0PREVALENCE OF HYPERTENSIVE DISORDERS, ASSOCIATED RISK FACTORS AND EFFECT OF SPECIFIC ORGAN FUNCTION AMONG ADOLESCENTS IN SOME SELECTED SENIOR HIGH SCHOOLS IN ASHANTI REGION OF GHANA

BY

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A Thesis submitted to the Department of Biochemistry and Biotechnology, Kwame Nkrumah University of Science and Technology, Kumasi in partial fulfilment of the requirement for the Award of Degree of **MASTER OF PHILOSOPHY** in Human Nutrition and Dietetics.

DECLARATION

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

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ABSTRACT

Hypertension in adolescents has become an emerging health problem across the globe. The main objective of the study was to examine the prevalence of hypertension among 14-19 year-old adolescents, associated risk factors and effect on specific organ function. A multi stage sampling method was used to select 909 adolescents from three senior high schools (in three districts in the Ashanti Region of Ghana). A follow -up study was conducted on 142 who had raised blood pressure levels. Anthropometrics and blood pressure levels were measured with recommended instruments. Physical activity and dietary intake were assessed, through questionnaires. Blood samples of participants were also taken to assess their biochemical data. Data was analysed using the SPSS version 20. Pearson correlations were used to find out the associations between variables in the population. The study revealed a prevalence rate of 9.1% hypertension and 24.8% pre-hypertension. This prevalence of hypertension was significant when compared between selected schools. Males recorded a higher prevalence than females, 10.6% were hypertensive with 46.6% and 42.6% as pre-hypertensives and normotensives respectively. The data showed 81.6% of mothers of participants to be self-employed. The results also revealed a very low activity profile, 72.73% of participants with high blood pressure are not active whereas 40.32% and 59.97% of nomotensives and pre-hypertensive were also not active. This majority of the adolescent population were not physically active and this might have caused the prevalence of hypertension. Hematological indices were assessed to find out if there is any presence of anaemia or inflammation of the study subjects. The results showed that MCV had weak inverse association with systolic and diastolic blood pressures (r=-.230, r=-.183), MCHC had a weak direct relationship with systolic and diastolic blood pressure (r= .171, r=.256). RDW-SD had weak inverse association with systolic and diastolic blood pressure. P-LCR had a weak inverse association between systolic and diastolic blood pressure (r=-.185, r=-.167). Despite the prevalence of pre-hypertension and hypertension among adolescent population in the study, it had not caused any dysfunction in kidney, cardiovascular and liver. Hence, appropriate diet and lifestyle management are needed to prevent early and/or future complication of hypertension among adolescents.

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LIST OF ABBREVIATIONS

BMI	-	Body Mass Index
BOSS	-	Bonwire Senior High School
Cl^-	-	Chloride
EDTA	-	Ethylenediamin tetra acetic acid
GSS	-	Ghana Statistical Service
HDL-C	-	High Density Lipoprotein – Cholesterol
HTN	-	Hypertension
K	-	Potassium
KASS	-	Kumasi Anglican Senior High School
KOSS	-	Konongo Odumasi Senior High School
LDL-C	-	Low Density Lipoprotein-Cholesterol
MBP	-	Mean blood pressure
MCH	-	Mean Corpuscular Haemoglobin
MCHC	-	Mean Corpuscular Haemoglobin Concentration
MCV	-	Mean Corpuscular Volume
MMol/L	-	Millimole Per Liter
Na^+	-	Sodium
P-CLR	-	Plateletes Large Cell Ratio
RBC	-	Red Blood Cell
RDW	-	Red Cell Distribution Width
SHS	-	Senior High School
TC	-	Total Cholesterol
TG	-	Triglyceride
µg/dl	-	Microgram Per Deciliter
WC	-	Waist Circumference
WHO	-	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

