

**INVESTIGATION OF DIETARY PATTERN AND PREVALENCE OF  
METABOLIC SYNDROME IN HYPERTENSIVE OUTPATIENTS AND  
ASSOCIATED EFFECT ON TARGET ORGAN DAMAGE**

**BY**

**MONICA TALATA ATULE, BSC. COMMUNITY NUTRITION**

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## DECLARATION

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

Monica Talata Atule .....

PG4585315

Signature

Date

Student Name & I.D

Certified by:

Dr. Christopher Larbie .....

Supervisor

Signature

Date

Certified by:

Dr. Hillary Zakpaa .....

Head of Department

Signature

Date

## ABSTRACT

Hypertension is a common and major public health problem associated with metabolic syndrome, causing complications including cardiovascular diseases, kidney problems and liver damages. The study aimed to investigate the prevalence of metabolic syndrome in hypertensive outpatients and its associated effect on target organ damage. A cross-sectional study was conducted on 150 hypertensive outpatients and 50 non-hypertensives. Questionnaire was administered to collect data on sociodemographic characteristics, medical history and physical activity. The food frequency questionnaire was used to also solicit information on past dietary patterns. Anthropometric data including weight, height, body mass index, waist circumference, blood pressure, body fat, visceral fat and resting metabolic rate were measured. Biochemical data including fasting blood glucose, lipids profile, coronary risk, serum urea, serum creatinine, estimated glomerular filtration rate, alanine aminotransferase, aspartate aminotransferase and serum bilirubin were also determined. Generally, there was more female (85.5%) than male (14.5%) in the study, in the ratio 6:1. Metabolic syndrome were significantly prevalent among hypertensive group (70.0%) than non-hypertensive group (10.0%,  $p = 0.000$ ). Overweight and obesity ( $p = 0.000$ ), diabetes ( $p = 0.000$ ), high blood pressure ( $p = 0.015$ ), abdominal obesity ( $p = 0.000$ ), high total cholesterol ( $p = 0.000$ ), high low density lipoprotein cholesterol ( $p = 0.002$ ) and high coronary risk ( $p = 0.042$ ) were significantly higher among participants with metabolic syndrome. Coronary risk ( $r = 0.192$ ,  $p = 0.007$ ) and alanine aminotransferase ( $r = 0.162$ ,  $p = 0.023$ ) had weak, significant positive correlation in participants with metabolic syndrome. In conclusion, metabolic syndrome was found prevalent among hypertensive than healthy controls. Also, clusters of metabolic syndrome including prediabetes and diabetes, abdominal obesity, high total cholesterol, high low density lipoprotein cholesterol and low high density lipoprotein cholesterol were also significantly prevalent among hypertensive than non-hypertensive group. Overall, hypertensives were highly at increased risk of heart, kidney and liver damage compared to counterpart non-hypertensives which require intensive evaluation and monitoring of diet and clinical care of these patients.

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## ABBREVIATIONS

ACCE	America association of clinical endocrinology
AHA/NHLBI	America heart association/National heart, lungs and blood institute
ALT/AST	Alanine aminotransferase/aspartate aminotransferase
BMI	Body mass index
BP	Blood pressure
CHD	Coronary heart disease
CRP	C-reactive protein
CT Scan	Computed tomography scan
CVDs	Cardiovascular diseases
DASH diet	Dietary approach to stop hypertension
DHIMS	District health information management system
DM	Diabetes mellitus
Dy	Daily
eGFR	Estimated glomerular filtration rate
EGIR	European group for insulin resistance
ESH/ESC	European society of heart/European society of cardiology
FPG	Fasting plasma glucose
Freq	Frequency
HDL-C	High density lipoprotein-cholesterol
HIV	Human immunodeficiency virus
HPT	Hypertension
IDF	International diabetes federation
IGT	Impaired glucose test
Kg	Kilogram
LDL-C	Low density lipoprotein-cholesterol
LFT	Liver function test
LMICs	Low and middle income countries
M	Meter
Mon	Monthly
MetS	Metabolic Syndrome
mmHg	Millimeters of mercury
NCEP/ATP III	National cholesterol education program/adult treatment panel III
NEFA	Non-esterified fatty acids
Nev	Never
Occ	Occasionally
OGTT	Oral glucose tolerant test
RMR	Resting metabolic rate
TC	Total cholesterol
TGs	Triglycerides
TOD	Target organ damage
TZ	Tuo zaafi
VLDL	Very low density lipoprotein

WC	Waist circumference
WHO	World health organization
Wk	Weekly
Yr	Yearly

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background

A patient is normally diagnosed of hypertension when blood pressure rises above 140/90mmHg. Hypertension can be classified into two main types: essential hypertension which is the most common hypertension normally encountered. It makes up 90-95% of everyday hypertension cases; mostly the cause of essential hypertension is unknown. The other type of hypertension is called secondary hypertension. Unlike essential hypertension, this type is caused by the presence of other illness and accounts for just 5% of hypertensive cases. Blood pressure is thus defined as the force of blood pushing against the walls of the blood vessels. When the pressure in the arteries exceeds normal levels then it is said that there is high blood pressure (Campbell *et al*, 2012; Ong *et al.*, 2007). It can also be defined as the force of blood that pushes against the walls of the artery when it moves around the body. High blood pressure (hypertension) is the constant pumping of blood through blood vessels with excessive force (Callahan and Harriman, 1992).

Hypertension is one of the most common conditions that is often undiagnosed until it has emanated into a life-threatening condition such as cardiac and renal failure. It is therefore significant in the manifestation of MetS; showing up to 85% of patients (Duvnjak *et al*, 2008). Metabolic syndrome is defined by Malik and colleagues, (2004) as the assemblage of conditions characterized by three of the following factors:

- High blood pressure
- High blood sugar levels
- Low levels of HDL cholesterol in the blood

- High levels of triglycerides in the blood and
- Large waist circumference (> 102cm in men/> 88cm in women) or “Apple shaped body”

Before now, hypertension related to the more affluent parts of the world. Notwithstanding, the condition is progressively rising in low and middle-income countries (LMICs) where health resources are rare and affected mostly by infectious diseases, for example, HIV, malaria and tuberculosis, with awareness and treatment levels of hypertension very low.

Communicable diseases, maternal, perinatal and nutritional causes of death were accounted for as the highest burden of morbidity and mortality. This burden is swiftly moving from these factors to chronic non – communicable diseases and the prevalence of them all being cardiovascular diseases (CVDs) in Africa today. This burden is known as “double burden of disease”

Although hypertension was almost non-existent in African societies in the early days of the twentieth century, studies now shows that in a couple of settings in Africa, more than 40% of adults have hypertension. Hypertension has seen a significant rise within the last couple of decades. There were around 80 million adults with hypertension in sub-Saharan Africa in 2000 and projections considering current epidemiological data suggest that this figure will rise to 150 million by 2025 (Van de Vijver *et al.*, 2014).

Hypertension has been on the rise over the past century. There has been a substantial increase in the number of cases in Ghana. In 1988 Public Health Facilities reported 49,087 cases of hypertension and 505,180 cases were reported in 2007 which is 10 times the number of cases in 1988. In Ghana, research on hypertension has indicated a

crude prevalence between 25% and 48%, using the threshold of 140/90 mmHg with higher occurrences in urban populations than in rural populations. Many Ghanaians living with hypertension do not have any awareness of the condition and this has been recorded as one of the commonest causes of outpatient morbidity in most regions, ranking fifth amongst the others (Bonsu, 2010).

However, in the Greater Accra Region of Ghana, hypertension moved from fourth to become second to malaria as the leading cause of outpatient morbidity in 2007. Stroke and hypertension are among the leading causes of admission and death. Hypertension is an important cause of heart and renal failure in Ghana (Bonsu, 2010).

The condition of high blood pressure is principally avoidable by modifying certain standards of living which are associated with reduction in cardiovascular complications at an early stage. Such lifestyle modifications include reduction and management of mental stress through exercise, adopting meditation and other relaxation techniques, eating healthy diets with lots of fruits and vegetables which are a rich source of potassium and fibre, reducing the intake of salt to minimize sodium levels (the total daily intake of salt or sodium chloride from all sources should be no more than 5/gm per day [1 tea spoon]), as well as limiting the intake of foods with high saturated fats, reducing trans-fats in diet and maintaining a healthy weight. Engaging in physical activities can also help lessen blood pressure if it can be done for at least 30 minutes daily. Reduction in alcohol and tobacco intake coupled with maintaining healthy diets to reduce the risk of diabetes are also very effective ways of lowering blood pressure. If a person already has diabetes, the doctor may prescribe medications in addition to lifestyle changes (Room *et al.*, 2011; WHO, 1999)

## 1.2 Problem Statement

Akim Oda is the municipal capital of Birim Central in the Eastern Region. According to the Ghana health services-Districts information management system II report (GHS-DHIMs II), the incidence and prevalence of hypertension among adults in the municipality is very alarming. The table below presents the yearly cases of hypertensions from 2013 to 2015.

**Table 1.1 Yearly cases of hypertensions from 2013 to 2015 at the Akim Oda Gov. Hospital**

Yearly	Cases in Adult	Percentage (%)
2013	11,679	31%
2014	13,401	34%
2015	29,157	48%

Sources: DHIMs.

It is evident from the above table that cases keep increasing year after year in the municipality. These cases were those captured by the municipal hospital only. This probably represents a small chunk as most cases will not be reported because they may seek care from traditional herbalists or from chemical sellers. The dangerous aspect is that most of the cases are believed to be resorting to various treatments which are not in conformity with the standard treatment guidelines. Inadequately treated hypertension will lead to serious complications in future including morbidity and mortality associated with hypertension. Hypertension damages the heart, kidney, blood vessels and brain which may lead to ischemic heart disease, congestive cardiac failure, renal failure and stroke.

According to Chan, (2013) “we live in a rapidly changing environment. Throughout the world, human health is being shaped by the same powerful forces: demographic ageing, rapid urbanization, and the globalization of unhealthy lifestyles. Increasingly, wealthy and resource-constrained countries are facing the same health issues. One of the most striking examples of this shift is the fact that non-communicable diseases such as cardiovascular disease, cancer, diabetes and chronic lung diseases have overtaken infectious diseases as the world’s leading cause of mortality” (Chan, 2013).

