COMMON RISK FACTORS THAT CONTRIBUTE TO METABOLIC SYNDROME (METS) IN PATIENTS OF MANHYIA DISTRICT HOSPITAL

BY

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DECLARATION

I declare that this submission is my own work and that to the best of my knowledge and belief, it contains no material previously published or written by another person, nor material which to a substantial extent, has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

Metabolic syndrome is becoming a major problem in Ghana. The main objective of the study was to find out the prevalent factors contributing to metabolic syndrome in the Manhyia District Hospital in the Ashanti Region of Ghana. A sample size of 106 was used for the study. The type of patients used for the study were those who visit the out- patient department of the hospital and fall within the age group of 18 to 65 years. Recommended instruments were used for the measurement of both anthropometric and blood pressure levels. Questionnaires were used to assess physical activity levels and dietary intake while biochemical data of participants were assessed using their blood samples. Statistical Package for Social Science (SPSS), version 23 was used for the analyses of the collected data. Descriptive statistics (mean scores, frequency distribution), cross tabulation with chi-square test and Multiple Logistic Regression Model were used for the analysis. Microsoft excel was used to generate tables and figures. The study revealed that there was low level of education (88.6%) among the participants. As high as 86% of participants who were found to have smoked in the past had elevated systolic BP. Also, 50% of the respondents who smoked in the past had high level of triglyceride > 1.69mmol/L. Passive smokers showed a positive association with FBG (p-value of 0.034). Also, the prevalence of metabolic syndrome was 58.5% and the main contributory risk factors of metabolic syndrome among the participants were high BP, high central obesity and high FBG. It is therefore recommended that there should be routine health screening by the Ghana Health Service in the various communities to reduce the incidence of metabolic syndrome. Health education targeted at individuals should aim at encouraging a healthy lifestyle such as being engaged in physical activities, avoiding smoking and consuming low fat and healthy diet.

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LIST OF ABREVIATIONS

BMI	Body Mass Index
BP	Blood Pressure
EIGR	European Group for Study of Insulin Resistance
FBG	Fasting Blood Glucose
FFA	Free Fatty Acids
HDL-C	High Density Lipoprotein Cholesterol
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
LDL	Low Density Lipoprotein
NCEP-ATP III	National Cholesterol Education Program Adult Treatment Panel III
TG	Triglycerides
VAT	Visceral Adipose Tissue
VLDL	Very Low Density Lipoprotein
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist to Hip ratio

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Metabolic syndrome (MetS) has been given important attention recently due to the consequences it has on the population (Onyegbutulem *et al*., 2009). This is as a result of the fact that metabolic syndrome is a contributing factor for cardiovascular diseases and their related morbidity and mortality. It predisposes people to diseases like stroke, heart attack as well as renal disease (Zabetian *et al.*, 2007). Many researchers have given different names to MetS. These are Reaven's syndrome, hypertriglyceridemia, syndrome X, insulin resistance syndrome and deadly quartet (Grundy *et al.*, 2005).

MetS can be defined as the huddling of metabolic characteristics that proliferate the chances of a person's possibility to develop diabetes type 2 and cardiovascular diseases in the future (Alberti *et al*., 2006). The components of risk factors associated with MetS include hypertension, hyperglycemia, abdominal obesity, dyslipidemia (Alberti *et al*., 2006). Studies have shown that each of the components increases the risk of cardiovascular diseases. However, multiple components become much more powerful. It has been found out that as metabolic syndrome components increases, insulin resistance worsens (Bonora *et al.*, 2003). According to Gaillard (2014), the diagnosis of any three of the mentioned risk factors in a person indicates the presence of MetS and therefore that person needs follow-up by community health care providers. Halley *et al*. (2007) also designed some criteria for defining metabolic syndrome in adolescents and children. These include three or more chronic diseases, insulin resistance and arterial hypertension.

There are various diagnostic criteria used by organizations for determining the prevalence of MetS in a population. The organizations include the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP-III), World Health Organization (WHO), International Diabetes Federation (IDF) and the European Group on Insulin Resistance (EGIR) (Alberti *et al*., 2006). For abdominal obesity, the NCEP-ATP- III suggested that a waist circumference for men should be more than 102cm and more than 88cm for women. For blood pressure, it proposed the usage of >130mmHg systolic and /or >85mmHg diastolic blood pressure. For fasting glucose, it proposed the usage of >5.6mmol/L (Alberti *et al.*, 2006). According to the criteria suggested by NCEP-ATP-III, it is mentioned that the rate of occurrence of MetS is likely to reach two-thirds in adult population of Central Mexico (Halley *et al.* 2007). People affected by MetS are estimated to likely die from diseases like stroke or heart attack compared to those without MetS (Rossi *et al.*, 2008).

In Ghana, because of the rising westernization of lifestyle of the population, the occurrence of MetS is increasing (Val–Titty *et al*., 2008; Turpin *et al.*, 2008; Owiredu *et al*., 2009). Occurrence of metabolic syndrome among diabetics in Ghana in 2007 was reported at 55.9% by the NCEP-ATP-III criteria and 10% by the WHO criteria (Val–Titty *et al.*, 2008).

Reports show that the occurrence of MetS differ among males and females. In the United States, metabolic syndrome prevalence in women was greater (20.9%) than that of men (13.9%) during 1988 and 1994 (Ford *et al.*, 2002; Park *et al*., 2003). Similarly, the prevalence of MetS in African American was greater (43.3%) in females than in males (32.7%) (Taylor *et al*., 2008). Reports by Oladapo *et al.* (2010)

showed that the prevalence of metabolic syndrome in Nigerian population was 2.1% and 2.7% in women and men, respectively. Gyakobo (2012), reported that the prevalence of metabolic syndrome in Ghana was higher (24%) in females compared with males (5.9%).

Many factors such as lifestyle and socio-economic factors influence the presence of metabolic syndrome among adults. These include inactive lifestyle, poor dietary habits, substance abuse, smoking, educational status, alcohol intake, fast food intake, physical activity and type of occupation (Taylor and MacQueen, 2006; Suvisaari *et al.,* 2007). It is therefore important to investigate how different factors contribute to MetS at the Manhyia District Hospital in Kumasi.

1.2 Problem Statement

About sixteen million non-communicable disease-related deaths occur before 70 years of age. Of this premature death figure, low and middle income countries do account for about 82% (WHO, 2015).

In Ghana, reports on obesity (Amoah, 2003), hypertension (Pobee, 1992), type 2 diabetes mellitus (Amoah *et al*., 2002) are on the rise. Increase in morbidity and mortality has been documented with respect to cardiovascular diseases in Ghana (Biritwum *et al.,* 2000).

Metabolic syndrome, a condition characterized by a constellation of closely linked disease risk factors of metabolic origin, has been identified to be linked with the rise in cardiovascular diseases and diabetes. There have been extensive studies on this phenomenon in other jurisdictions. On the contrary, there have been few studies in

this area in sub-Saharan Africa and Ghana for that matter (Onyegbutulem *et al*., 2009). The very few studies conducted in Ghana however, concentrated on the connection between metabolic syndrome and some specific medical conditions such as diabetes (Nsiah *et al*., 2015), cardiovascular disease (Akpalu *et al*., 2011), and pregnancy-induced hypertensive patients (Owiredu *et al.,* 2008).

Manhyia Hospital facility has been chosen because of its high patronage level in Kumasi. Again, diabetes and hypertension which are among the key risk factors of metabolic syndrome is among the top ten diseases in the hospital with hypertension being ranked third on the list as at the year 2016.

Moreover, previous studies had been limited to Komfo Anokye Teaching Hospital (Owiredu *et al*., 2008) and Korle-Bu Teaching Hospital (Akpalu *et al.*, 2011). The present study focuses on adult patients between 18-65 years who attend the Manhyia District Hospital in the Kumasi metropolis.

1.3 Research Questions

1. What is the lipid profile pattern of the study population?
2. What are the anthropometric measures and blood pressure measurement of the study population?
3. What are the socio-economic status, lifestyle and physical activity pattern of the study population?
4. What are the dietary patterns of the study population?

1.4 Main Objective

To find the prevalent factors contributing to metabolic syndrome in the Manhyia District Hospital.

1.4.1 Specific Objectives

1. To determine the lipid profile pattern of the study population.
2. To determine blood pressure and some anthropometric measures of the study population.
3. To determine the socio-economic status, lifestyle and type of physical activity of the study population.
4. To determine the dietary patterns of the study population.

1.5 Study Justification

The aim of the study is to determine the contributing factors of metabolic syndrome, the role of nutrition in metabolic syndrome, as well as examining the lifestyle contributions to metabolic syndrome at the Manhyia District Hospital in the Kumasi Metropolis, Ghana using the NCEP-ATP III diagnostic criteria.

Knowledge of the prevalence of metabolic syndrome through diet, exercise, good sleep will help encourage a healthy life, which in the long run, will guarantee the decrease of occurrence of metabolic syndrome in the country. It will also influence the decision of policy makers to put in more resources for education and intervention to metabolic syndrome which can reduce morbidities and mortalities.

1.7 Definition of Terms

1.7.1 Metabolic Syndrome

Metabolic syndrome can be defined in various ways. The World Health Organisation and the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP-III) have different definitions of metabolic syndrome. Per the criteria of NCEP-ATP III which is commonly used by researchers, metabolic syndrome could be defined as serum HDL cholesterol (<1.04mml/L in men and <1.29 mmol/L in women), abdominal obesity (waist circumference > 88 in women and <102 cm in men), high serum triglycerides (>1.70 mmol/L), high serum fasting glucose (>5.6 mmol/L or higher), and elevated BP (>85 mmHg diastolic BP and/ or 130 mmHg systolic BP).

1.7.2 Prevalence

The proportion of people that have a unique features of a disease in a study population over certain period is said to be the prevalence.

1.7.3 Risk Factor

It is defined as any quality, features or experience of a population that enhance the rate of developing metabolic syndrome. In this study, the metabolic risk factors include obesity, high blood pressure or hypertension, smoking and alcohol consumption

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

Metabolic syndrome is the huddling of metabolic characteristics that increases a person's chance of getting diabetes type 2 and cardiovascular diseases (Alberti *et al.* 2006). Metabolic syndrome cannot be said to be a disease on its own but rather, a group of risk factors that predispose people to type 2 diabetes and cardiovascular diseases (Bermudes, 2005).

