

**SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF GHANA, LEGON**



**METABOLIC SYNDROME AND ASSOCIATED FACTORS AMONG OUT
PATIENTS IN KUMASI METROPOLIS.**

BY

SARAH DANSOWAA FORDAH

(10599257)

**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,
LEGON IN PARTIAL FULLFILMENT OF THE REQUIREMENT FOR THE
AWARD OF MASTER OF PUBLIC HEALTH DEGREE.**

JULY 2017

DECLARATION

I Sarah Dansowaa Fordah hereby declare that excluding referenced works of other people which have been cited and duly acknowledged, this work is an output of my own research and initiative conducted under the supervision of Dr. Adolphina Addo-Lartey, and the thesis has neither in whole nor in part been presented for an award of a degree elsewhere.

.....

Sarah Dansowaa Fordah

(Student)

Date

.....

Dr Adolphina Addo- Lartey

(Supervisor)

Date



DEDICATION

I dedicate this work to the Almighty God for his abundant grace and for guiding me through this work. To the Fordah Family for their immeasurable love and immense support. Also to the Opoku-Mensah, Agyei- Baah, Owusu-Aboagye, and the Adjirackor families for their encouragement and assistance and to the “learning to pass study group members” of MPH-Legon for their fellowship and encouragement towards the success of this work.



ACKNOWLEDGEMENTS

Praise be to God Almighty who is able to do immeasurably more than all we ask or imagine, He who gave me the strength to begin and end in success.

My very special gratitude to my director Dr Alberta Biritwum- Nyarko (Director of Health Services-Kumasi Metro.), my supervisor Dr Adolphina Addo-Lartey (Department of Epidemiology, School of Public Health, Legon), for their time, guidance and co-operation. Appreciation also to all lecturers and administrative staff of the School of Public Health, Legon, Mr Samuel Dery and Kofi Agyabeng (Department of Biostatistics, School of Public Health, Legon), Prof. Ankomah (PFRH department, School of Public Health, Legon), Mr. Akwasi Boaten- Sekyerehene (CEO of Optimum O₂-Company, Accra), Mr Samuel Dodzi (Administrator –Manhyia Hospital), Mr Kofi Eshun (Head of Health Information, GHS, Ashanti Region), Adwoa Opoku Amankwa (Head of Health information-Manhyia Hospital). Also to George Agyei (Biomedical scientist/Head of Laboratory- Kwadaso S.D.A Hospital), Kofi Ansah (Biomedical scientist-Manhyia Hosp.), Ebenezer Boakye Amponsah, Randy Afrane, Gifty Serwaa Mensah, Dominic Nyarko, Charles Ebo Abban, Massawudu Mahama and Beulah S.D.A Church members for their support and prayers.

I cannot forget the great contribution made by the following people: Elliot Amankwah, Charles Amankwa Enyah, Enoch Akyeampong, Robbert Opoku, Priscilla Afua Dunyo, Gloria Odoom, Dorinda Godson(I.T mama 1), Comfort Obuom Sekyi (I.T mama 2) and Stella Dede Nolly all of the Executive MPH 2016/2017 batch.

To Families, friends and all well-wishers whose names were not mentioned, your support has gotten me this far and am grateful. May the Lord make His face to shine upon you.

ABSTRACT

Background: Metabolic syndrome (MetS) has become a growing concern worldwide because it has a significant association with the development of cardiovascular diseases and diabetes type 2 disease. MetS has also been linked to high mortality among patients with cardiovascular diseases than among those who do not have cardiovascular diseases.

Aim: This study aimed at assessing the prevalence of metabolic syndrome and associated factors in the Kumasi Metropolis.

Methodology: A cross-sectional study design which involved outpatients 35-69 years of age was used. A sample size of 226 and a stratified and purposive sampling method were used to select five health facilities and respondents for the study. Consent was sought from all respondents. Data on clinical, lifestyle and dietary behaviour were collected from respondents. MetS was defined with the NCEP-ATP III Criterion. T-test, Chi-square and logistic regression test were applied in the data analysis.

Results: The overall prevalence of MetS was 23.45 % (53) with 13.59% males and 31.71% females. Females had 2.95 times high odds of being diagnosed MetS compared to males ($P=0.005$). Gender ($P=0.001$), age ($P=0.043$) and marital status ($P=0.042$) were significantly associated with MetS. Hypertension, Dysglycaemia and Obesity were significantly associated with MetS among the study group with 24.35, 12.29 and 15.001 times high odds respectively among those who have these conditions than those without ($P=0.0001$). The study again found that diet and lifestyle were not associated with MetS.

Conclusion: There was a high prevalence of metabolic syndrome among out-patients aged 35 to 69 years in the Kumasi Metropolis. Gender, marital status, hypertension, dysglycaemia and obesity were significantly associated with MetS.

TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Problem Statement	2
1.2 Conceptual Frame work	3
1.3 Research questions	4
1.4 Overall Objective	5
1.4.1 Specific Objectives	5
1.5 Justification of the Study	5
CHAPTER TWO	6
LITERATURE REVIEW	6
2.0 Introduction	6
2.1 Metabolic Syndrome Definition and prevalence	6
2.2 Components of Metabolic Syndrome	9
2.2.1 Blood pressure and metabolic syndrome	10
2.2.2 High blood glucose (Diabetes) and metabolic syndrome	13
2.2.3 Central obesity and metabolic syndrome	13
2.2.3.1 Measurement of Obesity	15
2.3 Socio-Demographic Determinants of Metabolic Syndrome	16
2.4 Dietary and Life Style Determinants of Metabolic Syndrome	20
2.5 Conclusion	24
CHAPTER THREE	25
METHODOLOGY	25
3.1 Study Design	25
3.1.1 Study population:	25
3.1.2 Inclusion criteria	25
3.1.3 Exclusion	26
3.2 Background of the study area	26
3.2.1 Vegetation/Climate	28
3.2.2 Occupation	28
3.2.3 Education	29
3.4 Variables	29
3.4.1 Sample Size determination	30
3.4.2 Sampling Procedure	30
3.5 Data collection	31

3.6 Data Processing and Analysis	33
3.7 Ethical Consideration	33
3.7.1 Consenting process	34
3.7.2 Potential risk/ Risks and Benefits	34
3.7.3 Right to refusal.....	34
3.7.4 Confidentiality	35
3.7.5 Compensation	35
3.7.6 Quality Assurance.....	35
3.7.7 Data storage and usage	35
3.7.8 Dissemination of findings.....	36
 CHAPTER FOUR.....	 37
RESULTS	37
 CHAPTER FIVE.....	 44
DISCUSSION	44
5.0 Summary of key findings	44
5.1 Prevalence of metabolic syndrome.....	44
5.2 Demographic factors and metabolic syndrome	44
5.3 Lifestyle factors and metabolic syndrome.....	46
5.4 Components of Metabolic Syndrome.....	48
5.5 Limitations of the Study	51
 CHAPTER SIX	 52
CONCLUSIONS AND RECOMMENDATIONS	52
6.1 Conclusion.....	52
6.2 Recommendations	52
 REFERENCES.....	 53
 APPENDICES	 58
Appendix 1: Informed Consent Form	58
Appendix 2: Questionnaire.....	62

LIST OF TABLES

Table 1: Current Criteria for Metabolic Syndrome Diagnosis.....	9
Table 2: Blood pressure levels	10
Table 3: Population Distribution per Sub-Metro Health Areas	26
Table 4: Distribution of Health Facilities in Kumasi Metropolis.	27
Table 5: Study variables.....	29
Table 6: Allocated quota of sample size to hospitals.....	31
Table 7: basic characteristics of respondents by sex.....	37
Table 8: Comparison of socio-demographic variables in all the study subjects.....	39
Table 9: Comparison of risk factors in all the study subjects.	40
Table 10: Comparison of all the components of MetS in the study subjects.....	41
Table 11: Simple logistic regression/multiple logistics regression of variables.....	42
Table 12: logistics regression of components of MetS	42



LIST OF FIGURES

Figure 1: Conceptual Framework - Metabolic syndrome.	4
Figure 2: Health Administrative Structure of the Kumasi Metropolis.....	28
Figure 3: Overall prevalence of MetS among study group.....	37
Figure 4: Prevalence of Metabolic Syndrome by Sex.....	38



LIST OF ABBREVIATIONS

AACE	American Association of Clinical Endocrinology
AHA	American Heart Association
AMP	Adenosine Monophosphate
BF	Body Fat
BMI	Body Mass Index
BP	Blood Pressure
CHD	Coronary Heart Disease
CHPS	Community Health Planning Service
CVD	Cardiovascular Disease
DBP	Diastolic Blood Pressure
DHDL	Decrease High Density Lipoprotein
DHIMS	District Health Information Management Systems
EGIR	European Group for the Study Of Insulin Resistance
FBG	Fasting Blood Glucose
FFMI	Fat Free mass index
FMI	Fat mass index
GHO	Global Health Observatory
GLU	Plasma Glucose
HBP	High Blood Pressure
HDL-C	High Density Lipoprotein Cholesterol
HF	Health Facility
HFBG	High Fasting Blood Glucose
LDL	Low density Lipoprotein
MetS	Metabolic Syndrome

mmHg	Millimeter Of Mercury
mmol/l	Millimole Per Litre
NCEP	National Cholesterol Education Programme
OP	Outpatients
OPD	Out Patients department
RTGL	Raised Triglycerides
T2DM	Type 2 diabetes mellitus
TC	Total Cholesterol
TGL /TG	Triglyceride
TNF	Tumour Necrosis Factor
VLDL	Very Low Density Lipoprotein
WC	Waist Circumference
WHO	World Health Organization
WtH	Weight to Height



CHAPTER ONE

INTRODUCTION

MetS commonly denotes a cluster of dangerous factors which includes obesity of the abdomen (or elevated waist circumference), raised triglycerides, decreased high-density lipoprotein cholesterol (HDL-C), raised fasting blood glucose, or raised blood pressure in an individual (International Diabetes Federation, 2006). Insulin resistance has been found to be a vital constituent of metabolic syndrome.

MetS is connected to the development of type 2 diabetes mellitus in addition to CVDs (Raman et al 2010) (B.M. Bello Rodriguez et al 2013). It has become a world health problem especially in the light of increasing prevalence of diabetes type 2 and cardiovascular diseases and increasing mortality in cardiovascular diseases.

There are many criteria to measuring this condition in an individual thus the International Diabetes Federation (IDF), the World Health Organization (WHO), the European group for the study of Insulin Resistance (EGIR), the National Cholesterol Education Program on Adult treatment panel III (NCEP-ATP III) and the American Association of Clinical Endocrinologist (AACE) criteria.

The IDF criteria has become the universal measure for clinical diagnosis and controlling MetS. (International diabetes Federation, 2006). However any of the criteria could be employed for research purposes.

Globally, different prevalence in metabolic syndrome has emerged from different studies resulting from the use of different criteria. Wide-world prevalence of MetS ranges from 13.6% to 46% (6-9), liable to the diagnostic criteria used and the population being assessed (Salaroli et al 2013).

This study sought to determine the prevalence of metabolic syndrome using the NCEP ATP III criteria and the factors associated to metabolic syndrome among adult to help combat its major effects, notably the development of diabetes mellitus (DM) and cardiovascular disease (CVD) in the Kumasi Metropolis.

1.1 Problem Statement

MetS is prevalent in 20-25% of the adult world's population. (Balakumar et al 2016). Decline in the metabolic health is a precursor for CVD and type2 DM . In Ghana, results from a study conducted among rural folks (who are perceived as being physically active per their farming activities) showed a high prevalence of MetS (15.0% and 35.9%) using ATP III and IDF criteria respectively (Gyakobo et al 2012).

Diabetes and hypertension are being increasingly diagnosed among out patients in Health Facilities in the Kumasi metropolis. In 2012 and 2014 high blood pressure which is a components of MetS recorded high incidence 13.1% and 30.4% 2 respectively. In 2014 and 2015 diabetes which is an outcome of MetS recorded 9.2% and 27.1% respectively (DHIMS report 2012, 2014).

In Kumasi where there is a lot of sedentariness and stress, obesity and high blood pressure which are major components of metabolic syndrome is perceived to be eminent. Early detection of MetS helps the individual adopt healthy lifestyles which may prevent the development of diabetes and CVDs which can have negative impacts on Ghana's economy.