Hypertension has become a public health menace in the world now and it is mostly related to the high number of cardiovascular morbidity and mortality. Hypertension which was previously very rare in several parts of Africa especially sub-Saharan Africa is now reporting several cases in each year. At first, studies revealed a higher prevalence of hypertension in urban areas than in rural areas but a recent study now shows an increasing trend in the prevalence of hypertension in rural areas as compared to urban communities. Lifestyle changes and an increase in age may be the cause of the high prevalence of hypertension in the rural areas (Akpan *et al.*, 2015).

The global disease burden and the rapid change in health across the world can mostly be attributed to growing influence of CVD. Nutrition and diet have been identified as a major risk factor for the most deadly CVD such as coronary heart disease (CHD) and stroke. It is also linked with other cardiovascular risk components such as hypertension, diabetes, and obesity compositely called metabolic syndrome. There is a substantial proof from studies worldwide that links many nutrients, minerals, food groups and dietary patterns with a high or low risk of CVD. Dietary pattern or food can impact on health positively and negatively. Dietary fats such as trans and saturated fats are heavily linked to an increased risk of cardiovascular diseases but polyunsaturated fats are known to be protective and useful to the body. Likewise,



dietary sodium is related to high levels of blood pressure but dietary potassium reduced the risk of hypertension and stroke (Reddy and Katan, 2004; Salehi-Abargouei *et al.*, 2013).

Many studies on organ damage due to MetS are mostly done outside Ghana and the very few done in the country are carried out in the cities. It is therefore imperative to undertake this research in the municipality where patronage to the health facility are mostly village dwellers and to find out the extent of metabolic syndrome among diagnosed hypertensives and its effects on specific organ damage and recommend ways to address the condition.

### **1.3 General Objective**

This research aims to investigate dietary pattern, prevalence of metabolic syndrome among diagnosed hypertensives and its effect on target organ damage.

### **1.4 Specific Objectives**

The research seeks to

- Determine prevalence of metabolic syndrome among hypertensive and non-hypertensive outpatients.
- Assess dietary pattern among hypertensive and control groups.
- Determine prevalence of cardiovascular risk, kidney, and liver damage among hypertensive and non-hypertensive outpatients with or without metabolic syndrome.

### **1.5 Justification**

An extensive body of evidence suggests that MetS may aggravate hypertension-related cardiac and renal changes (part of target organ damage-TOD). There is limited data linking MetS, hypertension (HPT) and dietary pattern on the African region and

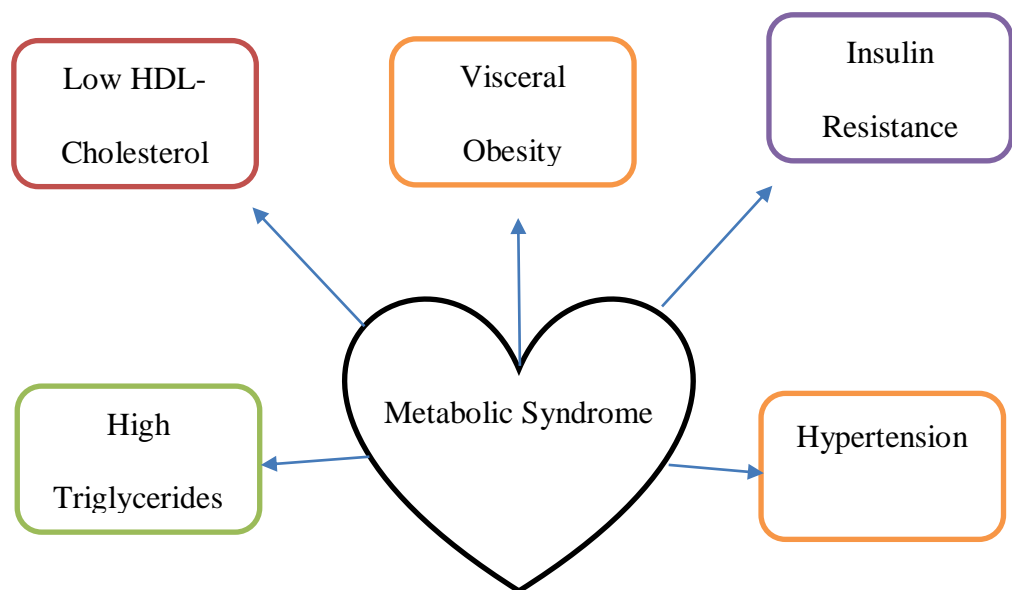
for that matter Ghana. This study will therefore contribute to scientific knowledge on the influence of dietary pattern on the prevalence of MetS in people with hypertension. It will also give a better understanding to public health workers as to how to educate the public.

## CHAPTER TWO

### 2.0 REVIEW OF LITERATURE

#### 2.1 Metabolic Syndrome

The metabolic syndrome is an assemblage of risk factors including obesity, glucose intolerance, insulin resistance, dyslipidemia and hypertension that surges the threat for cardiovascular disease and type 2 diabetes (Jesmin *et al.*, 2013; Haffner and Cassells, 2003). This condition can lead to both diabetes and heart disease, two of the most prevailing diseases in the world today.



**Fig. 1.1 Parameters of Metabolic Syndrome**

Source: [www.metabolicsyndromecanada.ca/about-metabolic-syndrome](http://www.metabolicsyndromecanada.ca/about-metabolic-syndrome)

Metabolic syndrome escalates the prospects of type 2 diabetes (the common kind of diabetes) somewhere in the range of 9 to 30 times over the typical populace. With regards to the risk of coronary illness (heart disease), there exist variation in the study, yet metabolic syndrome seems to increase the risk 2 to 4 times that of the ordinary populace (James *et al.*, 2014; Gallagher *et al.*, 2011).

In the vast majority with glucose intolerance or type 2 diabetes, there is a numerous arrangement of hazardous components that are normally put together to form what is currently known as the 'Metabolic Syndrome'. The metabolic variations from the norm that assemble in an individual seem to present a lot of additional cardiovascular risk which is far genuine than the aggregate of the risk related with every irregularity (Zimmet *et al.*, 2005).

The relationship of all these risk components has been known for over 80 years. It was depicted by Kylin (1923), a Swedish doctor as a group of hypertension, hyperglycemia and gout. Vague after persistent studies revealed that a correct obesity phenotype, upper body or male –type obesity was related with metabolic irregularities that typically accompanied type 2 diabetes and CVD (Vague *et al.*, 1979).

According to the findings of Dr. Gerald Reaven, he identified an assemblage of metabolic irregularities of insulin resistance, hyperglycaemia, hypertension, low high –density lipoprotein (HDL) cholesterol and raised very low –density lipoprotein (VLDL) triglycerides and termed it syndrome X. The clinical significance of metabolic syndrome was made known by Dr. Gerald Reaven. According to him, obesity wasn't a vital part of syndrome X and therefore omitted it from the cluster of risk factors (Reaven, 1988).

Obesity has since become a very essential risk factor of Mets especially abdominal (visceral) obesity. Metabolic syndrome is currently broadly perceived in cardiovascular, diabetes, and renal circles (Eckel *et al.*, 2005).

The International Diabetes Federation (IDF) singled out central Obesity as an imperative determinant of the metabolic syndrome, and asserted that there is a solid relationship between waist circumference, CVD and other segment of the metabolic

syndrome. Specifically, visceral fat gathering dictated by CT scan has been shown to have close connection with the advancement of metabolic and cardiovascular diseases. Therefore, central obesity was put in significant position of the new definition as a fundamental part of metabolic syndrome by the International Diabetes Federation (Matsuzawa, 1997).

Cardiovascular diseases and type 2 diabetes are not the only disorders associated with metabolic syndrome: people with the syndrome are apparently more helpless to different conditions, including polycystic ovary disorder, fatty liver, cholesterol gallstone, asthma, sleeplessness, and a few types of cancer, for example, breast, pancreatic, colorectal, and prostate (Grundy *et al.*, 2004; Bhandari *et al.*, 2014).

## **2.2 Criteria for Diagnosis of MetS**

### **2.2.1 International Diabetes Federation (IDF) criteria for diagnosing Metabolic Syndrome**

As per the new IDF definition, central obesity is the fundamental variable for deciding if a person has metabolic syndrome and any two of the accompanying: raised triglycerides, reduced HDL cholesterol, raised blood pressure or raised fasting plasma glucose (Alberti *et al.*, 2006). Metabolic syndrome is analyzed if there is central obesity (BMI  $>30\text{kg/m}^2$ , waist circumference  $> 90$  cm for men or  $>80$  cm for women) accompanying any two of the following:

- Reduced HDL cholesterol  $< 40$  mg/dL (1.03 mmol/L) in males'  $< 50$  mg/dL (1.29 mmol/L) in females. Raised blood pressure: systolic BP  $\geq 130$  mmHg or Diastolic BP  $\geq 85$  mmHg,
- Raised triglycerides  $\geq 150$  mg/dL (1.7 mmol/L)
- Raised fasting blood glucose (FPG)  $\geq 100$  mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes.

### **2.2.2 World Health Organisation (WHO) criteria for diagnosing metabolic syndrome**

The WHO criteria for diagnosing metabolic syndrome places emphasis on the presence of diabetes mellitus, insulin resistance, impaired glucose tolerance (IGT) and any two of the following (Lorenzo *et al.*, 2007):

Dyslipidaemia - Raised Triglycerides	$\geq 150$ mg/dl (1.7 mmol/l)
Reduced High Density Lipoprotein Cholesterol	( $\leq 0.9$ mmol/l) in males ( $\leq 1.0$ mmol/l in females)
Raised blood Pressure	Systolic BP $\geq 130$ mmHg Diastolic BP $\geq 90$ mmHg
Central Obesity	BMI $\geq 30$ kg/m <sup>2</sup> , waist to hip ratio > 0.90 for men > 0.85 for women

### **2.2.3 European Group for the study of Insulin Resistance (EGIR) criteria for diagnosing metabolic syndrome**

The EGIR criterion for diagnosis is the presence of insulin resistance and two or more of the following (Wood *et al.*, 1998):

Fasting blood sugar concentration	$\geq 6.1$ mmol/l without diabetes
Blood pressure	$\geq 140/90$ mmHg or treatment for elevated blood pressure
Triglyceride levels	$> 2.0$ mmol/l (177 mg/dl) or treatment for elevated triglycerides and/or HDL cholesterol levels $< 1.0$ mmol/l (88 mg/dl) or treatment for reduced HDL cholesterol levels.
Increased waist circumference	$\geq 94$ cm for men and $\geq 80$ cm for women

### **2.2.4 National Cholesterol Education Program-Adult Treatment Panel III criteria for the diagnosing metabolic syndrome**

The National Cholesterol Education Program Adult Treatment Panel III (2002) suggested that if a person has three or more of the following, metabolic syndrome should be diagnosed (Lorenzo *et al.*, 2007).

