PREVALENCE OF METABOLIC SYNDROME COMPONENTS BY AGE AND GENDER AMONG MASENO UNIVERSITY STUDENTS, KENYA

BY

SHEILA MALESI JAIKA

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICAL PHYSIOLOGY

SCHOOL OF MEDICINE

MASENO UNIVERSITY

DECLARATION

Declaration by the Candidate

I hereby declare that this thesis is my original work and has not been presented for the award of a degree in any other university or institution of learning. I have done all the work carried herein and all sources of information have been acknowledged by means of references.

Signature ..... Date .....

Sheila Malesi

MSC/SM/00120/2014

Supervisors
This thesis has been submitted for examination with our approval as University Supervisors.

Signature ..... Date .....

Prof. Gideon Magak Ng'wena

Department of Medical Physiology

School of Medicine

Maseno University

Signature ..... Date .....

Dr. George Michael Owiti

Department of Medical Physiology

School of Medicine

Maseno University

ACKNOWLEDGMENT

I would like to sincerely thank my two supervisors Prof. Gideon Magak Ng'wena and Dr. Michael George Owiti for their relentless sacrifice, guidance and encouragement over the entire study period without whom I would not have completed this thesis. I do also acknowledge with gratitude the administration of Maseno University for approval of the study.

My special thanks go to all the participants and to my research assistants for their cooperation and continued support during the period of data collection that led to this success.

My heartfelt gratitude goes to my beloved husband for his support, patience and dedication to our son during my busy schedule.

Above all, I thank the Almighty God for this far He Has brought me, especially during the time of this Masters program.

DEDICATION

This thesis is dedicated with love to my husband, Stephen Koluoch Omondi and my son Israel Shawnel Omondi for their consistent support, encouragement and patience.

ABSTRACT

Metabolic syndrome (MS) is rapidly increasing in prevalence worldwide and is a top risk factor for non-communicable diseases which are among the world's biggest killer diseases. In Africa, the prevalence of MS is estimated to be between 17% and 25%. Studies have compared the prevalence of MS but yielded varied rates among the youth and adults in various countries. These variations are suggestive of the fact that MS components could be population dependent. The prevalence of MS and association between age, gender and MS remains uncertain among the youth who are vulnerable of developing MS because they exhibit unregulated dietary habits. The purpose of this study was to establish the prevalence and components of MS by age and gender among university students in Kenya. Specifically the study; examined the prevalence and major components of MS, the association between age and MS components and between gender and MS components among Maseno university students. The study employed descriptive cross- sectional study design with a target population of 17,000 students. A sample size of 429 participants determined by Fisher *et al*. formula was recruited using stratified sampling technique by age and gender criterion. Socio-demographic data of participants were collected using a pre tested questionnaire. Anthropometric parameters including Body Mass Index, Waist Circumference and biochemical parameters of triglyceride and high-density lipoprotein cholesterol were measured by following the World Health Organization guidelines. Blood pressure was measured in mmHg using automated Omron M2 blood pressure device and fasting blood sugar by use of a Hemocue blood glucose analyzer. Descriptive statistics was used to present prevalence of MS while chi- square and correlation analysis determined the association between age, gender and MS components. The results indicated an overall MS prevalence of 12.4%. The most frequently observed components were low HDL-c at 98.1% (males 65% and females 33.1%), BMI $\geq$30kg/m^2 (4.9%), High fasting blood sugar (24.5%). Central obesity, high blood pressure and raised TG were observed less frequently (9.3%, 1.9% and 1.2% respectively). The study concluded that MS prevalence was high among the youthful population of Kenya and varies with age and gender. This study therefore recommended that surveillance policies be developed to identify affected youths and those at risk of having MS to ensure risk factors are detected early enough for appropriate preventive measures to be undertaken, involving education on the importance of healthy diet and maintenance of body fitness to reduce the risk of youths developing cardiovascular diseases.

TABLE OF CONTENTS

ABBREVIATIONS

ATP Adult Treatment Panel

BMI Body Mass Index

CVD Cardiovascular Diseases

HDL-c High Density Lipoprotein Cholesterol

LDL-c Low Density Lipoprotein Cholesterol

IDF International Diabetes Federation

IFG Impaired Fasting Glucose

MS Metabolic syndrome

NCDs Non- communicable Diseases

NCEP National Cholesterol Education Program

TG Triglyceride

WC Waist Circumference

WHO World Health Organization

OPERATIONAL DEFINITIONS

Metabolic Syndrome: A constellation of risk factors including central obesity, insulin resistance, dyslipidemia and hypertension that makes a person vulnerable of developing cardiovascular diseases

Metabolic Syndrome Components: Raised fasting blood sugar, high blood pressure, dyslipidemia and a raised body mass index.

Dyslipidemia: Is a constellation of elevated level of triglyceride, low concentration of HDL-c and greater concentration of LDL-c.

Prevalence: The frequency of metabolic syndrome in the students during the study period.

IDF definition: A person is said to have metabolic syndrome if he/she has central obesity and at least two of any of the following components: Raised triglycerides level, low high density lipoprotein cholesterol, raised fasting sugar and raised blood pressure.

NCEP definition: A person is considered to have MS if he has any three of the following components: Abdominal obesity, raised triglycerides level, low HDL-c level, high blood pressure and high fasting blood glucose.

WHO definition: A person is said to have MS if he has the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting blood glucose or insulin resistance and any two of the following: Raised blood pressure, Dyslipidemia, central obesity, raised BMI $>30kg/m^2$, Microalbuminuria (Urinary albumin excretion ratio. $\geq$ 20ug/min of albumin: creatinine ratio $\geq$ 30mg/gm).

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Metabolic syndrome (MS) is a constellation of risk factors including central obesity, insulin resistance, dyslipidemia and hypertension that makes a person vulnerable of developing cardiovascular diseases (CVDs) (Ahmed *et al*., 2015). Also known as cardio-metabolic syndrome or syndrome X or insulin resistance syndrome, the condition is a threat to global public health due to its escalating incidence in both developed and developing countries (Maxim, 2012). The condition is rapidly increasing in prevalence and in association with the rising childhood obesity and sedentary lifestyles worldwide (Ahmed *et al*., 2015). It is one of the risk factors for non-communicable diseases(NCDs), such as diabetes mellitus and cardiovascular disease, which are world's biggest killer diseases, estimated to cause 3.5 million deaths each year (Ahmed *et al*., 2015).

Worldwide, MS is a major health problem associated with increased morbidity and mortality which started as a characteristic of westernized societies, but is now emerging as well in developing countries (Sibai *et al* ., 2008). The prevalence of chronic or non-communicable disease is escalating rapidly around the globe where according to World Health Organization (WHO) estimates, by the year 2020, these diseases will account for approximately three quarters of all deaths in the developing world (Öğüş *et al*., 2013).

In Africa, the prevalence of metabolic syndrome is estimated to be between 17% and 25% (Kagaruki *et al*., 2015). Kenya is a rapidly developing country in Sub-Saharan Africa where the extent of most cardiovascular diseases and the associated risk factors at population level remain largely unknown (Kaduka *et al*., 2012). Chronic diseases have not received much attention due to over emphasis on communicable diseases, underreporting, missed diagnosis, misdiagnosis and misclassification of diseases (Kaduka *et al*., 2012). However, NCDs contribute over one half of the top twenty causes of morbidity and mortality in Kenya. Total mortality attributed to NCDs in Kenya rose from 31.8% in 2002 to 33% in 2007 which has been attributed to urbanization that brings with it changes in lifestyle that adversely affect metabolism (Kaduka *et al*., 2012).

Several studies comparing the prevalence of MS in different regions yielded varied prevalence rates with different frequencies of MS components in different populations. Whereas Ahmed *et al*., 2015 established an overall 7.8 % prevalence of MS in Sudanese undergraduate students with Body Mass Index (BMI) greater than 30 kg/m^2 as the major component, Singh *et al.*, 2015 established 34.3% prevalence with BMI of 30 kg/m^2 and hypercholesterolemia as major components in India. This varied prevalence of MS raised the need to establish the prevalence and major components of MS in this study. Further, few studies have analyzed the prevalence of MS among university students with none having been conducted in Kenya, making the prevalence unknown among Kenyan university students.

In European countries, the prevalence of MS varies from 4- 36 % depending on age and definition of MS. The prevalence of MS is reported to be highly age-dependent, increasing with increasing age, but seems to decline in the oldest population (> 70 years). Ahmed *et al.,*2015*,*

Singh *et al*.,2015 established that the prevalence of metabolic syndrome increases with age in both sexes in Sudan and India respectively. Even though most researchers agree on the fact that prevalence of MS increases with age, few studies have been done to investigate MS prevalence among university students. This makes the relationship between age and MS among Kenyan university students unknown.

The prevalence of metabolic syndrome in adult population worldwide varies from 8 to 24.2 % in males and from 7 to 46.5% in females(Abdoljalal *et al*., 2012). Analysis of the various studies clearly indicates mixed results. Whereas Ahmed *et al*., 2015 established that the prevalence of MS was higher in females than male students, Nwegbu and Jaiyesimi (2012) established a higher prevalence rate of 18.8% for males as compared to 14.8% for females. It is therefore not clear whether males or females are at a greater risk of developing MS. Further, few studies have analyzed prevalence of MS among universities making the association between gender and MS uncertain. This study therefore sought to determine the prevalence and major components of MS, the association between age and MS components and between gender and MS components among Maseno University students.

1.2 Statement of the Problem

Metabolic syndrome is a major driver of cardiovascular disease and for a long time it was an adult problem limited to affluent societies. In the last few years studies conducted in youthful populations appear to suggest that the problem is rapidly involving the youth as well as populations in developing countries due to the infiltration of fast foods stores and change in their eating habits. Many developing countries have limited health budgets and may not cater for the

increase in non communicable diseases. Few studies conducted in developed countries have varied results and since each country has its own cultural practices, makes conclusion very difficult because the results may not be representative of our country Kenya. In addition one study had been conducted among the youthful population in Kenya, making the prevalence of MS and association between age, gender and MS uncertain among this population. Besides, the frequency of the major components of MS in the different populations also varies. These components include raised BMI, high blood pressure, central obesity, high blood sugar and low HDL-c. Most researchers agree that prevalence of MS increases with age but they differ on the association between MS and gender. Some studies reported high prevalence among males while others had high prevalence among females. This raised the need to investigate the prevalence and components of MS by age and gender among Maseno University students, Kenya.

The most youthful population in Kenya are those students in high school, However, they have restricted diets. Therefore, the best capture site for these youthful population was the university since they have no diet restrictions, students are free to eat anything and decide whether to engage in exercises or not.

1.3 Justification of the Study

Developing countries have been experiencing a shift in disease type and prevalence, generally referred to as the epidemiologic transition. Infectious diseases, once dominant in low income countries, are now being replaced by non-communicable diseases (NCDs) which include cardiovascular disease (CVD), hypertension, dyslipidemia, diabetes, overweight and obesity, osteoporosis, and some types of cancer. The experiences of NCD mortality, morbidity and risk factors create challenges for public health and clinical care in settings already faced with scarce

resources Sibai *et al*., (2009). MS is considered a risk factor for the incidence of atherosclerosis and artery diseases (Ahmed *et al*., (2015). Developing countries can't afford to sustain the increasing levels of MS, In light of this information, knowledge of the risk factors of metabolic syndrome which include raised BMI, high blood pressure, central obesity, reduced HDL-c, triglycerides, central obesity and raised fasting blood glucose is of vital importance for necessary precautions to be taken by the Public health sector for prevention purposes. For this reason, it is important to have this study done in a youthful population to help inform policy making on health issues and at the same time help in sensitizing our population on the looming danger of the new dietary habits. This may influence students to make lifestyle choices in terms of observing better dietary habits and maintaining physical fitness that will better their future health.

1.4 Objectives of the Study

1.4.1 Main Objective

The purpose of this study was to investigate the prevalence of metabolic syndrome and components by age and gender among Maseno University students.

1.4.2 Specific Objectives

The specific objectives of this study were to;

i. Find out the prevalence of MS and the frequency of major components of MS; raised BMI, high blood pressure, low HDL-c, raised triglycerides, central obesity and raised fasting blood glucose among Maseno University students.
ii. Determine the association between age and MS components among Maseno University students.

iii. Determine the association between gender and MS components among Maseno University students.

1.5 Research Questions

i. What is the prevalence and components of MS among Maseno University students?

ii. What is the association between age and MS components among Maseno University students?

iii. What is the association between gender and MS components among Maseno University students?

1.6 Scope of the Study

This study was limited to Maseno University and its campuses. It was conducted during the months of June to August during the May/August 2017 semester and the study population comprised of healthy students in session. Maseno University is a national institution that recruits its subjects from the whole country based on merit and not quarter system as is found in secondary schools and other institutions thus eliminating the bias of having only a population from one region which may not give the true picture of what goes on in the whole country. The study basically looked at lipid profile, fasting blood sugar, blood pressure, waist circumference and body mass index, to determine the types and prevalence of metabolic syndrome components. The affected population was educated on the health risks and lifestyle changes including physical activity and dietary changes.

CHAPTER TWO

LITERATURE REVIEW

2.1 Metabolic Syndrome

The earliest description of the metabolic syndrome was by Kylin in 1923 when he described the involvement of hypertension, hyperglycemia, and high uric acid levels (Muhammad, 2007). In 1988 Reaven described "a cluster of risk factors predisposing a person towards diabetes and cardiovascular disease" naming this as Syndrome X. This was the first time that the insulin resistant state was implicated as being central to this collection of cluster of risk factors of Syndrome X(Muhammad, 2007). After Reaven put forward his concept of Syndrome X, there were many attempts to introduce the concept of risk factor clustering for cardiovascular disease and type II diabetes mellitus into the general clinical arena with different names such as deadly quartet and insulin resistance syndrome but this has come to be referred as the metabolic syndrome(Muhammad, 2007).

As explained by Ahmed *et al*., 2015, metabolic syndrome (MS) is a constellation of risk factors including central obesity, insulin resistance, dyslipidemia and hypertension that makes a person vulnerable of developing cardiovascular diseases (CVDs). MS is also known as cardio-metabolic syndrome or syndrome X or insulin resistance syndrome, the condition is a threat to global public health due to its escalating incidence in both developed and developing countries (Maxim, 2012).Worldwide, MS is a major health problem associated with increased morbidity and mortality which started as a characteristic of westernized societies, but is now emerging as well in developing countries (Sibai *et al* ., 2008).It is one of the risk factors for non-communicable

diseases, such as diabetes mellitus and cardiovascular disease, which are world's biggest killer diseases, estimated to cause 3.5 million deaths each year (Ahmed *et al*., 2015).

