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DIETARY PATTERN AND METABOLIC SYNDROME AMONG URBAN SLUM WOMEN, ACCRA GHANA.

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DEDICATION

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ABSTRACT

Background: Westernization of the Ghanaian diet and poor lifestyle choices are a growing public health concern particularly because of its association with the onset of metabolic syndrome. Urban slum dwellers are vulnerable to different stressors, poor dietary and lifestyle choices. This study seeks to determine dietary patterns and risk factors for metabolic syndrome among urban slum women in Accra, Ghana

Methods: This was a cross-sectional study involving 250 urban slum women of reproductive age (15-49 years) in Nima, Old Fadama and Jamestown in Accra. Information on background characteristics, stress pattern and physical activity were sought using a pre-tested semi-structured questionnaire. Food frequency questionnaire was used to derive women's dietary pattern. Waist circumference (WC) and height were measured following standard procedures. Weight, body mass index and percentage body fat (%BF) were determined using Omron Fat Loss monitor (HBF 400; Omron China). Blood Pressure (BP) and fasting blood sugar (FBS) were determined early in the morning using a digital phsygomanometer (Medisanna Upper Arm BP monitor) and glucometer (OneTouch Select Glucometer) respectively. Metabolic syndrome (MetS) was defined as a combination of overweight/obesity, high BP and high FBS as per WHO criteria. Pearson's chi-square test and binary logistic regression was used to test the association between MetS and background characteristics and p-value <0.05 was considered significant.

Result: Slum women had a mean age of (36.40±4 years). Majority (73.6%) were overweight/obese and 61.2% had high WC (≥88cm). Ninety-four percent of the women had high %BF (>35%). High systolic and diastolic BP was present in 13.6% of the women. About 9.6% had elevated FBS (≥6.1 mmol/l). MetS was seen in 9.6% of the women whereas 55.2% were at risk of MetS. The majority reported to be moderately physically active (96.4%) and had medium socio-economic status, SES (70.0%). Severe stress and depression were lower (4.8 %, 5.2%) respectively but severe anxiety was found among 23.6% of the population. High dietary diversity (62.0%) was the predominant pattern even among women with MetS risk. Starchy staples and oils were main contributors to the different dietary patterns. The less dietary diversity consisted mainly of starchy staples and oils. There were no significant relationships between dietary pattern, MetS and individual MetS components. There were no significant associations between MetS and SES, physical activity level and stress pattern.

Conclusion: Urban slum women are at high risk for developing MetS. However, within this group no significant and clear-cut risk factors could be identified which could guide public health intervention programmes.

Key words: metabolic syndrome, socio-economic status, physical activity, dietary pattern, non-communicable diseases, urban slum women.

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
BP	Blood Pressure
CVD	Cardiovascular Diseases
DASS	Depression Anxiety Stress Scale
FBS	Fasting blood sugar
FFQ	Food Frequency Questionnaire
GDHS	Ghana Demographic Syndrome
GPRS II	Ghana Poverty Reduction Strategy II
IDF	International Diabetes Federation
METS	Metabolic Syndrome
NCD	Non communicable disease
NCEP ATP III	National Cholesterol Education Program Adult Treatment Panel III
PAL	Physical Activity Level
SES	Socio-economic status
SSA	Sub Saharan Africa
UN	United Nations
WHO	World Health Organization
WC	Waist circumference
WHR	Waist to hip ratio

CHAPTER ONE

INTRODUCTION

1.1 Background

The annual urban growth rate in Sub–Saharan Africa (SSA) is almost 5%, double that of Latin America and Asia (UN-Habitat, 2009). However, SSA has the world's biggest proportion of urban residents living in slum which today serve as home for about 72% of urban Africa's citizens summing up to a population of about 187 million people (UN-HABITAT, 2009). As more people move from rural areas to seek greener pastures in urban areas, the urban slum population in Africa is projected to double every 15 years through a process called urbanization of poverty (UN-Habitat, 2009). Rapid urbanization is leading to a significant increase in numbers of people living in unstructured and underserved slums and informal areas of cities in developing countries (GPRS II, 2006). About 199.5 million people are there in SSA slum populations (Talukder *et al.*, 2015). Urban health in the post 2015 agenda stressed on the need for an understanding and addressing of poor health outcomes in slums as an opportunity for improving urban health (Talukder *et al.*, 2015).

In Ghana, slum settlements are characterized by poor living conditions. The growing incidence of slum development in Ghana has been the result of rural-urban migration, improper land distribution, and regulatory frameworks that at best, do not favor the poor (Doddman and Sattherthwaite, 2008). In 2001, the number of people living in slums in Ghanaian cities was estimated to be 4,993,000 and growing at a rate of 1.8% per annum of which 800,000 are urban poor who live in the country's capital. Accra is a major center for manufacturing, marketing, finance, insurance, transportation and tourism. With the service-sector being the largest, it absorbs about 531,670 people of which the informal service sub-sector giving employment to the largest number of the work-force, (GDHS, 2008).

Most people from rural areas shift to the cities in search of better economic opportunities, they undergo serious work -related stress, family hardship, social alienation and drastic change in their lifestyle (Fox, 2014). Usually, some take to habits of smoking and alcohol drinking (Fox, 2014). Many of them remain without jobs or turn to be stationary roadside vendors; resulting in rigorous change in their physical activity profile (Parikh *et al.*, 2012). Sometimes this populace gives up their eating habits and physically active lifestyle and adopt some of the risk factors prevalent in the urban environment. Subsequently, this transition could aggravate their risk for the development of non-communicable diseases (NCDs).

In many developing countries such as Ghana, there is a shift in patterns of dietary intake towards more westernized foods, characterized by increased intake of saturated fat, salt and refined foods with decreased fruits, vegetable and fiber intake. This increases the level of exposure to the CVD risk and diet related chronic diseases (Bourne *et al*., 2002).

1.2 Justification of research

This study seeks to determine metabolic syndrome (MetS) and dietary pattern of women internal migrants and indigenous slum dwellers in Ghana who live in the nation's capital. This group of the Ghanaian population are exposed to diverse scope of vulnerability in the capital city although they contribute to the economic development of the nation through the informal sector. They are involved in petty trading, head porterage, food vending, etc. Little is known about their health and nutritional status. The outcome of this study will be used to generate database for further studies and also identify if this vulnerable group is also following the nutrition transition and hence their increased risk for non-communicable diseases. This will give a basis for further pragmatic actions to be carried out to increase the awareness of the risk of non-communicable diseases and hence their control among slum dwellers.

In Ghana, slum settlements are characterized by poor living conditions which in turn have a major impact on health and access to health services for the population. They are exposed to vulnerabilities, different forms of stresses and risk factors that can lead to the development of metabolic syndrome and other non-communicable diseases (NCDs). Chronic non-communicable and communicable diseases like hypertension, diabetes, intentional and unintentional injuries, tuberculosis, rheumatic heart disease, and HIV infection are recognized to exist in slums only because of late complications of these diseases that the formal health sector sees and deals with. However, in slums, little is known about the extent, distribution, and risk factors for these illnesses before they manifest as stroke, myocardial infarction, kidney failure, suicide, multidrug-resistant TB, heart valve disease, and AIDS.

Of the total population of urban slum dwellers, 55% are women (Lai *et al*., 2008). The prevalence of overweight/obesity among women (15-49 years) grew from 25-30% within 2003-2008, (GDHS, 2008). Few studies that have been carried out in Ghana focused on public servants, people of higher socioeconomic studies and one study in a rural area. Those studies that were carried out on women focused on those in the formal sector and non-slum dwellers.

Moreover, comprehensive data on the nutrient intake among slum dwellers is scanty. Also, the increasing adaptation to western lifestyle coupled with increase in weight gain after birth is not limited to people of higher socioeconomic status only. No study in Ghana has looked at the dietary pattern of this group of the Ghanaian population as a determinant of their risk for developing metabolic syndrome.

1.3 Objectives

1.3.1 Main objective

This study seeks to assess the association between the dietary pattern and metabolic syndrome among urban slum women.

1.3.2 Specific objectives

- To assess the dietary pattern of the urban slum women.
- To determine how each food group contributes to the dietary diversity
- To assess the stress pattern and physical activity levels among the study participants
- To determine the body mass index, waist circumference, waist to hip ratio, blood pressure and fasting blood glucose of the study participants.
- To determine the prevalence of the risk factors for metabolic syndrome among the study population.
- To determine the prevalence of metabolic syndrome among the study participants
- To identify the predictors of Metabolic syndrome among the study participants
- To identify the relationship between the metabolic syndrome components and other characteristic variables

1.4 Research questions

- To what extent does dietary pattern of urban slum women increase their risk for metabolic syndrome?
- Does stress level among urban slum women increase their risk for metabolic syndrome development?
- Do the socio-economic status of urban slum influence development of metabolic syndrome?
- Does their physical activity level predispose them to the development of Metabolic syndrome?

1.5 Hypotheses

1.Ho**:** There is no relationship between socio-economic status of slum women with metabolic syndrome.

Hα: There is a relationship between socio-economic status of slum women with metabolic syndrome

2.Ho: There is no association between dietary pattern and metabolic syndrome among urban slum women.

Hα: There is an association between dietary pattern and metabolic syndrome among urban slum women.

3. Ho: There is no relationship between physical activity and metabolic syndrome among urban slum women.

Hα: There is a relationship between physical activity and metabolic syndrome among urban slum women.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Description of slums and their emergence

Slums are densely populated and uncared for parts of cities characterized by exceptionally poor housing and living conditions (Turley *et al*., 2013). From central city slums to spontaneous squatter communities at the edge of cities, slums are the outcomes of unplanned urbanization resulting in numerous socio-economic and health-related complications for the inhabitants, (Butala *et al.,* 2010, UN HABITAT, 2003a).

Between countries and even between residents within the same country, there are to some extent variations in the conditions of living in slums. Some may have fewer employment opportunities for inhabitants than others, whiles others may present a wealth of formal or informal income-earning opportunities. Rapid population growth, rural-urban migration and the failure of urban governance are considered the major contributory factors for the upsurge of slums (WHO, 2005).

The number of slum dwellers in Ghana is estimated at 5.9 million as at 2010 (Ghana Statistical Service, 2012). The slum population is set to reach 6.5 million and 7.1 million by the end of 2015 and 2020 respectively, up from 5.4 million in 2005, against a population of 22.5 million (UN-Habitat, 2011).

In Ghana, three different types of slums can be identified. They include-the *Indigenous community* which is characterized by traditional homes with sometimes good infrastructure without permits. These indigenous slum communities are usually situated within the city center, close to the business area and comprise the original settlement before urbanization (Abu Salia *et al*., 2015). The second type is the *migrant slums* occupied by first generation migrants and are adjacent to indigenous slums. These two form part of the city that has been helmed in by rapid urbanization (Abu Salia *et al*., 2015). The third which is the *squatter communities* is now coming forth accommodating recent migrants from rural areas.

2.2 Definition of metabolic syndrome

Metabolic syndrome is defined by a cluster of interlinked physiological, biochemical, clinical and metabolic factors that directly aggravate the risk of cardiovascular diseases, type 2 diabetes and all-cause mortality (Grundy *et al.*, 2005, Wilson *et al.*, 2005). Mostly, cardiovascular disease (CVD) is viewed as the primary clinical outcome of the metabolic syndrome. Majority of people with this syndrome have insulin resistance, which confers an elevated risk of type 2 diabetes. When diabetes becomes clinically significant, CVD risk rises quickly. Apart from CVD and type 2 diabetes, individuals with metabolic syndrome are prone to other conditions, notably polycystic ovary syndrome, fatty liver, cholesterol gallstones, asthma, sleep disturbances, and some forms of cancer, (Grundy *et al*., 2004).

2.2.1 Components of the metabolic syndrome

Markers used in determining this condition that relate to CVD include: atherogenic dyslipidemia, raised blood pressure, insulin resistance ± glucose intolerance, abdominal obesity, proinflammatory and a prothrombic state, (Grundy *et al*., 2004). The pathogenesis of MetS is unknown but there are three potential etiological categories: obesity and disorders of adipose tissue, insulin resistance and other factors that work between specific components of MetS. Depending on the number of components, the metabolic syndrome varies between individuals. Using the WHO criteria, about 25.1% of type 2 diabetic subjects had MetS whiles other combinations gave estimates of about 56% (Isezuo and Ezunu, 2005). In Africa, two combinations of three components of MetS are usually found; central adiposity, high blood pressure and hyperglycemia.

Obesity is one of the major components that defines the MetS. Basically, the accumulation of excess body fat which becomes evident as increased body mass index or waist circumference, (Okafor, 2012). The contribution of obesity to the explanation of MetS is highlighted by its addition by all expert groups in the definition of metabolic syndrome.

Hypertension, also another familiar component of the metabolic syndrome having indications for diagnosis, (Okafor, 2012). It is one of the most common cardiovascular disorders in the present day Africa, (Isezuo and Ezunu, 2005). A study conducted by Arthur et al., (2013) in Ghana showed 56% of premenopausal women to be hypertensive according to the WHO criteria whereas 83.2% of postmenopausal women were having high blood pressure. The risk of hypertension has been realized to increase with long- term urbanization and nutrition transition, (Sodjinou *et al*., 2008).

2.3 Criteria for clinical diagnosis of metabolic syndrome

There have been several criteria for MetS diagnosis which do have similar characteristics yet significantly different from each other.

The following organizations have a recommended clinical criteria for MetS diagnosis: WHO (Alberti and Zimmet,1998), the European Group for the study of insulin resistance (EGIR), (Balkau and Charles, 1999), the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), (Cleeman, 2001), American Association of Clinical Endocrinologists(AACE) (Einhorm, 2003) and the International Diabetes Federation(IDF), (http://www.idf.org/metabolic-syndrome). For the sake of this review, 3 organizational criteria will be considered.

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

Criteria of ATP III are shown in Table 2.1. When a participant has three of five listed criteria, a diagnosis of the metabolic syndrome can be made. The main clinical outcome of metabolic syndrome was identified as coronary heart disease, (CHD). ATP III defined the metabolic syndrome essentially as a congregate of metabolic problems of obesity, (Grundy *et al*., 2004). The criteria listed include abdominal obesity, set by increased waist circumference, raised triglycerides, reduced HDL, elevated blood pressure, and raised plasma glucose. Insulin resistance is not required for the diagnosis; however, most subjects meeting ATP III criteria will be insulin resistant. The presence of type 2 diabetes does not exclude a diagnosis of metabolic syndrome.

Table 2.1: NCEP/ATP III clinical identification of the metabolic syndrome

Risk factor	Defining Level
Abdominal obesity, given as waist circumference*† Men Women	>102 cm >88cm
Triglycerides	≥1.7 mmol/L
HDL cholesterol Men = Women	<1.04 mmol/L <1.30mmol/L
Blood pressure	≥130/≥85mmHg
Fasting blood glucose	≥6.1mmol/L

*Overweight and obesity are associated with insulin resistance and the metabolic syndrome. However, the presence of abdominal obesity highly corresponded with the metabolic risk factors than is an increased BMI. Therefore, the simple measure of waist circumference is proposed to identify the body weight component of the metabolic syndrome. †Some males can develop multiple metabolic risk factors when the waist circumference is only increased to a limited extent, e.g. 94 to 102 cm. Such patients may have a strong genetic contribution to insulin resistance. They should benefit from changes in life style, similarly to men with categorical increases in waist circumference. Adapted from Definition of Metabolic Syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association Conference on Scientific Issues Related to Definition (Grundy *et al*., 2004).

2.3.2 The World Health Organization (WHO) identification

The WHO perspective also takes into consideration CVD as the basic outcome of metabolic syndrome. Apparently, the WHO criteria unlike the ATP III definition of metabolic syndrome includes those persons with high blood glucose/ insulin resistance as the basis for diagnosis along with two other risk factors from high blood pressure, raised triglycerides, low HDL and increased BMI (or increased waist: hip ratio) and microalbuminuria, The obesity component can be measured by waist-hip or BMI and includes microalbuminuria, which links the syndrome with risk for developing chronic kidney diseases. Additionally, the WHO definition includes impaired glucose tolerance measured by oral glucose tolerance test or 2-hr post glucose challenge as part of the criteria, tests considered by some to be less practical and added cost with a small added value of predicting cardiovascular risk, (Grundy *et al*., 2004).

