins	43	23.4
	5-15 mins	42	22.8
	16-30 mins	28	15.2
	31 mins – 1 hr	70	38.0
	>1 hr	1	0.5
	Total	**184**	**100**

4.5.4. Physical Activity Level

The respondent's physical activity was assessed using the PAQ-C questionnaire (10 questions) and responses from each item were scored per the PAQ-C protocol and the summaries of each question as shown in Table 4.14. The scores of the first nine questions were consolidated and an average PA score was calculated to categorize the children's level of physical activity. An average PA score of 1 is considered low and a score of 5 high. In general, from the table, the high score (5) was rare, hence less physical activity. More than half of the respondents (64.8%) engaged in various physical activities for 1 to 2 times in the week preceding the survey. On the other hand, about a quarter (13.9%) did not play games/sports or dance right after school.

Table 4.14 Physical Activity Scores of the Children Per the PAQ-C Protocol

Variable	Score	Response	n	%
Frequency of engaging in various activities (e.g., jogging, swimming, basketball, 'kati', badminton, skipping rope, tag) in the past week.	1	Did not participate in any activity	90	32.0
	2	1-2 times	182	64.8
	3	3-4 times	8	2.8
	4	5-6 times	1	0.4
Frequency of being very active during PE classes e.g., running, jumping	1	I don't do PE	31	11.0
	2	Hardly ever	14	5.0
	3	Sometimes	90	32.0
	4	Quite often	87	31.0
	5	Always	59	21.0
Activities respondents did most during break time (recess)	1	Sat down (talking, reading, doing schoolwork)	85	30.2
	2	Stood or walked around	15	5.3
	3	Ran or played a little bit	80	28.5
	4	Ran around and played quite a bit	77	27.4
	5	Ran around and played most of the time	24	8.5
Activities respondents did at lunch breaks besides eating.	1	Sat down (talking, reading, doing schoolwork)	108	38.4
	2	Stood or walked around	23	8.2
	3	Ran or played a little bit	69	24.6
	4	Ran around and played quite a bit	69	24.6
	5	Ran around and played most of the time	12	4.3
Number of days the respondents did sports, danced, or played games right after school.	1	Did not participate	39	13.9
	2	Once last week	43	15.3
	3	2- or 3-times last week	90	32.0
	4	Four times last week	44	15.7
	5	Five times last week	65	23.1
Number of days the respondents did sports, danced, or played games in the evenings.	1	Did not participate	49	17.4
	2	Once last week	45	16.0
	3	2- or 3-times last week	87	31.0
	4	Four times last week	70	24.9
	5	Five times last week	30	10.7
Number of times the respondents did sports, danced, or played games in the previous weekend.	1	Did not participate	20	7.1
	2	Once	50	17.8
	3	2 or 3 times	118	42.0
	4	4 – 5 times	59	21.0
	5	Six or more times last	34	12.1

Variable	Score	Response	n	%
Respondents perceived level of PA during their free time in the previous 7 days.	1	All or most of my free time was spent doing things that involve little physical effort	18	6.4
	2	I sometimes (1 — 2 times last week) did physical things in my free time	84	29.9
	3	I often (3 — 4 times last week) did physical things in my free time	95	33.8
	4	I quite often (5 — 6 times last week) did physical things in my free time	57	20.3
	5	I very often (7 or more times last week) did physical things in my free time	27	9.6
Average frequency of engaging in PA in the previous 7 days.	2	Little bit	279	99.3
	3	Medium	1	0.4
	4	Often	1	0.4

On the tenth question of the PAQ-C, the respondents were asked if anything had prevented them from being active in the week preceding the interview. Three-quarters of the respondents (75%, n= 211) indicated that nothing had prevented them from being active. However, a quarter (25%, n=70) indicated that they experienced situations that prevented them from being active. General malaise (or feeling sick), headaches, common cold and physical injuries were cited as the most common reasons.

More than half of the participants 54.8% (n=154) were classified as active given the average PA score cut-off point of ≥ 2.75 as shown in Figure 4.2.

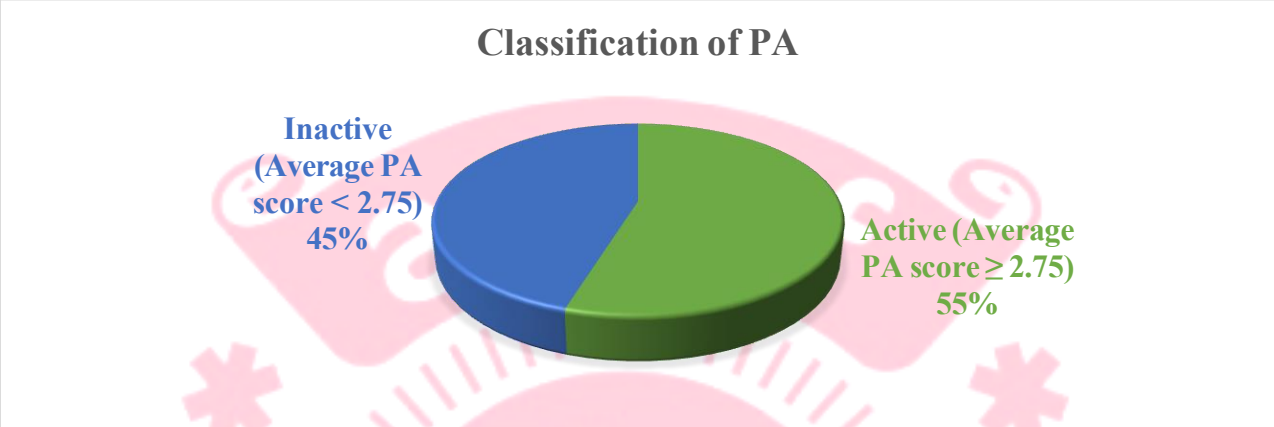

Figure 4.2 Classification by level of PA

The mean PA score was 2.85. More than half, 54.4% (n=153), had an average score of 3 and only 0.4% (n=1) of the respondents had a score of 5. Furthermore, the chi-square test results showed a p-value > 0.05, thus there is no correlation between the level of PA with the demographic variables i.e., school type, age of the pupil and gender as shown in Table 4.15.

Table 4.15 Association Between Average PA Score with Gender, Age, and School Type

		Average PA score										
		1		**2**		**3**		**4**		**5**		
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**P-value**
School type	Public	2	1.5	31	23.0	76	56.3	26	19.3	0	0.0	0.124
	Private	1	0.7	49	33.6	77	52.7	18	12.3	1	0.7	
Age in years	8	0	0.0	2	40.0	3	60.0	0	0.0	0	0.0	0.409
	9	2	2.2	23	25.6	50	55.6	15	16.7	0	0.0	
	10	1	0.8	41	34.5	62	52.1	15	12.6	0	0.0	
	11	0	0.0	14	20.9	38	56.7	14	20.9	1	1.5	
Gender	Female	1	0.6	44	28.4	80	51.6	30	19.4	0	0.0	0.205
	Male	2	1.6	36	28.6	73	57.9	14	11.1	1	0.8	
Total		**3**	**1.1**	**80**	**28.5**	**153**	**54.4**	**44**	**15.7**	**1**	**0.4**	

4.6. Nutrition Status

The average weight of the respondents was 32.12 (±7.52) kg, while the mean height was 141.55 (±7.87) cm. Most of the respondents, 66.6% (n=187) had a normal weight, 22.4% (n=63) were underweight, 10.3% (n=29) being overweight and 0.7% (n=2) being obese. The prevalence of overnutrition is therefore 11.03% (n=31) as shown in Figure 4.3.

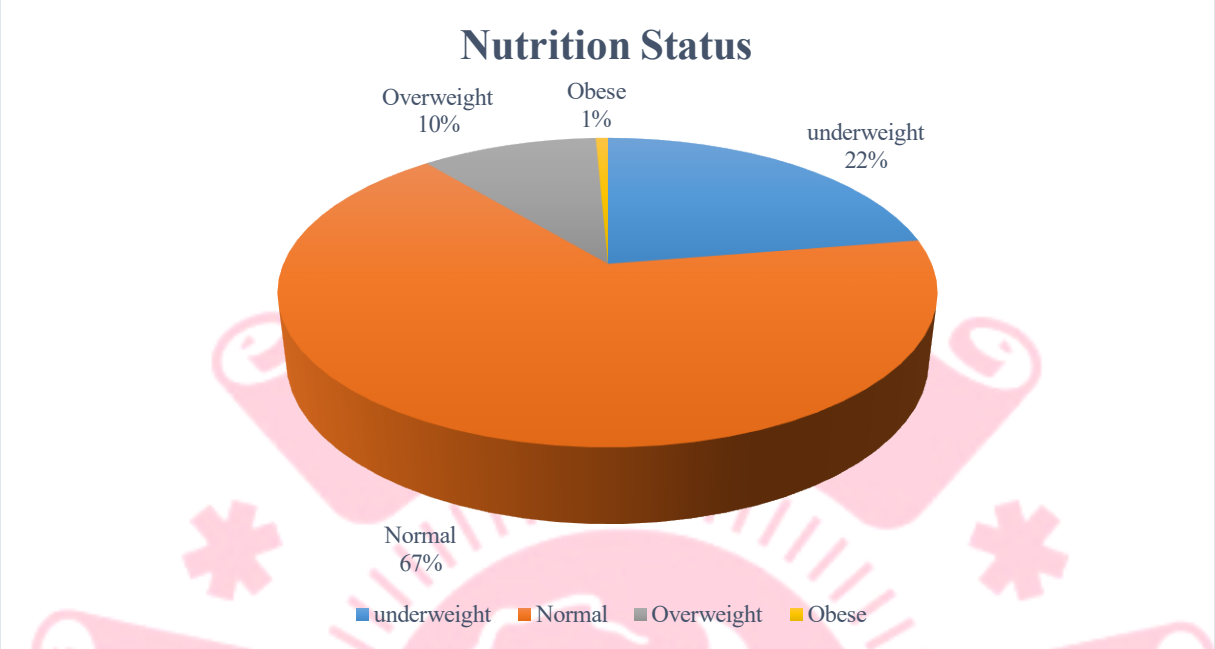

Figure 4.3 Nutrition Status of the Respondents

4.7. Association between Overnutrition and Other Study Variables

Nutrition status was categorized into two groups i.e., those who were OW or OB and those who were not (classified as either thin or normal BMI for age z-score). Chi-square and Fisher's exact tests were done to determine associations between OW/OB and the independent variables studied. Tables 4.16, 4.17, and 4.18 show the results of chi-square and Fisher's exact tests. Continuity/Yate's correction was applied for cells with counts greater than 5 but less than 10. At the bivariate level, the tests of association between the sociodemographic factors and overnutrition indicated that there were statistically significant associations between OW/OB and school type (p=0.003) as shown in Table 4.16.