2.2 Metabolic Syndrome Components Health Implications

Each component of metabolic syndrome significantly increases the risk of developing one or more diseases (Usha *et al*., 2014). Excess abdominal fat is associated with increased risk of type II diabetes and heart disease; hypertension is the most important risk factor for stroke; high blood LDL-c and low HDL-c levels increase the risk of developing heart disease; and insulin resistance is an initial step on the path to type II diabetes. In brief, having type II diabetes significantly increases the risk of developing heart disease, kidney disease and blindness, and increases the chance of limb amputation due to gangrene (Nasreddine*et al*., 2012).

Abdominal obesity is a marker of dysfunctional adipose tissue and is of central importance in the clinical diagnosis of metabolic syndrome (Usha *et al*., 2014). Adipose tissue is known to express and secrete a variety of factors known as adipokines including leptin, adiponectin, resistin as well as cytokines and chemokines such as tumor necrosis factor α, and Interleukin-6b (Usha *et al*., 2014). These adipokines and cytokines which are pro inflammatory markers are the underlying risk factors for metabolic syndrome. Also the release of adipokines by adipose tissue infiltrated macrophages leads to chronic inflammatory state that could play a central role in the development of insulin resistance (Usha *et al*., 2014; Puente *et al*., 2008).

2.3 Treatment of Metabolic Syndrome

The major aim in the treatment of the metabolic syndrome is to reduce the risk for cardiovascular disease and type II diabetes (Rutaihwa, 2011). There is no clear cut off point for treating metabolic syndrome; each individual is treated according to the risk factors that they have.

Treatment modalities as outlined by Rutaihwa (2011) include: Stopping smoking; reducing LDL cholesterol level, blood pressure and glucose levels to the recommended levels; For managing both long- and short-term risk, lifestyle therapies are the first-line interventions to reduce the metabolic risk factors which include: Weight loss to achieve a desirable weight (BMI less than 25 kg/m); increased physical activity, with a goal of at least 30 minutes of moderate-intensity activity on most days of the week; Healthy eating habits that include reduced intake of saturated fat, Tran's fat, cholesterol as well as calories diet.

2.4 Prevalence of Metabolic Syndrome

Ahmed *et al*. (2015) determined the prevalence and risk factors for metabolic syndrome (MS) among first year undergraduate students in three Sudanese universities using a total of 384 first year students using the NCEP/ATP III guidelines. The results indicated an overall prevalence of MS in the test group as 7.8 %. They concluded that the prevalence of MS among Sudanese first-year university students in Khartoum is moderately high. Incidence of MS among the students is directly proportional to BMI.

Singh *et* al. (2015) identified the prevalence of metabolic syndrome in the Urban Sikh Population in India by means of a door to door survey using WHO criteria. Their main aim was to identify the risk factors for the development of metabolic syndrome using a sample size of 1089. The overall prevalence of metabolic syndrome was 34.3%. BMI and hypercholesterolemia significantly contributed to the increased MS risk.

Kagaruki, et al. (2015) estimated the prevalence and risk factors for metabolic syndrome (MS) among HIV positive patients on antiretroviral therapy (ART) in Tanzania using 351 participants. A cross sectional study was conducted among adults aged ≥ 18years living with HIV-infection

and receiving ART. The prevalence of MS was assessed using International Diabetes Federation's criteria. Biochemical assays, anthropometric measurements, demographic characteristics and lifestyle behavioral data were collected. Results indicate that the prevalence of MS was 25.6% and was higher among participants from urban than those from rural areas (35.6% Vs 15.5%, p<.001). Three out of five components of MS was significantly higher among participants from which included: raised blood levels of triglyceride, reduced blood level of HDL-c and raised fasting blood glucose.

Barrimah *et al*. (2009) estimated the prevalence of metabolic syndrome among Qassim university personnel in Saudi Arabia using the definition proposed by NCEP ATPIII by employing a cross sectional study design that included 560 male university staff of different ages and careers. Results indicated that prevalence of metabolic syndrome was 31.4%. BMI and serum cholesterol were the most common component associated with the syndrome

Feliciano–Alfonso *et al*. (2010) estimated the prevalence and distribution of cardiovascular risk factors and Metabolic Syndrome (MS) in young individuals admitted to the National University of Colombia in Bogotá. A cross-sectional study was conducted in a sample of 249 individuals of both genders aged 15 to 20 years. Results showed prevalence of the MS varied markedly according to the definition employed: 9.2% using REGODCI (Research Group on Diabetes and Chronic Illnesses) criteria, 2% using IDF (International Diabetes Federation) criteria, and 2.4% using AHA (American Heart Association) criteria. Arterial prehypertension was the most common component followed by low High density lipoprotein cholesterol (HDL-c).

Nwegbu and Jaiyesimi (2012) determined the prevalence of metabolic syndrome amongst healthy Nigerian adults. One hundred and twenty-five (125) subjects aged between 40-70 years were evaluated for metabolic syndrome using the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria. These subjects comprised of sixty-one (61) and sixty-five (65) females and males respectively. Metabolic syndrome prevalence rate was 16.8% amongst the subject group. Hypertension was the commonest component of the syndrome noted in the subject group while obesity and decreased high density lipoprotein cholesterol (HDL-c) were the second and third commonest components respectively. Hypertriglyceridemia was the least common component observed in the study group. A strong association was found between increased waist circumference (WC) and hypertension amongst these apparently healthy subject cohort ($p<0.01$). Thirty-eight percent (38%) of the subject group with metabolic syndrome had greater than 3 components of the ATP III criteria, but none had 'full blown metabolic syndrome'. In addition 16% were found to have impaired fasting glucose (IFG).

Sibai *et al*. (2008) assessed the prevalence and correlates of metabolic syndrome in an adult population attending health centers in Lebanon using a sample 499 men and women aged 18-65 years from 23 health centre's. Based on the International Diabetes Federation classification criteria, the overall prevalence of the metabolic syndrome (P2 factors additional to abdominal obesity) was 31.2%. Abdominal obesity and low HDL-C were the factors that contributed most to the overall prevalence of metabolic syndrome. Lack of physical exercise was associated significantly with higher odds of metabolic syndrome. They concluded that the relatively high prevalence of MS was contributed by abdominal obesity, low HDL-c and the negative association observed between metabolic syndrome and physical activity.

Mirhosseini *et al*. (2009) determined the prevalence of the metabolic syndrome and its influencing factors among 15 to 17 years old adolescent girls in Mashhad, Iran based on the NCEP ATP III (2001) criteria. Results indicated that the prevalence of the metabolic syndrome was 6.5% and increased to 45.1% in obese subjects. Increasing BMI or WC, led to significant increment in the number of metabolic syndrome features ($p< 0.001$). High socioeconomic status of family, medical history of parents and dietary habits especially high consumption of carbohydrates were influencing factors in the prevalence of the metabolic syndrome.

Odum and Orluwene (2013) determined the prevalence of metabolic syndrome in apparently healthy individuals in the University of Port Harcourt Teaching Hospital using the revised National Cholesterol Education Program- Adult Treatment Panel III (NCEP- ATP III) and World Health Organization (WHO) definitions. Metabolic syndrome risk factors and prevalence were evaluated in 267 non- diabetic, apparently healthy individuals selected from the hospital environment. According to the ATP III and WHO definitions respectively, the overall prevalence of metabolic syndrome was 15.7% and 10.9%. The ATP III definition gave a higher prevalence than the WHO definition and thus identifies a greater number of individuals at high risk of CVD and T2D. High blood pressure was the most frequent component of metabolic syndrome with the ATP III definition while obesity was the most frequent component with the WHO definition.

Based on the reviews, it is evident that several studies have compared the prevalence of MS based on different guidelines (WHO, NCEP and IDF). However, their studies have yielded varied prevalence rates and showing different components as the most frequent components of MS. These components include BMI, high blood pressure, raised fasting blood glucose, waist

circumference and HDL-c. Further few studies analyzed the prevalence among university students making the prevalence unknown especially among Kenyan university students. This study therefore sought to determine the prevalence and major components of MS among Maseno University students.

2.5 Association between Age and Metabolic Syndrome

Ahmed *et al*. (2015) determined the prevalence and risk factors for metabolic syndrome (MS) among first year undergraduate students in three Sudanese universities using a total of 384 first year students using the NCEP/ATP III guidelines. The results indicated that the frequency of MS was directly proportional to age. Moreover, Singh *et al.* (2015) identified the prevalence of metabolic syndrome in the Urban Sikh Population in India by means of a door to door survey using WHO 1999 criteria. Their main aim was to identify the risk factors for the development of metabolic syndrome using a sample size of 1089. They also found that the prevalence of metabolic syndrome increases with age in both sexes.

Abdoljalal *et al*. (2012) evaluated the prevalence of metabolic syndrome among 160 Sistanee ethnic women aged 20-40 years in Iran using Adult Treatment Panel-III (ATP-III) guidelines. The results indicated that the mean body mass index, waist circumference, systolic blood pressure, diastolic blood pressure and fasting blood glucose levels were significantly higher in the subjects with metabolic syndrome and the prevalence of MS increased with age. Similarly, Barrimah *et al*. (2009) estimated the prevalence of metabolic syndrome among Qassim university personnel in Saudi Arabia using the definition proposed by NCEP ATPIII by employing a cross sectional study design that included 560 male university staff of different ages and careers. Results indicated that the prevalence was found to show a steady increase with

increasing age with age groups above 40 years. They concluded that almost a third of the university personnel have metabolic syndrome and therefore they are at higher risk for both cardiovascular disease and diabetes mellitus.

Odum and Orluwene (2013) determined the prevalence of metabolic syndrome in apparently healthy individuals in the University of Port Harcourt Teaching Hospital using the revised National Cholesterol Education Program- Adult Treatment Panel III (NCEP- ATP III) and World Health Organization (WHO) definitions. The results indicated that the prevalence of MS increased markedly with age and peaked in the age range of 50 -59 years with both definitions. With the ATP III and WHO definitions, sex - specific prevalence rates were 21.5% and 12.5% for females and, 8.9% and 8.9% for males respectively.

Although most researchers consent on the fact that prevalence of MS increases with age, very few studies have attempted to investigate MS prevalence among university students more so in Kenya. This makes the relationship between age and MS among Kenyan university students unknown justifying the need to determine the association between age and MS components among Maseno University students.

2.6 Association between Gender and Metabolic Syndrome

Ahmed *et al*.(2015); Nwegbu and Jaiyesimi (2012) determined the prevalence and risk factors for metabolic syndrome (MS) among healthy individuals using the NCEP/ATP III guidelines. The results by Ahmed *et al*., (2015) indicated an overall prevalence of MS was higher in females than male students while Nwegbu and Jaiyesimi (2012) established a higher prevalence rate of

18.8% for males as compared to 14.8% for females. It is evident that from the mixed results they lack consensus to whether females or males are at a greater MS risk.

Öğüş *et al*. (2013) determined the metabolic syndrome risk levels of students from the Faculty of Health Sciences, Baskent University using a survey study design. Regression analysis was performed to determine the risks. The results indicated gender as one of the important risk factors for metabolic syndrome. Males were at a higher risk of metabolic syndrome than females.

Singh *et al*.(2015) identified the prevalence of metabolic syndrome in the Urban Sikh Population in India by means of a door to door survey using WHO 1999 criteria. Their main aim was to identify the risk factors for the development of metabolic syndrome using a sample size of 1089. The results indicated a higher prevalence among women (41.4%) compared with men (28.2%). On the other hand, Sibai *et al*., (2008) assessed the prevalence and correlates of metabolic syndrome in an adult population attending health centers in Lebanon using the International Diabetes Federation classification criteria, established that the prevalence of the metabolic syndrome was significantly higher in men than women. These mixed results raise the need to compare the prevalence of MS in females and males using the same subjects.

Barbosa *et al*. (2016) conducted a cross-sectional population-based study on 968 university students of São Luís, Brazil. The prevalence of metabolic syndrome by the Joint Interim Statement (JIS) criteria was20.5%, almost three times more prevalent in men(32.2%) than in women (13.5%).The prevalence of insulin resistance was 7.3% and the prevalence of low HDL-

cholesterol was high(61.2%), both with no statistically significant differences by sex. The study concluded that University students of private institutions had higher prevalence of metabolic syndrome than students from public institutions suggesting that the burden of these diseases in the future will be increased.

Tadewos *et al*. (2017) conducted a cross-sectional study on 270 participants from March to November 2014 using structured questionnaires for data collection; blood glucose and lipid profiles were determined after overnight fasting according to modified National cholesterol Education Program Adult Treatment Panel-III guideline. Results showed that the prevalence of MS was 45.9% and the proportion of MS was significantly higher in women when compared to men at 60.6% and 36.7% respectively. Elevated TGs was the most frequently encountered MS component followed by Low HDL-c. Abdominal obesity and low HDL-c were significantly higher in women as compared to men.

Analysis of the various studies clearly indicates mixed results i.e. some studies establish high prevalence among males while others establish high prevalence among females by either using the same or different MS diagnosis guideline. It is therefore not quite clear whether males or females are at a greater risk. Further, few studies have analyzed prevalence of MS among universities in Africa making the association between gender and MS uncertain. This raised the need to establish the association between gender and MS components among Maseno University students.

2.7Metabolic Syndrome Analysis

There are several working definitions for the analysis of metabolic syndrome proposed by World Health Organization, the National Cholesterol Education Program Adult Treatment Panel III (NCEP/ ATPIII), European Group for the Study of Insulin Resistance (EGIR), and the International Diabetes Federation (IDF) Barrimah *et al*., (2009). However, researchers have varied views on which diagnostic criteria is most applicable. Whereas Barrimah *et al*., (2009) advocates for the NCEP; Rutaihwa(2011) advocates for WHO criteria. This study adopted the WHO guidelines based on the fact that it considers high fasting glucose and any other two components of blood pressure, low high- density lipoprotein cholesterol (HDL-c) and Central obesity or body mass index.