Central Obesity	>102 cm or 40 inches for men, >88 cm or 36 inches for women
Dyslipidaemia- Increased triglycerides	$\geq 1.7$ mmol/l (150 mg/dl)
Reduced High Density Lipoprotein Cholesterol	<0.90 mmol/l (<40 mg/dl) for men or <1.0 mmol/l or <50 mg/dl
Increased blood pressure	$\geq 130/85$ mmHg, increased fasting blood glucose levels >6.1 mmol/l

### 2.2.5 America Association of Clinical Endocrinology (ACCE) Criteria for Diagnosing Metabolic Syndrome

The ACCE criteria for diagnosis of metabolic syndrome places emphasis on the presence of impaired glucose tolerance and two or more of the following (Einhorn *et al.*, 2003):

Body mass index	$\geq 25$ kg/m <sup>2</sup>
Triglyceride	$\geq 150$ mg/dl and/or HDL-cholesterol <40 mg/dl in men <50 mg/dl in women
Blood pressure	$\geq 130/85$ mmHg

### 2.2.6 America Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI) criteria

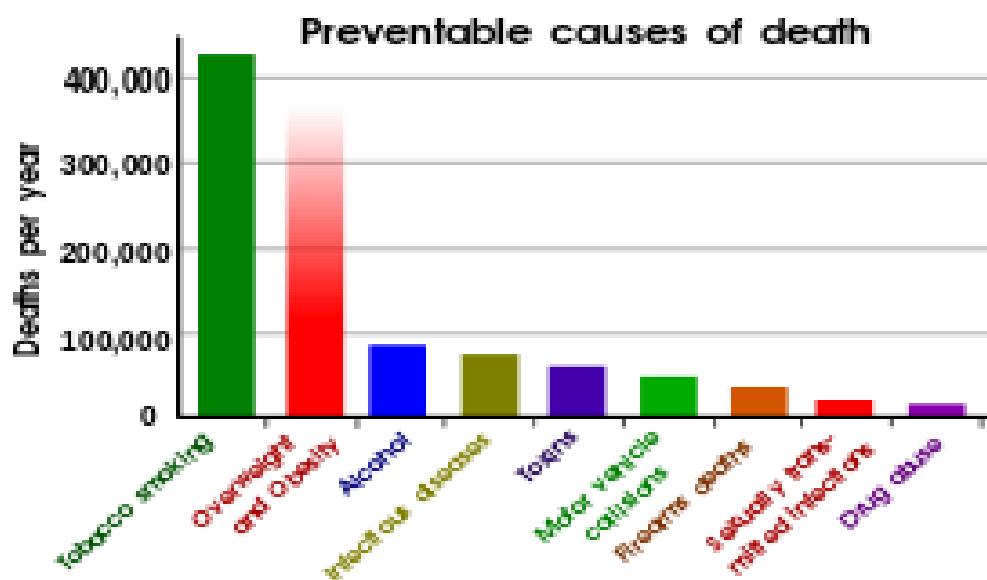
The AHA/NHLBI criteria for diagnosis are any three of the following (Kassiet *al.*, 2011):

BMI	$\geq 25$ kg/m <sup>2</sup>
Triglycerides	$\geq 150$ mg/dl
High density lipoprotein cholesterol	<40 mg/dl in men <50 mg/dl in women
Blood pressure	$\geq 130/85$ mmHg
Fasting blood glucose	$\geq 100$ mg/dl

## 2.3 Components of Metabolic Syndrome (MetS)

### 2.3.1 Obesity

Obesity (overweight) can be clarified as anomalous or exorbitant fat collection that may debilitate wellbeing. Obesity has become a very serious public health risk in Ghana and the world at large. It is one of the leading causes of premature death in the United States. It kills approximately 400,000 people in the United States each year (Després and Lemieux, 2006)



**Figure 2.1 Preventable Causes of Death**

Source; (Mokdad *et al.*, 2004).

Findings by the World Health Organization indicate that there is an epidemic of obesity in the developed and developing countries such as Ghana (WHO, 2000).

Body mass index (BMI) is generally used to categorize overweight and obesity in adults. It is explained as the weight in kilograms divided by the square of height in meters ( $\text{kg/m}^2$ ). ATP III considered the "Obesity epidemic" as essentially in charge of the rising commonness of metabolic syndrome. Hypertension, high serum cholesterol,



low HDL cholesterol, and hyperglycaemia are aggravated or borne from obesity, and it generally relates with higher CVD risk (Baker *et al.*, 2006). Abdominal obesity strongly shows a relationship with metabolic risk factors. Too much of adipose tissue dispenses numerous products that evidently intensify these risk factors. Some of these products are non-esterified fatty acids (NEFA), cytokines, plasminogen activator inhibitor-1 (PAI-1), and adiponectin (Grundy *et al.*, 2004).

A high plasma NEFA level over-burdens muscle and liver with lipid, which improves insulin resistance. High C-reactive protein (CRP) levels going with obesity may imply cytokine abundance and a pro-inflammatory state. A very high amount of PAI-1 adds to a prothrombotic state, though low adiponectin levels that go with obesity associate with declining of metabolic risk factors. The solid association between obesity (particularly abdominal obesity) and risk components drove ATP III to characterize the metabolic syndrome basically as an assemblage of metabolic inconveniences of obesity (Grundy *et al.*, 2004).

### **2.3.2 Diabetes**

Diabetes Mellitus (DM) alludes to a cluster of metabolic anomalies of different etiologies, which is described by a prolonged hyperglycaemia (high blood sugar). DM is brought on either by deformities in the production of insulin, the activity of insulin in the body or both. These insulin abnormalities may result in mal-digestion of carbohydrates, protein and fat (Alberti and Zimmet, 1998). Diabetes are grouped into Type 1 diabetes, type 2 diabetes and gestational diabetes. Type 2 DM, has accounted for 90-95% of all diabetes cases (International Diabetes Federation [IDF], 2011), being the most dominant cause of worldwide diabetes pandemic (Haslett *et al.*, 2002). A lot of changes in lifestyle in the 21<sup>st</sup> century such as diet, minimum or no physical

activity with resulting prevalence of overweight and obesity are the major reason why diabetes is now a serious health problem worldwide (Zimmet, 2001).

### **2.3.3 Dyslipidaemia**

Dyslipidaemia is a rise in plasma cholesterol, triglycerides (TGs) or both or a low high-density lipoprotein level that adds to the advancement of atherosclerosis (Chong and Bachenheimer, 2000). Dyslipidaemia may have essential (hereditary) or optional cause. It is analyzed by measuring plasma levels of aggregate cholesterol, TGs, and individual lipoproteins. Treatment of dyslipidaemia includes dietary changes, exercise, and lipid-lowering. Dyslipidaemia can also be brought about by an inactive way of life with huge dietary intake of saturated fat, cholesterol and trans fats.

Drugs like estrogens and progestin, thiazides and high active retroviral agents can cause dyslipidaemia as well as conditions like diabetes, chronic kidney disease, and hypothyroidism. A research conducted by lipids research clinics revealed that low HDL-C and high triglycerides levels provide a better contribution to coronary and cardiovascular mortality in women than cholesterol (Bass *et al.*, 1993).

### **2.3.4 Insulin Resistance**

Insulin resistance can be portrayed as a state of diminished responsiveness to common streaming levels of insulin and it accept an essential part in the improvement of type 2 diabetes (Savage *et al.*, 2005). Insulin resistance plays a major role in the association among obesity, diabetes, the metabolic syndrome (also commonly referred to as syndrome X), and atherosclerotic cardiovascular disease (Ginsberg, 2000).

### **2.3.5 Hypertension**

Hypertension is a typical condition in which the prolonged constrain of blood against the artery walls is sufficiently high that it might in the end cause medical issues, for

example, coronary illness (James *et al.*, 2014). It can also be defined as having a blood pressure greater than 140 over 90mmHg which is widely accepted as the standard worldwide (Chobanian *et al.*, 2003). Hypertension is diagnosed when one or both readings are high: systolic (the pressure as the heart directs blood around the body), given first; or diastolic (pressure as the heart unwinds and refills with blood), given second.

The current intake of salt-rich diets with processed and fatty foods, alcohol and tobacco use are the common trends that are responsible for the high number of hypertension cases in the world now. Hypertension can likewise be optional to different conditions - kidney ailment, for instance, and can be related with a few drugs. Hypertension itself does not show any manifestations but rather in the long-haul prompts intricacies brought on by narrowing of veins (Chobanian *et al.*, 2003). Changing the way of living is the basic way of tackling hypertension. Taking in low salt diets, reduction of the intake of alcohol and stress reduction are some of the ways hypertension can be managed.

**Table 2.1 Definition and Classification of Hypertension according to the European Society of Hypertension (ESH)**

CATEGORIES	SYSTOLIC(mmHg)	DIASTOLIC(mmHg)
High – Normal	130-139	85-89
Grade 1 Hypertension	140-159	90-99
Grade 2 Hypertension	160-179	100-109
Grade 3 Hypertension	>=180	>=110

Source; Guidelines Committee, 2003

#### **2.3.5.1 Hypertension and Physical Activity**

Any bodily effort that requires the use of energy in the skeleton muscle is termed as physical activity. There have been approximately 3.2 million deaths caused by physical inactivity, ranked as the fourth highest risk factor for death worldwide (Thompson *et al.*, 2003).

The health benefits of physical activities are enormous. Engaging in moderate physical activities such as walking, riding a bicycle or taking part in sports activities can significantly reduce the risk of High blood pressure, diabetes and many others (Thompson *et al.*, 2003). Physical activities can reduce blood pressure in pre-hypertensive significantly to a normal level. Even though there is a high possibility of an individual getting hypertension as they age, it is possible to prevent hypertension and lower its intensity through regular physical activities. Exercising once a day can have significant health benefits on people with hypertension that last for at least 24hours (Quinn, 2000).

