

**PREDICTORS OF METABOLIC DISORDERS AMONG ADOLESCENTS AGED
13-17 YEARS IN LANG'ATA SUB-COUNTY, NAIROBI, KENYA**

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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

Background: There has been a documented surge in the prevalence of metabolic disorder components, notably obesity, in Kenya. This has resulted in a rise in metabolic disorders in the country, especially in urban areas, thus constituting a severe epidemiological health problem.

Broad Objective: The primary objective of the study was to determine the predictors of metabolic disorders among adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi County, Kenya.

Methodology: The research employed a cross-sectional survey design. 216 adolescents aged 13–17 years old enrolled in 5-day schools, randomly selected. A questionnaire was used to collect data. The data was processed and analyzed using SPSS software Version 28. Socio-demographic variables were analyzed using univariate descriptive statistics. Categorical variables were analyzed using inferential statistics and logistic regression.

Findings: The prevalence of metabolic disorders was 13%. A multivariate regression analysis was done, and the following were determined: Students who went to public schools AOR 0.6 (95% CI) 1.83-2.439; participated in sporting activities in school AOR 0.6 (95% CI) 2.869-4.44; $P < 0.001$ and those who took part in home-based activities AOR 0.2 (95% CI) 1.172-1.437; $P < 0.001$ are protective risk factors as AOR < 1 . Females AOR 3.5 (95% CI) 1.061-1.093; $P < 0.001$, respondents who have ever been diagnosed with a lifestyle disease AOR 4.8 (95% CI) 0.221-0.570; $P < 0.01$, family history of lifestyle disorders AOR 2.1 (95% CI) 1.504-1.883; $P < 0.001$ are risk factors of metabolic disorders among adolescents aged 13-17 years as AOR > 1 .

Conclusions and Recommendations: The study has shown that females with metabolic disorders (obesity and pre-hypertension) were more than males. Also, factors such as type of school, if ever been diagnosed with lifestyle diseases, family history of lifestyle disorders, participating in sporting activities, and taking part in home-based activities were the most significant determinants of metabolic disorders in adolescents aged 13-17 years. Creating awareness and addressing factors associated with metabolic disorders is crucial among this age group.

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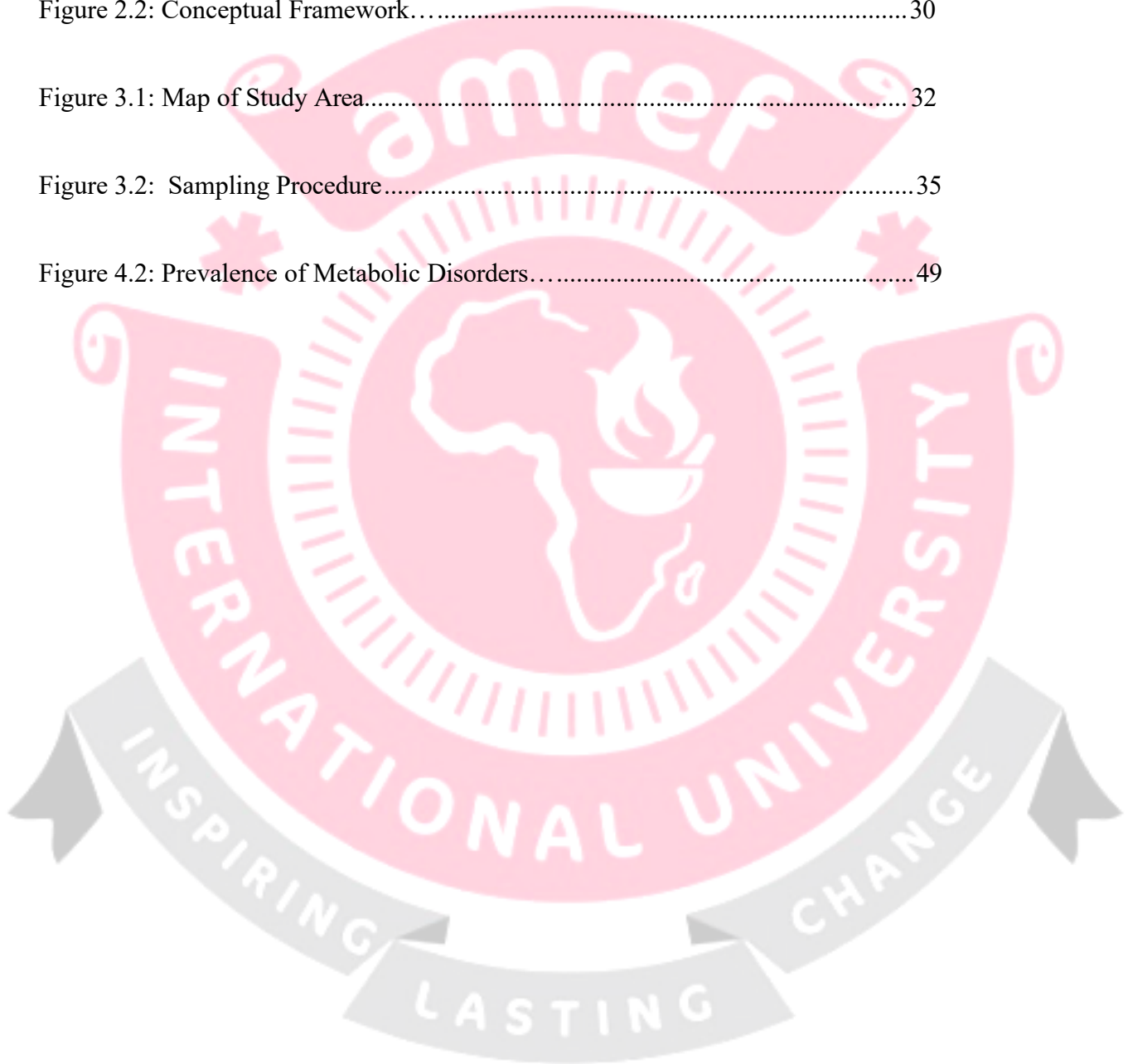
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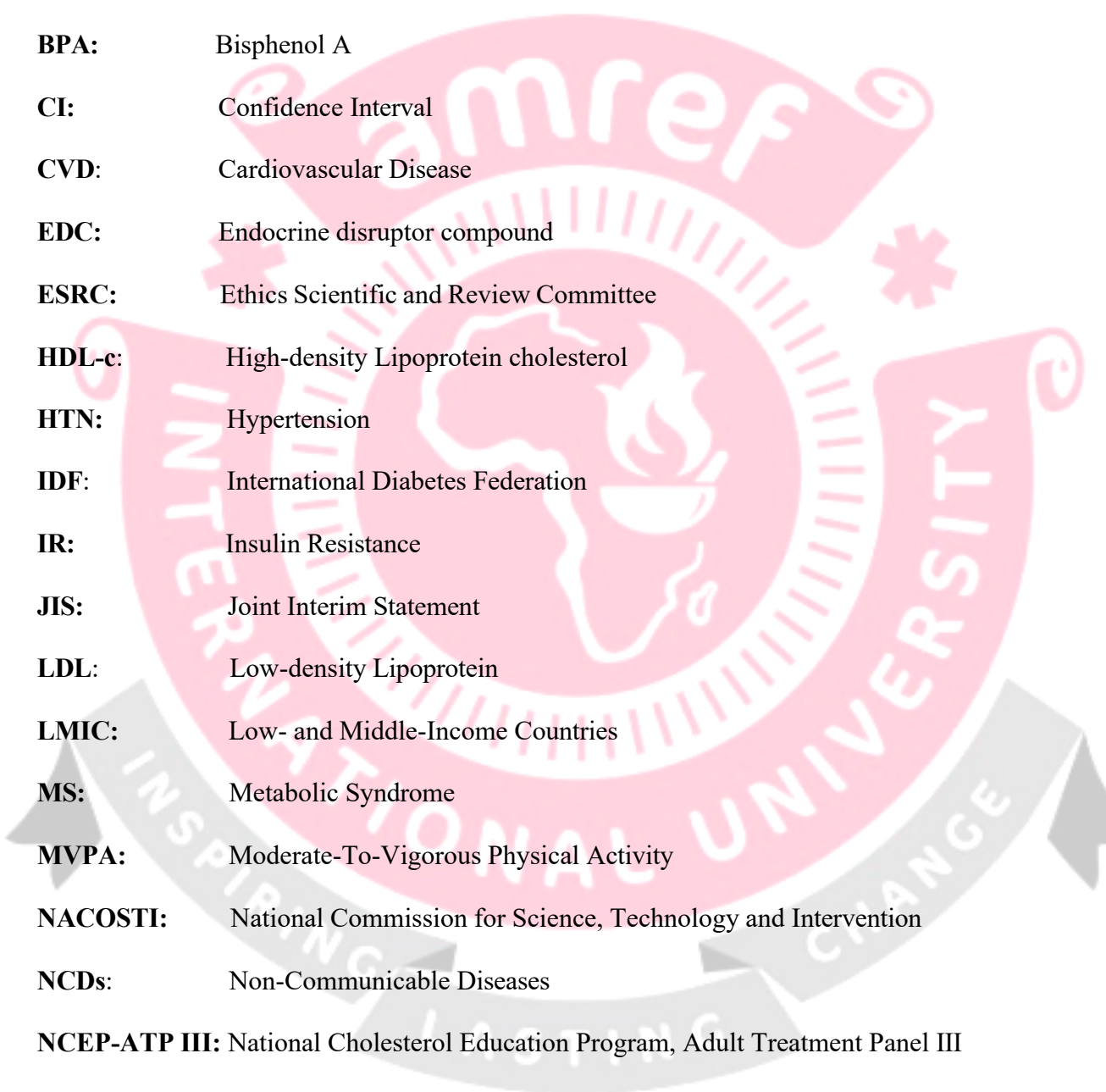
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ACRONYMS AND ABBREVIATIONS



AOR:	Adjusted Odds Ratio
BMI:	Body Mass Index
BPA:	Bisphenol A
CI:	Confidence Interval
CVD:	Cardiovascular Disease
EDC:	Endocrine disruptor compound
ESRC:	Ethics Scientific and Review Committee
HDL-c:	High-density Lipoprotein cholesterol
HTN:	Hypertension
IDF:	International Diabetes Federation
IR:	Insulin Resistance
JIS:	Joint Interim Statement
LDL:	Low-density Lipoprotein
LMIC:	Low- and Middle-Income Countries
MS:	Metabolic Syndrome
MVPA:	Moderate-To-Vigorous Physical Activity
NACOSTI:	National Commission for Science, Technology and Intervention
NCDs:	Non-Communicable Diseases
NCEP-ATP III:	National Cholesterol Education Program, Adult Treatment Panel III
SEM:	Social-Ecological Model
SES:	Socio-Economic Status
T1DM:	Type 1 Diabetes Mellitus

TG: Triglycerides
WHO: World Health Organization
WHtR: Waist-to-Height Ratio



OPERATIONAL DEFINITION OF KEY TERMS

Ampe: A game between two players or two groups of players. It's performed by clapping your hands, jumping, and shifting your feet.

Adolescents: Adolescence is the phase of life between childhood and adulthood, from ages 10 to 19.

BMI status: A person's weight in kilograms or pounds divided by their height in meters (or feet) is their body mass index or BMI. High body fatness may be indicated by a high BMI.

Cardiovascular diseases: Refer to heart-related and blood vessel disorders.

Children: A person below the age of 18 unless the relevant laws recognize an earlier age of majority.

Demographic factors: Variables that relate to characteristics of a population. In this study, this referred to age, sex, socio-economic status, religion, marital status and family history of overweight.

Diabetes: a chronic metabolic condition marked by high blood sugar levels (hyperglycemia), is brought on by a disturbance in insulin synthesis, insulin action, or both.

Metabolic disorders: Refers to a class of illnesses marked by abnormalities in the body's metabolic processes of converting food into energy and carrying out various chemical reactions in the body.

Metabolic syndrome: It is a group of metabolic abnormalities that include high blood pressure, high blood sugar levels, central obesity, and abnormal lipid profiles, which increase the chances of stroke, heart attack, and other complications.

Obesity: Unusual or excessive fat build up with a body mass index (BMI) greater than or equal to 30 that poses a health risk.

Overweight: Unusual or excessive fat build up with a body mass index (BMI) greater than or equal to 25 that poses a health risk.

Social-economic factors: Social and economic conditions that influence individuals' or communities' access to resources, opportunities, and overall well-being, such as income and education.

Youngsters: Those persons who fall within the 15–24 age range.



CHAPTER 1: INTRODUCTION

1.1 Overview

This chapter's goals were to present the research study to the reader, lay out the foundation, and get them ready for the following chapters' in-depth discussion of the findings, data analysis, research methodology, and literature review. The section describes the background of the study, the problem statement, the research questions, the study objectives, and the hypothesis regarding the predictors of metabolic disorders in adolescents between the ages of 13 and 17. It further probes the study's justification, significance, scope, and assumptions.

1.2 Background of the Study

Metabolic disorders have become a significant health concern globally, affecting millions of people (Chew et al., 2023). These disorders are associated with significant morbidity and mortality rates, leading to a reduced quality of life and increased healthcare costs. Children are not exempt from this burden, as metabolic disorders can develop at an early age and persist throughout adulthood. According to Lloyd et al. (2012), metabolic disorders refer to a group of conditions that arise due to an abnormal metabolism of nutrients in the body. These disorders include diabetes, hypertension, obesity, and dyslipidemia, among others.

The incidence of metabolic disorders among children has increased significantly in recent years, affecting their academic performance and overall well-being. WHO's recent report shows that the global prevalence of overweight and obesity in children below five years was 6.9% in 2019 (WHO, 2014). Several predictors are associated with the development

of metabolic disorders in children, including body mass index (BMI) or high waist circumference, insulin resistance, hypertension, and dyslipidemia. The BMI, which is often used to classify overweight and obesity in both adults and children, is computed by dividing a person's weight in kilograms by the square of their height in meters (kg/m^2).

Being overweight or obese during childhood is associated with several physical health complications, such as type 2 diabetes mellitus, hypertension, dyslipidemia, fatty liver disease, sleep apnea, and orthopaedic problems. Childhood obesity is also associated with an increased risk of cardiovascular disease and premature mortality in adulthood (Faienza et al., 2020). Obesity and overweight are linked to an increased risk of cardiovascular disease, diabetes, and malignant malignancies (Mkuu et al., 2018a).

BMI alone does not provide a comprehensive picture of how body fat is distributed and may not offer a precise assessment of the health implications associated with being overweight or obese. Among adults, the presence of abdominal fat is a recognized factor that increases the risk of developing type 2 diabetes mellitus and metabolic syndrome, both of which can lead to cardiovascular disease. Waist circumference, as a straightforward measure of body proportions, offers a more reliable means of predicting metabolic risk and mortality compared to BMI (Ross et al., 2020). This also holds true for children, where waist circumference is a more effective indicator of cardiovascular risk factors than BMI (Trandafir et al., 2020). Similar to BMI, it is essential to establish waist circumference references for children due to the dynamic changes in body composition during childhood and adolescence.

In recent years, interest has surged in the waist-to-height ratio (WHtR) as a gauge of pediatric abdominal obesity. It is considered a simple and helpful criterion for identifying abdominal obesity and predicting cardiometabolic risk. However, it's important to note that using waist circumference as a measure may have limitations when applied to young children, as the conventional cut-off points may not be suitable for those under 5 years. In such cases, it becomes essential to rely on age-specific reference charts (Fredriksen et al., 2018). Several studies have investigated WHtR utilization in children and adolescents as a predictor of metabolic disorders.

The emergence of the metabolic syndrome is also significantly influenced by insulin resistance, which is defined by decreased sensitivity to insulin in peripheral tissues such as muscles and adipose tissue. Because it disrupts the metabolism of glucose and lipids and causes persistent, low-level inflammation, insulin resistance is regarded as an essential pathogenic component in the development of the metabolic syndrome. Insulin resistance is commonly assessed by measuring fasting glucose and insulin levels, including more complex methods such as the euglycemic hyperinsulinemic clamp technique (Parvathareddy et al., 2024). It is important to note that obesity and insulin resistance are related. This technique involves maintaining a high insulin level by perfusion or infusion. Therefore, it helps to quantify how sensitive the tissue is to insulin. It is referred to as an euglycemic clamp. The hyperinsulinemic-euglycemic clamp is a sophisticated method used in research to precisely measure how sensitive an organism is to insulin. Insulin is a hormone that helps regulate blood sugar levels. In this procedure, a constant infusion of insulin is administered intravenously to elevate the insulin levels in the blood. At the same

time, glucose levels are closely monitored and kept stable at a specific target level by adjusting the glucose infusion rate. By maintaining the blood glucose at this steady level despite the increased insulin, researchers can determine how effectively the body responds to insulin and takes up glucose from the blood. This technique provides a direct and accurate assessment of insulin sensitivity and is considered the most reliable way to evaluate this aspect of metabolic health.

High blood pressure, known as hypertension, frequently coexists with metabolic syndrome and presents a significant risk factor for cardiovascular disease. The connection between hypertension and metabolic syndrome works in both directions: hypertension plays a role in the emergence of metabolic syndrome, and conversely, metabolic syndrome can contribute to hypertension development. The complex mechanisms underlying this relationship involve insulin resistance, endothelial dysfunction, and sympathetic nervous system activation. Hypertension is characterized by a systolic blood pressure equal to or exceeding 130 mm Hg, a diastolic blood pressure equal to or exceeding 85 mm Hg, or the use of medication for hypertension management.