2.7.1National Cholesterol Education Program Adult Treatment Panel III (NCEP/ ATP III)

According to Barrimah *et* al., (2009) MS based on NCEP definition, a person is considered to have metabolic syndrome if he has any three of the following: Abdominal obesity: waist circumference > 102 cm in men and > 88 cm in women, Hypertriglyceridaemia: Triglyceride (TG) level 150 mg/dl (1.69 mmol/l), Low high-density lipoprotein cholesterol (HDL-C) level: < 40 mg/dl (1.04 mmol/l) in men and < 50 mg/dl (1.29 mmol/l) in women, High blood pressure: 130/85 mmHg or use of anti-hypertensive medication, High fasting blood glucose: 110mg/dl (6.1 mmol/l) or use of hypoglycemic medication.

2.7.2 International Diabetes Federation (IDF) Analysis

According to Kagaruki, et al., (2015) based on IDF criteria a person is said to have Metabolic syndrome if he/she has abnormal waist circumference (≥ 80 cm in women and ≥ 94 cm in men) and at least two of any of the following: Raised triglycerides level ≥ 1.7 mmol/l, Reduced HDL cholesterol level in male <1.03 mmol/L and in females <1.29 mmol/L, Raised fasting blood

glucose 5.6mmol/l and Raised systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg.

2.7.3 World Health Organization (WHO) Criteria

According to Singh *et* al., (2015) based on the WHO criteria a person is said to have MS if he has the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting blood glucose or insulin resistance, and any two of the following: Blood pressure ≥ 140/90 mm Hg, Dyslipidemia: triglycerides (TG) ≥ 150 mg/dl or low high- density lipoprotein cholesterol (HDL-C) < 4 0 m g /d l, Central obesity: waist : hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m^2, Microalbuminuria: urinary albumin excretion ratio ≥ 20 μg/min of albumin: creatinine ratio ≥ 3 0 mg /gm.

CHAPTER THREE

METHODS AND MATERIALS

3.1 Study Area

The study was conducted at Maseno University, Kisumu County. It lies within longitudes 33° 20'E and 35° 20'E and latitudes 0° 20'South and 0° 50'South. The County is bordered by Homa Bay County to the South, Nandi County to the North East, Kericho County to the East, Vihiga County to the North West and Siaya County to the West. The County covers a total land area of 2009.5 km2 and another 567 km2 covered by Lake Victoria water (County Government of Kisumu, 2013). The county's population stands at 968,909 persons with 474,687 males and 494,222 females (2009 National Census). Maseno University has 17,000 students pursuing programs offered on the University campuses. The main campus is located in Maseno Township along Kisumu- Busia road, 25km from Kisumu city and 400km west of Nairobi. Maseno University is the oldest and largest public university in Western Kenya. The University has largest number of admissions as compared to other public universities in the region hence the highest number of young adults. It also hosts students from all over the country with different eating habits.

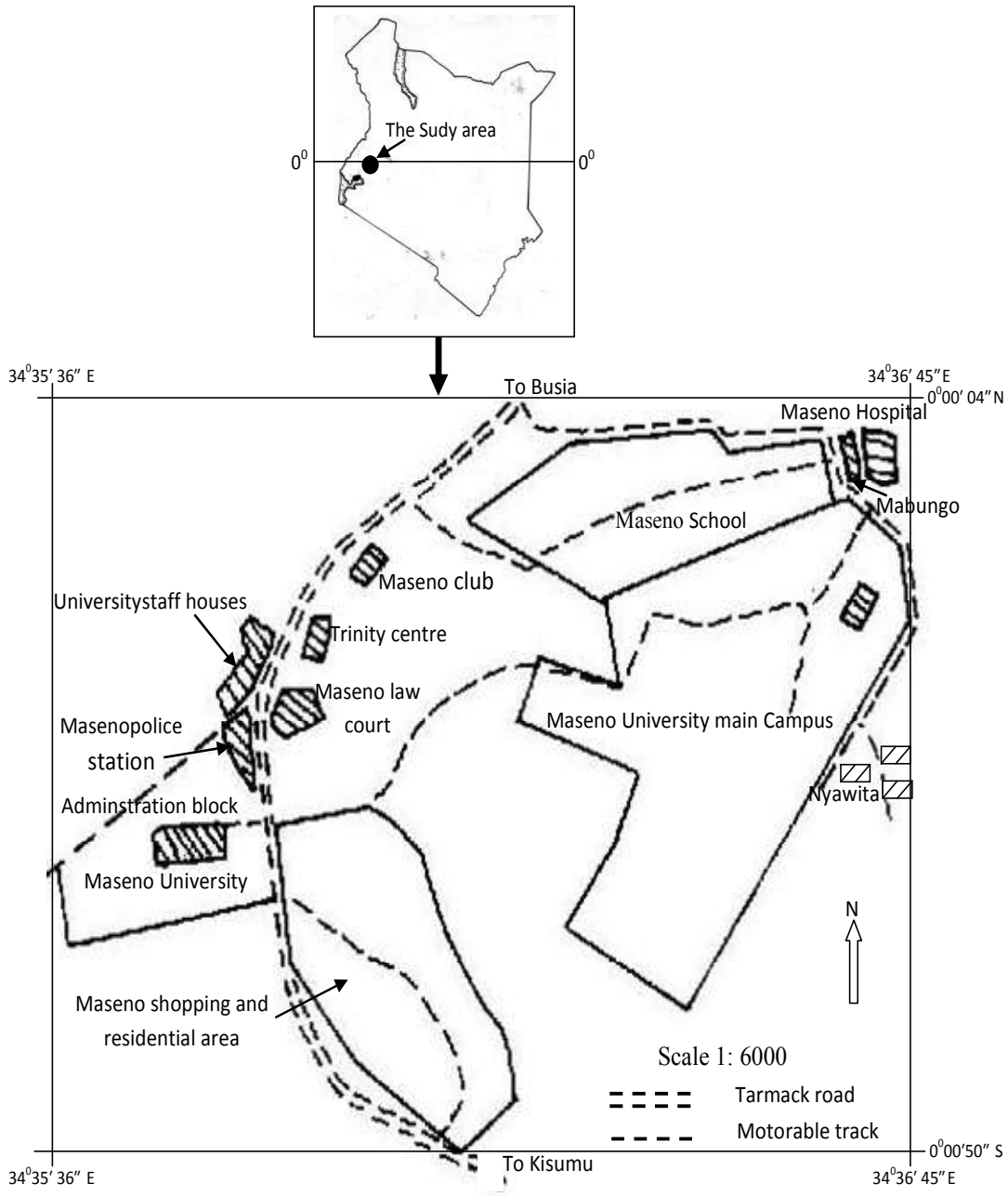


Figure 3.1. Map of Kisumu County (county Government of Kisumu, 2013)

3.2 Study Design

This employed a descriptive cross-sectional study.

3.3 Target Population

The target population involved undergraduate and postgraduate Maseno University students. Maseno University has approximately 17,000 students from 14 schools (data from Office of The Registrar, Academic & Student Affairs as attached in appendix: 6) and therefore the target population was estimated at 17000. However, the study collected data from a total of 520 students who consented to participate in the study. This involved 40 students from each of the 13 schools. School of graduate studies was not involved since it comprises of students from all the other 13 schools.

3.4 Sample Size and Sampling Technique

The sample size for the study was determined following Fisher *et al*. (1998) formula.

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

Where

n = sample size of the target population which is greater than 10,000;

$z = 1.96$ Value of the standard normal distribution curve corresponding to 95% level of significance

$p = 0.5$, Where data on the proportion of respondents with characteristic being investigated is not available, $p = 0.5(50\%)$ is regarded as appropriate Fisher *et al*., (1998).

d = Margin of error which is 5% (0.05)

Therefore, at 95% confidence interval assuming a target population of more than 10,000, the desired minimum sample size is

$$n = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2}$$
$$= 384$$

The sample size of 384 was adjusted by adding 10% of the calculated sample size to take care of sampling error with the corrected sample size being equal to 423 students. This sampling based on stratification was to involve a sample of 32.5 students from each of the 13 schools. However, this study rounded off the sample size to 33 students per school that resulted into a sample size of 429 students. The study employed stratified sampling method to ensure equitable representation among various schools, student's age groups and student's gender. According to Mugenda and Mugenda (2003), stratified random sampling subjects are selected such that the existing sub groups in the population are more or less reproduced in the sample. The population was divided into different schools, age groups and gender then a given number of cases was randomly selected from each population subgroup as depicted in Tables A.2, A.3 and A.4 in the appendix 4 and 5.

3.6 Inclusion and Exclusion Criteria

3.6.1 Inclusion

The study included Maseno University students who consented and were 18 years and above.

3.6.2 Exclusion Criteria

Those students who were unwilling to disclose information and give a fasting blood sample and those on treatment for any of the components of MS were excluded from the study.

3.7 Data Collection

3.7.1 Questionnaire Administration

Maseno University students who were sampled were subjected to an interview using a pretested, number coded questionnaire that had structured questions on their socio-demographic characteristics as shown in appendix 1. This was after they had gone through the consent form and signed. The questionnaire was first administered then followed by the anthropometric measurements.

3.8 Laboratory Methods

Study participants were taken through the tests to be done and type of sample required for biochemical measurements. After a 10 minute rest, anthropometric measurements were taken followed by blood pressure measurement, after another 5 minute rest. Blood for lipid profile and fasting glucose measurements was collected next morning after a 9-12 hour overnight fast.

3.8.1 Anthropometric Measurements

BMI (kg/m^2) and WC (waist circumference) were measured following the WHO diagnostic criteria.

WHO: a person is said to have MS if he has the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting blood glucose or insulin resistance, and any two of the following: Blood pressure ≥ 140/90 mm Hg, Dyslipidemia: triglycerides (TG) ≥ 150 mg/dl or low high- density lipoprotein cholesterol (HDL-C) < 35 m g /d l in men , HDL-C) < 39 m g /d l in women, Central obesity: waist : hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m^2, Microalbuminuria: urinary albumin excretion ratio ≥ 20 μg/min of albumin : creatinine ratio ≥ 3 0 mg /gm (Singh *et al*. , 2015)

WHO diagnostic criteria was preferred because It is based on the abnormalities of fasting blood glucose and insulin homeostasis, It therefore, targets individuals who are at high risk of developing Diabetes Mellitus if not already present (Odum et al. 2013) It also considers both WC & BMI whereas the IDF and NCEP use WC only. The blood pressure measurement in IDF and NCEP criteria is lower at 130/85 mmHg compared to WHO of 140/90 mmHg.

BMI was measured by the ratio of weight in kilograms to height in meters (kg/m^2). Weight of the participants was measured using a seca weighing scale, without shoes and in light clothing. Height assessment was done using a seca rod 220 stadiometer (seca, hamburg, Germany) without shoes. Height and weight was measured to the nearest 0.1cm and 0.1kg respectively. BMI was calculated by dividing weight (kilograms) with height squared (meter). Waist circumference (WC) in centimeters was measured using a Roche waist circumference tape to the nearest 0.1cm with the subject standing upright with their feet comfortably apart, their weight evenly balanced on both feet and arms hanging by their sides, at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, with light clothes on as described in WHO guidelines. These measurements were taken by a qualified nurse in the Maseno University nursing skills room.

3.8.2 Clinical and Biochemical Measurements

4mls of fasting venous blood samples was obtained from all study participants into sterile serum separator tubes with clot activator, in the morning after a 9-12 hours overnight fasting. All the requirements were assembled and the study participant was made to sit comfortably on a chair with the arm resting on a table. Hand hygiene was performed and with protective clothing on, a suitable vein was located by examining the antecubital fossa (forearm). After the participant had

relaxed enough a tourniquet was then applied about 4-5 finger widths above the venepuncture site and the vein re- examined, the torniquet was used to obstruct venous return and make veins be filled with blood. The skin over selected vein was cleaned with a sterile alcohol (70% isopropyl) swab for 30 seconds and allowed to dry.

Study participant was asked to make a fist for the veins to be more prominent and with the needle attached to the syringe and the bevel facing up , the skin below puncture site was pulled tight with thumb and the vein punctured at a 30^0 angle. 4mls of blood was drawn by pulling back slowly on the syringe stopper and then the tourniquet was released and study participant asked to loosen the fist. A gauze pad was placed over puncture site and the needle quickly removed. Study participant was asked to apply pressure to the gauze for 2 minutes until bleeding stopped. Blood was transferred into sterile serum separator tubes and placed in the ice box. The contaminated materials and needles were disposed off in the appropriate waste containers e.g., sharps in sharps container and those items that drip blood or body fluids in infectious waste material. The tubes were labeled appropriately. Used gloves were removed and placed in general waste and hand hygiene performed again. Blood collection was performed by trained Medical Laboratory Technicians at the Medical Physiology Laboratory.

3.8.3 Fasting Blood Glucose

Fasting Blood glucose was immediately determined using a hemocue 201 analyzer (Hemocue, Angelholm, Sweden).Blood samples were centrifuged and serum was obtained in labeled eppendorf tubes for biochemical analysis which included Triglyceride (TG) level and high-density lipoprotein cholesterol (HDL-c) level based on the WHO diagnostic criteria using fully automated Cobas Integra 400 plus chemistry analyzer (Roche diagnostics, Switzerland). The

labeled serum samples were transported to Moi Teaching and Refferal Hospital, Biochemistry laboratory in icebox for analysis within a day.

3.8.4 Blood Pressure Measurement

Blood pressure was measured by a qualified nurse from the branchial artery using automated Omron M2 Comfort blood pressure device and recorded in mmHg. It was done after the study participants had rested for 5 minutes in a sitting position with the arm horizontally supported at the level of the heart. The measurement was repeated after 5 minutes and the average of the two measures was taken as blood pressure.

Study participants who had high measurements of pressure (≥ 140/90 mm Hg) and glucose were asked to repeat the tests and those that maintained the high levels were referred to a physician in the university clinic for treatment and further management.

Those that had dyslipidemia, BMI > 30kg/m^2 and large waist circumference were also referred to an expert in the university health centre for education on lifestyle changes, which involved dietary and physical activity.

3.8.5 High Density Lipoprotein-cholesterol and Triglycerides

Test principle

The erythrocytes of the venous blood sample were separated from the serum by centrifugation.

In the next step, the serum sample was diluted with phosphate buffer. The HDL test used a precipitation method with Mg2+ and phosphotungstic acid as a precipitant reagent.