#### **2.3.5.2 Hypertension and Smoking**

Smoking is one of the biggest health hazards in the world right now. It includes the inhalation of fumes from burning tobacco that can be found in cigarettes, pipes and cigar. Smoking has taken many lives in the past decade and has been ranked number one as the leading cause of preventable deaths in America. It has caused the death of approximately 430,700 people in the United States each year. Smoking can lead to cardiovascular diseases such as hypertension (High blood pressure) stroke and so many other conditions (Virdis *et al.*, 2010).

#### **2.3.5.3. Hypertension and Alcohol**

Excessive intake of alcohol can raise blood pressure to unhealthy levels. Approximately 3.3million deaths in 2012 were attributed to alcohol. Excessive

alcoholism is a major contributor to hypertension induced deaths in the world. In Africa, there is a growing concern about the excessive consumption of alcohol. It has been a major contributor to the growing number of people with hypertension in the region. The continuous consumption of alcohol leads to organ damage which causes a disruption of blood flow to the heart. This leads to very serious health issues including hypertension (Klatsky, 2004).

## **2.4 Hypertension and its Effect on Target Organs**

Hypertension can gradually destroy certain organs in the body if it is not detected early or treated well. Organs such as the heart, kidney, brain, and arterial blood vessels are the most likely to be affected by hypertension's long term effects. Hypertension if not controlled can cause rapid destruction to target organs which may lead to organ not being able to function, cardiovascular death and permanent paralysis (Safar *et al.*, 2003).

### **2.4.1 Hypertension and the Brain**

The neurogenic factors are very essential in the control of most common types of hypertension, yet the brain is very powerless against the injurious impacts of high blood pressure (Phillips and Whisnant, 1992). There are several effects of hypertension on the brain which can be very deadly if not detected early. Some of these conditions are explained below:

- **Transient ischemic attack (TIA).**

When there is a brief interruption of blood supply to the brain, the resulting condition is termed as transient ischemic attack. It is also called mini stroke. It's mostly brought about by atherosclerosis or blood coagulation — both of which can emerge from high blood pressure (hypertension). Immediate

attention is required when a person develops transient ischemic attack because it can lead to full-blown stroke (Johnston, 2002).

- **Stroke**

When the passages that supply oxygen and nutrients to the brain are partially or fully blocked, the brain cells die and cause a condition termed as stroke. When high blood pressure is not checked and controlled, it damages and weakens the blood vessels in the brain causing them to shrink, rupture or leak. Hypertension also causes stroke by causing blood to clot in the arteries in the brain and interrupting the flow of blood (Thom *et al.*, 2006).

- **Dementia**

Dementia causes problems with thinking, talking, reasoning, memory, sight and movement. It specifically affects the brain and has several causes one of which is high blood pressure (hypertension). Hypertension causes a narrowing and blockage in the arteries that supplies blood to the brain. This type of dementia is termed as vascular dementia. Also stroke that is induced by hypertension can also cause dementia by interrupting the flow of blood to the brain (Sorrentino *et al.*, 2008).

- **Mild Cognitive Impairment**

Mild cognitive impairment like dementia can result from blocked passages of blood flow to the brain caused by hypertension. It is defined as the change from understanding and memory associated with ageing and Alzheimer's disease (Reitz *et al.*, 2007).

### **2.4.2 Hypertension and the Eye**

- **Retinopathy**

When the vessels that supply blood to the retina get damaged by hypertension, retinopathy occurs. It can lead to occasional bleeding from the eyes, blurry vision and total blindness. The presence of two of the risk factors of metabolic syndrome (diabetes and high blood pressure) leaves an individual at an elevated risk of getting retinopathy (Heidbreder and Heidland, 1987).

- **Choroidopathy**

Choroidopathy occurs when there is excess fluid accumulates under the retina. This happens when there is a leaky blood vessel in a layer under the retina. This condition can cause distorted vision or scars that impair vision (Bourke *et al.*, 2004)

- **Optic Neuropathy**

This occurs when the optic nerves get damage due to disruptions in the flow of blood caused by hypertension. It can lead to complete destruction of nerve cells in the eye or cause vision loss (Hayreh *et al.*, 1986).

### **2.4.3 Hypertension and the Kidney**

High blood pressure (hypertension) is a leading cause of kidney disease and kidney failure (end-stage renal disease). Hypertension can cause damage to the blood vessels and filters in the kidney, making removal of waste from the body difficult (Coffman and Crowley, 2008)

## **2.5 Dietary Pattern**

Investigation into dietary pattern has seen a rise as a matter of choice and a way to deal with the connection between eating regimen and the danger of prolonged illnesses. Rather than investigating an individual nutrients or diet, an impacts analysis is done on the general eating pattern (Hu, 2002).

Hypothetically, dietary pattern addresses a broader picture of sustenance and supplementary usage, and may similarly foresee the threat of illness than individual foods or supplements. A couple of surveys conducted suggest to the fact that, dietary cases gotten from variable or group examination suspect infirmity risk or mortality. Besides, there is eagerness for using dietary quality records to survey whether adherence to a particular dietary illustration (e.g. Mediterranean pattern) or stream dietary guidelines cuts down the risk of maladies (Hu, 2002).



## **CHAPTER THREE**

### **3.0 SUBJECTS AND METHODS**

#### **3.1 Study Setting**

##### **3.1.1 Profile of Akim Oda government hospital**

The Akim Oda Government Hospital is a general hospital which serves as the main referral facility for the Municipality and beyond. The facility has five (5) wards; the male, female, pediatric, labour and maternity wards. It also has an isolation ward, specifically designed for highly contagious cases like cholera.

In addition to these, the Hospital also organizes special clinics on specific days for clients. These clinics are the diabetic and hypertensive clinics on Wednesdays and Fridays respectively. Akim Oda lies on the banks of the river Birim within the tropical rain forest zone. Early rains are experienced from March, however, it virtually rains from March to early December, before the harmattan sets in.

#### **3.2 Study Design**

##### **3.2.1 Study Type**

A cross sectional design was used to collect data at the Akim Oda government hospital in the Eastern region of Ghana. A retrospective study on dietary pattern, physical activity and certain life style such as smoking and alcohol drinking were carried out on participants to assess the impact of these life style on their present condition.

##### **3.2.2 Sample Size**

The sample size is calculated using the formulae below;

$$N = \left\{ \frac{z_{\alpha/2}^2}{e^2} p(1 - p) \right\} \quad \text{where}$$

Margin of error (e) = 5%

Population prevalence (p) = 15% (Jaykaran and Tamoghna, 2013)

Z score or reliability coefficient  $Z_{\alpha/2} = 1.96$

$$n = \left\{ \frac{Z_{\alpha/2}^2}{e^2} p(1 - p) \right\} \rightarrow n = \left\{ \frac{1.96^2}{0.05^2} 0.15 (1 - 0.15) \right\} = 195.9216 = 196$$

### **3.2.3 Eligibility criterion (inclusion and exclusion criteria)**

Patients who had been diagnosed with hypertension for at least 1 month, and are 18 years and above with a sound mind and could communicate in either Twi or English were eligible participants of this research. Also 50 non- hypertensive within the age category were recruited to serve as control for the research. Patients on admission, deaf and dumb and those on a visit to the hospital were excluded.

### **3.2.4 Recruitment Process**

A total of 200 participants consisting of 29 males and 171 females from the hospitals hypertensive clinic opted to partake in this research work. A point by point clarification of the study was explained to participants and their consent for cooperation was sought for. Out of the total participants 150 were made up the hypertensive and 50 were for the control group.

Formal consent was acquired from all participants. The objectives of the survey and survey procedures were disclosed to them. Also, participants were made to understand that participation was completely voluntary and that they had the privilege to decline to take an interest in the survey or can withdraw from the survey at any point in time without their choice having an influence on the care that they are getting from the hospital.

### **3.3 Data Collection**

#### **3.3.1 Questionnaire**

Data on demography, medical history, family history and physical activity level were gathered using a standardized interview-based questionnaire with the help of a principal investigator. Physical activity questionnaire was adopted from Armstrong and Bull (2006) and WHO (2012).

#### **3.3.2 Dietary Assessment**

Food frequency questionnaire was used to collect information on dietary pattern of respondents. Respondents provided information on how often they took certain foods and how much (quantity) of the food they took in.

#### **3.3.3 Anthropometric Data**

Weight (kg) and height (m) were measured with weighing scale and stadiometer respectively. Body Mass Index was automatically calculated and provided by the body composition analyzer. The body composition analyzer (Omron, Germany) was also used to measure body fat, visceral fat, muscle mass and resting metabolic rate of all participants.

#### **3.3.4 Blood Pressure**

A trained hospital personnel was employed to take measurement of blood pressure using a mercury sphygmomanometer and a stethoscope and values were recorded in mm Hg. According to the American Heart Association and the European Society of Hypertension (ESH)/ European Society of Cardiology (ESC), hypertension is defined as systolic BP > 140 mm Hg and diastolic BP > 90 mm Hg. Therefore, a person is said to be hypertensive when there is either abnormally high systolic or diastolic BP or both being abnormally high for three consecutive times/visits.

### **3.3.5 Biochemical Analysis**

Five ml of blood sample of participants was taken by a trained hospital phlebotomist into gel activated tubes. Samples were centrifuged to obtain serum. Biochemical analysis was performed using manufacture instructions and measured on semi-automated chemistry analyzer. The patients were made to fast for about 12 hours before the laboratory tests were done on them, that is from their previous night meal times to the morning of the investigation. Biochemical investigations included fasting blood glucose, Lipid profile (total cholesterol, triglycerides, high density lipoprotein cholesterol), coronary risk, serum urea, serum creatinine, estimated glomerular filtration rate, liver function test (alanine aminotransferase, aspartate aminotransferase and bilirubin). All analyses were performed with an automated Selectra Pro S chemistry analyzer using the manufacturers' instruction (EliTech reagents, EliTechGroup solution, France).

The cardiac risk of a person was calculated using the formula:  $CR = \frac{chol}{HDL}$ . It is a calculated parameter and not a measured parameter. Hence cardiac risk is without a unit.