Environmental factors, including exposure to toxins and pollutants such as Endocrine Disruptor Compounds (EDCs) that include a range of substances, for example, phthalates and Bisphenol A (BPA), production goods (fragrance compound, organobromine flame retardant, fluorosurfactants, combatants (polychlorinated dibenzodioxins/furans, polyaromatic hydrocarbons), pesticides, herbicides and metals (arsenic, cadmium) when exposed to these toxins, can contribute to metabolic disorders development among children by impairing their immune system and increase the risks for development of metabolic condition such as diabetes and obesity (Khalil et al., 2023). Some fundamental

mechanisms have been proposed to connect pollution and obesity: oxidative stress caused by pollutants, epigenetic modifications, and physical inactivity (Parvathareddy et al., 2024). Some countries suffer from a dual burden of undernutrition and overweight/obesity since childhood. Undernutrition is also linked to an increased risk of obesity.

The prevalence varies geographically and regionally throughout the world. However, among obese and overweight people, a high frequency of 97.5% of metabolic syndrome was noted at Indus Hospital in Karachi, Pakistan, and 69.4% among Palestinian refugees (Abebe et al., 2021). The sex-specific proportion was higher in females than males, irrespective of the criteria. Intermediate-risk factors for cardiovascular diseases (CVD) include metabolic syndrome, unfavourable lipid profiles, and obesity, brought on by fast-paced urbanization and modernization, changes linked to unhealthy lifestyles, and climatic changes (Hai et al., 2019).

In India, the prevalence of metabolic syndrome among adolescents was approximately 6.5%, with a higher prevalence in males at 5.7% and females at 4.7% (Holdbrooke & Afolabi, 2022). In sub-Saharan Africa, the overall prevalence of metabolic disorders according to the different diagnostic criteria was: IDF: 18.0%, IDF-ethnic: 16.0%, JIS: 23.9%, NCEP-ATP III: 17.1% and WHO: 11.1% (Bowo-Ngandji et al., 2023). The prevalence of metabolic diseases was higher in women than in males, greater in those who lived in (semi-)urban areas compared to those in rural areas, and highest in SA, followed by Eastern, Western, and Central Africa.

Research has demonstrated that throughout lengthy evolutionary times, human societies have endured varying degrees of climate change, food, and metabolic abnormalities (which

are adaptations to lifestyle). These factors continuously impact basal metabolic rate (Abebe et al., 2021). The etiology of major metabolic illnesses, such as obesity and dyslipidemia, is thought to be significantly influenced by the biological processes that determine tolerance to climatic extremes. A diet heavy in sugar and salty foods, along with rising temperatures and, in some areas, falling water supply, can hasten the onset of metabolic syndrome.

Africa has long been recognized for its infectious disease outbreaks and undernutrition; however, due to the continent's nutritional shift and the lifestyle modifications brought about by industrialization, chronic non-communicable diseases, and overnutrition have skyrocketed (Bowo-Ngandji et al., 2023). The top causes of death globally, aside from the accumulation of belly fat, are low HDL-C levels, insulin resistance, hypertension, hypertriglyceridemia, and hyperglycemia. The phrase "metabolic syndrome" (MS) refers to a person who has three or more of these conditions. Both the risk of cardiovascular disease and type 2 diabetes are increased by a factor of two to three, respectively. Since it greatly increases the likelihood of high-mortality diseases, it is imperative to identify it in populations at an early age (Bowo-Ngandji et al., 2023).

Local studies conducted in Kenya revealed that women were more likely than males to be overweight or obese; in one research, 43.4% of women and 34% of men met the criteria. Elevated blood glucose and hypertension are associated with overweight and obesity in Kenya. Living in metropolitan regions, having a high income, and having a high level of education are predictors of overweight and obesity in Kenya, just like they are in other LMICs. In Kenya, metabolic syndrome was 19.2% and was found to be higher in women as compared to men folks (20.7% vs. 16.0%) (Kiama et al., 2018). In addition to physical

health complications, childhood obesity is also associated with psychological morbidity. These psychological complications can have long-term consequences on the child's mental health and well-being.

Research carried out on impoverished individuals also demonstrates that low-income groups have an elevated prevalence of obesity and overweight. Consumption habits are one reason why overweight and obesity rates are higher in high-income groups. According to one study, women with higher incomes in urban Kenya had a higher prevalence of overweight and obesity. They were more likely to eat meals high in calories, fat, and protein, which are linked to an increased risk of overweight and obesity (Mkuu et al., 2018a).

In addition to these predictors, several contributing factors are linked to the development of metabolic disorders among children. These factors can be broadly categorized into lifestyle, genetic predisposition, socio-demographic, and environmental factors. Lifestyle factors are key predictors of metabolic disorders in adolescents, such as dietary preferences and the magnitude of exercise. Most HTN cases in children and adolescents are triggered by a confluence of anthropometric, behavioural, inherited elements, and socioenvironmental risk elements. Prior research looked into the causative effects that gender, ethnicity, dietary practices, and physical activity play in the development of HTN in this environment. Of all these, obesity has the most significant impact on the prevalence of HTN in this age range. Likewise, inadequate physical exercise has been associated with an increased risk of metabolic diseases (Ekelund et al., 2019).

1.3 Problem Statement

The prevalence of metabolic syndrome (MetS) among early adolescents is a growing concern, particularly in low- and middle-income countries, where non-communicable diseases (NCDs) are on the rise. Metabolic syndrome, characterized by obesity and a clustering of metabolic abnormalities, is increasingly recognized as a significant health issue that can persist into adulthood. Early adolescence, marked by rapid growth and physiological changes, is a critical phase where the risks of chronic diseases, malnutrition, and MetS are strongly interconnected. As highlighted by Elfaki et al. (2022), the need to understand the prevalence, pathogenesis, and risk factors of MetS and develop effective management strategies is imperative, especially for young people and adolescents. This underscores the urgency of studying the frequency of MetS among early adolescents to address the escalating health challenges they face.

The prevalence and predicting factors of metabolic disorders in children and adolescents still lack clarity. Nevertheless, a prior review unveiled a broad range, from 0.2% to 38.9%, with a median of 3.3% (from 0% to 19.2%) in the general population. Notably, the prevalence appeared to be relatively higher in overweight individuals (11.9%) and notably higher in obese children (29.2%) (Jankowska et al., 2021). Research findings on metabolic disorders in this population, especially in low and middle-income countries (LMICs), exhibit considerable variation and inconsistency across different nations. Numerous factors, notably related to lifestyle, have been identified as being closely linked to a rise in the rates of metabolic diseases. Of particular note is the notable rise in fructose consumption through soft drinks, juice, and baked goods over the past four decades, contributing to the surge in obesity, a primary predictor of metabolic disorders in children

and adolescents. At the individual level, metabolic disorders such as diabetes, hypertension, and obesity can lead to a wide array of health complications, including cardiovascular disease, kidney failure, neuropathy, and blindness. These health complications significantly diminish the quality of life, reduce life expectancy, and escalate healthcare costs for those affected and their families. Effectively addressing metabolic disorders necessitates a comprehensive, multi-sectoral approach involving collaboration among various stakeholders, including healthcare providers, policymakers, community organizations, and individuals.

Lang'ata Division was selected as a suitable location for the study due to its composition of both slum and non-slum settlements. It encompasses the southern and southwestern regions of Nairobi. Previously, it shared borders with the now non-existent Kibera Division of Nairobi. Spanning an extensive area of 196.80 km² (76.0 sq. mi), Lang'ata constituency is the largest constituency in Nairobi. Notably, Lang'ata constituency shares a border with Kibera, Kenya's largest slum. Lang'ata Sub-County has an estimated population of about 439, 000 of which 93,000 are aged between 15-24 years. Sub-County figures captured for nutritional studies are limited. However, 1,234 have been reported with obesity.

Lang'ata Sub-County, situated in Nairobi, represents an urban area characterized by diverse socioeconomic backgrounds, lifestyle patterns, and environmental factors that may influence metabolic health. By focusing on adolescents in this locality, the study provided insights into the unique risk factors contributing to metabolic disorders in Kenya's urban context. These factors are crucial for the research as they help identify the multiple factors contributing to metabolic disorders among adolescents.

The metabolic disorders that adolescents in Kenya are at risk for are not well-studied. Thus, this study sought to examine the predictors of metabolic disorders among adolescents aged 13-17 in Lang'ata Sub-County Nairobi.

1.4 Research Questions

- i. What is the prevalence of metabolic disorders among adolescents aged 13-17 years in Langata Sub-County, Nairobi?
- ii. Is there a relationship between social-demographic factors of adolescents aged 13-17 years and the occurrence of metabolic disorders in Langata Sub-County, Nairobi?
- iii. Is there an association between family medical history and the occurrence of metabolic disorders in adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi?
- iv. What is the association between the level of physical activity and the occurrence of metabolic disorders in adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi?

1.5 Objectives of the Study

1.5.1 Broad Objective

The primary objective of the study was to determine the predictors of metabolic disorders among adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi County, Kenya.

1.5.2 Specific Objectives

- i. To determine the prevalence of metabolic disorders among adolescents aged 13-17 years in Langata Sub-County, Nairobi.

- ii. To identify the social-demographic predictors associated with the occurrence of metabolic disorders among adolescents aged 13-17 years in Langata Sub-County, Nairobi.
- iii. To determine the association between family medical history and occurrence of metabolic disorders in adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi
- iv. To determine the association between the level of physical activity and the occurrence of metabolic disorders in adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi.

1.6 Hypothesis

H₀₁: There is no association between social-demographic factors and metabolic disorders among adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi

H₀₂: There is no association between family medical history and the occurrence of metabolic disorders among adolescents aged 13-17 years in Lan'gata Sub-County, Nairobi.

H₀₃: There is no association between the level of physical activity and the occurrence of metabolic disorders among adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi.

1.7 Justification

Metabolic disorders, encompassing conditions like overweight and obesity, have emerged as a substantial global public health concern, carrying adverse consequences for both physical and mental well-being. The rising prevalence of metabolic disorders among children is alarming and warrants urgent attention. Globally, the prevalence of childhood overweight and obesity has been rising, with detrimental impacts in both the short and long term (Ferentinou et al., 2023). In Kenya, research studies have consistently highlighted

elevated prevalence rates of youngsters who are overweight or obese, underscoring the urgency of addressing this pressing concern (Mkuu et al., 2018b).

Despite the worldwide and national alarm surrounding metabolic disorders, there is a shortage of extensive studies explicitly dedicated to investigating these conditions in detail and their predictors among school-going adolescents in Lang'ata Sub-County, Nairobi County. Existing research in Kenya has primarily focused on urban areas or nationwide samples, making it crucial to explore the specific predictors within the unique context of Lang'ata Sub-County (Echakara, 2015).

Furthermore, since lifestyle patterns formed during this time frequently carry over into adulthood, childhood is a crucial time for intervention. Early identification and intervention are key to preventing the progression of metabolic disorders and associated health complications. School-based interventions have shown promise in promoting healthy behaviours and reducing the risk of metabolic disorders among children (O'Brien et al., 2021). Therefore, identifying the risk factors for metabolic disorders in adolescents might help establish specific interventions. This study determined the predictors of metabolic disorders among adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi County, Kenya.

1.8 Significance of the Study

Obesity and type 2 diabetes are increasingly prevalent among children, which can have severe consequences on the overall well-being of the population. The identification of risk factors by healthcare professionals will be made possible, and they will also be able to

create effective prevention and intervention strategies with the support of research findings on the predictors of metabolic disorders.

Metabolic disorders can lead to heightened healthcare expenses, reduced work efficiency, and a lower quality of life, which can be a significant economic burden on families, communities, and the healthcare system. The study findings will aid the Ministry of Health and Health Non-Governmental Organizations in developing cost-effective strategies for preventing and managing these conditions.

Additional complications of metabolic disorders in adolescents include a higher risk of heart disease, kidney disease, and other chronic illnesses. By identifying adolescents who are more susceptible to metabolic diseases, better preventative or mitigating strategies can be developed. An understanding of the predictors of metabolic disorders can aid. On the other hand, metabolic disorders disproportionately affect specific populations, including those from low-income backgrounds and certain ethnic and racial groups. From the study findings on the predictors of metabolic disorders, we can identify and rectify health inequalities, ensuring that all adolescents have equal access to essential resources, healthcare services, and support they need to maintain good health.

Studying the predictors of metabolic disorders can advance scientific understanding of these conditions and inform the development of new treatments and prevention strategies. This study's findings will improve knowledge of the underlying mechanisms that contribute to metabolic disorders and identify new targets that will assist stakeholders in prioritizing policy actions.

1.9 Scope of the Study

The study focused on predictors of metabolic disorders among adolescents in Lang'ata Sub-County, Nairobi, Kenya. It also highlighted dangerous elements, including exercise, family medical history, and socio-economic status, that result in metabolic disorder development. The study also focused on how common metabolic problems are in this population's adolescents between the ages of 13 and 17.

1.10 Limitations of the Study

There are certain potential limitations to consider in this study, including that the sample size did not accurately reflect the entire population of school-going adolescents in Lang'ata Sub-County, Nairobi, Kenya. To address this limitation, a random sampling technique that selects participants from a wide range of schools and geographic locations in Lang'ata Sub-County was used.

Another limitation was the accuracy of the data collected, which may have been limited by the reliability of the measurements used to assess metabolic disorders and the accuracy of self-reported information about dietary habits and physical activity levels. It was addressed by recalibration of sliding weights and sphygmomanometer.

There may also have been confounding factors, such as genetics, that could have influenced the development of metabolic disorders but were not accounted for in the study. To counter these limitations, the researcher used validated tools and methods to measure metabolic disorders and related risk factors and control for potential confounders in the analysis.

1.11 Delimitations of the Study

Delimitations are defined as a set of boundaries put in the research that are within the researcher's control. They are essential in keeping the goals of the research concise. The study was carried out in 5 schools. The language barrier was a potential source of data errors, and the researcher recruited data collection experts fluent in simple English and, therefore, easily translated questions. The data collection personnel also received adequate training from the researcher to ensure they understood the questions in the data collection tool. The sample size was sufficient to capture the emergence of non-responders and non-response bias.

1.12 Assumptions of the Study

The study assumed that the risk factors for metabolic disorders among adolescents in the Lang'ata Sub-County were comparable to those in other populations. The metabolic disorders prevalence among adolescents in Lang'ata Sub-County are significant enough to warrant investigation and intervention. Additionally, the study participants between 13 and 17 provided accurate and truthful information about their dietary habits, physical activity levels, and health status. Lastly, the study instruments and measures used to assess metabolic disorders and related risk factors were valid and reliable.

The study findings offered valuable acumens for stakeholders in determining and prioritizing policy actions to address metabolic disorders. By understanding the various factors, such as demographic, lifestyle, and psycho-social variables, that contribute to overweight/obesity, policymakers can develop targeted interventions and strategies out of this study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The theoretical bases of the research are reviewed in this chapter, along with the empirical review and conceptual framework that highlights the study's objectives, which included the prevalence of metabolic disorders, social-demographic predictors of metabolic disorders, the association between family medical history and occurrence of medical disorders and lastly, the association between the level of physical activity and occurrence of metabolic disorders.

2.2 The Theoretical Framework

The study was anchored by one theory of behavioural change to examine the predictors of metabolic disorders among adolescents aged 13-17: The Social-Ecological Model (SEM). The model is a widely used framework that facilitates understanding complex interactions among individuals and their environment. Developed by Urie Bronfenbrenner, the SEM emphasizes many factors influencing human behaviour at various levels and provides a comprehensive framework for analyzing and addressing various social issues. The Social-Ecological Model consists of five interconnected levels, each representing a different aspect of an individual's environment. These levels are the “individual level, interpersonal level, organizational level, community level, and public policy” (McLeroy et al., 1988). From an individual perspective, factors ranging from knowledge and attitudes to personal characteristics influence behaviour. While the importance of the other rings is not to be underestimated, this one holds the highest degree of personal significance.

At the individual level, the SEM highlights how children's dietary habits, physical activity levels, and other lifestyle choices can lead to metabolic disorders development. Unhealthy

dietary patterns, as shown from existing research, for example, the consumption of calorie-rich, nutrient-poor foods, as well as sedentary behaviours such as prolonged screen time and insufficient physical activity, are linked to a heightened risk of metabolic disorders in children (Klabunde et al., 2017). Therefore, investigating individual factors like dietary preferences, knowledge about healthy eating, and engagement in physical activities becomes crucial to understanding the predictors of metabolic disorders.

The interpersonal level includes relationships with family, friends, and colleagues, which shape behaviour through social interactions. Whether or not a person is aware of it, the people they interact with can influence them. Although eating is an individual choice, social and environmental factors can impact one's actions. Hence, the Socio-Ecological Model (SEM) emphasizes the role of family support and peer networks in shaping children's health-related behaviours. Family plays a significant part in moulding children's dietary preferences and physical activity routines by making healthy foods accessible at home, establishing mealtime habits, and setting examples through parental behaviour (Yee et al., 2017). Furthermore, peer interactions can affect children's attitudes and behaviours towards food and exercise. Research has demonstrated that children tend to adopt similar eating and physical activity habits as their peers (Salvy et al., 2012). Thus, exploring the role of family dynamics and peer influence within the Lang'ata Sub-County context can provide insights into the predictors of metabolic disorders.

The organization level includes jobs, schools, or institutions. The choices made by institutions or organizations determine whether the members will be carried out or not; hence, they may have either a positive or negative effect on various groups. For instance, if physical education is not provided in schools, students are likely to spend most of their

time in school being sedentary. Schools are designed to offer children the tools necessary for success in life. However, when they limit physical activity within the educational setting, they may inadvertently set students up for future challenges. Also, the school's nutrition feeding program plays a significant role in the meals provided to students.