Most studies have been conducted in countries with different demographics from that of Ghana. However, in Ghana, no studies have assessed the effect of demographic variables on MetS. Because of the unique demographic features of Ghana, it is important for the country to establish its own contextual features that affect MetS. Understanding the

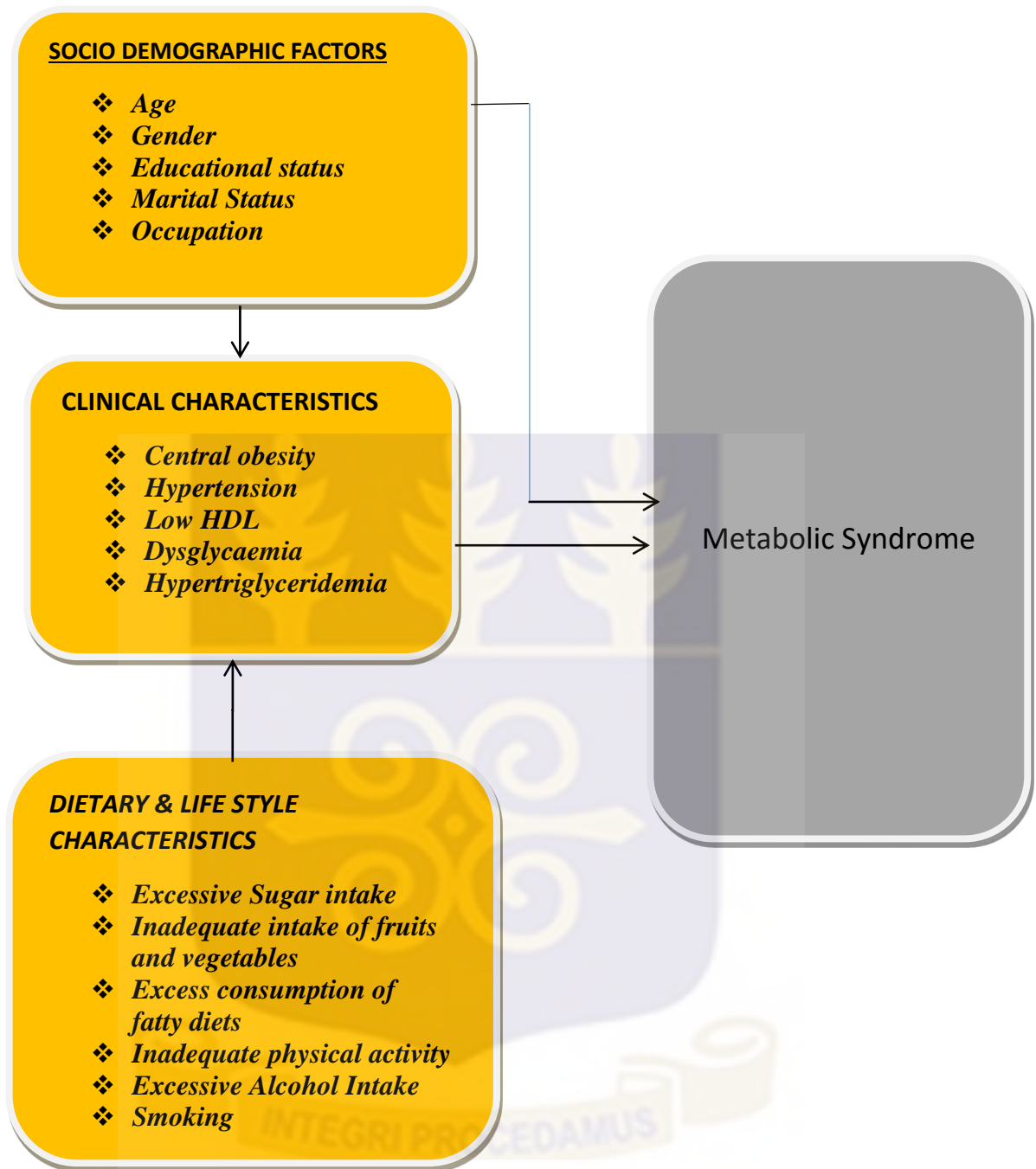
association of dietary and lifestyle to MetS may offer strategies for early intervention in the normal progression of Diabetes type 2 and cardiovascular diseases. Knowing the prevalence of MetS will also inform major stakeholders of health on future position of the Metropolis with regards to prevalence of diabetes and cardiovascular diseases which would enable them set their priorities right.

1.2 Conceptual Frame work

This study conjectures that MetS is associated with factors such as Socio demographic factors, lifestyle factors, dietary and clinical factors. Results from some studies show socio-demographic factors such as age, sex, ethnicity, marital status, educational level, and social status of an individual (Salaroli et al., 2013), lifestyle factors such as lack of exercise or inadequate exercise and smoking, dietary factors such as excessive carbohydrate intake, excessive sugar intake, inadequate or lack of fruits and vegetables were associated with MetS.

The socio-demographic and lifestyle factors result in some clinical factors including obesity, decreased HDL cholesterol, and hypertriglyceridemia, increased BP, and high fasting plasma glucose which are a measure of MetS. MetS can lead to diabetes mellitus and CVDs and also increase mortality in patients with diabetes mellitus and cardiovascular diseases, if control measures are not applied.

Figure 1: Conceptual Framework - Metabolic syndrome.



1.3 Research questions

1. What is the prevalence of Metabolic Syndrome among OPD patients in Kumasi Metropolis?

2. What are the socio-demographic and lifestyle factors associated with Metabolic Syndrome Kumasi Metropolis?
3. Is dietary intake associated with metabolic syndrome in this population?

1.4 Overall Objective

To assess the prevalence and determinants of metabolic syndrome among adult out patients in Kumasi Metropolis.

1.4.1 Specific Objectives

1. To determine the prevalence of metabolic syndrome among out patients in the Kumasi Metro.
2. To determine the socio-demographic and lifestyle factors associated with Metabolic Syndrome among the Patients.
3. To determine if dietary intake is associated with metabolic syndrome in this population

1.5 Justification of the Study

This study will establish the baseline prevalence of metabolic syndrome among OPD patients in Kumasi Metropolis. This will inform management of the health care system and policy makers on the future position of the metropolis in the incidence of diabetes and cardiovascular diseases and help prioritize the problem for appropriate preventive measures.

It will again make recommendations which will enable early detection of metabolic syndrome among the individuals and stimulate people's conscience to adopting healthy lifestyles to controlling MetS will prevent its consequences. The study would also add to existing literature which could be used as reference for other related studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will explore relevant research on metabolic syndrome to bring to view the depth of the problem, and the effects of the individual variables on the problem identified by similar studies.

2.1 Metabolic Syndrome Definition and prevalence

MetS was initially described as a cluster of hypertension, hyperglycaemia and gout by Kylin in the 1920s (Alberti et al., 2006). Subsequently MetS has assumed many other descriptions by individuals and groups. Some of these include dysmetabolic syndrome, hypertriglyceridemia waist, insulin resistance syndrome, obesity syndrome, the deadly quartet, and Syndrome X.

The World Health Organization (WHO, 1988) gave a definition of MetS using insulin resistance as the focus. The European group for the study of Insulin Resistance (EGIR) amended the WHO definition to abdominal obesity and Insulin resistance as the primary and other constituents respectively. The National Cholesterol Education Program on Adult treatment panel III (NCEP-ATP III) in 2001 also described the condition without highlighting on insulin resistance. The American Association of Clinical Endocrinologist (AACE) amended the NCEP-ATP III definition in 2003 bringing back insulin resistance as a core component of metabolic syndrome. The different definitions created confusion in clinical diagnoses and comparative studies. There was the need to synchronise the definitions to getting a universal assessment.

In 2005, the International Diabetic Federation finally came out an agreement statement for universal diagnosis which also took into perspective the different ethnic differences (Alberti et al., 2006). However, any of the definition given by IDL, WHO, NCEP ATP III, AACE when used in epidemiological studies, yields different prevalence. Any of these criteria could be used for research purposes.

MetS is known to be associated with DM and CVDs. MetS, as reported by Larkin (2001) is an exceptionally vital corresponding dangerous contributor to heart disease. Isomaa et al. (2001) also reported a threefold increased risk of coronary heart ailment and stroke, in addition to noticeably increased cardiovascular transience among matters with MetS. There is a swell in predominance of many of the attributable components of MetS, leading to a worldwide pandemic with consequence for both clinical and public health (Salaroli et al. 2013). Existing evidence shows that in most countries, 20% to 30% of the adult population can be considered as having MetS. Prevalence of risk factors for metS is 53% for obesity, 40% for hypertension, 39% for hypertriglycedemia 31% and low HDL 25% (Alexander et el., 2007). Central obesity, HBP and low HDL are major factors responsible for MetS (Gyakobo et al., 2013).

MetS is also reported to serve as a simple clinical tool for finding individuals with a comparatively high long-term risk of cardiovascular disease. While non-communicable diseases are reasonably more predominant in advanced countries, their effect is extremely disturbing in developing countries as they denote a major burden on the present under-resourced public health service (Reddy, et al., 1998). WHO report recognizes CVDs as accounting for 9.2% of overall deaths in the African region in 2001, and was projected that by 2015, the number of deaths in Africa owing to NCDs in general will surpass that owing to communicable diseases (WHO, 2011). This impending widespread is adequate reason for

the timely institution of suitable interventions to lessen the risk factors for CVDs, comprising that associated with MetS (Alberti et al., 2005).

About a quarter of the world has MetS which makes them three times at risk to developing heart attack or stroke, twice at risk to dying from heart attack or stroke and five times at risk to becoming type 2 DM than those without MetS (Balakumar et al., 2016).

Numerous studies amongst several subpopulations in Ghana have testified diverse frequency rates dependent on diverse definitive measures. Gyakobo et al. (2012) conveyed an incidence of 35.9% using the International Diabetes Federation (IDF) criteria and 15.0% using the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) in a rural community. Arthur et al. (2013) have also indicated a prevalence of 14.4%, 25.6%, 29.2%, and 30.4% using the World Health Organization (WHO) criteria, the NCEP-ATP III criteria, the IDF criteria, and the Harmonised Metabolic Syndrome (HMS) criteria, respectively, among adult females. There is a chiefly high prevalence of MetS among the Ghanaian population with diabetes (24-78.8%), as indicated at different locations, with different definitive criteria (Rodriquez et al., 2013).



Table 1: Current Criteria for Metabolic Syndrome Diagnosis

	NCEP-ATP III	IDF
Hypertension	Present antihypertensive therapy OR SBP \geq 130 OR DBP \geq 85	Present antihypertensive treatment OR SBP \geq 130 OR DBP \geq 85
Dyslipidemia – Elevated Triglycerides	Plasma triglycerides \geq 150 mg/dL(\geq 1.7mmol/l)	Plasma triglycerides \geq 150 mg/dL (\geq 1.7mmol/l)
Dyslipidemia - Depressed HDL	HDL $<$ 40 mg/dL(\geq 1.03mmol/l) in men or $<$ 50 mg/dL(\geq 1.29mmol/l) in women	HDL $<$ 40 mg/dL(\geq 1.03mmol/l) in men or $<$ 50 mg/dL(\geq 1.29mmol/l) in women
Obesity	Waist circumference \geq 40(\geq 102cm) inches in men or \geq 35 inches in women	Waist circumference \geq 40 inches in men or \geq 35 inches in women
Glucose	Fasting blood glucose \geq 100 mg/dL (\geq 5.6mmol/l)	Fasting blood glucose \geq 100 mg/dL (\geq 5.6mmol/l)
Requirements for diagnosis	Any 3 of the above criteria.	Obesity plus Any 2 of the above criteria.

2.2 Components of Metabolic Syndrome

The five major components of MetS which are also known to be associated with CVDs are raised blood pressure (hypertension), raised blood glucose (or type II diabetes), central obesity, high triglycerides, and low HDL-cholesterol. These risk factors are reported to mostly interconnected and coexist with each other in individuals more often than might be

expected by chance (Alberti, et al., 2005). The WHO definition however also added micro albuminuria as a component of MetS (WHO, 1999).

2.2.1 Blood pressure and metabolic syndrome

Blood pressure denotes force applied by the blood on the walls of the arteries as it circulates through the body. When an excessive force is constantly used by the heart in pumping blood through the blood vessels, it is known as high blood pressure or hypertension. Blood pressure is expressed as two values, one over the other. The upper value which is systolic symbolizes the force in blood vessels at the beat of the heart while the lower value diastolic represents the force in the vessels when the heart rests between beats.

Table 2: Blood pressure levels

Normal BP	Systolic: < 120 mmHg Diastolic: < 80 mmHg
At risk (Prehypertension)	Systolic: 120–139 mmHg Diastolic: 80–89 mmHg
HPB-High bloodpressure (hypertension)	Systolic: \geq 140 mmHg or Diastolic: \geq 90 mmHg

*(Hypertension fact sheet Department of Sustainable Development and Healthy Environments September 2011)

Blood pressure has a tendency to increase with age hence one can say that threat for hypertension upsurges with age. Some behaviors and lifestyles can also place individuals at a greater risk for developing high blood pressure (Lawrence et al. 2014). This comprises too much intake of food intake, excess salt (sodium) consumption, inadequate potassium intake (by inadequate intake of fruits and vegetables), being overweight, inadequate physical activity, excess alcohol intake and smoking. Hypertension could be inherited, thus people with inherent genes are more likely to develop the condition than those who do not

have. The risk for high blood pressure is even higher when one who has the inherent gene combines unhealthy lifestyle choices. High blood pressure is named the "silent killer" since it oftentimes gives no warning or symptoms, and a lot of people never realize they have it; for this reason, it is important to get regular blood pressure checks (Cappuccio, 2004).

Even though hypertension is usually without any symptoms, it could result in early-morning headache, bloody nose, irregular heartbeats and buzzing in the ears. Symptoms of severe hypertension include tiredness, nausea, vomiting, confusion, anxiety, chest pain, and muscle tremors. The only way to detect high blood pressure is to have it measured by a doctor or a health professional. Taking blood pressure is fast and comes with no pain (Cappuccio, 2004).

HBP can result in severe damage to health. It can harden the arteries which further decreases blood flow and oxygen to the heart. This reduced flow can lead to angina (chest pain), heart failure when the heart cannot pump enough blood and oxygen to other organs, heart attack when blood distribution to the heart is obstructed and heart muscle cells die from lack of oxygen. The lengthier the blood flow is obstructed, the greater the heart damage. High blood pressure can again rupture or block arteries that supply blood and oxygen to the brain and cause stroke (Owiredu, et al., 2011).

High blood pressure is mostly avoidable by assuming lifestyle reforms at early stages. Jeppesen, et al. (1997), suggests the following actions as preventive measures to hypertension.

- Reduction and management of mental stress through yoga,
- Meditation and using other relaxing techniques
- Eating healthy diet thus consisting of lots of fresh fruits and vegetables, which provides nutrients such as potassium and fibre.

- Limiting sodium intake by reducing the amount of salt added to food. The total daily intake of salt or sodium chloride from all sources should not exceed 5gm per day (1 tea spoon). Processed foods are high in sodium and should be avoided.
- Taking food high in saturated fats in moderation and eliminating trans-fat in diet.
- Overweight can raise blood pressure hence maintaining healthy weight is also advised. Physical activities can also help lower blood pressure. Adults should involve in moderate physical activity for at least 30 minutes on most days of the week.
- Smoking which is considered as a major risk factor for heart diseases and stroke should be completely avoided since it injures blood vessels and speeds up the hardening of arteries.
- Avoiding excess alcohol intake since it is associated with high blood pressure. alcohol should be avoided or taking in moderation.