Table 2.2: WHO Clinical Criteria for Metabolic Syndrome

Insulin resistance, identified by one of the following:
Type 2 diabetes
Impaired fasting glucose
Impaired glucose tolerance
Or for those with normal fasting glucose levels (<6.1 mmol/L), glucose, uptake below the lowest quartile for the background population under investigation under hyperinsulinemic, euglycemic conditions
Plus, any two of the following:
Antihypertensive medication and /or high blood pressure (≥140 mmHg systolic or ≥ 90mmHg diastolic)
Plasma triglycerides ≥1.7mmol/L
HDL cholesterol< 0.9mmol/L in men or <1.0mmol/L in women
BMI > 30kg/m^2 and /or waist:hip ratio > 0.9 in men,> 0.85 in women
Urinary albumin excretion rate ≥ 20µg/min or albumin: creatinine ratio ≥ 3.4mg/mmol

Adapted from (Grundy *et al*., 2004) Definition of Metabolic Syndrome: Report of the National Heart, Lung and Blood Institute/ American Heart Association Conference on Scientific Issues Related to Definition.

2.3.3 American Association of Clinical Endocrinologists (AACE)

The AACE has suggested a third set of criteria for the insulin resistance syndrome (MetS). This AACE definition seems to blend the ATP III and WHO definitions without a defined number of risk factors. The diagnosis is usually left to clinical judgment.

2.4 Epidemiology of metabolic syndrome

Depending on the region being urban or rural environment, the age, sex, race and ethnicity of a given population under study, the MetS prevalence ranges from <10%- 84% also varying depending on the definition used (Kolovou *et al.*, 2007). It has been estimated by the IDF that one-quarter of the world's adult population has the MetS (http://www.idf.org/metabolic-syndrome), there is significant association between MetS and the following indicators: socioeconomic status, sedentarism and BMI. Genetic background differences, dietary patterns, physical activity level, stress, educational status, family history of diabetes all have got influence on Mets prevalence and its components (Cameron and Zimmet, 2004). The National Health and Nutrition Examination Survey observed the prevalence of MetS to be 5% among normal weight subjects, 22% among overweight subjects and 60% among obese individuals (Park *et al.,* 2003). MetS increases with age and so as one advances in age, the risk for MetS developing increases. An example was seen with individuals 20-29yrs having 10% increased risk, this increased to 20% within the ages 40-49 and for 60-67yrs it was about 45% (Ponholzer *et al.*, 2008). A study conducted by Ponholzer *et al.*, (2008), reported that postmenopausal women stand a high prevalence varying from 32.6%-41.5%. Also, a heart study report in Framingham showed that a weight increase of ≥2.25kg over a period of 16yrs was associated with an up to 45% increased risk of developing the Mets. Palaniappan *et al*., (2004) also reported that for a 11cm increase in waist circumference increases the risk for developing the MetS at an 80% adjustment.

2.5 Pathophysiology of metabolic syndrome

The underlying mechanisms of MetS are not well explained, (Eckel *et al.*, 2005). The role of sedentary lifestyle habits in the development of MetS is well known (Reaven, 1988). This syndrome is a complicated situation which is caused by the interaction between genetic and environmental factors as well as these two factors standing on their own can cause MetS. It is known to have many causes but the most accepted and consolidated hypothesis to delineate the pathophysiological basis of MetS is insulin resistance and abdominal obesity (Wansink *et al.*, 2007 and Eckel *et al.*, 2005). Adding to that, the pathogenesis of hypertension as part of the Mets is not clearly understood, (Laaksonen *et al.*, 2008).

Insulin resistance can be defined as an insufficient insulin action in the liver, skeletal muscle and adipose tissue. When there is insulin resistance, it gives rise to increased gluconeogenesis in the liver, decreased glucose disposal in the muscle, endothelial dysfunction in the arteries and the increased release of free fatty acids from the adipose tissue. Hyperglycemia occurs if the compensatory mechanism of production of insulin leading to hyperinsulinemia to maintain euglycemia fails (Reaven, 2005). Elevated levels of circulating free fatty acids contribute to the development of insulin resistance by inhibiting insulin signaling, (Wansink *et al.*, 2007). Plasma free fatty acids are derived mainly from adipose tissue by the action of lipases, (Eckel *et al.*, 2005). Insulin hinders lipolysis in adipose tissue and glucose production in the liver, (Eckel *et al.*, 2005). When insulin resistance develops, the inhibitory effect of insulin on lipolysis is suppressed.

Adipose tissue is not merely a passive storage depot, but functions as a highly active metabolic organ producing free fatty acids and vast variety of bioactive molecules. In case of obesity, particularly abdominal obesity, the release of free fatty acids is increased. In addition, there are elevated levels of inflammatory cytokines and reduced production of anti-inflammatory adipokines (Eckel *et al.*, 2005, Wansink *et al.*, 2007).

Hypertension has been suggested to relate to insulin resistance in several mechanisms, (Wansink *et al.*, 2007). For example, free fatty acids produced by the adipose tissue may directly mediate vasoconstriction, (Tripathy *et al*., 2003). Adipocytes give rise to different vasoactive peptides which may alter the vasodilatory effect of insulin. Apparently, the association between insulin resistance and hypertension is more obvious in obesity cases, which pre-supposes that the effect may be mediated by adipose tissue, (Wills *et al.*, 1996). In addition, it has been suggested that low-density lipoprotein and triglycerides may damage the arterial epithelium, inhibit nitric oxide release and cause endothelial dysfunction. Therefore, dyslipidemia characterized by raised levels of apoB containing lipoproteins could lead to hypertension by mechanisms only partly related to obesity and insulin resistance, (Laaksonen *et al.*, 2008).

There has been a genetic basis for the individual components of the MetS (obesity, hypertension, dyslipidemia, hyperglycemia), (Sutton *et al.*, 2005, Pollex and Hegele, 2006) that have been shown from results obtained from multiple genome-wide studies. With such associations, the development of MetS is enabled. A low variance has been explained with the proportion of contribution to the development of MetS, (Vaag, 2008, Peeters *et al.*, 2008, Pietilainen *et al.*, 2006). Genetics of MetS include a large number of genes having weak effects but they may interact with each other and work hand in hand with environmental factors (diet, physical activity, alcohol intake, and smoking) in the pathogenesis of the Mets (Andreassi and Botto, 2003).

The risk for MetS may even be evident at birth. This is because Barker *et al.*, (1993) have put forward that intrauterine malnutrition, marked by low birth weight may bring about reduced insulin sensitivity especially if they experience a rapid catch-up growth during the first years of life. The above mentioned occurrence favors the progression of hypertension, insulin resistance, hypercholesteromia, hence MetS in adult life.

2.6 The nutritional and lifestyle modifications that enhance development of obesity and the metabolic syndrome

2.6.1 Nutrients

Explicitly stated, if intake of energy by an individual is relatively higher than what he or she expends through physical activity, it poses a high risk for development of obesity, (Vuori, 2001). Rural-based people in developing world primarily consume simple diets comprising of low carbohydrate, low total and saturated fat, high fiber and overall low intake of energy, (Unger *et al*., 2015). Affluence and urbanization lead to increased consumption of energy, carbohydrate and fat (especially saturated fat) and decreased intake of dietary fiber. High levels of rural-urban migration has exposed more people to the urbanized environment, leading to obesity and development of non-communicable disease, (Unger and Riley, 2007).

Nutrients that have been evaluated in relation to MetS include total energy (kilocalories), fats, carbohydrates, alcohol, calcium, Vitamin D, and magnesium, (Kimoti and Brown, 2011). Macronutrients, including fat and carbohydrates, have been studied more into details as compared with micronutrients, and the evidence base permits more reliable conclusions concerning the utility of changing dietary composition.

Both the quantity and the quality of dietary fat have been probed in relation to MetS and its components. All inclusive, the evidence on the role of total fat (quantity) in the etiology of MetS in prospective studies is vague, (Kimokoti and Brown, 2011). Although MetS has been associated with elevated total fat intake in selected prospective cohort studies such as the Tehran Lipid and Glucose Study (TLGS), (Mirmiran *et al*., 2008) and the Coronary Artery Risk Development in Young Adults (CARDIA) study, (Carnethon *et al*., 2004), no clinical trials have been carried out to test whether the association is causal, (Melanson *et al*., 2009).

Verification suggesting that the quality of fat influences risk factors is more convincing. Intervention trials indicate that the exchange of saturated fatty acids (usually found in meat and high-fat dairy) with monounsaturated fatty acids and polyunsaturated fatty acids, such as those found in vegetable oils, reduces the risk of developing MetS comparable to replacement of saturated fatty acids with carbohydrates, (Kimokoti and Brown, 2011).

Contrarily, replacing saturated fatty acids with trans-fat raises the total cholesterol: HDL-cholesterol ratio and heightens the risk. Raising monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) as a percentage of total calories also favors insulin resistance. Adding to that, diets with high levels of monounsaturated fatty acids are linked with lower blood pressure as compared with high-carbohydrate/low fat diets (Melanson *et al.*, 2009, Micha and Mozaffarian, 2010).

The quality and quantity of dietary carbohydrates have been researched in relation to the progression of MetS and its individual components, (Kimokoti and Brown, 2009). The intake of high amounts of carbohydrate, defined as ranging from 48 to 63% of total energy intake, has been associated with accrued risk for MetS in several prospective studies which include the TLGS, the CARDIA study and the British Regional Heart Study, Mimiran *et al*., 2008, Carnethon *et al*., 2004 Ruxton *et al*., 2010 and Wannamethee *et al*., 2006).

In spite of the observed association, it is uncertain as to whether a change in percentage of dietary carbohydrate influences the long term management of MetS risk (Brand-Miller *et al*., 2009). A meta-analysis of clinical trials conducted in 2009, showed very-low carbohydrate diets (≤60g/day) were efficacious in reducing body weight, systolic blood pressure, and triglycerides while elevating HDL cholesterol comparable to low-fat diets (≤ 30% energy from fat), up to 1 year; that not being the end, more investigation is needed to be carried out in order to evaluate the outcome of low-carbohydrate diets over a long period of time, (Kimokoti and Brown, 2009). This will allow a continuous association with positive metabolic outcomes, (Hession et al., 2009).

In as much as low carbohydrate diets have shown positive results with respect to MetS risk factor management, it could mean that not the quantity but the quality of dietary carbohydrate is more crucial for disease prevention.

The most common measure of carbohydrate quality is the glycemic index, (GI). High-GI foods such as white bread quickly increase the postprandial blood glucose, leading to hyperinsulinemia (Kimokoti and Brown, 2009). Consequently, lower –GI foods (such as whole grains and vegetables release glucose slowly hence lowering insulin release. However, both low-carbohydrate and low-GI diets appear to have similar effects in progressing metabolic risk, low- carbohydrate diets may cause a change in lipid profile in the long term and should be approved with caution. No unfavorable findings are at the present associated with low –GI diets, which may therefore be the favored therapeutic option, (Moeller *et al.*, 2007).

Few studies including the Amsterdam Growth and Health Longitudinal Study, have published significant findings relating total energy intake to development of MetS. In this particular study, there was a relationship between higher energy intake and MetS development in young adults, (Ferreira *et al.*, 2005). Higher total energy intake was shown to be associated with risk for MetS, exclusive of other risk factors, in individuals followed from age 13 years through age 36 years, (Ferreira *et al*., 2005). Given the fact that the available evidence is small, the relationship between total energy and the development of MetS is currently vague, however, individuals should be monitored for indications of excess energy intake and emanating weight gain.

2.6.2 Foods

Most often, people's dietary intake entails variety of foods and a complex mix of nutrients. Few reports that relate diet to MetS do cite individual foods or food groups. However, there is proof that some types of beverages, meat and fried foods may be associated with a higher risk of MetS development whereas dairy products may be linked with a lower risk.

Intake of sugar-sweetened beverages in high amounts including soft drinks, fruit drinks, iced tea and energy and vitamin-water drinks may be linked with MetS risk and its components. This suggestion has been made by a number of prospective cohort studies including the Framingham Offspring/Spouse Study, the Atherosclerosis Risk in Communities (ARIC) Study and the Multi-Ethnic Study of Atherosclerosis, (Dhingra, 2007, Lutsey *et al*., 2008 and Nettleton *et al*., 2009). However, from clinical trials, findings are inexplicit, (Micha and Mozaffarian, 2010). Also, from the ARIC cohort study, a suggestion was raised concerning higher intake of meat and fried foods. This evidence was that higher intakes of above mentioned foods have ill effect in that they raise the MetS risk. This may be assigned to the high content of saturated fats in meat and in foods fried in trans fats, (Micha and Mozaffarian, 2009 and Lutsey *et al*., 2008). As observed in a 2011 review by Crichton *et al*., increased intake of dairy products may improve insulin sensitivity and shield against MetS. Apparently, this may not be applicable in most African countries where dairy products do not form a major part of their diet and also related issues of lactose intolerance. More so, evidence for this beneficial effect is ambiguous.

There is an existing relationship between alcohol intake and the risk for development of MetS and cardiovascular health (Athyros *et al*., 2008). Alcohol intake has become an extensive prevalent lifestyle in many societies and cultures. Apparently about 40% of the world's population drink alcohol regularly, (Shield *et al*., 2013). A study done by (Lee *et al*., 1990) proposed that moderate alcohol intake protects health than abstinence. Also McKee and Britton, (1998) laid emphasis on the protective effect of alcohol. Nevertheless, a study conducted in Russia tried to identify the relationships of alcohol consumption to total and cardiovascular disease mortality in US and Russian men and women (Deev *et al*., 1998). In this study, men between the ages of 40-59 and women 40-69 were screened in Russia and the U.S between 1972 and 1982. They were then followed up for 13 years as part of the Lipid Research Clinics Prevalence and Follow-up studies based on a 7-day recall of all types of alcoholic beverages. It was then discovered that alcohol consumption had no cardio-protective effect.

Moreover, excessive alcohol consumption has also been associated with increased risk of obesity, (Baik and Shin,2008), dyslipidemia (Wakabayashi, 2013), hyperglycemia (Cullmann *et al*., 2012) and hypertension (Wakabayashi, 2008), of which all are risk factors for the development of cardiovascular diseases and MetS components. According to a study conducted by Bermúdez *et al*., (2015), a multivariate analysis of the relationship between alcohol consumption and MetS and its components showed hypertriacyl glyceridemia to be the most significantly associated with alcohol consumption in females. Alcohol consumption could be said to be determined mainly by population-specific geographic, sociodemographic and cultural factors, (Hu, 2011). It is imperative to study these characteristics in each population and their overall relation to cardiovascular and metabolic disorders, (Bermúdez *et al*., 2015).

2.6.3 Dietary pattern

Existing data on the relationship between empirical dietary patterns and metabolic syndrome (MetS) and its components in prospective study designs are limited, (Kimokoti *et al*., 2012). Also, the demographic characteristics and lifestyle determinants of MetS may alter or change the association between dietary patterns and the syndrome, (Kimokoti *et al*., 2012).

Guidelines aimed at preventing MetS target mainly the single risk factors which sum up to develop the syndrome, (Grundy *et al*., 2005, Dandona *et al*., 2005 and Kimokoti and Brown, 2011). Many foods/nutrients have been shown to affect more than one component of MetS. For example, soft drinks may increase the risk for abdominal obesity, hypertension, hyperglycemia, low HDL-cholesterol, and hyper-triglyceridemia, (Dhingra *et al*., 2007); and fiber intake has an inverse relationship with abdominal obesity, hypertension, and hyperglycemia, (Anderson *et al*., 2009). MUFA and PUFA have been shown to enhance HDL-cholesterol and hypertriglyceridemia, (Kris-Etherton, 2007). The use of dietary pattern method which may better inform the comprehensive effect of diet on health outcomes, is thus appropriate for testing associations between diet and overall MetS, (Newby and Tucker, 2004).

