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PREVALENCE AND FACTORS ASSOCIATED WITH HYPERTENSION AMONG SENIOR HIGH SCHOOL STUDENTS OF SAINT THOMAS AQUINAS AND ACCRA HIGH SENIOR HIGH SCHOOL

BY

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DECLARATION

I, Michael Obu- Afful, hereby declare that except for references to literature and other people's work, which I have duly acknowledged, this work is my own research.

…… ……..

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(STUDENT)

…… ……..

DR SAMUEL SACKEY DATE

(SUPERVISOR)

DEDICATION

I dedicate this work to the Almighty God, the giver of life, for protection and guidance and also to my family; my father, Rev Richard Obu- Denyarko, my mother, Hannah Atramah Donkoh, my siblings, (Akua and Isaac), (Kwasi Saah and Eunice) and also to the special one, Akua Owusu- Amponsah.

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LIST OF ABBREVIATIONS

BMI	-	Body Mass Index
BP	-	Blood Pressure
CVD	-	Cardiovascular Disease
HDL	-	High Density Lipoprotein
LDL	-	Low Density Lipoprotein
LMIC	-	Low and Middle- Income Country
PA	-	Physical Activity
SSA	-	Sub- Saharan Africa
WHO	-	World Health Organization

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DEFINITION OF VARIABLES

Population in the study made reference to adolescents in senior high schools aged between 14- 20 years

Hypertension - Systolic BP >/= 140mmHg, diastolic BP >/= 90mmHg for ages 18 and 19 and a systolic of 120mmHg, diastolic of 80mmHg which falls in the 95th percentile for age groups between 13 and 17 years old (Flynn et al., 2017).

Obesity - Body Mass Index (BMI) >/= 30kg/m^2. (WHO fact sheet, 2004)

Overweight - Body Mass Index (BMI) > 25kg/m^2. (WHO fact sheet, 2004)

Normal weight - Body Mass Index (BMI) between 18.5kg/m^2 and 25kg/m^2. (WHO fact sheet, 2004)

Underweight - Body Mass Index (BMI) < 18.5kg/m^2. (WHO fact sheet, 2004)

Central Obesity - Waist/Hip ratio > 0.85 for girls and 0.90 for boys. (WHO, 1999)

Tobacco use - Use of tobacco by smoking, chewing, ingestion of tobacco containing Products. (CDC, 2017).

Alcohol consumption- Intake of more than 16g per day for alcohol users and less than 8g per day for insignificant alcohol use. (Keller et al., 2018).

Physical activity - Adolescents who involve themselves in moderate to vigorous daily activity (60 minutes in a day) will be described as active.

Adolescents who spend less than 60 minutes in day without involvement in any activity will be described as sedentary (WHO. Global strategy on diet, physical activity and health, 2017).

ABSTRACT

Introduction: Hypertension is a major risk factor for cardiovascular diseases. Many factors contribute to the development of hypertension, which may include nutrition, obesity, lack of exercise, alcohol intake, and tobacco use. The prevalence of hypertension in adolescents far exceeds the number who have been diagnosed. Early diagnosis of hypertension in adolescents will help reduce the prevalence of hypertension and its complications in adulthood. The objective of this study was to assess the prevalence of hypertension and its associated factors among Senior High School students of Saint Thomas Aquinas and Accra High Senior High Schools

Methods: A descriptive cross-sectional study was performed**.** A total of 266 senior high school students aged between 14- 20 years from Saint Thomas Aquinas Senior High School and Accra High Senior High School were recruited from May – July 2017. A self – administered questionnaire was used to obtain data from the senior high school students. The arterial blood pressure, weight, height, and waist circumference were checked by means of an electronic sphygmomanometer, a mechanical weighing scale with stadiometer and a tailors measuring tape respectively. Data obtained was analysed using Excel 2010 and Stata 14 SE.

Results: The mean age of respondents was 16.5 years. The overall prevalence of prehypertension was 42.2% (95% CI: 36.5 – 48.1%) while that of hypertension was 16% (95% CI: 12.1 – 20. 7%).The systolic and diastolic blood pressures were averagely 123.9mmHg and 68.7mmHg respectively. The estimated average Body Mass Index was 20.9 kg/m2 (range: 14.9 - 31.9). Gender was significantly associated with hypertension and the odds of being hypertensive among the male students was more than three times that of females (24.36% vs 5.56%, p=0.001). The average body mass index of hypertensive senior high school students was higher than that of senior high students who had normal blood

pressure (24.9 kg\m^2 vs 20.8 kg\m^2, p = 0.0189). High blood pressure was not associated with smoking, alcohol intake and physical activity.

Conclusion: The prevalence of prehypertension and hypertension was high. There was a strong association between hypertension and BMI. A link between hypertension and factors such as alcohol abuse, tobacco use and physical inactivity could not be established which is inconsistent with literature.

CHAPTER ONE

INTRODUCTION

1.1 Background

High blood pressure (HBP) is the most prevalent cardiovascular disease risk factor in the world and cardiovascular diseases (CVDs) take the lives of 17.7 million people every year, representing 31% of all global deaths (WHO, 2017). Physical inactivity and its associated abnormal weight gain as well as certain behaviours such as the use of tobacco and alcohol consumption, are the major triggers of these diseases. (WHO fact sheet, 2017). According to the WHO, more people die annually from CVDs than from any other cause. Over three quarters of CVD deaths take place in low – and middle income countries (Bowry AD et al., 2015). Most of these deaths unfortunately occur prematurely, (82%). It has been shown that Hypertension seen in children can progress into adulthood thus contributing to the increase in the cardiovascular morbidity and mortality in adults. The prevalence of HBP among the aged in West Africa is shown to be 33% in some urban communities, however, some studies report a prevalence of between 30-40% for rural communities (Essouma et al., 2015). Ghana has a high HBP prevalence of 28.7%. A rural–urban study in Ghana suggests a prevalence of 27%, each for both rural men and women and 33.4% and 28.9% for urban men and women respectively (Afrifa et al., 2015).

Individual lifestyle behaviours that come with urbanization contribute to the increasing prevalence of HBP among adolescents. Among them are lack of physical activity (PA), alcohol overconsumption, smoking or substance use, unhealthy diets, obesity and psychosocial stress (Odunaiya et al., 2015). These factors are now recorded and gradually increasing among the younger population (13–19). However, while it is established in most developed countries that PA in adolescents and youth reduces risk of obesity and HBP in

later life, the association is unclear in most developing countries. For instance, in Nigeria, female students in senior secondary schools were more physically inactive compared to their male counterparts (39.9% vs 36.0% respectively; $p < 0.05$) (Ujunwa et al., 2013). In the same study, participants who were inactive were found to have high BMI. Similarly, physical inactivity was found to be accompanied by a high prevalence of overweight and obesity among youth in South Africa. In Cameroon, it was observed that the BP of adolescents 15years and over decreased for high energy expenditure (Sobngwi et al., 2012).

In Ghana, the overall prevalence of overweight among women aged 15–49 years has increased from 25.5% to 30.5% between 2003 and 2008. Overweight and obesity which have been attributed to aging are equally now common among adolescents and children due to lifestyle behaviours such as low levels of PA, poor diets and increasing levels of alcohol intake. Childhood obesity increased from 0.5% in 1988 to 1.9% in 1993 and to 5% in 2008 in Ghana (Afrifa-Anane et al., 2015). In this same study, among youths aged 15–19 and 20–24 in Ghana, there has been an increase from 7.2% to 9.0% and 15.1% to 16.6%, respectively in the same period. Childhood and adolescent PA has an effect on adult obesity and BP. PA reduces risk of obesity, which are difficult to reverse once established. Furthermore, physically active adolescents are at a lower risk of developing other conditions such as type II diabetes in future. Hence BMI and PA are significant factors that relate with BP. Prevention therefore, should begin early in life to reduce the overall number of cases.

1.2 Problem Statement

Hypertension is a complex disease with different features. It is said to be the commonest non communicable disease. Hypertension in adolescents mostly goes unrecognized.

Individual lifestyle behaviours have been said to contribute to the increasing prevalence of HBP. Among them are lack of physical activity (PA), alcohol overconsumption, smoking or substance use, unhealthy diets, obesity and psychosocial stress. These factors are now evident and also high among the younger population 15–24 years (Afrifa-Anane et al., 2015). While it is established in most developed countries that PA in adolescents and youth reduces risk of obesity and HBP in later life (Jackson et al., 2014), the association is unclear in most developing countries. For instance, in Nigeria, female students in Senior Secondary Schools were more physically inactive compared to their male counterparts (39.9% vs 36.0% respectively; p 0.05) (Ujunwa et al., 2013).

Physical inactivity was found to be accompanied by a high prevalence of overweight and obesity among youth in South Africa (Essouma et al., 2015). In a study that was conducted in Cameroon, BP decreased for high energy expenditure among urban and rural respondents 15 years and older (Sobngwi et al., 2013). Increase in the prevalence of hypertension has been associated with increase in the prevalence of childhood obesity (Carvajal et al., 2014) The number of obese children and adolescents have risen from 11 million in 1975 to 124 million in 2016 (WHO fact sheet, 2017). In Ghana, the overall prevalence of overweight among women aged 15–49 years has increased from 25.5% to 30.5% between 2003 and 2008. Childhood obesity increased from 0.5% in 1988 to 1.9% in 1993 and to 5% in 2008. In addition, among the youths aged 15- 19 and 20- 24 years, there has been an increase from 7.2% to 9.0% and 15% to 16.6%, respectively in the same period (Afrifa- Anane et al., 2015).

In a Global Youth Tobacco Survey (GYTS) that was conducted among Junior High School students; 51% of the students had used tobacco, 20% of them lived in homes where others smoked and 40% were exposed to environmental tobacco smoke (Sarmento et al., 2016).

In a meta-analysis that was conducted, the prevalence of adolescent hypertension was estimated to be 1-5% in high – income countries and 0-22.3% in some selected African countries (Essouma et al., 2015). Similarly, the prevalence of hypertension among urban poor youth in Ghana was estimated at 4% (Afrifa- Anane et al., 2015).