The prevalence of hypertension among adolescents has become an emerging health problem across the globe (Pramanike *et al.*, 2015). Hypertension is a non-communicable disease that is very common and affects both male and female adolescents of all races (WHO, 2002). It is detected when the Systolic Blood Pressure (SBS) is greater than 140 mmHg or Diastolic Blood Pressure (DBP) is greater than 90 mmHg or a combination of both (NIH, 2005). It can be classified as pre-hypertension, essential hypertension and secondary hypertension (Sur *et al.*, 2015). Within the age group of 3 to 18 years, the prevalence of pre-hypertension is 3.4 % and prevalence of both essential and secondary hypertension is 3.6 % (Hansen *et al*., 2007).

A hypertensive individual is susceptible to increased cardiovascular diseases such as ischemic heart disease, left ventricular hypertrophy and pathological vascular changes and renal failure (Sanchez *et al.*, 1992). It is also identified to be associated with high risk of chronic kidney disease, cerebro- and cardiovascular diseases and insulin resistance. The hazard ratio of cerebrovascular disease is 1.41 and that of cardiovascular disease is 2.0 in male and female respectively (Arima *et al.*, 2012; Lee *et al*., 2011). Consequently, it is argued that cardiovascular diseases have resulted in the death of approximately 16.7 million in adult population in both developed and developing countries. This figure is expected to increase to about 23 million, with increasing rate of 37.72 % by the year 2030 (WHO, 2012). This portrays the risky nature of hypertension on the adolescent population (Hajjar and Kitchen, 2003). Kaerney *et al.* (2005) describes the disease as a silent threat to the health of a

population. This is because records indicate that about 1 billion adult population worldwide had hypertension in 2000. This figure is expected to increase to about 1.56 billion by 2025 (Kaerney *et al*., 2005).

The prevalence of hypertension differs in both developed and developing countries (Munter *et al.*, 2004). Studies indicate a significant difference of the prevalence of hypertension among males and females (Kaerney *et al*., 2005; McNiece *et al*., 2007; Stray-Pedersen *et al.,* 2009 Sundar *et al*., 2013). However, Gupta (2004) found no significant difference in the hypertension prevalence in both males and female. India records the lowest prevalence of 3.4 % in males and 6.8 % in females. However, the prevalence rate is higher in males (72.5%) and females (68.9 %) in Poland, compared with other countries (Kaerney *et al*., 2005). The prevalence rate is 27.8 % in the United States of America, 42% in Europe, 27.4 % in Canada, 37.7 % in Italy and 55.3% in Germany (Ong *et al*., 2007). In Africa, the prevalence of hypertension ranges from 40% to 50 % and several of these are undiagnosed (Addo *et al*., 2007). A report from the World Bank (2012) indicates that in Africa, about 80 million people had hypertension in 2000 and this figure is expected to rise by 2025. In Ghana, the prevalence of hypertension is 27.6 % in males and 29.5% in females (Amoah, 2003).

The risk factors associated with hypertension include family history, obesity, dietary habits, body fat, increased stress and decreased physical exercise (Mohan *et al*., 2004). Studies indicate that the prevalence of hypertension (pre, essential/primary and secondary hypertension) in obese adolescents is high for males (30%) than females (23%) (McNiece *et al*., 2007). Among the various risk factors, hypertension in childhood has been identified as a critical predictor of adult hypertension. Due to this phenomenon, investigations have been done on the pattern of blood pressure in

childhood and adolescent to determine remedial measures. It is also noted that many of the lifestyle choices adolescent people adopt make them vulnerable to hypertension. Sedentary lifestyles, lack of physical exercises, and unhealthy diet are mostly found among adolescents. Studies indicate that about 67 % of premature death and 33 % of disease burden are associated with these lifestyles (McNiece *et al.,* 2007). This is because majority of adolescents with this lifestyle are at risk of getting hypertension.