Recently, metabolic syndrome (MetS) has been given priority attention owing to the consequences it has on the population (Onyegbutulem *et al*., 2009). For example, it predisposes people to high risk of stroke, heart attack and renal conditions (Zabetian *et al.*, 2007). Many different names have been given to MetS, including Reaven's syndrome, deadly quartet, hypertriglyceridemia, insulin resistance and syndrome X (Grundy *et al.*, 2005).

2.1 Identification of Metabolic Syndrome

2.1.1 The World Health Organization's Definition of Metabolic syndrome

The World Health Organization which came out with its first definition in 2008 suggested that evidence of the presence of insulin resistance is an important requirement for the definition of metabolic syndrome (Huang, 2009). Apart from the absolute presence of insulin resistance, two other risk factors such as high blood pressure and BMI is enough for the diagnoses of metabolic syndrome according to the WHO (Grundy *et al.*, 2004). The WHO defined metabolic syndrome as an individual

with impaired glucose tolerance or diabetes mellitus, glucose intolerance and/or insulin resistance together with two or more of the following components:

1. High blood pressure (≥140/90mmHg)
2. High plasma triglyceride(≥1.68mmol/L) and /or low HDL-C(<0.89 in men and < 1.0 in women)
3. Central obesity (W/HR) >0.9 in men and >0.85 in women and /or body mass index (BMI) >30kg/m^2
4. Microalbuminuria, i.e., urinary albumin excretion rate ≥20 μgm/minute or albumin/creatine ratio ≥ 30 μgm/mg. (Parikh and Mohan, 2012).

2.1.2 European Group for Study of Insulin Resistance's Definition of Metabolic Syndrome

The European Group for Study of Insulin Resistance (EGIR) in its definition of metabolic syndrome modified the definition of the WHO by using the term insulin resistance syndrome in place of metabolic syndrome. The criteria for the diagnoses of metabolic syndrome according to the EGIR is increased in plasma insulin (>75^{th} percentile) in addition to any two of the following:

1. Abdominal obesity: Waist circumference (WC) ≥94cm in males and ≥84cm in females
2. Hypertension:≥140/90mmHg or on antihypertensive treatment
3. Elevated triglycerides (≥150mg/dl) and or reduced HDL-C (<39mg/dl) for both males and females
4. Elevated plasma glucose: impaired fasting glucose or impaired glucose tolerance, but no diabetes (Parikh and Mohan, 2012).

The EGIR did not include type 2 diabetes mellitus in the criteria because insulin resistance was viewed basically as a risk factor for diabetes (Parikh and Mohan, 2012).

The similarity between the EGIR and the WHO criteria is that in both definitions, insulin resistance is core in the diagnosis of metabolic syndrome. Also, in both definitions, it requires two additional criteria from the following: obesity, hypertension and dyslipidemia (Huang, 2009).

Microalbuminuria which formed part of the WHO definition was replaced by hyperinsulinlinemia in the EGIR criteria. Again, instead of BMI, waist circumference was used as the main indicator to define obesity by the EGIR criteria (Kassi *et al*., 2011).

2.1.3 International Diabetes Federation's (IDF) Definition OF Metabolic Syndrome

The new International Diabetes Federation definition suggests that for a person to be diagnosed as having metabolic syndrome, he or she must have central obesity also known as waist circumference (with ethnicity specific values) in addition to any two of the following risk factors;

1. Raised triglycerides (>1.7mml/L),
2. Low HDL cholesterol (1.03mmol/L for males and 1.29mmol/L for females),
3. High blood pressure (systolic BP ≥130 or diastolic BP ≥85 mmHg or treatment of previously diagnosed hypertension) and

4. High fasting plasma glucose level (5.6mmol/L or previously diagnosed diabetes) (Alberti *et al*., 2017).

2.1.4 The American Heart Association's Definition of Metabolic Syndrome

Due to the differences in the criteria for the definition of metabolic syndrome by the various organizations such as the WHO, the NCEP ATP III, IDF and the EGIR, the National Heart, Lung and Blood Association collaborated with the American Heart Association in a conference to look at scientific issues related to the definition of metabolic syndrome. They were therefore able to come out with the following criteria for the definition of metabolic syndrome.

1. BMI $\geq$25kg/m^2
2. High triglyceride $\geq$ 1.70mmol/L
3. Low HDL cholesterol for men should be <1.04mmol/L and <1.30mmol/L for women.
4. High blood pressure $\geq$ 130/85mmHg
5. 2- hour post glucose challenge >7.8mmol/L
6. Fasting glucose 6.1 to 6.9mmol/L
7. Other risk factors such as family history of type 2 diabetes, hypertension or CVD, polycystic ovary syndrome, sedentary lifestyle, old age and ethnic groups having high risk for type 2 diabetes or CVD (Beilby, 2004).

2.1.5 The National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP-III)

According to the National Cholesterol Education Programme Adult Treatment Panell III, an individual is said to have a metabolic syndrome if three or more of the following criteria are met:

1. Waist circumference for men should be more than 102cm and more than 88cm for women.
2. For blood pressure, it proposed the usage of >130mmHg systolic and /or >85mmHg diastolic blood pressure.
3. For fasting glucose, it proposed the usage of >5.6mmol/L
4. (Alberti *et al.*, 2006).
5. Triglyceride level of >1.68mmol/L
6. High Density Lipoprotein level of >1.02mmol/L (for males) and >1.28mmol/L (for females) (Huang, 2009).

The NCEP ATP III definition is one of the most common criteria for diagnosing metabolic syndrome. The measurements and the laboratory results that the criteria uses are readily available which helps in the clinical and epidemiological application. It is simple and easy to remember and does not need any special criterion to be met but only that at least, three of five criteria are to be met (Huang, 2009).

2.2 Pathophysiological Features of Metabolic Syndrome

2.2.1 Insulin Resistance

The pathophysiology of metabolic syndrome can best be explained by the mechanism behind insulin resistance. It is based on this reason that metabolic syndrome is

referred to as insulin resistance. Insulin resistance can be described as inefficiency of insulin action that results in hyperinsulinemia which is an attempt of the body to maintain euglycemia. Central obesity has been found to be a key factor to the progress of both insulin resistance and MetS, when there is over-production of adipokines (Akpalu *et al.*, 2011).

The presence of large quantities of fatty acids circulating in the blood is one of the causes accounting for increase in insulin resistance. This can occur as a result of the expansion of the adipose tissue mass. The sensitivity of insulin in the muscles is decreased by free fatty acids (FFA), by preventing the uptake of insulin – mediated transport of glucose into tissues. Pancreatic insulin secretion increases when the level of glucose circulating in the blood increases resulting in hyperinsulinemia. The production of glucose, triglycerides and very low density lipoprotein (VLDL) is increased by the presence of FFA in the liver. The effect of this is that it leads to the reduction of glucose transformation to glycogen and increases the level of triglyceride (Aganović and Dušek, 2014). Secretion of high levels of insulin to sustain standard glucose and lipid homeostasis is caused by insulin resistance. When this happens, a number of signals are sent to the pancreatic beta cells to respond to the insulin resistance. Inability to respond appropriately by the beta cells leads to impaired glucose tolerance, impaired fasting glucose, increased levels of insulin and diabetes type 2 (Olatunbosun, 2015).

One of the important characteristics of insulin resistance is the ineffectiveness of the insulin action. The state where insulin becomes resistant is defined by the impairment of glucose uptake in the muscles and the increased levels of endogenous glucose

production by the liver, leading to hyperglycemia, both in fasting and postprandial states (Castro *et al*., 2014).

2.2.2 Glucose Intolerance

WHO (2005) defines glucose intolerance as a fasting blood glucose level of above 6.0 mmol/L or over 7.8mmol/L 2 hours after intake of 75g glucose. The consequences of insulin action failure is its inability to overpower gluconeogenesis in the liver and to ensure the use of glucose by insulin-sensitive tissues like the muscle and adipose tissue. In order to ensure that tissues can take in glucose from the blood, the level of insulin secretion should be raised to maintain euglycemia. In the case where there is failure to sustain euglycemia, defects in insulin secretion occurs and hyperglycemia also occurs (Aganović and Dušek 2014).

Glucose intolerance is a change of state from normal blood sugar level to diabetes. The progression to diabetes type 2 is basically influenced by genetics and environmental factors like sedentary lifestyle and dietary habits of an individual (Olatunbosun, 2015).

2.2.3 Obesity and Increased Waist Circumference

Obesity is of different types. Individuals with obesity have varying fat distribution in their bodies. Those with abdominal obesity tend to have higher risk of getting diabetes and are more likely to develop cardiovascular diseases in future, as compared to people with peripheral or gluteofemoral obesity (Ibrahim, 2010). Individuals with central obesity are considered as a higher risk group than those with generalized fat distribution (Olatunbosun, 2015).

Adipose tissue can either be found in the subcutaneous areas or at the abdominal cavity, also known as visceral adipose tissue. Visceral adipose tissue (VAT) is mainly found in the mesentery and omentum (Ibrahim, 2010).

2.2.4 Dyslipidemia

Dyslipidemia involves constant changes of free fatty acids, apolipoprotein B, increased amount of triglycerides, increased low density lipoprotein and lower level of high density lipoprotein cholesterol (Kolovou *et al., 2005*).

High production of very low-density lipoprotein (VLDL) is as a result of increased level of free fatty acids in the liver. Insulin is able to prevent the secretion of VLDL into the systemic circulation under normal conditions. When there is insulin resistance, free fatty acids that move to the liver increase hepatic triglycerides synthesis. Hence, the presence of elevated levels of triglycerides in the blood is a proof of insulin resistant condition and it can be used to diagnose metabolic syndrome (Aganović and Dušek, 2014). The presence of hypertriglyceridemia is the result of the reduction of high density lipoprotein (HDL) (Aganović and Dušek, 2014).

Low HDL mostly occurs when there is increase in the level of triglycerides. The presence of increased levels of triglycerides allows the exchange of TG-cholesteryl ester between LDL and VLDL. The same lipid exchange takes place between VLDL and HDL, leading to the formation of TG-rich HDL. TG-rich HDL becomes depleted of cholesterol and as such, more susceptible to catabolism. The TG part of the TG-rich HDL goes through hydrolysis and its protein component, called apo A is disconnected (Kolovou *et al.,* 2005). The continuous changes of lipid in the liver as a

result of insulin resistance is one of the reasons why there is low level of HDL (Kolovou *et al*., 2005).