From a WHO reports, HBP is one of the major public health issues that affects over a billion of people and records millions of death cases yearly. WHO again reported that sub optimal blood pressure (BP) (>115 mmHg Systolic BP) accounts for 62% of cerebrovascular disease (CVD) and 49% of coronary heart disease (CHD), with little differences in sex distribution. Besides, suboptimal BP is the chief attributable risk of death worldwide (Zhao, et al., 2014). Close to one billion people have hypertension worldwide with two-thirds residing in developing country. Hypertension is one of the greatest origins of premature deaths internationally and keeps increasing by day (W.H.O, 2009). For instance, it has been projected that about 1.56 billion adults will be living with hypertension by 2025 (W.H.O, 2009). It is known to kill closely 8 million people yearly and about 1.5 million people each year in the South-East Asia (SEA) Region. Almost one-third of the adult population in the SEA regions has high blood pressure (World Health organization facts sheet, Sept 2011).

In Ghana, a study conducted at the Komfo Anokye Teaching Hospital in Kumasi concluded that high blood pressure was the commonest risk factor, followed by central obesity and dyslipidaemia among the study group with type 2 DM (Nsiah, et al., 2015). One of the reasons among others which has brought a lot of insight and allowed for early detection and treatment of metabolic syndrome is the inclusion of hypertension in the component of metabolic syndrome. To implement operative mediations to control this MetS prevalent, there is the need for more studies such as this present one to add to the understanding of the clustering of the MetS components.

2.2.2 High blood glucose (Diabetes) and metabolic syndrome

MetS is a well-known incidence among people with type 2 DM (Eckel et al., 2005). Given that T2DM in itself is already a significant debilitating health condition, were we to ignore the economic cost involved in its treatment; the co-prevalence of MetS and type 2 DM whether or not the risk to CVD or mortality is increased undisputedly imposes unquantifiable amount of suffering to those affected. Despite there being international recommended guidelines on the clinical diagnoses and management of the MetS (Grundy, et al., 2004), primary care facilities in Ghana are not known to routinely diagnose the syndrome among at risk subjects. Perhaps this is due to the lack of data to support the need for its diagnoses and management.

2.2.3 Central obesity and metabolic syndrome

Abdominal or central obesity also remains one of the major clinical features of MetS. From the research of Alberti *et al.* (2006), Due to the high occurrence and the sickness and transience associated with MetS, a thorough understanding of the risk factors involved is vital to developing apt primary and secondary preventive measures. Obesity is a progressively significant public health problem and is considered a major risk factor for

diet-related chronic diseases including MetS, T2DM, hypertension, stroke and certain forms of cancer (Grundy *et al.*, 2004). Excess body fat also known as obesity is of developmental concern because, numerous diseases are associated with excess weight gain within populations (Wang *et al.*, 2011).

Globally, obesity is rising at a disturbing rate. Prevalence of obesity and overweight in low and middle income countries have move toward levels found in developed countries, often synchronized with under-nutrition (Bhurosy and Jeewon 2014). Further, the problem is growing across all age groups, and the health consequences are already apparent. Obesity is related to increased cardiovascular morbidity and mortality (Amato *et al.*, 2013; Finucane *et al.*, 2011; Van et al., 2014). The prevalence of metabolic syndrome was 6.8 percent among overweight adolescents and 28.7 percent among obese adolescent. By 2008, an estimated 502 million adults worldwide were obese and 1.46 billion were overweight. This increased to 2.1 billion in 2014 Obesity is the third social burden generated by human beings after smoking and war (McKinsey Global Institute [MGI], 2014). 50% of the world's adult population is projected to be overweight or obese by 2030 if the growth rate in the prevalence of obesity continues on its present route. This is closely 2.5 times the number children and adults who are undernourished (MGI, 2014). Furthermore, estimated 170 million children age under 18 years have been classified as obese or overweight globally (Lobstein *et al.*, 2004). Obesity during childhood and adolescence is a major threat for obesity in adulthood, NCDs and its associated illnesses which contributes to metabolic syndrome (Black *et al.*, 2013). In a study conducted by Akpalu et al., (2011) among cardiovascular patients at the korlebu Teaching hospital-Accra, the occurrence of MetS constituents for cases and controls showed that hypertension, which is also known to be the most frequently diagnosed component, was the highest recorded thus in 83% of the cases and 45% of the controls. There was a higher odds ratio 5.38(95% CI 3.22-8.98) in central

obesity from the test of relationship between NCEP: ATP III which was followed by hypertension.

2.2.3.1 Measurement of Obesity

Body Mass Index (BMI) is a widely used measure of body size and standardized BMI thresholds define overweight and obesity (World Health Organization, 2011). Studies have shown a strong association between high percent body fat and an increased risk of chronic diseases such as hypertension, dyslipidaemia, diabetes mellitus, and coronary heart disease (Willett, 2006; Sharma, 2005; Yusuf, 2004). While BMI and fat mass are highly correlated at high BMIs, these measures are less well correlated in normal weight ranges (Jaffrin, 2009; Romero-Corral, 2008).

Additional measures capturing differences in body composition have also been proposed, including percent body fat (%BF fat mass/total mass), Fat Mass Index (FMI- fat in kg/height in m²) and Fat-free Mass Index (FFMI - fat-free mass in kg/height in m²) (Allison, 2002; Zhu, 2003). The measurement of body fat has traditionally involved imprecise measures such as skinfold thickness or expensive machinery such as dual energy X-ray absorptiometry machines (Goran, 1998). Visceral fat, which is located in the abdominal region, is more strongly associated with adverse health effects than fat that is distributed in other areas, such as the hips (Ritchie, 2007). Changes in metabolic intermediates, such as blood pressure, lipid profile, and insulin sensitivity, have also been associated with an excess of abdominal fat (Canoy, 2010). As a result, measures that better reflect body shape and the anatomical distribution of adipose tissue have been proposed as clinically useful measures of obesity, including waist circumference (WC) and the subject's waist circumference divided by the subject's height, or waist-to-height ratio (WtH) (Ho, 2003; Ashwell, 2005; Welborn, 2007).

Ultimately, the test of a measure of obesity is its ability to reflect health risk; for an obesity measure to replace BMI in the clinical setting, the measure must consistently improve clinicians' ability to assess health risks associated with patient adiposity. Studies have assessed the relative value of anthropometric measures in predicting metabolic intermediates, cardiovascular disease, and mortality however, results have been inconsistent (Can, 2009; Willett et al., 2006).

Surprisingly, only one study compared the predictive value of impedance-measured body composition to BMI in a multi-ethnic population. However, the study used raw impedance data rather than the results of a commercially available impedance scale data (Willett et al., 2006). The study seeks to measure the clinical determinants of MetS which uses commercially available impedance clinical scale's body composition measures, as predictors of components of the metabolic syndrome among out patients in Kumasi.

2.3 Socio-Demographic Determinants of Metabolic Syndrome

Social disparity, poverty and uneven access to means such as health care, is brings about a high problem of NCDs among women internationally (WHO, 2014). Despite the fact that women in general end up having longer life with NCDs than men, they often have poor health (WHO, 2011), hence records higher morbidity than men. Jamison et al., (2006) revealed that men lose 7.8 years over their lifetimes due to poor health, women lose 10.2 years. This implies that women spend about 15% of their lives in unhealthy conditions while men spend just about 12%. Living longer lives should not be taken to mean better health for women (Jamison et al., 2006).

Research has continually made known that high socio-economic status is negatively related to overweight and obesity in developed countries, mostly among females but positively

linked in the developing countries (Kamadjeu et al., 2006). This is to mean that in developing countries, lower obesity rates are observed among the lower socio-economic status. People with lower income are limited in their capacity to obtain enough food, engage in moderate to heavy manual work and have little access to public transport which makes them thin. Therefore, thin adults are considered poor, and overweight and obesity are seen as signs of affluence (Popkin, 2003). Increase in income tends to be associated with increased consumption of fatty foods (WHO, 2000). In addition, improvement in socio-economic status of urban families increases proportion of obesity. (Shetty et al., 1994). Preference for food changes with fluctuating incomes. With the lower eaten grain-based diets high in fibre and low in fat content and begin to eat more fats, more sweeteners and more refined carbohydrates while there is an upward adjustment of income (Riley, 2001).

Sodjinou also came up with a results from a study conducted Sodjinou et al., (2008) that the risk of obesity increases with rising socio-economic status clarifying that people in the higher socio-economic groups have higher access to food and they may maintain a positive energy balance over a lengthy period of time while experiencing periodic food shortages may be common among the poor.

The positive correlation between obesity and income status turn to negative as result of increased affluence in developed countries, however, overweight is speedily gaining high prevalent in low and middle income countries, where incidence is increasing especially among poor households. (Sodjinou et al., 2008). Low income households in rural Mexico recorded 60% of adult women and more than 50% of adult men overweight (Fernald, 2004).

Obesity is a chronic disease and similarly affects children, adolescents and adults. It is the leading causes of death and disability in the United States and worldwide, the problem is

anticipated to increase in coming years (Mozaffarian, et al., 2016). Obesity is associated with the chances of developing hypertension, DM, CHD, stroke and osteoarthritis among others. Over-weight and obesity are expressed in terms of the body mass index (BMI) of ≥ 25 kg/m² and ≥ 30 kg/m², respectively (Global Status Report on Non communicable Diseases, 2014). More women are affected by obesity than men globally. Even though more men than women are seen to be overweight. Among women, lots of physical and biological developments that goes on contributes to an increased storage of fat again, women have a tendency to convey extra energy into fat storage while in males this energy is mostly used for protein synthesis. This pattern in females contributes to further positive energy balance and fat deposition (WHO, 2004). Mostly, women are known to have greater percentage of body fat than men, and there are signs that the basal fat oxidation is lower in females as compared to men, thereby contributing to a higher fat storage in women. This explains why women have a more difficult time losing fat in general, and from the hips and thighs in particular (Rolfes et al., 2006). Women again mostly depend on stored fat more than men for reproduction. Crucial body fat in women may account for 12% of total body weight versus 3% for men (Wardlaw, 2003).

Pregnancy and menopause has also been related to obesity among women. Suggestions have been given about differences in reproductive hormone concentrations of women having influence on their surplus weight. Also food intake is regulated differently between the sexes owing to difference in the regulation of serotonin, a hormone that helps to regulate food intake. Increase in BMI is inversely proportional to the amount of serotonin synthesis, apparently to specify satiety at minor levels of intake of food. Amongst men, this decline happens when they get to an overweight BMI whereas women experience this drop in serotonin synthesis at an obese BMI stage (Schlenker and Long, 2007). To add to this, when it comes to losing weight, men are more likely to lose fat within the abdomen, while women

are more likely to lose fat that resides just beneath the skin resulting in greater declines in triglyceride levels and increases in HDL cholesterol levels in men compared to women (Schlenker and Long, 2007). Kamadjeu indicated in a study in four urban districts of Cameroon that irrespective of age or measure used, women recorded higher occurrence of overweight and obesity than men. Kamadjeu et al., (2006), again obesity in women were found to be five times higher compared to men. In another research conducted in the United States of America done over a ten year period using a large sample size to trace the weight of people in, a major weight gain ($BMI > 5 \text{ kg/m}^2$) was two times common in women (5.3%) as in men (2.3%) (Andajani-sutjahjo et al., 2004).

Obesity globally has nearly doubled in prevalence between 1980 and 2014. Above one billion nine hundred grownups of 18 years and above were overweight in 2014, of which 600 million were obese (WHO, 2014). Again, 11% men and 15% women aged 18 years and above were obese in 2014. 2013 realized an estimated 42 million children under the age of 5 years overweight (Global Status Report on Non communicable Diseases, 2014). Increase in obesity is happening in all countries. The frequency of overweight and obesity is utmost in the regions of the Americas, i.e., 61% overweight or obese in both sexes and lowest in the South-East Asia regions i.e., 22% overweight in both sexes (WHO, 2011). Notably, men are more likely to be less obese than women. In the regions of Americas, Europe and Eastern Mediterranean, more than 50% of women are overweight, and about half of these overweight women are obese (30% in the Americas, 25% in Europe, 24% in Eastern Mediterranean countries) (Global Status Report on Non communicable Diseases, 2014).

DM is generally characterized with shortened life expectancy. Males and females afflicted with DM tend to live an average of 7.5 and 8.2 years less, respectively, than those who are without the condition (Mozaffarian et al., 2016). Rampant bursts of childhood and youth

obesity through more sedentary lifestyles (such as increased television and computer usage and decreased physical activity) and modifications to nutrition (increasing calorie intake) have led to a greater proportions of type 2 DM in younger generation. Postponing the early onset of type 2 diabetes mellitus in youngsters will be a major influence on the future burden of the diabetes mellitus, because onset of diabetes at a very young age presages many years of disease and a buildup of the full range of both micro and macro-vascular complications (Balakumar et al., 2016).

Several studies have reported on the effect of demographic factors on metabolic syndrome as per the literature reviewed above. Most of these studies have been conducted in countries with different demographics from that of Ghana. In Ghana, no known studies have accessed the effect of demographic variables on metabolic syndrome among individuals in Kumasi. The study seeks to fill this gap by accessing the effect of demographic variable on metabolic syndrome among outpatients in Kumasi.

2.4 Dietary and Life Style Determinants of Metabolic Syndrome

The lifestyle tactics for controlling MetS mostly involves dietary and physical activity alterations, low alcohol intake, weight management, and avoiding smoking (Wannamethee, et al., 2006). Choice of diet that comprises vegetables, fruits, cereals, fish, legumes, and fish are known to be autonomously related positive outcomes of MetS components. Nonetheless, meat, sweets, fats and alcohol intake are touted to have adverse effects on health (Farhangi, et al., 2015). Mediterranean diets have been shown to have protective value on MetS. Olive oil is used as the main source of fat in Mediterranean diet, and mainly stresses on cautious use of dairy products, low to reasonable consumption of fish and poultry, and substantial consumption of fresh fruits and vegetables on daily basis. Mediterranean diet is also known to encourage regular intake of whole grain cereals, reduced consumption of red meat, and

moderate consumption of alcohol also has a beneficial effects on MetS and its components (Kiortsis and Simos, 2014).