Table 4.16 Association between the Sociodemographic Factors and Overnutrition (Bivariate)

Variable		Nutrition Status					
		Thin/ Normal		Overweight/ Obese		χ^2	P-Value
		n	%	n	%		
School type	Public	122	84	24	16	9.050	**0.003**
	Private	128	95	7	5		
Age in years	8-9	85	89.5	10	10.5	0.037	0.847
	10-11	165	88.7	21	11.3		
Gender	Female	135	87	20	13	1.233	0.339
	Male	115	91	11	9		
Grade¥	Grade 5	108	86	17	14	2.939	0.214
	Grade 4	133	92	12	8		
	Grade 6	9	82	2	18		

¥ Fischer's exact test; *P<0.05

At the bivariate level, the tests of association between dietary practices and the outcome variable indicated a statistically significant association between overnutrition and the frequency of lentil consumption (p=0.044) and walking to school (0.005), as shown in Table 4.17.

Table 4.17: Association Between the Dietary Practices and Overnutrition (Bivariate)

Variable		Nutrition Status					
		Thin/ Normal		Overweight/ Obese		¥	P-Value
		n	%	n	%		
Crisps	Never	102	89	12	11	1.458	0.684
	1-3 times/ week	114	87	17	13		
	4- 6 times /week	22	92	2	8		
	≥ 1 /day	12	100	0	0		
Chips	Never	77	88	11	13	2.045	0.550
	1-3 times/ week	138	88	19	12		
	4- 6 times /week	26	96	1	4		
	≥ 1 /day	9	100	0	0		
Sugar-Sweetened Beverages	Never	103	87	15	13	1.568	0.660
	1-3 times/ week	121	91	12	9		
	4- 6 times /week	17	85	3	15		
	≥ 1 /day	9	90	1	10		
Pastries	Never	110	87	16	13	1.977	0.540
	1-3 times/ week	96	88	13	12		
	4- 6 times /week	33	94	2	6		
	≥ 1 /day	11	100	0	0		

¥ Fischer's exact test; *P<0.05

At the bivariate level, the tests of association between physical activity factors and the outcome variable indicated a statistically significant association between OW/OB and walking to school (0.006), as shown in Table 4.18.

Table 4.18: Association between the PA Factors and Overnutrition (Bivariate)

Variable		Nutrition Status					
		Thin/ Normal		Overweight/ Obese		Chi square	P-Value
		n	%	n	%		
Played Video Games on Weekdays	Yes	93	90	10	10	0.290	0.590
	No	157	88	21	12		
Watched TV on Weekdays	Yes	211	88	30	12	3.459	0.062
	No	39	98	1	3		
Spent Time Seating on Weekdays	Yes	240	89	29	11	0.405	0.524
	No	10	83	2	17		
Duration of watching TV on weekdays¥	< 2 hours	206	88	27	12	0.430	0.512
	>2 hours	44	92	4	8		
Duration of watching TV on weekends	< 2 hours	160	89	19	11	0.880	0.767
	>2 hours	90	88	12	12		
Participating in PE¥	Yes	217	89	26	11	0.202	0.653
	No	33	87	5	13		
Walking to School	Yes	171	68.40	13	41.90	7.415	**0.006**
	No	79	31.6	18	58.10		
PA level	Active	135	88	19	12	0.592	0.442
	Inactive	115	91	12	9		

¥ Fischer's exact test; *P<0.05

The factors that showed significance in association with the occurrence of overnutrition, i.e., type of school, frequency of consumption of lentils, and walking to school, were pulled into binary and multivariable logistic regression models, and the odds ratios were derived. The results of multivariate analysis, summarized in Table 4.19, showed that the prevalence of overnutrition was significantly higher among SGC aged 8-11 years in private schools compared to public schools (cOR 3.597; 95% CI = 1.496-8.652, $p = 0.005$). After adjusting

for the frequency of consumption of lentils and walking to school, the difference was still statistically significant (aOR 2.641; 95% CI = 1.013-6.887, p = 0.0047). There was a significantly higher prevalence of overnutrition amongst children who didn't walk to school compared to those who walked to school (cOR 2.997; 95% CI = 1.399-6.419, p = 0.004). After adjusting for the type of school and frequency of consumption of lentils, the odds of overnutrition were still higher amongst those who did not walk to school. However, the difference was found not to be statistically significant (aOR 2.017; 95% CI = 0.875-4.650, p = 0.1).

Table 4.19: Factors associated with Childhood Overnutrition (multivariate) (N=281)

Variable	cOR (95% C.I)	p-value	aOR (95% C.I)	p-value
School type				
Public (ref)	1		1	
Private	3.597 (1.496-8.652)	0.005	2.641 (1.013-6.887)	0.0047
Walking to school				
Yes (ref)	1		1	
No	2.997 (1.399-6.419)	0.004	2.017 (0.875-4.650)	0.1
Lentils				
Never (ref)	1			
1-3 times/week	2.037 (0.893-4.645)	0.091		
4-6 times/week	0 (0)	0.998		
≥ 1/day	3.815 (0.359-40.544)	0.267		

CHAPTER 5: DISCUSSIONS

5.1. Introduction

This chapter discusses the demographic characteristics, dietary practices, PA, and nutrition status of the SGC aged 8-11 years in Thika West constituency, Kiambu County, Kenya, presented in chapter four. It also highlights some of the factors associated with OW and OB within the sampled group.

5.2. Prevalence of OW and OB

This study's findings show an 11% prevalence of overnutrition among school-going children. Similarly, studies from Cote d'Ivoire, Nigeria, and Tanzania have also demonstrated averages of 10% OW and less than 5% OB (Fossou et al., 2020; Mwaikambo et al., 2015). These studies underscore the growing prevalence of overnutrition, which is rapidly emerging as a significant public health issue in LMICs (Fruhstorfer et al., 2016). Since OB in childhood affects all organ systems, it contributes to increased risk of NCDs such as type 2 DM, HTN, GERD, obstructive sleep apnea, dyslipidemia, sleep apnea, musculoskeletal complications, and negative psychological experiences. Children who are obese have a higher likelihood of being obese in adulthood (Balasundaram & Krishna, 2023). These factors combined are associated with an increased risk of premature mortality and may contribute to poor learning outcomes (Lindberg et al., 2021; Marcus et al., 2022). This is partially attributable to higher school absences, repeating grades, lower engagement in class, dropping out of school, social isolation due to bullying, and reduced physical activity (Carey et al., 2015; Ryabov, 2018).

The contribution of overnutrition as a key metabolic risk factor to NCDs cannot be underscored (Leocádio et al., 2021; WHO, 2017). Increased blood pressure, high blood cholesterol levels, and insulin resistance are associated with overnutrition. These problems increase the likelihood of developing NCDs and are also significant contributors to illness. Non-communicable diseases account for approximately 74% of global mortality (WHO, 2023). In Kenya, the growing prevalence of NCDs causes 33% of all deaths, 50%, and 55 % of hospital admissions and hospital deaths, respectively (STEPS Survey, 2015). The ability of health systems in developing countries to address population needs is being jeopardized by the extensive burden of NCDs (Allotey et al., 2014). The economic burden of OB is felt at the individual, household, and national level. This is due to increased healthcare expenditure, reduced productivity and absenteeism from work, disability, and mortality (Goettler et al., 2017; Tremmel et al., 2017).

If the status quo remains, the economic impact of OW and OB is predicted to continue rising, with the biggest burden concentrated in LMICs (Okunogbe et al., 2022). Even more concerning, in most LMICs, overnutrition co-exists with undernutrition, a phenomenon referred to as the DBM, which further strains the health systems (Best et al., 2010; Khan et al., 2022; Popkin et al., 2020; Wells et al., 2020; Wrottesley et al., 2023).

5.3. Dietary Practices

All the children met the MDD score of 5. This could be attributed to the fact that the study setting is a geographical area comprised of arable land and is also a major industrial town in Kenya. Access to arable land increases food production, significantly contributing to household food security (Zabala, 2018). The study's findings are in contrast with the

findings of a study conducted in rural Western Kenya that reported a low dietary diversity, i.e., a mean MDD score of 4.1 and 2.6 in the village's 'A' and 'B,' respectively (Liu et al., 2022). A study focusing on Ethiopia also demonstrated that children in schools were meeting the MDD, with about 70.2% achieving high DD (Biadgilign et al., 2023). However, a study conducted in Nigeria showed that only about a third of the respondents met the optimum dietary diversity (Adeomi et al., 2022) while another study assessing the dietary diversity of meals provided in primary schools in Ghana found that none of the schools met the MDD score (Agbozo et al., 2018).