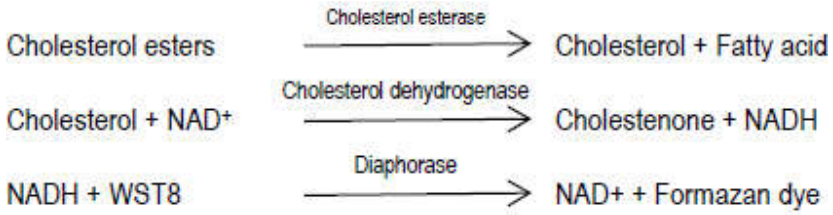
The components except for HDL-cholesterol were precipitated and removed.

The **cobas b** 101 system determined total cholesterol and HDL-cholesterol by an enzymatic method. Cholesterol esters in the sample were hydrolyzed to cholesterol and fatty acids.

Cholesterol and NAD+ generated cholestenone and NADH in the presence of cholesterol dehydrogenase.

WST8 was reduced to formazan dye by diaphorase and NADH through oxidation-reduction reaction.

The color intensity of formazan was measured at a specific wave length of 460 nm and was directly proportional to the concentration of HDL-cholesterol and total cholesterol in the sample.

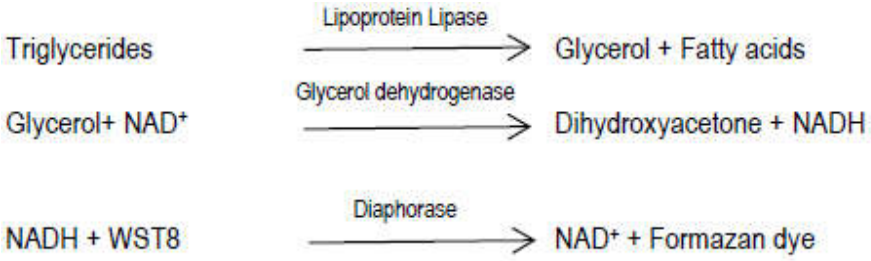


The triglycerides test was an enzymatic method.

Triglycerides in the sample were hydrolyzed to glycerol and fatty acids by lipoprotein lipase.

Glycerol and NAD+ generated dihydroxyacetone and NADH in the presence of glycerol dehydrogenase.

WST8 was reduced to formazan dye by diaphorase and NADH through oxidation-reduction reaction. The color intensity of the formazan was proportional to triglyceride concentration and calculated by measuring at a wavelength of 460 nm.



A standard pipette was used to transfer 19 µL of serum to the disc which was self-filling. After applying blood to the disc, it was inserted into the instrument within 8 minutes.

3.8.6 Calibration

Traceability: Total cholesterol and HDL-cholesterol are traceable to the designated CDC reference methods (Abell/Kendall as reference method for total cholesterol).Triglycerides are traceable to the ID/MS method.

The instrument automatically reads in the lot-specific calibration data from the barcode information printed on the disc, eliminating the need for calibration by the user.

3. 8.7 Quality control

For quality control, use **cobas** Lipid Control.

The control intervals and limits are adapted to each laboratory's individual requirements. Values obtained should fall within the defined limits. Each laboratory should establish corrective measures to be taken if values fall outside the defined limits.

Follow the applicable government regulations and local guidelines for quality control.

3.8.7.1. Quality Control (QC) info disc

Every **cobas** Lipid Control kit contains a lot-specific QC info disc for quality control. This QC info disc contains the target values and ranges for the **cobas** Lipid Panel.

The instrument display prompts the user to insert the QC info disc. The **cobas b** 101 instrument reads the disc providing the lot specific target ranges.

3.8.7.2 Display of results

At the end of the automatic determination, the **cobas b** 101 instrument displays the result in approximately 6 minutes. The measured total cholesterol, HDL-cholesterol, triglycerides and calculated LDL-cholesterol result will be displayed in mg/dL or mmol/L depending on the setting. Please refer to the operator's manual.

3.8.7.3 Interferences

Triglycerides

To test triglycerides using the **cobas** Lipid Panel test ensure that the subject fasts for 9-12 hours before the sample is collected.

Icterus: No significant interference up to a conjugated/unconjugated bilirubin concentration of 15 mg/dL.

Hemolysis: No significant interference up to a hemoglobin concentration of 200 mg/dL.

Ascorbic acid: no significant interference up to 5 mg/dL.

Criterion: Recovery within ± 10 % of initial values at triglyceride levels of 203 mg/dL (2.3 mmol/L).

Fatty substances such as hand creams or soaps may contain glycerol which leads to false high triglyceride results.

High density lipoprotein

Icterus: No significant interference up to 15 mg/dL for conjugated bilirubin and up to 30 mg/dL for unconjugated bilirubin.

Hemolysis: No significant interference up to a hemoglobin concentration of 200 mg/dL.

Lipemia (Intralipid): No significant interference up to 500 mg/dL.

Ascorbic acid: no significant interference up to 5 mg/dL.

Criterion: Recovery ≤10 % of initial value at a HDL concentration of 50 mg/dL(1.3 mmol/L).

Abnormal liver function affects lipid metabolism; consequently, HDL-cholesterol and LDL-cholesterol results are of limited diagnostic value.

In some patients with abnormal liver function, the HDL-cholesterol result may significantly differ from the designated comparison method (DCM) result.

3.8.7.4 Measuring range

Triglycerides: 45-650 mg/dL or 0.50-7.35 mmol/L

HDL-cholesterol: 15-100 mg/dL or 0.38-2.60 mmol/L

3.8.8. Precision

Precision was determined using controls in a CLSI EP5-A2 protocol. Serum samples were measured using a modified CLSI protocol in 5 series of 4 replicates in one day. The following results were obtained:

Sample			Repeatability		Intermediate precision	
		Mean value mg/dL (mmol/L)	SD mg/dL (mmol/L)	CV %	SD mg/dL (mmol/L)	CV %
Control/Level 1	TC	145 (3.76)	2.7 (0.069)	1.8	3.0 (0.078)	2.1
($n^{a)}$ = 84)	TG	97 (1.10)	1.3 (0.015)	1.3	1.4 (0.016)	1.4
	HDL	42 (1.08)	1.4 (0.037)	3.5	1.4 (0.037)	3.5
Control/Level 2	TC	269 (6.96)	4.8 (0.123)	1.8	5.1 (0.131)	1.9
(n = 84)	TG	395 (4.46)	4.2 (0.048)	1.1	4.3 (0.049)	1.1
	HDL	69 (1.78)	1.9 (0.048)	2.7	2.1 (0.055)	3.1
Whole blood 1	TC	166 (4.29)	3.1 (0.080)	1.9	3.7 (0.095)	2.2
(n = 20)	TG	336 (3.80)	4.0 (0.045)	1.2	4.4 (0.050)	1.3
	HDL	38 (0.97)	0.9 (0.023)	2.4	1.4 (0.035)	3.6

(Cobas Integra user manual)

3.9 Validity and Reliability Tests

The study conducted reliability test for the data collection instrument (questionnaire) by use of the test-retest technique and validity test was by construct method. Validity is the accuracy and meaningfulness of inferences, which are based on the research results while reliability is a measure of the degree to which a research instrument yields consistent results after repeated trials (Mugenda & Mugenda, 2003).

Thirteen identical students were involved for the pretest each from the thirteen schools with a time lapse of one week. None of the students was later involved in the study. The test – retest method of assessing reliability of data involves administering the same instrument twice to the same group of subjects with a time lapse between the first and second test (Mugenda & Mugenda, 2003). Cronbach's alpha was used to assess reliability of the questionnaire by correlating scores from the first and second tests. Table 3.5 results indicated Cronbach's alpha

coefficient of 0.478. After questionnaire improvement that involved adjustment to the questions a Cronbach's alpha coefficient of 0.812 was obtained an indication of high reliability of the data collection instrument since the value was greater than 0.7 as explained by Sasaka (2016) and Maina (2015). The study also employed construct validity technique where the questionnaire was reviewed by the two supervisors who recommended necessary amendments with regard to the content of the questionnaire in line with the study objectives.

Table 3.1: Reliability test results

Test	N of items	Cronbach's Alpha
First test	8	0.478
Second test	8	0.812

Note. A value greater than 0.7 indicates reliability of data collection instrument

3.10 Ethical Consideration

Study approval was obtained from School of Graduate Studies (SGS) - Maseno University. Ethical approval was also sought from Maseno University Ethical Review Committee (MUERC) and further permission from the Maseno University administration. The researcher also gave assurance to maintain confidentiality and sought informed consent from each participant before enrollment. Participants were free to withdraw from study at any time. Participants were explained to the procedures involved in details and the risks in details before allowing them to sign the consent.

Biological samples and data obtained from the participants was kept in secure cabinets and access to the research data was only limited to the investigators only. The information obtained was used for academic purposes.

The investigators used personal protective equipment like gloves, dust coats and masks. All infectious materials used like sharps, blood vials, vacutainer tubes containing blood, used gloves etc were disposed in appropriate biohazard bins for incineration.

Study participants found having metabolic syndrome were referred to the University clinic for treatment and care.

Contact details of participants had been taken together with their data for purposes of results dissemination.

3.11 Data Analysis

The study employed both descriptive and inferential data analysis techniques. Descriptive statistics encompassed use of frequency distribution tables and percentages to present prevalence of MS while chi-square and correlation analysis techniques were used to determine the association between age, gender and MS prevalence at 5% level of significance by use of p-values of less than 0.05. Data analysis was by the aid of SPSS version 20.

CHAPTER FOUR

RESULTS

4.1 Socio-Demographic Characteristics of Study Participants

The study based on the socio-demographic characteristics analysis as depicted in Table 4.1 indicated that; 282 (65.7%) were males and 147(34.3%) were females.

Table 4.1: Socio-demographic characteristics of study participants

Socio-demographics	Frequency (n)	Percentage (%)
Age		
18-20	173	40.3%
21-23	142	33.1%
24-26	9	2.1%
Over 26	105	24.5%
Total (N=429)	**429**	
Gender		
Male	282	65.7%
Female	147	34.3%
Total (N=429)	**429**	

Note. *N represents total students sampled; n represents students per socio- demographic category. % obtained by* $\frac{n}{N} \times 100\ \%$

The age bracket analysis showed that; 173(40.3%) were in the age bracket of 18-20 years; 142(33.1%) within 21-23; 9(2.1%) within 24-26 and 105 (24.5%) over 26 years.

4.2 Prevalence of MS and the frequency of major components of MS; raised BMI, high blood pressure, low HDL-c, raised triglycerides, central obesity and raised fasting blood glucose among Maseno University students

The study based on the WHO established that out of the 429 students sampled, 21 (4.9%) had a raised BMI of > 30 kg/m^2, 40 (9.3%) had a large waist circumference where 1 man had a waist circumference of over 102 cm and 39 women had a waist circumference of over 88cm, 5 (1.2%) had triglycerides of over 150 mg/dl, 421 (98.1%) had a low HDL-c count where 279 (65.0%) men had HDL-c of less 35 mg/dl and 142 (33.1%) women had HDL-c of less 39 mg/dl, 105 (24.5%) had high fasting glucose of over 110 mg/dl and 8 (1.9%) had blood pressure above $\geq {}^{140}\!/_{90}$ mm Hg.

Table 4.2: Prevalence of MS components among university students

MS Component	Frequency (n)	Percentage (%)
BMI (Kg/M^2)		
< 30	408	95.1%
> 30	21	4.9 %
Total (N=429)	**429**	
Central Obesity (cm)		
≥ 102 in men	4	0.9%
< 102 in men	278	64.8%
≥ 88 in women	36	8.4%
< 88 in women	111	25.9 %
Total (N=429)	**429**	
Triglycerides (Mg/dl)		
≥ 150	5	1.2 %
< 150	424	98.8 %
Total (N=429)	**429**	
HDL-c (Mg/dl)		
< 35 in men	280	65.2%
≥ 35 in men	2	0.5%
< 39 in women	142	33.1%
≥ 39 in women	5	1.2 %
Total (N=429)	**429**	
High fasting glucose (Mg/dl)		
≥ 110	105	24.5%
< 110	324	75.5%
Total (N=429)	**429**	
Blood pressure (mm Hg)		
$\geq 140/90$	8	1.9%
$< 140/90$	421	98.1%
Total (N=429)	**429**	

N represents total students sampled, n represents students per MS component. % obtained by $\frac{n}{N} \times 100 \ \ \%$

The study established the prevalence of MS among Maseno University student's based on WHO diagnostic criteria with results in Table 4.3 indicating that; out of the 105 students with impaired fasting blood glucose 1 had a large waist circumference and triglycerides. This implied an overall prevalence rate of 1% and a prevalence rate of 0% among males and 1.9% among females. Based on age, an MS prevalence rate of 1.9% was noted among students aged over 26 years and 0% among those below 26 years of age.

Based on the comparison of impaired fasting blood glucose, low HDL-c and a high waist circumference, 13 students had raised glucose level, low HDL-c count and a large waist circumference. This implied an overall prevalence rate of 12.4% and a prevalence rate of 0 (0.0%) among males and 13 (23.6%) among females. Based on age, an MS prevalence rate of 9(16.4%) for age bracket 18-20 years, 0(0.0%) for age bracket 21-23 years, 1(1.8%) for age bracket 23-26 years and 3(5.5%) for those aged over 26 years. Based on the comparison of impaired fasting blood glucose, BMI and triglycerides; impaired fasting blood glucose, BMI and blood pressure 0 students had MS. This implied an overall prevalence rate of 0.0% based on both age and gender.

