

**SCHOOL OF PUBLIC HEALTH  
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**PREDICTORS OF METABOLIC SYNDROME IN ADOLESCENTS IN TWO (2)  
JUNIOR HIGH SCHOOLS IN ABLEKUMA SOUTH DISTRICT.**

**BY**

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AWARD OF THE MASTER OF PUBLIC HEALTH DEGREE**



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**DECLARATION**

I, Elizabeth Mabel Bankah, declare that this dissertation is my original work. No material herein, has been partly or wholly presented elsewhere. All references to other persons' views and ideas have been duly acknowledged and cited.

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## DEDICATION

I dedicate this work to the Almighty God, my husband Patrick Ekow Bankah and our son Andrew Kofi Bankah.



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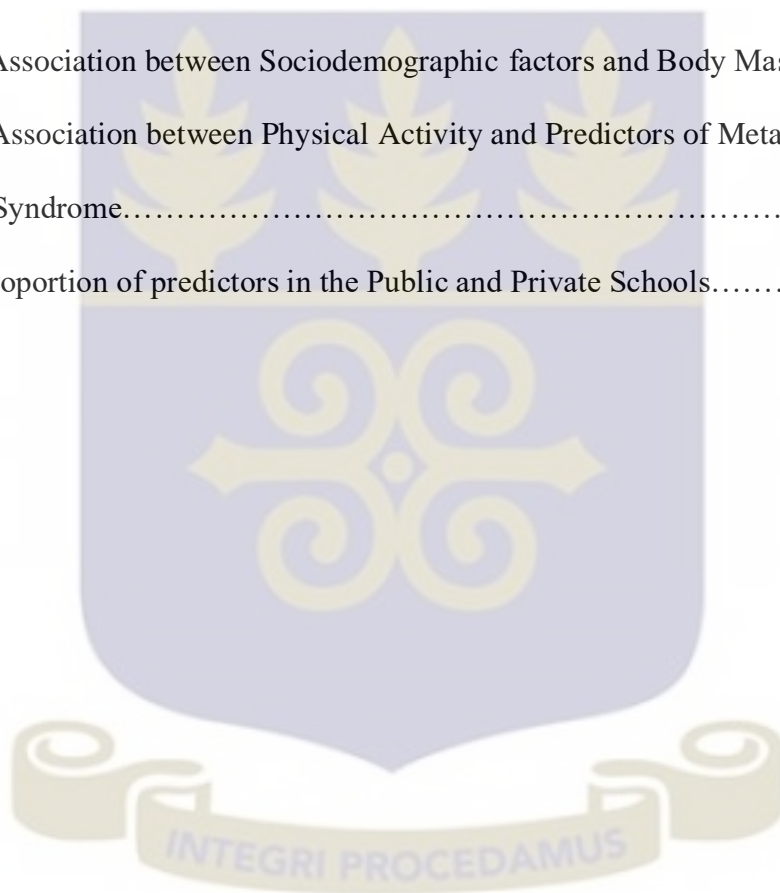
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## LIST OF ACRONYMS

BMI	Body mass index
BP	Blood Pressure
FPG	Fasting Plasma Glucose
HDL	High Density lipoprotein
IDF	International Diabetes Federation
LMIC	Low to Middle income countries
MetS	Metabolic Syndrome
NCD	Non-communicable diseases
PI	Principal Investigator
SSA	Sub Saharan Africa
TG	Triglycerides
WC	Waist circumference
WHR	Waist to Hip ratio
WHtR	Waist to Height ratio



## ABSTRACT

**Background:** Prevalence of metabolic syndrome in adolescents is increasing in the wake of the obesity epidemic among children and adolescents. There is paucity of data on the prevalence of metabolic syndrome among adolescents in Ghana. The aim of this study was to determine the prevalence of predictors of metabolic syndrome in adolescents using cost effective noninvasive methods, and its associations with sociodemographic factors and physical activity.

**Method:** A cross sectional study of 302 adolescents in two (2) junior high schools in Ablekuma South, was conducted. Questionnaires on sociodemographics and physical activity were self-administered. The predictors of metabolic syndrome assessed were Blood pressure (BP)  $\geq$  90<sup>th</sup> centile, Body Mass Index (BMI)  $>$  Z score of 2, Waist to Height Ratio (WHtR)  $\geq$ 0.5. Data was analyzed using SPSS (Version 21). Categorical variables were reported as proportions, percentages and ratios and continuous variables presented as means with standard deviations. Tests of associations between the independent variables and outcome variable which is the composite of body mass index, waist to height ratio and blood pressure were performed. Statistical significance was set at P-value of  $<$ 0.05.

**Results:** The study participants consisted of 140 males (46.40%) and 162 females. The mean age was 14.24 ( $\pm$ 1.39) years with a range of 12 years to 18 years. The predominant level of mothers' education (47.7%) was secondary school. Most of the fathers (52.0%) had tertiary education. Approximately 70% of mothers were traders/businesswomen and 35% of fathers worked in non-health related fields. Thirteen percent of the parents had hypertension, diabetes or both. Of the total respondents, 8.9% had WHtR  $>$ 0.5, BMI was  $>$  Z score of 2 in 5.6% and 9.3% had BP  $\geq$ 90<sup>th</sup> centile. The prevalence of predictors of metabolic syndrome was 1.7% amongst the participants.

**Conclusion** Risk of metabolic syndrome does exist among adolescents in Ghana. Sociodemographic factors and physical activity were not significantly associated with the predictors of metabolic syndrome.

**Keywords:** **Body Mass Index, Waist to Height ratio, Blood pressure, Metabolic Syndrome, Ghana**



## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background

Metabolic syndrome is a premorbid condition which predisposes a person to the development of arteriosclerotic cardiovascular disease (ASCVD) and type 2 Diabetes (T2DM)(Grundy et al., 2005). It was first described in the early 20<sup>th</sup> century as a clustering of hyperglycemia, hypertension and hyperuricemia (Okafor, 2012) Over the years, various definitions have been proposed, each one, an attempt to improve upon the latter in scope and practicability. These included the definitions provided initially by the World Health Organization (WHO) followed by The European Group for the Study of Insulin Resistance (EGIR) The National Cholesterol Education Program-Third Adult Treatment Panel (NCEP-ATPIII)( Alberti, Zimmet, & Shaw, 2006). The WHO definition consisted of diabetes or hyperinsulinemia and at least two additional conditions of obesity, dyslipidemia, hypertension or microalbuminuria. The EGIR then proposed a definition of insulin resistance or hyperinsulinemia (in non-diabetics) and at least two additional conditions of central obesity, hypertension, dyslipidemia or dysglycemia. In a bid to improve upon these former definitions, NCEP-ATPIII proposed a definition which consisted of at least three of the following conditions; central obesity, hypertension, hypertriglyceridemia, low HDL and dysglycemia(Zimmet, Magliano, Matsuzawa, Alberti, & Shaw, 2005). These definitions, however were cumbersome in assessing metabolic syndrome in practical clinical setting even though they were useful in the research setting. The need for a useable definition for the clinical setting thus became apparent and a consensus among experts in association with International Diabetes Federation, was finally reached to adopt unifying definition which comprised of central

obesity and two additional conditions of raised triglycerides, blood pressure, fasting plasma glucose or reduced HDL (Alberti, Zimmet, & Shaw, 2006).

*“As the prevalence of obesity in adults and youth continues at historically high rates, so does the occurrence of obesity-related comorbidities. Many chronic diseases that were once believed to be conditions of adults alone are now being seen in the young.”* (Wittcopp C, 2016)

Identification of metabolic syndrome in children and adolescents has become important as a result of the fairly recent increase in childhood obesity worldwide. The intensification of this raging obesity epidemic over a relatively short period of time, has necessitated the development of a practical definition for youth to be used in clinical and public health setting. (Alberti & Zimmet, 2007).

The challenges faced in coming up with such a definition was greatly influenced by adolescents being adolescents. The physiological and physical changes in adolescents does not allow for a wholesale adoption of the adult definition of metabolic syndrome. This is because the clinical parameters of interest such as insulin sensitivity, change with age and development in the adolescent period. Hormonal changes affect not only the distribution of adiposity but also the production and effectiveness of endogenous insulin (Jessup & Harrell, 2005).

The working definition of metabolic syndrome in children put forward by the International Diabetes Federation emanated from the consensus definition and has been modified to include children and adolescents. The cut-off values of the biochemical measurements and anthropometric indices such as waist circumference measured in adults had specific values but the pediatric definition uses percentiles to make up for variations in child development and ethnic origin. (Alberti & Zimmet, 2007).

The common denominator in all the definitions of metabolic syndrome is obesity or high adiposity. Worldwide the prevalence of obesity is on the ascendency; in 2014, 39% of all adults were obese or overweight (“WHO | Obesity and overweight,” 2015). This has immensely contributed to the increase in cardiovascular disease which is a major contributor to mortality caused by non-communicable diseases (NCD). Cardiovascular disease, thought to be the disease of the wealthy is now considered an epidemic in Africa. According to the WHO more than 90% of the 14 million premature deaths from NCDs occur annually in the low to middle income countries (World Health Organization, 2013). The prevalence of NCD is projected to rise in these countries as their economies and populations grow. The potential effect of NCDs on the productivity and limited healthcare infrastructure in the economically challenged countries led to the United Nations first high level meeting on NCD (Bloom et al., 2012).