At the community level, the SEM highlights the significance of surrounding elements significantly impacting children's health behaviours. In the context of Lang'ata Sub-County, access to healthy food options and recreational facilities becomes crucial. Limited availability and affordability of nutritious foods within the community can contribute to unhealthy dietary practices (Salvy et al., 2012). Similarly, a lack of accessible and safe places for physical activity, like parks or sports facilities, can act as a deterrent for children when it comes to participating in regular exercise (Story et al., 2008). The determinants of metabolic disorders can be addressed by understanding the community-level variables that affect children's access to nutritious meals and physical activity opportunities.

Local, state, national, and international laws are all part of the government/policy level, the broadest and outermost ring. Decisions made by officials have the potential to either help or hinder a person's efforts to change. Government intervention can take the form of rules requiring clear labelling and specifications so that eateries can calculate the exact number of calories in their servings. Taxing processed foods, junk food, and other unhealthy foods that raise the risk of obesity is a further example.

The SEM strength is characterized by its ability to consider multiple factors and their interactions in influencing behaviour. It recognizes that individual choices and actions are not isolated but are influenced by the larger systems in which individuals are embedded.

By understanding these complex interactions, interventions can be designed to address social issues more effectively. For example, the SEM has found extensive applications in both research and practical applications within the field of public health. In physical activity promotion, interventions based on the SEM have successfully addressed the multi-level determinants of physical inactivity. These interventions target individuals, social networks, schools, workplaces, and policy environments to create supportive environments for physical activity (Sallis et al., 2008). As such, the SEM provides a comprehensive background for studying the predictors of metabolic disorders among adolescents in Lang'ata Sub-County, Nairobi County, Kenya. By considering the individual, interpersonal, institutional, community, and organizational levels of influence, the study explored factors such as dietary habits, physical activity levels, family support, peer influence, access to healthy food options, environmental resources, cultural norms, socioeconomic disparities, and policy environments.



Figure 2.1: The Socio-Ecological Model

2.3 Review of Related and Empirical Literature

2.3.1 Prevalence of Metabolic Disorders

The prevalence rate associated with metabolic disorders, ranging from overweight, obesity, diabetes, and cardiovascular diseases, has been steadily increasing worldwide, posing significant public health challenges. The prevalence rate of metabolic disorders varies across countries and populations. Globally, the burden of metabolic disorders has risen substantially in recent decades. According to the WHO, “the global prevalence of obesity has nearly tripled since 1975, with more than 1.9 billion adults falling into the overweight category and approximately 650 million adults classified as obese in 2016” (Minja et al., 2022). The authors highlight that urbanization, changes in lifestyle, and dietary shifts towards more unhealthy diets contribute to this increasing prevalence. However, they also note the limited availability of comprehensive data on the prevalence rates associated with metabolic disorders in many Sub-Saharan African countries.

Diabetes, a common metabolic disorder, has also shown a significant increase in prevalence. According to the International Diabetes Federation (IDF), 463 million persons worldwide were predicted to have diabetes in 2019 (global prevalence rate: 9.3%) (Saeedi et al., 2019). This prevalence is expected to rise to 10.2% by 2030 (Sugathan et al., 2021). The prevalence rate of diabetes varies by country, with higher rates observed in low- and middle-income countries (Saeedi et al., 2019). The increasing prevalence rate of metabolic disorders has significant health and economic implications. These disorders are associated with a higher risk of various health complications, including cardiovascular diseases, stroke, certain types of cancer, and reduced life expectancy (Global Burden of Disease Study 2017, 2017). Additionally, metabolic disorders contribute to substantial healthcare

costs and economic burdens, including direct medical expenses, productivity losses, and decreased quality of life (Vesikansa et al., 2023).

Understanding the prevalence rate of metabolic disorders is essential for public health planning, resource allocation, and the development of effective prevention and intervention strategies. Surveillance systems, national health surveys, and population-based studies contribute significantly to collecting data on the prevalence and trends of metabolic disorders.

2.3.2 Socio-Demographic Factors Associated with Metabolic Disorders

Socio-demographic predictors contribute immensely to the development of metabolic disorders among adolescents. Several studies have examined how sociodemographic factors affect this population's risk and the prevalence of metabolic disorders. One crucial aspect is socioeconomic status (SES), which includes factors such as “income, education, and occupation.” Research suggests that children from lower SES backgrounds are considered to be in a higher risk of developing metabolic syndromes due to various reasons, including limited access to healthy food options, higher exposure to unhealthy dietary practices, and limited opportunities for physical activity (Ye et al., 2023).

An investigation by Sentalin et al. (2019) conducted in Brazil discovered that children from lower SES backgrounds had a metabolic syndrome, and the prevalence was higher compared to the higher SES counterparts. The research brought attention to the impact of socioeconomic factors on the emergence of metabolic illnesses, underscoring the necessity of developing interventions that specifically target at-risk populations. Family dynamics and the social environment are also quite important. For instance, parental education and

family structure can impact the adoption of healthy lifestyle behaviors and dietary habits among children (Slivšek et al., 2024). Empirical work by Whitley et al. (2018) established that higher parental education was associated with a lesser risk level of metabolic syndrome in children.

Furthermore, neighborhood characteristics, such as access to recreational facilities, safety, and walkability, have been linked to the development of metabolic syndromes among children. A study by Nguyen et al. (2021) demonstrated that children living in neighborhoods with higher levels of deprivation and limited access to recreational spaces had a higher risk of metabolic syndrome.

Demographic predictors, such as age, gender, and ethnicity, have been studied in relation to the development of metabolic syndromes among adolescents. Age is a critical demographic variable linked to the emergence of metabolic disorders. Research suggests that as children move from their early years of their childhood into adolescence, metabolic disorders risks are very high (Kyrrou et al., 2020). This may be attributed to changes in growth patterns, hormonal shifts, and lifestyle factors during this developmental period.

Gender variations have also been identified in the occurrence of metabolic syndromes. Studies have found that boys and girls may exhibit different patterns of metabolic risk factors. For example, boys may have higher levels of central obesity and insulin resistance, while girls may be more susceptible to alterations in lipid profiles (Mohamed et al., 2023). The importance of considering gender-specific approaches in the prevention and management of metabolic syndromes is highlighted by these gender disparities.

Ethnicity or race is another demographic factor that has been associated with metabolic syndromes among school-going children. Certain ethnic groups, such as Hispanic, African American, and South Asian children, have been reported through multiple existing studies to have a higher prevalence of metabolic disorders compared to their Caucasian counterparts (Cao et al., 2022). Genetic predispositions, cultural practices, and variations in lifestyle behaviors among different ethnic groups may influence these disparities.

Several empirical works have looked into the role of demographic predictors in developing metabolic syndromes among children. For example, a study by Moore et al. (2017) carried out in the US found that older age, female gender, and non-white ethnicity were significant predictors associated with metabolic syndrome in a sample of children and adolescents. Andersen et al. (2018) research has shown elevated rates of metabolic syndrome among Hispanic and African American children when compared to their non-Hispanic White counterparts. These ethnic disparities may be attributed to genetic predispositions, cultural differences in dietary patterns, socioeconomic factors, and healthcare disparities.

MacPherson et al. (2016) investigated the correlation among age, gender and metabolic syndrome features among Canadian children and adolescents. The results indicated that advanced age and being female were linked to a heightened risk of metabolic irregularities, such as elevated blood pressure and abnormal lipid profiles.

Additionally, demographic predictors may interact with other factors, such as socioeconomic status and lifestyle behaviors, to influence the development of metabolic syndromes among children. For instance, a study Lee (2019) investigated how the combined impact of demographic factors, socioeconomic status, and dietary habits

influenced the risk of developing metabolic syndrome in Korean children. The results demonstrated that socioeconomic factors and dietary behaviors mediated the relationship between demographic predictors and metabolic syndrome risk. Socioeconomic status (SES) is another essential demographic predictor that influences the development of metabolic syndromes in children. Similarly, a systematic review by Miranda et al. (2020) identified a significant socioeconomic gradient in the metabolic syndrome prevalence among children, with those from lower socioeconomic backgrounds having higher rates. Limited access to nutritious foods, increased exposure to obesogenic environments, and reduced opportunities for physical activity contribute to the higher prevalence of metabolic syndromes among children from lower SES backgrounds.

Furthermore, even the type of school attended is another sociodemographic factor. Another study by Kimbally et al. (2021) was set to discover the prevalence and determinants of metabolic syndrome among primary school pupils in Brazzaville, Congo. The study identified several determinants of metabolic syndrome, including age, sex, family history of metabolic disorders, and physical inactivity. There could be a difference in the dietary changes and level of physical activities in schools compared to public schools.

2.3.3 The Association between Family Medical History and Occurrence of Metabolic Disorders

According to studies, those who have a family history of metabolic diseases like type 2 diabetes or dyslipidemia are more likely to develop those conditions later. Genetic variants have also been implicated in metabolic disorders. For instance, specific gene variants related to insulin resistance or lipid metabolism have been associated with an elevated risk

of metabolic disorders (Jääskeläinen & Klemetti, 2022). Sedentary behavior has also emerged as a predicting factor for metabolic disorders. Prolonged sitting and low physical activity levels contribute to metabolic dysfunction, including insulin resistance, dyslipidemia, and obesity. Unhealthy dietary habits, characterized by high consumption of processed foods, added sugars, and unhealthy fats, have been strongly linked to metabolic disorders (Witek et al., 2022).

Children's physical health is significantly impacted by metabolic diseases. Obesity, which ranks among the most prevalent metabolic disorders, is linked to numerous physical health complications, including cardiovascular diseases, hypertension, and dyslipidemia. Excess body weight, particularly central adiposity, contributes to reduced sensitivity to insulin, dyslipidemia, and other metabolic abnormalities (Kansra et al., 2021). Numerous researches has shown a significant correlation between “obesity and metabolic disorders, including type 2 diabetes, metabolic syndrome and cardiovascular diseases” (Davoudi-Kiakalayeh et al., 2017). These conditions can significantly affect the quality of life of children, limit their mobility and physical activity, and lead to a decreased sense of well-being (Arsenovic et al., 2022). Additionally, children with metabolic disorders may experience fatigue, joint problems, and difficulties being active in social and physical activities, all of which contribute to diminished physical well-being (Reinehr, 2018).

Metabolic disorders also impact the psychological well-being of children. Children with metabolic disorders often face social stigmatization, bullying, and discrimination, which further exacerbate their psychological distress and reduce their overall well-being (Haqq et al., 2021). Psychological support and interventions are crucial in addressing the well-being challenges faced by children with metabolic disorders.

Metabolic disorders can also influence the social well-being of children. Obese children may experience social isolation, exclusion, and difficulties in forming positive peer relationships due to weight-related stereotypes and biases (Salas et al., 2019). These social challenges can lead to feelings of loneliness, reduced social support, and lower overall social well-being. Additionally, children with metabolic disorders may face limitations in participating in social activities, sports, and recreational events due to physical limitations or health concerns, which further impact their social well-being (McDermott et al., 2022). Children who suffer from metabolic disorders typically have a significant impact on their quality of life. It encompasses various dimensions, including physical, social, and psychological well-being. Children with metabolic disorders often report a diminishing quality of life compared to their healthy peers (Lister et al., 2023). Their physical limitations, health-related complications, psychological distress, and social challenges collectively contribute to a diminished overall quality of life.

A study by Julian et al. (2022) sought to find out how obese adolescent patients' levels of physical activity, along with their sedentary behavior, related to their diagnosis of metabolic syndrome. A total of 134 obese adolescents (13.4 2.2 years on average) were enrolled in the study. To measure physical activity and sedentary behavior, the researchers collected data using accelerometry during a 24-hour period for seven days. They also measured waist circumference, triglycerides (TG), blood pressure, insulin resistance (IR), and high-density lipoprotein-cholesterol (HDL-c) as indicators of cardiometabolic risk. The results showed that participants with “lower sedentary behavior and higher levels of moderate-to-vigorous physical activity (MVPA) had lower prevalence of metabolic syndrome and lower MetScore.” Among the different groups, those with lower sedentary

behavior and higher MVPA had the lowest cardiometabolic risk. While sedentary behaviour and MVPA times were lower in participants with lower sedentary behaviour and MVPA than those with higher sedentary behaviour and MVPA, the MetScore was lower in the former group, regardless of body mass index (BMI). MVPA time was independently associated with the diagnosis of metabolic syndrome, while both MVPA and sedentary behaviour times were independently associated with the MetScore. The results indicate that increased levels of MVPA and reduced sedentary behaviour are linked to a reduced overall cumulative risk of cardio-metabolic issues.

In research done by Chen et al. (2021), researchers aimed to investigate the link between being a single child and the occurrence of metabolic syndrome (MS) in adolescents and young children. The study encompassed 11,784 participants, with an average age of 11.3 ± 3.1 years, including 5,880 boys. The researchers employed multivariate logistic regression analysis to compute odds ratios (OR) and 95% confidence intervals (CI) to evaluate the relationship between single-child status and MS and its constituent components. The findings revealed a significant association between being a single child and MS, primarily among urban boys and rural boys. However, this association was not significant in girls. Additionally, among the various combinations of MS components analyzed, two specific combinations exhibited a significant association with being a single child. These combinations comprised elevated blood pressure, abdominal obesity, low high-density lipoprotein cholesterol (HDL-C), elevated blood pressure, abdominal obesity, low HDL-C, and hypertriglyceridemia.

In a study conducted by Chen et al. (2021), the aim was to assess the occurrence of metabolic syndrome, dietary preferences, and sedentary behaviors among students at the

main campus of Mount Kenya University. The research employed statistical methods, including Pearson's chi-square tests and non-parametric independent t-tests, to explore several aspects: the relationship between gender and the “prevalence of metabolic syndrome criteria, the link between the number of metabolic syndrome criteria and body mass index (BMI), and how the prevalence of metabolic syndrome criteria varies across different BMI categories.” The study established that 1.9% of the participants met the criteria for diagnosis of metabolic syndrome. The study's outcomes revealed a statistically significant association between leading a “sedentary lifestyle and maintaining poor dietary habits as risk factors for metabolic syndrome.” This suggests that university students who engage in sedentary behaviours and follow unhealthy dietary practices are more likely to develop metabolic syndrome.

2.3.3 Association between Level of Physical Activity and Occurrence of Metabolic Disorders

The primary contributing factors to obesity, insulin resistance, and eventually elevated cardiometabolic risk in individuals with type 1 diabetes mellitus (T1DM) are thought to be a sedentary lifestyle, lack of exercise, inadequate nutrition, and poor treatment compliance (Koca et al., 2019). Insulin resistance, defined by restricted stimulation of glucose metabolism in the muscles and liver, is a characteristic shared by most people with type 1 diabetes. In these patients, insulin-mediated glucose absorption has been shown to be reduced by 30–50%. Certain insulin-dependent individuals might exhibit phenotypic traits linked to type 2 diabetes. Patients with this condition have been referred to as having "double diabetes." Both macrovascular and microvascular problems are more likely to

occur in these people. Compared to insulin-sensitive and slim people, they have greater rates of illness and mortality (Koca et al., 2019).

Frequent exercise offers several advantages, including improved quality of life and reduced cardiovascular risk and death. Engaging in physical activity can serve as a potent inducer of homeostasis, as it improves peripheral insulin sensitivity and balances energy (Davies et al., 2018). Exercise's hormonal and metabolic effects are influenced by its intensity, duration, and specific training status. Skeletal muscles are an endocrine organ that, in addition to being an organ of movement, also produce and release a variety of myokines, growth factors, and metalloproteinases in response to contraction. The metabolism may be impacted by myokines secreted. Independent of insulin, muscle contraction causes an increase in glucose absorption and the recruitment of glucose transporters to the cell membrane (Koca et al., 2019).

2.4 Identification of Knowledge Gap

There is ample literature on predictors, factors, and metabolic syndromes among children. Still, existing studies lack consideration of the specific geographical and cultural factors that could influence the predictors of metabolic disorders from regional and local perspectives. The variations in age groups of children are also not evident in the available literature. Variations in dietary patterns, age groups, physical activity levels, and socio-cultural norms across different regions or communities could impact the findings and generalizability.

2.5 Conceptual Framework

In this study, the dependent variable is the presence or absence of metabolic disorders, while the independent variables are categorized as socio-demographic factors, family history of metabolic disorders, and level of physical activity, as shown in Figure 2.2. This means that the study aimed to explore how these variables are associated with the occurrence of metabolic disorders.