Fridewald's equation was used to calculate LDL:  $LDL = (Cholesterol - HDL) - \left[ \frac{TG}{2.2} \right]$

Blood Glucose level of participants was measured using a Point of Care Testing (POCT) equipment SD glucometer brand.

### **3.5 Ethical Approval**

Ethical clearance was sought from the KNUST Committee on Human Research, Publication and Ethics (CHRPE/RC/204/16). Permission was obtained from the Akim

Oda government hospital for participation of patients in this research. Participants' consent was sought for before the commencement of data collection.

### **3.6 Data Analysis**

A combination of tools such as ANOVA and correlation were used for data analyses and presented as charts, graphs and tabulation using the SPSS version 23 for windows. Descriptive analysis was done with continuous data expressed as mean  $\pm$  SD and categorical data as proportions. An unpaired T-test was used to compare means. A p-value of  $<0.05$  was considered statistically significant in all comparisons.

## **CHAPTER FOUR**

### **4.0 RESULT**

#### **4.1 Sociodemographic Characteristics and Physical Activity Levels of Study Population**

The study reports sociodemographic, anthropometric and biochemical data, including; cardiovascular risk factors, kidney and liver parameters of hypertensive and non-hypertensive participants attending Akim Oda government hospital. The result shows that there were more female (85.5%) than male (14.5%) in the study, in the ratio 6:1. Majority of the study participants were within 51-60 years (31.0%) and 45.0% of participants had primary education. There were significant differences between gender, age and educational level among hypertensive and non-hypertensive participants ( $p= 0.001$ ,  $p= 0.000$ ,  $p= 0.000$  respectively). All hypertensive patients were on anti-hypertensive drugs.

#### **4.2 Dietary Pattern of Participants**

Three months past dietary history was obtained from both participating groups to ascertain the dietary pattern of participants using a food frequency table. These were mostly the main local diets consumed by people. Options were provided for participants should they eat any other meal other than their main local diets. The study revealed that consumption of fish and fish products were high in both groups than the other protein meals like meat and dairy products; thus (87.3%) of hypertensives and (92%) for non-hypertensives. Ampesi and vegetable sauce is highly patronized by non-hypertensives (60%) than hypertensives (37.3%). It was also realized that consumption of white bread is highest among hypertensives (55.3%) than non-hypertensives (38%). Alcohol and soda drinks are rarely consumed by both groups.

**Table 4.1 Sociodemographic Characteristics and Physical Activity Levels of Study Population**

<b>Sociodemographic data</b>	<b>Total, N (%) n=200</b>	<b>Hypertensive n=150</b>	<b>Non-Hypertensive n=50</b>	<b>P value</b>
Gender				
Male	29 (14.5)	14 (9.3)	15 (30.0)	0.001
Female	171 (85.5)	136 (90.7)	35 (70.0)	
Age group (Years)				
19-30	16 (8.0)	0 (0.0)	16 (32.0)	0.000
31-40	6 (3.0)	1 (0.7)	5 (10.0)	
41-50	28 (14.0)	23 (15.3)	5 (10.0)	
51-60	62 (31.0)	52 (34.7)	10 (20.0)	
61-70	45 (22.5)	41 (27.3)	4 (8.0)	
71-80	36 (18.0)	27 (18.0)	9 (18.0)	
81-95	7 (3.5)	6 (4.0)	1 (2.0)	
Education Level				
Primary/JHS	90 (45.0)	64 (42.7)	26 (52.0)	0.000
SHS/O level	70 (35.0)	65 (43.3)	5 (10.0)	
Vocational	3 (1.5)	3 (2.0)	0 (0.0)	
Tertiary	37 (18.5)	18 (12.0)	19 (38.0)	
Use of Antihypertensive drugs	150 (100)	150 (100)	N/A	N/A
Physical activity				
Low activity	126 (63.0)	97 (64.7)	29 (58.0)	0.577
Medium activity	69 (34.5)	50 (33.3)	19 (38.0)	
High activity	5 (2.5)	3 (2.0)	2 (4.0)	

**Table 4.2: Dietary Pattern of Hypertensive and Non-hypertensive Participants**

Variable	With Hypertension N=150						Control N=50					
	Dy Freq (%)	WkFreq (%)	Mon Freq (%)	YrFre (%)	Occ Freq (%)	NevFreq (%)	Dy Freq (%)	WkFreq (%)	Mon Freq (%)	YrFreq (%)	Occ Freq (%)	NevFreq (%)
Meat and meat products	11 (7.3)	12 (8.0)	28 (18.7)	14 (9.3)	50 (33.4)	35 (23.3)	6 (12.0)	10 (20.0)	14 (28.0)	6 (12.0)	7 (14.0)	7 (14.0)
Fish and fish products	131 (87.3)	11 (7.3)	3 (2.0)	0 (0)	3 (2.0)	2 (1.4)	46 (92.0)	4 (8.0)	0 (0)	0 (0)	0 (0)	0 (0)
Dairy and dairy products	17 (11.3)	10 (6.7)	15 (10.0)	6 (4.0)	31 (20.7)	71 (47.3)	3 (6.0)	7 (14.0)	8 (16.0)	8 (16.0)	11 (22.0)	13 (26.0)
Fufu and palm soup	21 (14.0)	40 (26.7)	42 (28.0)	12 (8.0)	19 (12.7)	16 (10.6)	4 (8.0)	23 (46.0)	10 (20.0)	3 (6.0)	5 (10.0)	5 (10.0)
Fufu and any other soup	54 (36.0)	47 (31.7)	25 (16.7)	4 (2.7)	11 (7.3)	9 (6.0)	5 (10.0)	28 (56.0)	11 (22.0)	1 (2.0)	2 (4.0)	3 (6.0)
TZ and vegetable soup	19 (12.6)	5 (3.3)	11 (7.3)	4 (2.7)	15 (10.0)	96 (64.0)	3 (6.0)	7 (14.0)	5 (10.0)	0 (0)	10 (20.0)	25 (50.0)
TZ and other soup	2 (1.4)	5 (3.3)	3 (2.0)	6 (4.0)	56 (37.4)	78 (52.0)	2 (4.0)	6 (12.0)	4 (8.0)	0 (0)	10 (20.0)	28 (56.0)
White rice and vegetable sauce	31 (20.7)	53 (35.3)	21 (14.0)	4 (2.7)	33 (22.0)	8 (5.3)	25 (50.0)	12 (24.0)	3 (6.0)	3 (6.0)	3 (6.0)	4 (8.0)
Braise rice and pepper without egg	0 (0)	24 (16.7)	16 (10.6)	12 (8.0)	45 (30.0)	53 (35.3)	5 (10.0)	8 (16.0)	11 (22.0)	4 (8.0)	6 (12.0)	16 (32.0)



Fried rice	1 (0.7)	14 (9.3)	16 (10.7)	3 (2.0)	36 (24.0)	80 (53.3)	1 (2.0)	4 (8.0)	11 (22.0)	3 (6.0)	17 (34.0)	14 (28.0)
Jollof rice	3 (2.0)	27 (18.0)	25 (16.7)	6 (4.0)	57 (38.0)	32 (21.4)	4 (8.0)	7 (14.0)	17 (34.0)	4 (8.0)	12 (24.0)	6 (12.0)
Ampesi and vegetable sauce	56 (37.3)	49 (32.7)	11 (7.3)	0 (0)	33 (22.0)	1 (0.7)	30 (60.0)	14 (28.0)	2 (4.0)	2 (4.0)	1 (2.0)	1 (2.0)
Banku and okro soup	16 (10.6)	42 (28.0)	30 (20.0)	4 (2.7)	33 (22.0)	25 (16.7)	13 (26.0)	22 (44.0)	6 (12.0)	0 (0)	3 (6.0)	6 (12.0)
Banku and any other soup	10 (6.7)	35 (23.3)	17 (11.3)	2 (1.4)	63 (42.0)	23 (15.3)	9 (18.0)	24 (48.0)	10 (20.0)	1 (2.0)	4 (8.0)	2 (4.0)
Alcoholic beverage	2 (1.4)	2 (1.4)	1 (0.7)	1 (0.7)	12 (8.2)	132 (88.0)	1 (2.0)	2 (4.0)	2 (4.0)	2 (4.0)	8 (16.0)	35 (70.0)
Soda drink	6 (4.0)	3 (2.0)	12 (8.0)	11 (7.3)	48 (31.0)	70 (46.7)	2 (4.0)	8 (16.0)	9 (18.0)	5 (10.0)	12 (24.0)	14 (28.0)
White bread	86 (55.3)	42 (28.0)	6 (4.0)	2 (1.4)	6 (4.0)	8 (5.3)	19 (38.0)	18 (36.0)	4 (8.0)	2 (4.0)	2 (4.0)	5 (10.0)
Brown bread	73 (48.7)	15 (10.0)	9 (6.0)	3 (2.0)	13 (8.7)	37 (24.7)	7 (14.0)	14 (28.0)	7 (14.0)	0 (0)	9 (18.0)	13 (26.0)
Beans and beans products	29 (19.4)	35 (23.3)	27 (18.0)	10 (6.7)	22 (14.7)	27 (18.0)	1 (2.0)	22 (44.0)	14 (28.0)	5 (10.0)	3 (6.0)	5 (10.0)
Kenkey and pepper	7 (4.7)	34 (22.7)	27 (18.0)	10 (6.7)	59 (30.7)	23 (15.3)	2 (4.0)	20 (40.0)	15 (30.0)	4 (8.0)	4 (8.0)	5 (10.0)
Kenkey and soup	7 (4.7)	14 (9.3)	11 (7.3)	8 (5.3)	79 (52.7)	31 (20.7)	2 (4.0)	12 (24.0)	13 (26.0)	5 (10.0)	6 (12.0)	12 (24.0)

### 4.3 Comparison of mean difference of age and anthropometrics among participating groups

Table 4.3 compares the mean differences of age and anthropometrics among hypertensive and non-hypertensive groups. There was significant difference in age between hypertensive ( $62.18 \pm 11.1$  years) and non-hypertensive ( $48.0 \pm 19.9$  years,  $p$  value= 0.000). BMI, waist circumference (WC), body fat, visceral fat and systolic pressure were significantly higher among hypertensive compared to non-hypertensive groups (BMI:  $p= 0.007$ , WC:  $p= 0.000$ , body fat:  $p= 0.001$ , visceral fat:  $p= 0.002$ , systolic pressure:  $p= 0.000$ )