High blood pressure affects the health of adolescents and result in other health problems in later life. It has been shown that hypertension seen in children can progress into adulthood thus contributing to the increase in the cardiovascular morbidity and mortality in adults.

Many studies on hypertension worldwide have been on the middle aged and the elderly patients giving the impression that hypertension is a disease meant for only these age groups. The true prevalence of hypertension and the link between the associated factors among Senior High School students remain unstudied. The purpose of this study was to estimate the prevalence of hypertension and its associated factors among Senior High School students.

1.3 Justification

The possibility of a permanent disability associated with hypertension and subsequent development of other NCDs requires early diagnosis and putting in place necessary measures to forestall its occurrence. Hypertension among adults is estimated to be 28.7% in Ghana (Afrifa- Anane et al., 2015); an alarming situation indeed. The prevalence of hypertension among adolescents has remained between 0-22.3% in Africa (Essouma et al., 2015), however, the factors that have been recognised as the major risks of hypertension are on the ascendancy among adolescents. There has been a tenfold increase in childhood obesity from 1975 to 2016 (WHO fact sheet, 2017). There is also the rise in tobacco and alcohol usage among adolescents (Sarmento et al., 2016). The risk of developing hypertension as an adolescent is becoming a growing public health concern because of the

increased prevalence of the major factors that are associated with hypertension. This has necessitated the establishment of Obesity Action Coalition to educate and give support so far as obesity is concerned. The WHO has also set up a commission on ending childhood obesity. In Ghana, there are school health programs that are targeted on educating Junior and Senior High School students on substance use. Little attempt has been made in a bid to quantify adolescent hypertension because it is deemed to be a disease meant for the middle age and the elderly. Most clinicians accept the news of an increased blood pressure in a child with a bit of apprehension because it's mostly not expected. With the constant increase of the factors that are associated with hypertension among adolescents, it would be an error not to find out the prevalence of hypertension among this age group.

It was therefore appropriate and very important that this study be conducted to find out the prevalence of hypertension and the factors that are associated with it among Senior High School students. Identifying these will give a better picture of the prevalence of hypertension among adolescents that will necessitate the implementation of necessary preventive steps to reduce the associated factors. This will in the long run reduce the morbidity and mortality associated with cardiovascular disease. The quality of life will generally improve as a result.

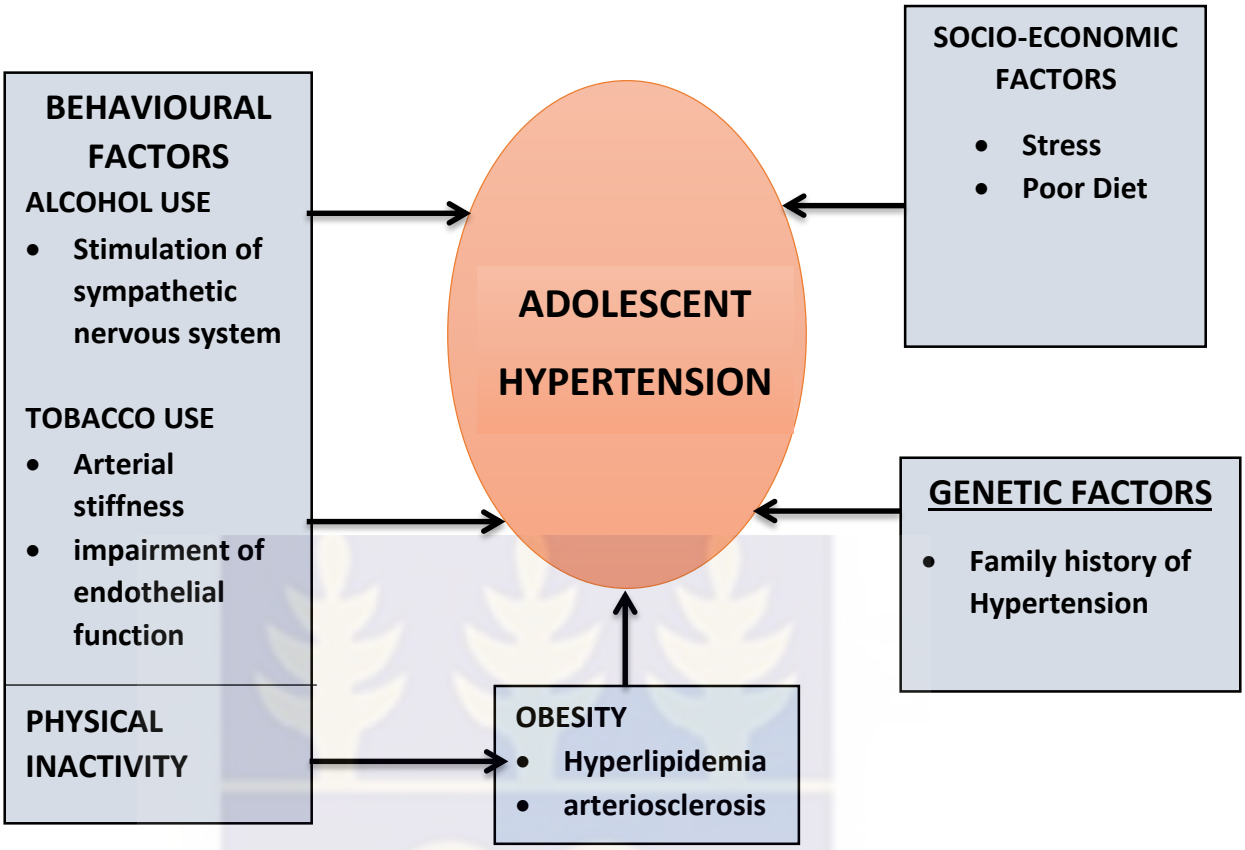

Figure 1.1: Conceptual Framework

Identifying childhood and adolescent hypertension and its associated factors could contribute to better prevention of hypertension and cardiovascular disorders in adults.

High blood pressure can run in a family, the risk for high blood pressure can increase based on age, race or ethnicity. Members of a family pass traits from one generation to another through genes. Genetic factors likely play some role in high blood pressure, heart disease and other related conditions. However, it is also likely that people with a family history of high blood pressure share common environments and other potential factors that increase their risk. The risk of high blood pressure can increase even more when heredity combines with unhealthy lifestyle choices, such as smoking cigarette, abusing alcohol and eating an unhealthy diet (CDC, 2014).

Obesity and its associated cardiovascular, metabolic, and renal disorders have rapidly become a major threat to global health. Worldwide obesity has nearly tripled since 1975 (WHO. Fact sheet, 2017). The Framingham Heart Study, suggests that 78% of primary hypertension in men and 65% in women can be ascribed to excess weight gain. Poor dietary habit such as excess intake of high energy diet has a direct link to excess weight gain. Obesity in a way ensures an increased activity of the renin- angiotensin aldosterone and insulin resistance which predisposes to hypertension (Sadoh W. E et al., 2016). It is well recognised that regular physical exercise is cardio protective. On the other hand, sedentary living is an established risk factor for cardiovascular diseases. There is mostly accumulation of plaques in the blood vessels that increases blood pressure (Crisafulli A. et al., 2015).

Epidemiological, preclinical, and clinical studies have established association between high alcohol consumption and hypertension. Alcohol causes an imbalance of the central nervous system, impairment of the baroreceptors, enhanced sympathetic activity, stimulation of the renin-angiotensin aldosterone system, increased cortisol levels, increased vascular reactivity due to increase in intracellular calcium levels, and the stimulation of the endothelium to release vasoconstrictors (Husain K. et al., 2014).

Tobacco use causes an impairment of endothelial function, arterial stiffness, inflammation, lipid modification and also alteration of antithrombotic and prothrombotic process. It also causes a stimulation of the sympathetic nervous system. All these physiological activities link up with each other and finally give rise to an increased blood pressure, hence adolescent hypertension.

1.4 Research Questions

1. What is the prevalence of hypertension among Senior High School students?
2. What are the factors associated with hypertension among Senior High School students?

1.5 Objectives

1.5.1 General Objective

The general objective was to determine the prevalence and factors associated with hypertension among Senior High School students of Saint Thomas Aquinas and Accra High Senior High School from May- July 2017.

1.5.2 Specific Objectives

The specific objectives were:

- To determine the prevalence of hypertension among Senior High School students.
- To determine the factors associated with hypertension among Senior High School students

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure. Blood is transported from the heart to all parts of the body in the vessels. The heart beats, to supply certain amount of blood into the vessels. Blood pressure is created by the force of blood pushing against the walls of the blood vessels as it is pumped by the heart. The higher the pressure, the harder the heart has to pump (WHO, 2013). Hypertension is mostly unaccompanied by symptoms. One of the key risk factors for cardiovascular disease is hypertension. Hypertension already affects one billion people worldwide, leading to heart attacks and strokes (WHO. Fact sheet, 2017). Most dangerously, hypertension is silent, invincible killer and rarely causes symptoms. Raised blood pressure is a serious warning sign that significant lifestyle changes are urgently needed (WHO, 2013). The steep rise in the prevalence of hypertension is attributed to population growth, and behavioural risk factors such as unhealthy diet, harmful use of alcohol, lack of physical activity, excess weight and exposure to persistent stress (Afrifa-Anane et al., 2015). Blood pressure (BP) is measured in millimetres of mercury (mmHg) and is recorded as two numbers usually written one above the other. The upper number is the systolic blood pressure – the highest pressure in blood vessels and happens when the heart contracts, or beats. The lower number is the diastolic blood pressure – the lowest pressure in blood vessels in between heartbeats when the heart muscles relaxes (CDC, 2017). Normal adult blood pressure is defined as systolic blood pressure of 120mmHg and a diastolic blood pressure of 80mmHg. Hypertension is defined as a systolic BP equal to or above 140mmHg and/or diastolic BP equal to or above 90mmHg. In adolescents, their age, sex, and height

are taken into consideration in defining whether they are hypertensive or not (Christensen, 2014).