With the increasing prevalence rate of hypertension in adult and adolescent population in developing countries and its associated cardiovascular diseases, it can be argued that hypertension is an obvious threat to human health. This therefore requires strenuous efforts from government and organisations to develop pragmatic means of reducing the prevalence of hypertension in adolescent. Thinking about what needs to be done, good dietary intake, some lifestyle factors such regular physical exercise, and routine blood pressure measurement have been identified to influence the prevalence of hypertension (WHO, 2012). According to Sundar *et al*. (2013), the ability of an individual to spend more time to engage in physical exercises play crucial role in delaying and preventing the onset of hypertension. Though some studies (Sundar *et al.,* 2013; Savitha *et al*., 2007) did not show significant effects of physical exercise and diet on hypertension, others (Hu *et al.,* 2004; Geleijnse *et al.,* 2005) found a relationship. This study therefore sought to examine the prevalence of hypertension among male and female adolescents in Senior High Schools in the Ashanti region of Ghana and its associated risk factors and associated organ damage.

1.2 Statement of the Problem

In Ghana, the prevalence rate of hypertension among adolescent is increasing and this has become a major concern to health practitioners. In Ashanti region, a prevalence of 28 % was reported (Cappucio *et al*., 2004). In the Upper West Region of Ghana, a prevalence rate of 3.9% was recorded among adolescents; 2.6% for males and 1.3% for females (Ngminkuma, 2015). In the Adansi South District of the Ashanti region of Ghana, a prevalence rate of 27.1% of hypertension was recorded (Duah *et al.,* 2012). In the Volta Region of Ghana, a prevalence of 32.8% for hypertension in male and 30.7% in female were recorded (Burket, 2006).

Though researches have been done on the prevalence of hypertension in Ghana and other countries, data on adolescent hypertension are very scarce (Sundar *et al*., 2013). The consequences of adolescent hypertension are spreading across the globe, despite the growth of the economy. Adolescent stage provides opportunity for smooth healthy transition from childhood to adulthood (Cordeiro *et al*., 2006). This is the best time to address childhood problems and promote good dietary choices and healthy living for adulthood. However, since this age has been assumed as a healthy stage globally, issues on hypertension of adolescent have been ignored (Gore *et al.,* 2011). Few studies have investigated the contribution of other risk behaviours, such as an inappropriate diet and socio-economic factors on the prevalence of hypertension. Also, few studies have been conducted to establish the precise extent of the hypertension prevalence rates and incidence of hypertension risk factors (Duah *et al.,* 2012; Owusu-Sekyere *et al*., 2013; Sundar *et al*., 2013).

The conditions in the school setting does not promote much activity, coupled with students' low intake of nutrients, irregular meal times and high intake of sugary and

salt-based products. These lifestyles can expose them to risk factors of hypertension. Also, bad dietary pattern practised at this period may lead to obesity and eating disorders that may result in several chronic diseases of which hypertension is one. Early assessment of the risk factors and prevalence of hypertension among adolescents in SHS, as well as diabetes and dyslipidaemia is warranted to curb future development especially for Ghana, where much data does not exist.

1.3 Aim and Objectives

The aim of this study was to examine the prevalence rate of hypertension among adolescent (14-19 years) in Senior High Schools in the Ashanti Region of Ghana. The specific objectives of this study include the following;

1. To determine the prevalence of hypertension among adolescents.
2. To assess the association among anthropometry, dietary intake and hypertension among the adolescents in the selected Senior High Schools.
3. To determine the association between physical activity and hypertension among adolescents in Senior High Schools.
4. To find out the impact of hypertension on specific organs (kidney and liver).

1.4 Justification of the Study

As mentioned earlier, there is limited studies on the prevalence of hypertension and its associated risk factors among adolescents in Ghana. Therefore, findings from this study can add to literature on the prevalence of hypertension and its associated risk factors among adolescents. Again, sufficient data on the prevalence of hypertension can guide policy makers to design proactive and workable programmes for managing and controlling the condition.