In sub-Saharan Africa, rising prevalence of NCD has been attributed to epidemiological and nutritional transitions characterized by decreasing infant and child mortality with socioeconomic development and increase in lifestyle diseases; caused by calorie rich diet and physical inactivity (BeLue et al., 2009). Unfortunately, even though the sub region is experiencing positive development in epidemiologic transitional conditions, there is a rise in non-communicable diseases, whilst pre transitional diseases (communicable diseases) are still rife. Dalal et al described the region as being double burdened with high prevalence of both communicable and non-communicable diseases and that the impact of the disease burden in SSA is disproportionately larger than what pertains in developed countries(Dalal et al., 2011). According to WHO, almost a third of deaths caused by NCD occur before the age of 60, in the developing world, compared to approximately one fourth in developed countries. It has been projected that while disability adjusted life years are

increasing rapidly due to NCD morbidity, it will also be responsible for 46% of the total mortality by 2030 in the sub region(Baldwin & Amato, 2012).

In the wake of childhood and adolescent obesity pandemic, the prevalence of metabolic disease is on the increase(Misra & Vikram, 2007). Adolescence is a period of opportunity where habits and lifestyle can be influenced by external forces. According to the World Bank, more than half of the incidence of NCD can be avoided through health and preventive interventions(Baldwin & Amato, 2012). Targeting adolescents has been described as “the last best chance” to minimize the effect of this epidemic in order bring about a sustainable solution to situation in the long-term(Baldwin, 2013).

Traditionally, investments in healthcare and infrastructure in the sub region has been directed towards communicable and poverty-related diseases. The impact of NCD pandemic is projected to be devastating in that, at present there is a dearth of healthcare personnel and infrastructure and lack of political will to tackle the situation( BeLue et al., 2009). The cost of effective medical treatment, which is long term, is enormous and would be an incredible financial and social burden on any developing country. This has made it imperative for prevention to be priority in the management of this epidemic.

Ghana, considered a low middle income country, estimated 42% of total deaths to be due to NCDs, 18% from cardiovascular diseases as reported by WHO Non-communicable diseases Country profile 2014(“WHO | Noncommunicable diseases country profiles 2014,” 2015) There is a dearth of studies on prevalence of metabolic disease in the Sub-Saharan region. Some research done in rural adult populations in Ghana and in Nigeria estimated 15% and 12% prevalence respectively(Gyakobo, Amoah, Martey-Marbell, & Snow, 2012b).

Prevalence of metabolic syndrome among Ghanaian adolescents is not readily available. However, there have been some studies on components of the syndrome. A study done on the prevalence of obesity among Ghanaian and Ugandan adolescents reported 10.4% for females and 3.2% for males (Peltzer & Pengpid, 2011). Afrifa-Anane et al conducted a study among the urban poor youth in Accra, Ghana, where they found the proportion of pre-hypertension and hypertension to be 32.3% and 4% respectively (Afrifa-Anane, Agyemang, Codjoe, Ogedegbe, & de-Graft Aikins, 2015).

Policy making and intervention programs can be carried out effectively if data is available for informed decision making. Therefore studies on risk factors among adolescents in the local setting is imperative to the participation in the fight to stem this epidemic.

## **1.2 Problem Statement**

Adolescence, ideally a period of vitality and good health is currently faced with a problem of obesity, development of metabolic syndrome and consequently cardiovascular disease. Adolescents in most countries in the world are becoming fat due to the adoption westernized lifestyle which is now pervasive in societies. A study done in the United States of America showed a metabolic syndrome prevalence of 4.5% in the adolescent population. (Ford, Li, Zhao, Pearson, & Mokdad, 2008). Singh et al found that 4.2 % of North Indian adolescents had metabolic syndrome (Singh, Bhansali, Sialy, & Aggarwal, 2007) In Sub Saharan Africa, this increase in non-communicable diseases has been attributed to epidemiological and nutritional transitions (Dalal et al., 2011).

Complications from cardiovascular disease and type 2 diabetes, which may emanate from metabolic syndrome occurs earlier in adolescents as compared to adults who develop the syndrome later in life. Morbidity and mortality occur at the peak of socioeconomic

productivity in the youth thus resulting in lost income and poverty from high medical costs(Baldwin & Amato, 2012).

The effect of metabolic syndrome on the adolescent is far reaching and early detection is key. Diagnosis of metabolic syndrome is not routine in adolescents. Physicians usually make a retrospective diagnosis when a patient presents with the manifestation of disease resulting from metabolic syndrome such as arteriosclerotic cardiovascular disease. At the point of presentation when the disease has occurred, modifying risk factors only, does not constitute adequate management unless chemotherapy is included. Early intervention fortunately, has been proven to remarkably reduce the risk of metabolic syndrome and its subsequent effects(Waling, Bäcklund, Lind, & Larsson, 2012).

Metabolic syndrome prevalence in adolescents has not been extensively investigated in Ghana. Since obesity is an important risk factor in the development of metabolic syndrome, increasing prevalence of adolescent and childhood obesity in the country represents an inadvertent rise in risk of metabolic syndrome.

Considerable resources have been put into decreasing child mortality which has resulted in the increase of the population of adolescents(Nakamura, Ikeda, Stickley, Mori, & Shibuya, 2011). As the future human capital, adolescents must therefore be safeguarded into productive adulthood.

### **1.3 Justification**

The major driver of the development of metabolic syndrome is obesity. Studies done in Ghana have shown an increasing trend in the prevalence of obesity among adolescents, predisposing them to the development of metabolic syndrome and its attendant complications of cardiovascular diseases. In Ghana, there is paucity of studies conducted

on prevalence of cardiovascular disorders emanating from lifestyle diseases in adolescents. Although these conditions are recognized public health concerns, availability of data is a challenge.

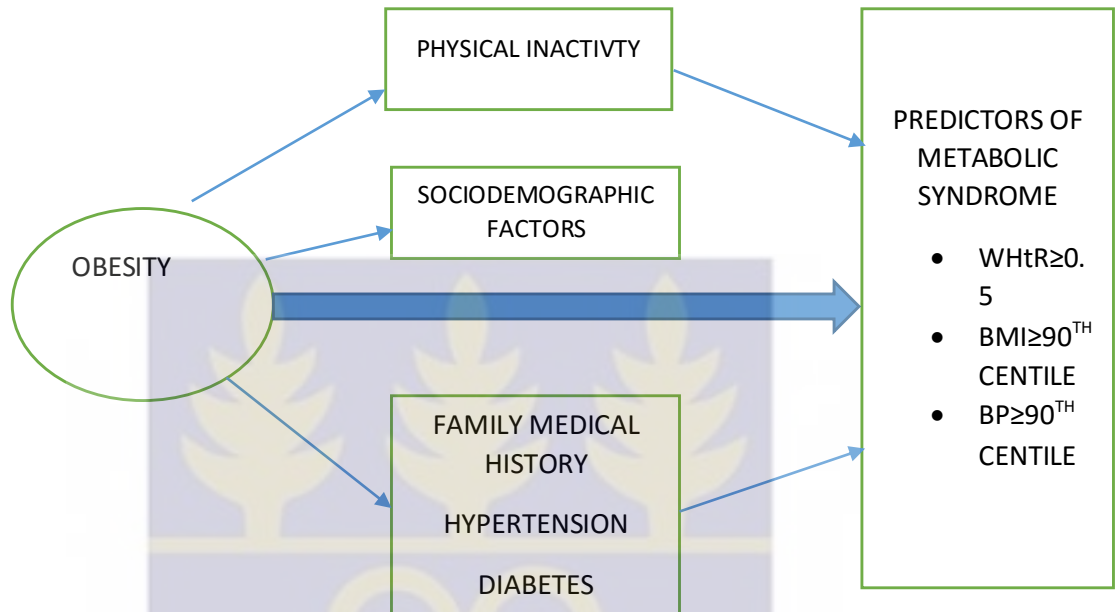
Comprehensive investigations and management of metabolic syndrome is expensive. The high cost of care and the lack of adequate infrastructure and health personnel to manage the trend of lifestyle diseases emerging in our resource challenged setting has led to the need for simple, cost effective and reliable means to address the problem. Anecdotal evidence has shown that in practice, lifestyle change in adolescents, with the full complement of metabolic syndrome, has had mixed success and pharmacotherapy has had challenges with compliance. The better alternative is prevention.

This study seeks to assess the metabolic syndrome risk profile of adolescents in the wake of increasing obesity using noninvasive procedures which will contribute to medical knowledge in the area of Adolescent health whilst providing an affordable and sustainable means of screening risk factors for prevention of cardiovascular diseases associated with this syndrome.



#### 1.4 Conceptual framework

**Figure 1: Conceptual Framework of Factors Contributing to Metabolic Syndrome in Persons Aged 10-19 Years**



#### Narrative

Obesity is an independent major contributor to the development of metabolic syndrome and physical signs and symptoms can be used as a proxy in the determination of predisposition to acquired cardiovascular disease.