2.1 Diagnosing Adolescent Hypertension

Untreated paediatric hypertension has long-term serious health consequences. Sustained hypertension in children is often caused by a serious underlying health problem affecting the heart, kidneys, or endocrine system. This type of hypertension is known as secondary hypertension, because it develops due to a medical condition. Mild to moderate hypertension with no known underlying disease process is classified as primary or essential hypertension. This is the type of hypertension that many older children and most adults have (American Heart Association, 2016). In children with hypertension, 30% to 60% have secondary hypertension, while 40% to 70% have primary hypertension (Luma et al., 2014).

In children, prehypertension is persistent BP that equals or exceeds the 90th percentile for a normotensive child of the same age, sex, and height, *or* is below the 95th percentile but exceeds 120/80 mm Hg (either SBP exceeds 120 mm Hg, or DBP exceeds 80 mm Hg, or both). Hypertension is persistent BP that equals or exceeds the 95th percentile for a normotensive child of the same age, sex, and height (Ujunwa et al., 2013).

2.2 Prehypertension

Prehypertension is defined as blood pressure between 120-139/80-89 mmHg. It is a major public health concern. Prehypertension is very prevalent. It is often associated with other cardiovascular risk factors and independently increases the risk of hypertension and subsequent cardiovascular events (Papadopoulos et al., 2008).

Early recognition of prehypertension provides important opportunities to prevent hypertension and cardiovascular diseases. Stage 1 prehypertension is blood pressure 120-129/80-84 mmHg and stage 2 as blood pressure 130-139/85-89 mmHg. Stage 2 prehypertensive individuals have a threefold greater risk for developing hypertension and twofold higher risk for cardiovascular events compared to normotensives (Egan & Julius, 2008).

2.3 Causes of Adolescent Hypertension

The degree of persistent hypertension, the age of the child, the symptoms found during physical examination, and the risk factors documented in a thorough patient history will determine the next steps taken by the physician. For example, a child with low birth weight, family history of hypertension, and/or obesity has an increased probability of developing paediatric hypertension. Undiagnosed hypertension results in measurable organ damage in children, and overweight and obese children have a significantly increased risk of developing hypertension as adults. Risk factors for hypertension that cannot be modified include a family history of hypertension or CVD, low birth weight, gender, race, genetic inheritance, socioeconomic status (SES), premature birth, and use of umbilical artery catheters. Risk factors that can be modified include decongestants, nose/eye drops, oral contraceptives, bronchodilators, dietary habits, salt intake, excess adiposity, physical activity level, second-hand smoke, and poor sleep quality and/or short sleep duration. Sleep-disordered breathing (SDB) and obstructive sleep apnoea (OSA) have both been associated with paediatric hypertension and should be ruled out or treated. The prevalence of OSA in all children is estimated at less than 3%, but estimates in obese youth range from 5.7% to 36%, with prevalence and severity positively correlated with the degree of obesity. The risk of SDB in general increases by 12% for every 1 kg/m^2 above mean body mass index (BMI),

and for each standard deviation above mean BMI, the risk of OSA is 3.5-fold greater. Typically, older children and adolescents are more likely to present with primary hypertension, while younger children are most likely to have secondary hypertension. Low renin and abnormal sodium transport in the kidneys are characteristics of secondary hypertension with an underlying genetic basis, which should be further investigated. For all children with persistent elevated BP, a baseline evaluation to exclude secondary causes should include certain blood and urine tests, a kidney ultrasound, and an echocardiogram. If these are found to be abnormal, the child should be referred to a paediatric nephrologist or paediatric cardiologist for further evaluation; if the baseline evaluation is normal and no medical condition has been found, primary hypertension is diagnosed (Luma et al., 2014).

2.4 Classification of blood pressure

Optimal blood pressure is defined as a systolic blood pressure of 90-119 mmHg and a diastolic blood pressure 60-79 mmHg. Systolic blood pressure of 120-139 mmHg and or diastolic blood pressure 80-89 mmHg is defined as prehypertension. Systolic blood pressure of 140 mmHg or greater and or a diastolic blood pressure 90 mmHg or greater is defined as hypertension. Hypertension is further divided into three stages. Stage 1 hypertension is a systolic blood pressure of 140-159 mmHg and or a diastolic blood pressure 90-99 mmHg, stage 2 hypertension is a systolic blood pressure of 160-179 mmHg and or a diastolic blood pressure 100-109 mmHg and stage 3 hypertension is defined as a systolic blood pressure greater than or equal to 180 mmHg and or a diastolic blood pressure greater than or equal to 110 mmHg. Blood pressure can be classified as follows (Table 2.1 below):

Table 2.1 Classification of blood pressure

Category	Systolic (mmHg)	Diastolic (mmHg)
Optimal BP	90-119	60-79
Prehypertension	120-139	80-89
Stage 1 hypertension	140-159	90-99
Stage 2 hypertension	160-179	100-109
Stage 3 hypertension	≥180	≥110

(Source: Rashid et al., 2011).

Interventions

The single most effective way to prevent or reduce hypertension in adolescents is to measure height, weight, BP, and WC, and calculate BMI %, for every child, every year, in every school grade, so that early signs can be followed up and corrective measures can be taken before organ damage occurs. As the literature has shown, conventional practices are not all-inclusive; many health care screenings do not include BP measurements for children, and BMI is rarely calculated or used unless the child is already obese. These simple screening measurements could be incorporated into existing school or community programs, and should include children who have little or no access to regular health care, such as low income, immigrant, and minority youth, who are most at risk for and most affected by hypertension and obesity. Early intervention and preventive measures would reduce the number of children and adolescents who reach adulthood before they are diagnosed with hypertension. Prevention is also the best strategy for reducing the incidence of overweight and obesity, and exercise for personal fitness should be emphasized in physical education programs. Obese children should be evaluated for hypertension before beginning any exercise regimen. Interventions focused on preventing or minimizing further weight gain are needed, which combine the expertise of professionals in the fields of exercise

physiology, physical therapy, behavioural health, and nutrition as appropriate. Nutritional counselling to achieve weight loss is an important part of managing hypertension and obesity and should include family. Dietary interventions need to emphasize reduced intake of fruit-flavoured drinks, and other foods containing high-fructose corn syrup, promote increased consumption of low-fat milk or 100% fruit juice, and provide calcium-rich alternatives for lactose-intolerant children. The sale of energy-dense, nutrient-poor drinks and snacks through school-based stores, vending machines, and snack bars should be reduced or eliminated. Intervention strategies should focus on replacing unhealthy selections with better-quality options in the home, school, and child care environments, modelling of healthy behaviours by parents and educators, and reducing children's exposure to marketing that promotes unhealthy choices. (Luma et al., 2014).

2.5 Prevalence of Adolescent Hypertension and prehypertension - Global Perspective

Hypertension in children is often caused by a secondary factor (an already existing health problem). The problem may be emanating from the heart, kidneys or the endocrine system (Saragih et al., 2015). Hypertension without an underlying cause is considered as primary or essential hypertension. In children, secondary hypertension is estimated to be around 30% to 60% and 40% to 70% is estimated for essential hypertension (Ewald and Haldeman, 2015). The prevalence of hypertension in children is estimated to be between 2% and 5% and prevalence of prehypertension is estimated between 4% and 15% (Ewald and Haldeman, 2015). Studies in the United States of America and Europe have found that only 13% to 26% of childhood hypertension is properly diagnosed (Ewald and Haldeman, 2015). In a study that was conducted in Kerala, India, among 2,438 students aged between 13- 17 years the prevalence of hypertension and prehypertension was found to be 21.4 % (Tony L et al., 2016).

2.6 Prevalence of Adolescent Hypertension and prehypertension - African Perspective

Hypertension is gradually graduating into an epidemic among African adults. As part of measures to control this menace, accurate epidemiological data on hypertension in African children and adolescents should be obtained to institute preventive policies. Rise in non-communicable diseases (NCDs) is a major concern in Low- and – middle income countries ((LMIC). Hypertension which was not too common has become a major public health problem because of its high prevalence. Children who present with high BP are at a high risk of becoming hypertensive at an adult age. Many epidemiological studies have attempted to estimate the prevalence of adolescent hypertension. In high income countries, there is an increasing burden of hypertension in children and adolescents with prevalence rate of 1- 5% and this also applies to African countries where there is a considerable variability of the estimated prevalence in South Africa and certain West African countries being 0-22.3%. (Essouma et al., 2015). In a similar study conducted in Enugu, South Eastern Nigeria the prevalence of hypertension was estimated to be 5.4%, 6.9% in females and 3.8% in males (Ujunwa et al., 2013).

2.7 Prevalence of Adolescent Hypertension and prehypertension - Ghanaian Perspective

High BP among adolescents affect their health and results in other health problems in later life. Most studies in Ghana have focussed on adult hypertension. The proportion of pre hypertension and hypertension among youth (15- 25 years) is said to be 32.3% and 4% respectively. The rates of pre hypertension (42.0 vs 24.80) and hypertension (6.8 vs 1.80) are said to be higher in males than in females. These are according to a study which was conducted by Afrifa- Anane et al., 2015. In the above statistics, females were more inactive

than males. The average BMI was 22.8kg/m^2. For overweight, (17.7 vs 6.8) and obesity (13.3 vs 2.3), females had higher rates than males.

2.8 Risk Factors for Hypertension

The ca uses of hypertension are unknown but several factors are said to pose as risks. Risk factors are defined as any attribute or characteristics or exposure of an individual, which increases the likelihood of developing a disease. Risk factors for adolescent hypertension include; genetic, behavioural, and socioeconomic factors.

2.8.1 Genetic Factors

An adolescent may develop hypertension because of his or her genetic predisposition. A family history of hypertension has the possibility of putting an individual at risk of developing hypertension. This mostly occurs when there is an inter twinning with other risk factors (Liu et al., 2015). In a recent study among adults in Sri Lanka, it was found that hypertension was significantly higher in those with a family history of hypertension (Ranasinghe et al., 2015).