The complex interactions among dietary factors creates conflicting findings in studies that focused on single nutrients and individual foods (Kimokoti and Brown, 2009). The afore mentioned reason has caused current nutrition researches to concentrate on dietary patterns, laying emphasis on the total diet so as to assess the relationships between diet and health outcomes (Moeller *et al*., 2007). The use of identifying dietary patterns and aiming at them in interventions has been confirmed in large-cohort studies as well as in well-designed intervention trials, (Lutsey *et al*., 2009). Longer-term (≥5years) prospective studies show that, in general, a higher-quality diet distinguished by appreciable intake of whole grains, vegetables, fruits, nuts, fish, poultry, and vegetable oils, as well as moderate consumption of alcohol, constitutes a dietary pattern dubbed the prudent pattern, that protects against MetS. In contradiction, a pattern high in intake of refined grains, meat/meat products, animal oil/fat, fried foods, alcohol, sweetened beverages-known as the 'Western' pattern- is associated with a significant risk for MetS, (Tortosa *et al*., 2007). Results from intervention trials also show that healthful dietary patterns, including the Dietary Approaches to Stop Hypertension (DASH) diet (high in fruits, vegetables, complex carbohydrates, nuts, legumes, low-fat dairy, fish, and poultry and low in meat, sweets and fats) and the Mediterranean diet, boost MetS components. Esposito *et al*., (2004) compared the effect on MetS of a Mediterranean-like diet (carbohydrates 50-60%, proteins 15-20%, total fat<30%, plus advice to increase intake of whole grains, vegetables, fruit, nuts and olive oil) with that of a prudent diet (dietary counseling recommending a diet with a macronutrient composition close to that of the intervention diet but no exact individualized program) between 180 patients (n=90 in each group). Both groups were encouraged to increase their physical activity to 30 minutes per day of walking or swimming. Over 2 years of follow-up, there was a lower prevalence of MetS associated with the Mediterranean-like diet as compared to the prudent diet (43% vs. 17%; $P<0.001$). The mean changes in metabolic risk factors were also greater in those on the Mediterranean-like diet, (all $P<0.05$) (Esposito *et al*., 2004).

Dietary quality indicators in both cross-sectional (Fogli-Cawley *et al*., 2007, Babio *et al*., 2009, Alvarez *et al*., 2006) and prospective studies have shown an association with MetS and its components. In a variety of populations, including Framingham, high-level diet quality distinguished by greater intake of low-glycemic index foods, fruits, vegetable and vegetable oils, poultry and nuts as well as moderate alcohol consumption have been shown to have vested lower risk for MetS (Fogli-Cawley, *et al*., 2007, Babio *et al*., 2009, and Alvarez, *et al*., 2006) and MetS components (Millen *et al*., 2006 and Rumawas, *et al*., 2009). The association based on pragmatic patterns and MetS and its risk factors has also been verified mostly in cross-sectional studies. A healthy pattern that is corresponding in intake with higher diet quality equally lowers MetS risk and its components Esmaillzadeh, *et al*., 2007 and DiBello *et al*., 2009).

Distinctively, dietary patterns designated by high intakes of refined grains, processed and red meats, trans fat, sweetened beverages, and soft drinks such as adopted by the Western world and similar patterns elevates the MetS risk (Panagiotakos, *et al*., 2007 and Esmaillzadeh, *et al*., 2007). In the Framingham Nutrition Studies (FNS), the Empty Calorie pattern was associated with a higher prevalence of MetS (Sonnenberg, *et al*., 2005). However, in another recent population-based prospective study, the Prudent pattern, which is similar to the Heart Healthier pattern in the FNS, was not appreciably associated with the syndrome (Lutsey, *et al*., 2008). There is a well-established association between dietary pattern and MetS. According to Pasanisi, *et al*., 2001, Dattilo and Kris-Etherton, 1993, Dengel, *et al*., 2006). A good dietary habit can be used for treating all of the components of MetS. Previous reports explained that increases fruit and vegetables intake are associated with lower prevalence of MetS (Esmaillzadeh *et al.*, 2006). Dietary pattern analyses have made clear that a diet rich in cereals, fish, vegetables and fruits was independently associated with reduced levels of clinical and biological markers linked to MetS whereas a higher prevalence of MetS was found with individuals who consume westernized diets characterized by high intakes of refined grains, processed meat, fried foods and red meat (Esmaillzadeh *et al.*, 2006 and Esmaillzadeh, *et al.*, 2007, Lutsey, *et al.*, 2008).

According to Esposito *et al.*, (2004), a Mediterranean dietary pattern characterized by high consumption of whole grains, fruits and vegetables and nuts and olive oil decreases MetS components and thus is proposed to provide a benefit on CVD risk. In this study, there was an observed weight loss (-4.0±1.1kg) in the intervention group than those who were recruited into the control group. This signals the beneficial changes that may have occurred due to weight loss. In this study, intake of a Mediterranean-style diet by patients with the metabolic syndrome was linked with progression of endothelial function and a meaningful decrease in the markers of systemic vascular inflammation. Apparently, participants who followed the intervention diet came out with a decrease in the number of the components of the syndrome even that, the total prevalence of the MetS decreased by approximately one half (Esposito *et al*., 2004).

2.6.4 Physical activity

Physical activity according to Bouchard *et al*., (1994) is defined as bodily movement brought about by the skeletal muscles that end up in a significant increase in the body energy expenditure. There has been increased knowledge and awareness on the health benefits of physical activity and also the consequences of physical inactivity (Bouchard *et al*., 1994). In the area of health sciences, physical activity can be termed low, moderate or high, depending on the physiological characteristics including its intensity, duration, and frequency. Sometimes the type of activity enables one to identify level of physical activity such as walking, cycling, swimming, etc. (Bouchard et al., 1994). Increasing physical activity improves insulin sensitivity by enhancing glucose transport and insulin action in muscles, increases high density lipoprotein (HDL) cholesterol levels, lowers triglyceride levels and prevents hypertension (Cornier *et al*., 2008, Lakka *et al.*, 2003, Stewart, 2012 and Hu *et al.*, 2004). Physical activity is a behavioral pattern adapted over time and then becomes a lifestyle. It is shown to protect against development of MetS through its effect on the individual components, (Cornier, *et al.*, 2008).

Physical activity is multidimensional and a complex behavior to measure (Westerterp, 2009). Measures used in assessing physical activity in research work include: behavioral observation, questionnaires in the form of diaries, recall questionnaires and interviews, motion sensors and calorimetry. A study that was carried out by Roberts *et al.*, (2006) previously showed an association between physical activity and low levels of inflammatory cytokines and markers of oxidative stress. Laaksonen *et al.*, in 2002 showed in their 4-yr follow –up study that men engaging in >3hr/week of moderate or vigorous physical activity were half as likely to have MetS compared to sedentary men. It is still unclear as to whether exercise independent of weight loss lowers the risk of developing the MetS (Magkos *et al.,* 2009). Physical activity whether accompanied with weight loss is an important intermediary in beneficial changes on the individual components of MetS (Magkos *et al*., 2009).

Physical inactivity poses a risk factor for developing coronary heart disease. It has complicated links with several causal risk factors for MetS including high blood pressure, low and high density lipoprotein cholesterol and high plasma glucose and high serum triglycerides and coagulation (Fletcher *et al*., 1992).

2.6.5 Depression, anxiety and stress

There exist two longitudinal results concerning depressive symptoms and MetS. These 2 studies were conducted with middle-aged women. In effect, these findings provided preparatory support for an effect of depression on the MetS, mainly in women, (Matthews and Kuller, 2002). Räikkönen *et al*., (1999) carried out a study which proved that women with higher waist circumference (central adiposity) reported more anxiety with time. Other cross-sectional data report mixed effects of anxiety on MetS. Ahlberg *et al.*, 2002 and Wing *et al*., 1991 concluded on the positive association between anxiety and waist-to hip ratio or insulin resistance, whereas Suarez, (2006) and Cota *et al*., (2001) do not. One of the major factors that cause health-related problems is stress. It is defined as a condition characterized by symptoms of physical and mental strain which can result from reaction to a situation in which a person feels threatened, pressured, etc (Hedley *et al.*, 2004) Several reasons can induce stress; for instance, they can be physical illness or injury, or mental in the case of a job, health or fitness. Bjorntorps hypothesis (Bjorntorp, 1999) postulates that psychosocial stress triggers the onset of visceral obesity, insulin resistance and dyslipidemia.

Visceral fat accumulation is seen as a pathological adaptation to stress (Drapeau *et al.*, 2003). It is very sensitive to cortisol, which may be due to high density and apparent sensitivity of glucocorticoid receptors in this region. Hypercotisolaemia has often been associated with adiposity usually visceral (Rosmond *et al.*, 1998, Goldbacher, 2005). Hypercortisolaemia in the viscera occurs when 11β-hydrosysteroid hydrogenase type 1 (11HSD1) activity in an obese individual heightens at adipocytes and depresses at the liver. This Visceral fat (fat stored within the abdominal cavity and is therefore stored around a number of important internal organs such as the liver, pancreas and intestines) is quick to respond to cortisol, maybe because of high density and apparent sensitivity of glucocorticoid receptors in this region. This hypercortisolaemia also creates conducive conditions for raised lipoprotein lipase (LPL) and hormone-sensitive lipase (HSL) activity, the chief enzymes involved in the transformation of free fatty acids in circulation and intracellular respectively. LPL is responsible for raising the amount of triglycerides at the adipocyte, (Bjorntorp, 1999) and as insulin resistance often becomes evident and at the same time with visceral adiposity, the increased circulating insulin exerts anti-lipolytic effects and further decreased lipid mobilization, (Bjorntorp,1999). Also, cortisol appears to have a stimulatory effect on LPL action when insulin is available (Ottosson *et al.,* 1994). It is believed that chronic hypersecretion of cortisol may lead to faltered feedback and resistance which mimics insulin resistance. HSL imparts its most damaging effect in the development of atherosclerotic plaque. This process is made worse in persons with hyperactive stress response given that glucocorticoids stimulate the esterification of sterols in smooth muscle, (Petrichenko *et al.*, 1997).

2.6.6 Socio-economic status

Socio-economic status (SES) is a concept that factors one's access to social and economic resources (Laaksonen *et al.,* 2007). It is recognized as a basic force in determining health outcomes either directly or indirectly. Example of one direct mechanism is stress. Stress due to lack of social support can disrupt hypothalamic-pituitary- adrenal axis activity and immunologic function (Case *et al.,* 2002). An indirect system could be social impact on health behaviors such as physical activity, dietary pattern, alcohol intake and smoking habits (Ramsay *et al.,* 2008). Several measures are used for SES including household characteristics, level of education just to mention a few. It can be used in most studies as a predictor or confounding variable. Previously, diabetes mellitus, obesity and high blood pressure have been considered as "diseases of affluence" (Misra *et al.,* 2000). However, in developed countries, the prevalence of established risk factors including obesity and high blood pressure are seen to be elevated even among persons of low socio-economic status as measured by educational status, level of income and household size, (Millen *et al.,* 2006). This situation appears to be not much different in developing countries where poverty and scarcity of food is greater, (Misra et al., 2000). For instance, in the Klong Toey slums of Bangkok, in addition to high prevalence of hypertension and dyslipidaemia, 25.5% of the subjects were overweight, 10% obese and 4.5% had diabetes mellitus (Misra *et al.,* 2000). Also, Chakraborty *et al.,* (2016) identified the upper social class stood higher chances of developing metabolic syndrome compared to lower class in urban West Bangal. These outcomes show that SES, is a likely predictor of the development of metabolic syndrome.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Research design and study area

The study was a cross-sectional cohort study carried out over a two month (July-August) period in Accra, Ghana. The study was carried out in 3 slums in Accra Ghana. Slums are characterized as households lacking one or two of sufficient living space, durable housing, adequate sanitation, security of tenure and easy access to safe water and other basic amenities in a city (UN-HABITAT, 2005). Most slum dwellers are internal migrants from the rural parts of the country to seek greener pastures in the cities, and in this case Accra, Ghana.

Accra is the capital of Ghana with an estimated population of about 4 million. In Accra, physical development runs faster than planning, leading to the birth of slums which houses about 58% of Accra ‘s population (Rain *et al.*, 2011). The study sites were Nima, Old Fadama and Jamestown. These study sites were chosen because they are densely populated and contribute largely to the population of Accra. Old Fadama and Nima, have been settled by migrants from other parts of Ghana and sometimes other countries in the West Africa region. Nima, a poor neighborhood of Accra that emerged in the 1940s, is a composed of several ethnic groups and nationalities, especially from northern Ghana and West Africa Sahelian countries of Mali, Niger and Burkina Faso. However, Old Fadama is a more recent settlement, which emerged in the mid-1990s and is a settlement for migrants from northern Ghana and is now the largest slum in the capital city. The exponential growth of Old Fadama which is also known as Sodom and Gomorrah is because of its proxy to the central business district and low cost of living (GSS, 2011) These two settlements together with Jamestown would provide a good context to compare the dietary shifts or patterns and other indicators of the MetS (Awumilla *et al.*, 2014).

3.2 Study population, participants and sample size

The subjects were urban slum women aged 15-49 years living in Accra, Ghana. The participants were selected through convenience sampling in the slums. Recruitment was based on the participants’ willingness to partake in the study after the study protocol has been outlined to them.

Sample size was calculated using the formula; $n=z^2$ P (1-P)/d2, where n is the sample size, p is the prevalence of hypertension =22.7% (Bosu, 2010), d is the desired precision =5 and z = confidence interval (1.96) and a total of 250 participants were recruited into the study. Sampling was done out of convenience; based on the population density of the slums in a ratio 7:7:5 in Nima, Old Fadama and Jamestown respectively.

3.3 Inclusion and exclusion criteria

Women above 49 years of age, pregnant females, disabled subjects and acutely ill were excluded from the study. Also, participants' who were willing to participate but had previous history of any of the MetS risk factors were excluded from the study. *Women who fell within 15-49 years and were willing to participate in the study were included.* Participants must have lived in the slum for at least a year.

3.4 Data collection and instrumentation

Data was collected one time from participants who agreed to the study. A pretested semi-structured questionnaire was used to obtain information on socio-demographic characteristics, stress assessment was done using version 21 of the Depression Anxiety Stress Scale (DASS 21), physical activity level was measured using the WHO global physical activity questionnaire (GPAQ) to identify moderately active sedentary and very active participants. Frequency and daily duration of different types of physical activities in 1 typical week was recorded, and the total amount of weekly physical activity calculated. On the basis of both frequency and total amount of weekly physical activity, Physical activity level (PAL) was categorized. A validated food frequency questionnaire (FFQ) was used to collect dietary information over the past 1 month. Anthropometric data and biochemical measurements were conducted after the questionnaire administration.

3.4.1 Anthropometric measurements

Height was measured without shoes to the nearest 0.5cm using a freestanding stadiometer following standard procedures. Weight of study participants was taken in light clothing and without shoes to the nearest 0.1kg using an Omron Fat Loss monitor (HBF 400; Omron China) digital scale. Standard measurement protocol for measuring height and weight was adapted (WHO, 1995). The body mass index of study participants was obtained as an output from the Omron digital scale. The central adiposity was determined by measuring thrice the waist circumference to the nearest 0.5cm at the smallest circumference between the iliac crest and the lower ribs using a non-stretchable tape and measuring in the horizontal plane with the individual in light clothing. This was done in a relaxed standing position with slight expiration of study participants. The hip circumference was measured at the maximum circumference of buttocks at the horizontal level posterior with the subject wearing minimum clothes possible. Measurements were done in triplicates and reported as mean for the calculation of waist: hip circumference ratio (WHR).

3.4.2 Biochemical measurements

A standardized digital automatic blood pressure (BP) monitor (Medisana Upper Arm Blood pressure monitor) was used for measuring blood pressure. Blood pressure and pulse measurements were taken at rest thrice (after every five minutes) and the average recorded. The mean± standard deviation of diastolic and systolic blood pressure was determined. Individual blood pressure was categorized based on the WHO criteria.

Fasting blood sugar (FBS) was determined early in the morning in a fasted state using a glucometer (OneTouch Select Glucometer). Capillary blood was used for each of the fasting blood sugar measurement.

3.5 Quality control

To ensure high accuracy, and precision of measurements, all the instruments were appropriately calibrated and standard methods used for the data collection.

In addition, ahead of the data collection, the tools were pretested in Madina, Greater Accra which was not part of the main study areas. The location for the pretesting of the questionnaire was chosen in consultation with the local supervisor. This was done to ensure clarity in the questions, test the length of time for administering each questionnaire and allow for appropriate modifications and corrections to be made. Weight measurements were carried out with minimal clothes on participants and no extraneous materials such as mobile phones that may affect the measurements were removed. All measurements were taken thrice and the average and standard deviation calculated to minimize random errors. All possible confounders were identified and controlled during data collection, processing and analysis.

3.6 Data analysis

Data analysis was carried out as outlined in the sections below:

3.6.1 Statistical analysis

Data was entered into an excel spreadsheet and double checked for errors and normality using Q-Q plots, and histograms. Analysis was done using SPSS version 22. For categorical variables such as stress pattern and physical activity level, proportions and frequencies were computed. For continuous variables such as BMI, waist circumference; mean and standard deviations were derived. Chi square analysis and student t-test was used to determine associations between categorical and continuous variables respectively. The dependent variable in this study was metabolic syndrome and the independent variables; socio-economic status, (derived based on SES score) waist circumference, WHR, stress, depression and anxiety, BMI, HBP, FBS and dietary patterns.