In this study, predictors of metabolic syndrome as the outcome of interest are; waist to height ratio greater or equal to 0.5, a body mass index(BMI) of greater than 90<sup>th</sup> centile for age, waist circumference, as a proxy of dysglycemia and a blood pressure greater of equal to 90<sup>th</sup> centile for age.

Factors that may be associated with these predictors include family history of diabetes or hypertension, sociodemographic factors and physical inactivity.

## **1.5 Objectives**

### **1.5.1 General objective:**

- To determine the prevalence of predictors of metabolic syndrome in adolescents in two (2) Junior high schools in Ablekuma South district, Accra.

### **1.5.2 Specific Objectives**

1. To determine the prevalence of metabolic syndrome among adolescents in two Junior secondary schools in Ablekuma South district, Accra
2. To determine the socio demographic factors associated with predictors of metabolic syndrome in Junior high schools in Ablekuma South district, Accra.
3. To determine the association between the level of physical activity and predictors of metabolic syndrome in adolescents in Junior high schools Ablekuma South district, Accra.

## **1.6 Research questions**

1. What is the association between physical activity levels and predictors of metabolic syndrome?
2. Is there a relationship between socio-demographic profile and adolescents who have predictors of metabolic syndrome?
3. Is there an association between family medical history and predisposition to metabolic syndrome in adolescents in Ghana?

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

The importance of chronic or non-communicable diseases (NCDs) has become quite prominent worldwide within the last decade. In previous times the global burden of disease was mostly communicable or infectious diseases but the situation has been changing rapidly in recent years. According to the WHO, cardiovascular diseases, cancers, chronic respiratory diseases and diabetes together are responsible for the deaths of 38million people each year(WHO, 2014). Of the four main types, cardiovascular diseases such as heart attacks and strokes contributing to more mortality and morbidity than the other three combined. All the four diseases caused 82% of non-communicable disease deaths(Baldwin & Amato, 2012).

The NCDs were traditionally the disease of the western and industrialized countries of the world. As the Low and Middle Income Countries (LMICS) suffered infections and communicable diseases, the West was plagued with the chronic non-communicable diseases. With the changes in epidemiological transitions in the LMICs these chronic diseases have emerged and at rates faster than that observed in the developed countries(Kelishadi, 2007). The UN secretary general described the situation in developing countries as a “*public health emergency in slow motion*” at the UN's high-level meeting on the prevention and control of non-communicable diseases (Oncology, 2011).

The sharp rise in prevalence of NCDs being described now as an epidemic is occurring as a result of several factors. Epidemiological transitions which is marked by improvement in the economic, social and health status brings with it post-transitional diseases. These diseases of “*affluence*” are usually as a result of urbanization and westernized diet and lifestyle(Hancock, Kingo, & Raynaud, 2011). People eat diets that are high in energy and

lead sedentary lives. Even though LMICs are experiencing improved socioeconomic status, the commensurate reduction of communicable diseases which is known to be the usual occurrence of this phenomenon is not the case. Both communicable and non-communicable diseases are co-occurring leading to LMICs being known as “double burdened” with disease (BeLue et al., 2009).

The decrease in child mortality in some countries in sub-Saharan Africa has led to an increase in the number of young people living the sub region; most of the countries have an inverted cone shaped population structure (Dalal et al., 2011). The prevalence of NCDs is found to be highest among younger people. According to the WHO, 82% of premature deaths by NCDs, which is death below 70 years occurred in the LMICS (WHO, 2014). In other words, people who survived communicable diseases in their childhood lived to be killed by non-communicable diseases in adulthood. Childhood survivors are growing up to be at risk of NCDs because of their disproportionate vulnerability to factors that predispose to the epidemic. Proimos et al. intimated that not only do the risks and diseases begin in childhood but they are actually present in fetal life due to maternal exposure to unhealthy diet, reduced activity, alcohol and risky behavior. (Proimos & Klein, 2012).

Targeting adolescents for early awareness and prevention was described as the “last best chance” for several reasons (Baldwin, 2013). The period of adolescence presents with various opportunities to instill values that will set the path into adulthood in a positive, healthy and productive way (Baldwin, 2013). Considering that during this formative period, adolescents are heavily influenced by media and observational learning and therefore consistent exposure to healthy alternative lifestyle options can positively influence their adulthood.

Cardiovascular disease accounting for 17.5million of deaths caused annually by NCDs has the highest mortality(World Health Organization (WHO), 2010). Since most of the risk factors of cardiovascular diseases are due to unhealthy lifestyle such as high energy diet, physical inactivity and obesity, interventions are likely to succeed if addressed in a timely manner.

### **2.1 Predictors of metabolic syndrome in adolescents**

The increase in prevalence of childhood and adolescent obesity has resulted in increased prevalence of metabolic syndrome among this group. Until recently, there was no definitive criteria for diagnosis of the syndrome in adolescents but the rise in obesity and hence risk factors of cardio metabolic disease globally, necessitated a definition that would be globally acceptable (Alberti, Zimmet, & Shaw, 2006b). The criteria for diagnosis in children and adolescents is a slight modification of the consensus adult criteria. Components of the criteria; Hypertension, Dysglycemia, Dyslipidemia and Obesity runs through all the definitions with the variations being clinical assessment of physical measurements. Whilst adults have specific cut-off values for blood pressure and anthropometric measurements, children and adolescent have been divided into three groups which use percentiles for unique categorization. Alberti et al., 2006b).

Criteria for diagnosis in adolescents require the presence of abdominal obesity and two or more other clinical features namely; High triglycerides (TG), Low High Density Lipoprotein (HDL), High Plasma glucose (FPG) or High blood pressure (BP). Thus comprehensive assessment of metabolic syndrome involves an invasive measurement of triglycerides, lipoproteins and plasma glucose and a noninvasive measurement of blood pressure and abdominal obesity. As the denominator of all the other component risk factors, obesity is an independent risk factor that can be used to predict the predisposition

to metabolic syndrome and hence the risk of metabolic disease (Bener et al., 2013). The various methods by which physical fatness can be assessed, such as body mass index, have been used as predictors of metabolic syndrome (MetS).

The challenge in designating a singular method for physical measurement of adiposity in adolescents is the inconsistent distribution of fat during the adolescent period which is influenced by gender and ethnicity (Misra & Vikram, 2007). As the adolescent grows, hormonal influences contribute to the physical modelling of the body and therefore one size fits all approach is not expedient for this group. To address this issue, several studies have been done to prove the superiority of one method over the other. Body mass index is a simple easy cost effective measure of excess body fat. It is calculated by dividing the body weight in kilograms by the height in meters squared. Even though BMI has been widely used in the assessment of fatness, there has been criticisms about its effectiveness in predicting risk due to obesity.

It has been used widely for the evaluation of nutritional states in children and adults. However, with the increase in non-communicable diseases worldwide, both the developed and developing world are in search of a more precise but cost effective means of evaluating risks of cardiovascular disease to sustain the medical economies (Takahashi et al., 2009). The precision of the measurement of fatness improved when BMI was interpreted in conjunction with waist circumference (Alberti & Zimmet, 2007). Research has shown that central or abdominal obesity is representative of visceral adipose tissue which is more metabolically active than fat at the other sites of the body (Carroll et al., 2008). Waist height ratio (WHtR) is also being recommended as superior to BMI and WC. As BMI measures just the excess fat, WHtR takes into consideration the distribution of fat around the abdominal and is therefore, as a single measure, more efficient in predicting metabolic syndrome (Ashwell, Gunn, & Gibson, 2012). WHtR has been

recommended by various studies as a tool of choice for screening obese and overweight adolescents and children (Weili et al., 2007).

## **2.2 Physical activity and Metabolic Syndrome**

Obesity is a major factor that underlies all the various definitions of metabolic syndrome. Evidence supports the fact that low or absence of adequate physical activity leads to the tendency to become obese and therefore predisposition of metabolic syndrome. Regular physical activity has been shown to have a reductive effect on metabolic and cardiovascular risk factors that constitute metabolic syndrome (Vaughan et al., 2009).

According to Golbidi et al, excess fat on the body acts as an endocrine organ which produces substances that leads to insulin resistance and glucose intolerance as well as the development of the requisite inflammatory state that underlies cardiovascular disease occurrence(Golbidi & Laher, 2014). The benefit of exercise therefore leads to the reduction of adiposity which in turn increases endogenous insulin sensitivity and improves glucose tolerance.

The WHO Global Strategy on Diet, Physical Activity and Health recommends that adolescents up to 17years old must accumulate at least sixty minutes of moderate to vigorous-intensity physical activity which is mostly aerobic at least three times in a week(World Health Organization, 2004).

Physical activity as exercise is invaluable in the prevention and management of metabolic syndrome on many fronts. Reducing obesity leads reduction of factors that cause cardiovascular disease such as arteriosclerosis, dyslipidemia and dysglycemia. Exercise training has been shown to reduce blood pressure to normal levels thus addressing component of hypertension in metabolic syndrome(S. Carroll & Dudfield, 2004).