**Table 4.3: Comparison of means of age and anthropometrics among hypertensive and non-hypertensive participants**

Parameters	Total, N=200	Hypertensive Means $\pm$ SD	Non- hypertensive Means $\pm$ SD	P value
Age (years)	58.6 $\pm$ 15.1	62.18 $\pm$ 11.1	48.0 $\pm$ 19.9	0.000
Anthropometric data				
BMI (kg/m <sup>2</sup> )	26.5 $\pm$ 6.3	27.1 $\pm$ 6.4	24.6 $\pm$ 5.4	0.007
WC (cm)	88.2 $\pm$ 14.3	91.9 $\pm$ 13.2	76.9 $\pm$ 11.1	0.000
Body fat (%)	35.8 $\pm$ 12.1	37.4 $\pm$ 11.7	30.9 $\pm$ 12.2	0.001
Visceral fat (%)	8.7 $\pm$ 3.8	9.2 $\pm$ 3.7	7.2 $\pm$ 3.7	0.002
RMR(kcal)	1387 $\pm$ 173.6	1379.2 $\pm$ 171.1	1413 $\pm$ 180.3	0.249
Systolic (mmHg)	139.6 $\pm$ 17.8	144.0 $\pm$ 16.4	126.2 $\pm$ 15.1	0.000
Diastolic (mmHg)	82.9 $\pm$ 10.2	83.5 $\pm$ 9.9	80.8 $\pm$ 10.7	0.124

#### 4.4 Biochemical indices of hypertensives and non-hypertensives

Table 4.4 presents means of biochemical indices of hypertensive and non-hypertensive participants. ALT was significantly higher ( $p=0.013$ ) among hypertensive ( $26.9\pm13.1$ U/l) compared to non-hypertensive groups ( $21.3\pm13.7$ U/l). However, HDL-C was significantly higher ( $p=0.018$ ) among non-hypertensive ( $1.8\pm1.0$ mmol/l) compared to hypertensive groups ( $1.4\pm0.4$ mmol/l).

**Table 4.4: Comparison of means of biochemical parameters among hypertensive and non-hypertensive participants**

Biochemical data	Total, N=200	Hypertensive Means $\pm$ SD	Non- hypertensive Means $\pm$ SD	P value
CVDs parameters				
FBG (mmol/L)	6.3 $\pm$ 1.5	6.4 $\pm$ 1.5	6.4 $\pm$ 1.6	0.868
TC (mmol/L)	5.5 $\pm$ 1.5	5.6 $\pm$ 1.3	5.1 $\pm$ 1.9	0.073
TG (mmol/L)	1.3 $\pm$ 0.7	1.3 $\pm$ 0.6	1.4 $\pm$ 0.9	0.661
HDL-C (mmol/L)	1.5 $\pm$ 0.6	1.4 $\pm$ 0.4	1.8 $\pm$ 1.0	0.018
LDL-C (mmol/L)	3.5 $\pm$ 1.2	3.6 $\pm$ 1.2	3.4 $\pm$ 1.4	0.314
Coronary risk	4.2 $\pm$ 1.5	4.2 $\pm$ 1.3	4.3 $\pm$ 1.7	0.605
Kidney function test				
Creatinine ( $\mu$ mol/L)	72.4 $\pm$ 36.0	71.7 $\pm$ 39.1	74.3 $\pm$ 25.0	0.582
Urea ( $\mu$ mol/L)	4.4 $\pm$ 2.1	4.3 $\pm$ 2.0	4.5 $\pm$ 2.1	0.566
eGFR (mL/min/1.73m <sup>2</sup> )	110.8 $\pm$ 49.5	110.9 $\pm$ 50.5	110.6 $\pm$ 46.7	0.973
Liver function test				
ALT (U/L)	25.5 $\pm$ 13.5	26.9 $\pm$ 13.1	21.3 $\pm$ 13.7	0.013
AST (U/L)	22.4 $\pm$ 13.1	22.5 $\pm$ 13.7	22.1 $\pm$ 11.3	0.812
Bilirubin ( $\mu$ mol/L)	15.6 $\pm$ 8.0	15.8 $\pm$ 8.1	14.9 $\pm$ 7.7	0.486

#### 4.5 Prevalence of metabolic syndrome indicators and elevated kidney and liver parameters among subjects

Table 4.5 shows the prevalence of metabolic syndrome parameters and elevated kidney and liver parameters among hypertensive and non-hypertensive groups. The prevalence rate of overweight and obesity ( $p=0.014$ ), abdominal obesity ( $p=0.001$ ),

TC (p=0.000) and high coronary risk (p=0.042) were significantly high among hypertensives compared to non-hypertensive group. However, high urea was higher among non-hypertensive (6.0%) compared to hypertensive (14.0%) (p= 0.042).

**Table 4.5: Prevalence of metabolic syndrome indicators and elevated kidney and liver Parameters among hypertensive and Non-hypertensive groups**

<b>Biochemical data</b>	<b>Total=200 N (%)</b>	<b>Hypertensive n=150</b>	<b>Non-hypertensive n=50</b>	<b>X<sup>2</sup></b>	<b>P value</b>
CVDs risk factors					
Overweight and Obesity					
BMI >25.0 (Kg/m <sup>2</sup> )	108 (54.0)	91 (60.6)	17 (34.0)	12.576	0.014
Prediabetes 5.7-6.9 (mmol/L)	110 (55.0)	87 (58.0)	23 (46.0)	2.872	0.238
Diabetes > 7.0 (mmol/L)	41 (20.5)	27 (65.9)	14 (28.0)		
Abdominal obesity (cm)	101 (50.5)	89 (65.4)	12 (34.3)	12.049	0.001
High TC > 5.18 (mmol/L)	118 (59.0)	100 (66.7)	18 (36.0)	14.579	0.000
High TG >1.7 (mmol/L)	47 (23.5)	32 (21.3)	15 (30.0)	1.619	0.445
Low HDL-C (mmol/L)	60 (30.0)	48 (35.3)	12 (34.3)	0.184	0.842
High LDL-C > 4.12 (mmol/L)	55 (27.5)	41 (27.3)	14 (28.0)	0.008	1.000
High Coronary risk	126 (63.0)	101 (67.3)	25 (50.0)	4.833	0.042
Elevated Kidney Parameters					
High creatinine >110 (μmol/L)	17 (8.5)	10 (5.6)	7(14.0)	3.904	0.142
High Urea > 7.5 (μmol/L)	16 (8.0)	9 (6.0)	7 (14.0)	6.33	0.042
eGFR (mL/min/1.73m <sup>2</sup> )					
stage 2 60-89	68 (34.0)	44 (29.3)	24 (48.0)		
stage 3 30-59	7 (3.5)	7 (4.7)	0 (0.0)	7.585	0.055
stage 4 15-29	0 (0.0)	0 (0.0)	0 (0.0)		
Stage 5 < 15	1 (1.0)	1 (1.0)	0 (0.0)		
Elevated Liver Parameters					
High ALT > 40 (U/L)	18 (9.0)	14 (9.3)	4 (8.0)	0.081	1.000
High AST > 40 (U/L)	8 (4.0)	6 (4.0)	2 (4.0)	0.000	1.000
High Bilirubin > 150 (μmol/L)	32 (16.0)	25 (16.7)	7 (14.0)	0.198	0.824

Table 4.6 is an indication of the prevalence of metabolic syndrome among hypertensive and non-hypertensive participants. Metabolic syndrome was significantly prevalent among hypertensive group (70.0%) than non-hypertensive group (10.0%) (p= 0.000).

**Table 4.6: Prevalence of metabolic syndrome among hypertensive and non-hypertensive**

<b>Variable</b>	<b>Total=200 N(%)</b>	<b>Hypertensive n=150</b>	<b>Non hypertensive n=50</b>	<b>P value</b>
Metabolic Syndrome	110 (55.0)	105 (70.0)	5 (10.0)	0.000
No Metabolic Syndrome	90 (45.0)	45 (30.0)	45 (90.0)	

#### **4.7 Effects of physical activity on the development metabolic syndrome among participants**

Table 4.7 displays physical activity levels among subjects with and without metabolic syndrome. There was no significant difference in physical activity levels performed by subjects with metabolic syndrome and those without metabolic syndrome ( $p=0.208$ ). However, subjects without metabolic syndrome recorded highest numbers in their engagement in medium to high activities level (medium activity: 37.9%, high activity: 4.6%) as compared to subjects with metabolic syndrome (medium activity: 33.0%, high activity: 0.9%).

**Table 4.7: Effects of physical activity in the development metabolic syndrome among participants**

<b>Level of Physical activity</b>	<b>Total= 200 N (%)</b>	<b>Metabolic syndrome n=110</b>	<b>No metabolic syndrome n=90</b>	<b>P value</b>
Low activity	126 (63.0)	73 (66.4)	53(58.9)	0.208
Medium activity	69 (34.5)	36 (33.0)	33 (37.9)	
High activity	5 (2.5)	1 (0.9)	4 (4.6)	

#### 4.8 Risk factors of cardiovascular diseases, probable kidney and liver dysfunction among participants with and without metabolic syndrome

Table 4.8 shows risk factors of CVDs, probable kidney and liver dysfunction among study participants with and without metabolic syndrome. High coronary risk (0.000) was significantly higher among subjects with metabolic syndrome.