Table 4.3: Prevalence of MS among Maseno university students

MS Component		Frequency (n)	Percentage (%)
	Glucose/Triglycerides/Waist circumference		
	Male (n= 50)	**Female** (n= 55)	Total (N =105)
Age			
18-20 (n=30)	0(0.0%)	0(0.0%)	0(0.0%)
21-23(n=20)	0(0.0%)	0(0.0%)	0(0.0%)
24-26(n=0)	0(0.0%)	0(0.0%)	0(0.0%)
Over 26(n=55)	0(0.0%)	1(1.9%)	1(1.0%)
Total	0(0.0%)	1(1.9%)	1(1.0%)
	Glucose/HDL-c/Circumference		
Age	**Male** (n= 50)	**Female** (n= 55)	**Total** (N =105)
18-20 (n=30)	0 (0.0%)	9(16.4%)	9 (8.6%)
21-23(n=20)	0 (0.0%)	0(0.0%)	0 (0.0%)
24-26(n=0)	0(0.0%)	1(1.8%)	1 (1.0%)
Over 26(n=55)	0(0.0%)	3(5.5%)	3(2.9%)
Total	0(0.0%)	13(23.6%)	13(12.4%)
	Glucose/BMI/Triglycerides or Glucose/BMI/Blood pressure		
Age	**Male** (n= 50)	**Female** (n= 55)	**Total** (N =105)
18-20 (n=30)	0(0.0%)	0(0.0%)	0.0%
21-23(n=20)	0(0.0%)	0(0.0%)	0.0%
24-26(n=0)	0(0.0%)	0(0.0%)	0.0%
Over 26(n=55)	0(0.0%)	0(0.0%)	0(0.0%)
Total	0(0.0%)	0(0.0%)	0(0.0%)

N refers to total students with high fasting glucose while n refers students with high fasting glucose per socio-demographic component. Overall prevalence (%) given by $\frac{n}{N} \times 100\%$ *and prevalence by socio-demographic given by* $\frac{students}{n} \times 100\%$

4.3 Association between age and MS components among Maseno University students

Table 4.4 test results indicated that a large waist circumference (central obesity) depends on the age of the student. Most students in the age bracket of over 26 years had a large waist circumference. A chi-square analysis value with a probability value of 0.000 which is less than 0.05 implied that the null hypothesis of no association between age and waist circumference among Maseno university students is rejected at 5% level of significance. Thus, age and waist circumference are associated. Further, correlation analysis results depicted in Table 4.6 indicated a positive correlation coefficient of 0.103 with a probability value of 0.032 that is less than 0.05 for the association between student's age and waist circumference. This implied that as age increases, the student is more likely to have a large waist circumference.

It was also noted that based on chi- square and correlation analysis, low HDL-c and high fasting glucose had an association with the student's age given chi- square probability values of 0.003 and 0.000 in Table 4.4 that are less than 0.05 for HDL-c and glucose respectively. The correlation coefficients of - 0.317 with a p-value of 0.000 for HDL-c and 0.010 with p-value of 0.042 for glucose in Table 4.6 implied that there is a negative association between student's age and low HDL-c i.e. as the age increases, the HDL-c count decreases while the risk of large waist circumference (central obesity) increases with increase in age. This is depicted in Table 4.4 where more students (173) in the age bracket 18-20 years had low HDL-c count as compared to those (98) in the age bracket of over 26 years. Similarly, there is a positive association between student's age and high fasting glucose i.e. the level of high fasting sugar increases with increase in student's age. Table 4.4 supports this since majority of students (105) in the age bracket of

over 26 years had a raised fasting sugar as compared to those (30) in the age bracket of 18-20 years.

Analysis of the association between triglycerides and student's age based on chi-square and correlation analysis indicated that there was no association between age and triglycerides count. This was based on the chi-square p-value of 0.974 and correlation coefficient p-value of 0.700 that were greater than 0.05. Thus an indication of the acceptance of the null hypothesis of no association between age and triglycerides count among students.

Table 4.4: Association between age and MS components

Age	**Circumference (N=40)** Male ($\geq 102cm$) & Female($\geq 88cm$)	**Triglycerides (N=5)** $\geq 150mg/dl$	**HDL-c (N=422)** Male($< 35mg/dl$) & Female ($< 39mg/dl$)	**Glucose (N=105)** $> 110mg/dl$
18-20	13 (32.5%)	2(40.0%)	173(41.0%)	30(28.6%)
21-23	0(0.0%)	2(40.0%)	142(33.6%)	20(19.0%)
24-26	1(2.5%)	0(0.0%)	9(2.1%)	0(0.0%)
Over 26	26(65.0%)	1(20.0%)	98(23.2%)	55(52.4%)
Total students	**40**	**5**	**422**	**105**
Pearson chi-square	[87.661]*	[0.221]	[4.548]*	[60.465]*
Sig. (P-value)	(0.000)	0.974	(0.003)	(0.000)

N refers to total students per the MS component and n refers to number of studiers in a given age bracket per MS component. (%) given by $\frac{n}{N} \times 100\%$*.* indicates significant association at 5% level of significance.*

4.4 Association between Gender and MS components among Maseno University students

Table 4.5 test results indicated that there is an association between the gender of a student and the MS components of waist circumference (central obesity), low HDL-c and high fasting glucose. Chi-square p-values of greater than 0.05 in Table 4.5 for male students on all the MS components of waist circumference (central obesity), triglycerides, low HDL-c and high fasting glucose indicated that males are not at risk but females are at a greater risk of having MS given the chi-square p-values of less than 0.05 for waist circumference (central obesity), low HDL-c and high fasting glucose except triglycerides.

Correlation analysis results depicted in Table 4.6 with a positive correlation coefficient of 0.894 for waist circumference, a positive correlation coefficient of 0.059 for high fasting sugar and a negative correlation coefficient of – 0.115 for low HDL-c with p-values of less than 0.05 implied that females are at greater risk of having MS.

Table 4.5: Association between gender and MS components

Age	Circumference		Triglycerides		HDL-c		Glucose	
	Male ($\geq 102cm$)	Female ($\geq 88cm$)	Male ($\geq 150mg/dl$)	Female ($\geq 150mg/dl$)	Male($< 35mg/dl$)	Female($< 39mg/dl$)	Male ($> 110mg/dl$)	Female ($> 110mg/dl$)
18-20	4 (100%)	9(25.0%)	1(50.0%)	1(33.3%)	92(32.9%)	81(57.0%)	8(14.5%)	23(46.0%)
21-23	0(0.0%)	0(0.0%)	1(50.0%)	1(33.3%)	120(42.9%)	22(15.5%)	7(12.7%)	11(22.0%)
24-26	0(0.0%)	1(2.8%)	0(0.0%)	0(0.0%)	6(2.1%)	3(2.1%)	0(0.0%)	0(0.0%)
Over 26	0(0.0%)	26(72.2%)	0(0.0%)	1(33.3%)	62(22.1%)	36(25.4%)	39(70.9%)	16(32.0%)
Total students (N)	**4**	**36**	**2**	**3**	**280**	**142**	**55**	**50**
Pearson chi-square	[9.393]	[45.143]*	[0.658]	[1.056]	[7.888]	[91.378]*	[5.733]	[83.488]*
Sig. (P-value)	(0.402)	(0.000)	0.883	(0.797)	(0.246)	(0.033)	(0.125)	(0.000)

N refers to total students per the socio-demographic factors while n refers to number of studiers in a given age bracket per socio-demographic factor. (%) given by $\frac{n}{N} \times 100\%$*. * indicates significant association at 5% level of significance.*

Table 4.6: Correlation analysis test results

Age	Circumference	Triglycerides	HDL-c	Glucose
Age	0.103* (0.032)	-0.019 (0.700)	-0.317*(0.000)	0.010*(0.042)
Gender	0.894*(0.000)	0.917(0.074)	-0.115*(0.017)	0.059*(0.022)

Value not in brackets represents the correlation coefficient while value in brackets represents the p-value. * indicates significance at 5% level of significance

CHAPTER FIVE

DISCUSSION

5.1 Prevalence of MS and the Frequency of Major Components of MS

The present study established that high fasting blood glucose, low HDL-c and large waist circumference were the major MS components among Maseno University students with an overall prevalence rate of 12.4%. Insulin resistance and abdominal obesity are associated with increased risk of type 11 diabetes and heart disease, low HDL-c also increases the risk of developing heart disease (Nasreddine *et al*., 2012). Females were at a greater risk of having MS with a prevalence rate of 23.6% compared to 0.0% in men. Also females in the age bracket of 18-20 were at a greater risk with a prevalence rate of 8.6%. Previous studies indicate that highest prevalence in females could be attributed to poor dietary habits among female students that may involve high consumption of fast foods and lack of physical exercise for purposes of maintaining body fitness. The observed differences may also be due to hormonal differences between males and females. However, these factors were not considered in this study.

The finding of 12.4% MS prevalence conformed to Nwegbu and Jaiyesimi (2012) who established MS prevalence rates of 16.8% which is between 10% - 20%. Nwegbu and Jaiyesimi (2012) had hypertension, obesity and low HDL-c as most common MS components. This study's prevalence rate of MS was higher than that of Ahmed *et al.* (2015) who had an overall prevalence rate of 7.8%, Feliciano-Alfonso et al. (2010), 2% using International Diabetes Federation criteria. The prevalence rate was also higher compared to that of Rutaihwa (2011)who had an overall prevalence rate of 0.2% and that of Odum & Orluwene (2013), 10.9% using the

WHO diagnostic criteria. However, this study's finding of an overall MS prevalence rate of 12.4% were lower than the studies conducted in Lebanon 31.2%, India 34.3%, Tanzania 25.6%, Saudi Arabia31.4% and Ethiopia 45.9% (Sibai et al., 2008, Singh et al., 2015, Kagaruki et al., 2015, Barrimah et al., 2009 and Tadewos et al., 2017 respectively).These variations might be due to differences in sample size or could be attributed to differences in geographical location of the studies as well as socio-cultural variation of the study participant. Many cultures have different cuisines that can affect health. Western countries have diets high in saturated fats and carbohydrates compared to the Mediterranean cultures that have diets high in healthy fats with lots of vegetables. The variations may also be due to the different diagnostic criteria used to define metabolic syndrome. This study used the WHO guidelines. It was also noted that the finding of female students being at a greater risk of having MS compared to their male counterparts conformed to Ahmed *et al.* (2015) with raised BMI as the major MS component and Singh *et al*. (2015) who had raised BMI and hypercholesterolemia as components that increased MS risk. Further, the finding of high fasting glucose, low HDL-c and waist circumference as major MS components conform to the findings of Kagaruki *et al*. (2015), Feliciano–Alfonso *et al*. (2010), Sibai *et al*. (2008), Nwegbu and Jaiyesimi (2012) who established reduced HDL-c, raised fasting glucose and large waist circumference (central obesity) as major MS components. However, some of these studies focused on different population like adults, hospital workers and HIV patients unlike the other studies which focused on young adults in the universities.

5.2 Association between Age and MS Components among Maseno University Students

This study established that high fasting blood glucose, low HDL-c and large waist circumference had a significant association with the age of the student. However, triglycerides had no

significant association with age. A positive association between age and abnormal waist circumference and high fasting glucose may be attributed to poor dietary habits and reduced physical activity. The finding of an association of increased MS prevalence with increasing age conforms to Abdoljalal *et al*. (2012); Ahmed *et al*. (2015); Singh *et al*. (2015); Odum and Orluwene (2013). This could also be due to an increase in many predisposing conditions as age increases e.g., obesity, insulin resistance and hypertension.

5.3 Association between Gender and MS Components among Maseno University Students

The data presented on this report show that there is an association between the gender of a student and the MS components of waist circumference (central obesity), low HDL-c and high fasting glucose. It was noted that males are not at risk but females are at a greater risk of having MS. This may be attributed to the fact that female student rarely engage themselves in body fitness activities as compared to their male counterparts and prefer fast foods an indication of poor dietary habit. The findings conform to the findings of Ahmed *et al*. (2015), Singh *et al*. (2015) and Tadewos *et al*. (2017) who established a higher prevalence of MS among females than males. The findings differ with those of Ogus *et al*., (2013) , Barbosa *et al*. (2016) and Sibai *et al*., (2008) who found a higher MS prevalence in males than females. Another possible explanation for the high MS risk in females could be due to hormonal differences between males and females.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of the Findings

The first objective of this study was to find out the prevalence of MS and the frequency of major components of MS. This was based on the research question of what is the prevalence and components of MS among Maseno University students. High fasting blood glucose, low HDL-c and waist circumference were established as the major MS components among Maseno University students with a prevalence rate of 12.4%. This may be as a result of poor dietary habits involving high consumption of fast foods and limited physical activity. The students are always attending classes and revising hence limited time for body fitness activities. However these factors were not considered in this study.

The second objective of this study was to determine the association between age and MS components; raised BMI, high blood pressure, low HDL-c, raised triglycerides, central obesity and raised fasting blood glucose among Maseno University. It was established that high fasting blood glucose, low HDL-c and waist circumference had an association with the age of the student such that increased age was associated with high fasting blood glucose, low HDL-c and waist circumference. However, triglycerides had no association with age. This may be as a result of poor dietary habits that involve increased consumption of carbohydrates and foods with high sugar content.

The third objective of this study was to determine the association between gender and MS components; raised BMI, high blood pressure, low HDL-c, raised triglycerides, central obesity

and raised fasting blood glucose among Maseno University students. The study established that there is an association between gender and MS components of waist circumference (central obesity), low HDL-c and high fasting glucose. It was noted that males are not at risk but females are at a greater risk of having MS. This may be attributed to the fact that female student rarely engage themselves in body fitness activities as compared to their male counterparts and prefer food with high sugar and fats content.

6.2 Conclusion

In conclusion this study found that;

The prevalence of MS among Maseno University students is high compared to studies done in the youthful population using the WHO diagnostic criteria.

MS components were associated with age and gender an indication that socio-demographic factors are the most important MS risk factors among students.

6.3 Recommendations

i. Surveillance policies to be put in place, to identify youthful population in Kenya Universities at risk of having MS and those already affected. For early detection of risk factors and appropriate preventive measures to be undertaken to reduce the risk of students developing CVDs, hence lower Public Health burden.

ii. Develop MS prevention measures that are socio-demographic factors oriented.

iii. Develop program on healthy living to educate youths on maintaining healthy lifestyles

6.4 Study Limitations

i. This study focused only age and gender differences as they influence the MS prevalence, which meant that other factors such as marital status, dietary habits and physical activity among others remained unknown.

ii. This study concentrated on one diagnostic criterion (WHO), use of other criteria would have yielded different prevalence rates for better comparison with other previous studies.

iii. There was no way of proving whether a study participant had fasted or not, this could affect results by giving false high fasting blood sugar.

6.5 Areas for Further Research

i. The study recommends that future studies on the prevalence of MS involving other socio-demographic factors besides age and gender among university should be conducted. This will lead to the identification of other MS risk factors among university students.

ii. More studies to be done on youthful population in Kenya to identify if this is a national problem

iii. Other diagnostic criteria to be used to see if they will yield different prevalence rates

REFERENCES

Abdoljalal, M., Shahini, N., Atabay, O. A., & Tabari, R. G. (2012). Prevalence of metabolic syndrome among sistanee ethnic women. *Advanced Studies in Biology, 4* (8), 363 – 372.