## CHAPTER THREE

### 3.0 METHODOLOGY

#### 3.1 Research Design

A cross sectional descriptive study was conducted. It involved anthropometric measurements of adolescents in junior high schools and administration of a short questionnaire.

#### 3.2 Study Area

Ablekuma South, is one of the 11 sub metropolitan districts of the Accra Metropolitan Assembly (AMA) in the Greater Accra Region. It is bounded on the east by the Odododiodio constituency, on the west by Weija constituency, on the south by the Gulf of Guinea (sea) and on the north by Ablekuma Central and North constituencies. The AMA has a total population of 1,848,614 (GSS, 2010) with an under 15years population making up 31.6%. The main occupation of the people in the sub metro is civil service, trading and fishing. There are 39 public junior high schools in Ablekuma South.

#### 3.3 Study population

Students from New Hope Junior High School and Dr F V Nanka Bruce Junior High School were used in this study.

3.3.1 Inclusion Criteria: Adolescents between ages 12 to 18 at their last birthday who presented a signed parental consent form and also to assent to participate in the study

3.3.2 Exclusion criteria: Adolescents who did not present parental consent and did not assent to participate in the study. Adolescents who were not within the specified age bracket were excluded.

### 3.4 Sample size

Prevalence of metabolic syndrome in adolescents in Ghana is not readily available, however, a study done among adults in rural Ghana showed a prevalence of 35% using the IDF criteria (Gyakobo, Amoah, Martey-Marbell, & Snow, 2012a). A study, similar to this one, done among adolescents in Mexico using predictors of metabolic syndrome had an overall prevalence of 23% (Elizondo-Montemayor, Serrano-González, Ugalde-Casas, Bustamante-Careaga, & Cuello-García, 2011). Therefore the reference prevalence rate of 23% was used for this study

The sample size was calculated using the formula:

$$N = z^2 p (1-p) / e^2$$

Where Z = 1.96 normal deviate representing the 95% confidence limit

d = 0.05 as the acceptable margin of error

p = the probability of the event occurring, in this case the prevalence of predictors of metabolic syndrome

(1 – p) is the probability of the event not occurring, in this case: 1 – 0.23 = 0.77

The sample size was determined as follows:

$$N = (1.96)^2 (0.23) (0.77) / (0.05)^2$$

Minimum sample size required is = 299(including 10% non-response rate)

### **3.5 Sampling method**

A private junior secondary school was randomly selected from the Ablekuma South cluster of schools and a public junior high school most proximal private school was also selected. All the students aged between twelve to eighteen years, which consisted of all eligible students at New Hope School and majority of the eligible students at Dr F V Nanka Bruce Junior Secondary School. Ablekuma South was selected because given the geographic situation of Korle bu Teaching Hospital, the surrounding schools are relatively more cooperative in research studies to improve health.

### **3.6 Data collection**

#### **3.6.1 Method**

At each school the total participants were divided into three groups due lack of space to accommodate the entire group simultaneously. The first group after being seated comfortably in a designated classroom, were given an introduction to the research to be undertaken and its objectives, by the principal investigator. The students were encouraged to ask questions about the study for which clear answers were given. A structured questionnaire was administered to all who assented to the exercise, to obtain information on socio-demography, family medical history and physical activity. Subsequent groups went through identical process.

Socio-demographic information of interest included the mother's and father's education which were categorized as tertiary, secondary, primary and no formal education. Mother's and Father's occupation were grouped into six categories; health related professional, non-health related professionals, trader/businessperson, artisans, retired and unemployed/unknown.

Family medical history was recorded as the presence of Hypertension or Diabetes Mellitus or both in either biological parent. Respondents who did not have a parent with either Hypertension or Diabetes were categorized as “negative” whilst those who had either or both parents having hypertension or Diabetes were categorized as “positive”.

Physical activity was assessed by the number of times in a week the respondent participated in moderate to high intensity activity. Moderate intensity was described as activity that increases heart rate but does not cause sweating or puffing, such as walking and ampe, and high intensity; when there is a substantial increase in breathing and heart rate, such as football and jogging. This was also categorized as ‘none at all’ and ‘once or twice’ a week. Physical exercise was adequate if it occurred greater than three times a week and inadequate if less than three times. Activities carried out by respondents in their leisure time was either sedentary such as reading, playing video games or watching TV or non-sedentary such as playing soccer, playing ampe or walking.

Their weights, heights, waist circumference, hip circumference and blood pressures were taken.

Blood pressure was measured after the respondents had completed their questionnaires and were seated for at least 5minutes. Blood pressures were classified according to age and height percentile and reported in percentiles for respondents between ages 12 and 17years. Normal blood pressure is blood pressure below the ninetieth (90<sup>th</sup>) centile for age and height, prehypertension is blood pressure between the ninetieth (90<sup>th</sup>) and the ninety fifth (95<sup>th</sup>) centile and hypertension (systolic or diastolic) is above the ninety fifth (95<sup>th</sup>) centile. Participants above 17years at their last birthday were considered hypertensive if blood pressure had a systolic of greater than 120mmHg and a diastolic of

greater than 80mmHg. Medcalc. Those whose blood pressures were above normal were informed and advised to see their family doctor for a recheck.

### **3.6.1.1 Questionnaires**

A self-administered structured pre-coded questionnaires was given to each student after the study had been thoroughly explained, consent from parents and assents from the students had been obtained to participate in the study. Each question on the questionnaire was read out loud by the principal investigator and instructions were explained to guide the students in the filling of forms and to ensure completion.

### **3.6.1.2 Weight**

The weights were measured using pre -standardized Omron weighing scales. Participants were weighed whilst in only their school uniforms with pockets emptied and bare footed. Weights were recorded in kilograms to the nearest 100g.

### **3.6.1.3 Height**

The heights were measured with student against a smooth vertical wall affixed with a standard measuring tape in standing position, bare foot with occiput, buttocks and both heels touching the wall. It was recorded in meters to the nearest centimeter (cm).

Each reading was made by a pair of research assistants with one ensuring that the participant was well positioned whilst the other took the reading. This was repeated with the research assistants switching roles. The average of the two readings was then determined

### **3.6.1.4 Waist and Hip Circumference**

These were measured using inelastic tape measures. The waist measurement was taken midway between the last palpable rib and the top of iliac crest on normal exhalation. The

hip measurement was taken at the widest part of the hip which over the trochanter bilaterally with the tape measure parallel to the floor. The measurement was taken by the same person in order to prevent inter observer biases

### **3.6.1.5 Blood Pressure**

A calibrated Omron electronic sphygmomanometer with appropriate cuff size (covering 40 to 60% of right upper arm) was used to measure the blood pressures. The measurements were taken after the participants had been sitting for at least 15minutes. Two readings were taken at five to ten minutes intervals and the average recorded.

### **3.6.1.6 Body Mass Index (BMI)**

**BMI, which measures general obesity**, was calculated as weight in kilograms (kg) divided by height in meters squared ( $m^2$ ). The Body Mass Index was classified as normal if it had a z score of not more than 2; The World Health Organization age and gender specific percentile charts for 5 to 19years were used to evaluate the BMI (“WHO | BMI-for-age,” 2014).

### **3.6.1.7 Waist to height ratio (WHtR)**

This was obtained by dividing waist circumference by the height, all in centimeters. The cut-off point of WHtR, which is a measure of cardiovascular risk, is considered to be within normal limits if less than or equal to 0.5.

## **3.7 Quality Control**

### **3.7.1 Training of research assistants**

Four nurses were trained as research assistants. The standard protocol for taking anthropometric measurements were thoroughly reviewed prior to the exercise as well as all the necessary actions to reduce biases.

### **3.7.2 Elimination of Biases**

The questionnaires were numbered before study was carried out and inspected individually for completeness after administration. The heights and waist and hip circumferences were measured by a research assistant with the principal investigator (PI) as the verifier to recheck all measurements for accuracy. The average of two measurements was determined for each of the anthropometric variables. There was research assistant designated solely for data recording. Each entry was doubly checked by the PI and assistant.

### **3.7.2 Pre-testing**

The content validity of the questionnaires was determined by pretesting. Questionnaires were pre tested on five junior high students at New Hope School who were excluded from the study. The exercise provided an opportunity to recognize and improve communication of the purpose of the study to the level of their thorough understanding. It helped to determine the approximate time spent on each participant. The contents were also modified appropriately after the pretest.

### **3.8 Ethical Considerations**

Ethical clearance was obtained from the Ethical Review Committee of the Ghana Health Service. Permission was granted by the Accra Metropolitan Director of Education of Ghana Education Service for the study to be carried out at Dr F V Nanka Bruce Junior High School. Permission was obtained from Proprietors of New Hope Junior High School and Headmaster of Dr F V Nanka Bruce Junior High School. Parental consent forms were given to all the students between the ages of twelve and eighteen in both schools, forty-eight hours prior to data collection. Students whose parents consented were included in the study after they had assented to participate.

### 3.9 Data Processing and analysis

Excel 2013 and SPSS software (Version 21, Inc., Chicago, USA) were used to process and analyze data.

Univariate descriptive statistics were used to analyze demographic information; categorical variables into proportions, percentage and ratios and continuous variables presented as means with standard deviations. These are presented as Tables.