The highest frequency of food consumption was observed within the starchy foods, deep-fried and salty foods, sweet foods, and sugar-sweetened beverages food groups, respectively. This agrees with the findings of a study conducted in Nairobi that reported that most of the respondents had consumed SSBs (70%) and junk food (73%) in the week preceding the survey (Kigaru et al., 2015). Consuming these foods consistently in large amounts can lead to poor health outcomes due to their high sodium, sugar, and saturated fat content. Over the past 30 to 40 years, many countries and regions have experienced a significant shift towards the nutrition transition. During this time, consumption of animal-source foods, fats, empty calories, and ultra-processed foods (UPF) has significantly increased. On the other hand, there is a decrease in the consumption of plant-based diets comprised of fresh and unrefined foods such as vegetables, fruits, and nuts (Bodirsky et al., 2020; Popkin & Ng, 2022). These poor-quality diets contribute to nutrient deficiencies and the obesity pandemic (Kupka et al., 2020).

Research demonstrates that schools play a crucial role in shaping children's eating habits due to their established facilities and the fact that children consume approximately one-third of their daily energy intake while at school. The school environment offers extended exposure to many children, hence presenting an opportunity for public health interventions. Schools should adopt policies and practices, such as a comprehensive approach to promoting healthy eating, focusing on various aspects of the school system, including the curriculum, environment, and partnerships. These strategies should encompass learning, teaching, professional development, physical and cultural aspects, and policies and procedures. Additionally, they should involve students, families, staff, and the community (O'Brien et al., 2021; WHO, 2022).

5.4. Physical Activity

5.4.1. Sedentary Behaviors

Globally, excessive screen time is common amongst SGC, particularly after the COVID-19 pandemic (Carson et al., 2016; Qi et al., 2023). In our study, the most popular SA among the children was watching TV, with 85.4% and 88.6% doing it on weekdays and weekends, respectively. Of those who watched TV, 20% and 61% reported on average, spending more than the recommended 2 hours watching TV on a weekday and weekend, respectively. About 9.7% and 5.7% of the children with access to computers spent more than the recommended 2 hours using them to play video games or for non-school activities on a weekday and weekends, respectively. The number of children spending on average, 2 hours of screen time increased on the weekends as compared to weekdays.

One systematic review found some increase in the average proportions of children who had a range of ≥ 2 hours per day screen time, from 41.3% to 59.4%, respectively, before and after the COVID-19 pandemic (Qi et al., 2023). Screen-based activities (SBA) are a major source of inactivity in childhood. Excessive screen time may lead to adverse social, behavioral, and psychological outcomes, less time spent with family and friends affecting family functioning, sleep problems as well as weight problems (Muppalla et al., 2023; Nakshine et al., 2022; Twenge & Campbell, 2018).

5.4.2. Moderate and Vigorous Physical Activity

The study found that despite PE being a mandated lesson in the Kenyan curriculum for basic education, about 13.5% of them reported having yet to participate in a PE class in the week preceding the survey. This could be an indication of a lack of emphasis on the importance of PE. This finding agrees with the findings of the national assessment system for monitoring learner achievement (NASMLA) class three study conducted by the Kenya National Examinations Council (KNEC) in 2018, which reported that about 18.8% of pupils did not attend P.E. lessons. A similar study conducted amongst class seven pupils revealed that nearly half (47.9%) did not attend P.E. lessons (KNEC, 2020). An even higher proportion, i.e., 32.1%, did not attend PE classes in South Africa (Silva et al., 2018). This could indicate ineffective delivery and a lack of emphasis on the importance of PE. Several studies have documented barriers to PE delivery, including inadequate training, negative perceptions, lack of expertise, and a lower burden of accountability on the part of the teachers. Furthermore, inadequate resources and lack of support from colleagues affect the quality of these programs (Kofi et al., 2021; Lynch & Soukup, 2017; Sofo & Asola, 2016).

The mean PA score for the study participants was 2.85, and nearly half of the respondents were classified as inactive. The results showed no significant association between the average PA levels and gender. This is in contrast with the findings of a study conducted in South Africa that concluded that the mean PA for boys was significantly higher than that for girls (Gomwe et al., 2022b). Another study conducted in Senegal found a significant difference in objectively measured MVPA in boys and girls (Diouf et al., 2016).

Additionally, several studies have demonstrated a decrease in the PA in SGC. This decrease has been linked to deficiencies in curriculum materials, culture, gender, time, and built environment constructs, such as inadequate play facilities and infrastructure, motorized transport to schools, and street connectivity (Gomwe et al., 2022a, 2022b; Pretorius et al., 2022). Globally, physical inactivity has been rising across all population groups partly due to inactivity during leisure time as well as increased sedentary behavior (WHO, 2022). Being physically active provides a variety of health benefits during growth and later in life. For children, accruing an average of 1 hour of MVPA daily is associated with improved bone health, cardiorespiratory and muscular health and fitness, cognition, reduced adiposity, and decreased risk of depression (Piercy et al., 2022; Westerterp et al., 2021).

5.5. Factors associated with Overnutrition

5.5.1. Demographic Characteristics and Overnutrition

Statistical tests of association were conducted between the various sociodemographic characteristics and OW/OB (BMI for age Z-score ≥ 1). The study found evidence of an association between school type and OW/OB. This agrees with the findings of a scoping systematic review examining the factors contributing to the risk and health conditions

linked to childhood obesity in sub-Saharan Africa that showed significantly higher rates of overnutrition in private schools compared to public ones (Danquah et al., 2020). This is like the findings of a study conducted in Ethiopia amongst 736 children also found a higher prevalence of OW/OB among private schools compared to government school children (Ali et al., 2020). The observed phenomenon might be explained by the fact that affording private school is a proxy indicator of higher SES of the children's families. Additionally, children in private schools accrue higher sedentary time due to motorized transport, fewer PE lessons, and access to electronics used for entertainment and indoor gaming, e.g., TVs and high-energy foods and drinks (Adetunji et al., 2019; Adom et al., 2019; Olutende et al., 2021).

5.5.2. Dietary Practices and Overnutrition

The frequency of lentil consumption was significantly associated with OW/OB. This finding could be because lentils are legume seeds. Legume seeds are high in protein and fiber and have a low glycemic index and pancreatic lipase inhibitory properties. These factors are beneficial in the maintenance of a healthy weight (Alexander et al., 2024; Grdeń & Jakubczyk, 2023; Havemeier et al., 2017). Other foods assessed in the study did not correlate significantly with the outcome variable. This included foods that have previously been shown to increase the risk of OW/OB and diet-related NCDs, e.g., sugar-sweetened beverages, deep-fried and salty foods, and sweets. Although the dietary practices assessed did not show a significant association with BMI, they reveal patterns concerning food consumption that require further investigation as well as appropriate interventions to enhance healthful eating habits. For instance, the most frequently consumed foods were

from grains, white roots, tubers and plantains, and deep-fried and salty foods groups. Conversely, the least frequent foods were from the eggs and milk and milk products groups.

These findings could indicate looming and widespread poor food consumption patterns among the SGC propelled by the nutrition transition (Rousham et al., 2020). Unhealthy feeding habits in childhood can continue into adulthood, increasing the risk of developing NCDs (Kim & Lim, 2019; Verduci et al., 2021). In contrast, a study conducted in Kenya found that increased consumption of cakes/pastries, potato crisps, fast foods, and milk products decreased BMI (Wachira et al., 2021). On the other hand, a study conducted among adolescents in Ghana and Uganda also found no significant association between the intake of fruits and vegetables and OW and OB (Peltzer & Pengpid, 2011). Another study conducted among 981 students in the Gambia demonstrated a significant association between the frequency of consumption of SSBs, sweet snacks, e.g., cakes and biscuits, and eating seafood such as fish, oysters, shrimps, and lobsters to be significantly associated with OW and OB (Tunkara-Bah et al., 2021).

5.5.3. Sedentary Behaviors, MVPA and Overnutrition

The study subjectively measured PA as well as the time spent on SB; therefore, cannot eliminate the possibility of under/overreporting. The study found no significant association between the SB and overnutrition. This is in contrast with a study that found higher screen-based SB to be significantly associated with an unhealthy body composition (Carson et al., 2016). A scoping systematic review found that ≥ 2 hours per day of screen time and low levels of PA are associated with an increased risk of childhood OB in SSA (Danquah et al., 2020). Furthermore, a study conducted in Ethiopia concluded that physical activity,

particularly in children from private schools, was associated with overnutrition (Ali et al., 2020). Furthermore, another study conducted in over 10,000 children in Finland concluded that heavy screen-based SB is associated with OW/OB (Engberg et al., 2019). Increasing and heavy screen-based SB not only increases the risk of OW/OB but also results in a decline in PA among children (Paduano et al., 2021).

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary, limitations of the study, and conclusions from the current study's findings. It also presents the recommendations to improve nutrition status and the associated factors.