Results from this study would help to identify adolescent (14-19 years) at the Senior High Schools with or without hypertension. Through this study, epidemiological data would be provided on prevalence of hypertension that can support diagnosis, management, prevention and planning. Moreover, the study population would benefit from the pre-test counseling on the prevalence and nature of hypertension and the value of relevant laboratory tests.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition and Classification of hypertension

Hypertension is a non-communicable disease that is very common and affects both male and female adolescents in all races (WHO, 2002). It is detected when the Systolic Blood Pressure (SBS) is greater than 140mmHg or Diastolic Blood Pressure (DBP) is greater than 90 mmHg or a combination of both (NIH, 2005). It can be classified as pre-hypertension, essential hypertension and secondary hypertension (Sur *et al.,* 2015).

Pre-hypertension is not a disease entity, rather it is a reminder to modify the patient's lifestyle immediately, to prevent its progression to hypertension. The systolic blood pressure is usually between 120-139mmHg (Chobanian *et al*., 2003). Essential hypertension has no underlying cause. It is the most common type of hypertension affecting 90-95 % of hypertensive patients and its prevalence increases with age. Essential hypertension remains a major risk factor for cardiovascular disease (Carretero and Oparil, 2000). Secondary hypertension results when there is a known physical or metabolic disorder in the organ or hormone involved in blood pressure regulation (Goldman *et al*., 2008)

2.2 Prevalence of Hypertension in Adolescent Population: A Cross-Country Review

Prehypertension and hypertension have been noted to start in the early stage of life (Moussa *et al.,* 2016). The prevalence of hypertension and its associated cardiovascular risk factors have a propensity to crowd together in either sex. Hypertension is more likely to be found in females than males. That is, females

develop higher systolic blood pressure compared with male adolescents. The prevalence of both essential and secondary hypertension is 3.6 % (Hansen *et al*., 2007).

The World Health Organisation (WHO) in 2012 reported that the prevalence of hypertension decreased globally from 32 % in 1980 to 27 % in 2008. However, in developing countries, within the same period, hypertension increased, especially in African and South-East Asia. The prevalence rate increased from 10 to 20 % (WHO, 2012). Records indicate that about 1 billion adult population worldwide had hypertension in 2000. This figure is expected to increase to about 1.56 billion by 2025 (Kaerney *et al*., 2005). In the developed countries, the prevalence of hypertension ranges from 1-2 % and in the developing countries it is 5-10 % (Munter *et al.*, 2004). This agrees with the figure given by the National High Blood Pressure Education Program Working Group (2004) in 2000.

In Africa, the prevalence of hypertension ranges from 40% to 50% and a number of these are undiagnosed (Addo *et al*., 2007). A report from the World Bank (2012) indicates that in Africa, about 80 million people had hypertension in 2000 and this figure is expected to rise by 2025. In sub-Saharan Africa, hypertension is estimated to fall between 10 million and 20 million people (Cappuccio *et al*., 2004). A previous study in Ghana has shown that between 1972 and 1987, the prevalence of hypertension was 4.5 % in the rural population and between 8% and 13% in the urban populations (Pobee, 1993). In 2003, hypertension was 28.3% in the urban population in Accra and 28.7% in Ashanti region (Amoah, 2003; Cappuccio *et al.*, 2004). It can be deduced that the trend in the rate of hypertension will continue to rise in Ghana, without appropriate intervention measures. In most cross-sectional studies, it has been

observed that females develop higher blood pressure than males (Sorof *et al*., 2004; Davis *et al*., 2005).

In West Bengal, it was found that the prevalence of hypertension and pre-hypertension was about 15% for males and 18% for females (Pramanike *et al.*, 2015). In India, the prevalence of hypertension in adolescent between 13 and 18 years was about 4%, while pre-hypertension in adult population was 3.4% (Bagga *et al.*, 2007). The prevalence rate is 27.8% in the United States of America, 42% in Europe, 27.4% in Canada, 37.7% in Italy and 55.3% in Germany, all in 2006 (Ong *et al*., 2007). The prevalence of pre-hypertension in Canada in the year 2006 was (28%) but in 2008 30.6% rate was recorded (Godwin *et al.*, 2008). This implies that the prevalence of pre-hypertension continues to rise in various countries, which calls for proper intervention to remedy the situation.