2.2.5 Hypertension

Studies on arterial hypertension have proven that when there is consistent disturbance of an individual which is psychological in nature, it can lead to high level of activity of the sympathetic nervous system. The rise in sympathetic nervous system may cause the acute rise in blood pressure and produce renal ischemia which would stimulate the adrenal cortex to become active. The presence of renal ischemia leads to the production of pressor substances which leads to hypertension (Schroeder, 1951).

The development of hypertension starts gradually before it finally gets to well established hypertension. The gradual advancement of hypertension begins by increase in cardiac output among persons aged between 10-30 years, which makes them develop pre-hypertension. Early hypertension occurs among persons between 20-40 years, as a result of increased peripheral resistance. Hypertension becomes established among the age groups of 30-50 years. By age 40-60 years, complications of hypertension begin (Alexander *et al.*, 2017).

2.2.6 Hypertriglyceridemia

Hypertriglyceridemia is a condition in which there is increased levels of triglycerides in the blood. Uncontrolled diabetes, obesity and sedentary lifestyle are the leading causes of elevated blood levels of triglycerides (Fredrickson and Lees, 1965). The NCEP-ATP III defines hypertriglyceridemia as a fasting plasma triglyceride level

exceeding 11.1mmol/L. If the level of a patient's triglyceride exceeds 27.7mmol/L, it may lead to acute pancreatitis (Leaf, 2008).

High levels of plasma triglycerides leads to the danger of developing cardiovascular disease. Usually, such elevations of plasma triglyceride concentration is associated with excessive weight gain, metabolic syndrome, proinflamatory and prothrombic biomarkers and diabetes type 2 (Yuan *et al.,* 2007).

There are two main origins of plasma triglyceride. These are exogenous and endogenous plasma triglycerides. The exogenous plasma triglyceride is mainly the fat from dietary sources and it passes through chylomicrons. The liver manufactures endogenous plasma triglycerides and it is carried in very-low-density lipoprotein (VLDL) particles. These lipoprotein and chylomicrons are broken down into smaller particles and this is done in the capillaries within the fat and muscle tissue into free fatty acids. The chylomicrons release circulating triglycerides which originate from the intestine after meal consumption, but during fasting periods, the liver secretes endogenous triglycerides as VLDL. The increase in plasma triglyceride-rich lipoproteins is as a result of over production by both liver and intestines (Yuan *et at*., 2007).

2.3 Prevalence of Metabolic Syndrome

The global prevalence of metabolic syndrome is reported to be between 20 and 25% of the adult population (Rossi *et al*., 2008). Prevalence of metabolic syndrome in Saudi Arabia varied between 13.6% and 57% in 2010. Gender was cited to be the main reason behind the variation. Females were reported to have higher prevalence compared to males (Bahiiji *et al*., 2013). There was an increase in prevalence from

23 percent to 26.7 percent between 2000 and 2003 in the United States of America (Park *et al*., 2003; Taylor *et al*., 2008). According to Ford *et al*. (2002), prevalence of metabolic syndrome among US adult population is estimated to be at 24%.

In Africa, Oladapo *et al.* (2010) reported prevalence of MetS to be at 2.7%.
A study in Botswana which used the IDF criteria to define MetS reported that 34% of health workers found to have metabolic syndrome. Katchunga *et al*. (2013) revealed that the prevalence of MetS in Congo was 43.6%.

The prevalence of metabolic syndrome in Ghana is 5.9% using the NCEP-ATP III criteria and 10% using WHO criteria (Val-Titty et al., 2008). The prevalence rate of MetS among psychiatric patients in the Kumasi Metropolis was 11.5%, 13.5% and 15.5% using NCEP ATP III, WHO and IDF criteria respectively. The prevalence was significantly higher among psychiatric patients on treatment as compared to treatment-naïve group using NCEP ATP III and IDF and not WHO. These recorded prevalence rate of MetS was higher compared to 3.9%, 2.2% and 7.8% that represent the general Ghanaian population prevalence rates determined with the NCEP ATP III, WHO and IDF criteria respectively (Owiredu *et al*., 2012). These values differ compared with the prevalence rate recorded in 2011. Owiredu *et al*. (2011) recorded MetS prevalence of 4.6%, 7.4% and 14.4% using the criteria proposed by NCEP-ATP III, IDF and WHO respectively. These prevalence rates were higher among sedentary groups compared with active population. They found out that obesity was the key determinant of Mets prevalence in Ghana (Owiredu *et al*., 2011). The study by Val–Titty *et al.* (2008) and Turpin *et al.* (2008) in Kumasi (2008) have revealed a prevalence rate of 55.9% and 62% among diabetic and pregnancy induced hypertensive patients using the NCE-ATP III and WHO respectively.

2.4 Risk Factors of Metabolic Syndrome

NCEP-ATP III has identified five criteria to be used in the identification of metabolic syndrome. These are:

- insulin resistance/glucose intolerance (diabetes)
- high level of triglycerides (hypertriglyceridemia)
- abdominal obesity
- high blood pressure (hypertension)
- lowered level of HDL

The NCEP-ATP III maintains that the manifestation of any three of the above in an individual suggests that he or she has a metabolic syndrome (Bermudes, 2005).

A study conducted on the occurrence of MetS and risk factors of cardiovascular disorders in an urban population revealed that about 23% of the population had MetS that increases with sedentary lifestyle and age. Also, people with low level of education were identified as having high prevalence of metabolic syndrome. Furthermore, it was revealed that risk factors associated with metabolic syndrome included high waist circumference, high blood pressure, and low HDL cholesterol. The study therefore concluded that prevalence of metabolic syndrome was influenced by poor physical activity, high BMI, low level of educational background and age (Moreira *et al.*, 2014).

Carnethon *et al*. (2004) in a study to find the link between metabolic syndrome and demographic features and to determine the risk factors that are modifiable for

increased metabolic syndrome, revealed that the following factors; increased BMI, increased consumption of carbohydrate and decreased consumption of dietary fiber increases a person's chance of getting metabolic syndrome. Increased physical activity was seen to be protective. However, increased weight gain by at least 4.5kg was also seen to increase the danger of acquiring metabolic syndrome.

A study conducted by Akpalu *et al*. (2011) in Korle Bu Teaching hospital, Accra, showed that hypertension and central obesity were two key components that were identified among people with metabolic syndrome. Arthur *et al*. (2013), in a study on the prevalence of metabolic syndrome and its principal components between pre- and post-menopausal Ghanaian women in the Kumasi Metropolis, revealed that high blood pressure, central obesity and raised fasting blood glucose were the noticeable components that lead to the syndrome.

A report by Bahijri and Al Raddadi (2013) showed that in adults aged between 30 – 70 years had overall metabolic syndrome prevalence of 40% with the most common factor being low HDL-C. In a 3-year study aimed at changing the behaviour of individuals on metabolic syndrome parameters, increasing sporting activity saw a decreased level of insulin, glucose, systolic blood pressure and waist circumference in males. However, in females, the only outcome was a decrease of waist circumference. Intensification of physical activity also raised the level of HDL-cholesterol, reduced waist circumference and BMI in men but no effect was seen in their female counterparts. It has also been noticed that a decrease in cigarette smoking in men saw a considerable decline in triglycerides and BMI and in women, HDL- cholesterol increased (Balkau *et al.,* 2006*).*

According to NCEP ATP III and the International Diabetes Federation criteria showed that the prevalence of metabolic syndrome by ATP III and IDF increases with age and BMI and decreases with educational level and physical activities. Additionally, the prevalence of metabolic syndrome was predominantly found in women, and central obesity was found to be more in the study population (Bener *et al*., 2009).

According to Byberg *et al*. (2001) a number of vital metabolic variables such as in fasting glucose, proinsulin and HDL cholesterol, independent of body weight change significantly with increased physical activity.

It has been observed that there is a positive association among both systolic and diastolic blood pressure and BMI. According to a study, there is a variation between BMI levels and blood pressure amongst the African diaspora populations. The influence of blood pressure and BMI levels is that blood pressure increases as BMI rises. The report therefore suggested that there is a complex relationship between excess body weight, adiposity and energy expenditure (Cappuccio *et al*., 2008).

A research done to define the prevalence of metabolic syndrome among rural and urban populations of Cameroon, found central obesity to be one of the core elements of the prevalence of the metabolic syndrome (Fezeu *et al*., 2007). A study revealed that the prevalence of MetS among adults of the United States showed a rise in aged-adjusted prevalence by 23.5% and 2.2% among women and men. This was attributed

to waist circumference, increase in high blood pressure, and hypertriglyceridemia, particularly among women (Ford *et al.,* 2004).

Adults in the U.S have high prevalence of metabolic syndrome. People who have metabolic syndrome are at a higher risk of getting diabetes mellitus and cardiovascular diseases, in addition to higher mortality from cardiovascular diseases (Ford *et al*., 2002). According to the National Health and Nutrition Examination Survey, Black Americans have a lower level of prevalence of metabolic syndrome, as compared to their white counterparts (Gillard *et al*., 2009). This can be ascribed to the fact that there seems to be lower prevalent rates of some major components of metabolic syndrome. The components include serum triglyceride and high density lipoprotein cholesterol levels among blacks. However, blacks have higher cardiovascular disease (CVD) mortality and morbidity than their white counterparts (Gaillard *et al*., 2009).

A report by Garrido *et al*. (2009) showed that 34% of the study participants had metabolic syndrome, 28.7% were also obese and 27.3% were overweight. Obesity and metabolic syndrome were seen to be most associated with female gender. The age group of 35-54 years was seen to be the most affected by metabolic syndrome (Garrido *et al*., 2009). According to Gyakobo *et al.* (2012), central obesity, low high density lipoprotein and high blood pressure were the most significant factors for metabolic syndrome among a rural population in Ghana.

A study on physical activity in relation to risk for type 2 diabetes mellitus in men revealed that sedentary lifestyle such as watching television for longer hours was a major threat for developing diabetes type 2 (Hu *et al*., 2001).

It has been found that metabolic syndrome is predominant among women with large waist circumference, using the IDF or NCEP/ATP III criteria. However, the study revealed that in men with accumulation of visceral fat, the disease was also high (Katchunga *et al*., 2013). A study to define the association between cardiorespiratory fitness and mortality in healthy men and in those with metabolic syndrome showed that after adjustment for age, year of examination, smoking status, year of examination, parental CVD and alcohol consumption, the relative risks (RRs) (95% confidence interval) of all-cause and CVD mortality for men with the metabolic syndrome and healthy men were 1.29 (1.05-1.57) and 1.89 (1.36-2.60), respectively (Katzmaryk *et al*., 2004). Healthy men with metabolic syndrome had better metabolic fitness profile than unhealthy men with metabolic syndrome (Katzmaryk *et al.,* 2004).