Nine different food groups cereals and porridges, dairy and dairy products, beverages, juices and drinks, protein foods, main starches and foods, fruits and vegetables, breads and oils were derived from the different foods items. Frequency analysis was carried out on all newly created variables to ensure all values are either 0 or 1. A new variable was created as dietary diversity score, (DDS). Values were computed for the dietary diversity variable by summing all the food groups incorporated in the dietary diversity score (9 food groups in all). A check was carried out to ensure all scores were within the range (0-9). Dietary patterns were obtained from less dietary diversity to high dietary diversity. Lowest dietary diversity (≤ 3 food groups), Medium dietary diversity, (≥ 6 food groups). This gave a clue as to which foods are predominantly consumed at different levels of the scores and for those foods that are eaten by those with the lowest dietary diversity to highly consumed foods. This output was compared with METS components using chi square analysis. Binary logistic regression was used to determine predictors of metabolic syndrome. Standardized β coefficient or odds ratios (ORs) and their respective 95% confidence intervals (CI) are presented in results reflecting the association of SES and other lifestyle variables with MetS. Physical activity was identified as a possible confounder and was controlled for. Multiple linear regression was used to determine the relationship between metabolic risk components and independent variables. Results were reported as standardized coefficients. A two-sided *P*- value <0.05 was deemed statistically significant.

3.6.2 Independent variables

Data analysis was carried out on independent variables; body mass index, waist circumference, waist: hip ratio, blood pressure, fasting blood glucose, socio0economic status, physical activity level and stress pattern and food frequency data.

Table 3.1: Classification of WC, WHR and BMI

Risk of Metabolic complications	**Waist circumference (cm)**	**BMI Category**	**BMI (kg/m^2)**
Very Low	<70		
Low	70-88	Underweight	<18.5
High	89-109	Normal	18.5-24.9
Very high	>110	Overweight (Pre-obese)	25-29.9
	WHR	Class I Obesity	30-34.9
Very Low	<0.75	Class II obesity	35-39.9
Low	0.75-0.79	Class III obesity	≥40
High	0.80-0.85		
Substantially Increased	>= 0.86		

Table 3.2: Blood pressure and fasting blood glucose classification

Category	**Systolic BP(mmHg)**		**Diastolic BP (mmHg)**
Optimal	<120	&/or	<80
Normal	120-129	&/or	80-84
High Normal	130-139	&/or	85-89
Stage 1 Hypertension	140-159	&/or	90-99
Stage 2 Hypertension	160-179	&/or	100-109

Stage 3 Hypertension	>180	&/or	>110
Fasting blood glucose (FBS)	**Classification**		
Normal	≤ 6.1mmol/l		
High	≥ 6.1mmol/l.		

3.6.2.1 Socioeconomic and demographic variables

Socioeconomic information and data on age, place of previous stay, level of education, employment status, number of children were obtained in data collection. Educational level and SES groupings were factored in the background characteristics that influence the development of MetS. The SES grouping was done based on the women's; I. educational level, II. monthly income, III. ownership of residence, the ownership of residence (residence type), IV. type of building, V. number of rooms available, VI. source of lightening, VII. toilet facility, VIII. source of water and IX. Ownership of household items including television, radio, blender, source of building, mobile phone, refrigerator was considered. Items I-VIII above was scored on a scale of 1 to 7 depending on the number of responses provided on the questionnaire (appendix 1). In scoring the responses the best option was always 1 and the least had the highest score. For example, in providing scores for educational level, tertiary level was scored 1 while no education was scored 5 because there were five responses available. For item IX, ownership of radio, television, etc. are scored on a scale of 1-3. One was for owning more than 3 and 3 for owning one. Luxury items such as fixed telephone line, air conditioner, and fan were scored on a two-point scale, I for owning and 2 for not owning. All scores for the various items were then summed to give the best score of 17 and worst score of 65. The scores between 17 and 65 were split into tertiles to represent three socio-economic classes; high, middle, and low. Similar scorings have been used in the department of Nutrition and Food Science, University of Ghana –Legon where it was modelled from. The scores were split as shown in table 3.3 below.

Table 3.3: Socio-economic scores of study participants

Score	Socio-economic status
17-33	High class
34-49	Middle class
50-65	Low class

3.6.2.2 Physical activity

Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ). 15 physical activity questions were asked. The intensity level of each activity was rated in metabolic equivalents. Subjects were classified as having low PAL, Moderate PAL and high PAL as shown below:

Table 3.4: Physical activity cut-off values

Level of total physical activity	Physical activity cut-off value
High	• IF:(P2 + P11) >= 3 days AND Total physical activity MET minutes per week is >= 1500 **OR** • IF: (P2 + P5 + P8 + P11 + P14) >= 7 days AND total physical activity MET minutes per week is >= 3000
Moderate	IF: (P2 + P11) >= 3 days AND ((P2 * P3) + (P11 * P12)) >= 60 minutes **OR** • IF: (P5 + P8 + P14) >= 5 days AND ((P5 * P6) + (P8 * P9) + (P14 * P15)>= 150 minutes **OR** • IF: (P2 + P5 + P8 + P11 + P14)>= 5 days AND Total physical activity MET minutes per week >= 600
Low	IF: The value does not reach the criteria for either high or moderate levels of physical activity

Adapted from the WHO Global physical activity questionnaire and analysis version 2.0

3.6.2.3 Dietary pattern

Regarding dietary pattern, subjects were asked how often they consumed 102 food and beverage items in a food frequency questionnaire. Frequency of consumption was based on the past month. These food items were grouped under nine different food groups. Amount consumed was based on local food measures. Dietary pattern was derived based on women's dietary diversity score. For each food group a DDS variable was computed to sum all the foods that were consumed by participants in the past month. Low, medium and high dietary diversity were derived for ≤ 3 food groups, 4-5 food groups, ≥ 6 food groups respectively.

3.6.2.4 Depression, anxiety and stress pattern

For the DASS-21, the following cut-off scores was recommended for each subscale (subscale scores =sum of item scores):

Table 3.5: Stress, depression and anxiety cut-off scale

Category	**Depression**	**Anxiety**	**Stress**
Normal	0-4	0-3	0-7
Mild	5-6	4-5	8-9
Moderate	7-10	6-7	10-12
Severe	11-13	8-9	13-16
Extremely severe	14+	10+	17+

DASS 21 by (Antony *et al.*, 1998).

3.6.3 Dependent variable (Metabolic syndrome)

3.6.3.1 Criteria for assessing Metabolic Syndrome in study participants

The metabolic syndrome for the study participants was defined according to the WHO criteria. Obesity was defined as BMI≥25kg/m^2, % Body fat was defined as typical of obesity if it was ≥30%, waist circumference ≥ 88.0 cm. High WHR is defined as 0.85. Elevated blood pressure was categorized as (≥140 mmHg systolic or ≥ 90mmHg diastolic). Impaired fasting hyperglycemia was inferred when fasting blood sugar was ≥ 6.1mmol/l.

3.7 Ethical consideration

Ethical approval was obtained from ethics committee for basic and applied sciences (ECBAS), (Appendix 2) University of Ghana and Universitair Ziekenhuis Gent, Belgium (Appendix 1). Informed consent was sought from study participants before data collection. Study participants had the right to withdraw from the study anytime they wanted to.

CHAPTER FOUR

4.0 RESULTS

4.1 General characteristics of the study population

Table 4.1 shows the characteristics of 250 study participants. The mean age of the study participants was 36±9.32 years. About 52.8 % of the study participants were Gas who originate from the city capital. This ethnic group of people was observed to record the highest percentage among the study population. The Northerners which formed the second largest ethnic group *26.0%* of the study population are internal migrants originating from the Northern part of Ghana. Of the whole study population, 39.6% were married while 37.6 % of study participants were single. The majority of the study participants *39.6* % had fully completed Junior high school while 22.8% had completed Primary school successfully. The average number of children born by the study participants was 2. For the average wage, it is accounted for only 170 study participants because 80 of them were unemployed at the time of the study. Total number of children for all the study participants were 190. 60 of the study participants as at the time of the study had no children.

Table 4.1: Background characteristics of the population

Variables	**Total (N=250)** **n(%)**
Age (Mean± SD)	**(36.40 ±9.32)** [a]
15-29	73 (29.2)
30-39	59 (23.6)
40-49	118 (47.2)
Ethnicity	
Ga	132 (52.8)
Northerner	65 (26.0)
Akan	28(11.2)
Ewe	24(9.6)
Other	1 (0.4)
Religion	
Christianity	164 (65.6)
Muslim	82 (32.8)
Marital Status	
Single	94 (37.6)
Engaged	5 (2.0)

Table 4.1 Contd.

Married	99 (39.6)
Divorced	35 (14.0)
Widowed	17 (6.8)
Educational level	
Low	101 (40.4)
Middle	133(53.2)
High	16 (6.4)
Number of children (Mean± SD)	**(2±2)[b]**
0	60 (24.0)
1-3	82 (32.8)
4-5	34 (13.6)
≥6	14 (5.6)
Occupation	
Manual	189 (75.6)
Non-manual	2 (0.8)
Unemployed	59 (23.6)
Average daily wage (GHS) (Mean±SD)	**(66.22±100.91)[c]**
≤50	138 (55.2)
51-100	24 (9.6)
101-300	5 (2.0)
301-500	3 (1.2)
≥500	

N=250 participants. n (%) refers to number observed and their percentage in bracket. a,b,c (in superscripts) as indicated in the table refer to the means and standard deviations (SD) of the study variables age, number of children and average wage respectively.

4.2 Socioeconomic status of the study population

From the figure 4.1 below, most of the study participants (75.6%) were involved in petty trading, food vending, bakery, catering services which are all forms of manual/informal jobs. Only 0.8% were security personnel and typist which are quite formal jobs. Almost one quarter of the study participants were unemployed at the time of the study. The average daily wage obtained by the participants was approximately 70GHS (17.5 Euro). Measuring their socio-economic status (SES) by their assets such as television, the number of people they share rooms with, their level of education, the kind of housing material used and sanitation facilities used, 70.4 % fell in the middle socio-economic status. Almost 17% obtained low SES and 12.8% were in high SES.

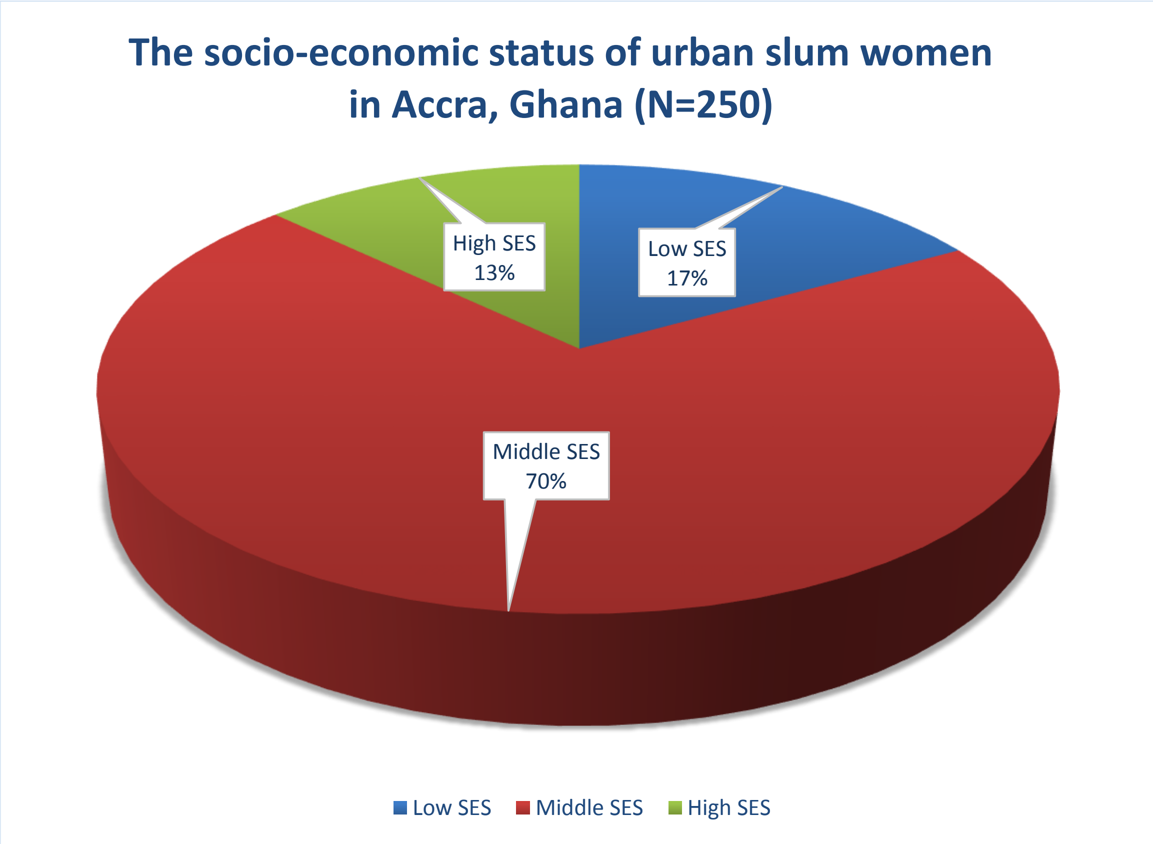

Figure 4.1: Socio-economic status of urban slum women in Accra, Ghana (N=250)

4.3 Anthropometric profile of women in slums in Accra

The prevalence of obesity among the study population was measured by waist circumference, waist- to hip ratio, body mass index and also body fat. All these indicators gave a high estimate of the population's prevalence of obesity. The most significant was waist circumference where 61.2% of the study population recorded measures above 88.0cm. This showed most of these people that had abdominal obesity also had waist-to hip ratio above 0.86. About 42.8% had BMI falling within obesity grade I-III which correlates or confirms the high prevalence of obesity among the study population. The average waist circumference was 92.7 ± 15.6 cm showing at least almost 40% of the study population had no abdominal obesity. The average body mass index was 29.3 ± 6.4kg/m^2 which shows any participant was likely to be overweight/obese or in the normal range according to WHO cut-off values.

Table 4.2: Anthropometric profile of women in slums in Accra, Ghana (N=250)

Parameter	Total (N=250) n(%)
Waist circumference (cm) (Mean±SD)	**(92.7±15.6)[a]**
Normal (<88.0)	97 (38.8)
Obese (≥88.0)	153 (61.2)
Waist-to hip ratio (Mean±SD)	**(0.88±0.09)[a]**
Very low (<0.75)	13 (5.2)
Low (0.75-0.79)	24(9.6)
High (0.80-0.85)	70 (28.0)
Very high (≥0.86)	143(57.2)
Body mass index (kg/m^2) (Mean±SD)	**(29.3±6.4)[a]**
Underweight (<18.5)	9(3.6)
Normal (18.5-24.9)	57(22.8)
Overweight (25.0-29.9)	77(30.8)
Grade I obesity (30-34.9)	58(23.2)
Grade II obesity (35-39.9)	33(13.2)
grade III obesity (≥40)	16 (6.4)
Body fat(%) (Mean±SD)	**(40.2±8.4)[a]**
Normal (≤30.0)	8(3.2)
High (≥30.0)	7(2.8)
Very high	235 (94.0)

N=250 participants. n (%) refers to number observed and their percentage in bracket. a,a,a (in superscripts) as indicated in the table refer to the mean and standard deviations obtained from descriptive analysis.

4.4 Biochemical profile of urban slum women (N=250)

From table 4.3, Both the systolic and diastolic blood pressures were within the normal range on average. Approximately the same number of people who had high systolic blood pressure also had high diastolic blood pressure. Fasting blood glucose which gives an indication of diabetes was averagely within the normal range 5.0±1.4mmol/l. About 10.0% had high fasting blood glucose which gives an indication of either upcoming or existing diabetes among study participants.