In Indonesia, hypertension in adolescent males was about 25% and 27% in females. This implies that the prevalence of hypertension in the country is higher in females, compared with males (WHO, 2012). In the United States of America (USA), the National Health and Nutrition Examination Survey (NHANES) reported that the prevalence of pre-hypertension among adolescents was 31% in the late 1990s. However, the trend in the incidence of hypertension has been reducing gradually. Zarchi and Gahangiri (2010) reported a prevalence rate of 7.8% among adults, aged between 18 and 39 years. In Taiwan, it was found that 34% of the adolescent population had pre-hypertension. This figure differs from the report given by the Basic Health Research in 2007 that showed that 48.4% of the adolescent population (12-19 years) had hypertension (Zarchi and Gahangiri, 2010).

Kumar *et al.* (2016) concluded in their study that the prevalence of hypertension among adolescents was chillingly high. They further indicated that about 16% of adolescents were found in the pre-hypertensive category. Also, about 2% of them were found in the stage I hypertensive and 0.7% was stage II hypertensive. In Indonesia, Widjaja *et al.* (2013), found that the prevalence of hypertension and pre-hypertension was comparatively higher among adolescents in rural areas. They found that the prevalence of pre-hypertension among those aged 11 years was about 34%, while 18% experienced hypertension. The prevalence of hypertension was higher in males. However, the prevalence of pre-hypertension was higher in females, according to a study conducted by Widjaja *et al. (*2013). This finding is similar to the one given by Zhang and Li (2011), stating that the prevalence of pre-hypertension was between 32% and 39%, within the adult population. A further meta-analysis of 20 research works revealed a prevalence rate of 36% between the age groups of 15 and 19 years. In Israel, Kitai *et al.* (2007), showed 40% prevalence of pre-hypertension between the ages of 18 and 25 years. Ejike *et al.* (2010) found that the prevalence of pre-hypertension in Nigeria was about 32% among those aged 18 years and over in semi-urban or urban areas. This finding is quite different from a study by Oba *et al.* (2013), in which the prevalence rate of hypertension was 24.8% and 47.3% for pre-hypertension. They also fo\und that the prevalence of sustained hypertension was 13.9% and that of pre-hypertension was 51.7%.

In Korea, Choi *et al.* (2006) found that the prevalence of hypertension in the adolescent population was about 23%. Among some Ethiopian University students, Tadesse and Alemu (2014), revealed a prevalence rate of hypertension to be 7.7% and concluded that it was higher in males, compared with females. In Palestine, Okasha (2013), reported a hypertension prevalence rate of 3.7% and 24.4 % in both

adolescent and adult population respectively. In Portugal, Silva *et al.* (2012), identified among 234 adolescents that the prevalence of hypertension was 34% in males and 12% in females. In Kuwait, the prevalence of hypertension was estimated to be 26.3% in the late 1990s (El Reshaid *et al.*, 1999). Another study of 800 adolescents reported about 7% (Al-Jarky *et al*., 2007).

In Germany, Laaser and Breckenkamp (2006) reported a prevalence of hypertension to be 41.3%, while Efstratopoulos *et al.* (2006), indicated 32.8% among adolescents in Greece. In Malaysia, a study found that a prevalence of hypertension was 29.8% among adolescent population. It was also found that half of the population of those found with hypertension were undiagnosed and 48% of those who were diagnosed with hypertension had uncontrolled blood pressure (Tee *et al.,* 2010). It can be deduced from the above discussion that the rate of hypertension differs across country. This may be attributed to some factors that may include the following; the method of data collection, the population age groups, time of collecting the data and the scope of the study.