Dietary Action to Stop Hypertension (DASH) diets, stresses on adding slice sizes to fruits and vegetables, limiting alcohol and avoiding smoking can reduce most of the metabolic risks in both men and women (Azadbakht et al., 2005). Regardless of the indication in support of healthier food choices, concerns about the protective role of whole grains in fighting against MetS has been alarmed by some researchers. A Cochrane, it was stated that the confirmation from prospective unit trials was too weak for conclusions to be under listed on the part that whole grain foods plays in the deterrence from raised blood glucose/T2DM (Priebe, et al., 2008). Giacco et al. (2014) also found that postprandial insulin and triglyceride response was reduced in subjects treated with whole grain cereals compared to those treated with refined cereals (Giacco et al., 2014). These findings implicate the role of whole grains as a healthy food choice for the dietary management of METs. These findings notwithstanding, dietary approaches that reduce macronutrients and are rich in functional food constituents such as vitamins, flavonoids and unsaturated fats when combined with weight loss and anti-inflammatory nutrients has beneficial effects to people with MetS (Steckhan et al., 2015). Western dietary patterns are associated with obesity while wise dietary habits are linked to healthful weight (Marshall, 1997). Making minor changes toward a healthy lifestyle may prevent and treat MetS (Kiortsis and Simos, 2014).

The MetS is a disorder caused by many factors, diet plays a key role in its development. Diet can be looked at as dieatry patterns, a method that has been used to explore diet-disease relations. Current approximations show that MetS is highly predominant in the United States., with 24% of population adult affected (Ford, 2002). Although the etiology of this syndrome is largely unknown, it is presume to characterize a multifaceted interaction

between genetic, metabolic, and environmental factors, including diet (Groop, 2000; Lidfeldt, 2003; Wolever, 2000).

Likewise, there is contradictory evidence exist on the influence of total carbohydrate intake on insulin sensitivity. A topical study on dietary intervention found that insulin sensitivity is improved among obese individuals after 6 months of low-carbohydrate and low high-fat diet, however, the source and quality of dietary carbohydrates may differentially improve insulin action and hence affect the degree of insulin resistance, which is a major underlying metabolic constituents of this syndrome (Mckeown et al. 2004). Observational studies have identified that the levels of fasting insulin concentrations are lesser in individuals that engages in higher dietary fiber or whole-grain intakes taking into consideration other lifestyle and dietary factors (Samaha, 2003).

The glycemic index which is used as a measure of the glycemic response to carbohydrate-containing foods has previously been used to physiologically group dietary carbohydrates even though it is an old criterion (Jenkins, 1981). Proof from observational data proposes that a high dietary glycemic index is allied with components of the MetS such as increased triglyceride concentrations and low HDL cholesterol (Liu, 2001; Ford 2001). Other clinical studies have established that low glycemic index carbohydrate improve glycemic control and lipid profiles among people with and without type 2 diabetes (Jimenez-Cruz, 2003; Foster-Powell, 2002; Bouche', 2002). Glycemic load which is a measure of both carbohydrate quality and quantity, has been associated with high risk of type 2 diabetes in some observational studies (Meyer, 2000; Stevens, 2002).

Physical activity is a crucial component of energy outflow, energy balance and weight control. According to World Heart Federation (2015)), The benefits of exercise and physical activity training include reduction in mortality from metabolic syndrome, increased exercise

capacity and improved quality of life. More than 150 min of moderate physical activity or 60 minutes of vigorous physical activity a week can reduce the risk of CHD by about 30% (Heart Federation, 2014) however, insufficient physical activity can increase the crude mortality by 20% to 30% as compared to individuals with a least of 150 minutes of reasonable intensity physical activity per week, or equivalent (Global health observatory, 2014). Physical activity which is adequate may be defined as being at least five times per week of 30 minutes moderate activity, or at least three times of 20 minutes vigorous activity per week, or equivalent (Heart Federation, 2015).

In 2010, worldwide, 23% of adults aged 18+ years did not have sufficient physical activity (men 20% and women 27%). According to the Global Health Observatory (GHO) data of WHO, the maximum proportion of inadequate physical activity was observed in the Eastern Mediterranean and American regions 31% and 32% respectively while the lowest proportion was reported in the South-East Asia (15%) and African (21%) regions (2014). It should be noted that women were less active than men across all regions. In addition, the popularity of decreased physical activity varies with the size of income. In this context, men 41% and women 48% from high income countries did not engage in adequate physically activities relative to men 18% and women 21% of low income countries, (Global Health Observatory (GHO) data of WHO (2014). Decreased physical activities have is a risk factor for incidence of diabetes mellitus, abnormal circulating lipids and obesity.

Although high-carbohydrate and low-fat diets is beneficial in reducing chronic diseases and hence recommended, increasing carbohydrate intake however may harmfully affect blood lipid and lipoprotein concentrations and glucose metabolism which may predisposing some individuals to develop the MetS (Jeppesen et al., 1997; Mittendorfer, 2001). Numerous dietary factors have been connected to metabolic syndrome, in spite of this, only two studies

have examined the association between dietary patterns and the metabolic syndrome (McKeown, 2002).

Understanding the association of dietary and life style with the MetS condition may help in the provision of strategies which will enhance early identification and intervention in the natural progression of type 2 diabetes. This study will look at the effect of dietary and life style factors on MetS among OPD patients in Kumasi.

2.5 Conclusion

Only one known study compared the predictive value of impedance-measured body composition to BMI in a multi-ethnic population (Willett et al., 2006). As shown above, several studies have reported on the effect of demographic factors on MetS. Most of these studies have been conducted in countries with different demographics from that of Ghana. In Ghana, no known studies have examined the connection between demographic variables and MetS. Because of the unique demographic features of the Ghana, it is important to identify risk factors associated with Mets. Knowledge on the dietary and lifestyle impacts on metabolic syndrome may help to curb the situation at an early stage and reduce its effects thus the progression of type 2 diabetes and cardiovascular diseases.

Although the ideal study design for this study is cohort, cross sectional study was used due to inadequate resources and time. Routine screening for metabolic syndrome in patients is important in ensuring early detection of diabetes and hypertension to prescribe early treatment. This sought to fill this gap by accessing metabolic syndrome and associated factors among OPD patients in Kumasi Metropolis.

Future studies should examine the relationship between metabolic syndrome screening and early detection of non-communicable diseases in patients.

CHAPTER THREE

METHODOLOGY

3.1 Study Design

A descriptive cross-sectional study which was based in the health facilities was used for this study. This involved the selection of one hospital from each of the five sub-metros in Kumasi metropolis. Each hospital was assigned a quota of the sample size which was two hundred and twenty six (226) based on the average monthly outpatient attendance. With consent from patients, questionnaires which included demographic characteristics, dietary and lifestyle factors were administered to patients aged 35 – 69 who also represent risk group for metabolic syndrome in the Kumasi metropolis. clinical and anthropometric measurement were also done for all the respondents, plasma blood sample was collected from each respondents for analysis on fasting blood glucose and plasma triglycerides. The components of metabolic syndrome which includes hypertension, Elevated triglycerides, low density lipoprotein and high blood glucose were measured in each respondent.

3.1.1 Study population:

The target population for this study included out patients aged 35-69 years who sought care in the five Sub-metro hospitals in the Kumasi Metropolis at the time of contact. This age group are the risk group for metabolic syndrome.

3.1.2 Inclusion criteria

All Adult 35-69 years out patients who had not taken in any food or drinks (with the exception of water) 8-10hours at the time of contact were included in the study. This was because plasma glucose and lipid profile required a fasting plasma serum.

3.1.3 Exclusion

Pregnant women were exempted from the study. Pregnancy could be a confounder and may not give a true reflection of the outcome.

3.2 Background of the study area

The study was carried out in five Hospitals of the Kumasi metropolitan in the Ashanti Region.

Table 3: Population Distribution per Sub-Metro Health Areas

KUMASI METROPOLIS POPULATION PROFILE 2016						
	Asokw a	Bantam a	Manhyi a South	Manhyi a North	Subin	Metro
Total Population	536,354	531,840	335,589	331,664	227,06	1,962,50
Proportion of Total Population	27.33%	27.10%	17.10%	16.90%	11.57 %	100%

Kumasi is the most populated District of the Ashanti region and forms 36.2% of the total population of the Region. It is sub-divided into five sub-metros in terms of Health and ten sub-metros politically. The five sub-metros are Asokwa, Bantama, Manhyia North, Manhyia South and Subin sub-metros. There is one sub-metro hospital in each of the five sub-metros which is owned by the government, these hospitals serve as referral. These government hospitals are the head of offices of the various sub-metro. There are a total of about one hundred and seventy one health facilities (HF) which includes five government hospitals, six quasi government hospitals, four christian health hospitals, fifty private

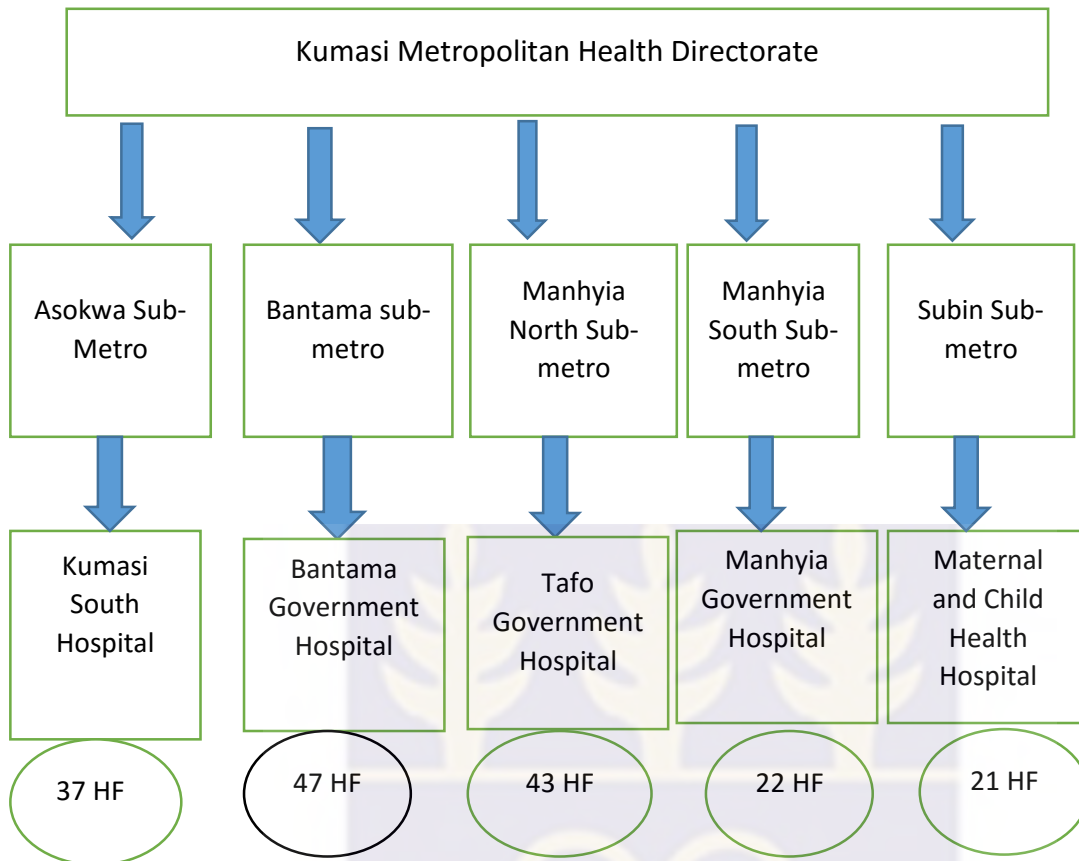
hospitals, sixty one private clinics, thirty seven maternity homes, six health centres and two CHPS compounds. Private laboratories 25, Pharmacy Shops 510, Chemical shops 672.

Table 4: Distribution of Health Facilities in Kumasi Metropolis.

HEALTH FACILITIES	NUMBER
Teaching Hospital	1
Government Hospitals	5
Government health centres	7
Quasi government	6
CHAG	4
Private hospitals	50
Private clinics	41
Maternity homes	37
Homeopathic/Acupuncture	20
CHPS compound	2
Total	173



Figure 2: Health Administrative Structure of the Kumasi Metropolis



3.2.1 Vegetation/Climate

The climate is typically wet equatorial with the major rainy season running from late February to early July and the minor from mid-September to early November. The dry season is at its peak in the months of December and January to 30°C in March. The vegetation can be described as mostly semi-deciduous forest with several valuable trees.

3.2.2 Occupation

Kumasi is a cosmopolitan city and trading is the main occupation of the inhabitants. Central Market (The largest Open Air Market in the Ecowas Sub-Region), Adum Shopping Centre (Heart Beat of Commerce), Suame and Asafo Magazines; and Kaase/Asokwa Industrial Area and Anloga Timber Products Markets are the main trading centres. There are other satellite trading centres located in the various sub-metros. The communities at the outskirts of Kumasi engage in farming activities.

3.2.3 Education

There are 2 public universities, 3 private universities, 1 polytechnic, 2 Teacher training colleges, 83 secondary schools and over 1,018 Basic schools. At the pre-school level, the private sector forms the bulk of these institutions.

3.4 Variables

Table 5: Study variables

Variable	Indicator	Measurement
Dependent Variable		
Metabolic Syndrome		Three or more of any of the clinical indicators indicates the presence of metabolic syndrome.
Independent Variables		
Demographic characteristics	age ,sex, educational level, ethnicity, marital status, occupation	Questions were asked
Anthropometric characteristics	Waist circumference height, weight, BMI	Tape measure, Seca scale was used in taking the waist circumference, height and weight of the respondents. BMI was measured as weight divided by the square of the height(W/h^2)
Lifestyle and dietary factors	inadequate physical activity, inadequate intake of fruits and vegetables, excessive sugar intake, excessive fat intake, excessive alcohol intake, smoking	Respondents were asked questions on physical activities done, adequacy of fruit and vegetable intake, smoking and intake of alcohol
Clinical	high blood pressure, low HDL, dysglycaemia, hypertriglyceridemia, central obesity	Systolic and diastolic BP were taken using sphygmomanometer, waist circumference was used to measure central obesity, dysglycaemia was measured using the test results of Erba glucose rapid test kit

3.4.1 Sample Size determination

Earlier study conducted among rural settlers in Ghana estimated the proportion of Mets as 15.0% using the NACEP ATP III criteria (Gyakobo et al 2012). Using a confidence level of 95% $Z_{\alpha/2}$ with a 5% margin of error ($d=0.05$) and a prevalence of 15%, and a non-response rate of 15%, a sample size of 226 was estimated for this study. This estimated proportion by the earlier study was used as a precision because it was the only study which considered a general population. Most of the studies conducted in Ghana were conducted among special groups who either had specific health conditions such as stroke and diabetes or with specific occupation such as banking. The total sample used for the study was 226 taking into consideration a presumed 15% non-response rate. A total of 103 males and 123 females participated in the study thus almost equal numbers of males and females took part in the study. The actual sample size (n) for the study was calculated as follows:

The Cochran sample size formula

$$n = (Z^2 * (pq) / d^2)$$

$$n = [(1.96)^2 * (0.15) (1-0.15)] / (0.05)^2$$

$$n = 195.9216 + 15\% (195.9216) = 226$$

Where n : sample size, $Z=1.96$ (constant) at 95% confidence level, $d= 0.05$, p (estimated proportion) = 15%, $q=1-p$, and 15% non-response rate.