Table 4.3: Biochemical profile of urban slum women (N=250)

Parameter	Total (N=250) n (%)
Systolic blood pressure (mmHg) (Mean±SD)	**(125.7±22.1)**
Optimal (<120)	110 (44.0)
Normal (120-139)	85 (34.0)
Grade I hypertension (140-159)	38 (15.2)
Grade II hypertension (160-179)	17 (6.8)
Diastolic blood pressure(mmHg) (Mean±SD)	**(81.4±17.0)**
Optimal (<80)	138 (55.2)
Normal (80-89)	49 (19.6)
Grade I hypertension (90-99)	30 (12.0)
Grade II hypertension (100-109)	33 (13.2)
High blood pressure(mmHg)	
No HBP	166 (66.4)
High systolic and high diastolic BP	34 (13.6)
High systolic blood pressure	21 (8.4)
Fasting blood glucose (g/dl) (Mean±SD)	**(5.0±1.4)**
Normal (<6.1g/dl)	226 (90.4)
High (≥6.1g/dl)	24 (9.6)

4.5 Physical activity level, alcohol consumption and stress pattern of urban slum women

With respect to the nature of work the participants were involved in, their physical activity profile revealed that 96.4% of the study participants were moderately physically active and 3.6 % were highly physically active. 4.8 % of the study population suffered from severe stress whereas 72.0 % had no stress. Also, the level of severe depression among the study participants according to the DASS 21 analysis was about 5% but almost half of participants suffered mild/moderate depression and about 24% of the entire study population were severely anxious. Only 34.4% of the study population were consuming alcohol at the time of the study.

Table 4.4: Physical activity level, alcohol consumption and stress pattern of urban slum women

Parameter	Total (N=250) n (%
Alcoholic intake	
Yes	86 (34.4)
No	164 (65.6)
Physical activity level	
Low PAL	0 (0.0)
Moderate PAL	241 (96.4)
High PAL	9 (3.6)
Stress level	
No stress	180 (72.0)
Mild/moderate stress	58 (23.2)
Severe stress	12 (4.8)
Depression	
No depression	129 (51.6)
Mild/moderate depression	108 (43.2)
Severe depression	13 (5.2)
Anxiety level	
No anxiety	98 (39.2)
Mild/moderate anxiety	93 (37.2)
Severe anxiety	59 (23.6)

PAL =physical activity level. Depression, anxiety and stress levels were obtained using the DASS21 clinical scale.

4.6 General characteristics of the urban slum women stratified by age group

With the results as shown in table 4.5, stratifying the study population by age, the majority were within the ages 40-49 years. Marital status was observed to be statistically significant (***P*<0.001)** with age. There were more single mothers and unmarried amongst the ages 15-29 years than among the 30-39 or 40-49 years. The socioeconomic status of the individuals was higher amongst the older age group although it was not statistically significant. The level of education attained by study participants was mostly was middle whereas 49.2% of the 40-49years populace had only low level of education. The level of education was statistically significant with age, (***P*=0.004)**. At the time of the study, 50.7% of the younger age group had no employment whereas those within 40-49 years had about 16% unemployed. Overall, 83% the oldest population of study participants were employed.

Table 4.5: General characteristics of the urban slum women stratified by age group

Parameter	(15-29 yrs.) n=73 n(%)	(30-39 yrs.) n=59 n(%)	(40-49 yrs.) n=118 n(%)	p-value
Marital status				**<0.001***
Single	57 (78.1)	18 (30.5)	19 (16.1)	
Married/engaged	10 (10.7)	35 (59.3)	59 (50.0)	
Divorced/widowed	6 (8.2)	6 (10.2)	40 (33.9)	
Total number of children				**<0.001***
1-3	72 (98.6)	49(83.0)	81 (68.7)	
4-5	1 (1.4)	9 (15.3)	24 (20.3)	
≥6	0 (0.0)	1 (1.7)	13 (11.0)	
Educational level				**0.004**
Low	17 (23.3)	26 (44.1)	58 (49.2)	
Middle	50 (68.5)	27 (45.8)	56 (47.5)	
High	6 (8.2)	6 (10.1)	4 (3.4)	
Employment status				**<0.001***
Yes	36 (49.3)	50 (84.7)	99 (83.9)	
No	37 (50.7)	9 (15.3)	19 (16.1)	
Socio-economic status				**0.161**
Low	10 (13.7)	7 (11.9)	25 (21.2)	
Medium	51 (69.9)	48 (81.4)	77 (65.3)	
High	12 (16.4)	4 (6.8)	16 (13.6)	

4.7 Prevalence of slum women with metabolic risk components classified by age

From table 4.6, the prevalence of all the risk factors for developing metabolic syndrome was higher among the older population. This suggests that the risk factors become pronounced with increasing age. There was also a level of statistical significance between waist circumference and age, BMI and age as well as body fat and age at **(*P* <0.001), (*P*=0.038) and (*P*= 0.002)** respectively**.** Moreover, high systolic blood pressure was higher among the older group but not statistically significant **(*P*=0.110).** The high diastolic blood pressure was also higher with the older age group but not statistically significant **(*P*=0.734)**. Overall, fasting blood sugar was recorded to be normal among the population. About 9.6 % of the total population had higher fasting blood glucose with the majority of them between 40-49 years and this age related difference in fasting blood glucose is statistically significant, **(*P*= 0.015).**

Table 4.6: Prevalence of metabolic risk components classified by age among slum women

Variable	Age 15-29(yrs) n=73 (%)	30-39(yrs) n= 59 (%)	40-49(yrs) n=118 (%)	p-value
Waist circumference (cm)				**<0.001***
Low	39 (53.4)	29 (49.2)	29 (24.6)	
High	34 (46.6)	30 (50.8)	89 (75.4)	
Waist-to hip ratio				
Very low	5 (6.8)	2 (3.4)	6 (5.1)	**0.003***
Low	8 (11.0)	10 (16.9)	6 (5.1)	
High	28 (38.4)	19 (32.2)	23 (19.5)	
Very high	32 (43.8)	28 (47.4)	83 (70.3)	
Body mass index (kg/m^2)				
Underweight	6 (8.2)	2 (3.4)	1 (0.9)	**0.038***
Normal	23 (31.5)	13 (22.0)	21 (17.8)	
Overweight	21 (28.8)	22 (37.3)	34 (28.8)	
Grade I obesity	14 (19.2)	12 (20.3)	32 (27.1)	
Grade II obesity	6 (8.2)	5 (8.5)	22 (18.6)	
Grade III obesity	3 (4.1)	5 (8.5)	8 (6.8)	
Systolic blood pressure (mmHg)				**0.734**
Optimal	35 (48.0)	28 (47.4)	47 (39.8)	
Normal	22 (30.1)	22 (37.3)	41 (34.7)	
Grade 1 hypertension	11 (15.1)	7 (11.9)	20 (17.0)	
Grade2 hypertension	5 (6.8)	2 (3.4)	10 (8.5)	
Diastolic blood pressure(mmHg)				**0.110**
Optimal	47 (64.4)	36 (61.0)	55 (46.6)	
Normal	14 (19.2)	11 (18.6)	24 (20.3)	
Grade I hypertension	4 (5.5)	5 (8.5)	21 (17.8)	
Grade II hypertension	8 (11.0)	7 (11.9)	18 (15.3)	
Body Fat (%)				**0.002***
Normal	6 (8.2)	2 (3.4)	0 (0.0)	
High	5 (6.9)	1 (1.7)	1 (0.8)	
Very high	62 (84.9)	56 (94.9)	117 (98.2)	
Fasting blood glucose (g/dl)				**0.015***
Normal	69 (94.5)	57 (96.6)	100 (84.7)	
High	4 (5.5)	2 (3.4)	18 (15.3)	

P-value< 0.05 indicates statistical significance at 95% confidence interval. Pearson Chi-square was used to derive statistical significance. FBS: Fasting blood sugar, BP: Blood pressure, BMI: Body mass index, BFAT: Body fat, WC: Waist circumference, WHR: Waist-to hip ratio. The metabolic syndrome was defined as the presence of 2 or more of the following 6 conditions: high fasting blood sugar (> 6.1 mmol/l); elevated body fat (>30%); and high blood pressure (systolic >130 and/or diastolic blood pressure >85mmHg), high waist circumference (> 88 cm), high waist-to hip ratio (>0.85) and body mass index (>25kg/m^2).

4.8 Food consumption frequencies of urban slum women in Accra, Ghana

The graph below shows the foods consumed often by study participants. Most of the foods were often consumed by study participants. Drinks and juices were an exception because only 9.6% of the population consumed within the study period. Breads (koose, akara, white bread, sugar bread, chips, meat pie) and main starchy staples (banku, kenkey, rice, waakye, etc.,) were the most consumed foods. These two food types form the bulk of the average Ghanaian dish. Oils were also consumed by 85.2% of the study population. Oils also form part of main soups and sauces in most Ghanaian communities. Fruits and vegetables (orange, pineapple, cocoyam leaves, ademi, tomatoes, okra) were mainly consumed by the 69.6% of the total population. Apparently, the graph below shows only frequency of consumption and does not describe in amounts, the adequacy of intake. The other food groups were also consumed fairly by the study population as indicated in the graph.

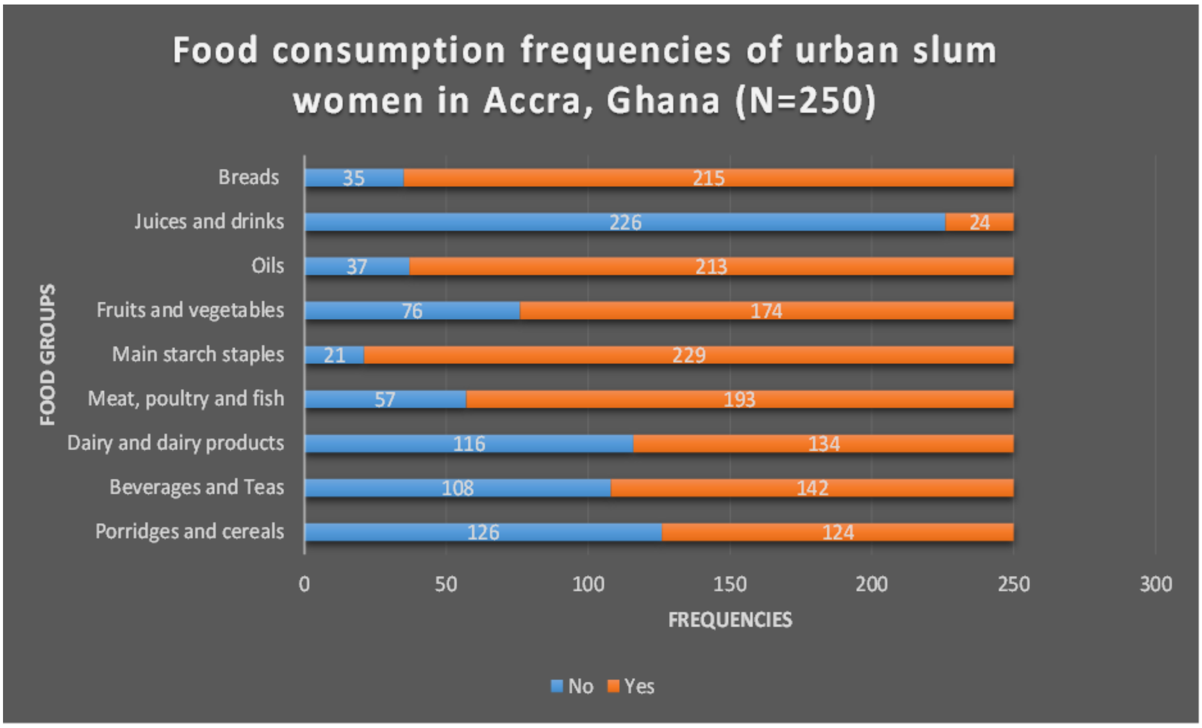

Figure 4.2: Food consumption frequencies of urban slum women in Accra, Ghana. (N=250)

Porridges and cereals include: (Hausa koko, corn porridge, rice water, tom brown), beverages and tea included milo, cocoa powder and Lipton. Most of the milk consumed were evaporated milk i.e. ideal milk, peak milk, peak powdered milk. Fruits mainly consumed by study participants were orange, pineapple and mango. Oils used most often were vegetable cooking oil and red palm oil. Main starchy foods consumed were banku, waakye, kenkey and fufu just to mention a few. No; means individual participant did not consume the type of food for the past month at the time of the study and Yes; means individual participant did consume the type of food for the past month at the time of the study.

4.9 Dietary pattern among urban slum women based on dietary diversity score

Figure 4.3 below shows the dietary pattern of urban slum women based on dietary diversity score. Generally, 62% the study population had a highly diverse diet of more than the food groups indicated in the graph above. Those who recorded medium dietary diversity formed 27% of the population and only 11% had a low dietary diversity based on the 9 food groups that were examined in the study.

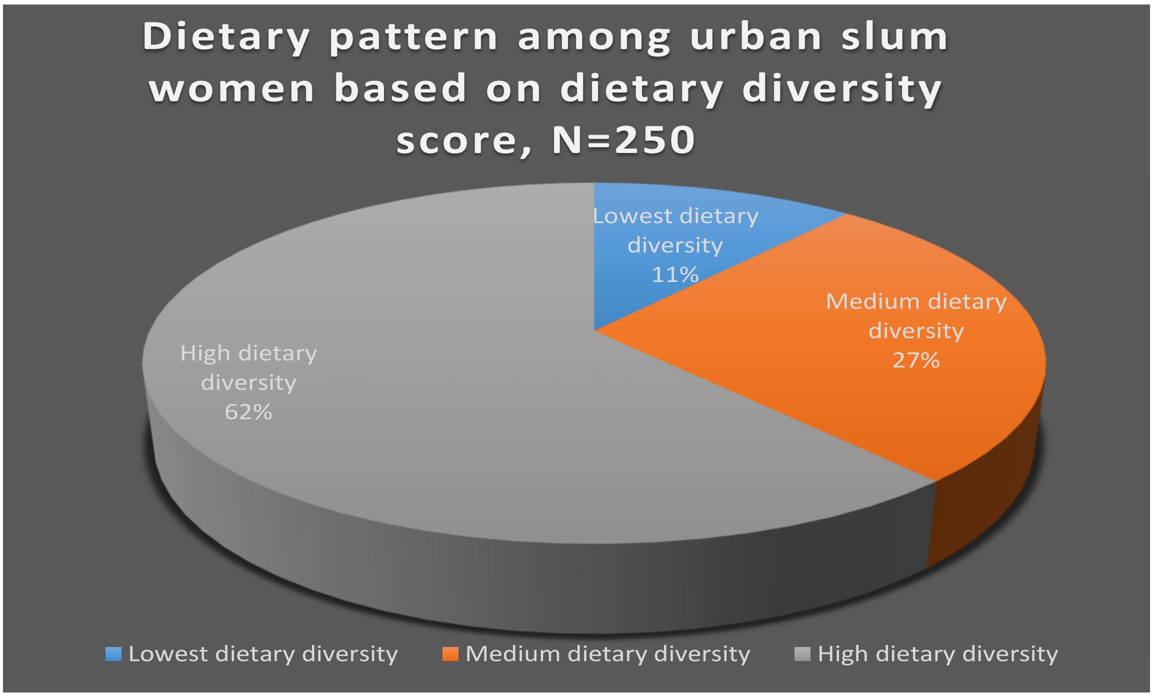

Figure 4.3: Dietary pattern among urban slum women based on dietary diversity score, N=250

Lowest dietary diversity score (≤3 food groups), Medium dietary diversity score (between 4 and 5 food groups) and High dietary diversity score (≥6 food groups). Dietary diversity and hence dietary pattern was derived using the standard procedures of FAO women dietary diversity score.

4.10 Food groups and dietary pattern of urban slum women in Accra, Ghana

Considering the table below; all the 9 food groups had contributed significantly to the dietary pattern of the study population. Juices and drinks contributed more to less dietary diversity (100%) and this was statistically significant (P= 0.006). Oils were consumed by 146 participants who fell in high dietary diversity. Fruits and vegetables were consumed by almost 129 participants who had high dietary diversity compared to only 9 participants who consumed fruits and vegetables in the less dietary diversity group.