Body mass index (BMI) was calculated using the WHO Anthroplus tool for Nutritional survey by inputting the age in months, height in centimeters and weight in kilograms. It was reported as z scores but then converted into dichotomous variables; normal and abnormal. . BMI was categorized as abnormal if it had a Z score of greater than 2 for age otherwise categorized as normal.

Waist to height ratio (WHtR) which was derived by dividing the waist circumference by the height in meters. Ratio which were  $< 0.5$  were considered to be within normal range and  $\geq 0.5$  were above normal limits.

Blood pressures was inputted into Medcalc 3000, a validated medical reference tool, where they were categorized into normal, prehypertensive and hypertensive. For the purpose of this study, values which were within the normal limits for age and height in percentiles were categorized as normal and those who were above the normal limit, abnormal (prehypertensive and hypertensive) to enable dichotomous categorization..

Cross tabulations were performed to describe associations among the variables and the Pearson's Chi Square of association reported along with p values which represented the statistical significance of each; statistically significant p-value was  $< 0.05$

Each risk factor of metabolic syndrome was categorized as a dichotomous variable giving "0" to absence of factor and "1" to presence of factor. The total score was

determined for each respondent. A score of 0 meant no risk factor, 1 meant one risk factor, 2 meant two risk factors and 3 meant all three factors being measured were present. Those with all the 3 risk factors present were considered as having risk of metabolic syndrome. For the purpose of this study, risks were further classified as no risk, mild, moderate and high, for scores of 0, 1, 2 and 3 respectively



## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1 Background and Sociodemographic characteristics of respondents

Three hundred and two (302) junior high school students participated in the study; 145 from New Hope Junior High School (Private School) and 157 students from Dr F V Nanka Bruce Junior High School (Public School). They consisted of 140 males (46.40%) and 162 females. The mean age was 14.24 ( $\pm 1.39$ ) years and ranged from 12 years to 18 years. The modal age was 15 years. Table 1 describes the socio-demographic characteristics of the respondents.

Family medical history of parents of respondents was categorized as positive if either parent had a history of Hypertension or Diabetes Mellitus or both, and was negative if neither had a history. Data showed that forty (13.2%) of the respondents said their parents had either Hypertension, Diabetes or both.

Physical activity was described as adequate in 175 (57.9%) of the respondents. Adequate physical activity meant that they exercised at least three times in a week. One hundred and ninety-four (64%) of the respondents spent their leisure time involved in sedentary activities such as watching TV, playing video games and reading, 34 (11.3%) were active in their leisure time and 74 (24.5%) were involved in both sedentary and active leisure time.

**Table 1: Sociodemographic characteristics of respondents**

	<i>Categories</i>	<i>Frequency</i>	<i>(%)</i>
SEX	Male	140	46.4
	Female	162	53.6
Age group(years)	12-14	169	56.0
	15-17	127	42.1
	18	6	2.0
Mother's education	None	19	6.3
	Primary	48	15.9
	Secondary	144	47.7
	Tertiary	91	30.1
Mother's occupation	Health Related Professional	21	7.0
	Non-Health Related Professional	36	11.9
	Trader/Business	209	69.2
	Artisans	25	8.3
	Retired	0	0.0
	Unemployed/Unknown	11	3.6
Father's education	None	11	3.6
	Primary	24	7.9
	Secondary	110	36.4
	Tertiary	157	52.0
Father's occupation	Health Related Professional	16	5.3
	Non-Health Related Professional	106	35.1
	Trader/Business	78	25.8
	Artisans	86	28.5
	Retired	2	0.7
	Unemployed/Unknown	14	4.6
Parents' Medical history	Negative Family History	261	86.7
	Positive Family History	40	13.3

#### 4.2 Anthropometric measurements of Respondents

Table 2a shows the anthropometric measurements of respondents.

The mean weight for all respondents was 52.1kg ( $\pm 11.84$ ). The mean height was 161cm ( $\pm 8.55$ ) with a modal value of 153cm. One hundred and fifty-five (51.3%) respondents were below the 50<sup>th</sup> percentile for height, 76 (25.2%) were within the 50<sup>th</sup> and the 75<sup>th</sup> percentile and 71(23.5%) were above the 75<sup>th</sup> percentile. The mean hip and waist circumference were 87.1cm ( $\pm 10$ ) and 68.3 cm ( $\pm 8.8$ ) respectively.

**Table 2a: Anthropometric measurements of respondents**

	Mean	Standard Deviation	Minimum	Maximum
Weight(kg)	52.1	11.8	28.3	112.8
Height(cm)	161.3	8.5	137.0	183.3
Hip(cm)	87.1	10.0	63.5	124.0
Waist circumference(cm)	68.3	8.8	33.4	114.0

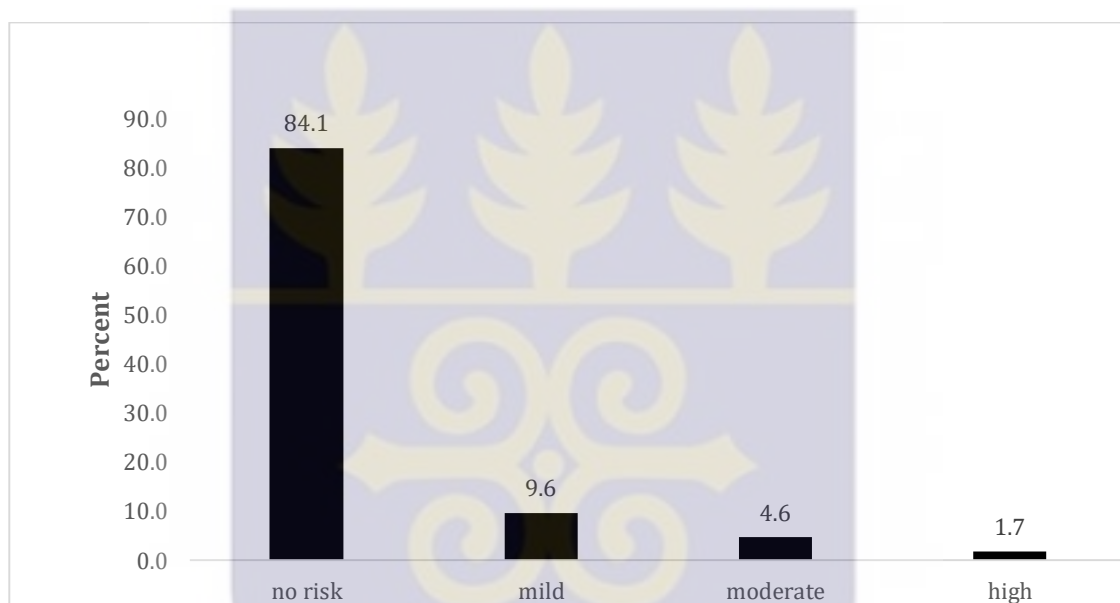
Table 2b shows the frequencies of Predictors of Metabolic Syndrome in the study population. Waist to height ratio was normal if it was less than 0.5; 8.94% of the respondents had abnormal ratios. Among the respondents, 5.63% had an abnormal BMI. The blood pressure readings of 9.27% of respondents had a blood pressure above the 90<sup>th</sup> centile for height and age; this consisted of both Pre-hypertensive and Hypertensive.

**Table 2b: Predictors of Metabolic Syndrome among respondents**

Measures		Frequency	%
WHtR			
≤0.5	normal	275	91.1
>0.5	high<0.5	27	8.9
BMI			
Z score ≤2	normal	285	94.4
Z score >2	high	17	5.6
Blood pressure			
BP < 90 <sup>th</sup> centile	normal	274	90.7
BP ≥ 90 <sup>th</sup> centile	high	28	9.3

### 4.3 Prevalence of predictors of Metabolic syndrome by risk category

'No risk' represents the category of 250(84.1%) respondents who had Blood Pressure (BP), waist to height ratio (WHtR) and Body mass index (BMI) within normal limits. Mild category (9.6%) signified one abnormality out of the 3 indices, moderate category (4.6%) had 2 abnormal indices and high category had all three indices being abnormal. Five (1.7%) out of the 302 participants were in the high category.



**Figure 2:** Shows the prevalence of the predictors by risk categories.

### 4.4 Bivariate analysis of predictors

Although females and respondents aged 12 to 14 years tended to have a high BMI, BP and WHtR, the association was not statistically significant in each model. Respondents' whose mothers had tertiary education also tended to have a high BMI, and those whose mothers had secondary education tended to have a high waist to height ratio and high blood pressure. These associations were not statistically significant. Although mother's occupation as trader/business woman tended towards having a high WHtR and high blood pressure, none of these attained statistical significance.

Table 3a, 3b and 3c show the relationships discussed above.