3.4.2 Sampling Procedure

The five sub-metros were used as strata. One hospital was selected from each sub-metro based on availability of laboratory services and biomedical scientist, large OPD attendance and for the fact that they are referral points for most of the Health facilities within their catchment areas. Proportional allocation of respondents was utilized using the average monthly OPD attendance of the hospital for 2016 as shown by the table below.

Table 6: Allocated quota of sample size to hospitals

Sub-Metro	Hospital	Average monthly OPD attendants	Proportional allocation	Number allocated
Asokwa	Kumasi South Hospital	10155	28.1	64
Bantama	Kwadaso S.D.A Hospital	6412	14.1	32
Manhyia North	Tafo Hospital	6128	17.0	38
Manhyia South	Manhyia Hospital	11418	31.6	71
Subin	Maternal and Child Health Hospital	3313	9.2	21
Total				226

Questionnaire were administered to at most 22 respondents per day in each of the hospitals consecutively until the allocated quota for that facility was exhausted. The same research assistants with the exception of the laboratory personnel administered the questionnaire in the five hospitals. At the OPD unit of the hospital, on each day, consent was sought from the first 22 or less people who had taken their turn at the OPD table and met all the inclusion criteria to becoming a respondent. Questionnaire was then administered to them.

3.5 Data collection

Data collection started early in the morning at 7am each day. The questionnaire constituted socio-demographic variables, risk factor variables which included lifestyle and dietary behaviour and the components of MetS. Socio-demographic variables included age, gender, marital status, educational status, ethnicity and Occupation. The risk assessment included physical activity which was assessed using the American Heart Association assessment

criteria thus 30 min \geq 5 days of the week for moderate physical activity and 20 min of vigorous-intensity physical \geq 3 days per a week.

Smoking status was measured on daily, weekly or occasional smoking of any form of cigarette or secondary smoking. Daily, weekly, occasional and no intake of Fruits, vegetables, roughages, confectionaries and fatty meat/food were used to assess for dietary behaviour.

The weight and height of the respondents were taken by using a seca scale which has a measuring tape attached to it with respondents standing in an erect barefooted position with their arms by their side, and feet together, the weight and height of the respondents were taken at the same time.

Blood pressure was taken after respondents seated and rested for at least 5minutes using digital Sphygmomanometer with a cuff wrapped around the right arm, the sphygmomanometer took an average of a three reading and displayed the results of the systolic, diastolic and pulse reading after which respondents were given a paper card that bore an ID number which was different from the hospital patients ID but corresponded to that of the questionnaire, respondents took the ID to the hospital laboratory for blood samples to be taken for the glucose and biomedical analysis. Fasting blood glucose analysis was done with Erba glucose rapid test kit. With the biochemical analysis, 3-4mls of venous blood was taken from respondents who were under fasting into a serum separator tube. Blood was allowed to clot and spun with a centrifuge to separate the serum from the plasma, a chemical analyser selectra pro S machine was programmed with identifications of sample such as questionnaire number also used as laboratory numbers, sex and age. The machine was calibrated with Elical-2 and controls set with Elitro I and Electrol II. Serum sample was

placed in a sample cup and into the machine and the start button was clicked on. The results of the test were displayed for print.

3.6 Data Processing and Analysis

After the data collection, the data was validated and captured into SPSS version. The data was then exported to Stata version 14 software for analysis.

Descriptive statistics – mean and standard deviation of continuous variables were determined. Frequencies and proportions of categorical variables were also measured. Chi-square test was applied to establish the association between each of the independent variables and the dependent variable (MetS). All the variables that had significant p-values in the chi2 test were included in the logistic regression model. Variables that were not significant in the chi2 test were not included in the logistic regression model. Multiple logistic regression test results was not possible as a result of collinearity. Odds Ratio (OR) were determined for the independent variables and statistical significance was set at a 5 % probability level ($P \leq 0.05$).

3.7 Ethical Consideration

Ethical approval for the study was obtained from the Ghana Health Service Ethical Review Board. In addition, introductory letters from the School of Public Health, University of Ghana-Legon were given to the Metropolitan Health Directorate and the five hospitals that were included in the study for to seek for permission before the study was carried out.

3.7.1 Consenting process

Consent was sought from all participants during which the purpose of the study and the merits of its outcome were communicated to them. Informed consent was developed based on the World Health Organization (WHO) guidelines and contained information detailing the researcher's background and contact information, purpose of the study, procedure, confidentiality, risk, voluntary participation and benefits of participating in the study and a certificate of consent which was signed and/or thumb printed by participants to indicate their willingness of participation. The participants were duly informed about the purpose, procedures, risks and benefits of participating in the study in either Akan language or English depending on the choice of the participants. There was no conflict of interest in this study on the part of the investigator.

3.7.2 Potential risk/ Risks and Benefits

The study did not cause any risk to the participants because all standard procedures were used for all anthropometric, clinical and also for the biochemical test. All procedures were duly explained to respondents prior they were done. It is hoped that the results obtained for this study will be used by policy makers and the Metropolitan Health Directorate in particular to improve upon existing health service delivery. Respondents benefited by knowing their BMI and plasma glucose levels with regards to Mets which will motivate them to adopt lifestyles that will help prevent the development of type 2 diabetes and cardiovascular diseases or to reduce risk of dying in case one already had these conditions.

3.7.3 Right to refusal

Participation in this study was voluntary and participants chose not to answer any particular question or all questions. They were at liberty to withdraw from the study at any time.

3.7.4 Confidentiality

The identity of all those involved in the interviews were kept confidential. Confidentiality of information shared and results obtained was also guaranteed before participants were engaged in the study. Participants were assured that there were no consequences like, loss of benefit or withdrawal from the study. Only the researcher, the research assistants and the project supervisor had access to the data.

3.7.5 Compensation

Each respondent was refreshed at the end of the laboratory session. This research was funded solely by the principal investigator.

3.7.6 Quality Assurance

To ensure quality control, Nurses and laboratory personnel's who were used as research assistants were trained before assisting with the administration of the questionnaire, blood samples and biochemical analysis were performed by the laboratory personnel. The training was done to ensure that the research topic, objective the sensitivity of the topic and the need for confidentiality of data collected were understood by the research assistants and also be adequately equipped to undertake the data collection.

The Data collection tool was pre-tested in Suntreso Hospital prior to the data collection. Adjustment were made on the lifestyle and dietary assessment after the pre-testing based on problems uncouncted during the pretesting. Supervision was carried out by the principal investigator during the entire period of the field work.

3.7.7 Data storage and usage

The data collected from respondents was used for academic and research purposes only. The data will be stored for one year from the time of collection before discarding.

3.7.8 Dissemination of findings

The results of this research will be submitted to the School of Public Health in partial fulfilment of the requirements for the award of a Master of Public Health degree. A copy will also be delivered to the Metropolitan Health Directorate, Kumasi.



CHAPTER FOUR

RESULTS

This chapter presents the results of the study on demographic characteristics of respondents, components of MetS as well as dietary and lifestyle factors of MetS. The results had been presented depending on the nature of the variables. In frequencies, means and standard deviation using both tables and figures. Descriptive and inferential analysis in the form of chi-square, simple and multiple logistic regressions were conducted and the results presented in this section.

Table 7: basic characteristics of respondents by sex

Variable	Mean \pm standard deviation			P-value
	male(n=103)	Female(n=123)	Total	
Age	47.19 \pm 9.9	49.4 \pm 10.5	48.7 \pm 10.2	0.268
Waist circumference	35.5 \pm 5.7	36.0 \pm 6.1	35.8 \pm 5.9	0.548
Sysbp	123.5 \pm 10.6	125.9 \pm 20.6	124.8 \pm 18.9	0.335
Diabp	77.5 \pm 11.3	80.2 \pm 14.2	78.8 \pm 13.0	0.131
Trig	38.8 \pm 37.6	40.6 \pm 40.4	39.8 \pm 39.0	0.735
HDL	30.6 \pm 18.1	27.1 \pm 9.00	28.7 \pm 14.0	0.062
Glucose	85.1 \pm 49.6	109.6 \pm 51.0	-24.5	<0.001

*P-values from a 2-tailed test which compares the mean values stratified by sex of selected determinants of metabolic syndrome (MS) waist circumference; Sysbp: systolic blood pressure; diabp: diastolic blood pressure; Glucose: fasting plasma glucose; HDL: high density lipoprotein, Trig: triglycerides.

Figure 3: Overall prevalence of MetS among study group

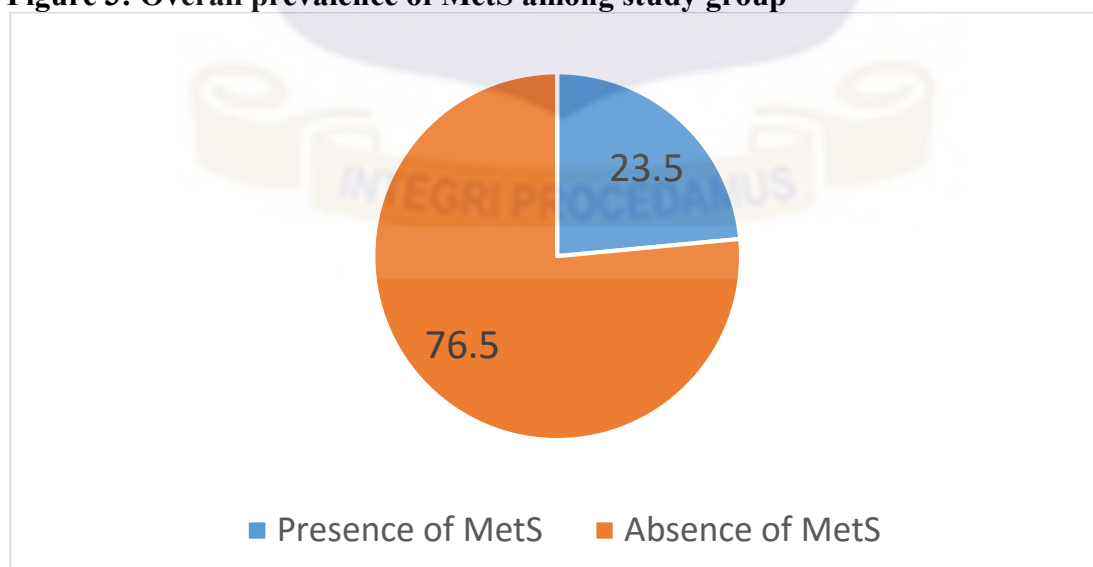
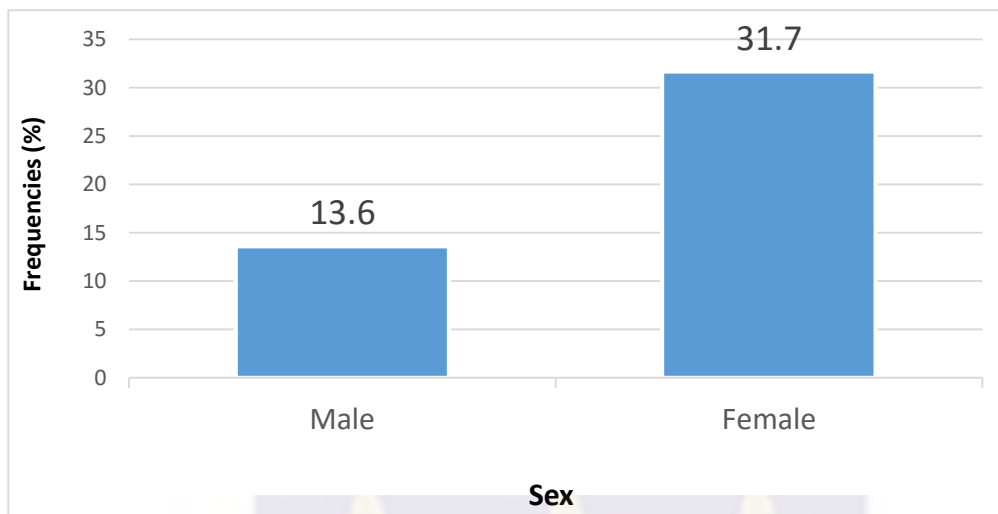


Figure 4: Prevalence of Metabolic Syndrome by Sex



Among sexes, females had been more (31.71%) frequently diagnosed with MetS than males (13.59%) with a statistically significant relation ($P= 0.001$).



The presence of MetS increased with increasing age, prevalence was high among age group 60 years and above as compared to age group 45 to 59 years which was also higher than age group 35 -44years. This was statistically significant ($P=0.043$).