2.8.2 Age

There is an increase in blood pressure with ageing. This is associated with structural changes in the arteries; mostly stiffness of large arteries. According to the Framingham Heart Study, systolic blood pressure increases steadily from 30 years onwards. Diastolic blood pressure varies with ageing; it increases up to about 50 years of age but steadily decreases from 60 years onwards (Leitschuh et al., 1991; Pinto, 2007).

2.8.3 Gender

In the second and third decades of life, women have slightly lower blood pressure compared to men of similar ages (Syme et al., 2009). Blood pressure in women after menopause is

however comparable with that of men of similar ages or even higher. This is attributed to postmenopausal hormonal changes in women (Reckelhoff, 2001).

2.8.4 Race

Various studies report a higher prevalence of hypertension in people of African descent and other minority racial groups than in Caucasians living in the United States of America (Lackland, 2014). The higher prevalence of hypertension in people of African origin in the United States of America than in Africa demonstrates that environmental and behavioural characteristics are likely to account for the higher prevalence of hypertension in Afro-Americans (Fuchs, 2011).

2.8.5 Behavioural Risk factors

Many behavioural risk factors have been associated with the development of hypertension, they include; alcohol abuse, tobacco use and physical inactivity.

2.8.6 Nutrition

Diet has an influence on the development of hypertension. Consumption of high fat diet causes a blockade in the blood vessels. The heart exerts more pressure in pumping blood which results in increased BP. Increased sodium intake also causes an increase in the total blood volume. The consumption of fibre on the other hand helps to speed up the transit time of all materials through the colon (Berz, 2012).

2.8.7 Alcohol intake

The effect of alcohol on cardiovascular diseases is a controversial issue. There is considerable amount of evidence that a modest intake of alcohol, especially red wine has a protective effect against coronary heart disease because of the presence of antioxidants (Saleem et al., 2010). However, the sharp increase in mortality associated with more than

two drinks per day suggests that public health recommendations that emphasized the positive health effects of alcohol would likely do more harm than good. Research suggests that moderate alcohol intake raises High Density Lipoprotein (HDL) cholesterol and therefore reduces the risk of heart diseases, however, consumption in high doses is associated with hypertension (Husain et al., 2014).

One of the harmful effects of excessive alcohol intake is its association with hypertension. The positive relationship between the amount of alcohol consumed and blood pressure is one of the strongest associations of potentially modifiable risk factors for hypertension. Many studies show progressively higher blood pressure levels with increasing levels of alcohol intake and decreases in blood pressure over time when alcohol intake decreases (Husain et al., 2014). Alcohol intake has also been associated with resistance to antihypertensive therapy. These could be due to poor compliance among heavy drinkers or interaction of alcohol with medications (O‟Keefe et al., 2007).

According to Ghana Demograhpic and Health survey, alcohol consumption is highest among young people between the ages of 15-39 years than other groups. In a study that was conducted in Ghana, the prevalence of alcohol among the youths was estimated at 43% (Osei- Bonsu et al., 2017). Similarly, the prevalence of alcohol use among Senior High School students in the Ga Central Municipality of Ghana was 35% (Annor, 2016).

2.8.8 Tobacco use

Addiction to tobacco products has adverse effect on the cardiovascular system. Studies have demonstrated that tobacco in all forms greatly increases the risk of premature death from chronic disease including hypertension (Kaplan, 2015). Cigarette smoking acutely exerts a hypertensive effect, mainly via the stimulation of the sympathetic nervous system. Cigarette smoking is a powerful cardiovascular risk factor

Stoppage of smoking is the single most effective lifestyle measure for the prevention of a large number of cardiovascular diseases. Impairment of endothelial function, arterial stiffness, inflammation, lipid modification as well as an alteration of antithrombotic and prothrombotic factors are smoking-related major determinants of initiation, and acceleration of the atherothrombotic process, leading to cardiovascular events. Regarding the effect of chronic smoking on blood pressure, available data do not indicate a direct causal relationship between chronic smoking and hypertension. Hypertensive smokers however, are more likely to develop severe forms of hypertension such as malignant and renovascular hypertension, due to accelerated atherosclerosis (Virdis et al., 2010).

In a study that was conducted in Botswana, 10% of students were current smokers with 29% reporting to have tried smoking (Mbongwe et al., 2017). In a similar study that was conducted among 1,174 students, 140 were current smokers giving a smoking prevalence of 12.5% (Adeyeye, 2011).

2.8.9 Physical inactivity

Activities such as walking help to maintain normal body weight. Frequent exercise has been identified to control cholesterol levels and hence the prevention of atherosclerosis. This confirms findings of a cross- sectional study among a Japanese population that revealed that high HDL cholesterol levels were associated with high frequencies of physical activity (Hedge et al., 2015).

2.8.10 Obesity

This is the excess or abnormal accumulation of fat. Obesity is seen as one of the most serious public health challenges in the 21st century. The prevalence of overweight and obesity in adolescents is defined according to the WHO growth reference for school- aged children

and adolescents (overweight=one standard deviation body mass index for age and sex, and obese= two standard deviations body mass index for age and sex).

It is estimated that at least 75 % of the incidence of hypertension is related directly to obesity (Landsberg et al., 2013). Obesity is associated with numerous comorbidities including hypertension. Blood pressure is usually increased in overweight people. Overweight and hypertension interact with cardiac function. A key determinant of the weight-induced increases in blood pressure is a disproportional increase in cardiac output that cannot be fully accounted for by the hemodynamic contribution of new tissue. The hypertension among overweight people seems strongly related to altered sympathetic activity (Gray, 2009).

The prevalence of obesity among Senior High School students has been found to be 47.06% in a study that was conducted in Ghana (Amoh et al., 2017). According to a WHO report, 18% of children and adolescents aged 5-19 were overweight or obese in 2016 (WHO fact sheet, 2016).

2.8.11 Socioeconomic Factors

Social determinants of health e.g. income, education and housing, have an adverse impact on behavioural risk factors and in this way influence the development of hypertension. For instance, rapid unplanned urbanization encourages the development of hypertension as a result of unhealthy environments that encourage the consumption of fast food, sedentary behaviour, tobacco use and harmful use of alcohol (Cuschieri et al., 2017).

2.8.12 Stress

Stress can cause hypertension through repeated blood pressure elevations as well as by stimulation of the nervous system to produce large amounts of vasoconstricting hormones

that increase blood pressure. Overall, studies show that stress does not directly cause hypertension, but can have an effect on its development. Although stress may not directly cause hypertension, it can lead to repeated blood pressure elevations, which eventually may lead to hypertension (Virdis et al., 2010). Stress also leads to the production of excessive amount of cholesterol which can occlude blood vessels and lead to hypertension (Garbarino & Magnavita, 2015).

2.9 Symptoms of Hypertension.

Most hypertensive people have no symptoms at all. However, increase in blood pressure may result in headaches, shortness of breath, dizziness, chest pain, palpitations and bleeding from the nose. It can be dangerous to ignore such symptoms but they can also not be relied upon to signify hypertension.

2.10 Hypertension and Life – Threatening Diseases

High blood pressure increases the chances of life threatening complications. Untreated hypertension results in harmful consequences to the heart and blood vessels in major organs such as the brain, and kidneys. A list of complications of hypertension may include the following; kidney failure, heart failure, stroke, eye complications etc.

2.11 Diagnosing Hypertension in Adolescents

Normal blood pressure values for children and adolescents are based on age, sex, and height, and are available in standardized tables. Prehypertension is defined as a blood pressure in at least the 90^{th} percentile, but less than the 95^{th} percentile for age, sex, and height, or a measurement of 120/80mmHg or greater. Hypertension is defined as blood pressure in the 95^{th} percentile or greater based on at least three separate readings.

2.12 Interventions for the Prevention of Adolescent Hypertension

The single most important way to reduce or prevent adolescent hypertension is the ability to identify early signs. This can be achieved by frequently checking BMI. Regular exercise and physical fitness should be emphasized. Dietary interventions such as the reduction of foods with excess fats and salt will be an important measure. Policies regarding harmful use of alcohol and tobacco must also be instituted.

2.12.1 The role of the health worker

Skilled health professionals have a role to play in designing hypertension control programmes among adolescents. This is by creating awareness that hypertension does only affect adults but adolescents as well. Activities such as regular BP measurements and education about hypertension can be carried out in senior high schools.

2.12.2 Nutrition

Scientific studies have demonstrated that a modest intake of sodium helps to reduce BP. WHO recommends the intake of 5g of sodium per day. Processed foods are said to contain high amount of sodium. Adolescents need to be educated to cut down on the intake of processed foods.

CHAPTER THREE

METHODOLOGY

3.1 Study Population

The study population comprised of senior high school students of Saint Thomas Aquinas Senior High School and Accra High Senior High school. They are adolescents of different ages and gender.

Saint Thomas Aquinas Senior high school is a public Senior High day school. It is a boys' school with about 1500 students who read different courses ranging from Science, General Arts, Agricultural Science, Business and Visual Arts.

Accra High Senior High school is also a public Senior High day school with a population of 1300 students. It is a mix school comprising of 500 boys and 700 girls. The following courses are offered in the school; Science, Business, Home Economics, and Visual arts.

3.2 Study area

Saint Thomas Aquinas Senior High school is a public senior high day school (6.663^0N, 1.645^0 W) and is located on the cantonment street, Osu in the Greater Accra Region of Ghana.

Accra High Senior High school is also a public Senior High day school located at North Ridge, Accra Ghana.

Figure 3.0 and 3.1 show maps of Saint Thomas Aquinas and Accra High Senior High School respectively.