Assessment and screening of the risk factors in metabolic syndrome by Katzmaryk *et al*. (2014), found that women above 50 years whose status were within the middle socio-economic class, illiterate and are unemployed were found to be more associated with metabolic syndrome. People who were found to be physically inactive, have higher BMI, have inadequate sleep, eat both animal and plant diet, go through stress and have a positive family history recorded high level of metabolic syndrome prevalence (Katzmaryk *et al*., 2014). According to Kellinny *et al*. (2008), prevalence of metabolic syndrome increases significantly with age in both sexes. Diabetic

individuals were also identified as having greater prevalence (80%) of metabolic syndrome, as compared to non-diabetic individuals (Kelliny *et al.,* 2008).

Using the NCEP ATP definition, metabolic syndrome was predominantly higher within the age group of 45-54 for men (Kelliny *et al*., 2008). Metabolic syndrome is higher in females than in males when the ATP and IDF definition are used but when the WHO definition is used, the prevalence is almost the same in both sexes (Kelliny *et al*., 2008).

About 40% of people with essential hypertension tends to have hypercholesterolemia. Studies have shown that there is a relationship between hypertension and dyslipidemia. Type 2 diabetes and hypertension can also occur at the same time. Hypertension is more commonly found in individuals who have diabetes than those who do not have it. The danger of developing myocardial infarction is also more common among diabetes than non-diabetics (Alexander *et al*., 2017).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

A quantitative cross-sectional design was employed to collect data.

3.2 Study Site

The study was carried out at the Manhyia District Hospital, Kumasi. It is a district hospital. The bed capacity of the hospital is 102. The hospital is located within the Manhyia South Sub-District in the Kumasi Metropolis, about 400 metres away from the Manhyia Palace in the Ashanti region. The sub-metro is found in the North Eastern part of Kumasi Metropolis and bounded by three sub-metros; to the north by Manhyia North, south by Subin and east by Asokwa sub-metro. The total population of the sub-metro within which the hospital is located is 343615 and it forms 20.6% of the entire population in the Kumasi Metropolis. According the annual performance review report in 2016, the top ten diseases report at the hospital as at the year 2016 are listed below:

1. Malaria
2. Upper respiratory tract infections
3. Hypertension
4. Diarrhoea
5. Urinary tract infections
6. Typhoid fever
7. Anaemia
8. Diabetes mellitus
9. Skin diseases
10. Rheumatism

3.3 Study Population

The study population was made up of out-patients from 18 to 65 years who reported to the Manhyia District Hospital in the Kumasi Metropolis. This facility was chosen because of its high patronage level. Moreover, previous studies had been limited to Komfo Anokye Teaching Hospital (Owiredu *et al*., 2008) and Korle Bu Teaching Hospital (Akpalu *et al*., 2011). Again, diabetes and hypertension which are among the key risk factors of metabolic syndrome is among the top ten diseases with hypertension being third on the list as at the year 2016.

3.4 Inclusion Criteria

- Out-patients who visited the Manhyia District Hospital
- Should be between the ages of 18-65 years

3.5 Exclusion Criteria

- Patients aged below 18 and those above 65 years
- In-patients at the Manhyia District Hospital were excluded from the study.

3.6 Sample Size Calculation

$$\text{Sample size} = \frac{Z^2\, p(1-p)}{P^2}$$

Where;

Z; Is the confidence interval

p; Is the prevalence

M; Is the margin of error

(Young and Bolton, 2009).

Using a confidence level of 95%, precision at 5%, prevalence of metabolic syndrome from a study by Owiredu *et al*. in 2011 was 7.4%.

Sample size = $\frac{1.96^2 \times 0.074(1-0.074)}{0.05^2}$

= 105.29

Sample size was 106.

3.7 Data Collection Method

The study involved the use of a questionnaire, clinical examination, anthropometric measurements and the collection of blood for the assay of FBG and lipid profile of the subjects. The information that the questionnaire was used to obtain included demographic characteristics, socio-economic characteristics, health status, family history, smoking habits, drinking habits, physical activity levels and dietary habits of respondents. The physical activity was defined as being engaged in physical exercise for at least 3 times a week for a minimum of 30 minutes. Examples of physical activities included brisk walking, skipping, trotting, running, etc. On dietary habit, a 24-hour dietary recall chart was used to collect information on participants' meal time, type of food, quantity of food consumed during breakfast, mid-morning snack, lunch, supper and bedtime snack.

Trained field assistants including two nurses assisted in the taking of blood pressure, anthropometric measurement of the participants and administration of questionnaire. A professional laboratory technician also collected the blood samples for the biochemical analysis.

The anthropometric measurements were done to determine the body mass index (BMI) and the waist circumference. The waist circumference of the respondents were measured in centimeters using a flexible measuring tape at mid-point of lower border of the rib cage and the iliac crest. The widest part of the hip was measured and recorded as hip circumference. Participants were requested to stand and if there were excess clothes on them, they were asked to remove them in order to record accurate circumference.

Blood pressure (BP) measurements of respondents were taken twice at 30 minutes apart on the day the examination was done. If the second measurement was not consistent with the first one, then a third measurement was recorded. If the third measurement was consistent with either of the first two recordings, then that measurement was taken. The Omron 3 series digital BP monitor machine with model number BP710N was used for the measurement of the blood pressure.

Venous fasting blood samples of 5mls were taken for the measurement of fasting blood glucose (FBG), total cholesterol, HDL cholesterol and LDL cholesterol.

3.7.1 Fasting Blood Glucose Analysis

The glucose oxidase – peroxidase method was employed in the blood glucose analysis.

Method

Blood sample collected into a sodium fluoride tube of each of the participants was centrifuged at 4000rpm for 5 minutes to obtain the plasma. A volume of 10µl was pipetted into a labelled test tube, but a second tube labelled as the blank had no

sample added. Then 1ml of Liquidzone Glucose MR reagent was pipetted into each of the test tubes. The reagent and the serum was thoroughly and gently mixed and incubated for 10 minutes in a water bath at 37^0C. After the incubation, the concentrations of each sample was read using Biolabo diagnostic Kenza spectrophotometer with a 1cm light path cuvette, at a wavelength of 590nm.

3.7.2 Total Cholesterol

Serum total cholesterol analysis was done using the cholesterol oxidase/peroxidase aminophenazone (CHOD-PAP reagent) method. Enzymatic *in vitro* test was used for the quantitative determination of total cholesterol.

Method

Blood samples of each of the participants was collected into a serum separated tube and centrifuged at 4000rpm for 5 minutes to obtain the serum. A serum total cholesterol of 10µl was measured into a labelled test tube and 1ml of Cholesterol reagent was added. The mixture was mixed thoroughly and incubated in a water bath at 37^oC for 5 minutes. A test blank and standard was prepared by measuring 1ml of Total cholesterol reagent for blank and 1ml of Total cholesterol reagent with 10µl of Total cholesterol standard reagent for the standard. They were incubated appropriately for 5 minutes at 37^oC. After reading the standard and the blank with Kenza Biochemistry analyser, the test sample was read. The Kenza Biochemistry analyser measures the absorbance at 505nm through the intensity of the red quinoneimine dye formed when hydrogen peroxide produced from the oxidation of cholesterol by cholesterol oxidase reacts with phenol and 4-aminoantipyrine. The intensity of the dye

formed is directly proportional to the concentration of cholesterol present in the serum. The concentration provided by the analyser is recorded in mg/dl.

3.7.3 Serum HDL Analysis

Addition of phosphotungstic acid in the presence of magnesium ions precipitates low density lipoprotein cholesterol, from the serum sample. The HDL fraction retained in the supernatant was determined by cholesterol assay.

Method

HDL was analyzed by measuring 500µl of the serum into a clean dry test tube and 1ml of Rl HDL precipitant reagent added to it. The mixture was mixed thoroughly and incubated at room temperature (25^{o}C - 30^{o}C) for 10 minutes. Afterwards, the mixture was centrifuged (Centrifuge 5804 Eppenddorf Nethelar-Hinz) at 4000pm for 10 minutes and 100µl of the supernatant was measured into another clean test tube. This is because the phosphotungstic acid present in HDL precipitant reagent precipitates LDL leaving HDL in the supernatant. One milliliter of cholesterol reagent was then measured and added to the supernatant and incubated in a water bath at 37^{o}C for 5 minutes. A reagent blank and a standard was prepared by measuring 100µl of distilled water and 100µl of the standard reagent (standard R4) plus 1ml of cholesterol reagent. They were both incubated. After the said time, the absorbance of the sample and the standard was read at 500nm using Kenza Biochemistry analyser against the reagent blank and the concentration recorded in mg/dl. The reagents and procedure were as provided by FORTRESS diagnostics Limited.

3.7.4 Serum LDL Analysis

Serum LDL was determined by the Friedewald's equation:

LDL = Total cholesterol – HDL cholesterol – (triglycerides ÷ 2.2)

The NCEP: ATPIII criteria of three or more of the following was used to define metabolic syndrome:

a. Abdominal/central obesity (waist circumference: > 102cm in men, >88cm in women)
b. Hypertriglyceridemia (>1.70mmol/L)
c. HDL cholesterol (<1.04 mmol/L in men, and <1.29 mmol/L in women)
d. Fasting plasma glucose (=5.6 mmol/L), or higher
e. High blood pressure (>130 mmHg systolic and/or >85 mmHg diastolic BP).

3.8 Dietary History

A 24-hour dietary recall form was used to obtain information on previous day's food intake. In this, the actual foods were described by participants and information on portion weights were obtained. Foods and drinks from the previous morning, from first thing upon waking up to the time of interview were described in details by participants.

3.9 Ethical Considerations

Ethical approval with reference number CHRPE/AP/478/16 was obtained from the Committee on Human Research, Publications and Ethics of the School of Medical Sciences of the Kwame Nkrumah University of Science and Technology (KNUST)

and permission was granted from the Manhyia District Hospital, before the commencement of the study.

3.10 Informed Consent

Study participants were made to sign consent forms. This was to seek their permission and to assure them of high level of confidentiality before the data was collected. The consent form was explained thoroughly to participants in the language they understood, especially those who could not read.

3.11 Statistical Analysis

Data was entered into Census and Survey processing (CSPro 6.2) software. This was to aid in minimizing errors in entry. Data was exported from CSPro to Statistical Package for Social Science (SPSS) version 23 used for data analysis. Descriptive statistics (mean scores, frequency distribution), crosstabulation with chi-square test and Multiple Logistic Regression Model were used for the analysis. Microsoft excel was used to generate tables and figures. The results were statistically significant at $p<0.05$ (95% confidence level).