Ahmed, A. M., Elabid, B. E., Elhassan, K. E., & Waggiallah, H. A. (2015). Metabolic syndrome among undergraduate students attending medical clinics for obligatory medical screening. *Tropical Journal of Pharmaceutical Research, 14* (2), 317-321.

Barbosa, J. B., Santos, A. M., Barbosa, M. M., Barbosa, M. M., Carvalho, C. A., Fonseca, P. C., et al. (2016). Metabolic syndrome, insulin resistance and other cardiovascular risk factors in university students. *Artigo Article, 21* (4), 1123-1136.

Barrimah, I. E., Mohaimeed, A. R., Midhat, F., & Al-Shobili, H. A. (2009). Prevalence of metabolic syndrome among Qassim university personnel in Saudi Arabia. *International Journal of Health Sciences, Qassim University, 3* (2), 133-142.

County Government of Kisumu.(2013). *Kisumu county, first integrated development plan 2013-2017.* Kisumu: Kisumu County Government.

Feliciano–Alfonso, J. E., Mendivil, C. O., Ariza, I. S., & Pérez, C. E. (2010). Cardiovascular risk factors and metabolic syndrome in a population of young students from the national university of colombia. *Rev Assoc Med Bras, 56* (3), 293-298.

Hollman, G., & Kristenson, M. (2008). The prevalence of the metabolic syndrome and its risk factors in a middle-aged Swedish population - mainly a function of overweight? *European Journal of Cardiovascular Nursing*, (7), 1, 21-26.

Kaduka, L. U., Kombe, Y., Kuria, E., Bore, J. K., Bukania, Z. K., & Mwangi, M. (2012). Prevalence of metabolic syndrome among an urban population in Kenya. *Journal of Diabetes Care, 35*, 887-893.

Kagaruki, G. B., Kimaro, G. D., Mweya, C. N., Kilale, A. M., Mrisho, R. M., Shao, A. F., et al. (2015). Prevalence and risk factors of metabolic syndrome among individuals living with HIV and receiving antiretroviral treatment in Tanzania. *British Journal of Medicine & Medical Research* , 1318-1327.

Maina, M. W. (2015). *Determinants of interest rate spreads among commercial banks of Kenya (Unpublished doctoral thesis).* Nairobi: Jomo Kenyatta University of Agriculture and Technology.

Maxim, D.M. (2012). *Relationship of metabolic syndrome to physical activity in selected population of Mangalore (Unpublished Masters Proposal)*. Father Muller Medical College: Mangalore.

Mirhosseini, N.-Z., Yusoff, N. A., Shahar, S., Parizadeh, S. M., Mobarhen, M. G., & Shakery, M. T. (2009). Prevalence of the metabolic syndrome and its influencing factors among adolescent girls in Mashhad, Iran. *Asia Pacific Journal Clinical Nutrition, 18* (1), 131-136.

Mugenda, O. M., & Mugenda, A. G. (2003).*Research methods: quantitative and qualitative approaches* (Revised ed.). Nairobi: Acts Press.

Muhammad, Z. I. (2007). *Metabolic syndrome and insulin resistance in Pakistan: A population based study in adults 25 years and above in Karachi (unpublished master's thesis)*. Oslo: University of Oslo.

Nasreddine, L., Naja, F., Tabet, M., Habbal, M. Z., Aida, E. A., Haikal, C., et al. (2012). Obesity is associated with insulin resistance and components of the metabolic syndrome in Lebanese adolescents. *Annals of Human Biology, 39* (2), 122–128.

Nwegbu, M. M., & Jaiyesimi, O. O. (2012). Prevalence of metabolic syndrome amongst apparently healthy Nigerian adults in a hospital setting. *Journal of Medicine and Medical Sciences, 3* (1), 77-82.

Odum, E. P., & Orluwene, C. G. (2013). Metabolic syndrome prevalence in healthy individuals in University of Port Harcourt Teaching Hospital (Upth), Port Harcourt. *Journal of Dental and Medical Sciences, 10* (3), 17-22.

Öğüş, E., Tekindal, M. A., Ceylan, Y., Demirel, M., Emecioğlu, N., Ercan, İ., et al. (2013). Risks of metabolic syndrome in students of the faculty of health sciences. *Balkan Medical journal, 30*, 296-300.

Puente, A. B., Feve, B., Fellahi, S., & Bastard, J. P. (2008). Adipokines: The missing link between insulin resistance and obesity. *Journal of Diabetes Metabolism, 34* (1), 2-11.

Rutaihwa, M. K. (2011). *Prevalence and risk factors of metabolic syndrome among students at the university of Dar-es-salaam (Unpublished masters' dissertation))*. Dar-es-salaam: Muhimbili University.

Sasaka, P. S. (2016). *Effect of strategic management practices on the performance of corporate social responsibility of state parastatals in Kenya (unpublished doctoral thesis)*. Nairobi, Kenya: Jomo Kenyatta University of Agriculture and Technology.

Sibai, A., Tohme, R. A., Mahfoud, Z., &Chaaya, M. (2009). *Non-communicable diseases and behavioral risk factor survey*. Beirut: World Health Organization.

Sibai, A.-M., Obeid, O., Batal, M., Adra, N., Khoury, D. E., &Hwalla, N. (2008). Prevalence and correlates of metabolic syndrome in an adult Lebanese population.*CVD Prevention and Control, 3*, 83–90.

Singh, A., Shenoy, S., & Sandhu, J. S. (2015). Prevalence of metabolic syndrome and its risk factors among urban sikh population of Amritsar. *Journal of Postgraduate Medicine, Education and Research, 49* (1), 18-25.

Tadewos, A., Ambachew, H., & Assegu, D. (2017). Pattern of metabolic syndrome in relation to gender among type-II diabetes mellitus patients in Hawassa University comprehensive specialized hospital, Hawassa, Southern Ethiopia. *Health Science Journal, 11*, 1-8.

Usha, S. M., Chandrika, N., Shetty, H. V., & Reena, R. (2014). A study of the components of metabolic syndrome in young adults. . *Biomedical Research, 25* (1), 45-5

Vasilios, G. A., Ganotakis, E.A., Bathianaki, M., Ioannis, M., Ioannis, A. G., Athanasios, A. P., Kakafika, A.I., Dimitri,P. M., &Elisaf, M. (2005). Awareness, treatment and control of the metabolic syndrome and its Components: A multicentre Greek study. *Hell J Cardiol,* 46, 380-386.

APPENDICES

Appendix 1: Study Questionnaire

Part A: Socio –demographic characteristics of the student

1. What is your age in years?

   ☐ 18-20 ☐ 21-23 ☐ 24-26 ☐ Over 26

2. What is your Gender?

   Male ☐ Female ☐

Part B: Anthropometric parameters of the student

3. Height in m^2?

   ☐

4. Weight in Kgs?

   ☐

5. BMI in Kg/m^2

   ☐ $\leq 30 kg/m^2$ ☐ $> 30 kg/m^2$

6. Waist Circumference (obesity) in cm

   ☐ $Men \geq 88cm$ ☐ $Men < 88cm$ ☐ $Women \geq 102cm$ ☐ $Women < 102cm$

Part C: Clinical and Biochemical parameters of the student?

7. Triglycerides (TG) in mg/dl or mmol/l

   ☐ $\geq 150 mg/dl$ ☐ $< 150 mg/dl$

8. High-density lipoprotein cholesterol (HDL-c) Level in mg/dl or mmol/l

   ☐ $Men \geq 35 mg/dl$ ☐ $Men < 35 mg/dl$ ☐

   ☐ $Women < 39 mg/dl$

9. Fasting blood glucose in mg/dl or mmol/l

☐ $>110 mg/dl$ ☐ $\leq 110 mg/dl$

10. Blood pressure in mm Hg

i. Systolic

☐

ii. Diastolic

☐

iii. ☐ $\text{Pr}essure > \frac{140}{90} mmHg$ ☐ $\text{Pr}essure \leq \frac{140}{90} mmHg$

Appendix 2: Consent Form

Title: To determine the Prevalence of Metabolic Syndrome Components by Age and Gender among Maseno University Students, Kenya

Dear Participant,

I am Sheila Malesi Jaika, from the department of Medical physiology. I would like to conduct the study above as a necessary requirement for fulfilment of my postgraduate studies. This study requires you to participate so that important information can be obtained from you regarding your health.

This study aims to determine the prevalence of metabolic syndrome components by age and gender among Maseno University students that will recommend the implementation of a program to screen the risk factors by means of routine medical exams and improving lifestyles.

Students who meet the inclusion criteria will be recruited into the study. They will be interviewed using a questionnaire, which will include their social demographic characteristics, medical history and physical examination.

Blood tests for glucose level and lipid profile will be taken, weight, height and waist circumference will be measured. There will be a slight pain and thrombophlebitis risk on venipuncture.

You are free to decide whether to take part or not. It is of importance to note that there is no financial benefit by participating and there will be no cost implications for participating.

Questions posed to the participants with regard to their socio-demographic characteristics may cause discomfort. The researcher wishes to assure the participants that their information will be treated with high level of confidentiality but not guaranteed.

You are free to withdraw from this study when you deem it necessary.

Participant: I have understood the above information and out of my own will I accept to participate in this study.

Signature: ..... Date: .....

NOTE: below are the key contacts

Sheila Malesi Jaika, Principal Investigator (0723645602)

Maseno University Ethics Review Committee (MUERC): +254 57 351 622- Ext.3050

Appendix 3: Different clinical criteria's for Clinical Diagnosis of Metabolic Syndrome

Table A.1: Clinical Criteria

CLINICAL MEASURES	**WHO. Individual has to be either DM, or have IFG,IGT or insulin resistance + at least 2 of the following:**	**ATP III Individual must have 3 or more of the following below:**	**IDF Central obesity define as :waist circumference and any of the following below**
WAIST CIRCUMFERENCE	≥102cm in men ≥88cm in women	≥102cm in men ≥88cm in women	≥102cm in men ≥88cm in women
TRIGLYCERIDES	≥150mg/dl	≥150mg/dl	≥150mg/dl
HDL-C	<35mg/dl in men <39mg/dl in women	<40mg/dl in men <50mg/dl in women	<40mg/dl in men <50mg/dl in women
BLOOD PRESSURE	≥140/90mmHg	≥130/85	≥130/85
GLUCOSE	Fasting>110mg/dl	Fasting>110mg/dl (IFG)	Fasting>100mg/dl (IFG)
BMI	BMI>30kg/m2	NO	NO
MICROALBUMINURIA	YES	NO	NO
INSULIN RESISTANCE	YES	NO	NO

Source: Rutaihwa, M. K. (2011).

Appendix 4: Total participants and sampling per school

Table A. 2: Participants per school based on gender

School	**Participants per School (X=40)**		
	Male (**x**)	Female (**x**)	Total (**N**=520)
Business & Economics	27 (67.5%)	13 (32.5%)	40
The Arts & Social Studies	24 (60.0%)	16 (40.0%)	40
Education	16 (40.0%)	24 (60.0%)	40
Medicine	29 (72.5%)	11(27.5%)	40
Development & Strategic Studies	27(67.5%)	13(32.5%)	40
Environment & Earth Sciences	29 (72.5%)	11(27.5%)	40
Biological & Physical Science	25 (62.5%)	15(37.5%)	40
Public Health & Comm. Dev.	24 (60.0%)	16 (40.0%)	40
Mathematics, Statistics & Actuarial Sciences	34 (85.0%)	6 (15.0%)	40
Computing & Informatics	28 (70.0%)	12 (30.0%)	40
Agriculture & Food Security	23 (57.5%)	17 (42.5%)	40
Planning & Architecture	33 (82.5%)	7 (17.5%)	40
Institute of Gender Studies	23 (57.5%)	17 (42.5%)	40
Total participants (**n**)	**342** (65.7%)	**178** (34.3%)	**520**

N is total participants, n is total number of male or female participants, X represents total participants per school while x represent number of male or female participants per school. % of male or female participants per school given by $\frac{x}{X} \times 100\ \%$ *while total %of male or female participants given by* $\frac{n}{N} \times 100\ \%$

Table A.3: Students Sampled per school based on gender

School	**Students Sampled per School (X=33)**		
	Male (**x**)	Female (**x**)	Total (**N**=429)
Business & Economics	67.5% (22)	32.5% (11)	33
The Arts & Social Studies	60.0% (20)	40.0% (13)	33
Education	40.0% (13)	60.0% (20)	33
Medicine	72.5% (24)	27.5% (9)	33
Development & Strategic Studies	67.5% (22)	32.5% (11)	33
Environment & Earth Sciences	72.5% (24)	27.5% (9)	33
Biological & Physical Science	62.5% (21)	37.5% (12)	33
Public Health & Comm. Dev.	60.0% (20)	40.0% (13)	33
Mathematics, Statistics & Actuarial Sciences	85.0% (28)	15.0% (5)	33
Computing & Informatics	70.0% (23)	30.0% (10)	33
Agriculture & Food Security	57.5% (19)	42.5% (14)	33
Planning & Architecture	82.5% (27)	17.5% (6)	33
Institute of Gender Studies	57.5% (19)	42.5% (14)	33
Total sampled(**n**)	65.7% (**282**)	34.3% (**147**)	**429**

N is total sample size, n is total number of male or female sampled, X represents total sample size per school while x represent number of males or females sampled per school. % value corresponds to percentage distribution of male or female participants per school as in Table A.2. $x = \frac{\%\, value}{33} \times 100$ *and* $n = \frac{\%\, value}{429} \times 100$.