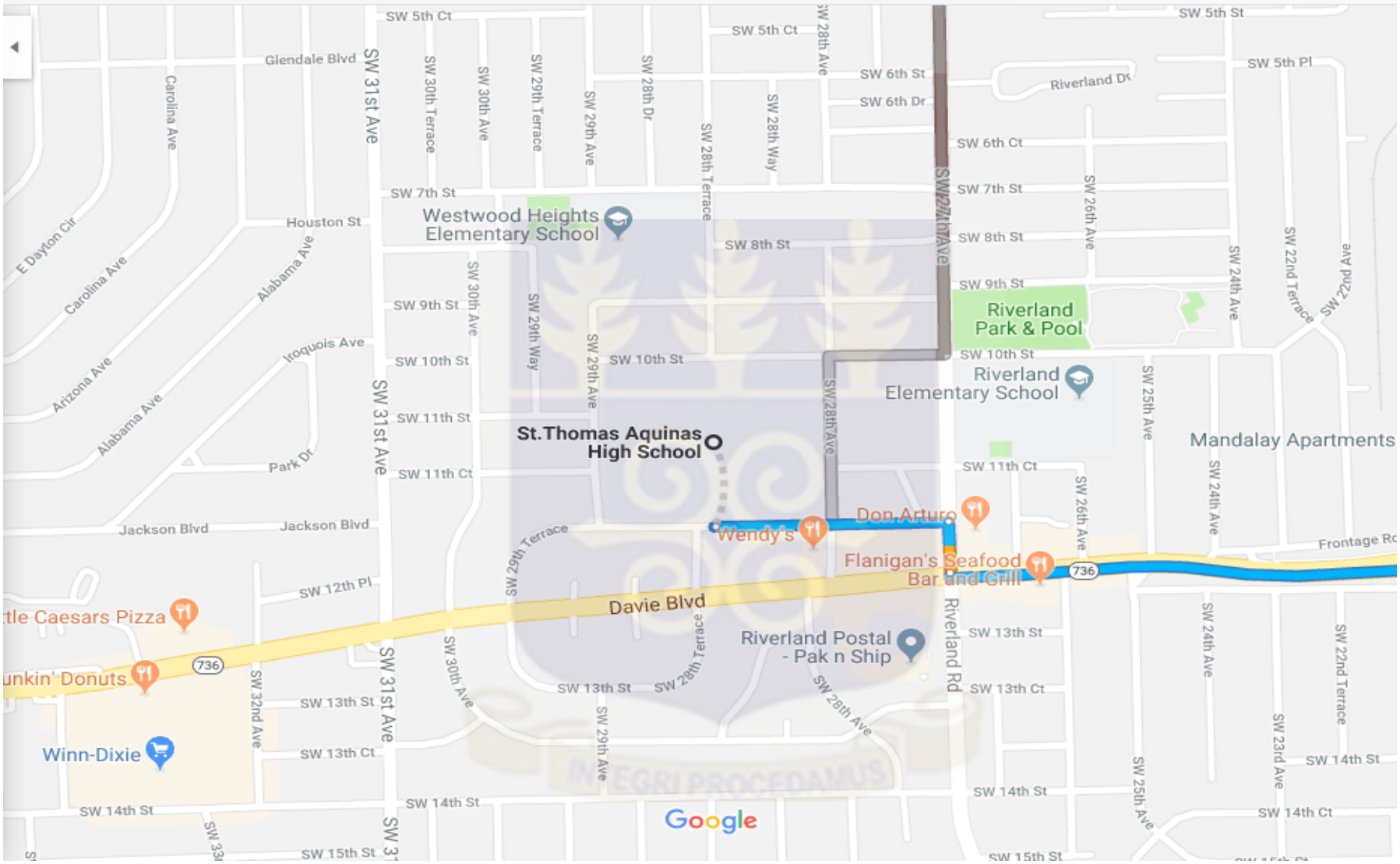

Figure: 3.0: Map showing St. Thomas Aquinas Senior High School

Figure: 3.1: Map showing Accra High Senior High School

3.3 Inclusion and exclusion criteria

The study took into consideration mainly Senior High School students between the ages of 14- 20years and excluded Senior High School students of the same age bracket who have a history of hypertension due to existing disease conditions such as kidney conditions. This information was obtained by interviewing the subjects about their past medical history.

3.4 Study design

It was an institution based descriptive cross- sectional quantitative study. Data was obtained by the use of questionnaire, measurement of blood pressure, weight and height of participants.

3.5 Ethical Consideration

Ethical clearance was obtained from the Ghana Health Service Ethical Review (Protocol number; GHS- ERC: 154/02/17). Permission was obtained from the Head Master and Head Mistress of Saint Thomas Aquinas and Accra Girls Senior High School respectively. Consent was sought from the parents/guardian of the respondents through the head of the various institutions. The participants were given a brief introduction about the study and their consent were sought for before enrolment. Each participant was told about the non – invasive nature of the procedure except for a minor discomfort that may come with BP cuff inflation.

3.6 Variables

3.6.1 Dependent variables

- Presence of hypertension

3.6.2 Independent Variables

- Obesity
- Physical inactivity
- Consumption of alcohol
- Tobacco use

3.7 Sample Size Calculation

A total number of 266 students, aged between 14-20years was studied. All the 266 agreed to participate fully after appropriate explanation was given that they could opt out. Calculation was based on the Cochrane formula below:

$$n_0 = Z^2pd/d^2$$

where n_0 = Estimated sample size

Z = Level of confidence interval= 1.96

p = prevalence (estimated proportion) = 22.3% (0.223). The prevalence was obtained from a meta-analysis study of childhood hypertension conducted by Esouma et al., 2015.

q = 1 – p (the probability of not having hypertension) = 0.777.

d = acceptable margin of error= 5%(0.05).

Therefore, $n_0 = \frac{(1.96)^2(0.223)\ (0.777)}{(0.05)^2}$

$n_0 = 266.14$

$n_0 = 266.$

3.8 Sampling technique/ procedure

Participants were selected using the simple random sampling. Teachers of the various classes were made to pick pieces of papers with the inscriptions **YES** or **NO.** The classes of teachers who picked **YES** were selected. Within the chosen classes, students were made to pick pieces of papers with similar inscription **YES** or **NO.** Those who picked the paper with the YES inscription were recruited into the study.

3.9 Materials and tools

Tools and equipment:

1. Digital sphygmomanometer; PhysioLogic (AMG Medical Inc., New York USA)
2. Mechanical weighing scale; ADE scale with adjustable stadiometer for measuring height (GmbH & Co, Humburg Germany)
3. Tape measure; TM170 Cloth Tape Measure (Amazon).
4. Questionnaire; WHO stepwise approach.

3.10 Data collection

Data collection was carried out from 8th May, 2017 to 22nd May, 2017. Participants were gathered in a room early in the morning before classes begun and their blood pressure, weight, height and waist circumference measured.

3.11 Study Measures

Questionnaire was developed using WHO stepwise approach and the international physical activity questionnaire (IPAQ). The questionnaire considered the following profile (demographics, smoking, alcohol, physical activity and nutrition). Alcohol and tobacco use requires financial commitment. Though the population under study were only students and therefore had no or little financial assess to acquire the substance, considerations were made based on the fact that they could purchase the substance using their pocket money.

After completing the survey, objective measurements of blood pressure (BP) and anthropometrics were taken by the principal researcher and three qualified nurses.

3.12 Weight and height measurement

Weight was measured with a mechanical ADE scale, with a capacity of up to 150kg and a 50g interval variation. Height was measured using the stadiometer attached to the scale, with a 1mm resolution and a measuring capacity of up to 230cm. The scale (ADE) was placed on a level floor. The scale was zeroed before each participant stepped onto it. Subjects were made to wear light clothing without shoes. Participants emptied their pockets of all heavy substances. Participants were made to stand upright with arms resting by them, head up and eyes looking straight up before reading were taken. Weight was recorded to the nearest kilogram and height in centimetres. Height was further converted to meters by dividing the figure by 100.

3.13 Body mass index (BMI) determination.

BMI of each participant was calculated by dividing the weight in kilograms by the square of the height in meters. The participants were then grouped, based on their BMI into:

underweight; BMI less than 18.5kg/m^2, normal weight; BMI 18.5- 24.9kg/m^2, overweight; BMI 25.0- 29.9kg/m^2 and obese; BMI 30.0 kg/m^2 and above.

3.14 Waist circumference

Waist circumference was measured using cloth tape measure which was 150 centimetres long on one side and 60 inches on the other side. Waist circumference was measured at the approximate midpoint between the lower margin of the last palpable rip and the top of the iliac crest, while hip circumference was measured at the widest point of the buttocks (both in centimetres) using a tape measure. The tape measure was tight enough and the respondents positioned appropriately (i.e. parallel to the floor at the level at which measurement is made) Waist-hip ratio was calculated as waist measurement divided by hip measurement (WHO, 2008b).

3.15 Blood pressure measurement

BP was measured using a pre- calibrated digital monitor (PhysioLogic). Each participant was made to rest for at least 5 minutes before the blood pressure measurement was taken. Pulse rate of respondents was recorded to rule out any emotional interference. An appropriate cuff size (depending on the arm size of respondents) was wrapped around the left upper arm approximately 2 centimetres above the cubital fossa with participants seated with both feet on the floor and arms resting on a flat surface at the level of the heart. If BP fell out of the normal limits it was recorded again after 10-minute rest and the average value used. This was to address any anxiety introduced by participating in the study. Participants were grouped based on their blood pressure into, Optimal blood pressure; systolic blood pressure of less than 120mmHg and a diastolic blood pressure of less 80mmHg, prehypertension; systolic blood pressure of 129-139mmHg and a diastolic blood pressure

80-90mmHg, hypertension; systolic blood pressure of more than 140mmHg and diastolic blood pressure of more than 90mmHg.

3.12 Data entry

Data was entered into Excel 2010 worksheet in batches on a daily basis. Each participant was given a specific identification number. The data of each participant was entered in a row.

3.13 Data Analysis

Data analysis was done using Microsoft Excel 2010 and Stata SE version 14 statistical software (StataCorp, 2014). The data were inspected and sorted. There were no missing values. Data were descriptively reported using means and standard deviations, or percentages and 95% confidence intervals (CIs) as appropriate.

Chi square was used to test the association between hypertension and the various variables with p- value less than 0.05 as significant. Bivariate logistic regression model was fitted to test the strength of the association between hypertension and the individual variables. Multivariate logistic regression analysis was done to show the effect of demographic, clinical and life style factors on hypertension.