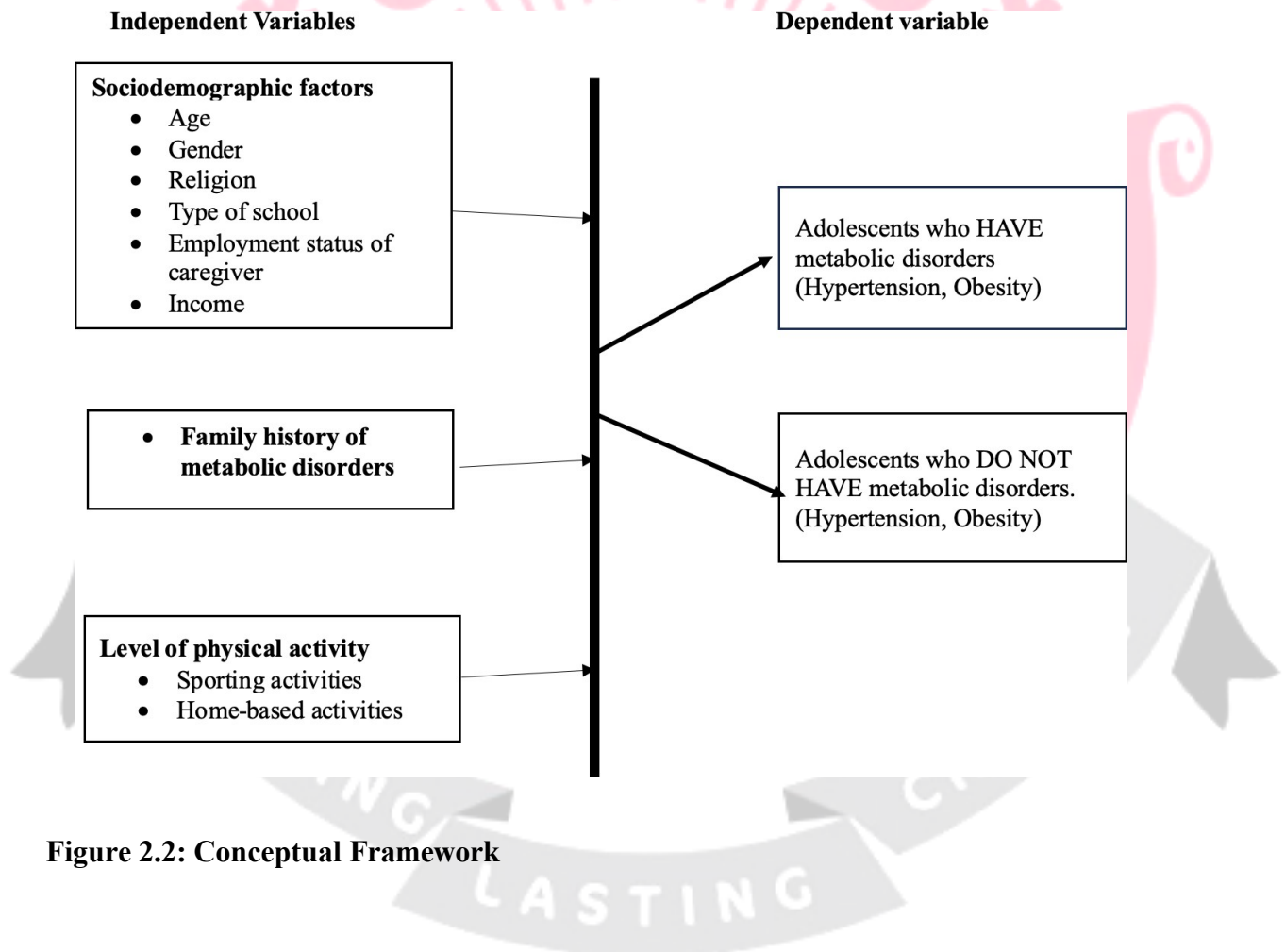


Figure 2.2: Conceptual Framework

CHAPTER 3: METHODOLOGY

3.1 Introduction

This section outlines numerous techniques that were utilized for the collection and analysis of field data. It has been divided into the following sections: research design, study area, target population, sampling techniques, data collection methods, validity and reliability, data analysis, and ethical considerations.

3.2 Research Design

The study utilized a cross-sectional design targeting adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi County. This design enabled the researcher to interview and examine participants from the study population at a single instance, providing an accurate depiction of the population's characteristics. This study design was appropriate because it enabled the random selection of a sample that can be considered representative, and it also facilitated the researcher's quantitative data collection.

3.3. Study Area

Lang'ata constituency is an electoral division situated within Nairobi City County and is among the seventeen constituencies found in the County. It encompasses Nairobi's southern and southwestern regions, as indicated in the figure 3.1. Previously, it shared borders with the now non-existent Kibera Division of Nairobi. Spanning an extensive area of 196.80 km² (76.0 sq. mi), Lang'ata Constituency is the largest constituency in Nairobi. Notably, Lang'ata Constituency shares a border with Kibera, Kenya's largest slum. Before the establishment of Kibra constituency by the Independent Electoral and Boundaries Commission, a portion of Kibera was included within the Lang'ata Constituency. Presently,

a smaller section of the slum still falls under the jurisdiction of Lang'ata Constituency. Additionally, Lang'ata Constituency comprises the well-to-do suburb of Karen, the predominantly middle-class suburb of Lang'ata, and Mugumoini and Nairobi West in the Mugumoini location, all located within Nairobi. Lang'ata Division was selected as a suitable location for the study due to its composition of both slum and non-slum settlements. Moreover, the division is inhabited by diverse ethnic groups with varying socio-economic backgrounds. These factors are crucial for the research as they help identify the multiple factors contributing to metabolic disorders among adolescents.

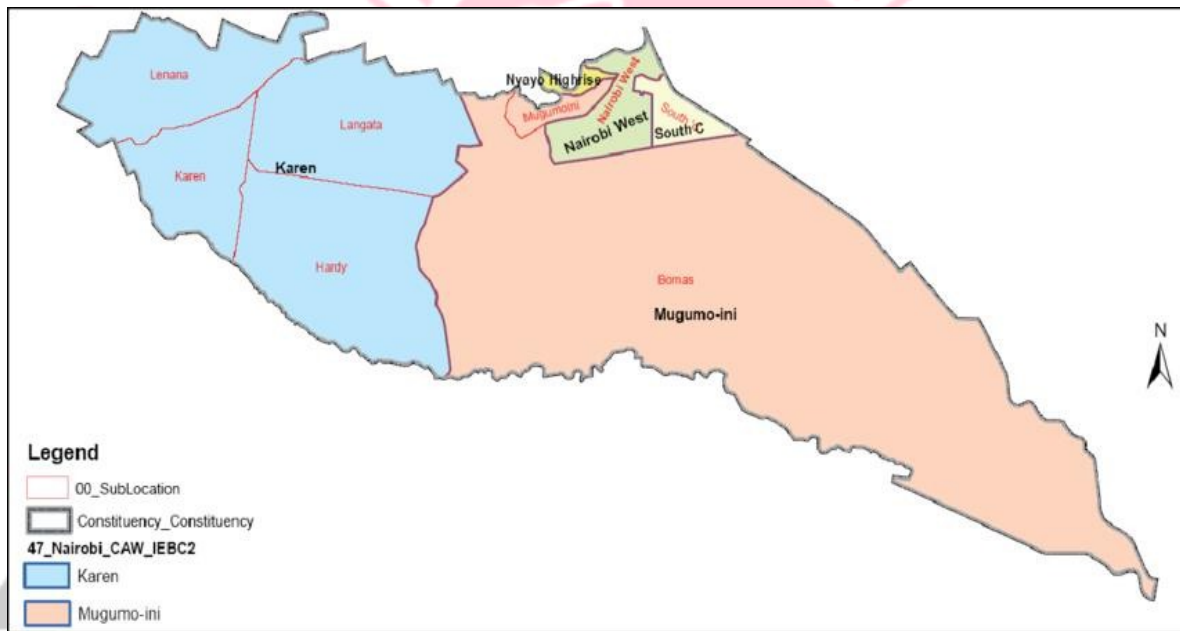


Fig 3.1: Map of the Study Area

3.4 Target Population

This research comprised adolescents 13 to 17 years of age enrolled in day secondary schools located within the Lang'ata Sub-County. Notably, there is a shortage of data regarding the metabolic syndrome status among adolescents within this age group in Nairobi County. Adolescence accounts for a critical period of development when

significant physiological changes occur. Adolescents aged 13-17 typically experience puberty, hormonal fluctuations, and rapid growth, which can influence metabolic processes (Agudelo et al., 2014; WHO, 2021). The age group the study has chosen aligns with this critical developmental stage.

Inclusion Criteria: The study included adolescents aged 13-17 years who were residents of Lang'ata Sub-County. Participation in the study required those who signed an Assent form and had signed consent from their parents/guardians. Also, they must have lived in Langata Sub-County with their parents for at least 3 months.

Exclusion Criteria: Adolescents who provided consent from parents and assent but did not show up or participate in the study for various reasons, such as being sick.

3.5 Sample and Sampling Procedures

The Cochran formula (Cochran, 1963; Fisher *et al.* (1998) was used to establish the sample size. The formula is expressed as $N = (Z^2pq) / d^2$,

$$n = \frac{Z^2 p(1 - p)}{d^2}$$

Where:

n = the desired sample size.

Z = standard normal deviation (1.96)

p is assumed to be 0.5 due to the unknown prevalence of metabolic syndromes among school-going adolescents in the study area

q = 1 - p

d = the required degree of accuracy (0.05)

By substituting the values into the formula, the calculation becomes

$$(1.96 \times 1.96) \times 0.5(1 - 0.5) / (0.05)^2 = 384.$$

Adjusting for a smaller sample size and reducing the sampling error margin, the second formula (Fisher's finite correction formula) was used as follows:

$$n_f = \frac{n}{\{1 + \frac{n}{N}\}} = \frac{384}{1 + (384/495)} = 216$$

n = sample size (384)

N = total population (aged 13-17 years) in 5 schools (495)

The sample size was reduced from 384 to 216 because there are no more than 10,000 adolescents in Lang'ata Sub-County schools.

Lang'ata Sub-County was purposefully chosen as one of the study areas because it is peri-urban and has a characteristic environment that poses risks for metabolic disorders. Urban and peri-urban regions in Kenya have undergone significant socio-economic and demographic changes due to increased urbanization. From the calculated sample size 216, five secondary schools were sufficient for generating the required sample using a multi-stage sampling approach.

With the guidance of the Lang'ata Sub-County records office, I categorized the schools into 5 categories based on their perceived economic zone: large-scale business owners, small-scale business owners, heads of households employed in the formal sector, casual workers, and unemployed. Systematic random sampling was used to select five schools (Hillcrest Sec School, Langata High Sch, Raila Educational Center- Sec Sch, Shree Cutchi

Leva Patel Sec, and Brookhouse Schools- Sec) from the total of 35 mixed-day schools listed in Appendix IV. Every 7th school from the list of 35 schools was picked. The total population (aged 13-17) of the 5 schools was 495. The sample of 216 participants was distributed, utilizing probability proportionate to size sampling at five schools. To guarantee representation across several classes, stratified sampling was used at the school level, and a student from the age group of 13-17 years was picked randomly, as each student in the strata had an equal chance of being picked.

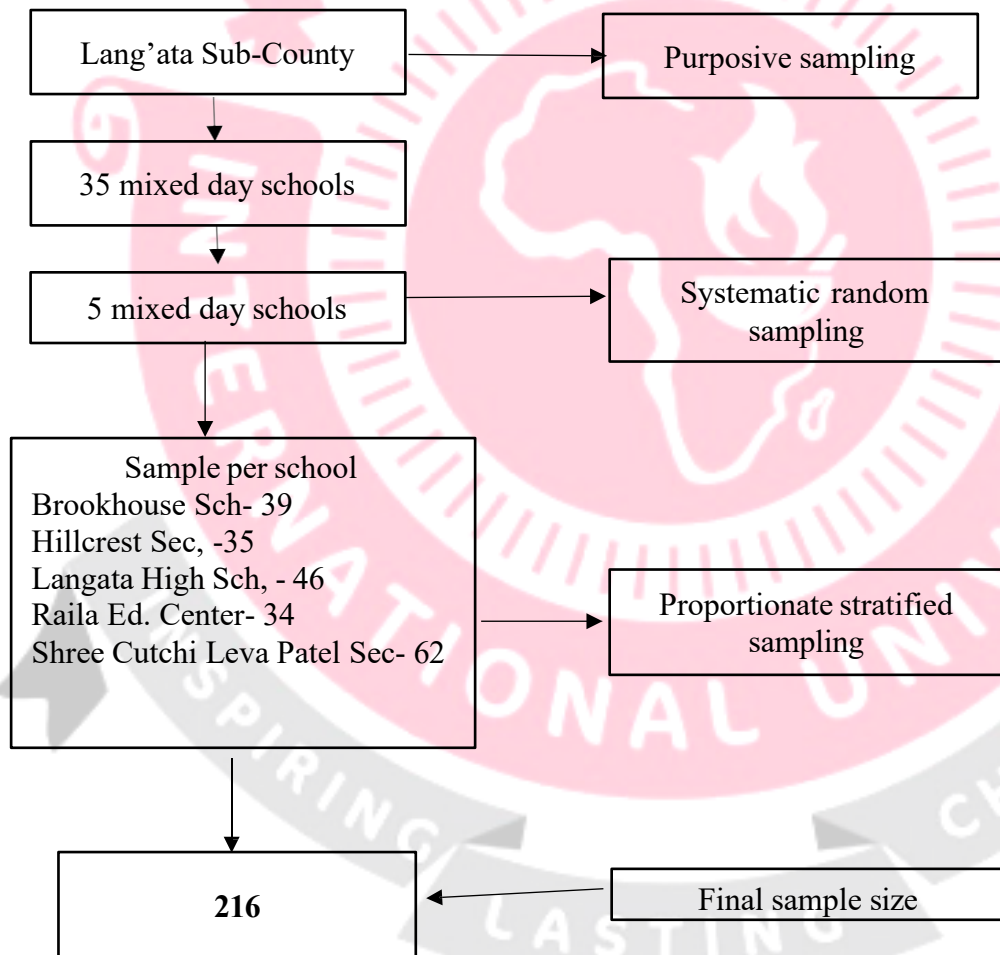


Figure 3.2: Sampling Procedure

3.6 Data Collection Instruments

The researcher utilized a structured questionnaire that had closed-ended questions that were administered in the classroom to collect data regarding sociodemographic profile, information on family medical history of metabolic disorders, and level of physical activity in school and at home. According to Cochran (1977), a self-administered questionnaire is the most suitable method for gathering self-reported data on people's opinions, attitudes, beliefs, and values.

3.7 Reliability and Validity of the Data Collection Tools

3.7.1 Validity

The adopted questionnaires were carefully pretested to ensure their validity using participants who were not in the study and from a different school. Prior to this, university supervisors played a crucial role in the assessment of the questionnaires to ensure their appropriateness and accuracy for the subject of study. Any necessary modifications recommended by the supervisors were compulsory. Inputs from the Amref Ethics and Scientific Review Committee (ESRC) were also incorporated to ensure the data collection tool was valid. The questionnaire was then revised in line with these expert opinions as well as the results from the pretest run to ensure thorough validity testing. To ensure accurate results, calibration of the anthropometric measurement equipment, such as the sliding weights used for weighing, was conducted after each measurement to reset it to zero. This calibration process helped to ensure that the equipment provided correct and reliable measurements. To ensure accurate data collection, research assistants went through training on the data collection procedures, objectives, and purpose of the study. The researcher also carefully reviewed the questions to ensure they were clear and consistent

for all respondents. Furthermore, data verification was conducted twice before data entry to minimize errors and ensure the accuracy of the collected data.

3.7.2 Reliability

To assess the reliability of the selected questionnaires, the study employed the test-retest technique. This involved administering the questionnaires to 4 different respondents who were not involved in the study and were enrolled in a different school on two separate occasions, with a five-day interval between the discussions to assess the consistency in the responses. The results from the two sets of responses were compared by calculating the correlation coefficient. Based on previous research by Adom et al. (2019), a correlation coefficient above 0.70 is considered an acceptable threshold for reliability. The questionnaire's reliability was assessed using Cronbach's alpha scale, which provides a measure of the correlation among the items and ranges from 0 to 1. Cronbach's alpha value of 0.7 or greater is generally considered indicative of good reliability for a measurement scale or questionnaire, while values below 0.7 are considered unsatisfactory."

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N - 1)\bar{c}}$$

Number of items
Average variance
Average inter-item covariance among the items

Where N is equal to the number of items, \bar{c} is the average inter-item covariance among the items, and \bar{v} equals the average variance.

$$\bar{v} = (1.168+1.012+1.169+1.291)/4=1.16$$

$$\bar{c} = (0.724+0.673+0.690+0.720+0.574+0.557)/6=0.656$$

$$\alpha = \frac{4(0.656)}{1.16 + (4 - 1)0.656}$$

$$\alpha = 0.839$$

The correlation coefficient is above 0.7 and hence was considered acceptable

3.8 Data Collection Procedures

3.8.1 Method

Data collection began with the researcher recruiting five undergraduate research assistants. After recruitment, the researcher embarked on training the research assistants on the parameters and the methods of data collection. The training took two days before they proceeded to data collection. All the research assistants reported directly and took instructions from the researcher. Before the data collection, the researcher wrote a letter to the Sub-County administration explaining the purpose of the information she was about to collect and the benefits to the local community. The letter's purpose was for the local administration to furnish her with the authorization letter to collect the data from designated schools within their jurisdiction. Each research assistant was assigned one school for data collection. The initial group was situated comfortably in a specially designated classroom where they listened to the primary investigator provide an overview of the study and its goals. Any student queries regarding the study were acknowledged, and clear explanations were given. Then, every student whose parents or guardians provided written consent and the participants themselves a written assent to participate in the study was given a standardized questionnaire. Information on socio-demographic variables, family medical history, and level of physical activity were gathered through the questionnaire. For the

subsequent groups, the same procedure was used to ensure everyone received the same introduction and completed the questionnaire.

The socio-demographic information of interest included the educational level of both the mother and father, categorized as “tertiary, secondary, primary, or no formal education.”

The family medical history was recorded based on Individuals who have a parent/family member with hypertension, diabetes mellitus, or both were categorized as "positive," indicating the presence of these conditions in their biological parent(s). Conversely, respondents who do not have parents suffering from diabetes or hypertension were grouped as "negative."

Physical activity levels were evaluated based on the frequency of participation in moderate to high-intensity activities throughout the week. Moderate-intensity activities refer to those that elevate the heart rate without causing excessive sweating or breathlessness, such as activities like walking or playing ampe. Conversely, high-intensity activities involve a significant increase in both breathing and heart rate, as seen in activities like football or jogging. Children and adolescents ages 6 through 17 years should do 60 minutes (1 hour) or more of moderate-to-vigorous physical activity daily ("2008 physical activity guidelines for Americans," 2021).