6.1.1. Dietary Practices of the SGC

According to the findings of the study:

i. All the participants achieved the minimum dietary diversity, unlike other SGC in studies conducted in Western Kenya, Ethiopia, Nigeria, and Ghana (Adeomi et al., 2022; Agbozo et al., 2018; Biadgilign et al., 2023; Liu et al., 2022).

ii. Consumption of foods from unhealthy food groups, such as deep-fried and salty foods, was high. A considerable percentage of the children reported having consumed caffeinated drinks. Additionally, grains, plantains, white roots, and tubers were consumed at the highest frequency. There was also a notably high frequency of consumption of foods within the unhealthy food group, more so from the deep-fried and salty food group. This is in line with another study conducted in Nairobi (Kigaru et al., 2015).

6.1.2 Physical Activity amongst the SGC

The current study found that,

i. On average, more than a quarter of the children spend more than the recommended 2 hours watching TV on weekdays and weekends. More than half reported attending PE

lessons and walking to school. Nearly half of the respondents were categorized as inactive. This is in line with

6.1.3 Nutrition status of the SGC

The study also shows that,

i. Most of the respondents had an adequate nutrition status. However, the study also found the existence of a DBM, characterized by the cooccurrence of underweight and overnutrition. The prevalence of overnutrition was like the estimates of other countries in the region, e.g., Cote d'Ivoire and Tanzania, for this age group (Fossou et al., 2020; Mwaikambo et al., 2015). There are no national or county rates to compare these findings to.

6.1.4 Factors Associated with Overnutrition amongst the SGC

Children from private schools and those who did not walk to school were significantly more likely to be overnourished than their counterparts in public schools, agreeing with the findings of a systematic review assessing the contributors of overnutrition in Africa (Danquah et al., 2020).

6.2 Recommendations

This thesis has explored the scope of individual risk factors associated with overnutrition among SCG in the Thika West constituency, shedding light on the multifaceted nature of this problem and its implications for public health. Through an in-depth analysis of the existing literature and empirical research, this study has uncovered that school type and

walking to school are associated with the prevalence of overnutrition in SGC. By highlighting these risk factors, we identify overnutrition as a growing problem amongst SGC in the Kenyan context and gain a deeper understanding of the complex dynamics that perpetuate it. Through the collective effort of all stakeholders, this understanding can inform the development of effective prevention and management strategies as recommended below.

6.2.1 Recommendations for Parents

Children in the study were inactive and periodically spent more than the recommended two hours a day on screen-based activities. Parents should promote PA and minimize screen time in children as this is pivotal for their holistic development and well-being. This can be achieved by encouraging outdoor play, enrolling in sports, and fostering a family culture of movement to establish positive habits early in the children's lives. Simultaneously, when parents limit screen time, the amount of time accrued on SB decreases, which helps safeguard against potential adverse effects on the children's mental and physical health. Parents will play a vital role in shaping their children's health and future habits by creating an environment that prioritizes active living over excessive screen use.

6.2.2 Recommendations for School Administrators

More than two-thirds of the children in the study were not attending PE. Since schools are widely recognized as the optimal delivery platform for varied nutrition and health interventions for SGC, school administrators should ensure the provision of healthy school meals. They should also provide PE facilities. This will ensure that all children accrue adequate PA, ultimately improving their well-being and nutrition status. Additionally, they

should ensure that resources such as instructional materials, PE prerequisite facilities, and equipment/gear are adequate within the schools. They should also promote continued professional development amongst the PE teachers to increase their technical know-how as well as improve their perceptions of PE and sports activities.

6.2.3 Recommendations for Further Research

This study assessed the individual characteristics that could influence overnutrition. However, the socioecological model recognizes that environmental factors, such as family and peer influence, childcare and school, community and built environment, society, and public policy, all influence childhood overnutrition. Therefore, studies should be conducted to explore how these factors contribute to poor nutrition outcomes within the Kenyan context.

This study sample was drawn from SGC in a geographical area that not only comprises arable land but is also a major industrial town in Kenya. This can significantly influence its occupants' economic capabilities and food availability. Therefore, studies can be conducted on a larger and more diverse sample to allow for generalization for all SGC in Kenya. They should also work to develop context-specific and standardized tools for the assessment of physical activity as well as methods to measure the school food environment.

6.2.4 Recommendations for Policymakers

The Ministry of Education in Kenya should invest in developing guidelines related to healthy screen time use, adequate school feeding programs, and adequate physical activity, particularly within the school environment where SGCs spend most of their waking time.

The Ministry of Health should extend budgetary allocations to set up routine nutrition surveillance for SGC to appraise the trends of nutrition status (and other health outcomes) as well as the risk factors associated with it at all administrative levels. The lack of standardized nutrition surveillance systems in middle childhood and adolescence (5 - 19 years) limits understanding of their nutrition challenges and how best to address them.

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APPENDIX I: Parent's/Guardian's Informed Consent Form

Study Title	**Dietary practices, physical activity and overnutrition among school-going children aged 6-11 years in Thika town, Kiambu County**
Investigator(s)	▪ Principal Investigator – Margaret Mburu Cell: +254780912991 Email: Margaret_mburu@outlook.com ▪ Co-Principal Investigators – Prof. Anselimo Makokha Cell: +254713817436 Email: anmakokha@gmail.com Dr. Peninah Masibo Cell: +254721952175 Email: peninahmasibo@gmail.com
Study Sponsor(s)	
Collaborators	

This Informed Consent Form has two parts:

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

FOR A MINOR

1. **What you should know about the research study**
    - We give you this consent form so that you may read about the purpose, risks and benefits of this research study.
    - The main goal of research studies is to gain knowledge that may help current and future populations.
    - You have the right to refuse to take part, or agree to take part now and change your mind later on.
    - Please review this consent form carefully and ask any questions before you make a decision.
    - Your participation is fully voluntary and you can withdraw at any point without any repercussions.
    - By signing this consent form, you agree that your child should participate in the study as it is described.
2. **Who is doing the study?**

Principal Investigators Information: Ms. Margaret Mburu is a student at AMREF International University in the school of Public Health pursing a Masters degree in Public Health (Biostatistics and Epidemiology).

3. Where is the study being conducted?

This study will take place in various schools in Thika town. Data collection will be conducted in your child's school as a representative of other schools that may not mt be chosen to participate in the study and will be aided by trained research assistants.

4. What is the purpose of this study?

The purpose of this study is to learn more about the role of dietary practices and physical activity on overweight and obesity in children 6 to 11 years of age.

5. Who is eligible to participate in the study? Who is ineligible?

Your child is eligible for the study if:

- Your child is enrolled in a school from Nairobi County that participates in the study.
- Your child is 6 to 11 years old at the time of study enrollment.
- You (the parent or legal guardian) and your child agree (by signing this form) to participate in the study.
- The child signs the separate assent form indicating that he/she agrees to volunteer for the study.

Your child will not be eligible for the study if:

- You (the parent or legal guardian) do not sign this consent form, or your child does not sign the assent form indicating that they wish to volunteer for the study.
- Your child is ill at the time of conducting the study.

6. What will happen to you if you take part in the study?

Aided by research assistants, your child will be asked to respond to a questionnaire assessing their dietary habits and physical activity. Additionally, all children enrolled in the study will have their body measurements taken. All measurements will be confidential and will not be shown to anyone other than researchers involved in the study. School personnel will not be allowed to see your child's measurements.

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

The measurements will include:

a) Weight
b) Height (standing and sitting)
c) Waist and hip circumferences
d) Questionnaire about diet and physical activity

7. What are the possible risks and discomforts?

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

8. What are the possible benefits?

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

9. If you do not wish to take part in the study, are there other choices?

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

10. What information will be kept confidential?

All data will be collected, stored and processed in a confidential manner. Every effort will be made to maintain the confidentiality of your study records and those of your child's. Your child will be assigned a unique identity number and names will not appear on questionnaires or data collection forms

Results of the study will be published; however, we will keep the child's name and other identifying information private. Other than as set forth above, your identity will remain confidential unless disclosure is required by law.

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

You and your child may withdraw from the study at any time without penalty. The decision to withdraw can be communicated to the principal investigator through the phone number provided. Data that will have been collected will be linked to the participant withdrawing from the study using the unique identifiers assigned to them and will be excluded from the

analysis. Furthermore, the researcher may withdraw your child from the study for objective reasons e.g. disruptive behavior related to the conduct of the study.

12. What charges will you have to pay?

None

13. What payment will you receive?

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

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

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

15. Confidentiality

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

16. **Who can I contact?**

If you have any questions, you can ask anyone from our team now or later. If you have questions later, you may contact **Margaret Mburu through phone number: +254780912991 or email address: margaret mburu@outlook.com.** If you have questions about your rights as a study subject, you may contact:

The Research Officer

Amref Health Africa in Kenya

Wilson Airport, Lang'ata Road

Office Tel: +254 20 6994000

Mobile No: 0795746777

Fax: +254 20 606340

P.O Box 30125-00100

Nairobi, Kenya

17. Do you have any questions at this time?

Part II: Certificate of Consent

I have read the above information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to participate in this study.

Print name of Subject	[at least forename and surname]
Signature of Subject	
DD/MM/YYYY	

If visually impaired, physically impaired, mentally impaired or illiterate

I have witnessed the accurate reading of the Consent Form to the potential study subject, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print Name of Subject	[at least forename and surname]
Thumb/Foot print of Subject	
Signature of Witness	[A literate witness must sign and should be selected by the study subject and MUST have no connection to the research team.
DD/MM/YYYY	

Statement by the researcher/person taking consent

I confirm that the study subject was given an opportunity to ask questions about the study, and all the questions asked by the study subject have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the study subject.