Table 4.7: Food groups and dietary pattern of urban slum women in Accra, Ghana (N=250)

Food group	Consumption frequency	Less dietary diversity(n=28) n (%)	Medium dietary diversity (n=68) n(%)	High dietary diversity (n=154) n(%)	p-value
Breads	No	16 (57.1)	13 (19.1)	6 (3.9)	<0.001*
	Yes	12 (42.9)	55 (80.9)	148 (96.1)	
Juices and drinks	No	28 (100.0)	66 (97.1)	132 (85.7)	0.006
	Yes	0 (0.0)	2 (2.9)	22 (14.3)	
Oils	No	14 (50.0)	15 (22.1)	8 (5.2)	<0.001*
	Yes	14 (50.0)	53 (77.9)	146 (94.8)	
Fruits and vegetables	No	19 (67.9)	32 (47.1)	25 (16.2)	<0.001*
	Yes	9 (32.1)	36 (52.9)	129 (83.8)	
Main starch staples	No	10 (35.7)	6 (8.8)	5 (3.2)	<0.001*
	Yes	18 (64.3)	62 (91.2)	149 (96.8)	
Meat, poultry and fish	No	19 (67.9)	20 (29.4)	18 (11.7)	<0.001*
	Yes	9 (32.1)	48 (70.6)	136 (88.3)	
Dairy and dairy products	No	24 (85.7)	49 (72.1)	43 (27.9)	<0.001*
	Yes	4 (14.3)	19 (27.9)	111(72.1)	
Beverages and Tea	No	25 (89.3)	49 (72.1)	34 (22.1)	<0.001*
	Yes	3 (10.7)	19 (27.9)	120 (77.9)	
Porridges and cereals	No	24 (85.7)	45 (66.2)	57 (37.0)	<0.001*
	Yes	4 (14.3)	23 (33.8)	97 (63.0)	

Pearson Chi-square for Beverages and drink equals 75.316, Dairy and dairy products equals 56.544, juices and drinks equals 10.344, breads 57.823, main starchy staples equal 32.480, Meat, fish and poultry equal 44.786, oils equal 41.622, fruits and vegetables equal 42.093 and porridges and cereals equal 31.779. P-value <0.05 indicates statistical significance

4.11 Prevalence of metabolic syndrome obtained by clustering two or more risk factors

Metabolic syndrome as categorized by the different risk components was relatively low. Study participants stood no risk of MetS had fell within the normal ranges of the different risk components. Those who were at risk had one or two high levels of the components and those who had metabolic syndrome had higher levels of all components considered. Grouping all 6 variables gave 87.6% of the population to be at risk of developing the metabolic syndrome. Clustering FBS with BP and BMI according the WHO criteria showed 19 out of the 250 participants to have metabolic syndrome. This same criterion also showed 55.2% of the population to be at risk of developing metabolic syndrome. Clustering FBS, BP and BFAT, it was observed that 86.4% of the population was at risk of developing MetS, however the instrument used in measuring BFAT of the study participants gave higher values and could be a reason for observing 86.4% of the population to be at risk. For the sake of this research the second (WHO) cluster is considered in further analysis of MetS association with other study variables.

Table 4.8: Prevalence of metabolic syndrome obtained by clustering two or more risk factors

Cluster	No Risk n (%)	At Risk n (%)	Metabolic syndrome n (%)
FBS+BMI	93 (37.2)	154 (61.6)	3 (1.2)
FBS +BP+ BMI	**93 (37.2)**	**138 (55.2)**	**19 (7.6)**
FBS+BP+BFAT	10 (4.0)	216 (86.4)	24 (9.6)
FBS + BP+ BMI+ WC+ WHR + BFAT	7 (2.8)	219 (87.6)	24 (9.6)

FBS: Fasting blood sugar, BP: Blood pressure, BMI: Body mass index, BFAT: Body fat, WC: Waist circumference, WHR: Waist-to hip ratio. The metabolic syndrome was defined as the presence of 2 or more of the following 6 conditions: high fasting blood sugar (> 6.1 mmol/l); elevated body fat (>30%); and high blood pressure (systolic >130 and/or diastolic blood pressure >85mmHg), high waist circumference (> 88 cm), high waist-to hip ratio (>0.85) and body mass index (>25kg/m^2).

4.12 Association of metabolic syndrome and various characteristics of urban slum women

Dietary pattern of the women was not statistically significant with MetS risk/MetS category, (P=0.893). 61.1% of study participants who had high dietary diversity were found to be at risk or with metabolic syndrome. Also, 62.4% of individuals with no risk of metabolic syndrome had high dietary diversity. It would be easy to say that participants with less dietary diversity were likely to be more at risk of MetS, however only 12.1% of this group has less dietary diversity score. Age was statistically significant with metabolic risk and this increased with age, **(P <0.001)**. There was no association between ethnicity and metabolic risk of the study participants **(P= 0.184)**. The level of education attained by urban slum women was not statistically significant with their risk for metabolic syndrome **(P= 0.184)**.

Those who had attained middle level of education stood similar chances of either not be at risk or at risk of the MetS. About 46.5% of women who were at risk of Met were married or engaged and this was statistically significant **(P= 0.012)**. Participants who consumed alcohol were also at risk of the metabolic syndrome. Being at risk or not for any of the participants was not associated with their socio-economic status. None of the urban slum women was less physically active and for those who stood a risk of MetS, 96.8% of them were moderately physically active but this was not statistically significant, **(P= 0.647).** Being at risk for MetS was not associated with the level of stress since 72% of slum women with MetS or at risk had no stress. Neither anxiety nor depression was associated with metabolic syndrome. The anthropometric variables considered here were associated with MetS. Urban slum women who had a risk for MetS also had high waist circumference and very high waist: hip ratio and these were statistically significant.

Table 4.9: Association between metabolic syndrome and various characteristics of urban slum women in Accra, Ghana (N=250)

		Metabolic Syndrome		
		No risk (n=93)	**At risk/MetS (n=157)**	
Parameter	**Category**	**n (%)**	**n (%)**	**p-value**
Dietary pattern	Less	9 (9.7)	19 (12.1)	0.839
	Moderate	26 (28.0)	42 (26.8)	
	High	58 (62.4)	96 (61.1)	
Age	15-29	37 (39.8)	36 (22.9)	<0.001*
	30-39	28 (30.1)	31 (19.7)	
	40-49	28 (30.1)	90 (57.6)	
Ethnicity	Ga	41 (44.1)	91(58.0)	0.184
	Northerner	29 (31.2)	36 (22.9)	
	Akan	14 (15.1)	14 (8.9)	
	Ewe	9 (9.7)	15 (9.6)	
	Other	0 (0.0)	1 (0.6)	
Educational level	Low	34 (36.6)	67 (42.7)	0.595
	Middle	52 (55.9)	81 (51.6)	
	High	7 (7.5)	9 (5.7)	
Marital status	Single	46 (49.5)	48 (30.6)	0.012
	Married/engaged	31 (33.3)	73 (46.5)	
	Divorced/widowed	16 (17.2)	36 (22.9)	
Socio-economic status	Low	13(14.0)	29 (18.5)	0.573
	Middle	69 (74.2)	107 (68.2)	
	High	11 (11.8)	21 (13.4)	
Alcohol intake	No	72 (77.4)	65(41.4)	0.002
	Yes	21 (22.6)	92 (58.6)	
Physical activity level	Low	0 (0.0)	0 (0.0)	0.647
	Moderate	89 (95.7)	152 (96.8)	
	High	4 (4.3)	5 (3.2)	
Stress	No	67 (72.0)	113 (72.0)	0.938
	Mild/Moderate	21 (22.6)	37 (23.6)	
	Severe	5 (5.4)	7 (4.5)	
Anxiety	No	33 (35.5)	65 (41.4)	0.124
	Mild/Moderate	42 (45.2)	51 (32.5)	
	Severe	18 (19.4)	41 (26.1)	
Depression	No	47 (50.5)	82 (52.2)	0.966
	Mild/Moderate	41 (44.1)	67 (42.7)	
	Severe	5 (5.4)	8 (5.1)	
Body fat (%)	Normal (8-19.99)	6 (6.5)	2 (1.3)	0.040
	High (20-24.99)	4 (4.3)	3 (1.9)	
	Very high (≥ 25.0)	83 (89.2)	152 (96.8)	

Table 4.9 Contd.

Waist circumference (cm)	Low (≤ 88.0) High (≥88.0)	93 (100.0) 0 (0.0)	81 (51.6) 76 (45.4)	<0.001*
Waist:hip ratio	Low High Vey high	24 (25.8) 36 (38.7) 33 (35.5)	13 (8.3) 34 (21.7) 110 (70.1)	<0.001*

Pearson Chi-square for dietary pattern equals 0,352. 17.562 for age, ethnicity equals 6.217, educational level equals 1.040, marital status equals 8.895, SES equals 1.114, alcohol consumption equals 9.167, PAL equals 0.210, stress equals 0.127, Body fat equals 6.441, WC equal 156.662.

4.13 Predictors of metabolic syndrome among slum dwellers in Accra, Ghana

Table 4.9 shows whether predictors (age, SES, level of education, employment status, WC, WHR, stress, depression and anxiety) were significantly related to metabolic syndrome. Some significant associations were seen with WC and alcohol intake whereas most relationship were not significant.

Table 4.10: Predictors of metabolic syndrome among slum dwellers in Accra, Ghana (N=250)

Variables	**OR**	**95 % confidence interval**		**p-value**
		Lower	**Upper**	
Age				
15-29	1.00	-	-	0.592
30-39	0.59	0.16	2.15	0.427
40-49	0.94	0.25	3.48	0.924
Employment				
Yes	0.19	0.02	2.44	0.202
No	1.00	-	-	
Marital Status				
Single	1.00	-	-	0.345
Married/engaged	2.03	0.71	5.78	0.187
Widowed/divorced	1.20	0.33	4.34	0.786

Table 4.10 Contd.				
Educational status				
Low	1.00	-	-	0.758
Middle	1.12	0.39	1.12	0.836
High	0.57	0.46	4.07	0.571
Average working days	0.92	0.71	1.19	0.515
Socio-economic status				
Low SES	1.00	-	-	
Middle SES	1.28	0.43	3.81	0.475
High SES	2.79	0.51	15.32	0.664
Alcohol intake				
Yes	0.42	0.18	0.97	0.042*
No	1.00	-	-	
Depression state				
No	1.00	-	-	
Mild/moderate	0.92	0.36	2.35	0.853
Severe/extremely severe	0.33	0.03	3.84	0.374
Anxiety state				
No	1.00	-	-	
Mild/moderate	0.68	0.27	1.72	0.420
Severe/extremely severe	0.45	0.14	1.47	0.186
Stress state				
No	1.00	-	-	0.519
Mild/moderate	1.44	0.46	4.51	0.533
Severe	3.07	0.42	22.26	0.267
Average waist circumference (cm)				
Low	1.00	-	-	
High	11.60	4.50	31.78	<0.001*
Waist-to hip ratio				
Low	1.00	-	-	0.615
High	1.29	0.34	4.94	0.710
Very high	1.83	0.48	7.04	0.377

Table 4.10 Contd

Body Fat (%)				
Low	1.00			
High	0.75	0.03	20.70	0.863
Dietary patttern				
Low	0.84	0.46	1.54	0.578
Medium	1.13	0.66	1.92	0.660
High	1.00	-	-	0.839

Predictors of metabolic syndrome among slum dwellers in Accra, Ghana. P-value< 0.05 indicates statistical significance. Analyses are conducted among 250 women who have complete data for all components of the metabolic syndrome. All covariates are tested together in one model.2 The metabolic syndrome was defined as the presence of the following 3 conditions: high fasting plasma glucose (> 6.1 mmol/l); and high blood pressure (systolic >130 mmHg and/or diastolic blood pressure >85mm Hg) and High body mass index (>25kg/m^2). Physical activity was adjusted for in this model because of uneven distribution of this variable. Pearson Chi-square =4.477. Hosmer and Lemeshow Test =0.812 which is > 0.05 shows that the model is statistically significant.

4.14 Relationship between metabolic risk components and socioeconomic and lifestyle variables

Multiple linear regression model of the metabolic risk components as continuous variables on socioeconomic and lifestyle variables are shown in Table 4.10. In the model, the SES and other lifestyle factors are the independent variables. All the predictor variables were inversely associated with WC, BMI, FBS and systolic BP but were statistically insignificant. Alcohol intake however was inversely associated with WC (P = 0.001). This standardized relationship indicates that, for a one standard deviation increase in alcohol intake, the WC might decrease by 0.210cm. BMI was also inversely associated with alcohol intake. For a one standard deviation increment in alcohol intake, BMI could reduce by 0.235 kg/m2 (P< 0.001). From the table, it was also observed that when all other variables are kept constant, alcohol intake had a potential relationship with FBS, a unit increase in alcohol intake might increase the likelihood of FBS increase by 0,046mmol/l but it was statistically insignificant. PAL was positively associated with diastolic BP. A unit standard deviation of PAL could cause an increase in diastolic BP by 0.011mmHg, again this relationship was statistically insignificant. Anxiety level was positively associated with all the dependent variables but no statistical significance was seen.

Table 4.11: Relationship between metabolic risk components versus socioeconomic and other lifestyle variables (N=250)

Variables	Waist circumference (cm)	Waist: hip ratio	Body mass index (kg/m^2)	Fasting blood glucose (mmol/dl)	Systolic BP (mmHg)	Diastolic BP (mmHg)
SES	-0.072	-0.116	-0.005	-0.024	-0.073	-0.092
Educational level	-0.081	-0.097	-0.115	-0.095	-0.234*	-0.128
PAL	-0.058	-0.072	-0.043	-0.073	-0.001	0.011
Alcohol intake	-0.210*	-0.029	-0.235*	0.046	-0.029	-0.037
Dietary pattern	-0.038	0.067	-0.078	-0.042	-0.090	-0.058
Stress level	-0.033	-0.069	-0.112	-0.136	-0.023	0.012
Depression level	-0.065	-0.025	-0.102	0.069	0.017	0.086
Anxiety level	0.142	0.104	0.165	0.057	0.063	0.012

Data are expressed as standardized β coefficient, sample size, N= 250. Multiple linear regression adjusted for age. SES indicator (1=low, 2=medium, 3= high). Educational level (1=low, 2= middle, 3=high). Physical activity level, PAL (1=low, 2= moderate, 3= high), Alcohol intake (0= No, 1= Yes), dietary pattern (1=low dietary diversity, 2= medium dietary diversity and 3= high dietary diversity) * P-value <0.005. Stress, anxiety and depression level (1= low, 2= moderate/mild and 3= severe)

CHAPTER FIVE

5.0 DISCUSSION

In this study**,** socio-economic status, dietary pattern, physical activity profile, stress, depression and anxiety profile, anthropometric and biochemical indices of urban slum women in Accra, Ghana were obtained and related to incident MetS. These parameters tend to be dictated by population-specific and cultural factors. Hence it is important to examine these characteristics in the slum areas and their individual/ cumulative relation to the development of metabolic disorders. The association between the above mentioned indices and metabolic syndrome (components of BMI, HBP, FBS) were derived and the findings are discussed. The role of physical activity, stress and dietary pattern has been extensively discussed by other researchers in determining the prevalence and predominant components of MetS in a population (Cameron *et al.,* 2004). Metabolic syndrome is of public health concern due to its association with non-communicable diseases including stroke, polycystic ovarian disease and different forms of cancer (Cameron *et al.,* 2004).

5.2 Prevalence of metabolic syndrome among urban slum women

The overall prevalence of MetS in the study population was 7.6%. About 55.2% of urban slum women were identified to be at risk of MetS. Prevalence of MetS in these slum women was higher (9.6%) when all the components were included FBS, BP, BMI, WC, WHR, BFAT and 87.6% were at risk of developing MetS. Also, 1.2% of urban slum women had MetS and 61.6% of them were at risk of MetS when BMI and FBS were clustered. This study mainly focused on the WHO criteria for assessing metabolic syndrome and the prevalence was higher than the prevalence of metabolic syndrome among pre- menopausal women in Ghana, (6.3%) according to a study conducted by Arthur *et al*., (2013). The prevalence of MetS differs among women and it is affected by the characteristics of the population and the diagnostic criteria involved (Arthur *et al*., 2013). The difference in population characteristics could be used to explain this difference between prevalence among pre-menopausal women in Kumasi metropolis and women in Nima, Jamestown and Old Fadama. This prevalence was however not in agreement with other studies undertaken among German, Brazilian, Korean and Chinese women in which prevalence of women with MetS ranged from 10.7% through 36.1% (Cameron *et al.,* 2004). Also, the difference in exclusion and inclusion criteria could result in the observed variations in prevalence studies.