Table 8: Comparison of socio-demographic variables in all the study subjects

Variable	No MetS n(%)	MetS n(%)	Total No of respondents N=226 (%)	P-Value
Sex				
Male	89 (86.4)	14 (13.6)	103(45.6)	0.002*
Female	84(68.3)	39(31.7)	123(54.4)	
Age				
35 to 44	74(83.2)	15(16.9)	89(39.4)	0.043*
45 to 59	74(76.3)	23(26.5)	97(42.9)	
≥60	25(62.5)	15(32.4)	40(17.7)	
Marital Status				
Single	40(90.9)	4(9.09)	44(19.5)	0.042*
Married	100(73.5)	36(26.5)	136 (60.2)	
Divorced	23(67.7)	11(32.4)	34(15.0)	
Cohabiting	10(83.3)	2(16.7)	12(5.3)	
Educational status				
No education	51(90.0)	12(19.1))	63(27.9)	0.230
Primary	54(68.4)	25(31.7)	79(35.0)	
Secondary	47(79.7)	12(20.3)	59(26.1)	
Tertiary	21(84.0)	4(16.0)	25(11.1)	
Occupation				
Unemployed/Pensioners	18(58.1)	13(41.9)	31(13.7)	0.816
Trading	78(74.28)	27(25.71)	105(46.5)	
Public/Civil/Other White collar job	32(84.2)	6 (15.8)	38(16.8)	
Farming	11(73.3)	4(33.3)	15 (6.6)	
Artisan	32(86.5)	5(13.5)	37(16.4)	
MS Syndrome	173 (76.6)	53(23.5)	226	

*Chi2 Test for Demographic variable, Frequencies in brackets

There was association between sex and the presence of MetS ($P= 0.001$), with high proportions in females (31.7%) than males (13.6%). Age group also showed a significant association with the presence of MetS ($P= 0.043$). A significant association was also recorded between marital status and the presence of Mets ($P= 0.042$), with married having high prevalence (67.9%), followed by divorced (32.4%), cohabiting (16.7%) and single reporting the least prevalence (9.1%). The prevalence of MetS was higher in primary educational (31.7%) followed by secondary education (20.3%), no education (19.1%) with tertiary education recording the least prevalence (16.0%) however this relationship was not

statistical significant (P= 0.230). occupation had no significant association with the presence of MetS (P= 0.816).

Table 9: Comparison of risk factors in all the study subjects.

	No MetS n(%)	MetS n(%)	Total	P- Value
Physical Activity				
Adequate	72(73.46)	26(26.53)	98	0.753
Inadequate	85(75.89)	27(24.41)	112	
Dietary Habit				
Fruits intake				
Adequate	104(73.76)	37(26.24)	141	0.382
Inadequate	53(76.81)	16(23.19)	69	
Vegetable Intake				
Adequate	105(73.94)	37(26.06)	142	0.415
Inadequate	52(76.47)	16(23.53)	68	
Confectionaries/fatty food and meat				
Excessive intake	52(74.29)	18(25.71)	70	0.519
No/Moderate intake	105(75)	35(25.00)	140	
Smoking Status				
Smoke/Secondary smoking	53(100.0)	--	53	0.230
No smoking/ Secondary smoking	120(69.3)	53(25.95)	173	
Alcohol Intake				
Excessive intake	22(78.6)	6(21.4)	28	0.380
No/moderate intake	135(74.2)	47(25.8)	182	
*Chi2 Fishers Exact test for demographic variable				

We were not able to significant detect between MetS and physical activity, dietary habit, alcohol intake and smoking.

Adequate Physical activity reported higher proportions of MetS (26.53%) than inadequate physical activity (24.41%), MetS among respondents who take in adequate fruit and

vegetables was rather higher than among those who take inadequate fruits and vegetables. Fruits (26.2%, 23.2%) Vegetables (26.1%, 23.5%) respectively. There was almost same proportion of Mets among respondents who take in excessive confectionaries/fatty foods and those who took it in moderation. (25.7, 25.0%) respectively. Excess alcohol intake reported a lower proportion of Mets than no/moderate alcohol intake group.

Table 10: Comparison of all the components of MetS in the study subjects

Component of MS	MetS		Total	P-Value
	No MetS n(%)	n(%)		
Hypertension	15(28.85)	37(71.15)	52	<0.001
Obesity	43 (49.4)	44 (50.6)	87	<0.001
Low HDL	160(75.47)	52(24.53)	212	0.197
Dysglycaemia	23(38.33)	37(61.67)	60	<0.001

From table 10, Hypertriglyceridemia was not reported in any of the respondents. With the four other components of MetS, Low HDL was protective of MetS, with 75.47% among people with Low LDL but 24.53% among people without low HDL. Hypertension, Dysglycaemia and obesity recorded a significantly higher proportion of MetS 71.15%, 61.67% and 50.6% respectively.

Table 11: Simple logistic regression/multiple logistics regression of variables

Variable	Crude			Adjusted		
	OR	CI	P value	AOR	CI	P-value
Gender						
Male	Ref					
Female	2.95	1.49 – 5.82	0.002	2.76	1.37-5.57	0.005*
Age						
35-44	Ref					
45-59	1.533	0.74 – 3.17	0.248	1.249	0.570 - 2.69	0.528
≥60	2.96	1.27 – 6.91	0.012	2.15	0.800 - 5.448	0.100
Marital Status						
Single	Ref					
Married	3.60	1.20 – 10.78	0.02	3.15	1.02 - 9.81	0.048*
Divorced	4.78	1.36 – 16.76	0.014	3.18	0.84-12.01	0.087
Cohabiting	2.00	0.32 – 12.51	0.4	2.908	0.45 - 19.00	0.265

*represents significant p-values

The simple and multiple logistic regression shows that females has about 3times high odds of developing MetS over their male counterparts (AOR=2.76, 95% CI=1.37.5.57) there is a high odds in having MetS with advancing age this is significant with people who are 60 years and above . However, this is not statistically significant for age group 45-59 years. There is also a high odds of the presence of MetS among married as compared to the singles.

Table 12: logistics regression of components of MetS

Components of MS	Crude		P-value
	OR	CI	
Hypertension	24.35	11.05 -53.68	<0.001
Obesity	12.96	5.83 -28.79	<0.001
Low HDL	4.23	0.54 – 33.07	0.195
Dysglycaemia	15.081	7.23 – 31.37	<0.001

The simple logistic regression model revealed that all other component of MetS aside low HDL which was not significantly associated with MetS and hypertriglyceridemia which was not reported in the study, all other components were significantly associated with MetS, with hypertension having a higher odds (OR=24.35, 95% CI=11.053- 53.670, p<0.001),

followed by dysglycaemia (OR=15.08, 95% CI=7.23 – 31.37, $p<0.001$), and obesity (OR=12.96, 95% CI=5.83 -28.79, $p<0.001$). Adjusted odds could not be determined by the multiple logistic regression model as a result of collinearity.



CHAPTER FIVE

DISCUSSION

5.0 Summary of key findings

5.1 Prevalence of metabolic syndrome

This study was designed to measure the prevalence of out patients with MetS and the risk factors associated with MetS among this population. A number of studies reported different prevalence among different population. Gyakobo et al. (2012) reported an incidence of 35.9% using the International Diabetes Federation (IDF) criteria and 15.0% using the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) in a rural community

A total of 226 people were used for this study with males forming 45.6% and females 54.4%. The overall prevalence of MetS by the NACEP-ATP III criteria reported for this study was 23.5 %. This is within the world prevalence range of 20-25% (Balakumar et al. 2016). It is however, lower than that discovered by Arthur (2013) using the same criteria and higher than that reported by Gyakobo (2012). This prevalence again is in line with that of Salaroli et al. (2013) that available evidence indicates that in most countries, 20% to 30% of the adult population can be characterized as having Mets.

5.2 Demographic factors and metabolic syndrome

Among the demographic factors, sex and marital status played a vital role in the development of MetS. Educational status and occupation had no significant association with MetS in this study. The prevalence of MetS was 13.6% in males and 31.7% in females. This difference was statistically significant ($P=0.001$). The multiple logistic regression also showed a significant odds of having MetS among females compared to males (AOR = 2.76, 95% CI = 1.37-5.57, $P=0.005$).

The sex distribution of metabolic syndrome for this study is contrary to that of the National health statistics reports (NHSC, 2009). According to this report, there is no significant difference in the prevalence by sex. Another study by Kaur, (2014) resulted in higher prevalence in females (57.4%) than in males (42.6%) which is in line with the findings of this study. This could be as a result of the hormonal changes example oestrogen especially with women which affects metabolic changes which is a significant factor in MetS.

From the descriptive statistics of this study, the mean age of respondents for this study was 47.19 for males \pm 9.9 standard deviation and 49.4 \pm 10.2 standard deviation for females. MetS was prevalent with advancement in age. A chi-square test of age groupings showed that individuals aged 60 years and above group had high prevalence (37.5%) compared to the 45 -59 years (23.7%) and 35-44 years prevalence of MetS (16.9%) at a significant ($P=0.043$).

The multiple logistic analysis of age controlling for other demographic factors and using age group 35-44 as a reference resulted in an increasing odds of 1.25 among age group 45-59 and 2.69 among age 60 years and above which was not significant (AOR 24.55, 95% CI=0.53-53.67; $P=0.528$). This finding is contrary to Redon, et al. (2008) which shows that the prevalence of the metabolic syndrome itself is also increasing, at nearly 28% in the 2000 survey, with a progression in age. The difference could be due to the facts that out patients were used for this study. Another study suggests that fasting glucose, diabetes and systolic blood pressure (SBP) have a direct relationship with age and BMI, the prevalence of diabetes and hypertension which are components of metabolic syndrome increases with age which also increases the incident of metabolic syndrome (Alexander et al. 2007).

Marital status had an association with MetS. According to this study, people who were divorced had the highest proportion (32.4%) of metabolic syndrome, married people recorded the second highest proportion 26.5% followed people who were in co-habitation

and singles reported the least prevalence. The odds of having MetS for married was 3.15 high the odds of being single. In a study by Wendy and Troxel (2008), widows had higher odds in MetS (5.82) followed by married (3.17) and single and divorced having the least (2.84). The study associated satisfaction in marriage to low risk of MetS. 27.9% of the respondents had no education, 35.5% had primary education, 26.1% had secondary education and 11.1% had tertiary education.

People who had tertiary education had the lowest proportion (16.0%) of MetS and primary education recorded the highest 31.65% prevalence of Mets. With the exception of tertiary education, there was an inverse prevalence comparing no education to secondary education. However, this was not statistically significant ($P = 0.230$).

Most respondents (46.5%) were traders. 13.7% of the study group were either unemployed or pensioners, 16.8% were into white coloured jobs such as public and civil servants, financial institutions, security services or pensioners, etc most of which requires less physical activity. Artisans were 16.4% and farmers being the least represented (6.6%) of the respondents. Overall prevalence of MetS was higher among the unemployed/pensioners' 41.9%. Farmers and traders had almost the same prevalence 26.7% and 25.7% respectively. White coloured job employees had higher prevalence over that of artisans 15.8% and 13.5% respectively. In spite of these differences in prevalence, there was no statistical evidence to say that occupation is associated with MetS ($P = 0.816$).

5.3 Lifestyle factors and metabolic syndrome

Life style factors that were looked at in this study are physical activity, smoking and alcohol intake. Using the American college of sports medicine and the American heart association, measurement, thus, 30min of moderate intensity physical (≥ 5 days) per week or 20min of vigorous intensity physical (≥ 5 days) per week. Any physical activity below this range was

classified as inadequate physical activity. Approximately 46.7% of respondents had adequate physical activity while most (53.3%) had inadequate physical activity. Higher prevalence of MetS was recorded among people with adequate physical activity 26.5% than those with inadequate 24.1% ($P= 0.753$). In this study, physical activity was not associated with MetS. This is contrary to a study which identified diet and exercise patterns as contributing to the development of MetS (Amato *et al.*, 2013). Majority (76.5%) of the study group did neither smoke nor expose to smoking environment compared to 23.5% who smoked. Among the non-smokers, 25.9% had MetS while no MetS was not found among the smokers ($P= 0.230$). This study did not establish any association between smoking and MetS. Limiting alcohol and avoiding smoking can reduce most of the metabolic risks in both men and women (Azadbakht *et al.*, 2005). Alcohol intake was categorised into excessive intake and no/moderate intake, daily drinking was measured categorised as excessive and not at all, weekly and occasionally were categorised as moderate intake. Majority of respondents (69.5%) either took alcohol in moderation or did not drink alcohol and 23.5% of respondents were excessive alcohol drinkers. Prevalence of MetS among alcohol users was 21.4% while prevalence among non-alcohol users was 25.8%. However, this association was not statistically significant ($P= 0.380$). This concur with a study by Azadbakht *et al.* (2005) which shows that limiting alcohol and avoiding smoking can reduce most of the metabolic risks in both men and women. The larger sample size used by Azadbakht and the difference in the geographical location of the study may have contributed to the difference in the results. Dietary habits were assessed in line with the behavioural risk factor surveillance system (the fruit and vegetable module) United state department of Agriculture and the National cancer institute NCI. Daily intake of fruits, vegetables and roughages was considered as adequate intake, weekly and occasional intake were considered as inadequate intake. With confectionaries and fatty foods, Daily intake was considered as

excess intake, while weekly and occasional intakes were considered as moderate intake. More than half (67.1%) of the respondents had adequate intake of fruits and 32.9 % had inadequate intake. Almost the same prevalence of Mets was recorded among these group 26.4 for adequate intake and 23.2% for inadequate intake (P= 0.082).

For vegetables, frequencies and prevalence recorded for adequate and inadequate intake was similar to that of the fruit intake. Thus adequate intake 67.6% of sample to a prevalence of 26.0% and inadequate 32.3% to 23.5% prevalence at a (P= 0.415). People who took confectionaries/fatty foods in moderation formed 66.7% of the sample group, while the excess group formed 33.3%. Almost the same prevalence was recorded for the moderate and excess group 25.0% and 25.7% respectively (P=0.519). The study therefore showed no association between dietary habits and MetS as measured by Lutsey et al. (2008), that showed that dietary consumption of a western dietary pattern, meat, fried foods, and diet soda was adversely associated with incident Metabolic Syndrome.

5.4 Components of Metabolic Syndrome

Five components of MetS were used for this study, these include central obesity, high blood pressure, (hypertension), depressed High density lipoprotein (low HDL), high glucose levels (Dysglycaemia) and high triglyceride levels (hypertriglyceridemia).

All the five components were measured in each of the respondents and categorised as presence or absent in an individual. The NCEP-ATPIII criteria which is the presence in an individual any three of the five components was used as a measure. A chi-square analysis showed a statistically significant association between MetS and obesity, hypertension, dysglycaemia, and low HDL respondents (P=0.001). There was no hypertriglyceridemia in the study population. Approximately 23.0% of the respondents had a high BP, and 77.0% had a normal BP. Prevalence of MetS among those with high BP was 71.5% (P=0.001).