Print Name of researcher/person taking the consent	[at least forename and surname]
Signature of researcher/person taking the consent	
DD/MM/YYYY	

APPENDIX II: Child's Assent Form

ASSENT to participate in the research study titled **"Dietary practices, physical activity and overnutrition among school-going children aged 6-11 years in Thika town, Kiambu County".**

Principal Investigator: Margaret Mburu

Telephone Contact: +254780912991

Why am I here?

The researchers want to find out if I would be interested to be in a research study targeting school-going children in Thika town. Ms. Margaret Mburu assisted by other researchers are doing this study.

Why are they doing this study?

They want to learn more about the dietary practices, physical activity and overnutrition amongst children aged 6 to 11 years.

What will happen to me?

If I want to be in the study, I will fill out some papers assisted by the researchers, be weighed and get my height, waist and hip circumference measured.

Will the study hurt?

Being in the study should not hurt me.

What if I have any questions?

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

Do I have to be in the study?

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

Signature/Initials of Volunteer_____ Age _____ Date _____

Signature of Witness _____ Date _____

Signature of Person Administering Informed Consent_____ Date _____

APPENDIX III: Questionnaire

Participant ID: _____	**Date** ____/ ____/ _____
School name:_____	**School type**_____
Ward:_____	**Interviewer:** _____

Instructions read to the participant

1. Each question will be read carefully to you and you can respond based on the answer that comes to your mind first.
2. The interviewer will tick the box that fits your answer best and fill it in.
3. Remember: This is not a test so there are no wrong answers. It is important that you respond to all the questions to the best of your ability.
4. Your responses will not be shown to anybody. Also, nobody who knows you will be able to look at your questionnaire once it has been completely filled.

Socio demographic characteristics

Date of birth _____/_____/_____ Age (years)_____

dd mm yyyy

Sex

☐ Male

☐ Female

Which grade/class are you?

☐ Grade four

☐ Grade five

☐ Grade six

Section 1a

For the questions on this page, please tell about what you did *last week*.

Sedentary habits:

Most questions will ask you to think only about the LAST 7 DAYS, but a few questions will ask about what you typically do (during a normal week). THERE ARE NO RIGHT OR WRONG ANSWERS SO PROVIDE HONEST ANSWERS.

SEDENTARY HABITS refer to activities such as watching TV, or playing video games, computer games, or browsing the Internet or playing hand-held games. It includes time spent using a phone to talk or text with friends, play games.

On school days, (Monday – Friday)

1. a) How many days last week did you watch television?

☐ I did not watch

☐ 1 day

☐ 2 days

☐ 3 days

☐ 4 days

☐ 5 days

b) How long did you watch television on each day you watched?

☐ I did not watch

☐ Less than one hour (1 to 30 minutes)

☐ One hour (31 – 60 minutes)

☐ 1 to 2 hours

☐ More than two hours

2. a) How many days last week did you play video games, play with computer or use computer on non-school activities?

☐ I did not watch

☐ 1 day

☐ 2 days

☐ 3 days

☐ 4 days

☐ 5 days

b) How long did you play video games, play with computer or use computer on non-school activities?

- ☐ I did do this
- ☐ Less than one hour (1 to 30 minutes)
- ☐ One hour (31 – 60 minutes)
- ☐ 1 to 2 hours
- ☐ More than two hours

3. a) How many days did you spend reading or just sitting, by yourself or with friends or family?

- ☐ I did not watch
- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days

b) How long did you spend reading or just sitting, by yourself or with friends or family?

- ☐ I did do this
- ☐ Less than one hour (1 to 30 minutes)
- ☐ One hour (31 – 60 minutes)
- ☐ 1 to 2 hours
- ☐ More than two hours

On weekends, (Saturday and Sunday)

4. How long did you watch television on these days

- ☐ I did not do this
- ☐ Less than one hour (1 to 30 minutes)
- ☐ One hour (31 – 60 minutes)
- ☐ 1 to 2 hours
- ☐ More than two hours

5. Hong long did you play video games, play with computer or use computer on non-school activities?

- ☐ I did not do this

- ☐ Less than one hour (1 to 30 minutes)
- ☐ One hour (31 – 60 minutes)
- ☐ 1 to 2 hours
- ☐ More than two hours

6. How long did you spend reading or just sitting, by yourself or with friends or family?
   - ☐ I did do this
   - ☐ Less than one hour (1 to 30 minutes)
   - ☐ One hour (31 – 60 minutes)
   - ☐ 1 to 2 hours
   - ☐ More than two hours

Physical activity

This section asks about physical activities that is, any play, game, sport, exercise at home or school (either during recess or after school), transportation (like walking or cycling to school) that gets you moving and breathing harder.

7. How many physical education/ exercise (PE) classes are there in a week?
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4

8. What is the duration of each physical education/exercise (PE) class?
   - ☐ Less than 30 mins
   - ☐ 40 mins
   - ☐ 50 mins
   - ☐ 35 mins
   - ☐ 45 mins
   - ☐ 1 hour

9. In a typical week, how many days have you participated in physical education/ exercise (PE) classes, this means practical sessions.

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

10. In a typical week, do you normally walk to school?

- ☐ YES
- ☐ NO

IF THE ANSWER FOR QUESTION 10 IS NO, SKIP TO QUESTION 12.

11. How much time do you normally walk to reach to school?

- ☐ Less than 5 minutes
- ☐ 5 – 15 minutes
- ☐ 16 – 30 minutes
- ☐ 31 minutes to 1 hour
- ☐ More than 1 hour

12. **Physical activity in your spare time:** Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	□	□	□	□	
Tag	□	□	□	□	□
Walking for exercise	□	□	□	□	□
Bicycling	□	□	□	□	
Jogging or running	□	□	□	□	
Swimming	□	□	□	□	
Baseball, softball	□	□	□	□	□
Dance	□	□	□	□	
Badminton	□	□	□	□	
Table tennis	□	□	□	□	
Soccer/football	□	□	□	□	
Field hockey	□	□	□	□	
Volleyball	□	□	□	□	
Floor hockey	□	□	□	□	
Basketball	□	□	□	□	
Netball					
Handball					
Hop, step and jump					
'Bladder'					
'Kati'					
Hide and seek					
□Other:		□	□	□	

13. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

I don't do PE .....
Hardly ever .....
Sometimes .....
Quite often .....□
Always .....

14. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

Sat down (talking, reading, doing schoolwork)……
Stood around or walked around .....
Ran or played a little bit .....

Ran around and played quite a bit .....□
Ran and played hard most of the time .....

15. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

Sat down (talking, reading, doing schoolwork).…...
Stood around or walked around .....
Ran or played a little bit .....
Ran around and played quite a bit .....
Ran and played hard most of the time .....

16. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

None .....……
1-time last week .....
2- or 3-times last week .....
4 times last week .....□
5 times last week .....

17. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

None .....
1-time last week .....
2- or 3-times last week .....
4 or 5 last week .....□
6 or 7 times last week ..... □

18. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

None .....
1 time .....
2 — 3 times .....
4 — 5 times .....□
6 or more times .....

19. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort .....……
B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) .....……
C. I often (3 — 4 times last week) did physical things in my free time .....……..
D. I quite often (5 — 6 times last week) did physical things in my free time ……...
E. I very often (7 or more times last week) did physical things in my free time ……..

20. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	☐	☐	☐	☐	☐
Tuesday	☐	☐	☐	☐	☐
Wednesday	☐	☐	☐	☐	☐
Thursday	☐	☐	☐	☐	☐
Friday	☐	☐	☐	☐	☐
Saturday	☐	☐	☐	☐	☐
Sunday	☐	☐	☐	☐	☐

21. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes.....

No.....

If Yes, what prevented you? _____

Section 2a

Food Frequency Questionnaire

This section is asking about how many times (in a typical week) you usually eat the following foods (Please mark only one box on each line)

		≥ 2 /day	1/day	1-3/ week	4-6/ week	Never
	Starchy foods					
Cereals and products	Maize (githeri, muthokoi)					

	Rice					
	Sorghum					
	Millet					
	Wheat (chapati)					
	Oats					
	Pearl millet					
	Ugali (maize flour/soghurm)					
	Porridge/uji					
	Doughnuts					
	Mandazi					
	Bread					
	Pasta (spaghetti, indomie, macaroni)					
	Breakfast cereal e.g., Weetabix, cerelac, choco puffs, cornfalkes, weetos, choco rice etc.					
Roots and tubers	Irish potato					
	White sweet potato					
	Cassava/mhogo/mwanga					
	Yams/gikwa					

	Arrowroot/nduma					
	Green banana/matoke					
	Fruits and vegetables					
Vegetables	Carrots					
	Pumpkin/malenge					
	Butternuts					
	Orange-fleshed sweet potato					
	Red sweet bell pepper					
	Spinach					
	Kales (sukuma wiki)					
	Cow peas leaves (kunde)					
	Black African nightshade (managu)					
	Amaranthus (terere)					
	Stinging nettle (thabai/oilo)					
	Pumpkin leaves (seveve/susa)					
	Spider weed (saget/dek/akeyo/sagaa)					
	Cabbages					
	Cauliflower					
	French beans (michiri)					
	Okra					

	Green pepper, dhania, onions					
	Broccoli					
	Eggplant					
	Other (specify)					
	Other (specify)					
Fruits	Mango					
	Papaya					
	Avocado					
	Pineapples					
	Apples					
	Oranges, Tangerine, grape fruit					
	Ripe bananas					
	Melon					
	Passion fruit					
	Thorn melon					
	Other (specify)					
	Other (specify)					
	Legumes and pulses, nuts and seeds					
Legumes and nuts	Beans					