These levels of physical activity were divided into four categories: "not at all," "regularly," “rarely,” and “seldom.” In terms of leisure-time activities, respondents were classified into non-sedentary activities, which encompassed playing basketball, football, ample, or walking, or sedentary activities, such as watching TV, playing video games, using social media, or chatting.

Additionally, the respondents' health status (“weights, heights, waist circumference, hip circumference, and blood pressure”) was measured as part of the study.

Blood pressure measurements were taken on the respondents after they had completed their questionnaires and rested for a minimum of 5 minutes. The data was collected during breaks, preps, and lunch hours to ensure school programs were minimally disrupted during the study. Individuals with blood pressure measurements above the normal range were informed of their results and recommended to seek medical care for further review and evaluation.

3.8.2 Questionnaires

To collect data from the students, a self-administered structured pre-coded questionnaire was utilized. Before distributing the questionnaires, a comprehensive explanation of the study was provided to the students. In order to participate, the researcher sought consent from parents or guardians, and the students themselves were asked to provide their assent. During the questionnaire administration process, the principal investigator read each question out loud to the students. Clear instructions were provided to guide the students on filling out the forms accurately and warrant a conclusion.

Table 3.1 Measurement of Variables

Research question	Variable to be measured	Methods of data collection for the targeted variables under each research question	Analysis to be applied
Prevalence of metabolic disorders.	Diagnosed with metabolic disorders, weight, height, BMI, waist-hip circumference, waist-to-height ratio, Blood pressure	Interview Weight was measured using recalibrated sliding weights, height, waist and hip circumference using a standard measuring tape, and Blood pressure using Omron sphygmomanometer along with small, medium, and large cuffs.	Univariate analysis
Association between socio-demographic predictors and occurrence of metabolic disorders	Age, gender, religion, and the type of school were established.	Interview	Bivariate analysis- Chi-square test Multivariate- logistic regression
Association between family medical history and occurrence of metabolic disorders.	Confirm if there is family medical history of metabolic disorders.	Interview	Bivariate analysis- Chi-square test Multivariate- logistic regression
Association between level of physical activity and occurrence of metabolic disorders.	If involved in sports, frequency, duration, and type of sport played in school. High intensity-football, volleyball, hockey, tennis Moderate-intensity activities focused on whether they participate in home-based activities such as washing, cleaning, cooking, gardening, etc	Questionnaire	Bivariate analysis- Chi-square test Multivariate- logistic regression

3.8.3 Body Mass Index (BMI)

Body Mass Index (BMI), which is a measure of general obesity, was calculated by dividing the weight in kilograms (kg) by the square of the height in meters (m²). To determine the BMI classification, the following ranges were used:

Table 3.2 BMI Determination

BMI	Weight status
Below 18.5	Underweight
18.5-24.9	Healthy
25.0-29.9	Overweight
30 and above	Obese

3.8.4 Waist to Height Ratio (WHtR)

To calculate the WHtR, the waist circumference was divided by the height, both measured in centimeters. WHtR is a measure allied to cardiovascular risk and was used to assess the distribution of body fat. The cut-off point for WHtR is considered within the normal range if it is ≤ 0.5 . This means that individuals with a WHtR of 0.5 or lower are considered to have a lower risk of cardiovascular problems associated with abdominal obesity.

3.8.5 Blood Pressure

To measure blood pressure, a calibrated Omron electronic sphygmomanometer was used along with an appropriately sized cuff that covers approximately 40 to 60% of the right upper arm. The blood pressure measurements were taken after the participants had been seated for at least 5 minutes to ensure they were in a relaxed state. Two readings were

taken, with a time interval of five to ten minutes between each reading, to allow for any variations. All the sphygmomanometers were calibrated before the study started. The average pertaining to the two readings was then documented as the participant's blood pressure measurement. This approach helped ensure accuracy and reliability in the recorded blood pressure values. Blood pressure staging adhered to the American Heart Association classification. ('High blood pressure,' 2024)

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

Table 3.3: American Heart Association Blood Pressure Staging (Source: ('High blood pressure,' 2024))

3.9 Data Management, Analysis, Presentation and Dissemination

The data was collected in paper format. The questionnaires and consent/assent forms were stored in folders to maintain confidentiality. The already collected data were immediately entered into an Excel sheet, with the researcher ensuring that the Excel sheet had a unique password that was only known by the researcher. In cases where a participant withdraws from the study and the data has been collected, the researcher did not include the response in her study. Instead, she shredded the questionnaire and discarded it as per the participant's

wish. Data, including the consent and assent forms, were stored for two weeks. The paper questionnaires were shredded into small pieces and discarded immediately.

Version 28 of SPSS software was used for data processing and analysis. Social-demographic information was analyzed using univariate descriptive statistics. For categorical variables, they were presented in terms of proportions, percentages, and ratios. Continuous variables, on the other hand, were presented as average (mean) accompanied by standard deviations. These results were presented in tabular form.

Blood pressure measurements were entered into Medcalc 3000, a medically validated reference tool, to classify them as normal, prehypertensive, or hypertensive. Age and height percentiles were used to classify values. Those that fall outside of this range were classified as abnormal, which includes prehypertensive and hypertension categories. The result was a binary classification.

To explore relationships among the variables, cross-tabulations were carried out and tested, and the statistical significance of these relationships was assessed using Pearson's Chi-Square test. A p-value of <0.05 was deemed statistically significant.

Each risk factor of metabolic syndrome was converted into a dichotomous variable; a "0" value denoted the lack of the risk factor, while a "1" value signified the presence of the risk factor. The cumulative score for each participant was determined by adding together the individual scores assigned to each risk factor. A score of 0 indicated no risk factors, and a score of 1 indicated the presence of a risk factor.

The main predictor of metabolic disorder among adolescents aged 13-17 years in Langa'ta Sub-County is very critical for the residents; therefore, data was disseminated to the Graduate School via the Department of Community Health at AMREF International University and the Ministry of Health. Dissemination of information to the schools, parents, and even community leaders was done through Chiefs barazas, health education programs, and health talks in Lang'ata County through the Nairobi County Public Health Office with approval from the Kenya Medical Practitioners and Dentist Council. These sessions included lectures and health talks based on lifestyle modification, including diet and physical activities. Also, recommended measures that needed to be taken to ensure management of the disorders to avoid further complications.

3.10 Ethical Considerations

The study went through the necessary ethical clearance and approval process from the Amref Ethics and Scientific Review Committee (ESRC) to ensure that it meets the ethical standards and guidelines. After obtaining an introductory letter from the university, the researcher acquired a research permit from NACOSTI and the Ministry of Education. Research assistants signed Data Confidentiality Agreement forms to adhere to the ESRC guidelines on the confidentiality of the respondents. The researcher assured the respondents that the information collected was used exclusively for the study. Their identities were kept anonymous, as they were not required to provide their names or contact details. The principle of voluntary consent was upheld, with the respondents having the choice to participate willingly in the study. The researcher clearly explained the true purpose of the study to the participants, ensuring that they had a clear understanding of its objectives. In addition, consent was sought from the parents or guardians of the participants, recognizing

their role and involvement in the research process. The researcher addressed the principles of beneficence and non-maleficence by ensuring that all participants receive comprehensive and easily understandable information regarding the study's objectives, methods, potential risks, advantages, and any other pertinent information. Respondents were encouraged to seek clarification and provided their consent to participate voluntarily. The collection of data and physical examination of study participants were done at the sick bay of each school, one student at a time, to maintain privacy during physical examination. To maintain confidentiality of the data collected and the instruments, they were stored at the researcher's home.



CHAPTER 4: RESULTS

4.1 Introduction

In this chapter, the researcher presents the results of the data collection and analysis based on the objectives and hypothesis set out in the first chapter of the study. The researcher presents the results of the data collection and analysis based on the objectives and hypothesis set out in the first chapter of the study.

4.2 Participants Socio-demographic Characteristics for Metabolic Disorders

The total number of students who participated in the study was 216. They were interviewed on their age, religion and type of school. The majority of the students were 17 years of age. The mean age of the students was 15 years, with a standard deviation of ± 1.32 and a variance of 1.74. The modal age was 17 years. The median age was 16 years. Most of the students were females, 61.5%. A majority of the respondents were Christians (60.2%). Most of the students who participated were from private schools, 59.7% as shown in Table 4.1.

Table 4.1: Socio-Demographic Characteristics

Variable	Category	N=216(%)	Lifestyle Disorder	
			Yes N=28(13%)	No N=188(87%)
Age of the participant	13	20(9%)	1	19
	14	35(16%)	4	31
	15	45(21%)	6	39
	16	50(23%)	8	42
	17	66(31%)	9	57
Gender of respondent	Male	83(38.5%)	10	73
	Female	133(61.5%)	18	115
Religion of respondent	Christian	130(60.2%)	11	119
	Muslim	45(20.8%)	9	36
	Hindu	41(19%)	8	33
Type of school	Private	129(59.7%)	18	111
	Public	87(40.3%)	10	77

4.3 Prevalence of Metabolic Disorders among Adolescents

The research sought to determine the prevalence of metabolic disorders. As per the study, the majority of the respondents, 189 (87%), did not have any lifestyle disorder, and 28 (13%) had been diagnosed with lifestyle disorder. Of the 28 adolescents, 18(64.5%) were females, and 10(35.5%) were males, as shown in Table 4.2. Of the 28 adolescents, 18 of them were overweight (BMI 25.0-29.0)/obese (BMI >30) based on the Body Mass Index and waist-to-height ratio (>0.5), and 10 of them were pre-hypertensive. (BP>120/80 mmHg)

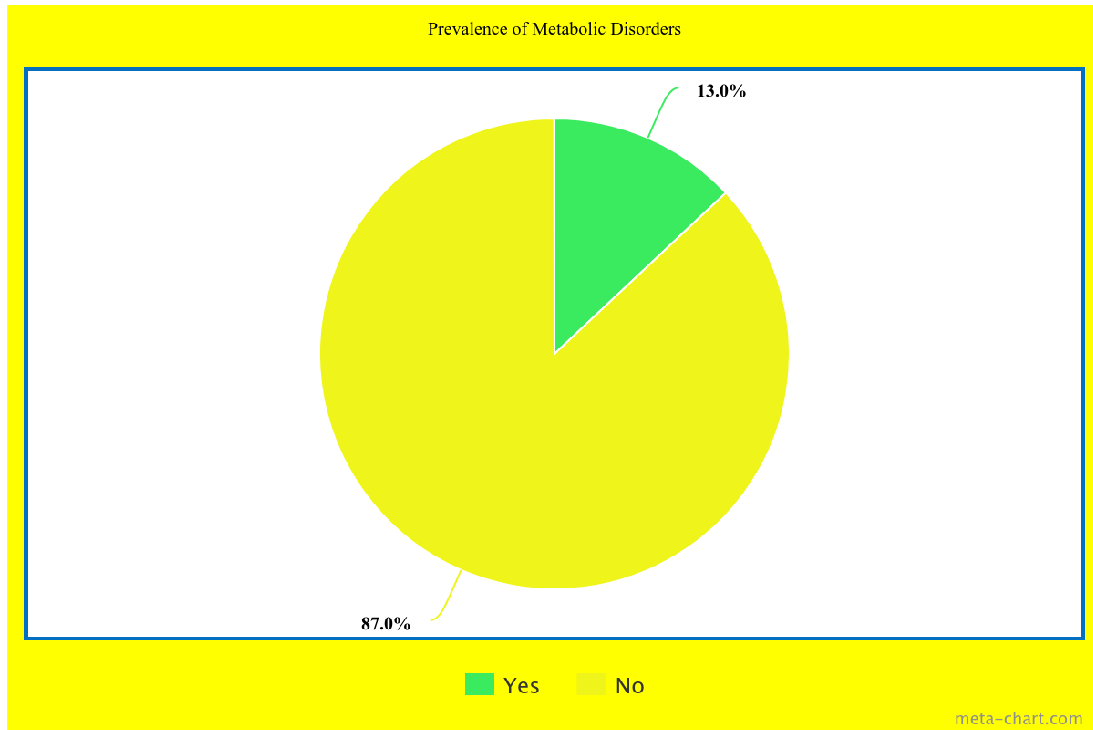


Figure 4.1: Prevalence of Metabolic Disorders

The research further sought to determine familiarity with lifestyle disorders. Based on the results, the majority of the students were very familiar, 121(55.9%), 66(30.7%) were somewhat familiar, and 29(13.4) were not familiar at all with lifestyle disorders. Out of the 216 respondents, the majority, 104(48%), were not familiar with the symptoms of lifestyle disorders, whereas 112(52%) were familiar with them. It was found that most of the respondents, 118(54.6%), have been screened or tested for lifestyle disorders, and 98(45.4%) have not been screened or tested for lifestyle disorders.

Therefore, familiarity with lifestyle disorders $X^2(P\text{-value})$ 8.512(0.014), familiarity with the symptoms of lifestyle disorders $X^2(P\text{-value})$ 36.406(0.001), and screening for lifestyle disorders $X^2(P\text{-value})$ 29.611(0.001) are significantly associated with the occurrence of metabolic disorders as $P < 0.05$ as shown in Table 4.2.

Table 4.2: Prevalence of Metabolic Disorders

Variable	Category	n=216(%)	Chi-square df=1	p-value
Familiarity with LSD	Very familiar	121(55.9)	8.512 ^a	0.014
	Somewhat familiar	66(30.7)		
	Not familiar	29(13.4)		
Familiarity with symptoms of LSD	Yes	104(48)	36.406 ^a	<0.001
	No	112(52)		
Ever been screened or tested for LSD	Yes	118(54.6)	29.611 ^a	<0.001
	No	98(45.4)		
Lifestyle disorder diagnosed with	Obesity	18(8.4)	238.000 ^a	<0.001
	Pre-hypertension	10(4.6)		
	None	188(87)		

4.4 Socio-demographic Factors Associated with Occurrence of Metabolic Disorders

Pearson Chi-Square, which is used to show whether or not there is a relationship between two categorical variables, was used to measure the association between adolescents' demographic characteristics (Age, gender, religion, and type of school) and the occurrence of metabolic disorders. A P-value of <0.05 showed an association between socio-demographic characteristics and the occurrence of metabolic disorders such as obesity and pre-hypertension.

There was no significant relationship between the age and occurrence of metabolic disorders. The chi-square test had a value of 134.016^a with 2 degrees of freedom and a p-value of 0.327. The results suggest that there's no significant association between age and the occurrence of metabolic disorders, as the p-value is >0.05 (Table 4.3).

The majority of the respondents were females. There was a significant relationship between gender and the occurrence of metabolic disorders, as chi-square test had a value of 42.579^a with 1 degree of freedom and a p-value of 0.001. The results suggest a significant relationship between females and the occurrence of metabolic disorders since $p < 0.05$, shown in Table 4.3.

Most respondents were Christians, and the chi-square value was 96.903^a with 2 degrees of freedom and a p-value of 0.001. The results suggest that there's a significant relationship between religion and the occurrence of metabolic disorders as $P < 0.05$.

Most of the students who had metabolic disorders were those from private schools. The Chi-square test value was 28.033^a with 3 degrees of freedom and a p-value of 0.001. The results suggest that the type of school the respondents attend is significantly associated with the occurrence of metabolic disorders since $P < 0.05$, as shown in Table 4.3.

Table 4.3: Pearson Chi-Square on the Adolescents Sociodemographic Characteristics and Occurrence of Metabolic Disorders

Variable	Category	Lifestyle Disorder		Chi-square	df	P value
		Yes	No			
Age of the participant	13	1	19	134.016 ^a	2	0.327
	14	4	34			
	15	6	48			
	16	8	52			
	17	9	57			
Gender of respondent	Male	10	73	42.579 ^a	1	<0.001
	Female	18	115			
Religion of respondent	Christian	10	120	96.903 ^a	2	<0.001
	Muslim	9	36			
	Hindu	8	33			
Type of school	Private	18	111	28.033 ^a	3	<0.001
	Public	10	77			

4.5 Association between Family Medical History and Occurrence of Metabolic Disorders

The research further sought to determine whether there's an association between family medical history and the occurrence of metabolic disorders. Based on the results, the majority of the students agreed that they had a history of lifestyle disorder in their family 140(64.7%), 76(35.3%) of the students responded they do not have a history of lifestyle disorder in their family. The chi-square (P-value) was 19.441(0.001), which is less than

0.05; thus, family medical history is significantly associated with the occurrence of metabolic disorders.

Based on the results on who has lifestyle disease, fathers were 17(8%), uncles were 54(25%), brothers were 17(8%), Sisters were 17(8%), grandmothers were 76(34.6%) and grandfathers were 35(16.4%). The chi-square (P-value) was 35.643(0.001); therefore, a family member with a lifestyle disorder is significantly associated with the occurrence of metabolic disorders, as shown in Table 4.4.

Of the 216 respondents, the majority used social media 91(42%), 77(35.7%) ate fast food, 21(9.7%) watched TV, 17(8%) smoked, and 10(4.6%) played video games. The chi-square test was conducted with a P-value of 47.523(0.001), which is less than 0.05; thus, the behaviours of the respondents are significantly associated with the occurrence of metabolic disorders.

The research further sought to determine the mode of transport to school used by students. Based on the results, most students walked to school 121(56%). 34(15.6%) used the school bus, 18(8.4%) cycled to school, and 43(20%) used a motorbike as a means of transport to school and back home. The means of transport to school is significantly associated with predictors of metabolic disorders as the Chi-Square P value of 148.813(0.001) is less than 0.05.

Additionally, based on the results on food items eaten more frequently were as follows: vegetables 45(21%), Meat 56 (26.1%), Green 39(17.6%), and eggs 76(35.3%). Foods eaten more frequently are significantly associated with the occurrence of metabolic disorders, as the Chi-square P-value of 65.345(0.001) is less than 0.05.