3.14 Advice to participants

Participants were encouraged to maintain healthy lifestyle by exercising regularly and eating healthy diet by reducing excess fat and confectionary intake and ensuring that their meals have large portions of fruits and vegetables. They were also advised on the dangers of alcohol and tobacco abuse.

CHAPTER FOUR

ANALYSIS AND RESULTS

4.0 Results on demographic/clinical/life style factors distribution of sampled participants

A total of 266 senior high school students were recruited as the participants for the study. The characteristics of these 266 students are shown in Table 4.0. The participants were aged from 14 to 20 years with a mean age of 16.5 years. More than half (55.3%) of the study participants were males. Most (69.7%) of the participants were in their first year (SHS 1). General Arts was the program offered by majority (48.9%) of the study participants. The estimated mean height and weight of the participants were 165.6 centimeters and 58.0 kilogram respectively. The shortest of the study participant was 114 centimeters tall while the tallest was 189.1 centimeters long. 30 kilogram was the weight of the lightest participant whilst the heaviest was 101 kilograms. The estimated average Body Mass Index was 20.9 kg/m^2 (range: 14.9 - 31.9). The study participants had a mean waist circumference of 90.1cm. The systolic and diastolic blood pressure were averagely 123.9mmHg and 68.7mmHg respectively. 14.7% of the participants reported to have had family members who were hypertensive. Majority (91.5%) of the participants reported to be active with a third (34.9%) of the participants exercising only once a week. 3.2% of the participants have ever smoked with less than 1% of them still smoking. About one of every ten selected study participant drinks alcohol. Some of the eating habit of the participants were in these forms: most (42.6%) of them occasionally or do not eat fruit whilst half or more (> 50%) of them eat roughage or vegetables foods every day. Details of characteristics of the study participants can be found in table 4.0

Table 4.0: Socio-demographic, clinical characteristics and lifestyle factors of the study participants

	Frequency(n=266)	Percentage(%)
Sex		
Female	118	44.68
Male	148	55.32
age(mean ± SD)	16.49 ± 0.97	
Class		
SHS 1	183	69.86
SHS 2	82	29.79
SHS 3	1	0.35
Program offered		
Gen Science	66	24.64
Gen Arts	126	48.93
Business	10	3.57
Visual Arts/ Home Econs	64	22.78
Weight(mean ± SD)	165.59 ± 11.03	
Height(mean ± SD)	57.80 ± 9.98	
BMI (mean ± SD)	20.90 ± 3.00	
Waist circumference (mean ± SD)	90.13 ± 9.81	
family history of hypertension		
No	116	85.29
Yes	20	14.71
Central Obesity		
No	88	87.13
Yes	13	12.87
Level of Aerobic exercise		
> once	92	34.88
>= 20 mins once\twice	71	25.98
>= 20mins\ 3 time	32	12.81
>= 20 mins\>=4 times	71	26.33
ever smoked		
No	255	96.79
Yes	9	3.21
currently smoke		
No	264	99.28
Yes	2	0.72
take alcohol		
No	239	90.39
Yes	27	9.61
Fruit eating habit		

Daily	75	26.6
Weekly	80	30.85
Occasionally/ not at all	111	42.55
roughages eating habit		
Daily	80	30.96
Weekly	82	30.96
Occasionally/ not at all	104	38.08
confectionaries eating habit		
Daily	120	44.13
Weekly	60	23.84
Occasionally/ not at all	86	32.03
vegetable eating habit		
Daily	148	56.03
Weekly	60	22.96
Occasionally/ not at all	58	21.01

SD: Standard Deviation

4.1 Prevalence of pre-hypertension and hypertension among the study participants

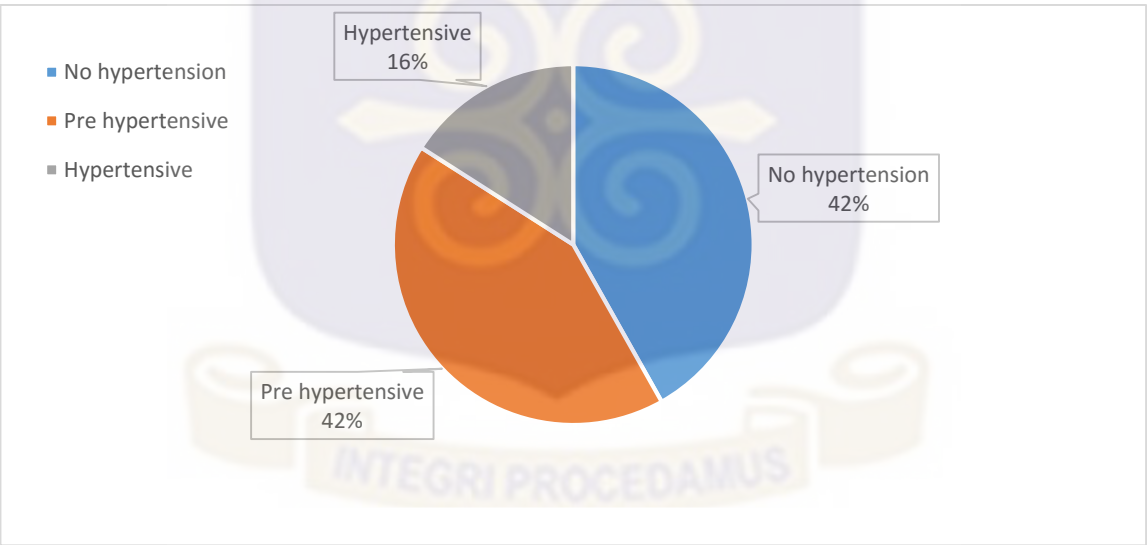

Figure 4.0: Distribution of hypertension status among school children

Of the 266 students studied, the proportion of pre – hypertensive students was 42.2% (95% CI: 36.5 – 48.1%) while the prevalence of hypertension was 16% (95% CI: 12.1 – 20.7%) with 41.8 (95% CI: 36.2 – 47.7%) having normal blood pressure.

4.2 Association between Socio-demographic, clinical and lifestyle factors of the study participants

The bivariate analysis of factors associated with hypertension are shown in table 4.1. Sex was significantly associated with hypertension, thus, the odds of being hypertensive among the male students was more than three times that of females (5.56% vs 24.36%, p=0.001). Programs studied by the students was significantly associated with their hypertension status (p=0.019). Though the average heights of participants were not significantly different among hypertensive and non-hypertensive participants (165.5 cm vs 169 cm, p=0.148), hypertensive students were averagely heavier than non-hypertensive students (57.4 kg vs 70.6 kg, p=0.013). The body mass index of hypertensive pupils was significantly 4.2 kg/m2 higher than that of the normal students (20.8 kg\m^2 vs 24.9 kg\m^2, p = 0.0189). There was not enough statistical evidence to conclude that smoking, alcohol intake and physical active are associated with the hypertension status of a student which is contrary to what literature has outlined. Table 4.1 Shows details of the bivariate analysis.

Table 4.1: Association between Socio-demographic, clinical and lifestyle factors of the study participants

	Non-hypertensive	Hypertensive	χ^2	P - value
Sex			18.38	<0.001**
Female	119(94.44)	7(5.56)		
Male	118(75.64)	38(24.36)		
age(mean ± SD)	16.45 ± 0.98	16.69± 0.92	-1.59	0.116
Class			0.46	0.796
SHS 1	164(83.25)	33(16.75)		
SHS 2	72(85.71)	12(14.29)		
SHS 3	1(100)	0		
Program offered				0.019*
Gen Science	56(80.00)	14(20.00)		
Gen Arts	110(80.29)	27(19.71)		
Business	9(90.00)	1(10.00)		
Visual Arts/ Home Economics	61(95.31)	3(4.69)		
Weight(mean ± SD)	164.81 ± 11.51	169.65 ± 6.78	-3.84	<0.001***
Height(mean ± SD)	56.58 ± 9.11	64.20 ± 11.83	-4.09	<0.001***
BMI (mean ± SD)	20.62 ± 2.75	22.34 ± 3.76	-2.91	0.005**
Waist circumference (mean ± SD)	89.70 ± 10.15	92.50 ± 7.38	-2.14	0.035*
family history of hypertension				0.306
No	98(84.48)	18(15.52)		
Yes	19(95.0)	1(5.00)		
Central Obesity				0.207
No	73(82.95)	15(17.05)		
Yes	13(100)	0		
Level of Aerobic exercise			8.36	0.039*
> once	88(89.80)	10(10.20)		
>= 20 mins once\twice	55(75.34)	18(24.66)		
>= 20mins\ 3 time	28(77.78)	8(22.22)		
>= 20 mins\>=4 times	65(87.84)	9(12.16)		
Are you active			0.01	0.921
No	20(83.33)	4(16.67)		
Yes	217(84.11)	41(15.89)		
ever smoked				1
No	227(83.76)	44(16.24)		
Yes	8(88.89)	1(11.11)		
currently smoke				1
No	234(84.84)	43(15.52)		
Yes	2(100)	0		
take alcohol				0.603
No	213(83.86)	8(3.15)		

Yes	23(85.19)	1(3.70)		
Fruit eating habit			2.16	0.339
Daily	67(89.33)	8(10.67)		
Weekly	71(81.61)	16(18.39)		
Occasionally/ not at all	99(82.50)	21(17.50)		
roughages eating habit			5.05	0.08
Daily	74(85.06)	13(14.94)		
Weekly	67(77.01)	20(22.99)		
Occasionally/ not at all	95(88.79)	12(11.21)		
confectionaries eating habit			1.38	0.501
Daily	104(83.87)	20(16.13)		
Weekly	58(88.06)	8(11.49)		
Occasionally/ not at all	73(81.11)	17(18.89)		
vegetable eating habit			0.25	0.881
Daily	119(82.64)	25(17.36)		
Weekly	50(84.75)	9(15.25)		
Occasionally/ not at all	46(85.19)	8(14.81)		