**Table 3a: Association between Sociodemographic factors and Blood Pressure**

	<b>Blood Pressure</b>		<b>Chi-Square</b>	<b>P-Value</b>
	<b>Normal (&lt;90<sup>th</sup> %)</b>	<b>High (≥90<sup>th</sup> %)</b>		
	<b>Frequency%</b>	<b>Frequency%</b>		
<b>Age (years)</b>			0.726	0.695
12-14	155(91.7)	14(8.3)		
15-17	114(89.8)	13(10.2)		
18	5(83.3)	1(16.7)		
<b>Sex</b>			0.621	0.431
Male	129(92.1)	11(7.9)		
Female	145(89.5)	17(10.5)		
<b>Family History</b>			1.775	0.183
Negative	239(91.6)	22(8.4)		
Positive	34(85.0)	6(15.0)		
<b>Education</b>				
<b>Mother</b>			0.01	0.91
Primary/None	61(91.0)	6(9.0)		
Secondary/Higher	213(90.6)	22(9.4)		
<b>Father</b>			0.596	0.44
Primary/None	33(94.3)	2(5.7)		
Secondary/Higher	241(90.3)	26(9.7)		
<b>Mothers' Occupation</b>			4.771	0.09
Skilled	56(98.2)	1(1.8)		
Unskilled	208(88.9)	26(11.1)		
one/Unemployed	10(90.9)	1(9.1)		

**Table 3b: Association between Sociodemographic factors and Waist to Height Ratio**

	Waist to Height Ratio		Chi-Square	P-Value
	Normal( $\leq 0.5$ ) Frequency%	High( $> 0.5$ ) Frequency%		
<b>Age (years)</b>			0.726	0.695
12-14	154(91.1)	15(8.98)		
15-17	116(91.3)	11(8.7)		
18	5(83.3)	1(16.7)		
<b>Sex</b>			0.621	0.431
Male	132(94.3)	8(5.7)		
Female	143(88.3)	19(11.7)		
<b>Family History</b>			1.775	0.183
Negative	239(91.6)	22(8.5)		
Positive	35(87.5)	5(12.5)		
<b>Education</b>				
<b>Mother</b>			0.231	0.42
Primary/None	62(92.5)	5(7.5)		
Secondary/ Higher	213(90.6)	22(9.4)		
<b>Father</b>			0.007	0.93
Primary/None	32(91.4)	3(8.6)		
Secondary/ Higher	243(91.0)	24(9.0)		
<b>Mothers' Occupation</b>			1.566	0.46
Skilled	53(93.0)	4(7.0)		
Unskilled	211(90.2)	23(9.8)		
None/Unemployed	11(100)	0(0.0)		

**Table 3c: Association between Sociodemographic factors and Body Mass Index**

	Body Mass Index		Chi-Square	P-Value
	Normal(<90 <sup>th</sup> ) Frequency%	High(≥90 <sup>th</sup> ) Frequency%		
<b>Age (years)</b>			1.731	0.42
12-14	157(92.9)	12(7.1)		
15-17	122(96.1)	5(3.9)		
18	6(100)	0(0.0)		
<b>Sex</b>			0.887	0.35
Male	134(95.7)	6(4.3)		
Female	151(93.2)	11(6.8)		
<b>Family History</b>			0.297	0.59
Negative	247(94.6)	14(5.4)		
Positive	37(92.5)	3(7.5)		
<b>Education</b>				
<b>Mother</b>			0.01	0.91
Primary/None	61(91.0)	6(9.0)		
Secondary/ Higher	213(90.6)	22(9.4)		
<b>Father</b>			0.596	0.44
Primary/None	33(94.3)	2(5.7)		
Secondary/ Higher	241(90.3)	26(9.7)		
<b>Mothers' Occupation</b>				
Skilled	56(98.2)	1(1.8)	4.771	0.09
Unskilled	208(88.9)	26(11.1)		
None/Unemployed	10(90.9)	1(9.1)		

Table 3d represents the association between the predictors of metabolic syndrome and Physical activity. Normal BMI was not associated with adequate physical activity in a significant manner. In general, participants who performed adequate physical activity had normal indices for all the predictors however, statistical significance was not observed.

**Table 3d: Association between Physical Activity and Predictors of Metabolic syndrome**

Predictors		Physical Activity		Chi-Square	P-Value
		Adequate	Inadequate		
<b>BMI</b>	Normal	169(59.3)	116(40.7)	3.79	0.51
	High	6(35.3)	11(64.7)		
<b>Waist to Height Ratio</b>	Normal	163(59.3)	112(40.7)	2.218	0.14
	High	12(44.4)	15(55.6)		
<b>Blood Pressure</b>	Normal	158(57.7)	116(42.3)	0.097	0.76
	High	17(60.7)	11(39.3)		

#### 4.5 Distribution of predictors of Metabolic syndrome amongst the two study sites

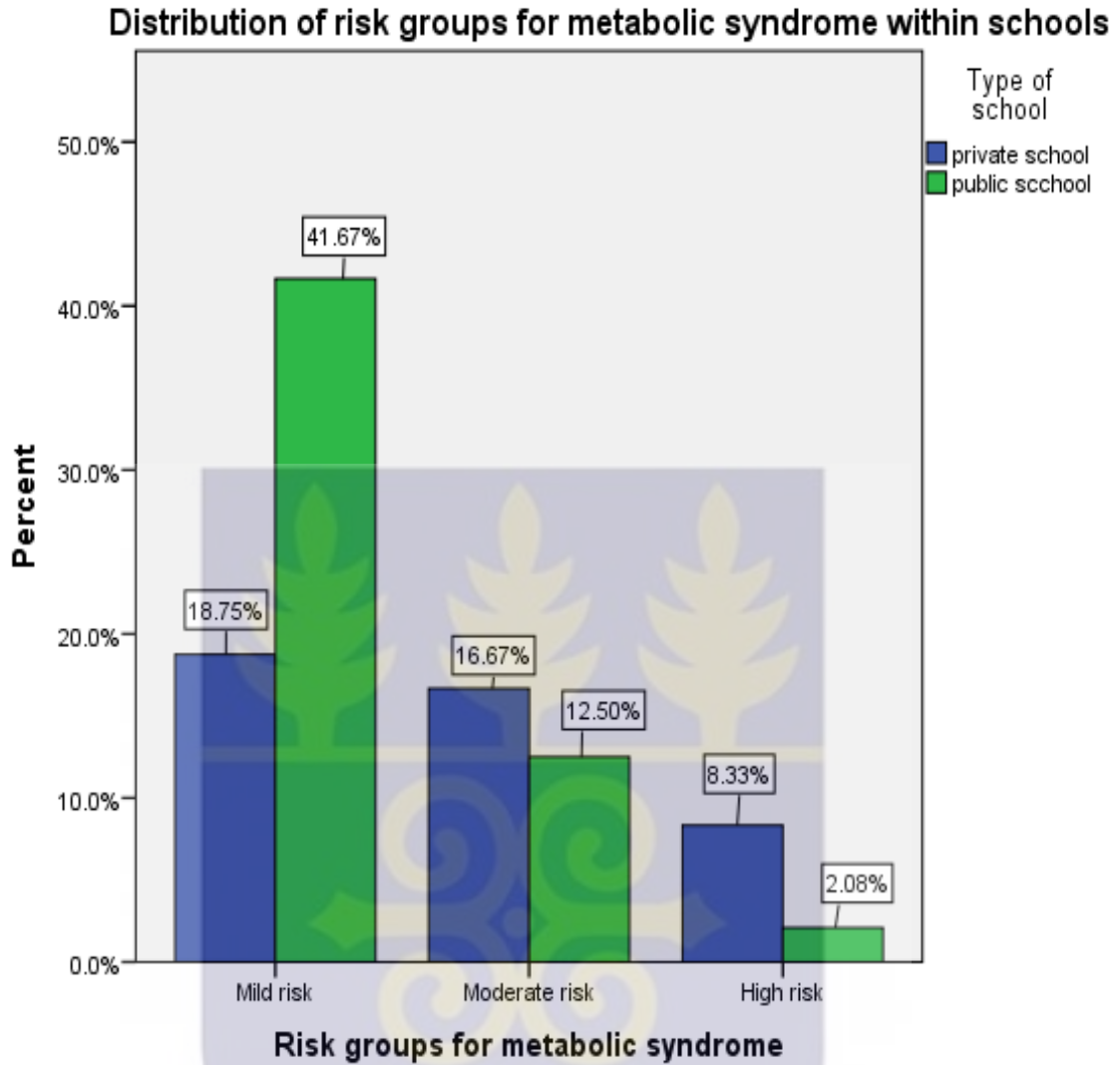
Table 5 shows the proportions of participants in the private and public schools used in the study. Approximately 1 in 10 of the private school participants had a BMI above the z score of 2 as compared with less than 2% in the public school. A little over 10 percent of public school participants had higher than normal weight to height ratio than was seen in the private school (9.7%). Higher blood pressures were also observed more in the public school than the private school.

**Table 5: Proportions of prevalence of predictors in the Public and Private schools**

		Private School	Public School	p-value
<b>BMI</b>	Normal	130(89.7)	155(98.7)	0.001
	High	15(10.30)	2(1.3)	
<b>Waist to Height Ratio</b>	Normal	13(90.3)	137(87.3)	0.031
	High	14(9.7)	20(12.7)	
<b>Blood Pressure</b>	Normal	137(94.5)	144(91.7)	0.676
	High	8(5.5)	13(8.3)	

Figure 3 shows the distribution of the various risk groups according to the schools. Eighty-four percent of all the participants combined had no risk and are not included in the figure3. Of the 15.9% with risk, patterns observed among the public school participants shows a reduction towards the risk of metabolic syndrome as compared to the private school. Private school participants have about four times the proportion of high risk category.