	Peas					
	Cow peas (thoroko/kunde)					
	Pigeon peas (mbaazi)					
	Soya beans					
	Dolicos beans (njahi)					
	Green grams (ndengu)					
	Lentils (kamande)					
Nuts and seeds	Ground nuts (peanuts)					
	Macadamia					
	Cashew nuts					
	Sesame (simsim)					
	Almond					
	Peanut butter					
	Other (specify)					
	Other (specify)					
	Meat, fish and animal protein					
Organ meats	Liver, kidney, heart					
Flesh meat	Beef					
	Pork					
	Goat meat					
	Mutton (sheep)					

	Rabbit					
	Chicken					
	Turkey/bata mzinga					
	Quail					
	Ducks					
Eggs	Chicken					
Fish and sea food	Omena/dagaa					
	Tilapia					
	Fish balls (street)					
	Other (specify)					
	Other (specify)					
	Milk and milk products					
	Fresh milk					
	Fermented milk (Mala)					
	Mursik					
	Yoghurt					
	Cheese					
	Oils and fat					
	Vegetable oil					
	Palm oil					
	Margarine					
	Ghee					

	Butter					
	Sugar and sweets					
	Table sugar					
	Sugar cane					
	Honey					
	Candies (sweets)					
	Pastries e.g., Cakes, biscuits					
	Chocolate					
	Ice cream					
	Sweetened beverages e.g., soda, yu fresh, lemonade, Ribena etc.					
	Snacks sold within or outside school premises					
	'Ringos'					
	Kebabs					
	Crisps					
	'Wow wow'					
	Pop corn					
	Fast foods from restaurants					
	Hotdog					
	Pizza					

	Fried chicken					
	Chips (French fries)					
	Sausages					
	Burgers					
	Samosa					
	Energy drinks					
	Predator energy					
	Power play energy					
	Red bull					
	Shark energy					
	Rock star					
	Monster					

Section 2b

Please indicate whether the following items are available in your home for you to use, select all that apply

- ☐ Television
- ☐ Computer
- ☐ Cell phone
- ☐ Electronic gadgets (ipad, tablet etc)
- ☐ Video games (PlayStation, Nintendo etc)

Think about the local area around your home; within 10 – 15 minutes' walk from home. Do you have any of the following in a walking distance from home? Please select all that apply

- ☐ Street vendors who sell snacks such as bajia, samosas, chips mayai
- ☐ Markets or local sellers who sell fruits and vegetables

The following questions ask about your neighborhood, please check all statements about your neighborhood

- ☐ There are playgrounds (public or private) eg: football pitch which can be used at any time
- ☐ There is much traffic which makes unpleasant to walk, or play around

Anthropometric measurements

Study ID:

Measure	1st reading	2nd reading
Height (cm)		
Weight (kg)		

APPENDIX IV: NACOSTI permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **176256**

Date of Issue: **14/February/2023**

RESEARCH LICENSE

This is to Certify that Miss. Margaret Wambui Mbora of Amref International University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: DIETARY PRACTICES, PHYSICAL ACTIVITY, AND OVERNUTRITION AMONG SCHOOL-GOING CHILDREN AGED 6 - 11 YEARS IN THIKA TOWN, KIAMBU COUNTY, KENYA for the period ending : 14/February/2024.

License No: **NACOSTI/P/23/23280**

176256

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document,
Scan the QR Code using QR scanner application.

See overleaf for conditions

APPENDIX V: ESRC approval letter

amref health africa

Amref Health Africa in Kenya

REF: AMREF – ESRC P1345/2022 **January 16, 2023**

Margaret Mburu
Amref International University
P.O Box 27691-00506,
Nairobi, Kenya
Tel: +254780912991
Email: margaret_mburu@outlook.com

Dear Margaret Mburu,

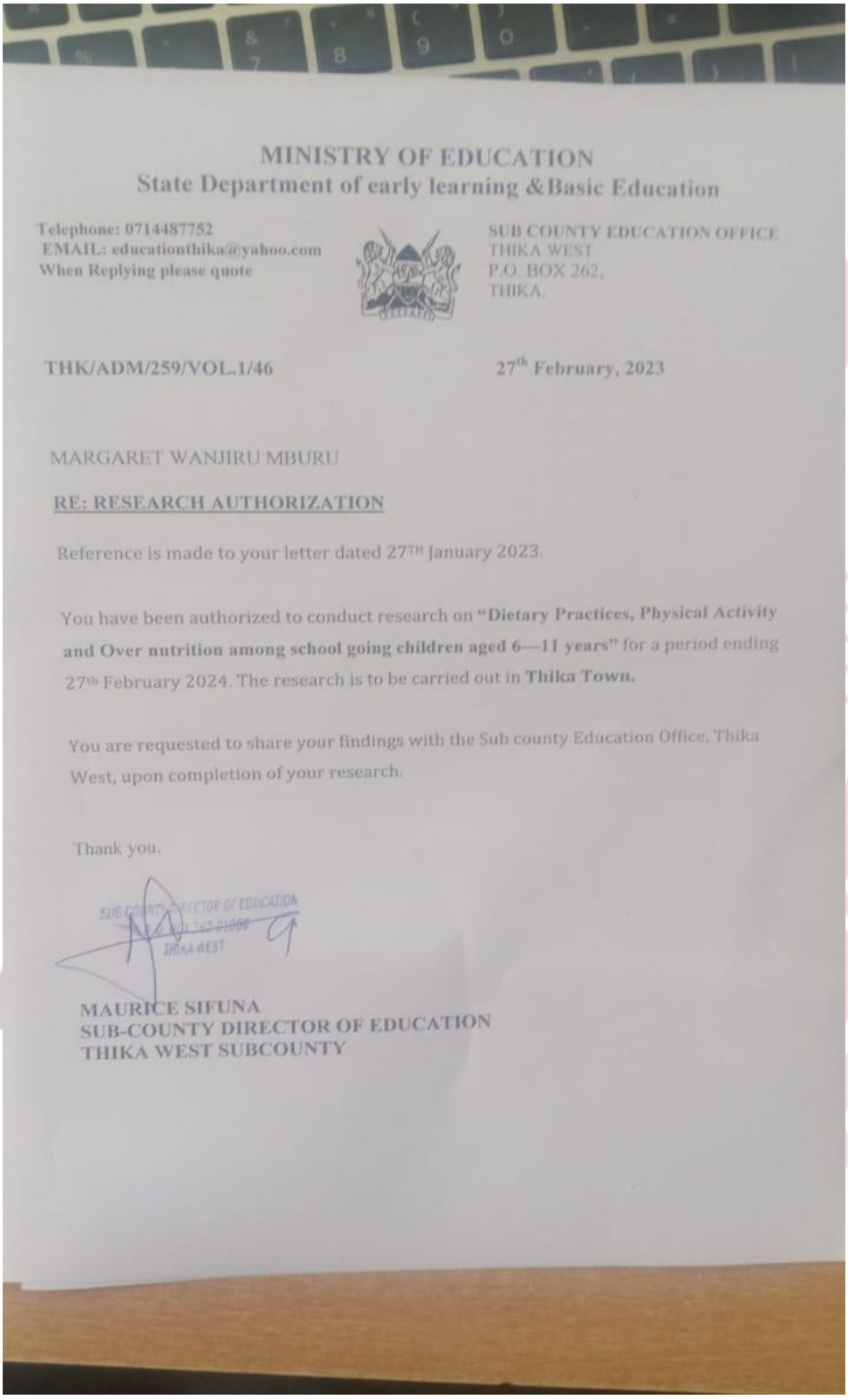
RESEARCH PROTOCOL: DIETARY PRACTICES, PHYSICAL ACTIVITY AND OVERNUTRITION AMONG SCHOOL-GOING CHILDREN AGED 6-11 YEARS IN THIKA TOWN, KIAMBU COUNTY, KENYA

Thank you for submitting your protocol to the Amref Ethics and Scientific Review Committee (ESRC).

This is to inform you that the ESRC has reviewed and approved your protocol. Your application approval number is ESRC P1345/2022. The approval period is from January 16, 2023, to January 15, 2024, and is subject to compliance with the following requirements:

a) Only approved documents (including informed consents, study instruments, advertising materials, material transfer agreements, etc.) will be used.
b) All changes including (amendments, deviations, violations, etc.) are submitted for review and approval by Amref ESRC before implementation.
c) Death and life-threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the Amref ESRC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to Amref ESRC within 72 hours.
e) Clearance for export of biological specimen must be obtained from the relevant government authorities for each batch of shipment/export.
f) 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.
g) In case of late renewal, the Amref ESRC shall not be held responsible for any serious adverse events (SAEs) that may occur as a result of research activities that were carried out after the expiry of approval.
h) Submission of an executive summary report within 90 days upon completion of the study to the Amref ESRC.
i) All government regulations for prevention and control of the spread of COVID-19 including social distancing, provision of personal protective equipment for participants and research assistants should be adhered to during data collection. All research assistants should be monitored for COVID 19 symptoms and referred for testing in case they present with symptoms.

APPENDIX VI: Thika West Subcounty Approval Letter



MINISTRY OF EDUCATION
State Department of early learning &Basic Education

Telephone: 0714487752
EMAIL: educationthika@yahoo.com
When Replying please quote

SUB COUNTY EDUCATION OFFICE
THIKA WEST
P.O. BOX 262,
THIKA.

THK/ADM/259/VOL.1/46

27th February, 2023

MARGARET WANJIRU MBURU

RE: RESEARCH AUTHORIZATION

Reference is made to your letter dated 27TH January 2023.