**Table 4.8: Risk factors of CVDs, kidney and liver dysfunction among participants with and without metabolic syndrome**

Biochemical data	Total=200 N (%)	MetS n=110	Non-MetS n=90	X <sup>2</sup>	P value
High Coronary risk	126 (63.0)	85 (77.3)	41 (45.6)	21.362	0.000
Elevated Kidney Parameters					
High creatinine >110 (μmol/L)	17 (8.5)	8 (7.3)	9 (10.0)	1.415	0.493
High Urea > 7.5 (μmol/L)	16 (8.0)	7 (6.4)	9 (10.0)	1.108	0.575
eGFR (mL/min/1.73m <sup>2</sup> )					
stage 2 60-89	68 (34.0)	35 (31.8)	33 (36.7)	1.945	0.584
stage 3 30-59	7 (3.5)	5 (4.5)	2 (2.2)		
stage 4 15-29	0 (0.0)	0 (0.0)	0 (0.0)		
Stage 5 < 15	1 (1.0)	1 (1.0)	0 (0.0)		
Elevated Liver Parameters					
High ALT > 40 (U/L)	18 (9.0)	9 (8.2)	9 (10.0)	0.200	0.805
High AST > 40 (U/L)	8 (4.0)	4 (3.6)	4 (4.4)	0.084	1.000
High Bilirubin > 150 (μmol/L)	32 (16.0)	13 (11.8)	19 (21.1)	3.181	0.084

#### 4.9 Relationship between coronary risk, kidney and liver parameters of participants with metabolic syndrome

Table 4.9 shows Pearson correlation between coronary risk, kidney and liver parameters of participants with metabolic syndrome in both hypertensive and non-hypertensive groups. Coronary risk (r=192, p=0.007) and alanine aminotransferase

( $r=0.162$ ,  $p=0.023$ ) had weak, significant positive correlation among subjects with metabolic syndrome.

**Table 4.9: Pearson correlation between coronary risk, kidney and liver parameters of participants with metabolic syndrome in hypertensive and non-hypertensive groups**

Biochemical Parameters	Total	Metabolic Syndrome	
		r	p value
Coronary risk	110	0.192	0.007
Kidney function test			
Serum Urea	110	-0.013	0.855
Serum Creatinine	110	0.011	0.879
eGFR	110	-0.065	0.361
LFT			
ALT	110	0.162	0.023
AST	110	0.033	0.648
Bilirubin	110	-0.125	0.079
Controlling for age and gender. Correlation is significant at 2 tailed ( $p < 0.05$ )			

## CHAPTER FIVE

### 5.0 DISCUSSION

A cross-sectional (case-control) study was performed among hypertensive and non-hypertensive patients attending Akim Oda government hospital. The study looked at the dietary pattern using a food frequency table, prevalence of metabolic syndrome in hypertensive and non-hypertensive and its associated effects on specific organs like the heart, kidney and liver.

Generally, there was more female (84.5%) than males (14.5%) in the study, representing a ratio of 6:1. Also, it was in no doubt that female subjects were significantly more hypertensive than male counterpart ( $p=0.000$ ). This was similar to a study by Motlagh *et al.* (2015) which found more females (60.7%) than males (39.3%) in a study among hypertensive and healthy control groups in southern Iran. The study subjects were predominantly above 51 years and hypertensive group were significantly having higher numbers in this age range compared to controls ( $p=0.000$ ). This means hypertension may be more common among ages above 51 years as shown in (table 4.1).

Furthermore, result showing mean anthropometric parameters including; BMI, WC, body fat, visceral fat and systolic blood pressure were significantly higher in hypertensive as compared to non-hypertensive ( $p=0.002$ , SBP:  $p=0.000$ ); (table 4.3). This means hypertensive participants had increased body weight, abdominal obesity and high systolic blood pressure compared to non-hypertensive participants and that conforms to the fact that they have the condition. An increased in body weight, abdominal obesity, and systolic blood pressure among hypertensive participants might increase their risk of cardiovascular diseases compared to non-hypertensive



participants. A study by Cheung *et al.* (2008) found significant higher body mass index, waist circumference, systolic blood pressure among hypertensive (BMI:  $25.0 \pm 3.3$  Kg/m<sup>2</sup>, WC:  $81.5 \pm 9.2$  cm, systolic blood pressure:  $123.0 \pm 11.0$  mmHg) than healthy controls groups (BMI:  $23.5 \pm 3.3$  Kg/m<sup>2</sup>, WC:  $76.7 \pm 9.3$  cm, systolic blood pressure:  $111.0 \pm 12.0$  mmHg,  $p < 0.001$ ).

Results obtained from meta-analysis studies (Whelton *et al.*, 2002; Kelley and Kelley, 2000) and prospective studies (Hu *et al.*, 2004) had shown that performing moderate to intensive physical activity reduced blood pressure in people with hypertension and normotensive individuals. Contrary to health benefit of physical activity, participants had low performance on physical activity. This means majority of the participants performed less than 150 minutes per week physical activity in either moderate or vigorous activities. There was no significant difference in physical activity performed by hypertensive and non-hypertensive group ( $p=0.577$ ) as seen in table 4.1. However, non-hypertensive group were more physically active (medium activity: 38.0%, high activity: 4.0%) compared to hypertensive group (medium activity: 33.0%, high activity: 2.0%).

Additionally, there was no significant difference in physical activity performed by participating group with and without metabolic syndrome ( $p= 0.208$ ) as revealed in Table 4.7. However, using their activity level, subjects with metabolic syndrome (medium activity: 37.9%, high activity: 4.6%) were more physically active compared to subjects with non-metabolic syndrome (medium activity: 33.0%, high activity: 0.9%). This implies that performance of physical activity did not influence any differences among the two groups.

Dietary plans are established by the dietician as soon as High Blood Pressure (HBP) is diagnosed and this is the recommendation of DASH DIET (Dietary Approaches to Stop Hypertension). The dietary plan focuses on the consumption of foods that are low in total and saturated fats, cholesterol and sodium. The plan also focuses on minimizing diet containing red meat, sweets and sugary beverages (Sacks *et al.*, 2001). Hypertension can be prevented or managed if the DASH diet program is strictly followed, as it helps reduce blood pressure considerably in just a matter of time for a lifetime. The DASH diet has other health benefits, including helping to prevent hypertension complication such as osteoporosis, coronary disease, stroke and diabetes.

The consumption of meat and meat products and fufu and palm soup were highest among hypertensives than their counter parts non-hypertensives as indicated in Table 4.2. Alcohol and soda drinks were rarely consumed by both groups even though majority of the hypertension group occasionally consumes soda drinks than non-hypertensives. The saturation in palm oil as found in palm soups could be of great threat when consumed in large quantity on a daily basis as is found among hypertensives. Saturated fat like the palm oil in palm soups can be classified as an atherogenic diet that facilitate the formation of plaques in the arteries of the blood which may increase ones chances of hypertension (Beegom and Singh, 1997). This implies that the group with hypertension fell susceptible to the condition due to their past dietary lifestyle.

Metabolic syndrome is a cluster of interlinked metabolic disorders which increases risk of developing cardiovascular diseases, diabetes and stroke (Salagre *et al.*, 2016). Researches had reported strong association between metabolic syndrome and increased prevalence of coronary artery diseases, peripheral vascular diseases and

stroke (Kelli *et al.*, 2015). Overall, the result showed 55.0% of the study subjects had metabolic syndrome (with 70% for hypertensive, 10% for non-hypertensive) which comprise of having 3 or more disorders in blood pressure, blood glucose, waist circumference, total cholesterol, high density lipoprotein cholesterol and low density lipoprotein cholesterol. This was consistent to a study by Salagre *et al.* (2016) which found 49.1% of hypertensive and healthy controls were having metabolic syndrome. Additionally, the result showed significant prevalence of metabolic syndrome among hypertensive (70.0%) compared to non-hypertensive group (10.0%,  $p=0.000$ ). Results from a study by Cordero and colleagues, (2006) also found that metabolic syndrome was more prevalent among hypertensive (30.2%) compared to healthy controls (1.0%). Hypertension exists as group of clinical disorders that defines metabolic syndrome (Marchi-Alves *et al.*, 2012). This means that metabolic syndrome is associated with hypertension. Metabolic syndrome is also a strong predictor of cardiovascular diseases and stroke. High prevalence of metabolic syndrome found among hypertensive could explain that metabolic syndrome is associated with hypertension. Metabolic syndrome has systematic influence in increasing risk of cardiovascular diseases, hence, hypertensives might be at risk of cardiovascular disease.

The result revealed that HDL-C was significantly higher among non-hypertensive ( $1.8\pm1.0$  mmol/L) compared to hypertensive ( $1.4\pm0.4$  mmol/L,  $p=0.018$ ). HDL-C is a known protective lipoprotein against cardiovascular diseases. Higher level of HDL-C among non-hypertensive could help improve their risk against cardiovascular diseases. Comparative to non-hypertensive, low HDL-C among hypertensive could increase risk of cardiovascular diseases. Uncontrolled blood pressure can impair blood vessels connected to the kidneys, as well as cause dysfunction to cardiovascular

system and liver (Sabbineni, 2016). Generally, the prevalence of risk factors of heart related diseases was high as found in Table 4.6. This implies that the prevalence of cardiovascular risk factors may predispose study subjects to increase risk of developing heart related diseases.

Additionally, the result showed overweight and obesity, abdominal obesity, total cholesterol (TC) and coronary risk were significantly higher among hypertensive (60.6%, 65.4%, 66.7% and 67.3%) compared to non-hypertensive (34.0%, 34.3%, 36.0% and 50.0% respectively, Table 4.5). Obesity, abdominal obesity, and high coronary disease risk are known associated risk factors of cardiovascular diseases. The prevalence of these CVDs risk factors implies that subjects with hypertension might be at a higher risk of developing heart related diseases when these risk factors are persistently high compared to non-hypertensive group. The prevalence of obesity was significantly higher in hypertensive compared to healthy controls in a study by Muhamedhussein *et al.*, (2016).

Despite increased cardiovascular disease risk among hypertensive, kidney problem was recorded as an associated complication of hypertension (Cordero *et al.*, 2006). The result showed prevalence of high urea and high creatinine among hypertensive and non-hypertensive as seen in table 4.5. This means non-hypertensive might be at high risk of kidney problem compared to hypertensive group, although hypertension is associated risk of kidney problem. Low-risk of kidney problem observed in hypertensive could be that drug treatment for hypertensive might have helped to control their risk of kidney problem. Kidney problem could be asymptomatic and might occur unaware. As such, high urea and high creatinine observed among non-hypertensive should be seen as public health concern for screening and detection among large population. The result showed 68% of study subjects had eGFR just

below normal value (60-89 mL/min/1.73m<sup>2</sup>). This could mean a possible acute kidney injury among majority of study subjects. However, it is not evident if they had been diagnosed of any kidney problems. The study found that 4.5% of study subjects had eGFR below 59 mL/min/1.73m<sup>2</sup>. This could be a worry as they might be within either stages of chronic kidney disease or exposed to acute kidney failure. It was not surprising that these 4.5% were among the hypertensive groups. This means hypertension could increase risk of kidney problem in poorly controlled blood pressure.