P-values in parentheses; *p<0.05, **p<0.01, ***p<0.001 values were based on Pearson chi-square and Fishers exact test for categorical variables, and t-test for comparing means. SD: Standard Deviation. (%) represent row percentage, ǂ estimated p-value from the Welch t-test, § p-value estimate from Fisher's exact test. Non-hypertensive constitutes both no hypertension and pre-hypertensive students

4.3 Effect of demographic, clinical and life style factors on hypertension status

The results from multivariable logistic regression analysis showed that the sex, class and body mass index (BMI) were significantly related to the hypertension status of the male students. Among the students. Males had 4.9 times odds of being hypertensive compared to the females (OR: 4.91, 95% CI: 1.65 – 14.62, p=0.004). The odds of being hypertensive was 66% less among Students in SHS 2 than those in SHS 1 (OR: 0.34, 95% CI: 0.12 – 2.10, p=0.037). Among the study participants, the odds of becoming hypertensive increases by 1.23 for every 1 kg/m2 rise in BMI (OR: 1.23, 95% CI: 1.08 – 1.40, p=0.002). Details of the analysis can be found in table 4.2

Table 4.2: Effect of demographic, clinical and life style factors on hypertension status

	OR	95% CI	P-value	AOR	95% CI	P-value
Sex			< 0.001			0.004
Female	ref					
Male	5.47	2.35 - 12.75		4.91	1.65 - 14.62	
Age	1.28	0.93 - 1.77	0.127	1.38	0.91 - 2.1	0.129
Class			0.606		-	0.037
SHS 1	ref				-	
SHS 2	0.83	0.40 - 1.70		0.34	0.12 - 0.94	
SHS 3				1.00	-	
Program			0.064		-	0.376
Gen Science	ref				-	
Gen Arts	0.98	0.47 - 2.02		0.58	0.22 - 1.49	
Business	0.44	0.05 - 3.81		0.33	0.03 - 3.92	
Visual Arts/ Home Economics	0.2	0.05 - 0.72		0.26	0.05 - 1.32	
BMI	1.19	1.08 - 1.32	0.001	1.23	1.08 - 1.4	0.002
Level of Aerobic exercise					-	0.673
	ref		0.046		-	
20 mins ..	2.88	1.24 - 6.69		1.89	0.66 - 5.42	
20mins\ ..	2.51	0.90 - 6.99		1.52	0.45 - 5.19	
20 mins\..	1.22	0.47 - 3.16		1.20	0.38 - 3.76	
Alcohol intake					-	0.842
No	ref				-	
Yes	0.9	0.30 - 2.75	0.858	0.87	0.22 - 3.44	
Fruit eating habit					-	0.386
Occasionally/ not at all	ref		0.347		-	
Daily	0.56	0.24 - 1.35		0.44	0.13 - 1.43	
Weekly	1.06	0.52 - 2.188		0.76	0.28 - 2.05	
Roughage eating habit			0.086		-	0.166
Occasionally/ not at all	ref				-	
Daily	1.39	0.60 - 3.22		1.86	0.62 - 5.59	
Weekly	2.36	1.08 - 5.16		2.83	0.97 - 8.28	
Confectionaries			0.506		-	0.456
Occasionally/ not at all	ref				-	
Daily	0.83	0.40 - 1.68		0.82	0.32 - 2.11	
Weekly	0.58	0.23 - 1.44		0.48	0.16 - 1.52	
Vegetable eating habit			0.882		-	0.778
Occasionally/ not at all	ref				-	
Daily	1.21	0.51 - 2.87		1.50	0.45 - 5.09	
Weekly	1.04	0.37 - 2.91		1.23	0.3 - 4.95	

ref: the reference category, AOR: adjusted odds ratio from the multiple binary logistic regression model, CI: confidence interval. p<0.05, **p<0.01, ***p<0.001

CHAPTER FIVE

DISCUSSION

5.0 Introduction

A total of 266 senior high school students participated in the study. More than half (53.3%) of the participants were males. Majority of them (69.7%) were in their first year.

This study found a 16 % overall prevalence of hypertension. 42.2% were prehypertensive. Among those who were hypertensive, 1.9% were females and 5.59% were males. The systolic and diastolic blood pressure were averagely 123.9mmHg and 68.7mmHg respectively. The mean BMI was 20.9kg/m^2 whilst a mean waist circumference of 90.1cm was recorded. 3.2% of the participants had smoked before. 34.9% exercised at least once in a week. About half the participants had roughages or fruits and vegetables incorporated in their diet.

5.1 The prevalence of hypertension

The findings of the study suggested 16% prevalence of hypertension. In a similar study, the prevalence found, fell within the range of 0-22.3% weighted prevalence in South Africa and certain West African countries (Essouma et al., 2015). In a sharp contrast, this prevalence was higher compared to that of urban Ghana (4%) in a study that sought to identify hypertension and pre hypertension among 201 youths aged between 15-24years (Afrifa-Anane et al.,2015). Similarly, a study that was conducted in Enugu, South Eastern Nigeria among 2694 adolescents recorded a lower prevalence of 5.4% (Ujunwa et al., 2013). It is worthy to note that majority of the participants (69.7%) were in their first year (SHS 1), the apparent high prevalence could therefore be linked to the stress and the unrest that accompanies SHS 1 work.

5.2 The prevalence of prehypertension

Results from the Framingham Heart Study indicate that the probability of persons with prehypertension developing hypertension is two to three times higher than in those with normal blood pressure (Leitschuh et al., 1991). This study found that a high proportion (42.2 %) of the senior high school students were prehypertensive hence, the trend of prevalence of hypertension is likely to increase among these students in adult life if no intervention is made among the prehypertensive group. This prevalence has failed to be consistent with a number of studies. In a study that was done by Tony et al. 2016 in Karela, India, the prevalence of prehypertension among 2,438 school children aged between 13- 17 years, was 21.4%(95% CI 19.64%- 22.96%). Similarly, the prevalence of prehypertension in children 2- 18 years was found to be 15% (Ewald and Haldeman, 2015). In trying to identify what might have caused the steep rise in the prevalence of prehypertension, it was observed that majority of the participants were in their first year of study and therefore had to battle with a number of stressful events coupled with studies.

5.3 Factors associated with blood pressure elevation

There are various factors responsible for the elevation of blood pressure. There are modifiable risk factors and non-modifiable risk factors. Age is a non-modifiable. Studies have shown that there is a strong positive correlation between increasing age and increase in blood pressure (Leitschuh et al., 1991; Pinto, 2007). The results of this study however showed no increasing trend of blood pressure with increasing age. The gender of the senior high school students was observed to be associated with hypertension. The odds of being hypertensive among the male students was more than three times that of females (5.56% vs 24.36%, p=0.001).

Many studies have demonstrated the correlation between excess body weight and blood pressure. Obesity has been shown to be an independent risk factor for hypertension (Park, 2009). Overweight and obesity are modifiable risk factors for hypertension. A study conducted in India demonstrated a strong positive correlation between BMI and blood pressure (Dua et al., 2014). The average heights of participants were not significantly different among hypertensive and non-hypertensive participants (165.5 cm vs 169 cm, p=0.148). That notwithstanding, hypertensive students were averagely heavier than non-hypertensive students (57.4 kg vs 70.6 kg, p=0.013). This study found that being overweight or obese was significantly associated with hypertension. There was a trend of increasing blood pressure among those who were overweight or obese. The body mass index of hypertensive students was 4.2 kg/m^2 higher than that of the normal students (24.9 kg/m^2 vs 20.8 kg/m^2, p = 0.0189).

Smoking and alcohol are notable factors that are associated with hypertension. Various studies (Raja et al., 2016 & Bowman et al., 2007) however indicate significant associations between smoking, alcohol intake and hypertension. However, no significant association was found between alcohol drinking habit, cigarette smoking habit and hypertension, in this present study. Even though the amount and frequency of alcohol intake and smoking significantly influence the development of hypertension, most of the senior high school students who participated in this study did not respond to questions related to the amount and frequency of intake of such substances.

CHAPTER SIX

CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

6.1 Conclusion

This study revealed a high prevalence of hypertension and an amazingly high prevalence of prehypertension among the senior high school students. Hypertension among these senior high school students was associated mainly with BMI. There was no link between hypertension and the other established factors such as alcohol intake, tobacco use and physical inactivity.

6.2 Recommendations

Hypertension, which is a significant driver of the cardiovascular disease burden in Africa has reached epidemic proportions in the adult population. Given that senior high school students presenting with high blood pressure have a major risk of becoming hypertensive, specific cost- effective interventions need to be introduced early in life to prevent cardiovascular disease in adulthood. Based on the findings of this study and as part of interventions to prevent the cardiovascular disease burden, there must be an urgent need to intensify awareness of hypertension among senior high school students, their parents and teachers. Parents and guardians should be sensitised on the effect of nutrition on the BMI of their wards. Physical education should be an integral part of the curriculum of senior high schools to ensure that the students are active physically. The Ministry of Health and the Ghana Health Service should incorporate Screening and blood pressure monitoring programmes into the school health programmes and general public health education on hypertension and its associated factors should be strengthened. Most studies on adolescent hypertension has been cross sectional or a review of already existing papers. The causal interference of associated factors has been difficult to provide. To ascertain the true

prevalence of adolescent hypertension, it is recommended that a prospective cohort study be carried out within adolescent years as a follow up to this study.

6.3 Limitations

Blood pressure measurement of students was collected on only one occasion; the estimated prevalence of high blood pressure may be overestimation. It was a cross- sectional study, therefore, the causal interference of the associated factors could not be provided.