You have been authorized to conduct research on **"Dietary Practices, Physical Activity and Over nutrition among school going children aged 6—11 years"** for a period ending 27th February 2024. The research is to be carried out in **Thika Town.**

You are requested to share your findings with the Sub county Education Office, Thika West, upon completion of your research.

Thank you.

SUB COUNTY DIRECTOR OF EDUCATION
THIKA WEST

MAURICE SIFUNA
SUB-COUNTY DIRECTOR OF EDUCATION
THIKA WEST SUBCOUNTY

APPENDIX VII: Graduate School Letter

Amref International University

OFFICE OF THE DEAN SCHOOL GRADUATE STUDIES

31st October 2022

Mburu Margaret Wanjiru SHS/MPH/4958-1/2022

PROPOSAL TITLE: Dietary Practices, Physical Activity and Overnutrition among School- Going Children Aged 6-11 Years in Thika Town, Kiambu County, Kenya.

Following your full proposal presentation on September 8th 2022, and subsequent review of your revised proposal, Graduate School has approved your work for submission for ethical review before the commencement of fieldwork.

You are advised to update the Graduate School of your progress every three months by submitting progress reports using the forms attached.

Dr Dancan Irungu

Dean Graduate School

CC: HOD Community Health

APPENDIX VIII: Frequency of Food Consumption

Table: Frequency of food consumption by the study participants.

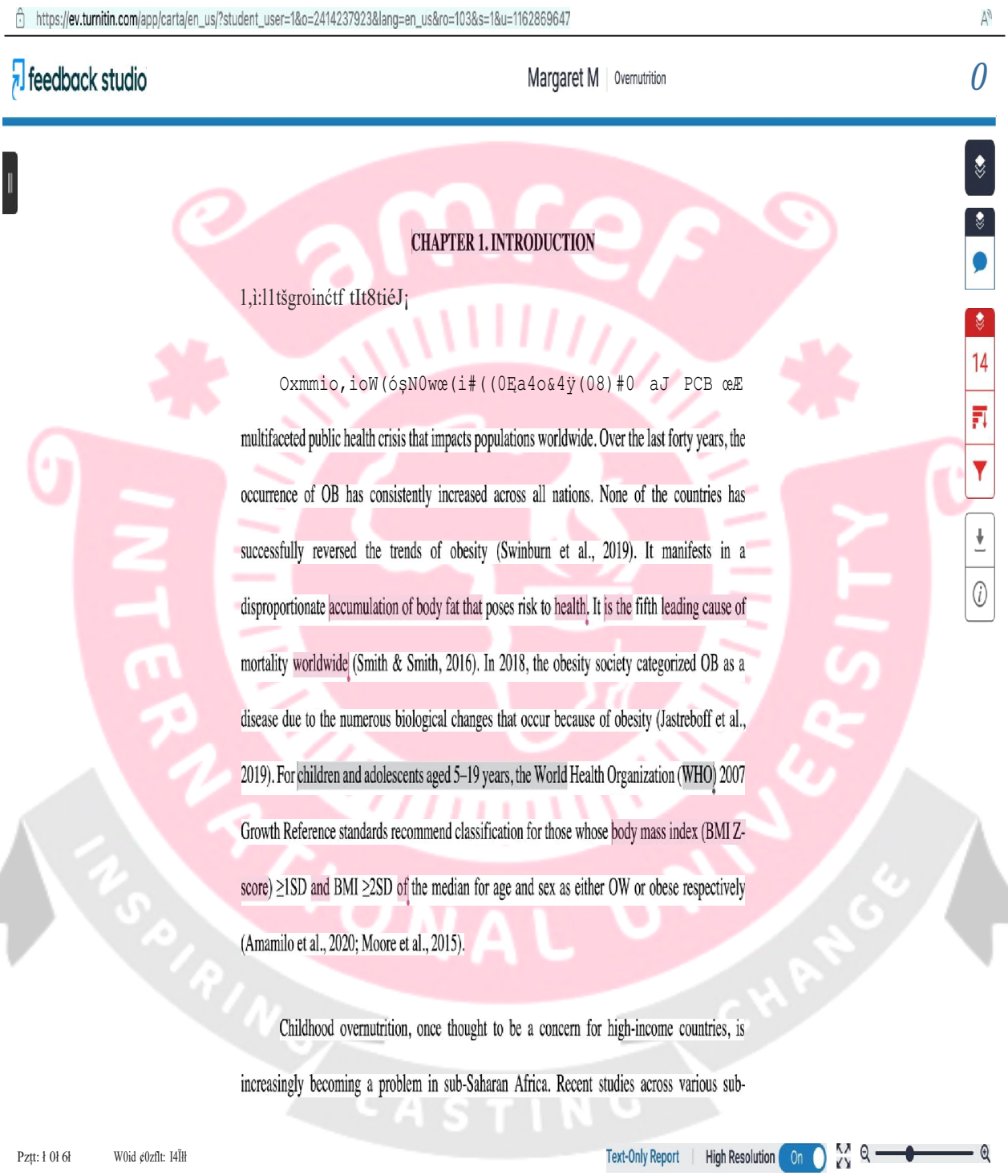
Food Group/Food Item	≥ 1 /day		1 - 3 times/week		4 – 6 times/week		Never	
	n	%	n	%	n	%	n	%
Grains, White roots and Tubers and Plantains								
Maize (*githeri*, *muthokoi*)	16	5.7	161	57.6	32	11.4	72	25.6
Rice	30	10.7	115	40.6	132	47	5	1.8
Wheat	24	8.5	190	67.6	32	11.4	35	12.5
Oats	2	0.7	24	8.5	3	1.1	252	89.7
Maize meal (Ugali)	32	11.4	133	46.6	110	39.1	8	2.8
Porridge (soghurm, millet, pearl millet)	31	11.0	113	40.2	38	13.5	99	35.2
Bread	85	30.2	67	23.8	114	40.6	15	5.3
Pasta (spaghetti, macaroni)	12	4.3	120	42.7	25	8.9	124	44.1
Breakfast cereal (e.g.,weetabix, choco puffs)	7	2.5	53	18.9	12	4.3	209	74.4
Potatoes	28	10.0	126	44.8	99	35.2	28	10
White sweet potatoes	11	3.9	89	31.7	22	7.8	159	56.6
Yams	1	0.4	40	14.2	5	1.8	235	83.6
Cassava/muhogo/ *mwanga*	7	2.5	72	25.6	6	2.1	196	69.8
Arrowroot (*nduma*)	8	2.8	112	39.9	14	5	147	52.3
Green Bananas / Matoke	8	2.8	100	35.6	21	7.5	152	54.1
Vit A fruits and Vegetables								
Carrots	52	18.5	75	26.7	122	43.4	32	11.4
Pumpkin/ malenge	3	1.1	46	16.4	13	4.6	219	77.9
Butternuts	4	1.4	28	10	2	0.7	247	87.9
Orange-fleshed sweet potato	4	1.4	61	21.7	14	5	202	71.9
Red sweet bell pepper (*hoho*)	7	2.5	58	20.6	24	8.5	192	68.3
Mangoes	13	4.6	113	40.2	36	12.8	119	42.3
Passion fruit	5	1.8	85	30.2	29	10.3	162	57.7
Papaya	3	1.1	84	29.9	16	5.7	178	63.3
Dark Green Leafy Vegetables								
Spinach	27	9.6	125	44.5	111	39.5	18	6.4
Kales (*Sukumawiki*)	24	8.5	136	48.4	96	34.2	25	8.9
Cow peas leaves (*kunde*)	2	0.7	71	25.3	19	6.8	189	67.3
Black African nightshade (*Managu*)	2	0.7	108	38.4	18	6.4	153	54.4
Amaranthus (*terere*)	9	3.2	118	42	38	13.5	116	41.3
Stinging nettle (*thafai*)	1	0.4	21	7.5			259	92.2
Broccoli	3	1.1	38	13.5	5	1.8	235	83.6
Pumpkin leaves (*mseveve*, *matawi ya malenge)*	5	1.8	64	22.8	15	5.3	197	70.1