CHAPTER FOUR

RESULTS

4.1 Demographic Characteristics of the Study Participants

The study involved 106 out-patients of the Manhyia District Hospital in Kumasi; 89 females and 17 males, with persons in the age range 46-65 years predominating, accounting for 63% of the study participants (Table 4.1).

Table 4.1 Demographic Characteristics of Respondents

Factor	Frequency(n)	Percent(%)
Sex		
Male	17	16
Female	89	84
Total	106	100
Age(years)		
18-35	22	21
36-45	18	17
46-55	41	39
56-65	25	23
Total	106	100
Marital Status		
Single	23	22
Married	68	64
Divorced	11	10
Widowed	4	4
Total	106	100
Religion		
Christian	66	62
Muslim	40	38
Total	106	100
Educational Status		
Low level	94	89
Tertiary level	12	11
Total	106	100
Occupational Status		
Unemployed	16	15
Informal	78	74
Formal	12	11
Total	106	100

Low level of education includes primary and junior high school

Majority of the participants were married 68(64%).There were more Christians 66(62%) than Muslims 40(38%). All the participants had some level of education, but a very high percentage (89%) of the participants had low level of education; that is, primary school and junior high school. The occupational status of the participants was mainly informal, represented by 78(74%). This comprised traders (market women, business men, products and service vendors) and artisans (hairdressers, seamstresses/tailors, drivers, etc). There were 16 (15%) of the respondents who were unemployed and only 12(11%) were employed in the formal sector.

4.2 Health Status and Lifestyle Habits

4.2.1 Health Status and Family History

It was found that 52(49%) of the participants had been diagnosed of at least a chronic condition. However, the remaining 54(51%), representing the majority, had not been diagnosed with any chronic condition. Investigating the type of condition diagnosed revealed that most of them were hypertensive 38(78%) and diabetics 8(16%). The other clinical conditions were hepatitis B, asthma, fibroid, stroke and ulcer.

Table 4.2 Health Status and Family History

Disorder	Frequency (n)	Percent (%)
Have You Been Diagnosed of any Chronic Condition?		
Yes	52	49
No	54	51
Total	106	100
If Yes, what Condition? (N=52)		
Asthma	2	3.8
Diabetes	8	15.3
Fibroid	3	5.7
Hepatitis B	3	5.7
Hypertension	32	61.5
Stroke	2	3.8
Ulcer	2	3.8
Do you have any family member who has the condition?		
Yes	40	38
No	66	62
Total	106	100
If Yes what Condition? (N=40)		
Diabetes	26	65
Hepatitis B	2	5
Hypertension	12	30
What is your relationship with this family member? (N=40)		
Parents	17	42.5
Siblings	7	17.5
Other family members	16	40.0

It was further noted that 66 or 62% of the participants had family members who had not been diagnosed with the reported clinical conditions. The main conditions participants' families had been diagnosed of were diabetes and hypertension. Few family members had asthma and hepatitis B.

4.2.2 Smoking Habits of the Study Participants

The current and past smoking habits are in Table 4.3 below.

Table 4.3 Smoking Habits of Study Participants

	Frequency(n)	Percent (%)
Have you ever smoked in the past?		
Yes	16	15
No	90	85
Total	106	100
How often did you smoke?		
Daily	16	100
Weekly	0	0
Monthly	0	0
Total	16	100
Do you currently smoke?		
Yes	23	22
No	83	78
Total	106	100
Have you been exposed to passive smoking?		
Yes	34	32
No	72	68
Total	106	100

From Table 4.3, 16(15%) had smoked in the past and majority, 90(85%) had not. Those who were identified to have smoked indicated they smoked daily. It was found that 23(22%) of the participants smoke currently, while 83(78%) do not. About 34(32%) of the patients (including those who smoked in the past and currently smoking) indicated they were exposed to passive smoking.

4.2.3 Drinking Habits of the Study Population

This segment of the analysis examined the drinking habits of the study population. Their current and past drinking habits were examined.

Table 4.4 Drinking Habits of Study Participants

Response(s)	Frequency(n)	Percent (%)
Did you drink alcohol in the past?		
Yes	30	28
No	76	72
Total	106	100
Do you drink alcohol currently?		
Yes	22	21
No	84	79
Total	106	100
If yes, how often		
Daily	11	37
Weekly	3	10
Occasionally	16	53
Total	30	100
What type of drink do you take?		
Normal Strength beer(Star, Guinness, etc)	22	73
Strong drinks(spirits, liquor)	8	27
Total	30	100
Quantity of drinks		
Tot	9	30
Small bottle	17	57
Big bottle	4	13
Total	30	100

A higher number 76(72%) of the participants indicated they did not take alcohol in the past, while 30(28%) indicated they drank alcohol. For current drinking of alcohol, 22(21%) were involved and majority 16(53%) of them take it occasionally.

Majority of the alcohol drinkers 22(73%) take normal strength beer and 8(27%) take strong drinks (spirits, liquor, etc). The quantity of drinks taken was also examined and

was found out that majority take small bottle 17(57%), followed by tot which is 30ml 9(30%) and big bottle 4(13%).

4.2.4 Physical Activity Level of the Subjects

It was observed that majority 83(78%) of the participants undertake physical activities, while 23(22%) do not undertake physical activities. The most predominant physical activity was walking. Other physical activities were running/jogging and skipping, indicated by a few of the participants.

Table 4.5 Physical Activity Level of Subjects

Activity	Frequency(n)	Percent (%)
Do you undertake any physical activity?		
Yes	83	78
No	23	22
Total	106	100
What physical activity are you involved?		
Brisk walking	74	89
Running/jogging	8	10
Skipping	1	1
Total	83	100
How often do you perform the physical activity above?		
Daily	46	55.4
Weekly	23	27.7
Monthly	14	16.9
Total	83	100
How do you rate your physical activity level?		
Moderately active	52	63
Active	25	30
Very active	6	7
Total	83	100
Average duration of activity or single exercises		
Less than 30 minutes	19	22.9
30 minutes	22	26.5
1 hour	20	24.1
Above 1 hour	22	26.5
Total	83	100

The study further measured the frequency at which the physical activities are done and it was observed that more than half of the participants who were involved in physical activities perform it daily 46(55%). Participants were asked to rate their physical activity level. Some of the participants 52(63%) rated it as moderately active and only a few 6(7%) said very active. This indicates that even though participants were involved in physical activities, their level of activities were quite low. The number of participants whose duration of activity was less than 30 minutes were 19 (representing 22.9%), while 22 persons or 27% were able to sustain it for 30 minutes.

4.2.5 Dietary Habits of the Study Population

From Table 4.6, a majority of 76(72%) of the participants ate 3 times in a day and 2 (2%) ate more than 3 times a day. Even though the study observed greater percentages of the participants who eat three times a day, it was however observed that majority, 75(71%) skip meals.

Table 4.6 Dietary Habits of the Study Population

Dietary habit	Frequency (n)	Percent (%)
How many times do you eat a day?		
2 times	28	26
3 times	76	72
More than 3 times	2	2
Total	106	100
Do you skip meals?		
Yes	75	71
No	31	29
Total	106	100
How often do you skip meals in a week?		
Once	85	80
2 times	14	13
3 times	4	4
More than 3 times	3	3
Total	106	100
Which meal time do you often skip?		
Breakfast	36	34
Lunch	24	23
Supper	11	10
Snacks	35	33
Total	106	100
Do you eat fruits?		
Yes	93	88
No	13	12
Total	106	100
How often do you eat fruits?		
Daily	29	27.4
Weekly	33	31.1
Monthly	33	31.1
Occasionally	11	10.4
Total	106	100
Do you take any soft/energy drink?		
Yes	82	77
No	24	23
Total	106	100
If yes, how often do you take such drinks?		
Daily	15	14
Weekly	16	15
Occasionally	75	71
Total	106	100
Do you sometimes Eat Outside?		
Yes	76	72
No	30	28
Total	106	100
If yes, how often?		
Daily	33	43.4
Weekly	14	18.4
Monthly	4	5.2
Occasionally	25	33
Total	76	100

The meals that was mostly skipped was observed to be breakfast 36(34%) and snacks 35(33%).

It was also observed that majority of the participants eat fruits 93(88%) but the fruits were eaten mostly on weekly 33(31.1%) and monthly 33(31.1%) basis. Furthermore, majority 82(77%) of the participants indicated they take soft and energy drinks. A high percentage (71) said they take them occasionally. It was also realized that 76(72%) of the participants eat outside home. Those who eat outside daily predominated; these were 33(43.4%).

Table 4.7 Type of Meal and amount of Salt added to Meal at table

Type of Food	Frequency(n)	Percent(%)
What food do you eat outside? (N=76)		
Banku and soup	2	3
Fried yam	4	5.2
Fufu and palmnut soup/light soup	13	17
Gari/beans	1	1.3
Indomie	1	1.3
Kenkey and hot pepper/stew/fish	20	26
Pastries	2	3
Ampesi	4	5.2
Porridge	1	1
Rice and stew	23	30
Tuozafi	3	4
Waakye	2	3
Do you add salt to your meals at table?		
Yes	51	48
No	55	52
Total	106	100
What quantity do you add?		
1/4 Teaspoon	12	23
1/2 Teaspoon	29	57
1 Teaspoon	10	20
Total	51	100

From the above table, the most popular meal that was eaten outside was rice and stew (30%), followed by kenkey and hot pepper with fish (26.3%). Gari and beans, indomie and porridge were the least foods (1%) eaten outside. A high number, 51(48%) admitted they add table salt to their meals at and majority (57%) of them add half teaspoon.