Appendix 5: Participants and sampling per Age group

Table A.4: Number of participants and sample size per age group

School		Total Participants			Sampled		
	Age in Years	Male (n)	Female (n)	**Total**	Male (x)	Female (x)	**Total**
Business & Economics	18-20	10 (37.0%)	6 (46.2%)	**16**	37.0% (8)	46.2% (5)	**13**
	21-23	1 (3.7%)	1(7.7%)	**2**	3.7% (1)	7.7% (1)	**2**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	16 (59.3%)	6 (46.2%)	**22**	59.3% (13)	46.2 % (5)	**18**
Total (N)		**27**	**13**	**40**	**22**	**11**	**33**
Arts & Social Studies	18-20	5 (20.8%)	10 (62.5%)	**15**	20.8% (4)	62.5% (8)	**12**
	21-23	4 (16.7%)	1 (6.3%)	**5**	16.7% (3)	6.3% (1)	**4**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	15 (62.5%)	5 (31.3%)	**20**	62.5% (13)	31.3% (4)	**17**
Total (N)		**24**	**16**	**40**	**20**	**13**	**33**
Education	18-20	2 (12.5%)	11 (45.8%)	**13**	12.5% (2)	45.8% (9)	**11**
	21-23	6 (37.5%)	2 (8.3%)	**8**	37.5% (5)	8.3% (2)	**7**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	8 (50.0%)	11 (45.8%)	**19**	50.0% (6)	45.8% (9)	**15**
Total (N)		**16**	**24**	**40**	**13**	**20**	**33**
Medicine	18-20	11 (37.9%)	7 (63.6%)	**18**	37.9% (9)	63.6% (6)	**15**
	21-23	16 (55.2%)	1 (9.1%)	**17**	55.2% (13)	9.1% (1)	**14**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	2 (6.9%)	3 (27.3%)	**5**	6.9% (2)	27.3% (2)	**4**
Total (N)		**29**	**11**	**40**	**24**	**9**	**33**

N is total participants and total sample size per school and peerage group, n is represents number of male or female participants per age bracket per school, x represent number of males or females sampled per school per age group with value in brackets. % of male or female participants per school per age group given by $\frac{n}{N} \times 100\ \% \cdot\ x = \frac{\%\ value}{N} \times 100$ *where % value corresponds to percentage distribution of male or female participants per school and per age group*

Table A.4: Number of participants and sample size per age group Cont…

School		Total Participants (N=520)			Sampled (N=429)		
	Age in Years	Male	Female	**Total**	Male	Female	**Total**
Dev. &Stra. Studies	18-20	5 (18.5%)	7 (53.8%)	**12**	18.5% (4)	53.8% (6)	**10**
	21-23	11 (40.7%)	1 (7.7%)	**12**	40.7% (9)	7.7% (1)	**10**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	11 (40.7%)	5 (38.5%)	**16**	40.7% (9)	38.5% (4)	**13**
Total		**27**	**13**	**40**	**22**	**11**	**33**
Env. & Earth Sciences	18-20	12 (41.4%)	6 (54.5%)	**18**	41.4% (10)	54.5% (5)	**15**
	21-23	16 (55.2%)	4 (36.4%)	**20**	55.2% (13)	36.4% (3)	**16**
	24-26	1 (3.4%)	1 (9.1%)	**2**	3.4% (1)	9.1% (1)	**2**
	Over 26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
Total		**29**	**11**	**40**	**24**	**9**	**33**
Biological & Physical Science	18-20	11 (44.0%)	8 (53.3%)	**19**	44.0% (9)	53.3% (6)	**15**
	21-23	12 (48.0%)	1 (6.7%)	**13**	48.0% (10)	6.7% (1)	**11**
	24-26	1 (4.0%)	0 (0.0%)	**1**	4.0% (1)	0.0% (0)	**1**
	Over 26	1 (4.0%)	6 (40.0%)	**7**	4.0% (1)	40.0% (5)	**6**
Total		**25**	**15**	**40**	**21**	**12**	**33**
Public Health & Comm. Dev.	18-20	2 (8.3%)	6 (37.5%)	**8**	8.3% (2)	37.5% (5)	**7**
	21-23	7 (29.2%)	1 (6.3%)	**8**	29.2% (6)	6.3% (1)	**7**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	15 (62.5%)	9 (56.3%)	**24**	62.5% (12)	56.3% (7)	**19**
Total		**24**	**16**	**40**	**20**	**13**	**33**

N is total participants and total sample size per school and peerage group, n is represents number of male or female participants per age bracket per school, x represent number of males or females sampled per school per age group with value in brackets. % of male or female participants per school per age group given by $\frac{n}{N} \times 100\ \%$ *.* $x = \frac{\%\ value}{N} \times 100$ *where % value corresponds to percentage distribution of male or female participants per school and per age group*

Table A.4: Number of participants and sample size per age group Cont…

School		Total Participants (N=520)			Sampled (N=429)		
	Age in Years	Male	Female	**Total**	Male	Female	**Total**
Mathematics, Statistics & Actuarial Sciences	18-20	15 (44.1%)	4 (66.7%)	**19**	44.1% (12)	66.7% (3)	**15**
	21-23	17 (50.0%)	2 (33.3%)	**19**	50.0% (14)	33.3% (2)	**16**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	2 (5.9%)	0 (0.0%)	**2**	5.9% (2)	0.0% (0)	**2**
Total		**34**	**6**	**40**	**28**	**5**	**33**
Computing & Informatics	18-20	10 (35.7%)	8 (66.7%)	**18**	35.7% (8)	66.7% (6)	**14**
	21-23	16 (57.1%)	2 (16.7%)	**18**	57.1% (13)	16.7% (2)	**15**
	24-26	1 (3.6%)	2 (16.7%)	**3**	3.6% (1)	16.7% (2)	**3**
	Over 26	1 (3.6%)	0 (0.0%)	**1**	3.6% (1)	0.0% (0)	**1**
Total		**28**	**12**	**40**	**23**	**10**	**33**
Agriculture & Food Security	18-20	10 (43.5%)	11 (64.7%)	**21**	43.5% (8)	64.7% (8)	**16**
	21-23	11 (47.8%)	3 (17.6%)	**14**	47.8% (9)	17.6% (3)	**12**
	24-26	1 (4.3%)	0 (0.0%)	**1**	4.3% (1)	0.0% (0)	**1**
	Over 26	1 (4.3%)	3 (17.6%)	**4**	4.3% (1)	17.6% (3)	**4**
Total		**23**	**17**	**40**	**19**	**14**	**33**

N is total participants and total sample size per school and peerage group, n is represents number of male or female participants per age bracket per school, x represent number of males or females sampled per school per age group with value in brackets. % of male or female participants per school per age group given by $\frac{n}{N} \times 100\ \% \cdot\ x = \frac{\%\ value}{N} \times 100$ *where % value corresponds to percentage distribution of male or female participants per school and per age group*

Table A.4: Number of participants and sample size per age group Cont…

School		Total Participants (N=520)			Sampled (N=429)		
	Age in Years	Male	Female	**Total**	Male	Female	**Total**
Planning & Architecture	18-20	15 (45.5%)	5 (71.4%)	**20**	45.5% (12)	71.4% (4)	**16**
	21-23	18 (54.5%)	2 (28.6%)	**20**	54.5% (15)	28.6% (2)	**17**
	24-26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
	Over 26	0 (0.0%)	0 (0.0%)	**0**	0.0% (0)	0.0% (0)	**0**
Total		**33**	**7**	**40**	**27**	**6**	**33**
Institute of Gender Studies	18-20	8 (34.8%)	9 (52.9%)	**17**	34.8% (7)	52.9% (7)	**14**
	21-23	11 (47.8%)	2 (11.8%)	**13**	47.8% (9)	11.8% (2)	**11**
	24-26	1 (4.3%)	1 (5.9%)	**2**	4.3% (1)	5.9% (1)	**2**
	Over 26	3 (13.0%)	5 (29.4%)	**8**	13.0% (2)	29.4% (4)	**6**
Total		**23**	**17**	**40**	**19**	**14**	**33**
Overall Total	18-20	116 (33.9%)	98 (55.1%)	**214**	95	78	**173**
	21-23	146 (42.7%)	23 (12.9%)	**169**	120	22	**142**
	24-26	5 (1.5%)	4 (2.2%)	**9**	5	4	**9**
	Over 26	75 (21.9%)	53 (29.8%)	**128**	62	43	**105**
Total		**342**	**178**	**520**	**282**	**147**	**429**

N is total participants and total sample size per school and peerage group, n is represents number of male or female participants per age bracket per school, x represent number of males or females sampled per school per age group with value in brackets. % of male or female participants per school per age group given by $\frac{n}{N} \times 100\ \%$ *.* $x = \frac{\%\, value}{N} \times 100$ *where % value corresponds to percentage distribution of male or female participants per school and per age group*

Appendix 6: Data for Target Population

Table A. 2: Number of Students Per School, Gender and Campus

MASENO UNIVERSITY

OFFICE OF THE REGISTRAR, ACADEMIC & STUDENT AFFAIRS

STUDENT ENROLMENT BY PROGRAMME AND GENDER-MAIN CAMPUS

PROGRAMS	2013/2014		2014/2015		2015/2016		2016/2017	
	M	F	M	F	M	F	M	F
SCHOOL OF EDUCATION								
BEd (Arts, with IT)	223	202	218	188	326	221	189	258
BEd (Science, with IT)	151	110	119	57	198	150	140	53
BEd (Early Childhood Education, with IT)	37	22	30	29	23	21	12	26
BEd (Special Needs Education, with IT)	47	34	11	29	25	16	12	28
BEd (French, with IT)	3	6	4	11	4	1	3	14
BEd (Music , with IT)	0	4	17	16	5	3	6	6
	461	**378**	**399**	**330**	**581**	**412**	**362**	**385**
SCHOOL OF ARTS & SOCIAL SCIENCES								
BA (Fine Arts, with IT)	17	8	7	11	16	6	22	21
BA, with IT	86	131	55	32	27	19	118	101

BA (Interior Design, with IT)	25	32	6	23	19	20	25	23
BA (Textiles Design. & Fashion Merch.)	8	42	7	17	4	18	12	26
BA (Music, with IT)	0	2	1	1	0	3	1	4
BA (Drama & Theatre. Studies, with IT)	18	12	14	5	18	5	14	12
BA (Comm. & Media Tech., with IT)	60	44	55	28	23	35	64	48
BA (Sociology & Anthropology, with IT)	39	28	30	23	22	17	27	18
BA (Criminology, with IT)	61	22	28	15	24	10	43	18
BA (Theology, with IT)	12	5	7	4	7	5	11	9
BA (Religion, with IT)	18	7	6	10	13	12	13	22
Bachelor of Psychology, with IT	27	46	12	16	24	49	12	33
BA (French, with IT)	6	8	5	15	6	12	4	13
BA (Language & Communication, with IT)	0	0	5	9	9	14	11	25
BA (Philosophy, with IT)	0	0	9	4	14	8	8	11
BA (Literature, with IT)	0	0	5	9	11	19	18	27
BA (History & Archaeology, with IT)	0	0	17	17	57	36	35	16
BA (Kiswahili, with IT)	0	0	5	8	26	25	19	23
	377	**387**	**274**	**247**	**320**	**313**	**457**	**450**
SCHOOL OF BUSINESS & ECONOMICS		0						
Bachelor of Business Administration, with IT	133	80	68	55	52	80	126	97
BA (Economics, with IT)	60	28	34	19	28	20	91	39
BA (Business Studies, with IT)	130	38	30	29	26	26	36	28
	323	**146**	**132**	**103**	**106**	**126**	**253**	**164**
SCHOOL OF PHYSICAL & BIOLOGICAL SCIENCES		0						
BSc, with IT	34	20	36	32	44	38	58	31
BSc (ECOHIM, with IT)	37	23	19	11	19	18	11	16
BSc (Aquatic Resources Conser. with IT)	12	7	7	2	5	6	5	7

BSc (Industrial Chemistry, with IT)	39	10	25	8	21	10	16	3
	122	**60**	**87**	**53**	**89**	**72**	**90**	**57**
SCHOOL OF MATHEMATICS, STATISTICS & ACTUARIAL SCIENCE		0					0	
BSc (Applied Statistics, with IT)	50	27	25	10	37	19	31	19
BSc (Actuarial Science, with IT)	58	29	36	16	28	21	41	11
BSc (Mathematics & Computer Science)		1	35	5	33	11	30	15
BSc (Mathematics & Economics, with IT)	121	32	28	10	34	17	25	18
BSc (Mathematics & Business Studies, with IT)	8	4	25	12	31	21	34	15
BSc (Mathematical Sciences, with IT)	62	14	40	8	34	13	39	10
	299	**107**	**189**	**61**	**197**	**102**	**200**	**88**
SCHOOL OF COMPUTING & INFORMATICS		0						
BSc (Computer Science)	71	20	26	12	20	15	30	9
BSc (Information Technology)	68	14	21	5	25	6	26	7
BSc (Computer Technology)	34	6	25	4	22	10	26	9
BSc (Computer Science & Technology)	12	0	3	1	0	0	30	5
	185	**40**	**75**	**22**	**67**	**31**	**112**	**30**
SCHOOL OF AGRICULTURE & FOOD SECURITY		0						
BSc (Horticulture, with IT)	40	19	31	31	19	14	18	12
BSc (Animal Science, with IT)	42	21	19	25	26	12	23	11
BSc (Agricultural Economics, with IT)	90	39	24	15	25	13	28	18
BSc (Soil Science, with IT)	19	10	9	7	9	3	8	10
BSc (Agronomy, with IT)	18	9	10	10	11	10	28	13
Bsc. Agribusiness Management , with IT	0	0	37	13	20	17	40	14
BSc (Fisheries & Aquatic Agr. with IT)	0	0	11	14	20	8	14	11
BSc (Agriculture & Education Ext., with IT)	0	0	22	14	28	10	39	13
	209	**98**	**163**	**129**	**158**	**87**	**198**	**102**

SCHOOL OF PLANNING & ARCHITECTURE	0	0				0		
BSc (Geospatial Information Science, with IT)	20	7	13	2	14	10	16	11
BSc (Disaster Management, with IT)	19	12	8	10	21	11	16	5
BA (Urban & Regional Planning, with IT)	49	18	12	8	23	12	15	11
	88	**37**	**33**	**20**	**58**	**33**	**47**	**27**
SCHOOL OF ENVIRONMENT & EARTH SCIENCES		0						
BSc (Environmental Sciences, with IT)	48	31	36	14	35	17	27	17
BSc (Earth Sciences, with IT)	16	16	19	1	20	1	9	5
BA (Geog. & Natural Resource Mgt., with IT)	21	36	19	13	18	13	21	12
BSc (Climate Change & Development, with IT)	16	11	18	1	16	1	16	9
	101	**94**	**92**	**29**	**89**	**32**	**73**	**43**
SCHOOL OF DEVELOPMENT & STRATEGIC STUDIES		0						
BA (International Relations & Dip. with IT)	46	71	36	41	22	29	29	38
BA (Development Studies, with IT)	51	45	13	25	20	36	25	33
BA (Political Science, with IT)	43	13	36	16	41	23	32	24
	140	**129**	**85**	**82**	**83**	**88**	**86**	**95**
SCHOOL OF PUBLIC HEALTH & COMMUNITY DEVELOPMENT		0						
BSc (Nutrition & Dietetics, with IT)	19	36	10	13	14	16	6	21
BSc (Medical Biotechnology, with IT)	46	9	27	11	27	17	30	9
BSc (Pharmaceutical Sciences, with IT)	52	21	26	19	14	16	19	16
BSc (Medical Laboratory Sciences, with IT)	40	22	22	21	30	16	17	10
BSc (Public Health, with IT)	38	31	21	18	22	20	26	9
	195	**119**	**106**	**82**	**107**	**85**	**98**	**65**
SCHOOL OF MEDICINE		0			0		0	0
Bachelor of Medicine & Bachelor of Surgery, with IT	44	32	42	18	43	31	53	24
BSc (Nursing, with IT)	0	0	11	14	23	10	17	16