Food Group/Food Item	≥ 1 /day		1 - 3 times/week		4 – 6 times/week		Never	
	n	%	n	%	n	%	n	%
Spider weed (*saget/sagaa)*	0	0.0	22	7.8	4	1.4	255	90.7
Other Vegetables								
Cabbages	15	5.3	139	49.8	104	37	23	8.2
Cauliflower	0	0.0	13	4.6	1	0.4	267	95
French Beans (*michiri*)	3	1.1	98	34.9	16	5.7	164	58.4
Okra	0	0.0	7	2.5			274	97.5
Green Pepper, dhania, onions	107	38.1	23	8.2	130	46.3	21	7.5
Eggplant (*biriganya*)	3	1.1	22	7.8	7	2.5	249	88.6
Other vegetables	9	3.2	63	22.4	18	6.4	191	68
Other Fruits								
Avocado	36	12.8	128	45.6	80	28.5	37	13.2
Pineapples	15	5.3	109	38.8	26	9.3	131	46.6
Apples	19	6.8	120	42.7	28	10	114	40.6
Oranges, tangerines, grapes	31	11.0	119	42.3	57	20.3	74	26.3
Ripe bananas	33	11.7	115	40.9	89	31.7	44	15.7
Watermelon	20	7.1	127	45.2	53	18.9	81	28.8
Thorn Melon	3	1.1	70	24.9	10	3.6	198	70.5
Pulses								
Beans	12	4.3	154	54.8	71	25.3	44	15.7
Peas	4	1.4	118	42	35	12.5	124	44.1
Cow peas	2	0.7	36	12.8			243	86.5
Pigeon peas	0	0.0	22	7.8	2	0.7	257	91.5
Soya beans	1	0.4	19	6.8	5	1.8	256	91.1
Dolicos beans (njahi)	6	2.1	133	47.3	14	5	128	45.6
Green grams (ndengu)	11	3.9	151	53.7	29	10.3	90	32
Lentils/ Kamande	4	1.4	139	49.5	26	9.3	112	39.9
Nuts and seeds								
Ground Nuts	5	1.8	107	38.1	18	6.4	151	53.7
Macadamia	11	3.9	81	28.8	33	11.4	157	55.9
Cashew nuts	1	0.4	14	5	3	1.1	263	93.6
Sesame (simsim)	3	1.1	35	12.5			243	86.5
Almonds	0	0.0	12	4.3	1	0.4	268	95.4
Peanut butter	25	8.9	79	28.1	43	14.9	135	48
Other nuts	1	0.4	18	6.4	1	0.4	261	92.9
Meats Poultry and Fish								
Organ meats (Liver, Kidney, Heart)	1	0.4	104	37	10	3.6	166	59.1
Beef	9	3.2	158	56.2	53	18.9	61	21.7
Goat meat	4	1.4	85	30.2	6	2.1	186	66.2
Mutton	1	0.4	29	10.3	4	1.4	247	87.9
Rabbit	1	0.4	21	7.5	1	0.4	258	91.8
Chicken	5	1.8	149	53	18	6.4	109	38.8

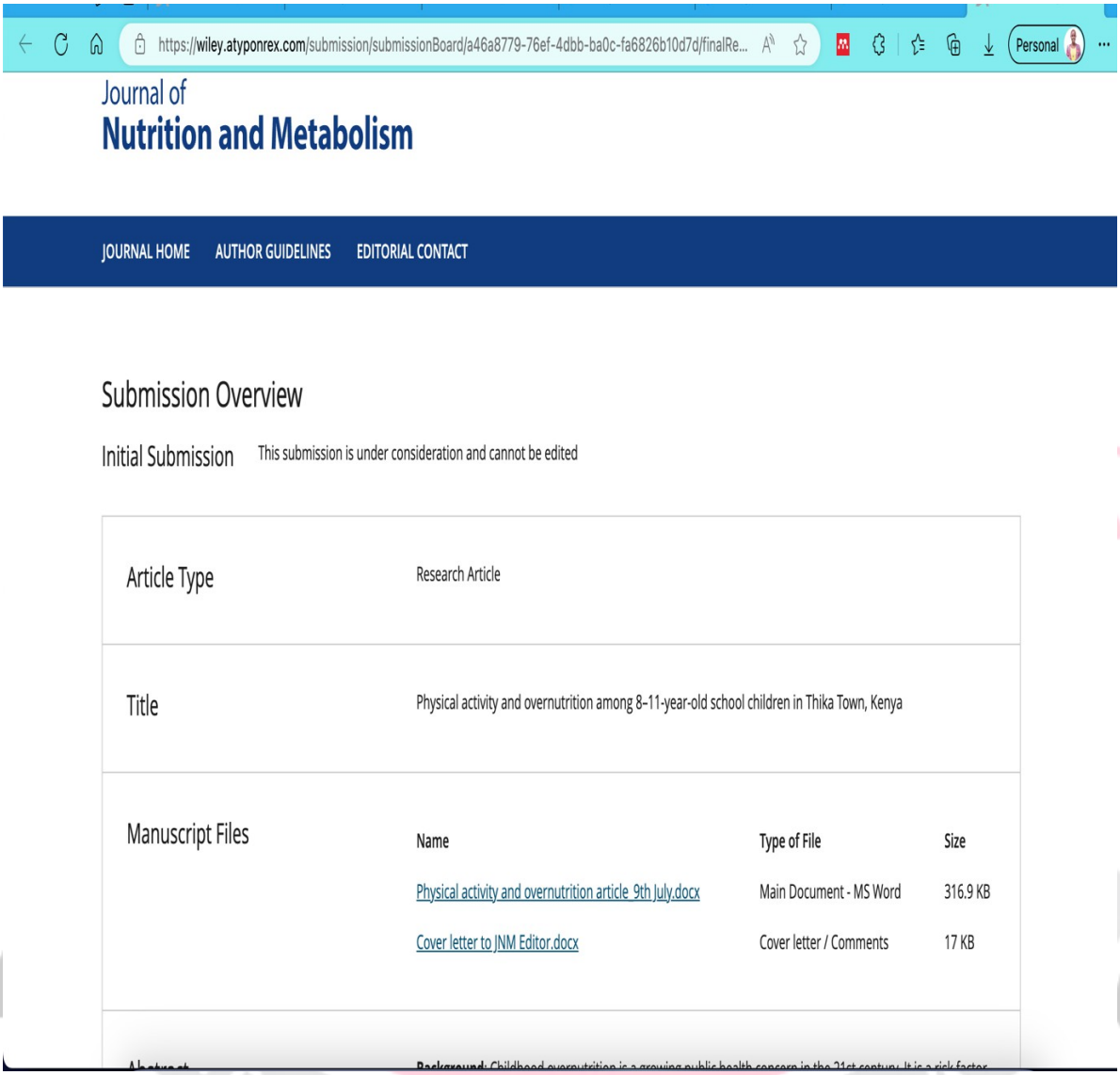
Food Group/Food Item	≥ 1 /day		1 - 3 times/week		4 – 6 times/week		Never	
	n	%	n	%	n	%	n	%
Turkey (*bata mzinga)*	2	0.7	5	1.8			274	97.5
Quail	0	0.0	1	0.4			280	99.6
Omena	4	1.4	68	24.2	11	3.9	198	70.5
Tilapia	1	0.4	52	18.5	2	0.7	226	80.4
Fish balls	1	0.4	31	11	4	1.4	245	87.2
Ducks	1	0.4	8	2.8			272	96.8
Eggs								
Eggs (chicken, quail)	9	3.2	171	60.9	40	14.2	61	21.7
Milk and Milk Products								
Fresh milk	116	41.3	70	24.9	67	23.8	19	6.8
Unsweetened fermented milk (*mala*)	7	2.5	85	30.2	13	4.6	176	62.6
Mursik	0	0.0	1	0.4	1	0.4	279	99.3
Cheese	0	0.0	6	2.1	1	0.4	274	97.5
Fats and Oils								
Vegetable oil	145	51.6	7	2.5	94	33.5	45	16
Palm oil	55	19.6	12	4.3	60	21.4	154	54.8
Margarine	39	13.9	68	24.2	61	21.7	113	40.2
Ghee	1	0.4	2	0.7			278	98.9
Butter	2	0.7	31	10.7	3	1.1	246	87.5
Sweet foods and sugar sweetened beverages								
Table sugar	158	56.2	17	6	82	29.2	24	8.5
Sugar cane	8	2.8	103	36.7	18	6.4	152	54.1
Honey	15	5.3	75	26.7	12	4.3	179	63.7
Pastries	11	3.9	109	38.8	35	12.5	126	44.8
Candies/sweets	27	9.6	82	29.2	40	14.2	132	47
Chocolate	10	3.6	73	26	8	2.8	190	67.6
Ice cream	3	1.1	82	29.2	14	5	182	64.8
Yoghurt	13	4.6	137	48.8	30	10.7	101	35.9
Sweetened beverages e.g., soda, yu fresh, lemonade, Ribena etc.	10	3.6	133	47.3	20	7.1	118	42
Caffeinated/energy drinks (predator, power play, monster, redbull)	1	0.4	29	10.3	3	1.1	248	88.3
Fried and salty foods								
Ringos	11	3.9	100	35.6	23	8.2	147	52.3
Kebabs	1	0.4	29	10.3			251	89.3
Crisps	12	4.3	131	46.6	24	8.5	114	40.6
Wow wow	3	1.1	74	26.3	17	6	187	66.5
Pop corn	7	2.5	107	38.1	18	6.4	149	53
Hot dog	0	0.0	32	11.4	6	2.1	243	86.5

Food Group/Food Item	≥ 1 /day		1 - 3 times/week		4 – 6 times/week		Never	
	n	%	n	%	n	%	n	%
Pizza	2	0.7	46	16.4	5	1.8	228	81.1
Fried Chicken	2	0.7	68	24.2	10	3.6	201	71.5
Chips	9	3.2	157	55.9	27	9.6	88	31.3
Sausages	7	2.5	112	39.9	23	8.2	139	49.5
Burgers	0	0.0	17	6	2	0.7	262	80.9
Doughnuts	17	6.0	88	31.3	20	7.1	156	55.5
Mandazi	26	9.3	128	45.6	68	24.2	59	21
Samosa	8	2.8	100	35.6	12	4.3	161	57.3

APPENDIX IX: Similarity Report



APPENDIX X: Evidence of Article Submission to the Journal



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JOURNAL HOME AUTHOR GUIDELINES EDITORIAL CONTACT

Submission Overview

Initial Submission This submission is under consideration and cannot be edited

Article Type	Research Article		
Title	Physical activity and overnutrition among 8–11-year-old school children in Thika Town, Kenya		
Manuscript Files	Name	Type of File	Size
	Physical activity and overnutrition article_9th July.docx	Main Document - MS Word	316.9 KB
	Cover letter to JNM Editor.docx	Cover letter / Comments	17 KB