5.3 Association between metabolic risk components and metabolic syndrome

Abdominal obesity was also seen to be prevalent among slum women. Waist circumference was identified as a predictor of MetS among urban slum women. This finding is consistent with many other studies. The prevalence of abdominal obesity increased with age among the study population. Also 57.2% of this population had very high waist: hip ratio and body mass index above 24.9kg/m^2 was found to be among 73.6% of the urban slum women. There was an overall increase in obesity with age. As seen in many other studies, obesity is a notable risk factor for CVD yet very pliable. Abdominal obesity increase is of much concern due to its measure of visceral adiposity which leads to higher morbidity and mortality. A study conducted in Benin found abdominal obesity was positively associated with increased chances of MetS (Ntandou *et al.,* 2009). Many sub-Saharan countries including Ghana have linked obesity to urban residence and wealth. This could be interpreted as the wealthier a person is, the more likely he/she is likely to be obese. Reasons that were associated with it include nutrition transition, reduced energy expenditure due to urbanization and increasing economic growth. However, the population under observation here happened to be urban slum women who are economically active and had moderate PAL. Yet most of them were found to be obese. Regressing the various obesity indicators with the lifestyle factors showed an inverse relationship. Socio-economic status was non-significantly associated with WC likewise educational level, dietary pattern, PAL, stress and depression with the exception of alcohol intake and anxiety. On the contrary, other studies have shown significant association between WC and the risk factors mentioned above in many parts of Africa and in Ghana. Could it be then, that there are other unknown factors that could influence the high level of obesity among the urban slum women? Genetic factors, accumulation of intra- abdominal fat as the number of parity increases just to mention a few, could be the cause for high levels of obesity among these women. Also, estrogen secretion among women of reproductive age causes fat accumulation in lower extremities to a higher extent as compared to men. Usually, blood flow after meals comprising high levels of chylomicrons to the fat stored in the hips and thighs increase in women and this is absent in men (Romanski *et al.,* 2000)

Urban slum women in Accra, Ghana generally showed very high levels of body fat. Majority of women within 40-49 years reported the highest prevalence of body fat. These high levels of body fat among study participants could be as a result of imbalance between energy intake and energy expenditure. This has implications on the risk of developing MetS. The equipment used in determining the body fat possibly could estimate relative body fat percentage with an error of 3% to 4% (Houtkooper *et al.,* 2000). Thus if the actual percentage of a participant was 40%, then predicted values could range from 37% to 43% (assuming an error of 3%). With this large error estimate, it makes it quite inappropriate to lay emphasis on the body fat recorded by study participants.

High blood pressure which was formerly scarce has now become a trending epidemic in most parts of West Africa, especially Ghana. The urban slum women had 13.6% of the population reporting high systolic and high diastolic blood pressure and 8.4% had high systolic blood pressure. Arthur et al., (2013) reported the high blood pressure in pre- menopausal women to be 31.5%. These women were recruited in Kumasi metropolis and about 45% of them were physically inactive. Comparing the two settings, it explains why prevalence was lower in urban slum women because they reported to be more physically active than those in Kumasi. However, the high blood pressure was a predominant component among the urban slum women. This lower prevalence in high blood pressure as compared to obesity may imply that lifestyle factors related to MetS and CVDs may first of all affect body weight before they impact other risk factors such as blood pressure. High blood pressure as a risk factor for MetS was not related with age in our study population.

Fasting blood sugar was found to be one of the predominant factors for the MetS risk. Among women between the ages of 40-49 years had 15.3% of them were found to have high FBS. This was statistically significant as compared to the other age groups ***(P= 0.015)***. In 2002, Amoah *et al.,* discovered prevalence of Ghanaians with diabetes to be 6.3% in Greater Accra. However, there is a difference in study settings and the population was heterogeneous as compared to only slum women. Also, changes in urbanization and nutrition transition have fast advanced over the past few years and so there is the possibility of differences in prevalence. Studies show that increasing age coupled with rapid urbanization leads to higher prevalence of diabetes (Kengne *et al.,* 2005). Apparently, this study showed a significant difference between age and high FBS but was non- significantly associated with other lifestyle variables that depict urbanization.

5.4 Socio-economic status as predictor of metabolic syndrome

Being an economically active group with moderate SES, 75.6% of this population were involved in petty trading, food vending and many other forms of manual self- employment. In a moderately active workforce such as this population, it could be presumed that since the nature of their occupation (mainly manual work) gives them the chance to be moderately active, metabolic syndrome and its components would be rare amongst them. However, it was observed in this cross-sectional study, components of MetS and the risk for metabolic syndrome is a health problem even among physically active population. These findings, thus, call for population-specific strategies to address this menace.

The likelihood of having MetS was lower among ages 30-39 as compared to that of those within 40-49 years. This was supported by many studies including Arthur et al., (2013), and Ford et al., (2002) which proves that MetS risk increases with age. Our study could not demonstrate an association between SES and MetS risk. However, this lack of relationship might be due to the relative homogenous SES in our study cohort with about 68% of the women who had MetS risk/MetS having a middle SES and only 13.4% were having high SES. This was also identified with an epidemiological study carried out by Chakraboty *et al*., (2016) although the odds were higher. The level of education attained by study participants was not associated with MetS. Only 5.7% who had or were at risk of MetS had attained high level of education. The majority who were at risk fell in the middle and low educational level. This suggests lower likelihood of MetS with higher level of education reflects a change in the perception of women towards fatness in our local communities. This was contradicting the effect of SES; as higher SES the higher number of women who were in high SES were those with or at risk of MetS. It is therefore incumbent on researchers to consider separately these variables in epidemiological studies.

5.5 Psychological risk factors as predictors of metabolic syndrome

The psychological risk factors considered in this research include depression, anxiety and stress. About 23.6% of the urban slum women were in the state of anxiety. Only 5.2% were depressed and 4.8% were stressed as analyzed by the DASS21 clinical scale (Antony *et al.*, 1998). These findings were non-significant between the different age groups. The levels of these psychological risk factors were almost uniform among the different age groups. In table 4.10, analysis of predictors of metabolic syndrome demonstrated that urban slum women who had severe stress stood a higher chance of developing MetS than those who were in a severe state of anxiety. Comparing with those who had severe depression, severely stressed women stood a higher chance of developing MetS (OR =3.07, CI = 0.42, 22.26) although there was no statistical significance.

Central adiposity, a central component of MetS has been found to be associated with stress, depression and anxiety (Matthews and Kuller, 2002). However, in this study, there was no significant association between stress, depression with waist to hip ratio and waist circumference. Few cross-sectional data present mixed findings, such that two of them support a positive association of anxiety with WHR (Ahlberg *et al*., 2002, Wing *et al.*, 1991) whereas others do not (Cota et al., 2001, Suarez, 2006). Another longitudinal study documented that women with greater overall WC reported trait anxiety time but anxiety did not predict WC, (Matthews and Kuller, 2002). In this study, stress, depression and anxiety were not associated with blood pressure. Reports on stress, depression and anxiety levels in this study did not show any association with MetS. This could be that the material used in determining the psychological risks were not really applicable in this population or it there were possible specificity and sensitivity errors.

5.6 Dietary pattern as a predictor of metabolic syndrome

Dietary pattern as studied in this population identified women's dietary diversity score as less, middle or high. Contrary to the hypothesis of this study, which expected women's dietary pattern to be conducive for the development of MetS and its components; dietary pattern was not associated with the MetS and its components. About 26.8% of women who were at risk of developing metabolic syndrome had moderate dietary diversity, 12.1% were having less dietary diversity (mainly starchy staples and oils) whereas 61.1% recorded high dietary diversity. The main food groups that contributed to middle dietary diversity were fruits and vegetables, main starch staples (banku, kenkey, waakye, etc.), meat, poultry and fish, oils and breads. Out of the nine food groups, eight of them contributed to high dietary diversity. Women who fell in less dietary diversity consumed mostly starchier staples and oils than the other foods. Dietary pattern was non-significantly associated with all the MetS risk components. A less dietary diversity or monotonous diet could result in the development of MetS especially when the fruits and vegetables are absent. Considering their risk for Metabolic syndrome, about 68% of women who had less dietary diversity were at risk or had MetS. Setting dietary pattern as a predictor of MetS, urban slum women who had middle dietary diversity had more odds (OR, 1.13; CI, 0.66, 1.92) of developing

MetS as compared to the others although non-significant. Considering the contribution of starchy staples to all the 3 dietary patterns to be very high, it signifies all the women mainly consume starchy staples every day. This could lead to the accumulation of triglycerides which eventually causes abdominal obesity and increased risk for MetS. This implies, getting them to eat more fruits and vegetables is important.

Other studies had derived dietary pattern based on individual food items and nutrients. A longitudinal study conducted by Kimokoti et al., (2012) over a 7-year period showed a Heart healthier pattern was not associated with a lower risk for MetS or its components. Rather, higher fat and wine and moderate eating patterns were inversely associated with abdominal obesity. Also, in a study carried out by Lutsey et al., (2008), no association between incident MetS and consumption of a prudent dietary pattern. Another study by Millen *et al.*, (2006) found out that poor dietary quality was not related to the development of MetS risk factors during 12y of follow-up in Framingham women but it predicted MetS risk. The above mentioned longitudinal studies support no association between dietary pattern and MetS risk factors. Although the overall diet quality was not assessed in this study, it is important to consider when examining diet disease relationship. This will enable effective strategies to be put in place to lower the disease risk. There was no evidence of the protective effect of high dietary diversity since most of the women at risk of MetS had high score for dietary diversity. Although fruits and vegetables contributed much to high dietary diversity, less can be said of its adequacy since this study did not consider the various nutrients or actual amounts present in the foods. Dietary diversity used in deriving dietary pattern did not give enough information to investigate MetS risk among the urban slum women. Knowledge on the level of ultra-processing of foods, caloric content and portion sizes could not be assessed using the dietary diversity score.

5.7 Public health implication of this study

Assessing the dietary pattern and metabolic syndrome among urban slum women in Accra, Ghana has given a better insight into the prevalence of MetS and MetS risk factors in a female slum population but failed to clearly identify risk factors contributing to this condition. The lifestyle factors among the formal sector or people living in other areas is similar to these slum dwellers. No study in Ghana had looked at this population, yet prevalence of MetS components especially obesity and high blood pressure is emerging among women in slums. This study has brought out the need for government, public health practitioners, clinicians and academia to continually investigate the causes and prevention of MetS in slum areas. This will help reduce the impact of MetS and subsequent chronic diseases in slum women and the health care costs involved.

5.8 Limitations of the study

The limitations of this study include its cross-sectional design and sample size which prevents generalizability and the possibility of identifying causality relationships between SES, lifestyle factors and metabolic risk factors. The bias that FFQ is subjected to could not be avoided. Dietary diversity did not give good interpretation of dietary pattern and associated risk with MetS. There was the likelihood of under/over reporting of physical activity and stress pattern. Otherwise, the models used in deriving these variables were not fully applicable to this population group. There was no control group to address homogeneity of study population with respect to PAL and SES. There was sampling bias as subjects were selected based on their willingness to participate in this study.

5.9 Strength of the study

This study was the first to consider urban slum women who form a bulk of the informal sector in Ghana. Almost all the factors that could trigger MetS development were considered. This study has helped to identify the potential rise of metabolic syndrome among urban slum women. The FFQ used has the advantage of reducing the effect of day-to-day variation in food choices.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The findings of this study revealed the presence of metabolic syndrome and high prevalence of obesity among female slum dwellers in Accra, Ghana. The predominant components seen were body mass index, waist circumference and high blood pressure although the population is active. The analysis carried out in our study did not detect any significant associations or increased odds of MetS with SES, dietary pattern, physical activity or psychological factors. Predictors of metabolic syndrome among urban slum women were difficult to identify due to homogeneity in study population with respect to PAL, SES and dietary pattern. However, alcohol intake and waist circumference were identified as predictors of MetS in this population. There could be a possibility that any of these variables still play an important role in the pathogenesis of MetS. However as compared to other studies carried out in Ghana and other African populations a conclusion can be drawn that MetS prevalence is population specific. This calls for early identification of other risk factors, the metabolic irregularities and appropriate intervention is key in slum communities.

6.2 Recommendation

The current outcome of this study suggests dietary pattern, SES and other lifestyle variables are not good predictors of MetS in this particular population. Until future research shows their predictive ability among urban slum women, intervention plans should consider putting in efforts in the area of screening for and preventing the development of the MetS component risk factors. Interventions aimed at reducing obesity most importantly central obesity should be developed and implemented among urban slum women. Awareness creation is necessary among urban slum women through health education since many of these risk factors are modifiable. Continuous research should be designed and conducted among urban slum dwellers regarding specific causes of the MetS and most importantly their diet. Funding should be provided for research by policy makers to discover other predictors of MetS. Different biomarkers are emerging, including adipocytokines, tumor necrosis factor-α (TNF-α), interleukin-6, and the inflammatory marker C-reactive protein (CRP). More research on the above mentioned biomarkers and their association with MetS should be taken up to help solve this public health issue.

CHAPTER SEVEN

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APPENDICES

APPENDIX 1: Levels of physical activity, depression, anxiety and stress as stratified by age of study population

Table 12 shows the level of physical activity (calculated using WHO GPAQ) of the study population was averagely moderate. It was also observed that those within the ages of 40-49 recorded the highest percentage of moderate (45.2%) and high physical (2.0%) activity but this was not statistically significant. The level of depression, was mild or moderate across all the age groups but it was statistically insignificant, (***P* =0.263**). The severity of anxiety was relatively higher compared to depression and stress although it was not statistically significant, (***P=0.666***).

Table A.1: Levels of physical activity, depression, anxiety and stress as stratified by age of study population

	Age			
Parameter	**15-29 N=73 n(%)**	**30-39 N= 59 n(%)**	**40-49 N=118 n(%)**	***P-value***
Physical activity				**0.860**
Low	0 (0.0)	0 (0.0)	0 (0.0)	
Moderate	71 (97.3)	57 (96.6)	113 (95.8)	
High	2 (2.7)	2 (3.4)	5 (4.2)	
Depression level				**0.263**
No	35 (47.9)	29 (49.1)	65 (55.1)	
Mild/moderate	34 (46.6)	24 (40.7)	50 (42.4)	
Severe	4 (5.5)	6 (10.2)	3 (2.5)	
Anxiety level				**0.666**
No	27 (37.0)	21 (35.6)	50 (42.4)	
Mild/moderate	25 (34.2)	25 (42.4)	43 (36.4)	
Severe	21 (28.8)	13 (22.0)	25 (21.2)	
Stress level				**0.350**
No	46 (63.0)	45 (76.3)	89 (75.4)	
Mild/moderate	23 (31.5)	11 (18.6)	24 (20.4)	
Severe	4 (5.5)	3 (5.1)	5 (4.2)	

Statistical significance at P-value <0.05. Pearson chi-square was used in deriving statistical significance. Physical activity profile was derived from the WHO global physical activity questionnaire. Clinical DASS 21 was used to derived the stress, depression and anxiety pattern.

APPENDIX 2: Ethical Clearance of Universitair Ziekenhuis Gent

Universitair Ziekenhuis Gent

UNIVERSITEIT GENT

Afz: Commissie voor Medische Ethiek

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BETREFT

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Advies werd gevraagd door:
Dr. B. LAPAUW ; Hoofdonderzoeker

BOVENVERMELDE DOCUMENTEN WERDEN DOOR HET ETHISCH COMITÉ BEOORDEELD.
ER WERD EEN POSITIEF ADVIES GEGEVEN OVER DIT PROTOCOL OP 10/07/2015. INDIEN DE STUDIE NIET WORDT OPGESTART VOOR 9/07/2016, VERVALT HET ADVIES EN MOET HET PROJECT TERUG INGEDIEND WORDEN.
Vooraleer het onderzoek te starten dient contact te worden genomen met Bimetra Clinics (09/332 05 00).

THE ABOVE MENTIONED DOCUMENTS HAVE BEEN REVIEWED BY THE ETHICS COMMITTEE.
A POSITIVE ADVICE WAS GIVEN FOR THIS PROTOCOL ON 10/07/2015. IN CASE THIS STUDY IS NOT STARTED BY 9/07/2016, THIS ADVICE WILL BE NO LONGER VALID AND THE PROJECT MUST BE RESUBMITTED.
Before initiating the study, please contact Bimetra Clinics (09/332 05 00).