Table 4.8 Anthropometric Measures and Biochemical Data

Anthropometric Measures	Overall	Under nutrition 12(11%)	Normal nutrition 22(21%)	Overweight 40(38%)	Obese 32(30%)
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)
Weight(kg)	70.40(16.53)	46.58(7.53)	55.27(5.391)	71.50(5.301)	88.34(11.57)
Height(cm)	160.94(8.213)	164.2(13.89)	157.49(6.79)	162.90(4.50)	159.63(9.17)
BMI(kg/m^2)	27.14(6.009)	17.07(0.72)	22.24(0.99)	26.92(1.40)	34.542.49)
		WHR			
Male	0.92(0.100)	-	0.84(0.037)	0.92(0.020)	1.06(0.039)
Female	0.85(0.060)	-	0.77(0.027)	0.82(0.011)	0.91(0.046)

Blood Pressure	**Overall**	**Normal**		**Abnormal level**	
	Mean(SD)	**N(%)**	**Mean(SD)**	**N(%)**	**Mean(SD)**
SBP(mmHg)	135.61(21.834)	39(37%)	115.59(8.191)	67(63%)	147.27(18.57)
DBP(mmHg)	88.18(18.847)	42(40%)	71.67(9.90)	64(60%)	99.02(15.07)

Lipid Profile	**Overall**	**Normal**		**Abnormal levels**	
	Mean(SD)	**N(%)**	**Mean(SD)**	**N(%)**	**Mean(SD)**
Total cholesterol	4.71(1.021)	70(66%)	4.10(0.59)	36(34%)	5.89(0.50)
Triglycerides	1.20(0.531)	82(77%)	0.98(0.29)	24(23%)	1.96(0.48)
HDL cholesterol	1.55(0.234)	29(27%)	1.84(0.09)	77(73%)	1.44(0.16)
LDL cholesterol	2.64(2.63)	91(86%)	2.38(0.81)	15(14%)	4.21(0.29)

BMI(kg/m^2): Underweight = "<18.5kg/m^2; Normal weight = "18.5-24.9 kg/m^2", Overweight = "25.0-29.9 kg/m^2", Obesity = "30.0-34.9 kg/m^2"
WHR: Male {Normal-weight = "<0.90", Overweight = "0.90-0.99", Obesity = ">1.00"}
Female {Normal-weight = "<0.80", Overweight = "0.80-0.84", Obesity = ">0.85"}
SBP(mmHg): Normal = "<130mmHg", Abnormal Level= "≥130mmHg"
DBP(mmHg): Normal = "<85mmHg", Abnormal Level= "≥85mmHg"
Total cholesterol: Normal = "<5.2mmol/L", Abnormal Level= ">5.2mmol/L"
Triglycerides: Normal = "<1.69mmol/L", Abnormal Level= ">1.69mmol/L"
HDL cholesterol: Male: {Normal = ">1.42", Abnormal Level= "<1.42"}
Female: {Normal = ">1.68", Abnormal Level= "<1.68"}
LDL cholesterol: Normal: "<3.88", Abnormal Level= ">3.88"

4.3 Anthropometric Measures of the Study Population

The anthropometric measures were height and weight for calculation of body mass index (BMI). There was also measurement of waist and hip circumference for calculation of waist-hip-ratio (WHR).

The overall mean weight (kg) and height (cm) for the 106 participants in the study population were 70.40 kg and 160.94 cm, respectively. The mean body mass index (BMI) was 27.14kg/m^2. The mean BMI for the participants in the study population suggested that the subjects in the study were overweight. Only 21% of the subjects had normal nutrition, while 79% were malnourished. Of the malnourished, undernutrition accounted for 11%, while over-nutrition accounted for 68% (overweight-38% and obese 30%).

The overall waist-to-hip ratio (WHR) of the patients in the study population was 0.91.

4.4 Biochemical Data of the Study Population

4.4.1 Blood Pressure

There were 67(63%) of the participants in the study who had raised systolic blood pressure and 64(60%) of the participants in the study population with high diastolic blood pressure.

4.4.2 Level of Lipid Profile

The mean total cholesterol of the participants in the study population was 4.71mmol/L. This was an indication that the participants in the study were averagely normal in their cholesterol level. From the distribution of the levels in Table 4.8, there were 70(66%) of the participants with their cholesterol level within the normal range

up to 5.2mmol. However, there were 36(34%) of the participants with elevated levels of cholesterol, who had mean total cholesterol of 5.89mmol/L. The mean triglycerides level of the participants in the population was 1.2 mmol/L, falling within the normal range of <1.69mmol/L. The study also showed a high number of participants with normal triglyceride level; with a mean of 0.98mmol/L. On the other hand, there were 24(23%) of the participants whose mean triglyceride level, 1.96 mmol/L, was higher than the normal level. Majority of the participants had abnormal HDL level 77(73%) with a mean HDL of 1.44mmol/L whilst minority of the respondents 29(27%) had normal HDL level. The mean LDL cholesterol level was 2.64mmol/L, which was within the normal level of LDL <3.88mmol/L. There were 91(86%), forming majority, whose LDL was normal, with a mean of 2.38mmol/L.

4.4.3 Fasting Blood Glucose (FBG)

The study found a mean FBG of 6.54mmol/L with standard deviation of 2.48mmol/L. Majority of the respondents 63(59%) had a mean glucose level of 7.47mmol/L. There were 43(41%) who had normal FBG\ of 5.18mmol/L.

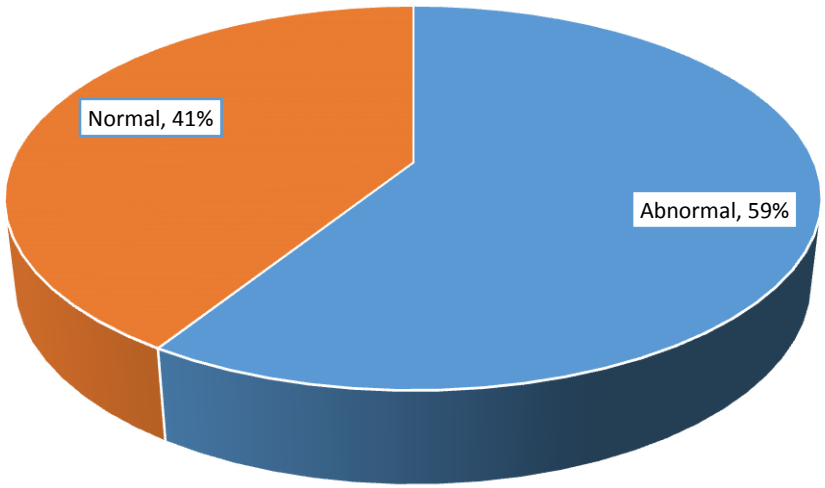

Figure 4.1 Fasting Blood Glucose Levels of Participants

FBG: Normal level: 5.6mmol/L

Abnormal level: >5.6mmol/L

4.5 Prevalence of Metabolic Syndrome

The overall prevalence of metabolic syndrome was 58.5%. Females had the higher prevalence of 63%, compared to a lower prevalence of 35.3% for males (Table4.9). Hypertension was the commonest risk component of metabolic syndrome (46%) in the overall population, followed by central obesity (34%).The risk component that was not common among the study participants was triglycerides (3%). The age group of 46-55 recorded the highest (59%) prevalence rate. This was followed by the 56-65 age group with 23%. The 18-35 age group recorded the lowest which was 5%. The details can be found in Tables 4.9, 4.10 and 4.11 below.

Table 4.9 Prevalence of Metabolic Syndrome

Sex	No. of respondents	No. with 3 or more components of Mets	Prevalence of Metabolic syndrome (%)
Male	17	6	35.3
Female	89	56	63
Total	**106**	**62**	**58.49**

Table 4.10 Prevalence of Metabolic Syndrome by Age

Variable	Frequency	Prevalence rate (%)
Age category		
18-35	5	5
36-45	14	13
46-55	63	59
56-65	24	23
Total	**106**	**100**

Table 4.11 Prevalence of various Components of Metabolic Syndrome amog participants with MetS

Component of MetS	Frequency	Prevalence rate in %
Waist circumference	21	34
Blood pressure	28	46
FBG	7	11
Triglycerides	2	3
HDL	4	6
Total	**62**	**100**

4.6 Subjects' Characteristics and Metabolic Syndrome

Table 4.12 Association between Blood Pressure and other Factors

Variables	Category	Model 1: SBP(mmHg)	Model 2: DBP(mmHg)
		OR(P-value)	OR(P-value)
Sex	Female (Ref)	1.00	1.00
	Male	0.240(0.068)	0.524 (0.380)
Age	18-35 (Ref)	1.00	1.00
	36-45	0.996 (0.996)	2.76 (0.208)
	46-55	9.843 (0.003)**	9.50 (0.005)**
	56-65	5.324 (0.045)**	2.23 (0.287)
Educational level	None (Ref)	1.00	1.00
	Primary	0.17 (0.102)	0.58 (0.591)
	J.H.S	0.35 (0.166)	1.09 (0.901)
	SHS	0.540 (0.544)	3.29 (0.254)
	Tertiary	3.35 (0.326)	21.97 (0.035)**
Occupation	Unemployment (Ref)	1.00	1.00
	Informal	2.33 (0.319)	3.02 (0.145)
	Formal	0.76 (0.822)	0.16 (0.234)
Currently smoke	No(Ref)	1.00	1.00
	Yes	7.01 (0.048)**	6.4 (0.024)**
Drink alcohol currently	No(Ref)	1.00	1.00
	Yes	1.49 (0.676)	1.14 (0.870)
Drink alcohol in the past	No(Ref)	1.00	1.00
	Yes	0.94 (0.952)	0.63 (0.592)
Physical activities	No(Ref)	1.00	1.00
	Yes	0.08 (0.002)**	0.19 (0.012)**

*****Indicates significance at 5%***

Logistic regression analysis was used to find the association of blood pressure (SBP and DBP) with the variables; sex, age, educational level etc. (Table 4.12). The odds ratio of males was 0.24, which means they are less likely to develop hypertension, as compared to females. With respect to age, those found within the age group of 46-55 are nine (9) times more likely to develop elevated systolic blood pressure than those within 18-35 (OR=9.843, $p<0.01$). For the same age group (46-55) they were nine (9) times more likely to develop elevated diastolic blood pressure than those in the 18-35 years. In terms of education, those at the tertiary level are 21 times more likely to develop elevated diastolic blood pressure than those that are not educated. Those who

currently smoke are seven (7) times more likely to develop high levels of systolic blood pressure than those who do not smoke. Physical activity tends to be protective as those involved in it are less likely to experience both high systolic and diastolic blood pressures.