The study investigated the food items eaten for the last one week by students. From the results, Beef stew was eaten by 87(40.3%), Rice was eaten by 12(5.5%), Ugali was eaten by 25(11.8%), Chips were eaten by 51 (23.5%) and vegetables by 41(18.9%). Further, the type of food eaten in the last one week was significantly associated with the occurrence of metabolic disorders as the Chi-square P value 52.721(0.001) is less than 0.05.

Based on the study results, the majority of the students did not go for wellness checkups 192(89.1%), and 24(10.9) went for wellness checkups. Further, going for wellness checkups is significantly associated with the occurrence of metabolic disorders as Chi-square, P value of 194.905 (0.001) is less than 0.05.

The study found that the oil used for cooking by the caregivers of the students in Langata Sub-County was as follows: a majority of them used liquid oil, 136(63%), 51(23.5%) used solid oils, and 29(13.4%) used olive oil. Consequently, the type of oil used is significantly associated with the occurrence of metabolic disorders as the Chi-square, P-value 20.910(0.001), is less than 0.05.

Table 4.4 Pearson Chi-Square on Family Medical History and Occurrence of Metabolic Disorders

Variable	Category	n=216(%)	Chi square	P-value
Is there history of any LSD in your family	YES	140(64.7)	19.441 ^a	<0.001
	NO	76(35.3)		
Who has lifestyle disease	Father	17(8)	35.643 ^a	<0.001
	Uncle	54(25)		
	Brother	17(8)		
	Sister	17(8)		
	Grandmother	76(34.6)		
	Grand Father	35(16.4)		
Do you have the following behaviors?	Smoking	17(8)	47.523 ^a	<0.001
	Eating fast foods	77(35.7)		
	Watching TV	21(9.7)		
	Playing video games	10(4.6)		
	Social media	91(42)		
Food item eaten more frequently	Vegetables	45(21)	65.345 ^a	<0.001
	Meat	56(26.1)		
	Greens	39(17.6)		
	Eggs	76(35.3)		
Food item eaten for the last 1 week	Beef stew	87(40.3)	52.721 ^a	<0.001
	Rice	12(5.5)		
	Ugali	25(11.8)		
	Chips	51 (23.5)		
Do you go for wellness clinic checkup	Vegetables	41(18.9)	194.905 ^a	<0.001
	Yes	24(10.9)		
Which oil are you used to cooking your meals	No	192(89.1)	20.910 ^a	<0.001
	Liquid	136(63)		
	Solid	51(23.6)		
	Olive	29(13.4)		

4.6 Association between Level of Physical Activity and Occurrence of Metabolic Disorders

Presented in Table 4.5, the study further sought to determine whether there is an association between the level of physical activity and predictors of metabolic disorders. The research sought to determine if the students take part in sports activities; a majority of the students, 216(100%), took part in sporting activities.

Based on the results, the students participated in sports activities as follows: football 92 (42%), Volleyball 45(21%), Tennis 18(8.4%), Handball 18(8.4%), Basketball 18(8.4%) and athletics 25(11.8%). A Chi-square test was conducted, and a conclusion was made that the sport played by the student is significantly associated with the occurrence of metabolic disorders, as the Chi-square P value was 215.49(0.001), which is less than 0.05.

The frequency of participation was categorized according to how frequently the student engaged in their preferred sporting activities; the results were as follows: Rarely 80(37%), seldom 47(21.8%), not at all 44(20.2%), and regularly 45(21%). From the results, the frequency of engaging in sports activities is significantly associated with the occurrence of metabolic disorders as the Chi-square P-value 134.016(0.001) is less than 0.05.

Based on the results, the majority of the students engaged in sporting activities for 1 hour, 154(71.4%), and 62(28.6%) engaged in sporting activities for 2 -3 hours. Furthermore, the number of hours spent in sports activities is significantly associated with the occurrence of metabolic disorders as the Chi-square (P-value) was 12.257(0.001), which is less than 0.05.

It was found that the majority of the students did not engage in home sporting activities 135(62.6%) and 81 (37.4%) engaged in home sporting activities. Moreover, engaging in home sporting activities is significantly associated with the occurrence of metabolic disorders as Chi-Square (P-value) was 56.636(0.001), which is less than 0.05.

Finally, based on the results, other than sporting activities, the majority of the respondents engaged in home-based activities such as cleaning at 135(62.6%), washing clothes at 34(15.6%), and cooking at 47(21.8%). Furthermore, a Chi-square test was conducted, and the Chi-square (P-value) was 21.290(0.001), which is less than 0.05, thus making engaging in other activities apart from sporting activities significantly associated with the occurrence of metabolic disorders, as shown in Table 4.5.

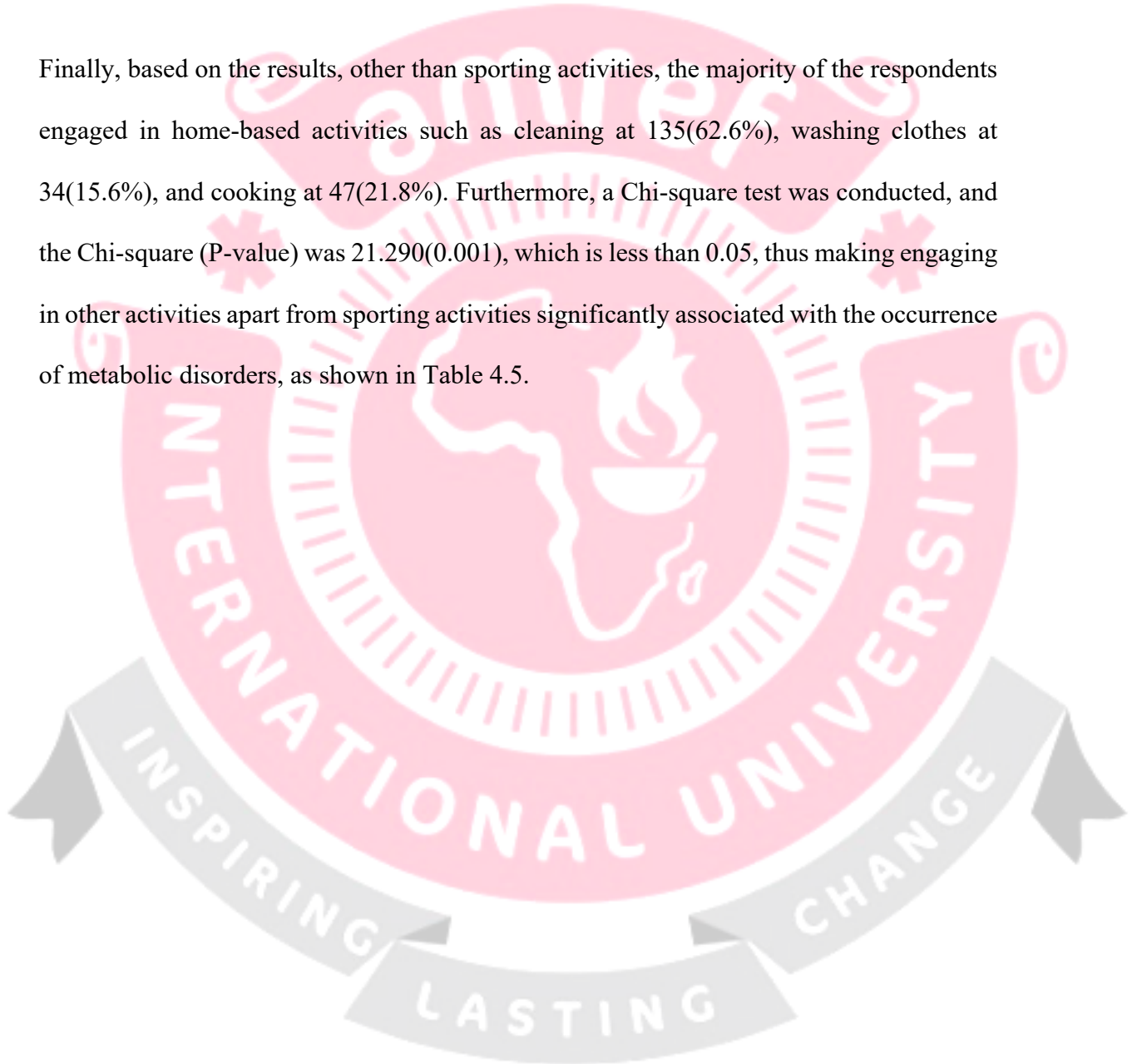


Table 4.5 Pearson Chi-Square on Level of Physical Activity and Occurrence of Metabolic Disorders

Variable	Category	n=216(%)	Chi-Square df=1	P value
Do you take part in sports activities	Yes	216(100)		
Which sports do you participate in	Football	92(42)	215.49 ^a	<0.001
	Volleyball	45(21)		
	Tennis	18(8.4)		
	Handball	18(8.4)		
	Basketball	18(8.4)		
	Athletics	25(11.8)		
How frequently do you engage in sports activity	Regularly	45(21)	134.016 ^a	<0.001
	Rarely	80(37)		
	Seldom	47(21.8)		
	Not at all	44(20.2)		
How long do you engage in preferred sporting activities in a week	1hour	154(71.4)	12.257 ^a	<0.001
	2-3h	62(28.6)		
Do you engage in home sporting activities	Yes	81(37.4)	56.636 ^a	<0.001
	No	135(62.6)		
Other than sports, which other physical activity do you engage in	Washing clothes	34(15.6)	21.290 ^a	<0.001
	Cleaning	135 (62.6)		
	Cooking	47(21.8)		

4.7 Multivariate Regression Analysis of Predictors of Metabolic Disorders.

A multivariate logistic regression was adopted to measure the effects of the independent variables on the dependent variable, as shown in Table 4.6. Sociodemographic factors such as type of school gender, if they have ever been diagnosed with lifestyle disorder, and if there is any family history of lifestyle disorders, participating in school activities, and home-based activities were factors that showed an association with the presence of metabolic disorders.

Students who went to public schools AOR 0.6 (95% CI) 1.83-2.439; $P < 0.001$ were at a lesser risk (protective factor) of getting a lifestyle disorder by 0.6 times compared to those who went to a private school, Based on gender, females AOR 3.5 (95% CI) 1.061-1.093; $P < 0.001$ were at a higher risk of getting a lifestyle disorder by 3.5 times compared to males. Participants who had ever been diagnosed with a lifestyle disease AOR 4.8 (95% CI) 0.221-0.570; $P < 0.01$ were 4.8 times at a higher risk of getting metabolic disorders compared to those who had never been diagnosed with them. Respondents who had a family history of lifestyle disorders AOR 2.1 (95% CI) 1.504-1.883; $P < 0.001$ were 2.1 times more likely to get metabolic disorders compared to those who had no family history of metabolic disorders, as shown in Table 4.6

Respondents participating in any sporting activities in school AOR 0.6 (95% CI) 2.869-4.44; $P < 0.001$ were at a lesser risk of getting a lifestyle disorder by 0.6 times, those participants who took part in home-based activities AOR 0.2 (95% CI) 1.172-1.437; $P < 0.001$ were also at a lesser risk by 0.2 times. Therefore, going to public schools, practising sporting activities in school, and carrying out home-based activities are protective factors against metabolic disorders.

However, females, participants who have ever been diagnosed with a lifestyle disorder, and those who have a family history of metabolic disorders are risk factors for metabolic disorders among adolescents aged 13-17 years, as shown in Table 4.6.

Table 4.6: Multivariate Regression Analysis for Risk Factors for Presence of Metabolic Disorders

Predictor Variables	Outcome variables		
Variable	Odds Ratio (95% CI)	95% CI	P value
Type of school			
Private	1(Ref.)		
Public	0.6	1.83-2.439	0.001 ***
Gender			
Male	1(Ref.)		
Female	3.5	1.061-1.093	0.001
Ever been diagnosed with a lifestyle disease			
Yes	4.8	0.221-0.570	0.01**
No	1(Ref.)		
Is there a History of lifestyle disorders in your family			
Yes	2.1	1.504-1.883	0.001
No	1(Ref.)		
Do you take part in any sporting activities			
Yes	0.6	2.869-4.44	0.001
No	1(Ref.)		
Do you take part in home-based activities			
Yes	0.2	1.172-1.437	0.001
No	1(Ref.)		

CHAPTER 5: DISCUSSIONS

5.1 Introduction

In this chapter, the researcher discusses the findings and outcomes during the study according to the variables, giving the research conclusion and recommendations to be adapted to reduce incidences of metabolic disorders not just in the adolescent population in Langata but all over the country.

5.1 Prevalence of Metabolic Disorders

The prevalence of metabolic disorders in adolescents who participated in this study is 13%, which is higher than the study conducted by Mbugua et al. (2017), the study established that 1.9% of the participants met the criteria for diagnosis of metabolic syndrome. The study's outcomes revealed a statistically significant association between leading a “sedentary lifestyle and maintaining poor dietary habits as risk factors for metabolic syndrome.” However, it also revealed that students who engage in sedentary behaviors and follow unhealthy dietary practices are more likely to develop metabolic syndrome.

Out of the 28 adolescents who had metabolic disorders, 18(64.5%) were females, and 10 (35.5%) were males; the prevalence in females is higher compared to the study that was carried out in Kenya, metabolic syndrome was 19.2% and was found to be higher in women as compared to men folks (20.7% vs. 16.0%) (Kiama et al., 2018). The results are also in agreement with a study that was conducted in sub-Saharan Africa (Faijer-Westerink et al., 2020). The prevalence of metabolic diseases was higher in women than in males, greater in those who lived in (semi-)urban areas compared to those in rural areas, and highest in SA, followed by Eastern, Western, and Central Africa.

Regular health check-ups are crucial for early detection and management of lifestyle disorders. The low frequency of check-ups indicates a potential lack of awareness or proactive health behaviour among the student population. While a significant number of respondents have been screened for lifestyle disorders, there is still a considerable portion who have not undergone screening. Regular screening is essential for early identification and management of lifestyle-related health issues, which can ultimately help in preventing or mitigating the development of metabolic disorders. According to Fajjer-Westerink et al. (2020), metabolic disorders contribute to substantial healthcare costs and economic burdens, including direct medical expenses, productivity losses, and decreased quality of life. As such it is important to do regular screening for early detection.

A majority of respondents are not undergoing treatment for lifestyle disorders. This may indicate a gap in healthcare access, awareness, or willingness to seek treatment among the student population. Given the significant association between the treatment of lifestyle disorders and the occurrence of metabolic disorders, addressing this gap is critical for preventing long-term health complications.

5.2 Relationship between Socio-Demographic Factors and Presence of Metabolic Disorders

These results shed light on various socio-demographic factors associated with the presence of metabolic disorders in adolescents, including the age, gender, religion, type of school, education level, employment status, and earnings of both mothers/caregivers and fathers. The gender distribution of the children involved in the study revealed a slight majority of females. Additionally, religion was found to be significantly associated with metabolic disorders, with the majority of children being Christians. These findings

highlight the importance of considering cultural and religious backgrounds in understanding the prevalence of metabolic disorders.

One important aspect is socioeconomic status (SES), which includes factors such as “income, education, and occupation.” Research suggests that children from lower SES backgrounds are considered to be in a higher risk of developing metabolic syndromes due to various reasons, including limited access to healthy food options, higher exposure to unhealthy dietary practices, and limited opportunities for physical activity (Pulgarón, 2013; Napoleão et al., 2021). This is because to have access to healthy food and opportunities for physical activity. Affordability plays a huge role since the caregiver must have gone to school to attain some level of education to understand and attain a qualification to be employed in the future. Employment and a good salary will therefore depict access to all the needs of their child’s well-being.

Both the education level and employment status of caregivers were found to be significantly associated with the presence of metabolic disorders in adolescents. Higher education levels and employment were linked to a lower prevalence of metabolic disorders, suggesting a potential socioeconomic influence on health outcomes. Similarly, the study found a significant association between the monthly earnings of caregivers and the presence of metabolic disorders in adolescents. Higher earnings were correlated with a lower prevalence of metabolic disorders, indicating the potential impact of financial stability on health. Similar patterns were observed for fathers, with their age, education level, employment status, and monthly earnings being significantly associated with the presence of metabolic disorders in adolescents. These findings emphasize the importance of considering the socio-economic status of both parents in

understanding and addressing metabolic disorders in adolescents. Overall, these results highlight the complex interplay of socio-demographic factors in the prevalence of metabolic disorders among adolescents. Addressing disparities in education, employment, and income may be crucial in mitigating the risk of metabolic disorders and improving the overall health outcomes of adolescents.

Furthermore, adolescents going to private schools are at a higher risk of getting metabolic disorders, in agreement with the study that was conducted in Brazaville, Congo (Ikama et al., 2019). This could be due to the sedentary lifestyle and poor, unhealthy dietary practices.

5.3 Association between Family Medical History and Occurrence of Metabolic Disorders

Specific gene variants related to insulin resistance or lipid metabolism have been associated with an elevated risk of metabolic disorders (Jääskeläinen & Klemetti, 2022). Therefore, a family medical history of metabolic disorders is more likely to be associated with the occurrence of metabolic disorders. This is evident from the results of the study as the majority of the students agreed that they had a history of lifestyle disorder in their family 140(64.7%), 76(35.3%) of the students responded they do not have a history of lifestyle disorder in their family. The chi-square (P-value) was 19.441(0.001), which is less than 0.05; thus, family medical history is significantly associated with the occurrence of metabolic disorders.

Furthermore, respondents who had a family history of lifestyle disorders after a linear logistic regression was done, AOR 2.1 (95%CI) 1.504-1.883; $P < 0.001$. This means that the

risk of getting metabolic disorders increases by 2.1 times more for those who have a family medical history of metabolic disorders. Thus, family medical history is one of the risk factors.