This was higher than a study conducted among hypertensive patients in Spain which recorded a prevalence of 40.0% with the IDF criteria (Sierra *et al.* 2006), In India, very high prevalence of MetS was associated with ex-servicemen with high BP (98.4%) (Jaspinder *et al.* 2014). Another study in Ghana by Gyakobo (2013) identified 39.5% prevalence among rural settlers which is lower than this current study. From Table 12, a logistic regression revealed a significant higher odds 24.35 of MetS among hypertensive group compared to the non-hypertensive, hypertension also formed the major contributing component of MetS among the study group (OR 24.35, 95% CI=11.053-53.670 P<0.001). This is in line with the study in Ghana which was conducted in Komfo Anokye teaching hospital which also identified high blood pressure as the major component of MetS. Another study identified hypertension as the second major component (Gyakobo *et al.*, 2013) but there was difference in the population group thus the study by Gyakobo was carried out in the communities among healthy people while this study was carried out in the hospital among people with ill health.

Approximately 41.4% of respondents were obese and prevalence of MetS in obese was higher (50.6%) than among the non-obese (7.32%) at a statistically significant value (P=0.001). The 50.6% prevalence recorded by this current study concurs with that of a study by Jaspinder (2014) (59.0%) in India and 55.3% in Ghana among rural settlers. This implies that no much difference was observed among rural and urban settlers of Ghana with respect to obesity and MetS, this could be as a result of the growing sedentary lifestyles in both rural and urban areas. From Table 12, a logistic regression showed a significant higher odds 12.96 of MetS among obese group compared to the non-obese, obesity also formed the third major contributing component of MetS among the study group (OR 12.96, 95% CI=5.83-28.79 P<0.0001). Obesity has placed either first or second in many studies, for instance in the study by Gyakobo *et al.* (2013) and Alexander *et al.*, (2007) central obesity was found to be the highest contributing component respectively while the Nsiah study carried out at

KATH identified obesity as the second major component. In all these studies, obesity was associated with metabolic syndrome. This may owe to the fact that obesity is also associated with many other conditions which includes other components of MetS.

Approximately 27.3% of the respondents were dysglycaemic and prevalence of MetS among this group was higher (61.7%) than among those with normal glucose levels (9.64%) at a statistically significant value ($P, < 0.001$), a logistic regression revealed a significant higher odds 15.08 of MetS among dysglycaemic group compared to the non dysglycaemic, this condition was also found to be the second major component contributing to MetS among formed the second major contributing component of MetS among the study group (OR 15.08, 95% CI=7.249 -31.370 $P<0.0001$).

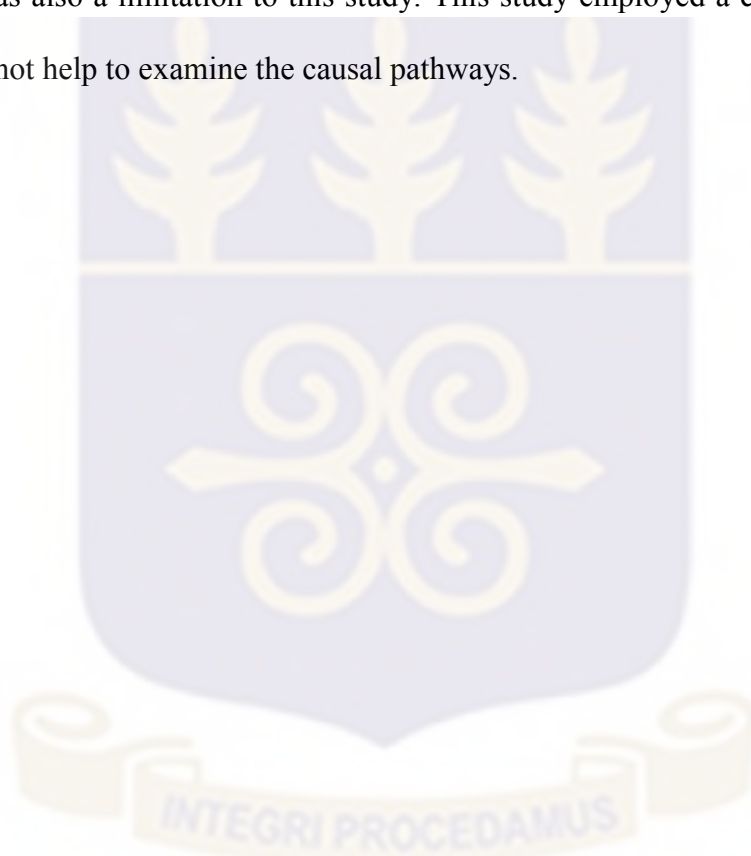
Almost all the respondents 93.8% had low HDL and prevalence of MetS in low HDL was (24.5%) than among those with normal HDL 7.1% ($P = 0.0001$). this study recorded lower prevalence of MetS among people with low HDL than was recorded in the other studies 42.7% (Gyakobo et al., 2013) and 33.3% (Bello et al., 2013) logistic regression revealed a significant higher odd 4.23 of MetS among low HDL group compared to the normal HDL. Low HDL and contributed the least of MetS among the study group (OR 4.23, 95%CI=0.539 -33.070 $P<0.0001$).

This study results concur with many other studies with exception of triglycerides which was not found among the study group and low HDL which showed a lower contribution as compared to many other studies. Komfo Anokye Teaching Hospital in Kumasi established that high blood pressure was the commonest risk factor, followed by central obesity and dyslipidaemia among the participants with Type 2 diabetes mellitus (T2DM) (Nsiah, et al., 2015). Indications further suggest that MetS is a well-known incidence among people with

T2DM (Eckel et al., 2005). In the study by Mawuli Gyakobo, central obesity, high blood pressure and low HDL were most prominent components for MetS.

5.5 Limitations of the Study

The cost for the biochemical analysis and the time frame for the study did not allow for a large sample size than what was used. As part of the study, Patients were made to recall their dietary pattern, physical activities, alcohol consumption and exposure to smoke. Hence recall bias was also a limitation to this study. This study employed a cross sectional data which could not help to examine the causal pathways.



CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The findings of the study showed a high prevalence of metabolic syndrome. Gender, Age, and marital status were significantly associated with metabolic syndrome with females being more prevalent than males. An increase in prevalence with advancing age was also recorded in this study. A significant prevalence in hypertension (71.5%; $p < 0.001$), dysglycemia (61.67%; $p < 0.001$), and obesity (50.57%; $p < 0.001$) was reported in MetS. Lifestyle and Diet were not associated with metabolic syndrome in this population.

6.2 Recommendations

- Community-based interventions such as periodic screening campaigns should be undertaken in the Metropolis to help in early detection of MetS
- Routine screening and counselling of patients in the hospitals especially with hypertensive, diabetics and obese patients, should also be incorporated in the service provision and cost should be boreed by the NHIS scheme.
- Education should be done on various media to create public awareness on MetS syndrome.
- Further research using more sample size and adding other measure for dietary and lifestyle assessment would be needed.

REFERENCES

- Allison, D.B., Zhu, S.K., Plankey, M., Faith, M.S., & Heo, M. (2002). Differential associations of body mass index and adiposity with all-cause mortality among men in the first and second National Health and Nutrition Examination Surveys (NHANES I and NHANES II) follow-up studies. *Int J Obes Relat Metab Disord*, 26(3), 410-6.
- Addo, J., Amoah, A.G., & Koram, K.A. (2006). The changing patterns of hypertension in Ghana: a study of four rural communities in the Ga District. *Ethn Dis*; 16(4), 894-9.
- Amoah, A.G.B. (2003). Hypertension in Ghana: A Cross-Sectional Community Prevalence Study in Greater Accra. *Ethn Dis*; 13(3), 310-5.
- Alberti, K.G., Zimmet, P., & Shaw, J. (2005). The metabolic syndrome - a new worldwide definition. *Lancet*; 366, 1059-62.
- Ashwell, M., & Hsiehm, S.D. (2005). Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *Int J Food Sci Nutr*; 56(16236591), 303-7.
- Balakumar, P., Arora, M.K., Ganti, S.S., Reddy, J., & Singh, M. (2009). Recent advances in pharmacotherapy for diabetic nephropathy: current perspectives and future directions, *Pharmacol. Res.* 60, 24–32.
- Bello-rodriguez, B. M., Sanchez-cruz, G., Delgado-bustillo, F., & Asiama, G. (2013). The relationship between metabolic syndrome and target organ damage in Ghanaian with stage-2 hypertension: *Ghana Medical Journal*, 47(4).
- Bhurosy, T. and Jeewon, R. (2014). Overweight and Obesity Epidemic in Developing Countries: A Problem with Diet, Physical Activity, or Socioeconomic Status: *Scientific World Journal*. 2014: 964236.
- Bouche', C., Rizkalla, S.W., Luo, J., Vidal, H., Veronese, A.,... Slama, G. (2002). Five-week, low-glycemic index diet decreases total fat mass and improves plasma lipid profile in moderately overweight nondiabetic men. *Diabetes Care*, 25, 822–828.
- Can AS, Bersot TP, Gonen M, et al. (2009). Anthropometric indices and their relationship with cardiometabolic risk factors in a sample of Turkish adults. *Public Health Nutr*; 12(4):538-46.
- Canoy, D. (2010). Coronary heart disease and body fat distribution. *Curr Atheroscler Rep*, 12(2), 125-33.
- Caprio S. (2011). Type 2 Diabetes in Youth: Epidemiology and Pathophysiology. *Diabetes Care*, 34(Supplement 2): S161-S165
- Cappuccio, F.P., Micah, F.B., Emmett, L., Kerry, S.M., Antwi, S., & Martin-Peprah, R. (2004). Prevalence, Detection, Management, and Control of Hypertension in Ashanti, West Africa. *Hypertension*; 43, 1017-22.

- Daly, M.E., Vale, C.V., Walker, M., Alberti, K.G., & Mathers, J.C. (1997). Dietary carbohydrates and insulin sensitivity: a review of the evidence and clinical implications. *Am J Clin Nutr* 66, 1072–1085.
- Diabetes Atlas, second edition, International Diabetes Federation, (2003).
- Ford, E.S., Giles, W.H., & Dietz, W.H. (2002). Prevalence of the metabolic syndrome among U.S. adults: findings from the Third National Health and Nutrition Examination Survey. *JAMA*, 287, 356–359.
- Ford, E.S., & Liu, S. (2001). Glycemic index and serum high-density lipoprotein cholesterol concentration among us adults. *Arch Intern Med*, 161, 572–576.
- Foster-Powell, K., Holt, S.H., & Brand-Miller, J.C. (2002). International table of glycemic index and glycemic load values: 2002. *Am J Clin Nutr*, 76, 5–56.
- Ghana Health Service, DHIMS report (2015)
- Goran, M.I. (1998). Measurement issues related to studies of childhood obesity: assessment of body composition, body fat distribution, physical activity, and food intake. *Pediatrics*, 101(3 Pt 2), 505—18.
- Groop L (2000). Genetics of the metabolic syndrome. *Br J Nutr* 83 (Suppl. 1):S39–S48.
- Global Report on Diabetes, (2016). World Health Organization, <http://www.who.int/diabetes/global-report/en/>
- Ho, S.Y., Lam, T.H., & Janus, E.D. (2003). Waist to stature ratio is more strongly associated with cardiovascular risk factors than other simple anthropometric indices. *Ann Epidemiol*; 13(10), 683—91.
- Isomaa, B., Almgren, P., Tuomi, T., Forsen, B., Lahti, K., Nissen, M., Taskinen, M.R., & Groop, L. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care*, 24, 683-9.
- Jaffrin, M.Y. (2009). Body composition determination by bioimpedance: an update. *Curr Opin Clin Nutr Metab Care*, 12 (19494768), 482-6.
- Jenkins, D.J., Wolever, T.M., Taylor, R.H., Barker, H., Fielden, H.,...Goff, D.V. (1981). Glycemic index of foods: a physiological basis for carbohydrate exchange. *Am J Clin Nutr*, 34, 362–366.
- Jeppesen, J., Schaaf, P., Jones, C., Zhou, M.Y., Chen, Y.D., & Reaven, G.M. (1997). Effects of low-fat, high-carbohydrate diets on risk factors for ischemic heart disease in postmenopausal women. *Am J Clin Nutr*, 65, 1027–1033.
- Jimenez-Cruz, A., Bacardi-Gascon, M., Turnbull, W.H., Rosales-Garay, P., & Severino-Lugo, I. (2003). A flexible, low-glycemic index Mexican-style diet in overweight and obese subjects with type 2 diabetes improves metabolic parameters during a 6-week treatment period. *Diabetes Care*, 26, 1967–1970.