Table 4.13 Association between FBS and other variables

Variables	Category	FBS OR(P-value)
Sex	**Female (Ref)**	1.00
	Male	0.24 (0.031)**
Age	18-35 (Ref)	1.00
	36-45	1.99 (0.363)
	46-55	0.70 (0.578)
	56-65	0.61 (0.457)
Educational level	**None (Ref)**	1.00
	Primary	3.62 (0.211)
	J.H.S	1.81 (0.338)
	SHS	0.57 (0.520)
	Tertiary	1.04 (0.964)
Occupation	**Unemployment (Ref)**	1.00
	Informal	1.61 (0.489)
	Formal	0.75 (0.780)
Currently smoke	**No(Ref)**	1.00
	Yes	2.21 (0.239)
Drink alcohol currently	**No(Ref)**	1.00
	Yes	0.58 (0.473)
Drink alcohol in the past	**No(Ref)**	1.00
	Yes	1.75 (0.465)
Physical activities	**No(Ref)**	1.00
	Yes	0.76 (0.603)

*****Indicates significance at 5%***

The results from the logistic analysis in Table 4.13 show that males are less likely to develop higher FBS than females (OR=0.24, $p<0.05$). The age group of 36-45 years, subjects with primary education, informal occupation and alcohol drinking in the past, had high odds ratios.

Table 4.14: Odds Ratio of Level of Lipid Profile in Relation to other Variables

Variables	Category	Model 1: TCHOL OR(P-value)	Model 2: TG OR(P-value)	Model 3: HDL OR(P-value)	Model 4: LDL OR(P-value)
Sex	Female (Ref)	1	1	1	1
	Male	2.04(0.296)	0.89(0.891)	3.19(0.136)	3.17(0.143)
Age	18-35 (Ref)	1	1	1	1
	36-45	0.68(0.637)	0.30(0.230)	2.00(0.398)	0.33(0.340)
	46-55	1.71(0.969)	0.21(0.096)	0.92(0.911)	0.37(0.309)
	56-65	1.03(0.969)	0.32(0.195)	2.05(0.333)	0.67(0.675)
Educational level	None (Ref)	1	1	1	1
	Primary	1.47(0.694)	0.92(0.946)	0.54(0.529)	2.66(0.420)
	J.H.S	1.43(0.578)	3.22(0.168)	0.72(0.612)	0.57(0.530)
	SHS	2.63(0.281)	1.27(0.839)	1.30(0.785)	2.21(0.477)
	Tertiary	0.00(0.998)	0.00(0.999)	10.28(0.088)	0.52(0.689)
Occupation	Unemployment (Ref)	1	1	1	1
	Informal	0.47(0.263)	1.49(0.612)	1.45(0.608)	5.39(0.146)
	Formal	1.91(0.588)	0.00(0.999)	0.36(0.397)	5.09(0.395)
Currently smoke	No(Ref)	1	1	1	1
	Yes	0.40(0.175)	7.37(1.005)**	1.30(0.690)	2.17(0.429)
Drink alcohol currently	No(Ref)	1	1	1	1
	Yes	0.47(0.357)	0.91(0.918)	3.43(0.155)	0.03(0.015)**
Drink alcohol in the past	No(Ref)	1	1	1	1
	Yes	1.24(0.788)	1.17(0.858)	1.81(0.498)	17.60(0.035)**
Physical activities	No(Ref)	1	1	1	1
	Yes	0.77(0.623)	1.13(0.843)	1.17(0.796)	1.64(0.536)

*****Indicates significance at 5%***

From the Table 4.14, the association between the level of total cholesterol was not statistically significant in terms of age, sex, level of education, physical activities, alcoholic intake, smoking and occupation. Those within the age group of 46-55 were less likely to have higher level of triglycerides as compared to those within 18-35 (OR=0.21, $p<0.05$). Those who smoke currently are seven (7) times more likely to have higher triglycerides, as compared to those who do not smoke. The changes in levels of HDL in relation to each of the variables are not statistically significant.

CHAPTER FIVE

DISCUSSION

Metabolic syndrome which is one of the main contributory factors of non-communicable diseases like diabetes mellitus type 2 and cardiovascular diseases is increasing rapidly. Most of the studies on the condition in Ghana have focused on Korle Bu Teaching Hospital and Komfo Anokye Teaching Hospital only. This study was therefore done at the Manhyia District hospital, Kumasi, in order to get a fair idea as to what was happening in district hospitals with higher OPD attendance. The NCEP/ATP III criteria was chosen to assess MetS prevalence because the indicators used are easily and readily measurable.

The study involved 106 subjects who were out-patients at the Manhyia District Hospital. They were made up of 17 males and 89 females (Table 4.1). All the subjects of this study had some level of formal education, except that majority (88.6%) of them had low level of education; that is, primary school and junior high school leavers. Only 12 (or 11%) of them had tertiary level of education. According to Bener *et al.* (2009), prevalence of metabolic syndrome is decreased by high level of education. Moreira *et al*. (2014) also confirmed it in a study on the occurrence of metabolic syndrome and the relationship with risk factors and cardiovascular complications; that people with low level of education tend to have a higher prevalence of metabolic syndrome.

The study showed that about 15% of the respondents were unemployed and according to Kartzmaryk *et al*. (2014), illiteracy and unemployment among women above 50 years is found to be a contributing factor to metabolic syndrome. The study found no

significant association between gender and metabolic syndrome. It is worth pointing out that because the number of females were far higher than the males in this study, this gender factor cannot be strongly explained.

From Table 4.3, participants' first degree relatives, like parents, siblings and second degree relatives like aunties, uncles, grandmothers and grandfathers, etc had been diagnosed with diabetes, hypertension and other diseases. Cross tabulation results in Table 4.4 show that participants who were diagnosed with diabetes and hypertension were those whose family members had similar conditions. According to Kartzmaryk *et al*. (2014), people who have family members with conditions like hypertension and metabolic syndrome record high level of metabolic syndrome.

Age was identified to have a significant association with metabolic syndrome. Those above 35 years were found to have greater prevalence of metabolic syndrome than those below 35 years. This means that as one advances in age, one is more likely to develop the condition. This finding is in line with the finding by Kelliny *et al*. (2008) which also revealed that MetS increases significantly with age in both sexes.

Occupational status also plays an important role in metabolic syndrome. There was a strong association between occupational status and metabolic syndrome. Participants who were unemployed and those employed in the informal sector were more likely to have metabolic syndrome. This could be due to the sedentary lifestyle that characterized the informal type of employment and also people who are unemployed tend to have a more sedentary lifestyle. Sedentary lifestyle can also exposed an individual to excessive weight or obesity which is one of the risk factors of metabolic

syndrome. This is in support of a study conducted by Katzmaryk *et al.* (2014) on assessment and screening of the risk factors in metabolic syndrome. According to them, women who are within the middle socio-economic class, illiterate and unemployed were found to show higher prevalence of metabolic syndrome.

From Table 4.14, total cholesterol, triglyceride, HDL cholesterol and LDL cholesterol and type of physical activities had no significant association with sex, educational level, occupation and physical activities (p-values > 0.05). The age 46-55 and current smoking however, had significant association with triglycerides ($p<0.05$), while current and past alcohol drinking had significant association with LDL.

In a study by Berner *et al*. (2009), physical activities were found to decrease the prevalence of metabolic syndrome. In much the same way, a study by Byberg *et al*. (2001) revealed that physical activity was associated with significant changes in several important metabolic variables such as FBG, proinsulin and HDL cholesterol, even though the current study did not show any significant association with HDL cholesterol, triglycerides, total cholesterol and LDL cholesterol. Past smoking habit showed no significant association with DBP (p-value = 0.105). Even though the results of the study proved that current smoking had no significant association with FBG, those who were exposed to passive smoking had a significant association with FBG.

It was also revealed in the study that about 38% of the respondents were overweight, whilst 30% were obese (Table 4.8). The study further revealed in table 4.6 that 72% of the participants eat outside. Rice and stew was the most popular food consumed by

30% of the study participants outside their home. The rice which is mostly polished has a high glycemic level which can also contribute greatly to the level of overweight and obesity among the study participants. High BMI, according to Moreira *et al*. (2014) is one of the factors that influence the occurrence of metabolic syndrome. A similar finding was revealed by Carnethon *et al* (2004) which suggested that increased weight gain by at least 4.5kg increases the danger of acquiring metabolic syndrome.

The overall waist-to-hip ratio (WHR) of the patients in the study population was 0.91, indicating a high health risk. Averagely, the patients were associated with health risk since WHR of >0.85 for females is obesity and WHR 0.90-0.99 is overweight. Central obesity among women was seen to be one of the key causes of metabolic syndrome according to Bener *et al.* (2009).

The overall prevalence of metabolic syndrome was 58.49%. Females had the higher percentage prevalence of 63% compared to 35.3% for males (Table 4.9). This finding is consistent with a study on metabolic syndrome among type 2 diabetics by Nsiah *et al*. In their findings, prevalence of MetS among females was 77.1%. According to Nsiah *et al*. (2015) the high prevalence among females could be due to their sedentary lifestyle in our part of the world as majority of women are traders while others are unemployed.

Hypertension was the commonest risk component of metabolic syndrome (46.2%) in the overall population, followed by people who were obese (33.9%) (Table 4.11). From Table 4.10, the age group of 46-55 recorded the highest (59.%) prevalence rate of MetS. This was followed by the 56-65 age group with 23%. The 18-35 age group

recorded the lowest which was 5%. This result is in fair agreement with a study by Garrido *et al*. in 2009 as in their study, 35-54year category was seen to be the most affected by metabolic syndrome. This could be attributed to the fact that the 34-55year group forms majority of the working class and some of them are almost at their retirement age and therefore they go through a lot of stress. Again, around this age, majority are already married and have children to cater for which can also put a lot of financial stress on them.

Through multiple logistic regression analysis of subject's characteristics on metabolic syndrome, it was realized that the age group of 46-55 years are nine times more likely to develop elevated systolic and diastolic blood pressure than those within 18-35year group (Table 4.12). This could be the reason why the same age group recorded high prevalence rate of MetS. In terms of education, those at the tertiary level are 21 times more likely to develop high diastolic blood pressure than those that are not educated. The reason could be that the highly educated respondents may fall in the age range of 46-55 years.

Those who currently smoke were seven (7) times more likely to develop high systolic blood pressure than those who do not smoke. Smoking is known to be a common risk factor to non- communicable diseases, including hypertension. Physical activity tends to be protective as those involved in it were less likely to develop both high systolic and diastolic blood pressure. A study on physical activity in relation to the risk for type 2 diabetes in men by Hu et al. (2001), revealed that sedentary lifestyle such as watching television for longer hours was a major reason for developing type 2 diabetes.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

All the out-patients recruited for this study had some level of formal education, but the majority of the respondents (88.6%) had low educational level, while 11% had tertiary level of education.