However, those adolescents who were ever diagnosed with a lifestyle disorder such as overweight or obesity, among others, are 4.8 times more likely to get a metabolic syndrome, corresponding to the findings by (Abebe et al., 2021).

5.4 Association between Level of Physical Activity and Occurrence of Metabolic Disorders

These findings provide valuable insights into the relationship between participation in sports activities, frequency of engagement, duration of activity, and engagement in other physical activities with the presence of metabolic disorders among students. The majority of students were found to participate in various sports activities in school, and from the findings adolescents who took part in sporting activities in school were at a lesser risk of getting metabolic disorders. Also, the findings of lack of inadequate physical activity have been associated with increased risk of metabolic disorders agrees with a study conducted by Ekelund et al. (2019).

The types of sports played in schools included football, volleyball, tennis, handball, basketball, and athletics. The significant association between the type of sport played, and the occurrence of metabolic disorders suggests that certain sports may have differential effects on metabolic health. This underscores the importance of promoting a diverse range of physical activities to address metabolic health risks effectively. The Socioecological Model at the organization level includes jobs, schools, or institutions applies here. The

choices made by institutions or organizations determine whether the members will be carried out or not; hence, they may have either a positive or negative effect on various groups. For instance, if physical education is not provided in schools, students are likely to spend most of their time in school being sedentary. Schools are designed to offer children the tools necessary for success in life. However, when they limit physical activity within the educational setting, they may be inadvertently setting students up for future challenges in their lives.

The frequency of engaging in sports activities varied among students, with categories ranging from rarely to regularly. The significant association between the frequency of participation and the occurrence of metabolic disorders highlights the importance of consistent physical activity in mitigating metabolic health risks. Encouraging regular and consistent participation in sports activities may be crucial for maintaining metabolic health among students.

The duration of sports activities also showed variability among students, with the majority engaging in activities for one hour. The significant association between duration of activity and predictors of metabolic disorders underscores the importance of sufficient duration of physical activity in promoting metabolic health. Prolonged engagement in sports activities may confer greater metabolic benefits and should be encouraged where feasible. The findings by Topçu et al. (2016) confirmed the same.

The socio-ecological model, at the individual level, highlights how children's dietary habits, physical activity levels, and other lifestyle choices can lead to metabolic disorders development. Unhealthy dietary patterns, as shown from existing research, for example,

the consumption of calorie-rich, nutrient-poor foods, as well as sedentary behaviours such as prolonged screen time and insufficient physical activity, are linked to a heightened risk of metabolic disorders in children (Sallis et al., 2020). Therefore, from the results, a considerable proportion of students did not engage in home sporting activities while others did. The significant association between engagement in home sporting activities and predictors of metabolic disorders suggests that such activities may affect metabolic health outcomes. Encouraging students to engage in physical activities at home, in addition to organized sports, may contribute to better metabolic health.

Apart from sports activities, students also engaged in various other physical activities at home, such as cleaning, washing clothes, and hiking. The significant association between engagement in these activities and the occurrence of metabolic disorders underscores the broader importance of overall physical activity levels in metabolic health. Adolescents who took part in home-based activities were at a lesser risk of getting metabolic disorders than those who never did, corresponding to the findings of Nguyen et al. (2021).

Promoting a variety of physical activities beyond sports may be beneficial for metabolic health outcomes among students. Overall, these findings highlight the multifaceted nature of physical activity in relation to metabolic health among students. Encouraging diverse types of physical activities, promoting regular engagement, and emphasizing the importance of both organized sports and daily physical activities at home may be key strategies for promoting the well-being of students.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this chapter, the researcher gives a summary of the conclusions and recommendations on completion of the study.

6.2 Conclusions

- i. The study has shown that sociodemographic factors such as gender and the type of school attended by adolescents are important factors associated with the occurrence of metabolic disorders. Females are at a 3.5 times higher risk of getting metabolic disorders than males. Also, adolescents attending private schools are at a higher risk of getting metabolic disorders.
- ii. Adolescents with a history of metabolic disorders such as obesity and those with a family medical history of metabolic disorders are risk factors associated with the occurrence of metabolic disorders.
- iii. Adolescents who participated in sports activities in school were at a lesser risk of getting metabolic disorders. Also, those who participated in home-based activities were at a lesser risk of getting metabolic disorders. Therefore, participation in sports activities in school and home-based activities were protective risk factors for the occurrence of metabolic disorders.

6.3 Recommendations

- i. The Ministry of Education should reinforce carrying out frequent health education and nutrition talks in schools must be encouraged to raise awareness of lifestyle

disorders. This includes the various lifestyle disorders, their causes, the symptoms, and what to do to prevent their occurrence. This also includes the sharing of knowledge, skills, practices and proper attitudes to learners in relation to health.

- ii. The Ministry of Education must make sure that schools make Physical Education (P.E) mandatory for all students regardless of their age and year of study to promote their well-being. Awareness and importance of home-based physical activities must be spread among parents to reduce the risk of metabolic disorders.
- iii. The Ministry of Education must train teachers to point out whether the learner shows progressive gains in weight and height without unusually wide variations or any other changes in their health and well-being.
- iv. The County Department of Health should sensitize the communities in collaboration with health agencies. This will form a good portal of entry into this area with culturally influenced beliefs and attitudes about the importance of the level of physical activities and their sociodemographic profile. This will ensure that adolescents are not stigmatized and are supported by the community. It will also point out the importance of how family history of lifestyle disorders predisposes adolescents to risk of getting metabolic disorders.
- v. Further research is warranted to gain a better understanding of how sociodemographic factors and level of physical activity are associated with the presence of metabolic disorders and to inform targeted preventive measures that can be taken at all levels to mitigate the risk of metabolic disorders.

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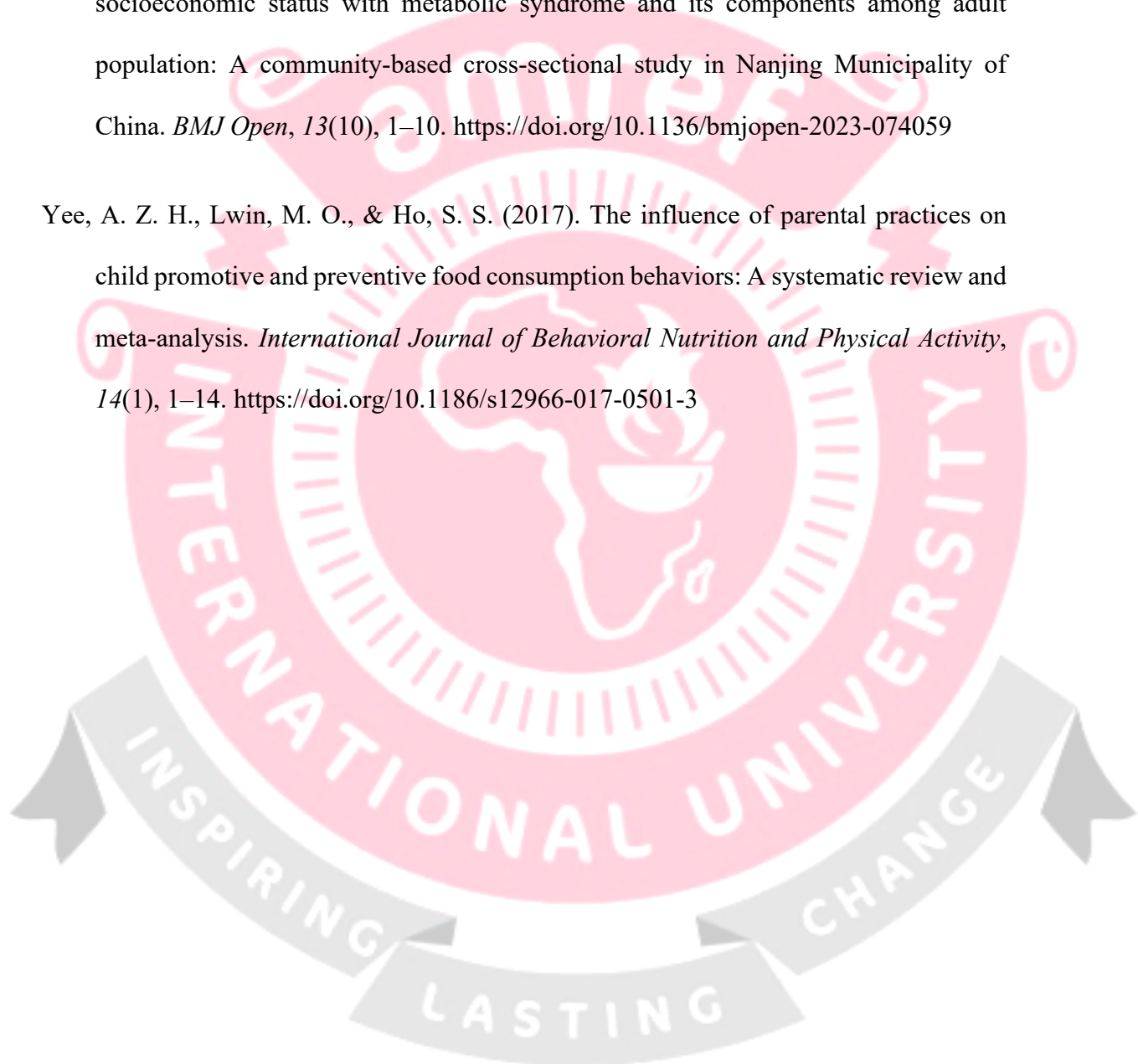
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APPENDIX I: Introductory Letter

Leela Mahajan

P.O BOX

Nairobi, Kenya

Dear sir/madam

RE: INTRODUCTION AND REQUEST TO PARTICIPATE IN STUDY

I am a postgraduate student at AMREF University Pursuing a Master's Degree in public health. As a requirement for the fulfilment of this degree course, I am expected to conduct a research thesis. My research title is the **Predictors of Metabolic Disorders Among Adolescents Aged 13 17 years in Lang'ata Sub-County, Nairobi, Kenya**. You have been purposively selected to participate in this study by filling in the questionnaire to enable the collection of the needed data for analysis. The information collected will be used for academic research only and will be treated with utmost confidentiality. I recognize that your time is valuable, and I assure you that we will do everything I can to make the data collection process as efficient and straightforward as possible.

Thank you in advance for considering our request.

Sincerely,

Leela Mahajan

Student/ Researcher

APPENDIX II: Questionnaire

Unique study number

A) PARENTS' DEMOGRAPHICS

I) Mother's profile (where applicable)

- i) Year of birth: _____
- ii) Gender: [M] [F]
- iii) Religion : Christian [] Muslim [] Hindu []
Others(specify) _____
- iv) Level of completed education: Primary [] Secondary [] College []
Others(specify) _____
- v) Occupation: _____
- vi) Employment status: Employed [] Unemployed []
- vii) Earnings per month: < 10,000 Kshs []
11,000-20,000 Kshs []
21,000-30,000 Kshs []
>30,000 Kshs []

II) Father's profile (where applicable)

- viii) Year of birth: _____
- ix) Gender: [M] [F]
- x) Religion : Christian [] Muslim [] Hindu []
Others(specify) _____
- xi) Level of completed education: Primary [] Secondary [] College []
Others(specify) _____

- xii) Occupation: _____
- xiii) Employment status: Employed [] Unemployed []
- xiv) Earnings per month: < 10,000 Kshs []
11,000-20,000 Kshs []
21,000-30,000 Kshs []
>30,000 Kshs []

B: BIOMETRICS OF THE STUDENT

- a) Weight (kgs) _____
- b) Height (m) _____
- c) Body Mass Index (w/h^2) _____
- d) Blood pressure (mmHg) _____
- e) Waist circumference (cms) _____
- f) Hip circumference(cms) _____
- g) Waist to height ratio _____

C: Prevalence of lifestyle diseases

i) How familiar are you with lifestyle disorders?

- Very familiar ()
- Somewhat familiar ()
- Not familiar at all ()

ii) Can you name any symptoms associated with lifestyle disorders?

- Yes ()
- No ()

If yes, please list them.

iii) Have you had a health check-up within the last year?

- Yes ()

- No ()

iv) Have you ever been screened or tested for lifestyle disorders?

- Yes ()

- No ()

If yes, when? _____

v) Have you ever been diagnosed with a lifestyle disease? Yes [] No []

vi) In reference to the following list, select any of the following lifestyle diseases you've been diagnosed with?

-DM []

-HTN []

-Heart diseases []

-Stroke []

-Others (specify) _____

vi) Are you currently on any treatment for any lifestyle related disease? Yes [] No []

If yes, specify: _____

D: Family History

a) Is there history of any lifestyle diseases in your family? Yes [] No []

b) Who has a life style disease in your family?

c) Mother [] Father [] Uncle [] Brother [] Sister []

Others(specify) : _____

d) Which of the following lifestyle disease has been diagnosed in your family?

Diabetes [] Hypertension [] Heart disease [] Stroke []

Others (specify) : _____

e) Indicate if you have any of the following behaviours? **(multiple responses allowed)**

Smoking [] Alcohol intake [] Eating fast foods [] Being idle []

Watching TV [] Playing video games [] Social media [] Chatting []

Passive most of the time [] Not applicable [] Others (specify):

f) Mode of transport to school used mostly :

Motorbike [] Bus [] School bus [] Walk [] Cycling []

Others (specify): _____

g) On average how many hours do you sleep?

<5hrs [] 5-8 hrs [] 9-12 hrs [] Others (specify) : _____

h) List the food items that you eat more frequently:

i) Indicate the food items that you have eaten for the last one week:

j) Do you go for wellness clinic check ups? Yes [] No []

k) Are you on any food supplements? Yes [] No []

l) Which oils are used to use to cook your meal?

Liquid oils [] Solid oils [] Olive oil []

Others (specify): _____

E: Physical Activity

a) Do you take part in any sport activities? Yes [] No []

b) Which of the following sport activities do you participate in?

Football [] Volleyball [] Hockey [] Tennis [] Handball []

Others (specify): _____

c) How frequently do you engage in sports activities?

Regularly [] Rarely [] Seldom [] Not at all []

d) How long do you engage in your preferred sports activity in a session?

<1 hr [] 2-3hrs [] 4-5 hours [] >5 hrs []

e) Do you engage in sports activities at home? Yes [] No []

f) Other than sports which other physical activities do you engage in?

Washing [] Digging [] Cleaning [] Gardening []

Others (specify): _____



APPENDIX III: Informed Co-Explanation, Consent Form and Consent

Withdrawal Form

Study Title: Predictors of Metabolic Disorders Among Adolescents Aged 13-17 Years in Lang'ata Sub-County, Nairobi, Kenya

Investigator: Leela Sunil Mahajan

Institutional affiliation: AMREF International University

Introduction

Good morning/afternoon, my name is..... a research assistant involved in the study on Predictors of Metabolic Disorders among Adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi, Kenya. The study is being conducted by Dr. Leela Sunil Mahajan a student at the School of Community Health, AMREF International University (Principal Investigator) and the co-investigators will be Dr. Micah Matinag'i and Dr. Lucy Namusonge. The area has been selected to conduct the study and the Amref Ethics and Scientific Review Committee has approved the study to be conducted.

Objective of the study

The objective is to determine the predictors of metabolic disorders among adolescent aged 13-17 years in Lang'ata Sub- County, Nairobi County, Kenya.

Duration of Study

The study will take place over a period of 12 months however, the collection of data will take 2 weeks.

Who Can Participate: Adolescents aged between 13-17 years.

Research Procedure: The participation permission form's the primary objective to get your agreement to take part in the study. In the event that you decide to take part in the survey, you will be given a questionnaire to fill out which will take about 10 minutes. The study will involve taking and assent from your child before asking you and your child some questions followed by a physical examination. The questions range from your personal information, findings of physical examination such as weight height etc, knowledge on metabolic disorders, family and medical history and information based on physical activity. Information given will be confidential. Where diagnosis of hypertension will be made, a referral to the nearest accredited medical facility will be made.

Risks/ Benefits

There is no anticipated physical harm from this study. However, you will benefit from a free screening, diagnosis, life style modification session and referral to the nearest medical facility where necessary. This research will assist in designing ways of preventing metabolic disorders. The information gathered will be put to use in the development of physical education programs, with the ultimate goal of lowering the prevalence of metabolic disorders. This will help even further, to the design and implementation of health services for persons living in informal settlements, who have limited access to resources.

Compensation

There are no monetary benefits that you will receive by agreeing to participate in the research study.

Voluntary Participation and Rights

Participation is entirely up to the individual. You have the option of participating or declining to do so. If you want to take part in the research, you have the option of avoiding

providing responses to any questions that make you feel awkward or uncomfortable. You are free to quit at any moment if you decide that participating in the study is no longer something that interests you. Before you sign the permission form for the research, you may ask whatever you want about it, and if you have any questions during the interview, you can ask for clarification whenever you need it.

Data Security and Confidentiality

The study team's data will be encrypted and password protected so that only the Principal Investigator has access. The data collected here will be utilized only for the study at hand (PI). Your identity will not be attached to the survey results in any way while they are being safely preserved.

Refusal to Participate or Withdrawal from the Study

You have the right to refuse to join the study after the research assistant has introduced the study to you. You also have a right to stop or decline to answer any question asked to you in the midst of the interview. You therefore have a right to withdraw from the study at any moment without self-explanation. However, in the event you choose to withdraw from part or all of the study, you will be required to fill in a withdrawal consent form that allows either for already data obtained to be used in data analysis or deletion of data already collected.

Dissemination of Results

Dissemination of information to the schools, parents and even community leaders will be done through Chiefs barazas, health education programs and health talks in Lang'ata County through the Nairobi County Public Health Office with approval from the Kenya Medical Practitioners and Dentist Council. These sessions include lectures, health talks

based of life style modification including diet and physical activities. Also, recommend measures that need to be taken to ensure management of the disorders to avoid further complications.