- Kaur, J.(2014). Assessment and Screening of the Risk Factors in Metabolic Syndrome: *Med. Sci* 2,140-152
- Lawrence, W., Alan S. G., Bauman, M. A., King, S. M. C., Fonarow, G. C. Williams, K. A. Sanchez, E. (2014). An Effective Approach to High Blood Pressure Control: Hypertension; 63:878-885
- Lidfeldt, J., Nyberg, P., Nerbrand, C., Samsioe, G., Schersten, B., & Agardh, C.D. (2003). Socio-demographic and psychosocial factors are associated with features of the metabolic syndrome: the Women's Health in the Lund Area (WHILA) study. *Diabetes Obes Metab*, 5, 106–112.
- Liu, S., Manson, J.E., Stampfer, M.J., Holmes, M.D., Hu, F.B., Hankinson, S.E., & Willett, W.C. (2001). Dietary glycemic load assessed by foodfrequency questionnaire in relation to plasma high-density-lipoprotein cholesterol and fasting plasma triacylglycerols in postmenopausal women. *Am J Clin Nutr*, 73, 560–566.
- Ludwig, D.S., Pereira, M.A., Kroenke, C.H., Hilner, J.E., Van Horn, L.,...Jacobs, D.R. Jr. (1999). Dietary fiber, weight gain, and cardiovascular disease risk factors in young adults. *JAMA*, 282, 1539–1546.
- Mayo, P. (2016). An overview of diabetes, *Nurs. Stand.* 30, 53–63.
- Marshall, J.A., Bessesen, D.H., & Hamman, R.F. (1997). High saturated fat and low starch and fibre are associated with hyperinsulinaemia in a non-diabetic population: the San Luis Valley Diabetes study. *Diabetologia*, 40, 430–438.
- Mckeown, N. M. Meigs, J. B. Liu, S. Saltzman, E. Wilson P.W.F. Jacques P F. (2004). Carbohydrate Nutrition, Insulin Resistance, and the Prevalence of the Metabolic Syndrome in the Framingham Offspring Cohort: *Diabetes Care* 27:538–546
- McKeown, N.M., Meigs, J.B., Liu, S., Wilson, P.W., & Jacques, P.F. (2002). Whole-grain intake is favourably associated with metabolic risk factors for type 2 diabetes and cardiovascular disease in the Framingham Offspring study. *Am J Clin Nutr*, 76, 390–398.
- McKinsey Global Institute [MGI]. (2014). overcoming obesity: An initial economic analysis.
- Meyer, K.A., Kushi, L.H., Jacobs, D.R., Jr., Slavin, J., Sellers, T.A., & Folsom, A.R. (2000). Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. *Am J Clin Nutr*, 71, 921–930.
- Mittendorfer, B., & Sidossis, L.S. (2001). Mechanism for the increase in plasma triacylglycerol concentrations after consumption of short-term, high-carbohydrate diets. *Am J Clin Nutr*, 73, 892–899.
- Mozaffarian, D., Benjamin, E.J., Go, A.S., Arnett, D.K.,..... Turner, M.B. (2016) American Heart Association Statistics Committee and Stroke Statistics

- Subcommittee. Executive Summary: Heart Disease and Stroke Statistics-2016 Update: A Report From the American Heart Association, *Circulation*, 133, 447–454.
- Pereira, M.A., Jacobs, D.R. Jr., Van Horn, L., Slattery, M.L., Kartashov, A.I., & Ludwig, D.S. (2002). Dairy consumption, obesity, and the insulin resistance syndrome in young adults: the CARDIA Study. *JAMA*, 287, 2081–2089.
- Raman, R., Gupta, A.S. Pal, S.S., Ganesan, S., Venkatesh, K., Kulothungan, V., & Sharma, T. (2010). Prevalence of Metabolic Syndrome and its influence on microvascular complications in the Indian population with Type 2 Diabetes Mellitus. Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetic Study (SN-DREAMS, report 14): *Diabetology & Metabolic Syndrome*, 2, 67
- Redon, J. Cifkova, R. , Laurent, S. Nilsson, P. Narkiewicz, K. Erdine, S. and Mancia, G. (2008). The metabolic syndrome in hypertension: European society of hypertension position statement: *Scientific Council of the European Society of Hypertension*, 26:1891-1900
- Ritchie, S.A., & Connell, J.M.C. (2007). The link between abdominal obesity, metabolic syndrome and cardiovascular disease. *Nutr Metab Cardiovasc Dis*, 17 (17110092), 319-26.
- Romero-Corral, A., Somers, V.K., Sierra-Johnson, J., et al. (2008). Accuracy of body mass index in diagnosing obesity in the adult general population. *Int J Obes (Lond)*, 32 (18283284), 959-66.
- Samaha, F.F., Iqbal, N., Seshadri, P., Chicano, K.L., Daily, D.A.,...Stern, L. (2003). A lowcarbohydrate as compared with a low fat diet in severe obesity. *N Engl J Med*, 348, 2074–2081.
- Sharma, A.M., & Chetty, V.T. (2005). Obesity, hypertension and insulin resistance. *Acta Diabetol*, 42(Suppl. 1), S3-8.
- Sierra, A D. L. Romero, R. Bonet, J. Perez, M. Lopez, J.S. Ravella, R.(2006). Prevalence and general features of the metabolic syndrome in the Spanish hypertensive population: *Med Clin*; 126, 406-409
- Stevens, J., Ahn, K., Juhaeri, Houston, D., Steffan, L., & Couper, D. (2002). Dietary fiber intake and glycemic index and incidence of diabetes in African-American and white adults: the ARIC study. *Diabetes Care*, 25, 1715– 1721.
- Welborn, T.A., & Dhaliwal, S.S. (2007). Preferred clinical measures of central obesity for predicting mortality. *Eur J Clin Nutr*, 61(17299478), 1373-9.
- Wirfalt, E., Hedblad, B., Gullberg, B., Mattisson, I., Andren, C., Berglund, G. (2001). Food patterns and components of the metabolic syndrome in men and women: a cross-sectional study within the Malmo Diet and Cancer cohort. *Am J Epidemiol*, 154,1150–1159.

- Whitworth, J.A., & Chalmers, J. (2004). World health organization- international society of hypertension (WHO/ISH) hypertension guidelines. *Clin Exp Hypertens*, 26(7-8), 747-52.
- Willett, K., Jiang, R., Lenart, E., Spiegelman, D., & Willett, W. (2006). Comparison of bioelectrical impedance and BMI in predicting obesity-related medical conditions. *Obesity (Silver Spring)*, 14(3), 480-90.
- Wolever, T.M. (2000). Dietary carbohydrates and insulin action in humans. *Br J Nutr*, 83 (Suppl. 1), S97–S102.
- World Health Organization [WHO]. (2011). Obesity and overweight; <http://www.who.int/mediacentre/factsheets/fs311/en/>
- World Health Organization [WHO] (2009). Global health risks: mortality and burden of disease attributable to selected major risks.
- World Health Organization [WHO]. (2011). Non communicable diseases country profiles
- World Health Organization [WHO]. (2014). Global Status Report on Non-communicable Diseases
- Yusuf, S., Hawken, S., Ounpuu, S., et al (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*, 364(9438), 937-52
- Zhu, S., Heo, M., Plankey, M., Faith, M.S., & Allison, D.B. (2003). Associations of body mass index and anthropometric indicators of fat mass and fat free mass with all-cause mortality among women in the first and second National Health and Nutrition Examination Surveys follow-up studies. *Ann Epidemiol*, 13(4), 286-93.

APPENDICES

Appendix 1: Informed Consent Form

School of Public Health

College of Health Sciences

University of Ghana

Title of study	“Metabolic Syndrome and associated factors among OPD patients in Kumasi Metro.	
Researcher	Department	Phone
Sarah Dansowaa Fordah	Epidemiology	0200327435

Background

Dear participant, my name is Sarah Dansowaa Fordah, a student of School of Public Health, University of Ghana, and Legon. I am undertaking a study in Metabolic Syndrome among OPD patients. The study hopes to assess the factors that contributes to the development of Metabolic Syndrome among OPD patients aged 35-69 in Kumasi Metropolis.

Procedure

The study will involve blood analysis and questionnaire administration. 10mls of veinal blood would be taken from respondents for biochemical and glucose level analysis. BP check and anthropometric measurement such as Weight, Height, and waist circumference would also be done. This is purely an academic research which forms part of my work for the award of Master of Public Health Degree. I would be

very grateful to have you as part of this study

Risks and Benefits

The study will not cause any risk to the participants because risk and safety measures would be applied during the anthropometric and clinical measurements. Nevertheless, you will experience some discomfort from the parameters that will be measured and discomfort from venue puncture.

It is hoped that the results obtained for this study will be used by policy makers and the Metropolitan Health Directorate in particular to either improve upon existing Health Service delivery. Respondents will also benefit by knowing their status with regards to Mets which will motivate them to adopt lifestyles that will help prevent the development of Diabetes type 2 and cardiovascular diseases or to reduce risk of dying in case one already has these conditions.

Right to refuse

Participation in this study is voluntary and participants can choose not to answer any particular question or all questions. You are at liberty to withdraw from the study at any time. However, it is encouraged that you participate since your opinion is important in determining the outcome of the study.

Anonymity and Confidentiality

I would like to assure you that whatever information provided will be handled with strict confidentiality and will be used purely for research purposes. Your data will not be shared with anybody who is not part of the research team. Data analysis will be done at the aggregate level to ensure anonymity. Blood samples will be discarded a week after the analysis. Patients recruited into this study would be referred to as

participants, no identity will not be disclosed in the final write up or material that is published.

Dissemination of results

A copy of the final write up would be given to the Metro Health Directorate-Kumasi for its planning. The individual clinical and anthropometric results would also be communicated to respondents as soon as it is done. Before taking the consent.

Do you have any question you wish to ask about the study?

Yes (if yes, questions to be noted below)

No

.....
.....
.....
.....

Consent

I....., declare that the purpose of the study has been thoroughly explained to me in English language and twi and I have understood. I hereby agree to answer the questions

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

Thumb print

Interviewer's Statement

I, the undersigned, have explained this consent form to the subject in the English/Twi language that he/she understands the purpose of the study, procedures to be followed as well as risks and benefits involved. The subject has freely agreed to participate in the study.

Interviewer's signature.....

Date.....

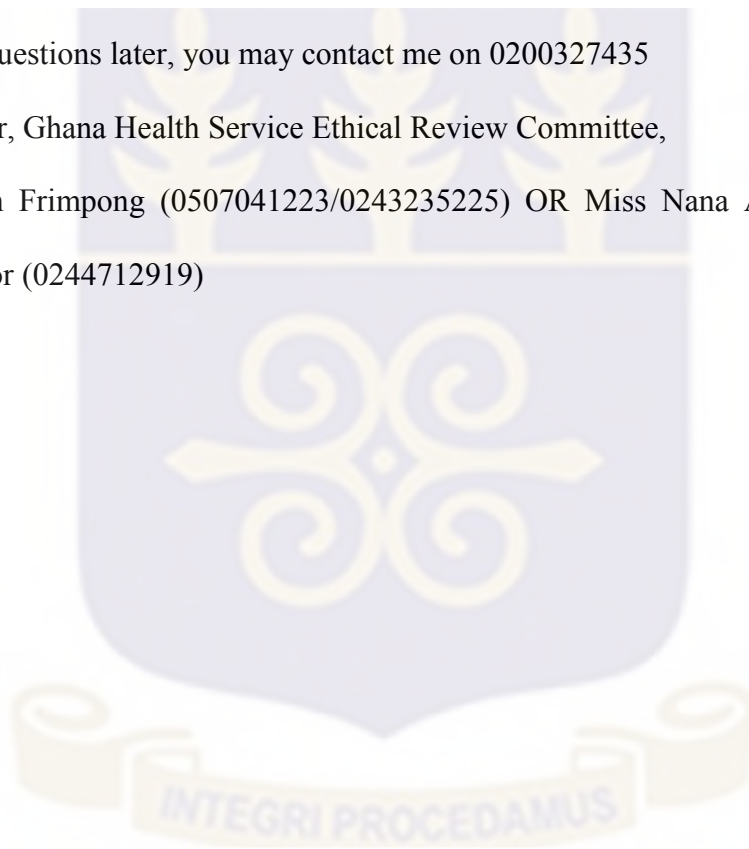
Address.....

If you have questions later, you may contact me on 0200327435

Administrator, Ghana Health Service Ethical Review Committee,

Miss Hannah Frimpong (0507041223/0243235225) OR Miss Nana Abena Kwaa

Addai-Donkor (0244712919)



Appendix 2: Questionnaire

PARTICIPANT CONSENT

Dear respondents,

I am Sarah Dansowaa Fordah a student of Public Health School, University of Ghana Legon, I am and researching on the topic: Metabolic Syndrome and Associated Factors among OPD Patients in Kumasi Metropolis. Data will be used for the purpose of this study only. You will be contributing immensely towards the success of this study by responding to these questions. Kindly give adequate information to the under listed questions. Your identity will not be disclosed in any way. Information gathered would be used only for the purpose of this research.

Thank you for your cooperation.

1. ID Number..... Date of Recruitment.....
2. Gender/sex: female [] male [] 3. Age.....
4. Address/Telephone number..... 5. Ethnicity.....
6. Marital status: 1. single 2. Married 3. divorced 4. Co-habiting
7. Educational status 1. nil 2. Primary 3. Secondary 4. Tertiary
8. Occupation 1. Unemployed 2. Trading 3. Public/Civil servant/financial/ 4. Farming
5. Artisan [] 6. Others (specify).....

ANTHROPOMETRIC MEASUREMENT

9. Height.....cm 10. Weight.....Kg
11. Waist circumference.....inches

CLINICAL ASSESSMENT

12. Blood pressure.....mmHg 13. Any previous history of hypertension yes
[] no []

14. Dyslipidaemia (LDL)mmol/L yes [] no [] 15. Dyslipidaemia (HDL)
..... mmol/L 16. Fasting blood Glucose..... \geq 100 mmol/L

LIFESTYLE ASSESSMENT

Physical exercise

17. How much aerobic exercise do you do? (By aerobic exercise we mean activity that raises your heart rate and makes you slightly breathless)

1. 30min of moderate intensity physical \geq 5days per week or 20min of vigorous intensity physical \geq 5days per week

2. \leq 30min of moderate intensity physical \geq 5days per week or 30min of moderate intensity physical \leq 5days per week

3. \leq 20min of vigorous intensity physical \geq 5days per week or 20min of vigorous intensity physical \leq 5days per week

18. Are you generally active as part of your daily routine? eg do you walk a lot, do you use the stairs instead of the lift, are you a keen gardener?

1. Yes 2. No

Smoking

19. Have you ever smoked any form of tobacco before? (Cigarette, pipe, cigars etc)

1. Yes 2. No

20. Do you currently/formerly smoke any form of tobacco? (Cigarette, pipe, cigars etc)

1. Yes 2. No

Alcohol intake

20. Are you a current/formal alcoholic?

1. Yes 2. No

21. How often do you take alcoholic drinks?

1. Daily 2. Weekly 3. Occasionally 4. Not at all

Dietary assessment

22. How often do you take fruits?

1. Daily 2. Weekly 3. Occasionally 4. Not at all

23. How often do you take Vegetables?

1. Daily 2. Weekly 3. Occasionally 4. Not at all

24. How often do you take roughages? (Whole grains etc)

1. Daily 2. Weekly 3. Occasionally 4. Not at all

25. How often do you take confectionaries/high saturated fat foods? (Sugary drinks, sweets, meat etc)

1. Daily 2. Weekly 3. Occasionally 4. Not at all