REFERENCES

A global brief on Hypertension, Silent killer, global public health crisis (WHO), Document number: WHO/DCO/WHD/2013. Retrieved from: http://apps.who.int/ iris/ bitstream/ 10665/ 79059/ 1/ WHO_DCO_WHD_2013.2

Addo, J., Amoah, A.G., &Koram, K. A. (2006). The changing patterns of hypertension in Ghana: a study of four rural communities in the Ga district. Ethnicity and disease Retrieved from: https://www.ncbi.nlm.nih.gov/pubmed/17061743. [Accessed: 7th July, 2017]

Alicke, M., Boakye-Appiah, J. K., Abdul-Jalil, I., Henze, A. Giet, M.,Schulze, B.M., Schweigert F. J., Mockenhaupt, F. P., Bedu-Addo, G., & Danquah, I. (2017). Adolescent health in rural Ghana: A cross- sectional study on the co- occurance of infectious diseases, malnutrition and cardio- metabolic risk factors. Retrieved from: https://doi.org/10.1371/journal.pone.0180436. [Accessed: 2nd November, 2017]

Arya, R., Antonisamy, B., & Garg, S.K. (2012). Sample Size Estimation in PrevalenceStudies. *The Indian Journal of Pediatrics, 79*(11). Retrieved from: doi: 10.1007/s12098-012-0763-3. [Accessed: 20th June, 2016].

Crisafulli, A., Pagliaro, P., Cohen- Solal, A., & Coats, J. A. (2015). The effect of physicalexercise on cardiovascular diseases: Biochemical, Cellular and Organ Effect. Retrieved from: https://www.ncbi.nlm.nih-gov/pmc/articles/PMC4692999. [Accessed: 19th November, 2017]

Drouin- Chartier, J-P., Gigleux, I., Tremblay, A. J., Poirier, L., Lamarche, B., & Couture, P. (2014). The impact of dairy consumption on essential hypertension: a clinical study. Retrieved from: https://nutritionj.biomedcentral.com/articles/10.1186/1475-2991-13-83. [Accessed: 22nd December, 2017].

Edwald, D.R., & Haldeman, L.A. (2016). Risk factors in adolescent hypertension. Global paediatric health. Retrieved from: DOI: 10.1177/2333794X15625159. [Accessed: 8th December 2016].

Ezenwosu, O. U., & Ekwochi, U. (2014). Elevated arterial blood pressure and body mass index among Nigerian preschool children population. Retrieved from: https://doi.org/10.1186/1471-2431-14-64. [Accessed: 3rd August, 2017]

Foëx, P., & Sear, J.W. (2004). Hypertension: pathophysiology and treatment. Retrievedfrom: ceaccp.oxfordjournals.org [Accessed 8th June, 2016]. Global Cardiovascular diseases (CVDs) Fact sheet (WHO), 2015. Available at http://who.int/ mediacentre/ factsheets/fs317/en/.

Global status report on non-communicable diseases 2014 (WHO), ISBN 978 92 4 1564854 (NLM classification: WT 500). Available at http://apps.who.int/ iris/ bitstream/ 10665/ 148114/1/9789241564854.

Google maps (2016). www.maps.google.com.gh.

Hedge, M. S., & Scott, D. S. (2015). Influence of physical activity on hypertension and cardiac structure. Retrieved from:DOI10.1007/s11906-015-0588-3. [Accessed: 22nd December, 2017].

Husain, K., Ansari, R.A., & Ferder, L. (2014). Alcohol-induced hypertension: mechanism and prevention. *World J Cardiol*. 6 (5): 245-252. Retrieved from: doi: 10. 4330/wjc. v6.15.245. [Accessed: 20th June, 2016].

Landsberg, L., Aronne, L.J., Beilin, L.J., Burke, V., Leon, I., Igel, L.I., Lloyd-Jones, D., Sowers, J. (2013). Obesity-Related Hypertension: Pathogenesis, Cardiovascular Risk, and Treatment. *The Journal of Clinical Hypertension.* 15(1), 14–33.

Leitschuh, M., Cupples, L.A., Kannel, W., Gagnon, D., & Chobanian, A. (1991). High-normal blood pressure progression to hypertension in the Framingham Heart Study. *Hypertension, 17*(1), 22-7.

Medical University of Vienna. (2014). Higher risk of high blood pressure for socially disadvantaged. Retrieved from: https//www.sciencedaily.com/releases/2014/05/140513091659.htm. [Accessed: 22nd December, 2017].

O"keefe, J.H., Bybee, K.A., & Lavie, C.J. (2007). Alcohol and Cardiovascular Health. *Journal of the American College of Cardiology, 50* (11).

Papadopoulos, D.P., Makris, T.K., & Papademetriou, V. (2008). Is it time to treat prehypertension? *Hypertens Res., 31*(9), 1681-6.

Pinto, E. (2007). Blood pressure and ageing. *Postgrad Med J., 83*(976), 109–114.

Rashid, A.A., Khalid, Y., & Chia, Y. (2011). Management of Hypertension. *Cardiovasc Diabetol*. *6*(1), 40–43.

Reckelhoff, J.F. (2001). Gender Differences in the Regulation of Blood Pressure. *Hypertension, 37*, 1199-1208.

Roger, V.L., Go, A.S., Lloyd-Jones, D.M., Benjamin, E.J., Berry, J.D., Borden, W.B., & Bravata StataCorp. (2014). *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP

Sadoh, W. E., Sadoh, A. E., & Onyiriuka, A. N. (2016). Physical activity, body mass index and blood pressure in primary school pupils attending private schools. *Afri Health Sci, 16*(4), 947-953. Retrieved from http://dx.doi.org/10.4314/ahs.v16i4.10. [Accessed: 26th July, 2017]

Sarmento, D. R., & Yehadji, D. (2016). An analysis of global youth tobacco survey for developing a comprehensive national smokinig policy in Timor- Leste. Retrieved from doi: 101186/s12889-016-274-5. [Accessed : 16th March 2018].

Tony, L., Areekal, B., Nair, A. T. S., Ramachandran, R., Philip R. R., Rajasi, R. S., & Vijayakumar, K. (2016). Prevalence of hypertension and pre- hypertension among

adolescents school children in Thiruvananthapuram, Karela, India. Retrieved from: http://dx.doi.org/10.18203/2394-6040.ijcmph20164291. [Accessed: 26th July, 2017].

Ujunwa, F. A., Ikefuna, A.N., Nwokocha, A. R., & Chinawa, J.M . (2013). Hypertension and prehypertension among adolescents in secondary schools in Enugu, South Nigeria. Retrieved from: doi: 10.1186/1824-7288-39-70. [Accessed: 17th July, 2017]

Virdis, A., Giannarelli, C., Neves, M.F., Taddei, S., & Ghiadoni, L. (2010). Cigarette smoking and hypertension. *Curr Pharm Des.* 2010, *16*(23), 2518-25.

WHO. (2017). New global estimates of child and adolescent obesity released on World Obesity Day. Retrieved from: www.who.int/end-childhood -obesity/news/new-estimates-child-adolescent-obesity. [Accessed: 24th December, 2017]

WHO. Fact sheet. (May, 2017). Cardiovascular disease (CVDs). Retrieved from: www.who.int/mediacentre/factsheets/fs317/en/. [Accessed: 24th December, 2017].

WHO. Fact sheet. (October 2017). Obesity and overweight. Retrieved from: www.who.int/mediacentre/factsheets/fs311/en/. [Accessed: 24th December, 2017]

World Health Organization (2013). A global brief on hypertension. Silent killer a global public health crisis. Retrieved from: http://www.who.int/cardiovascular_diseases/publications/global_brief_hypertension/en/ [Accessed: 25th November, 2015].

Yang, Y., Dong, B., Wang, S., Zhiyong, Z., Fu, L., & Ma, J. (2017). Prevalence of high blood pressure subtypes and its association with BMI in Chinese children: A national cross- sectional survey. Retrieved from: DOI 10.1186/s12889-017-4522-2. [Accessed:26th July, 2017]

APPENDIX: QUESTIONAIRE

PARTICIPANT CONSENT

Dear respondents,

I am Michael Obu- Afful a student of the School of Public Health, University of Ghana Legon, I am researching on the topic**:"** Prevalence and risk factors of Hypertension among Senior High School Students". This exercise will give the opportunity to know your blood Pressure, height, weight, waist- hip ratio and body mass index (BMI). You will be contributing immensely towards the success of this study by responding to these questions. Kindly give adequate information to the under listed questions. Your identity will not be disclosed in any way. Information gathered would be used only for the purpose of this research.

Thank you for your cooperation.

1. ID Number…… Date of Recruitment…….

2. Gender/sex: female [ ] male [ ] 3. Age……...

4. Address/Telephone number…… 5. Ethnicity……...

6. Educational level: SHS 1 [ ] SHS 2 [ ] SHS 3 [ ]

7. Course of Study: Science [ ] General Arts [ ] Business [ ] Visual Arts [ ] Home Economics: [ ] Others (specify)……

ANTHROPOMETRIC MEASUREMENT

8. Height……cm 9. Weight……...Kg

10. Waist circumference……...cm 11. Body mass index (BMI) ……

CLINICAL ASSESSMENT

12. Blood pressure……mmHg 13. Family history of hypertension yes [ ] no [ ]

14. Central obesity yes [ ] no [ ]

LIFESTYLE ASSESSMENT

Physical exercise

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

[ ] 20 minutes or more four or more times a week

[ ] 20 minutes or more three times a week

[ ] 20 minutes or more once or twice a week

[ ] Less than once a week

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

[ ] Yes [ ] No

Smoking

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

[ ] Yes [ ] No

18. Do you currently smoke any form of tobacco? (Cigarrete, pipe, cigars etc)

[ ] Yes [ ] No

19. How long have you been smoking?

[ ] less than one year [ ] 1-3years [ ] more than 3years

ALCOHOL INTAKE

20. Do you take alcohol?

[ ] Yes [ ] No

21. How long have you been drinking?

[ ] less than one year [ ] 1-3years [ ] more than 3years

22. How often do you take alcoholic drinks?

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all

Dietary assessment

23. How often do you take fruits?

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all

24. How often do you take Vegetables?

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all

25. How often do you take roughages (Foods that have fibre)?

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all

26. How often do you take confectionaries? (Sugary drinks, sweets etc)

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all

27. How often do you take Vegetables?

[ ] Daily [ ] Weekly [ ] occasionally [ ] Not at all