Moreover, elevated liver parameters including ALT (9.0%), AST (4.0%), and bilirubin (16.0%) were prevalent among study population. A study by Wang and Bautista (2015), found prevalence of high bilirubin (37.2%) among study population comprising of hypertensive and healthy controls. Elevated liver enzymes especially ALT and bilirubin could possibly explain that study population might be at risk of liver damages. And these elevated liver parameters were observed to be higher in hypertensive compared to non-hypertensive as shown in table 4.8 though not significant. Although, the study did not probe further to study possible liver damage, observed elevated liver parameters might send signals of possible liver damage as there were presence and persistent hypertension and other co-morbidities including dyslipidaemia, diabetes and high coronary risk.

According to Kaur, (2014), people with metabolic syndrome have three folds increased risk of cardiovascular diseases. The result showed participants with metabolic syndrome (Overweight and obesity: 70.0%, high coronary risk: 77.3%) had significantly higher cardiovascular risk factors compared to those without metabolic syndrome (Overweight and obesity: 34.4%,  $p= 0.000$ , high coronary risk: 45.6%,  $p=$

0.000) as shown in table 4.5. This means the presence of metabolic syndrome, together with high coronary risk might predispose them to increased risk of coronary heart diseases.

Also, metabolic syndrome is associated with markers of kidney diseases such as reduced glomerular filtration rate, either proteinuria or microalbuminuria (Prasad, 2014). According to Locatelli *et al.* (2006) people with metabolic syndrome might be at significant higher risk of renal diseases when there appear to be more components of metabolic syndrome. However, it is difficult to estimate the damaging effects on the kidney cause by metabolic syndrome in hypertensive but other features like abdominal obesity could independently cause the risk of developing renal diseases. However, there were no significant differences between elevated kidney and liver parameters among subjects with metabolic syndrome compared to those without metabolic syndrome ( $p > 0.05$ ).

A Pearson correlation between coronary risk, kidney and liver parameters in participants with metabolic syndrome of both groups were performed to find any association for these parameters when controlling for age and gender. The result revealed a weak direct association of coronary risk ( $r = 0.192$ ,  $p = 0.0070$ ) and alanine aminotransferase ( $r = 0.162$ ,  $p = 0.023$ ) with metabolic syndrome. This implies that an increase in metabolic syndrome may increase risk of coronary diseases in both groups. Also, an increase in metabolic syndrome may affect liver function among hypertensive and non-hypertensive alike. An elevated serum ALT is strongly linked to excess fat in liver which could be linked to metabolic syndrome as it is associated with obesity, dyslipidemia, and diabetes (Chen *et al.*, 2008). The clusters of metabolic syndrome may cause accumulation of fat in the liver which may lead to elevated alanine aminotransferase in blood.



## **CHAPTER SIX**

### **6.0 CONCLUSION AND RECOMMENDATION**

#### **6.1 Conclusion**

Metabolic syndrome was found prevalent among hypertensives (70.0%) than non-hypertensives (10.0%). Dietary pattern between hypertensive and non-hypertensive was not significantly different; however, hypertensive took more protein food sources than non-hypertensive. Cardiovascular risk factors including high coronary risk, diabetes, abdominal obesity, high total cholesterol, high low density lipoprotein cholesterol, low high density lipoprotein cholesterol were prevalent among study subjects and seen significantly higher among hypertensive than non-hypertensive group. Additionally, high urea and high creatinine were observed among non-hypertensive than hypertensive group. Reduced estimated GFR was higher among hypertensive compared to non-hypertensive. Elevated liver parameters such as alanine aminotransferase, aspartate aminotransferase and bilirubin were prevalent among study subjects, which were also observed higher levels in hypertensive than non-hypertensive group. Metabolic syndrome was weak and directly associated with strong cardiovascular risk factor such as coronary risk and liver parameter such as alanine aminotransferase. Overall, hypertensives were highly at increased risk of heart, kidney problem and liver damage compared to non-hypertensive, and this requires intensive evaluation and monitoring of diet and clinical care of these patients.

#### **6.2 Recommendation**

It is recommended that further study should include assessment of nutrient intakes of hypertensive and non-hypertensive groups, and look at age-matched subjects for both



case and non-hypertensive groups so as to determine its effects on target organs functions.

### **6.3 Limitation of the Study**

The study was limited in assessing particular nutrient intakes of hypertensive and non-hypertensive groups to fully assess effects of nutrient intakes on target organs of these study population.

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## APPENDICES

### KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY COLLEGE OF SCIENCE DEPARTMENT OF BIOCHEMISTRY AND BIOTECHNOLOGY

#### DIETARY PATTERN AND PREVALENCE OF METABOLIC SYNDROME ON TARGET ORGAN DAMAGE OF HYPERTENSIVE PATIENTS

Please provide response to the questions. The questionnaire is purely for academic research work and the information gathered will not be share with any third party or persons or institution without authorisation from the interviewee or the researcher.

Questionnaire No. ....

##### A) Demographic data

- 1) Age.....
- 2) Name of Hospital.....
- 3) Patient contact.....
- 4) Sex:                      Male ☐                      Female ☐
- 5) Level of Education:    Primary Education ☐                      Secondary Education ☐  
Vocational training ☐    University ☐                      No Formal education ☐
- 6) Marital Status:        Single ☐ Married/cohabiting ☐ Divorced/Separated  
[ ] Widow/widower [ ]
- 7) Do you snore during sleep?                      Yes ☐                      No ☐
- 8) Do you seldomly have chest pain:                      Yes ☐                      No ☐
- 9) Are you Hypertensive?                      Yes ☐                      No ☐
- 10) Duration since diagnosed of hypertension: .....(months)
- 11) Is any of your family members Hypertensive?                      Yes ☐                      No ☐
- 12) Are you using antihypertensive?                      Yes ☐                      No ☐
- 13) Duration on antihypertensive .....(months)
- 14) Use of antihypertensive:                      Regular ☐                      Irregular ☐

##### B) CARDIOVASCULAR RISK FACTORS

13. Are you Diabetic?                      Yes ☐                      No ☐
14. If Diabetic, Duration since diagnosis ..... (months)
15. Are you on treatment for Diabetes?                      Yes ☐                      No ☐
16. If yes, state method of treatment    Diet ☐    Hypoglycaemic drugs ☐  
Insulin ☐    Others (specify).....
17. How regular is your Treatment mode:                      Regular ☐                      Irregular ☐
18. Have you ever smoked cigarettes?                      Yes ☐                      No ☐
19. Are you current cigarette smoker?                      Yes ☐                      No ☐
20. If yes, for how long? .....(months)
21. How many cigarettes per day? .....

22. If stopped, when did you stop smoking? ..... (months ago)
23. Do you take alcohol Yes [ ] No [ ]
24. If yes, have you ever felt that you should cut down on your drinking?  
Yes [ ] No [ ]

### C) Physical Activity

#### International Physical Activity Questionnaire

The questions will ask you about your physical activities in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, in the house and even, movements from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that involve hard physical effort that make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

- 1) During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, jogging, aerobics, or fast bicycling?  
..... Days per week

If no vigorous physical activities, please skip to question 3

- 2) How much time did you usually spend doing vigorous physical activities on one of those days? .....minutes per day. Do not know [ ]  
Not sure [ ]

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that involve moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

- 3) During the last 7 days, how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or tennis? Do not include walking. ....Days per week.

If no moderate physical activities, please skip to question 5

- 4) How much time did you usually spend doing moderate physical activities on one of those days? .....minutes per day Do not know [ ]  
Not sure [ ]

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking like to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

- 5) During the last 7 days, how many days did you walk for at least 10 minutes at a time? .....Days per week. If No walking, please skip to question 7

6) How much time did you usually spend walking on one of those days?

.....minutes per day    Do not know [   ]    Not sure [   ]

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing chores and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7) During the last 7 days, how much time did you spend sitting on a week day?

.....minutes per day    Do not know [   ]    Not sure [   ]

Conclusion: Level of physical activity..... low [   ]    moderate [   ]    high [   ]  
very high [   ]

#### D) Dietary Pattern

Answer the following questions in relation to your dietary habit. Tick the appropriate box to suggest how often you consume a particular food in the last three (3) months.

Dietary assessment using the food frequency table

FOOD TYPE	SERVINGS/QUANTITY/ AMOUNT			HOW OFTEN					
	Small	Medium	Large	D	W	M	Y	O	N
1. Meat and meat products									
2. Fish and fish Products									
3. Dairy and dairy products									
4. Fufu and palm soup									
5. Fufu and any Other soup									
6. T.Z and vegetable soup									
7. T.Z and any Other soup (Specify)									
8. White rice and vegetable sauce									
9. Braise rice and pepper without egg									
10. Fried rice									
11. Jollof rice									
12. Ampesi and vegetable sauce									
13. Banku and okro soup									
14. Banku and any other soup (Specify)									
15. Alcoholic beverage									
16. Soda drink									
16. white bread									
17. Brown bread									
18. Beans and beans products. Eg. wakye, koose, Gari and beans etc									
19. Kenkey and pepper									
20. Kenkey and soup (specify)									
21. Others (specify)									

NB

D = daily; W = weekly; M = monthly; Y = yearly; O = occasionally; N = Never

## **E) Physical Examination**

### **1. Eye Examination**

Corneal Arcus Present [ ] absent [ ] ; xanthelasma Present [ ] absent [ ]

### **2. Anthropometry (body composition monitor)**

Height ..... cm

Weight .....kg

BMI ..... kg/m<sup>2</sup>

Waist circumference .....cm

Total body fat .....

### **3. Cardiovascular Examination**

	<b>Systolic</b>	<b>Diastolic</b>	<b>Pulse</b>
1			
2			
Mean			

## **F) LABORATORY TESTS**

1. Serum triglyceride .....mol/L

2. Serum LDL ..... Mmol/L

3. Serum HDL ..... mmol/dL

4. Total serum Cholesterol ..... Mmol/dl

5. Serum creatinine ..... mmol/L

6. Serum Urea .....

7. eGFR .....

8. Urine protein Present [ ] +1 [ ] +2 [ ] +3/+4 Absent [ ]

10. ALT

11. AST

12. Bilirubin