	44	32	53	32	66	41	70	40
INSTITUTE OF GENDER STUDIES		0						
BA (Gender Studies, with IT)	0	0	8	8	4	11	6	21
TOTAL	2544	1627	1696	1198	1925	1433	2052	1567
GRAND TOTAL								

MASENO UNIVERSITY

OFFICE OF THE REGISTRAR, ACADEMIC & STUDENT AFFAIRS

STUDENT ENROLMENT BY PROGRAMME AND GENDER-KISUMU CAMPUS

PROGRAMMES	2013/2014		2014/2015		2015/2016		2016/2017	
POSTGRADUATE PROGRAMMES	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
MA Economics	6	2	16	2	18	3	5	2
Master of Business Administration	19	27	37	22	23	16	15	4
MSc Finance			8	3	2	4	10	1
MSc HRM	0		0	0	0	1	0	0
MSc. Entreprenuership			0	0	1	1	0	0
MSc. Purch. and Supply Chain Mgt	4	3	2	2	5	1	4	1
Master of Public Health	26	24	23	20	15	14	9	1
MSc. Biomedical Sciences	8	2	19	16	5	4	4	0

MSc. Comm. Nutrition &Devt.	2	2	0	3	2	4	1	1
MA International Relations			1	3	3	1	1	1
MA Research and Public Policy			8	4	2	4	5	1
MSc. Environmental Sciences			6	2	4	1	3	1
MSc. Applied Statistics	0	3	7	2	7	1	3	1
MSc. Applied Mathematics			0	0	0	0	1	1
MSc. Pure Mathematics	2	1	0	0	0	0	4	1
Msc. Actuarial Science			0	0	0	0	1	1
MSc. Information Technology			11	4	3	2	0	1
MSc. Computer Science			10	1	4	1	0	0
MA Communication & Media Studies	7	5	5	7	5	4	2	5
Master of Social Devt. &Mgt	10	8	10	11	3	4	0	0
MA Sociology			0	0	0	3	3	2
MA Anthropology			1	2	4	1	0	0
MA Counselling Psychology			0	6	1	1	0	0
MSc. Hospitality Management			0	0	0	4	0	1
MA Geography	4	5	5	5	0	0	0	0
MA Project Planning & Management	5	2	0	0	0	0	0	0
MA Project Monitoring and Evaluation	2	3	0	0	0	0	0	0
MA Religion			0	2		0	0	0
MSC Enterprenuership			0	0	1	1	0	0
MSC Environmental Science	7	7	0	0	0	0	0	0
MA Geography	4	5	0	0	0	0	0	0
MA Linguistics			0	0	0	0	0	0
MA Literature			0	0	0	0	0	0
UNDERGRADUATE PROGRAMMES								

BBA With IT	76	57	75	62	69	48	49	15
BSc. Public Health With IT	13	20	10	16	5	2	0	0
BSc. Medical Laboratory Science			0	0	1	0	0	0
BSc. Health Systems Management			0	0	0	0	3	0
BA Political Science with IT			0	0	1	0	1	0
BA Dev studies With IT	3	3	13	18	4	16	1	3
BA Intern. Relations With IT	8	9	1	1	8	15	2	4
BSc. Computer Science			0	0	0	0	0	0
BSc. IT	14	6	22	2	16	1	10	1
BSc. Ecohim With IT			0	4	0	0	3	8
BED - (Arts)With IT- Regular	5	1	0	0	0	0	43	10
BED - SNE With IT- Regular			0	0	0	0	0	0
BA Com.& Media Tech. With IT	18	16	16	14	12	14	13	1
BA. Soc. and Anth. With IT			5	20	5	16	6	5
BA Criminology with IT	9	6	8	0	5	3	3	0
BA Urban Planning	15	3	8	1	2	0	0	0
BA Criminology with IT	9	6	4	3	1	8	0	0
BA Urban Planning	15	3	3	5		8	0	1
	291	229	334	263	237	207	205	74

MASENO UNIVERSITY

OFFICE OF THE REGISTRAR, ACADEMIC & STUDENT AFFAIRS

STUDENT ENROLMENT BY PROGRAMME AND GENDER-HOMA-BAY CAMPUS

	M	**F**	**M**	**F**	**M**	**F**	M	F
SCHOOL OF EDUCATION								
PHD	3				**0**	**0**	1	0
M.Ed	11	4	5		0	0	0	0
B.Ed. (Arts, with IT)	37	28	22	18	22	22	19	25
B. Ed. (Early Childhood Education)		0		7		3	1	2
Bachelor of Special Needs Education	1	2	1	2		1	0	2
							0	0
SCHOOL OF ARTS & SOCIAL							0	0
	1						0	0
Ma Religion	3	2					0	0
Ma Kiswahili	3	2					0	0
Ma. History							0	0
Ma Linguistic	0	0					0	0
Ma Comm and Media							0	0
MA.Socialdevpt	2	1		**3**			0	0

B.A. Sociology & Anthropology	5	10	2	4	1	4	0	3
B.A in Criminology, with IT							0	0
BA Communication & Media Studies	2						0	0
SCHOOL OF BUSINESS & ECONOMICS							0	0
PHD	6						0	0
Ma Economics	7						0	0
MBA	11	2	**5**	5	28	6	15	8
Bachelor of Business Admin.	21	8	29	14	23	12	11	9
Diploma Business Admin	4	2	9	6	11	20	11	8
Cert Business Admin	3	0	0	2			0	0
							0	0
SCHOOL OF MATHEMATICS, STATISTICS & ACTUARIAL SCIENCE							0	0
MSC Applied Startistics	2	0					0	0
MSC Pure Maths	3						0	0
							0	0
							0	0
							0	0
SCHOOL OF COMPUTING & INFORMATICS							0	0
B.Sc. Computer Science							0	0
B.Sc. Information Technology	0		1				0	0
							0	0
SCHOOL OF AGRICULTURE & FOOD SECURITY							0	0
PHD	1				**1**		0	0
MscAgri-Econ	1		**2**				0	0
MscAgri business			2				0	0
SCHOOL OF PLANNING & ARCHITECTURE							0	0
PPM	4	5	**1**	**0**	**12**	**1**	0	0

							0	0
							0	0
SCHOOL OF ENVIRONMENT & EARTH SCIENCES							0	0
MSC Environmental science	0	1					0	0
SCHOOL OF DEVELOPMENT & STRATEGIC STUDIES							0	0
PHD	1						0	0
B.A. Development Studies	7	4	7		3	4	4	7
Diploma Community Development	2	3	7	6	2	13	9	15
Certificate Community Development	1	2	3	0	0	3	1	0
SCHOOL OF PUBLIC HEALTH & COMMUNITY DEVELOPMENT							0	0
PHD	1						0	0
MPH	10	7	**10**	**5**			4	3
							0	0
							0	0
GRAND TOTALS	**153**	**83**	**106**	**72**	**103**	**89**	**76**	**82**

Appendix 7: Ethical Approval Letter

MASENO UNIVERSITY ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221
Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariat@maseno.ac.ke

FROM: Secretary - MUERC

DATE: 08th June, 2017

TO: Sheila Mafesi Jaika
PG/MSc/SM/00120/2014
Department of Medical Physiology
School of Medicine, Maseno University
P. O. Box, Private Bag, Maseno, Kenya

REF: MSU/DRPI/MUERC/00411/17

RE: Prevalence of Metabolic Syndrome Components by Age, and Gender among University Students, Kenya. Proposal Reference Number MSU/DRPI/MUERC/00411/17

This is to inform you that the Maseno University Ethics Review Committee (MUERC) determined that the ethics issues raised at the initial review were adequately addressed in the revised proposal. Consequently, the study is granted approval for implementation effective this 8th day of June, 2017 for a period of one (1) year.

Please note that authorization to conduct this study will automatically expire on 7th June, 2018. If you plan to continue with this study beyond this date, please submit an application for continuation approval to the MUERC Secretariat by 8th May, 2018.

Approval for continuation of the study will be subject to successful submission of an annual progress report that is to reach the MUERC Secretariat by 8th May, 2018.

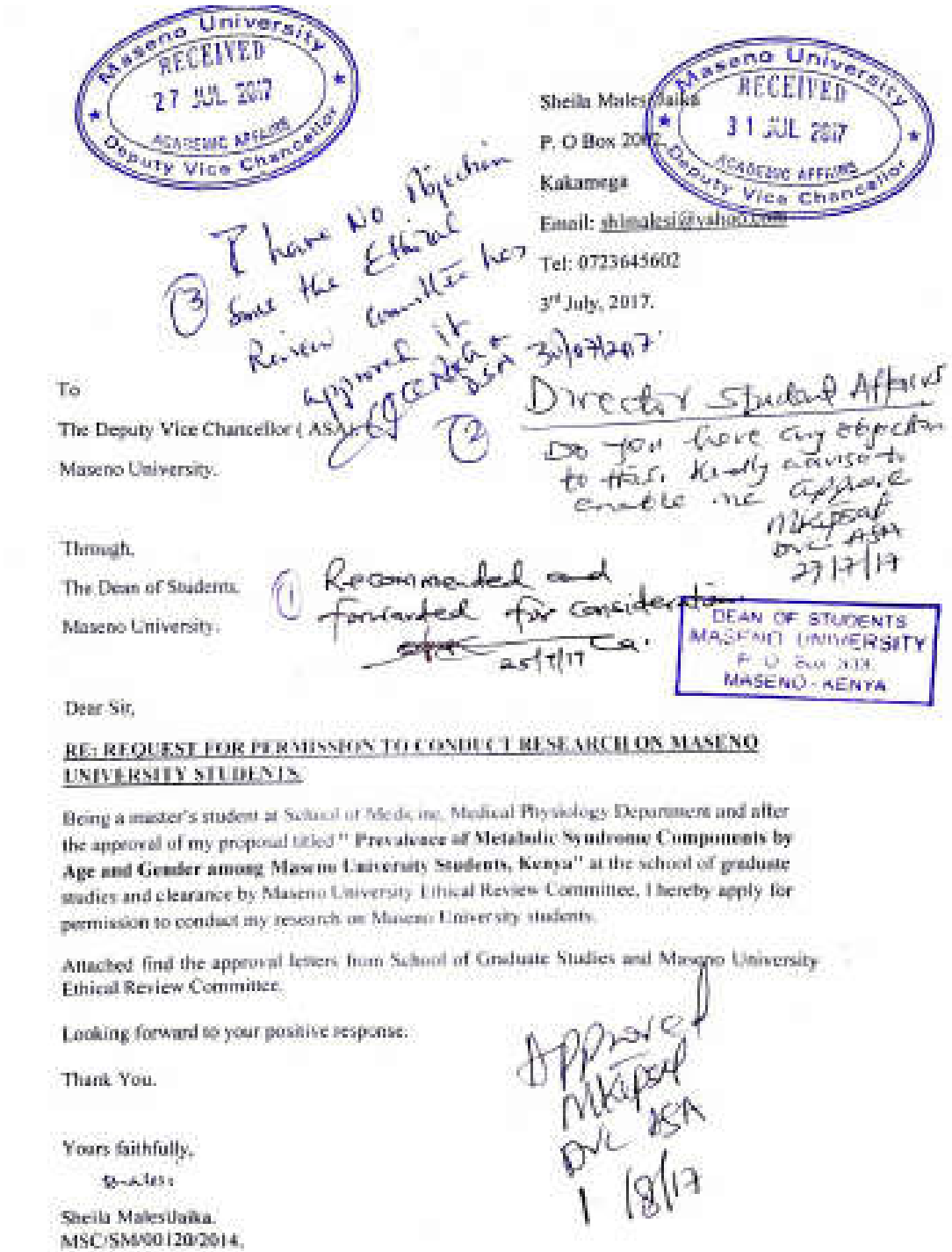
Please note that any unanticipated problems resulting from the conduct of this study must be reported to MUERC. You are required to submit any proposed changes to this study to MUERC for review and approval prior to initiation. Please advise MUERC when the study is completed or discontinued.

Thank you.

Dr. Eonuke Anyona,
Secretary,
Maseno University Ethics Review Committee

Cc: Chairman,
Maseno University Ethics Review Committee.

Appendix 8: Maseno University Administration Approval Letter



Maseno University
RECEIVED
27 JUL 2017
ACADEMIC AFFAIRS
Deputy Vice Chancellor

Maseno University
RECEIVED
31 JUL 2017
ACADEMIC AFFAIRS
Deputy Vice Chancellor

Sheila Malesi'aika
P. O Box 2062
Kakamega
Email: shimalesi@yahoo.com
Tel: 0723645602

3rd July, 2017.

To

The Deputy Vice Chancellor (ASA)
Maseno University.

Through,

The Dean of Students.
Maseno University.

DEAN OF STUDENTS
MASENO UNIVERSITY
P. O. Box 333
MASENO - KENYA

Dear Sir,

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH ON MASENO UNIVERSITY STUDENTS.

Being a master's student at School of Medicine, Medical Physiology Department and after the approval of my proposal titled " **Prevalence of Metabolic Syndrome Components by Age and Gender among Maseno University Students, Kenya**" at the school of graduate studies and clearance by Maseno University Ethical Review Committee, I hereby apply for permission to conduct my research on Maseno University students.

Attached find the approval letters from School of Graduate Studies and Maseno University Ethical Review Committee.

Looking forward to your positive response.

Thank You.

Yours faithfully,

Sheila Malesi'aika.
MSC/SM/00120/2014.