**Figure 3: Graph of risk categories of Predictors of Metabolic Syndrome within the two schools**

## CHAPTER FIVE

### 5.0 DISCUSSION

Metabolic syndrome in adolescents is an emerging condition worldwide in the wake of childhood obesity epidemic. In Sub Saharan Africa, there is paucity of research on metabolic syndrome in adolescents however, obesity which is an important precursor for this syndrome is on the ascendency (Muthuri et al., 2014). The components of metabolic syndrome namely Dyslipidemia, Insulin resistance, Obesity and Hypertension were addressed in some capacity by the composite of the anthropometric measurements and the blood pressure measurement of this study. The objectives of this study were to determine the prevalence of predictors of Metabolic Syndrome and its association with socio-demographic factors and physical activity among Ghanaian adolescents in Ablekuma South, Accra.

#### 5.1: Predictors of metabolic syndrome

The components of Predictors of metabolic syndrome were addressed in this study using anthropometric measurements namely; blood pressure levels (BP) to assess Hypertension, body mass index (BMI) to assess obesity and waist to height ratio (WHtR) to assess Insulin resistance and cardio metabolic risk. These non-invasive, simple and cost effective investigations have been proven to effectively screen those at risk of metabolic syndrome and cardiovascular disease (Wahrenberg et al., 2005).

With regards to BMI, this study showed that a little over 5% of participants had abnormally high BMI ( $\geq 90^{\text{th}}$  centile for age and sex). This implies that these respondents may have a predisposition to cardio metabolic disease due to obesity. A study done by Mohammed et al in Ghana, using the WHO BMI definition, showed a prevalence of

10.9% of obesity among University of Ghana Basic School Children in Accra (Mohammed & Vuvor, 2012) which is higher than that obtained in this study. Approximately one tenth of respondents in this study had blood pressures  $\geq 90^{\text{th}}$  centile for age and height. The prevalence of hypertension in adolescents in sub-Saharan Africa is not readily available however, studies done in Ghana on urban youth (15 to 24 years) showed that a third of their study participants were pre hypertensive and one in twenty were hypertensive (Afrifa-Anane et al., 2015). Their finding is in contrast to our study, which showed that 9% of respondents had blood pressures  $\geq 90^{\text{th}}$  for age and height, consisting of 3% pre-hypertensive and 6% hypertensive. In comparison with the study by Afrifa-Anane et al, an important finding in this study is that even though the age groups of the participants in both studies partially overlap, the younger cohort in our study had relatively higher incidence of abnormal blood pressures.

Approximately 8.9% of the participants were observed to have high waist to height ratio (WHtR  $\geq 0.5$ ). WHtR is a better measure of cardiovascular risk than BMI because intra-abdominal obesity, an independent risk factor of cardiovascular disease is captured more effectively in the measurement of WHtR (Khoury, Manlihot, & McCrindle, 2013).

## **5.2 Prevalence of Predictors of Metabolic Syndrome**

The prevalence of metabolic syndrome in the two study sites (private and public schools) combined was 1.7% using the criteria defined in this study. The private school accounted for 1.32% of the prevalence. Overall of the total respondents 84.1% had no risk. In the private school respondents were more likely to have mild and no risk but prevalence of moderate and high risk was higher than among the public school respondents. The respondents from the public school had comparatively high 'no risk' and 'mild risk' categories with low moderate and high risk categories. A study in Canada which utilized

both invasive and non-invasive methods found a prevalence of metabolic syndrome of among adolescents (12-19 years) to be 3.5% (Setayeshgar, Whiting, & Vatanparast, 2012). The higher prevalence in Canadian adolescents may be due to the western obesogenic lifestyle which is the known cause of cardiovascular disease and is being adopted in our setting.

### **5.3 Predictors of Metabolic Syndrome and Sociodemographic factors**

The sociodemographic factors considered in this study were age, sex, parental education and parental occupation. Other factors looked at was family history of hypertension or Diabetes Mellitus.

In general, females had high Body Mass Index, Waist to height ratio and Blood Pressure compared with their male counterparts. The age group 12-14 years in both sexes had high levels of the same indices as well as mother's tertiary education level and father's tertiary education level but were not statistically significant. Studies on socio demographic factors and their associations with metabolic syndrome in adult populations support these high indices in adult females with high education (Buckland, Salas-Salvadó, Roure, Bulló, & Serra-Majem, 2008). Even though mother's Secondary level of education and occupation as a trader or businesswoman tended to be associated with high Waist to Height ratio and high blood pressure. There was also an association with father's tertiary education level and high waist to height ratio.

The associations between predictors of metabolic syndrome and age, sex, parents' education and parents' occupation were not statistically significant ( $p$  value  $<0.05$ ). Research on socio demographic factors and metabolic syndrome in adolescents was not readily available for baseline comparison.

#### **5.4 Predictors of Metabolic Syndrome and Physical Activity**

Adequate physical activity is known to be protective against cardio metabolic disease in all ages. This study assessed the adequacy of physical activity by the number of times in a week the respondent was involved in moderate to high intensity exercise. It also included the activities performed in the leisure time; whether it was predominantly active or sedentary. Adequate physical activity was consistently associated with normal blood pressure and normal waist to height ratio. Conversely inadequate activity was associated with high blood pressure and high waist to height ratio. The BMI of respondents who had adequate physical activity was higher than their inadequate counterparts. This is in support of the discussion that BMI is not the most effective predictor of cardio metabolic risk (Rodea-Montero, Evia-Viscarra, & Apolinar-Jiménez, 2014). Muscle weighs more than fat and therefore a muscular person may have a higher body mass index due to fat free mass.

In this study the associations between physical activity and the predictors of metabolic syndrome, although supported by several studies (Nguyen, Tang, Kelly, van der Ploeg, & Dibley, 2010), were not statistically significant.

#### **5.5 Strengths and Limitations of the Study**

##### **5.5.1 Strengths**

- Methods used were simple, noninvasive, cost effective and evidence based

##### **5.5.2 Limitations**

- The paucity of research on metabolic syndrome in adolescents in the sub region provided no baseline for comparisons

- The study was conducted in urban setting which precludes generalization to include the rural setting
- Blood pressure measurements, even though taken in duplicate, did not rule out other factors that may affect the reading such as respondent's anxiety or ill health.
- Sample was not representative of all Basic schools in the Greater Accra region.
- The ideal criteria for diagnosing metabolic syndrome requires invasive procedure of phlebotomy which was not done in this study.



## CHAPTER SIX

### 6.0 CONCLUSION AND RECOMMENDATIONS

#### 6.1 Conclusion

Adolescents are generally healthy but the asymptomatic beginnings of cardio metabolic disease is important to assess. The prevalence rate of predictors of metabolic syndrome in the JHS students in Ablekuma South was 1.7% which represented students with all the 3 indices of interest namely: abnormal blood pressure, waist to height ratio and body mass index. Approximately 14% of students had one or two abnormalities which was also an important finding. Using noninvasive procedures such as anthropometric measurements to assess adolescents is cost effective way of screening for risk of cardio metabolic disease. In this study, sociodemographic factors and physical activity though they had no statistical significance, had important relationship with predictors of metabolic syndrome.

#### 6.2 Recommendations

1. Ghana Education Service and Ghana Health Service must encourage schools to have facilities for exercise and ensure that curricula includes adequate exercise. Even though not statistically significant adequate physical activity according to this study was consistently associated with normal anthropometric measurements.
2. Ghana Health Service should consider waist to height ratio as a cost effective way of assessing cardiovascular risk in adolescents which can be used as a screening tool for larger populations.
- 3 Even though the prevalence of metabolic syndrome was 1.7% further research should be done with a larger and more representative sample size.

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## APPENDICES

### Appendix 1: Informed Parental Consent Forms

**Project Title: Predictors of Metabolic Syndrome in adolescents in four (4) Junior High schools at Ablekuma South District.**

**Principal Investigator:**

**Elizabeth Mabel Bankah**

University of Ghana School of Public Health

Legion, Accra.

#### **General information about the study**

Cardiovascular health of children and adolescents is an important public health issue which has been gaining attention in recent times. The purpose of this study is to assess the cardiovascular health of adolescents using simple body measurements to determine if they are predisposed to the condition.

#### **Procedure**

Adolescents in junior high schools in Ablekuma South will be selected to participate in this study. The selected participant will be required to answer some questions about their daily physical activity family medical history. Measurements to be taken include body weight, height, waist circumference and blood pressure.

### **Possible Risks and Discomforts**

We anticipate minimal discomfort of less than ten minutes when blood pressure is being measured.

The University of Ghana School Of Public Health makes every effort to keep the information collected from study participant is private. In order to do so, we will use numbers in place of actual names. Results of the research may be presented at meetings or in publications, but actual names will not be used.