DIT ADVIES WORDT OPGENOMEN IN HET VERSLAG VAN DE VERGADERING VAN HET ETHISCH COMITE VAN 14/07/2015
THIS ADVICE WILL APPEAR IN THE PROCEEDINGS OF THE MEETING OF THE ETHICS COMMITTEE OF 14/07/2015

- *Het Ethisch Comité werkt volgens 'ICH Good Clinical Practice' - regels*
- *Het Ethisch Comité beklemtoont dat een gunstig advies niet betekent dat het Comité de verantwoordelijkheid voor het onderzoek op zich neemt. Bovendien dient U er over te waken dat Uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.*
- *In het kader van 'Good Clinical Practice' moet de mogelijkheid bestaan dat het farmaceutisch bedrijf en de autoriteiten inzage krijgen van de originele data. In dit verband dienen de onderzoekers erover te waken dat dit gebeurt zonder schending van de privacy van de proefpersonen.*
- *Het Ethisch Comité benadrukt dat het de promotor is die garant dient te staan voor de conformiteit van de anderstalige informatie- en toestemmingsformulieren met de nederlandstalige documenten.*
- *Geen enkele onderzoeker betrokken bij deze studie is lid van het Ethisch Comité.*
- *Alle leden van het Ethisch Comité hebben dit project beoordeeld. (De ledenlijst is bijgevoegd)*

CONTACT	TELEFOON	FAX	E-MAIL
Secretariaat	+32 (0)9 332 56 13 +32 (0)9 332 59 25	+32 (0)9 332 49 62	ethisch.comite@ugent.be
UW KENMERK	**ONS KENMERK**	**DATUM**	**KOPIE**
	2015/0677	14-jul-15	Zie "CC"

Vervolg blz. 2 van het adviesformulier betreffende project EC UZG 2015/0677

- *The Ethics Committee is organized and operates according to the 'ICH Good Clinical Practice' rules.*
- *The Ethics Committee stresses that approval of a study does not mean that the Committee accepts responsibility for it. Moreover, please keep in mind that your opinion as investigator is presented in the publications, reports to the government, etc., that are a result of this research.*
- *In the framework of 'Good Clinical Practice', the pharmaceutical company and the authorities have the right to inspect the original data. The investigators have to assure that the privacy of the subjects is respected.*
- *The Ethics Committee stresses that it is the responsibility of the promotor to guarantee the conformity of the non-dutch informed consent forms with the dutch documents.*
- *None of the investigators involved in this study is a member of the Ethics Committee.*
- *All members of the Ethics Committee have reviewed this project. (The list of the members is enclosed)*

Namens het Ethisch Comité / On behalf of the Ethics Committee
Prof. dr. D. MATTHYS
Voorzitter / Chairman

CC: De heer T. VERSCHOORE - UZ Gent - Bimetra Clinics
FAGG - Research & Development; Victor Hortaplein 40, postbus 40 1060 Brussel
Prof. dr. G. T'SJOEN

APPENDIX 2: Ethical Clearance from University of Ghana (ECBAS)

UNIVERSITY OF GHANA

ETHICS COMMITTEE FOR BASIC AND APPLIED SCIENCES (ECBAS)

P. O. Box LG 1195, Legon, Accra, Ghana

My Ref. No: ECBAS 001/15-16

11th November, 2015

Ms. Juliet Vickar
C/o Prof.Matilda Steiner-Aseidu
Department of Nutrition and Food Science
University of Ghana
Legon - Accra

Dear Ms. Juliet Vickar,

ECBAS 001/15-16: DIETARY PATTERN AND METABOLIC SYNDROME AMONG URBAN SLUM WOMEN IN GHANA

This is to inform you that the above reference study has been presented to the Ethics Committee for Basic and Applied Sciences for a full board review and the following actions taken subject to the conditions and explanation provided below:

Expiry Date:	13/08/15
On Agenda for:	Initial Submission
Date of Submission:	06/07/15
ECBAS Action:	Approved
Reporting:	Quarterly

Please accept my congratulations.

Yours sincerely,

Professor Daniel Bruce Sarpong
ECBAS Chairperson

Tel: +233-244692728 Email: saddo@staff.ug.edu.gh / ecbas@ug.edu.gh

APPENDIX 3: Informed Consent Form

Informed Consent Form

Study title: Dietary pattern and Metabolic Syndrome among urban slum women in Accra, Ghana

Principal Investigator: Ms Juliet Vickar, Prof B. Lapauw, Prof. C. Lachat, Prof. M. Steiner-Asiedu

Address: Ghent University

Invitation to participate:
This research seeks to assess the impact of dietary pattern on metabolic syndrome in women living in slums in Accra, Ghana. We kindly invite your participation in the study.

Purpose:
Due to an upsurge of rural-urban migration and very high rate of slum development, Accra is fast urbanising and the consumption of high energy dense foods are on the increase. Of those who migrate to the capital city, majority are women. This study will want to inquire if nutrition transition has transcended among slum populations and how their dietary pattern pose a risk for development of Metabolic Syndrome. Understanding of the association between dietary pattern and metabolic syndrome outcomes will help inform policies.

Description of procedures:
If you accept to participate in this research, you will be asked to provide certain information such as your age, level of education, usual food intake, physical activity and stress. Blood pressure, weight and height will be measured. A sterile lancet will be used to prick you to obtain blood for fasting blood glucose. Your measurements will be compared to cut-off values to determine your health status. All measurements and blood samples will not bear your name; therefore no one can associate you with it.

Eligibility:

Before you can participate you should be between 15-49 years and have lived in live in the selected community for at least 12 months. Pregnant, lactating mothers and acutely sick women will be excluded from this study.

Risks and inconveniences:

The inconvenience you may experience is the time you would have to dedicate to complete the questionnaires. Possibly, some questions may make you feel uncomfortable or lead to a loss of your privacy. The pricking of fingers to obtain spot blood samples may be slightly painful to you. You are not compelled to answer the entire questionnaire or to complete the interview if you so wish. You are free to decline to give your blood if you choose to.

Benefits:

Findings from the study will inform policies on nutrition transition trends among this population and the growing prevalence of NCDs for better health policies in Ghana

Economic considerations:

There is no cost for participation. If you choose to participate in the study the researcher assistants will visit you at home to conduct interviews as required.

Confidentiality:

Any information obtained from your participation will be kept strictly confidential. Your consent form will be kept separate from the data. The data will not be available to anyone other than the researcher. The information may be used in presentations and/or research papers. However, your name will never be used in any presentations, papers, or reports.

Occasionally the institutional review board (IRB) of Noguchi Memorial Institute may inspect study records as part of its auditing program, but these reviews will only focus on the researcher and not on your responses or involvement. The IRB is a group of people that reviews research studies to make sure they are safe for participants.

Compensation:

You will be a towel to show appreciation

Voluntary participation:

Participation in this study is not compulsory. You are free to stop at any point in time if you so wish. You will not be penalized for default.

Any questions:

Kindly take enough time to make a decision. We are ever ready to answer any questions you may have about the study. If you have further questions aimed at clarifications concerning your participation in the study, you may contact the principal investigator of the study at Ghent University- Belgium, Ms. Juliet Vickar on telephone (+233546011400) or by email; julietvickar@gmail.com. If you have any questions concerning your right as a research subject, you may contact the chairman of the Noguchi Memorial Institute Institutional Review Board (IRB).

Volunteer agreement:

The above document describing the benefits, risks and procedures for the research on the dietary pattern and Metabolic Syndrome among urban slum women in Accra, Ghana has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

……………………………… ……..… ………………………………….

Date Signature or mark of interviewee

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

……………………………… ……………………………………

Date signature of witness

I certify that the nature purpose of the potential benefits and possible risks associated with participating in this study research has been explained to the above individual.

…………………………………… …… …………………………………………………

Date signature of person who obtained consent

APPENDIX 4: Questionnaire

Questionnaire

Dietary pattern and Metabolic Syndrome among urban slum women Accra, Ghana

Ghent University

Place of interview:

Serial number: | | | | | | | **(day/month/code interviewer)**

Name of the interviewer:

Date:

---

1. Section A: Background Information

Please circle that which is applicable

Serial number	Code	Questions	Coding
101	AGE	How old (completed years) are you?	1. {15-29} 2. {30-39} 3. {40-49}
102	ETHN	What is your ethnicity?	1. Ga 2. Northerner 3. Akan 4. Ga- Adangbe 5. Other: specify………..
103	REL	What is your religion?	1. Christianity 2. Muslim 3. Traditionalist 4. None of the above
104	MARI	What is your current marital status?	1. Single 2. Engaged 3. Married 4. Divorced 5. Widowed
105	CHD	How many children do you have?	_____________Males _____________Females _____________Total
106	EDU	What is the highest level of schooling which you successfully completed?	1. None 2. Primary 3.JHS 4. SHS (General) 5. (Technical/ Vocational) 6. Other
107	SCH	Are you currently attending school?	1. Yes 2. No

108	EMP	Are you currently employed?	1. Yes 2. No
109	OCCP	What is your current occupation?	
110	NWO	Average number of working hours per day? (Reference to last week)	
111	DWO	Average number of working days per week? (Reference to last week)	
112	WAGE	What is your current wage (Ghana cedis) per day on average?	
113	FWAG	How often do you receive your wages?	1. Daily 2. Weekly 3. Monthly 4. Occasionally
114	YCIT	How long have you been staying here?	
115	ALC	Do you consume any form of alcohol?	1. Yes 2. No
116	HALC	How often do you consume the alcohol?	1. Daily 2. Weekly 3. Monthly 4. Occasionally
117	SFOD	How much do you spend on food (weekly)?	
118	PPST	Where was your previous place of stay?	
119	SLP	Where is your current place of sleep?	1. Rented block room 2. Rented wooden structure 3. Rented kiosk 4. Open space
120	SHR	How many people do you share room with?	
121	ITEM	Do you have any of the following items at your place of stay?	1. Television 2. Refrigerator 3. Gas stove 4. Radio 5. Blender 6. Mobile phone 7. Computer
122	TRANS	What is your usual mode of transport?	1.Walking 2. Biking 3.Public transport 4. Private car
123	LIGH	What lighting facility do you use?	1.electricity 2.Candle 3.Lamp 4. Lantern

124	TOIL	What toilet facility is available to you?	1.Free range 2. Public KVIP 3. Owned KVIP 4. Public W C
125	WATE	What is your source of water?	1.Public pipe water 2. Public well 3. Public borehole 4. Owned well

2. SECTION B: Physical Activity Profile: (Please answer appropriately)

	Activity	Duration
201	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads] for at least 10 minutes continuously?	1.Yes 2.No
202	In a typical week, on how many days do you do vigorous intensity activities as part of your work?	
203	How much time do you spend doing vigorous-intensity activities at work on a typical day?	
204	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?	1.Yes 2.No
205	In a typical week, on how many days do you do moderate intensity activities as part of your work?	
206	How much time do you spend doing moderate-intensity activities at work on a typical day?	
207	Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	1.Yes 2.No
208	In a typical week, on how many days do you walk for at least 10 minutes continuously to get to and from places?	
209	How much time do you spend walking for travel on a typical day?	
210	Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like for at least 10 minutes continuously?	1.Yes 2.No
211	In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (leisure) activities?	

	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	
212	Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, jogging for at least 10minutes continuously?	1.Yes 2.No
213	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	
214	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	
215	How much time do you usually spend sitting or reclining on a typical day?	

3. SECTION C: Stress pattern (DASS21)

The rating scale is as follows: Please circle the appropriate answer

0. Did not apply to me at all
1. Applied to me to some degree, or some of the time
2. Applied to me to a considerable degree, or a good part of time
3. Applied to me very much, or most of the time

	Action	Scores			
301	I found it hard to wind down	0	1	2	3
302	I was aware of dryness of my mouth	0	1	2	3
303	I couldn't seem to experience any positive feeling at all	0	1	2	3
304	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
305	I found it difficult to work up the initiative to do things	0	1	2	3
306	I tended to over-react to situations	0	1	2	3
307	I experienced trembling (eg, in the hands)	0	1	2	3
308	I felt that I was using a lot of nervous energy	0	1	2	3
309	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
310	I felt that I had nothing to look forward to	0	1	2	3
311	I found myself getting agitated	0	1	2	3
312	I found it difficult to relax	0	1	2	3
313	I felt down-hearted and blue	0	1	2	3
314	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
315	I felt I was close to panic	0	1	2	3
316	I was unable to become enthusiastic about anything	0	1	2	3
317	I felt that I was rather touchy	0	1	2	3
+318	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
319	I felt scared without any good reason	0	1	2	3

320	I felt that life was meaningless	0	1	2	3
321	I felt I wasn't worth much as a person	0	1	2	3

4. SECTION D: Food Frequency Questionnaire

For each of the following foods, mark the column to show how often respondent usually ate each food in the past month. Mark the usual amount (serving size) as small, medium or large.

`HOW OFTEN DID RESPONDENT EAT THESE FOODS IN THE PAST ONE MONTH

(Amount based on local food measures; show participant)

FOOD ITEM	FREQUENCY OF CONSUMPTION					USUAL AMOUNT*		
	1-2 times / day	5+ times /week	2-4 times per week	1 /week	Never or <1 /week	S	M	L
PORRIDGES & CEREALS								
Hausa koko								
Corn koko								
Tom Brown								
Ekuegbemi								
Oblayoo								
Rice water								
Oats								
Other porridges/cereals								
BEVERAGES & OTHER DRINKS								
Cocoa drinks e.g. Milo								
Cocoa powder								
Other beverages/drinks								
Tea e.g. Lipton								
Herbal tea								
Other tea								
Coffee e.g. Nescafe								
This way chocolate drink								
Cowbell coffee								
FOOD ITEM	**FREQUENCY OF CONSUMPTION**					**USUAL AMOUNT***		
	1-2 times / day	5+ times /week	2-4 times per week	1 time/ week	Never or <1 /week	S	M	L
EVAPORATED MILK								
Peak milk								
Ideal milk								
Carnation milk								
Carnation Tea Creamer								
Vega milk								
Whole milk (fresh milk)								
Skimmed milk (fresh milk)								

Yoghurt								
POWDERED MILK								
Nido								
Peak								
Cowbell								
JUICES & DRINKS								
Tampico								
Kalypo								
Vita Milk (Soya milk)								
Countre milk								
Minerals (e.g. Fanta, Coca Cola, Africa cola, special drink, etc)								
Rush energy drink								
BREADS								
Bread (Sugar, Tea, Brown etc.)								
Bofrot								
Akara/Koose								
Pie/chips								
Biscuits e.g. Malt and Milk								
Cream Crackers								

MAIN FOODS & STARCHES	1 - 2 times /day	5+ times/week	2-4 times / week	1 time / week	Never or <1 /week	S	M	L
Kenkey (Ga, Fante)								
Waakye								
Rice (Boiled/fried/jollof/balls)								
Fufu								
Banku								
Boiled yam								
Fried yam								
Sweet potatoes								
Boiled plantain								
Roasted plantain								
Fried plantain								
Cocoyam								
Gari								
Beans and gari								
Spaghetti								
Noodles								
Spring rolls								
Pizza								

FOOD ITEM	FREQUENCY OF CONSUMPTION					USUAL AMOUNT*		
	1-2 times / day	5+ times /week	2-4 times / week	1time /week	Never or <1 /week	S	M	L
Millet/ Sorghum								
Maize/corn (boiled/roasted/fried)								
Tuo zaafi								
Sugar								
Other main foods/starches								
PROTEIN FOODS								
Eggs (Boiled, fried)								
Fried fish								
Smoked fish/ Koobi								
Fresh fish								
Seafood (Crabs/shrimps/shellfish)								
Meat (farm animals)								
Bush meat								
Poultry (Chicken/duck/birds)								
Wele (cow hide)								
Sausage								
Corned beef								
Canned fish								
Beans (cowpea/soyabeans)								
Other protein foods								

FOOD ITEM	FREQUENCY OF CONSUMPTION					USUAL AMOUNT		
	1 - 2 times /day	5+ times /week	2-4 times per week	1time/ week	Never or <1 /week	S	M	L
VEGETABLES								
Cocoyam leaves (Kontomire)								
Other leaves (Ademi, bokoboko)								
Okra (okro)								
Tomatoes (fresh)								
Onions								
Garden eggs								
Cabbage								
Lettuce								
Cucumber								
Carrots								
Green pepper								
Mixed vegetables salad								
Other vegetables								

FOOD ITEM	**FREQUENCY OF CONSUMPTION**					**USUAL AMOUNT***		
	1-2 times / day	5+ times /week	2-4 times/ week	1 time/week	Never or <1 /week	S	M	L
FRUITS								
Orange								
Pineapple								
Water melon								
Mango								
Apple								
Guava								
Banana								
Pawpaw								
Avocado pear								
Mixed fruit salad								
Other fruits								
OILS								
Vegetable oil (cooking oil)								
Red palm oil								
Palm kernel oil								
Coconut oil								
Soyabean oil								
Groundnut oil								
Shea butter oil								

5. SECTION E: Anthropometric and Biochemical Measurements

Serial Number	Code	Measurement	Coding
01	WT	Weight Weight	____________________kg ____________________kg
02	HT	Height Height	____________________m ____________________m
03	WC	Waist circumference Waist circumference	__________________cm _________________cm
04	WHR	Waist-to-hip ratio	_________________ _________________
05	BMI	Body mass index	_________________
06	BP	Blood pressure Blood pressure	__________________mmHg __________________mmHg
07	FBS	Fasting blood sugar	___________________g/dL