Contact Information of the Researcher and Research

In the event that you have any inquiries, you may get in touch with the primary investigator at:

Dr. Leela Sunil Mahajan

(Principal Investigator)

Telephone Number: 0737886600

leela.mahajan@hotmail.com

AMREF International University

Contact Information of Amref Health Africa in Kenya Ethics and Scientific Review Committee (ESRC)

In case you have any questions or concerns about this research, you may reach out to the AMREF (ESRC) through the following contacts:

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

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 the study and any questions I have been asked have been answered to my satisfaction. I consent voluntarily for my child to participate in this study.

Print name of Parent/ Guardian [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:



Consent Withdrawal Form

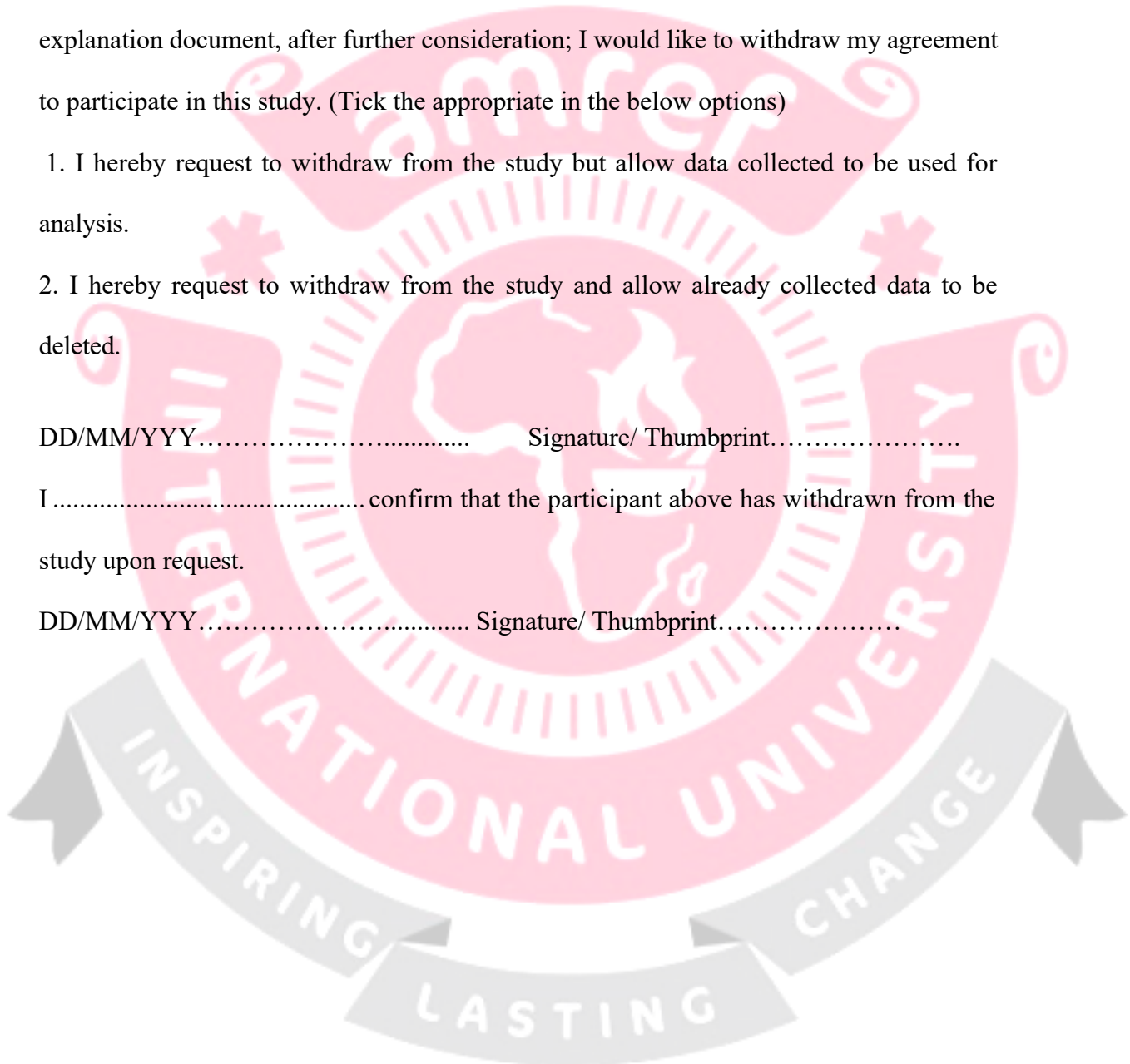
Having initially agreed to participate in the research (Predictors of metabolic disorders among adolescents aged 13-17 years in Lang’ata Sub-County, Nairobi, Kenya) and following detailed explanation given concerning participation in the research in the co-explanation document, after further consideration; I would like to withdraw my agreement to participate in this study. (Tick the appropriate in the below options)

- 1. I hereby request to withdraw from the study but allow data collected to be used for analysis.
- 2. I hereby request to withdraw from the study and allow already collected data to be deleted.

DD/MM/YYYY..... Signature/ Thumbprint.....

I confirm that the participant above has withdrawn from the study upon request.

DD/MM/YYYY..... Signature/ Thumbprint.....



APPENDIX IV: Assent form for minors (below 18 years)

Study Title: Predictors of Metabolic Disorders Among Adolescents Aged 13-17 Years

In Lang'ata Sub-County, Nairobi, Kenya

Investigator: Leela Sunil Mahajan

Institutional affiliation: AMREF International University

Introduction

Good morning/afternoon, my name is..... a research assistant involved in the study on Predictors of Metabolic Disorders among Adolescents aged 13-17 years in Lang'ata Sub-County, Nairobi, Kenya. The study is being conducted by Dr. Leela Sunil Mahajan a student at the School of Community Health, AMREF International University (Principal Investigator) and the co-investigators will be Dr. Micah Matinag'i and Dr. Lucy Namusonge. The area has been selected to conduct the study and the Amref Ethics and Scientific Review Committee has approved the study to be conducted.

Objective of the study

The objective is to determine the predictors of metabolic disorders among adolescent aged 13-17 years in Lang'ata Sub- County, Nairobi County, Kenya.

Duration of Study

The study will take place over a period of 12 months however, the collection of data will take 2 weeks.

Who Can Participate: Adolescents aged between 13-17 years.

Research Procedure: The participation permission form's the primary objective to get your agreement to take part in the study. In the event that you decide to take part in the

survey, you will be given a questionnaire to fill out which will take about 10 minutes. The study will involve taking and assent from your child before asking you and your child some questions followed by a physical examination. The questions range from your personal information, findings of physical examination such as weight height etc, knowledge on metabolic disorders, family and medical history and information based on physical activity. Information given will be confidential. Where diagnosis of hypertension will be made, a referral to the nearest accredited medical facility will be made.

Risks/ Benefits

There is no anticipated physical harm from this study. However, you will benefit from a free screening, diagnosis, life style modification session and referral to the nearest medical facility where necessary. This research will assist in designing ways of preventing metabolic disorders. The information gathered will be put to use in the development of physical education programs, with the ultimate goal of lowering the prevalence of metabolic disorders. This will help even further, to the design and implementation of health services for persons living in informal settlements, who have limited access to resources.

Compensation

There are no monetary benefits that you will receive by agreeing to participate in the research study.

Voluntary Participation and Rights

Participation is entirely up to the individual. You have the option of participating or declining to do so. If you want to take part in the research, you have the option of avoiding providing responses to any questions that make you feel awkward or uncomfortable. You are free to quit at any moment if you decide that participating in the study is no longer

something that interests you. Before you sign the permission form for the research, you may ask whatever you want about it, and if you have any questions during the interview, you can ask for clarification whenever you need it.

Data Security and Confidentiality

The study team's data will be encrypted and password protected so that only the Principal Investigator has access. The data collected here will be utilized only for the study at hand (PI). Your identity will not be attached to the survey results in any way while they are being safely preserved.

Refusal to Participate or Withdrawal from the Study

You have the right to refuse to join the study after the research assistant has introduced the study to you. You also have a right to stop or decline to answer any question asked to you in the midst of the interview. You therefore have a right to withdraw from the study at any moment without self-explanation. However, in the event you choose to withdraw from part or all of the study, you will be required to fill in a withdrawal consent form that allows either for already data obtained to be used in data analysis or deletion of data already collected.

Dissemination of Results

Dissemination of information to the schools, parents and even community leaders will be done through Chiefs barazas, health education programs and health talks in Lang'ata County through the Nairobi County Public Health Office with approval from the Kenya Medical Practitioners and Dentist Council. These sessions include lectures, health talks based of life style modification including diet and physical activities. Also, recommend

measures that need to be taken to ensure management of the disorders to avoid further complications.

Contact Information of the Researcher and Research

In the event that you have any inquiries, you may get in touch with the primary investigator at:

Dr. Leela Sunil Mahajan

(Principal Investigator)

Telephone Number: 0737886600

leela.mahajan@hotmail.com

AMREF International University

Contact Information of Amref Health Africa in Kenya Ethics and Scientific Review Committee (ESRC)

In case you have any questions or concerns about this research, you may reach out to the AMREF (ESRC) through the following contacts:

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

Do you have any questions at this time?

Certificate of Assent

PART II: Certificate of Assent

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 Assent 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 Assent Form to the potential study subject, and the individual has had the opportunity to ask questions. I confirm that the individual has given Assent 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 Assent

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 Assent, and the Assent has been given freely and voluntarily.

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

Print Name of researcher/person taking the Assent [at least forename and surname]

Signature of researcher/person taking the Assent

DD/MM/YYYY:.....

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 Assent 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

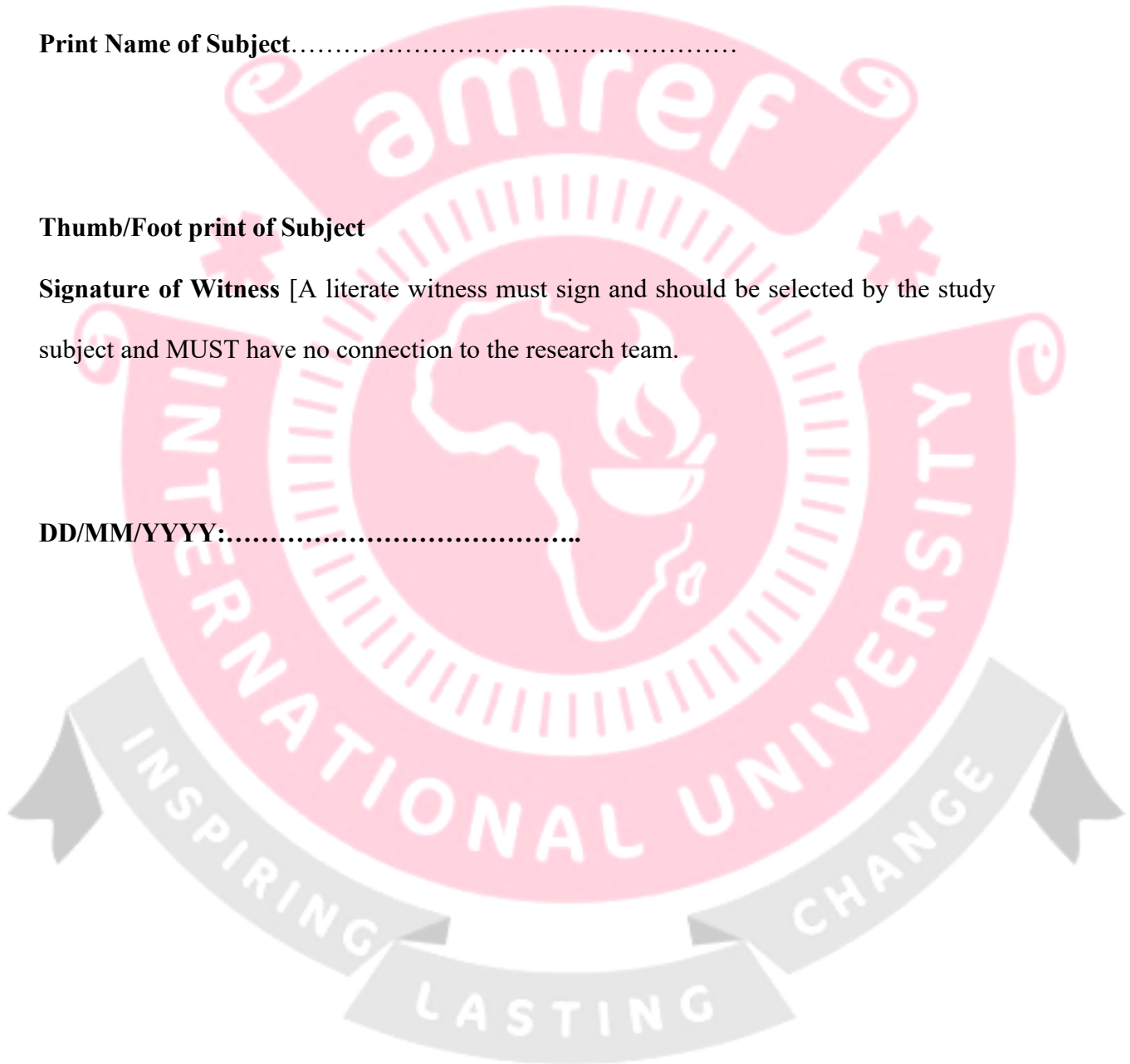
I have witnessed the accurate reading of the Assent Form to the potential study subject, and the individual has had the opportunity to ask questions. I confirm that the individual has given Assent freely.

Print Name of Subject.....

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 Assent

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 Assent, and the Assent has been given freely and voluntarily.

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

Print Name of researcher/person taking the Assent.....

Signature of researcher/person taking the Assent

DD/MM/YYYY:



APPENDIX V: List of Mixed Day Secondary Schools in Lang’ata Sub-County

	Secondary School	Total enrollment
1	St. Christophers' Sec Sch	203
2	Five Stars High Sch	-
3	Glory Sec. Sch.	157
4	Jeremic Adventist Sec. Sch.	24
5	His Imperial Majesty Sec. Sch	13
6	Jarmat Girls Sec Sch	17
7	Hillcrest Sec School	76
8	Karen C Sec Sch	44
9	St Marks Sec Sch	-
10	Karen South Sec Sch	33
11	Kibera Academy-Sec Sch	119
12	Kibra Academy Sec. Sch	147
13	Malezi School-Sec	44
14	Langata High Sch	100
15	Mashimoni Calvary High Sch	-
16	Maono Ed Centre Sec Sch	22
17	Mashimoni Sec Sch.	118
18	Nairobi Academy Sec	112
19	Nairobi Muslim Academy- Sec	159
20	Nairobi South Sec Sch	159

21	Raila Educational Center- Sec Sch	74
22	Pcea Silanga Sec Sch	91
23	Olympic Sec Sch	110
24	St. Aloysius Gonzaga Sec Sch	241
25	Sifma Secondary Sch.	19
26	Soweto Academy-Sec	26
27	Soweto Baptist Hgh Sch	189
28	Shree Cutchi Leva Patel Sec	160
29	Starays Hope Comm Center Sec Sch	250
30	St Augustus Sec Sch	61
31	St Charles Lwanga Sec Sch	52
32	St Gabriel Sec Sch	206
33	St Teresa Mixed Day	53
34	The Nairobi Japanese Sch-Junior High	-
35	Brookhouse Schools-Sec	85

APPENDIX V1: AMREF ESRC APPROVAL LETTER



REF: AMREF — ESRC P1584/2023

January 29, 2024

Leela Mahajan,
Amref International University
P.O Box 30125-00100
Nairobi, Kenya
Tel: +254737886600
Email: leela.mahajan@nairobi.westhospital.com

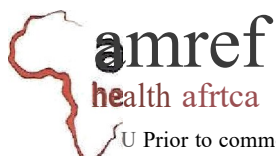
Dear Leela Mahajan,

RESEARCH PROTOCOL: PREDICTORS OF METABOLIC DISORDERS AMONG ADOLESCENTS AGED 13-17 YEARS IN LANG'ATA SUB-COUNTY, NAIROBI I, 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 P1584/2023. The approval period is from January 29, 2024 to January 28, 2025 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.



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

Please do not hesitate to contact the ESRC Secretariat (esrc.ken@amref.org) for any clarification or query.



Prof. Mohamed Karim
CC: Samuel Muhula, Senior Manager, Learning and Impact Amref Health Africa.



APPENDIX VII: NACOSTI PERMIT

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 947637	Date of Issue: 14/February/2024
RESEARCH LICENSE	
	
This is to Certify that Dr.. Leela Sunil Mahajan 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 Nairobi on the topic: PREDICTORS OF METABOLIC DISORDERS AMONG ADOLESCENTS AGED 13-17 YEARS IN LANG'ATA SUB-COUNTY, NAIROBI, KENYA for the period ending : 14/February/2025.	
License No: NACOSTI/P/24/32890	
947637	
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 VIII: PLAGIARISM REPORT

Dr. Leela Final Thesis Draft.docx

ORIGINALITY REPORT

10%	8%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	worldwidescience.org Internet Source	1%
2	www.science.gov Internet Source	1%
3	www.researchsquare.com Internet Source	1%
4	sci-hub.st Internet Source	<1%
5	erepository.uonbi.ac.ke Internet Source	<1%
6	fastercapital.com Internet Source	<1%
7	www.frontiersin.org Internet Source	<1%
8	"Abstracts", Diabetologia, 2005 Publication	<1%
9	repository.iaa.ac.tz:8080 Internet Source	<1%