### **Possible Benefits**

There may be no direct benefit to the participants of this study. However, the information you will provide will contribute to the overall knowledge of using measurements to assess cardiovascular health of adolescents. The potential benefit to participants in this study may be the offer of further medical evaluation if required after assessment.

### **Voluntary Participation and Right to Refuse**

Participation in this study is absolutely voluntary. During the interview, participant can choose not to answer any questions that he/she does not want to answer. Additionally, participants are at liberty to withdraw from the study or stop the interview at any time. However, we will encourage participation in order to be able to improve health assessment in adolescents in Ghana.

### **Confidentiality**

We would like to assure you that whatever information provided will be handled with strict confidentiality, will be used purely for research purposes, and will never be used against the participant. Data analysis will be done at the aggregate level to ensure anonymity. The name or personally identifying information will not be published in any report. Some staff of the research team may sometimes review the research records, but no unauthorized individual(s) will be able to access participant's information.

### **Compensation**

There is no compensation for participating in this study.

### **Contact for Additional Information**

If you have questions later, you may contact:

**Elizabeth Mabel Bankah**

University of Ghana School of Public Health

Legon, Accra

*Email:* [betashgh@yahoo.com](mailto:betashgh@yahoo.com)

*Ph.:* 0244369292



**Interviewer's statement:**

I, \_\_\_\_\_, certify that the nature and purpose, the potential benefits and possible risks associated with participating in the study have explained to the above individual in the English/Twi/Ga language. The participant has freely agreed to participate in the study.

\_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

Signature of person who obtained consent Date

**ADOLESCENT ASSENT FORM**

**Project Title: Predictors of Metabolic Syndrome in adolescents in two (2) Junior High schools at Ablekuma South District.**

**Principal Investigator:**

**Elizabeth Mabel Bankah**

University of Ghana School of Public Health

Legon, Accra

*Email:* [betashgh@yahoo.com](mailto:betashgh@yahoo.com)

*Ph.:* 0244369292

**What are some general things you should know about research studies?**

You are being asked to take part in a research study. Your parent or guardian needs to give permission for you to be in this study. You do not have to be in this study if you don't want to, even if your parent has already given permission. You are free to choose whether or not to be in this study. You may decide not to join, or, if you join, you may decide to stop being in the study, at any time, for any reason, without penalty.

**What is the purpose of this study?**

Research is how we learn new things. The purpose of this research study is to learn about the cardiovascular health of adolescents using body measurements.

You are being asked to be in the study because you are an adolescent in Junior High School.

**What will happen if you take part in the study?**

If you decide to take part in this study, you will be asked to answer questions on a survey about your physical activity levels and your family medical history. Measurements of your height, weight, waist circumference and your blood pressure will be taken.

**Who will be told the things we learn about you in this study?**

The information gathered from the study will be confidential and used only for the purpose of research. Your real name and identity will not be used.

**What are the possible risks or discomforts involved from being in this study?**

We anticipate minimal discomfort to you for less than ten (10) minutes when your blood pressure is being measured.

The University of Ghana School Of Public Health makes every effort to keep the information collected from you private. In order to do so, we will use numbers in place of your name. Results of the research may be presented at meetings or in publications, but your name will not be used.

**What are the possible benefits from being in this study?**

You might not benefit from being in this research study. The potential benefit to you from being in this study might be you will receive further medical evaluation if you require it after assessment.

**Do I have to be in this study?**

Taking part in this research study is your choice. You are free not to take part or to withdraw at any time, for whatever reason. No matter what decision you make, there will be no penalty or loss of benefit to which you are otherwise entitled. In the event that you do withdraw from this study, the information you have already provided will be kept in a confidential manner.

**Your rights as a Participant**

If you have any questions about your rights as a research participant, you can contact the Administrator of the GHS Ethical Review Committee at the following address:

Hannah Frimpong

GHS-Ethical Review Committee

Research and Development Division

Ghana Health Service

P. O. Box MB 190

Accra

Office: 0302 681 109

Mobile: 024 323 5225 or 050 704 1223

Email: [Hannah.Frimpong@ghsmail.org](mailto:Hannah.Frimpong@ghsmail.org)

**Subject Assent**

I have read (or have had read to me) the contents of this assent form and have been encouraged to ask questions. I have received answers to my questions. I agree to take part in this study. I have received (or will receive) a copy of this form for my records and future reference.

\_\_\_\_\_

Print name if you agree to be in the study

\_\_\_\_\_

Sign name if you agree to be in the study      Date

**Person Obtaining Assent**

I have read this form to the subject and/or the subject has read this form. I will provide the subject with a copy of this assent form. An explanation of the research was given and

questions from the subject were solicited and answered to the subject's satisfaction. In my judgment, the subject has demonstrated comprehension of the information. I have given the subject adequate opportunity to read the assent before signing.

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Name and Title (Print)

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Signature of Person Obtaining Assent

Date



**Appendix 2: Questionnaire on predictors of metabolic syndrome in adolescents**

**PREDICTORS OF METABOLIC SYNDROME IN ADOLESCENTS IN TWO**

**(2) JUNIOUR HIGH SCHOOLS IN ABLEKUMA SOUTH DISTRICT**

Date

School

Form

**I. SOCIO DEMOGRAPHY**

(i) Name

(ii) Gender      Male                      Female

(iii) Age

(iv) Mother

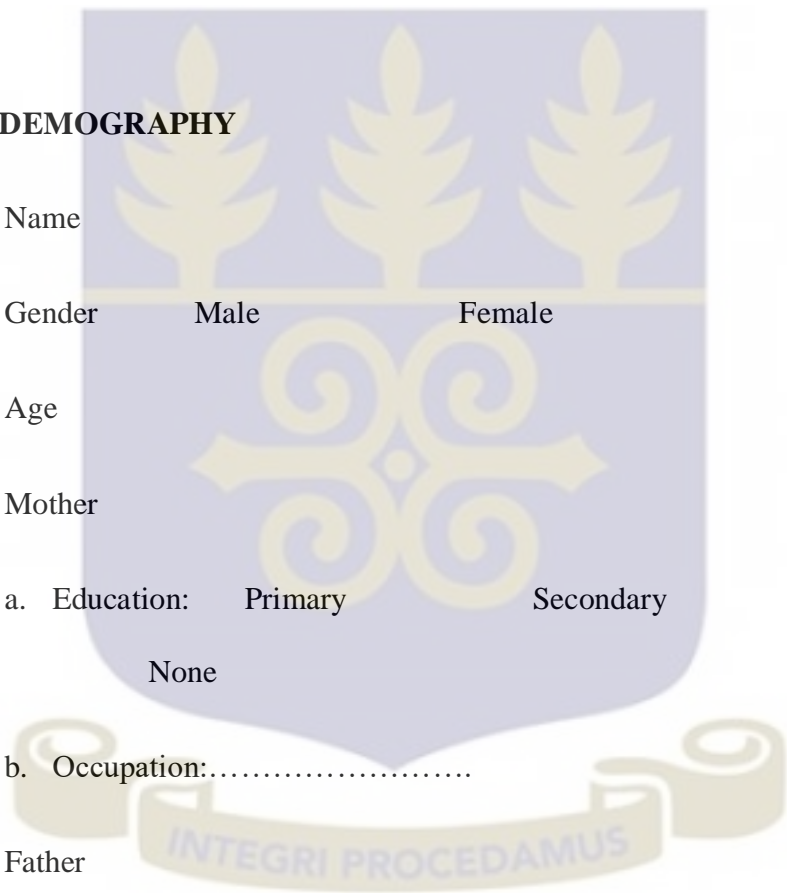
a. Education:      Primary                      Secondary                      Tertiary  
None

b. Occupation:.....

(v) Father

a. Education:      Primary                      Secondary                      Tertiary  
None

b. Occupation:.....



## II. FAMILY MEDICAL HISTORY

- (i) Does any of your parents have Hypertension? No [ ] If yes, specify.....
- (ii) Does any of your parents have Diabetes? No [ ] If yes, specify.....

## III PHYSICAL ACTIVITY

We are trying to find out about your level of physical activity from the last week

- (i) During an average school week, how many days do you go to physical education class? \_\_\_\_\_ Days per week.
- (ii) Do you do other types of physical activity in the average school week?  
 Yes  No

If yes, please specify.....

- (ii) Have you been involved in any of these sports during the past year at school or outside school? *(Please tick as many as applicable)*

Sport	Yes 1- 3times /wk	>3times/wk	No	Sport	Yes 1- 3times/wk	>3times/wk	No
<b>Basketball</b>				<b>Swimming</b>			
<b>Football</b>				<b>Table tennis</b>			
<b>Volley ball</b>				<b>Lawn tennis</b>			
<b>Hockey</b>				<b>Track sports (e.g. running)</b>			

<b>Other (pls. specify)</b> ..... .....							
---	--	--	--	--	--	--	--

(i) How do you spend your leisure time?

.....

(ii) In a typical week how often do you engage in the following?

Activity	Never	1-2x a week	3-4x a week	5-6x a week	Every day.
Play station					
Watching TV					
Video games					
Outdoor sports e.g. football, skipping, running, 'Ampe'					
Computer games					
Others (pls. specify) .....					