The overall percentage of prevalence of metabolic syndrome was 58.49%. Females had the higher prevalence of 63% compared to 35.3% for males. Hypertension was the commonest risk component of metabolic syndrome, accounting for 46%, followed by central obesity (34%). High BP, high central obesity, high FBS were the common risk factors associated with the study participants. The age group of 46-55 recorded the highest (59%) prevalence of MetS. This was followed by the 56-65 age group with 23%. The 18-35 age group recorded the lowest which was 5%.

Physical activities such as running and jogging were seen to be protective against metabolic syndrome.

6.2 Recommendations

The study focused on general patients at the OPD with a sample size of only 106. This limits the generalization of findings of the study to the general public. It is therefore recommended that another study be conducted outside the setting of the hospital, using a larger sample size. This will help to get the true picture of the current trend of metabolic syndrome.

Also, since prevalence of metabolic syndrome is gradually becoming a global problem, it is recommended that there should be routine health screening by the Ghana Health Service in the different communities to reduce the occurrence of the disorder.

Again, health education targeted at individuals should aim at encouraging a healthy lifestyle such as physical activities, smoking-free lifestyle and low fat diets.

Finally, individuals should also endeavour to regulate their meal times to prevent excess intake of foods rich in fats, salt and sugar which has the tendency to lead to metabolic syndrome.

6.3 Limitation

The study was limited to the Manhyia District Hospital with a sample size of 106. This could have been done in a community setting using a much larger sample size instead of the hospital setting.

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APPENDICES

Appendix A Questionnaire

DEPARTMENT OF BIOCHEMISTRY, KNUST

RESEARCH TOPIC: PREVALENCE OF METABOLIC SYNDROME IN PATIENTS OF MANHYIA DISTRICT HOSPITAL

DIET AND HEALTH QUESTIONNAIRE

NB: Please read carefully and indicate your answers in the provided boxes by ticking in box (□). Please provide answer where necessary.

Code Number.....

SECTION 1: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS.

1. Sex: □ Male □ Female

2. Age category □ 18-35 □ 36-45 □ 46-55 □ 56-65

3. Marital status: □ Single □ Married □ Divorced □ Widowed

4. Religion: □ Christian □ Muslim □ Traditionalist □ other Specify……

SECTION 2: SOCIO-ECONOMIC CHARACTERISTICS

5. Educational Status: □ None □ Primary □ JHS □ SHS □ Tertiary

6. Occupational status: ……..

SECTION 3: HEALTH STATUS AND LIFESTYLE HABITS

7. Health status and Family history

a. Have you been diagnosed of any chronic condition?

□ Yes □ No

b. If yes, what condition? ……..

c. Do you have any family member who have the condition?

□ Yes □ No

d. If yes, what condition? ……..

e. What is your relationship with this family member? ……..

8. Smoking Habits

a. Have you ever smoked in the past? □ Yes □ No

b. How often did you smoke? □ Daily □ Weekly □ Monthly

c. Do you currently smoke? □ Yes □ No

d. Have you been exposed to passive smoking? □ Yes □ No

9. Drinking habits

a. Did you drink alcohol in the past? □ Yes □ No

b. Do you drink alcohol currently? □ Yes □ No

c. If yes (7a or 7b), how often? □ Daily □ Weekly □ Monthly

□ Occasionally

d. What type of drink do you take? □ Normal strength beer (star, Guinness, etc.)

□ Strong drinks (spirits, liquor) □ Other alcoholic drinks (eg; Wine, Smirnoff, Pito,

etc) e. Quantity of drinks: □ Tot □ Canned bottle □ Small bottle □ Big bottle

10. Physical activity level

a. Do you undertake any physical activity? □Yes □ No

b. What physical activity are you involved?

□Walking □ Running/Jogging □ Press ups □ Swimming □ other aerobics

c. How often do you perform your physical activity above?

□ Daily □ Weekly □ Monthly □ Occasionally

d. How do you rate your physical activity level?

□ Sedentary □ Moderately active □ Active □ Very active

e. What is the average duration of your activity or single exercise?

□ Less than 30 minutes □ 30 minutes □ 1 hour □ above 1 hour

11. Dietary Habits

a. How many times do you eat a day?

□ Once □ 2 times □ 3 times □ More than 3 times

b. Do you skip meals? □Yes □ No

c. How often do you skip meals in a week?

□ Once □ 2 times □ 3 times □ More than 3 times

d. Which meal time do you often skip? □ Breakfast □ Lunch □ Supper

□ Snacks

e. Do you eat fruits? □ Yes □ No

f. How often do you eat fruits? □ Daily □ Weekly □ Monthly □ Occasionally

g. Do you take any soft /energy drinks (e.g. Coke, Fanta, Rush, 5 Star, Blue jeans etc.)? □ Yes □ No

h. If yes, how often do you take such drinks?

□ Daily □ Weekly □ Monthly □ Occasionally

i. Do you sometimes eat outside? □ Yes □ No

j. If yes, How often? □ Daily □ Weekly □ Monthly □ Occasionally

k. What food do you eat outside? ……

l. Do you add table salt to your meals? □ Yes □ No

m. What quantity of salt do you add? □ ¼ Teaspoon □ ½ Teaspoon □ 1 Teaspoon

24 HR RECALL DIETARY CHART

DATE RECALLED …/……./……..DAY OF WEEK

RECALLED…… START TIME: ……. . HRS (24)

MEAL TIME	TYPE OF FOOD	QUANTITY OF FOOD	WEIGHT (IN GRAMS)
Breakfast Time			
Mid-morning snack Time			
Lunch Time			
Mid-afternoon snack Time			
Supper Time			
Bed time snack Time			

LABORATORY MEASUREMENTS

VARIOUS MEASUREMENTS	VALUES
SBP(mmHg)	
DBP (mmHg)	
Pulse(bpm)	
Weight(kg)	
Height(cm)	
BMI (kg/m^2)	
WC (cm)	
HC (cm)	
WHR	
FBS (mmol/L)	
Total cholesterol (mmol/L)	
TG (mmol/L)	
HDL-C (mmol/L)	
LDL-C (mmol/L)	

THANKS

Appendix B CHRPE Application Form

APPLICATION FOR REVIEW FORM (2009)
(UPDATED November, 2010)

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
SCHOOL OF MEDICAL SCIENCES &
KOMFO ANOKYE TEACHING HOSPITAL

APPLICATION FOR ETHICAL REVIEW OF RESEARCH PROTOCOL

Submission forms may be obtained from the CHRPE Office, Room 8 Anatomy Block 3, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi or chrpe.knust.kath@gmail.com. **Completed forms must be returned; collated and stapled/clipped, to the CHRPE Office, SMS KNUST.**

The following documents should be enclosed to make a submission complete.

		NUMBER OF COPIES		
		General Research	Student Research	Please ☑
A	**For all research:**			
◊	Personalised Covering letter from the Investigator	1	1	
◊	Completed CHRPE Application Form	2	2	
◊	Copies of the Research Protocol	2	2	
◊	Participant Information Leaflet and Consent Form	2	2	
◊	Summary of protocol (Maximum of 3 pages)	2	N/A	
◊	Data capturing sheet(s)/questionnaires/interview guide	2	2	
◊	Proof of notification or written approval or permission from research site/facility (where study is to be conducted)	2	2	
◊	Soft Copies of all submitted documents (on CD)	1	1	
◊	Proof of payment of CHRPE Fees	1	1	
B.	**Where applicable:**			
◊	For all Clinical and Field trials, a brief Curriculum Vitae of Principal Investigator showing research experience	1	1	
◊	Written approval or permission on official letterhead from Supervisor (Research for Academic Purposes)	N/A	1	
◊	Other (Please specify) e.g. copy of diary cards	1	1	

Please note that ethics review is conditional upon submission of all the required documents in A above and B, where applicable

1.0 GENERAL INFORMATION

1.1 Title of Study

The Prevalence of Metabolic Syndrome in Patients of Manhyia District Hospital, Kumasi

1.2 Principal Investigator's Status

SMS Staff ☐ KATH Staff ☒ Student ☐ Other ☐ Please specify

1.3 Purpose of Research

Non Degree Purposes ☐ Diploma ☐ 1st Degree ☒ 2nd Degree ☐ PhD ☐

1.4 Nationality of Principal Investigator

Ghanaian ☒ Non- Ghanaian (Resident) ☐ Non-Ghanaian (Non-Resident) ☐

Committee on Human Research Publication and Ethics
Kwame Nkrumah University of Science and Technology and Komfo Anokye Teaching Hospital
Kumasi, Ghana. Tel: 233 3220 63248 or 233 20 5453785. Email: chrpe.knust.kath@gmail.com

Appendix C Permission Letter from Manhyia District Hospital

In case of the reply the number and the date of this letter should be quoted

My Ref. No: MDH/MR/2016
Your Ref. No:
Tel: 0322026311
Email: mdhosp@yahoo.com

GHANA HEALTH SERVICE
MANHYIA DISTRICT HOSPITAL
P. O. BOX 1908
KUMASI

24TH OCTOBER, 2016

HEAD OF DEPARTMENT
DEPT. OF BIOCHEMISTRY AND BIOTECHNOLOGY
COLLEGE OF SCIENCE
KNUST

ACCEPTANCE LETTER – MS. OPHELIA ACHIAA FRIMPONG
MSc. HUMAN NUTRITION AND DIETETICS STUDENT

I write to inform you that, the Management of this hospital has accepted to assist the above named student of your department to undertake her research project on **"Prevalence of Metabolic Syndrome among Patients in Manhyia District Hospital".**

Thank you.

.....
SAMUEL DODZI
DEP. CHIEF HEALTH SERV. ADMINISTRATOR

Appendix D Approval Letter from CHRPE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/478/16

22nd November, 2016.

Miss Ophelia Achiaa Frimpong
Department of Biochemistry and
Biotechnology
College of Science
KNUST-KUMASI.

Dear Madam,

LETTER OF APPROVAL

Protocol Title: *"The Prevalence of Metabolic Syndrome in Patients of Manhyia District Hospital, Kumasi."*

Proposed site: *Manhyia District Hospital, Kumasi.*

Sponsor: **Principal Investigator.**

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 24th October, 2016 from Manhyia District Hospital (study site) indicating approval for the conduct of the study in the Hospital.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning 22nd November, 2016 to 21st November, 2017 renewable thereafter. The Committee may however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Yours faithfully,

Osomfuor Prof. Sir J. W. Acheampong MD, FWACP
Chairman

Room 7 Block J, School of Medical Sciences, KNUST, University Post Office, Kumasi, Ghana
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