2.3 Adolescent Participation in Physical Activities and the Relevance: A Cross Country Review

Literature has indicated that the involvement of adolescents in continuous physical activities is different between males and females. However, the eagerness of the adolescent population to engage in continuous physical activities currently has been rated as low worldwide and more especially, in the sub-Saharan Africa. It was found in Saudi Arabia that about 33% of students who were males spent three hours and more watching television in a day (Mahfouz *et al.,* 2012). Similarly, for females, it was found that more than half of them spent three hours and more everyday watching

television. On the other hand, it was found that about 26% of the males and 43% of females who are adults had not been involved in any level of exercise for 30 minutes and more in a week. This scenario is more prominent in the school environment, where less than one-third of adolescents who are males and almost all female adolescents had failed to be involved in any form of exercise for the week. Less than one-third of the male adolescents and almost all the females had not participated in physical activity (Sallis *et al.,* 2000).

The situation is similar in the university environment, where Tadesse and Alemu (2014), emphasised that in Ethiopia, one-fifth of the adolescent population which is made up of 11% males and 23% females were involved in vigorous exercise for a week. It was also found that about 15% of the adolescents in the university were involved in moderate exercise. Majority of the adolescent population were inactive and this has effects on the occurrence of hypertension. It was found in New Delhi that close to 22% of girls and 18% of boys in the university had not participated in any form of physical activity for 60 minutes per day or just conducted three exercises per week. It was again found that about 54% of the boys and 69% of the girls had failed to be involved in sporting activities at school or exercise in the home.

Aerobic exercises have become the ideal physical activity recommended for patients across the world. It has also been mentioned that the loss of weight is important because it helps in controlling glycemia (Mota and Dinu, 2013). Some studies have revealed that the ability to engage in regular exercise is significant, as it enhances psychological well-being of the individual. This is because such regular exercise minimises stress, depression and anxiety (Jodi, 2012). Although psychological well-being is mostly pertinent in controlling and reducing cardiovascular diseases, it has

relevant effects on the management and control of some chronic diseases which include depression, cancer, diabetes and hypertension (Warburton *et al.,* 2006). It has also been reported in some studies that resistance and aerobic forms of exercise have correlation with minimised occurrence of cardiovascular diseases (Macera *et al.,* 2003; Hu *et al.*,2004; Warburton *et al.,* 2006). It has been reported that a 500 kcal or 2100 kJ of energy consumption for a week is correlated with the minimisation in the occurrence of some diseases (Warburton *et al.,* 2006).

Physical exercise is beneficial to populations with high body index (Macera *et al.,* 2003; Warburton *et al.,* 2006; Motala and Romaiya, 2010). Motala and Romaiya (2010) revealed that among 217 adolescent population that were involved in an organised physical activity for a week, experienced substantial sweating. It was found that being involved in 40 minutes exercise for a week is powerful enough in protecting the individual against the occurrence of many cardiovascular diseases, especially in middle-age men (Macera *et al.,* 2003).

2.3.1 Model of Physical Activity

It has been revealed in literature that the participation of adolescents in physical activities varies among males and females. Also, the enthusiasm for adolescents to engage in physical activities is low. The nature of physical activity includes the following; frequency, duration, intensity and type (Jodi, 2012) and these characteristics make it different from exercise. Exercise is a subset of physical activity that is done with the intention of enhancing physical fitness or health. The frequency of physical activity refers to how often an individual participates in exercise. An example is where an adolescent always walked to school five times in a week. If this same individual walks for pleasure on Saturdays, this makes a total of six times for a

week. Time or duration is another important factor in physical activity. Duration is defined as how long the activity lasts. This is typically reported or measured in minutes and/or hours. This is because certain youthful physical activities such as play or sports cannot be measured by conventional distance measurements (Jodi, 2012).

Physical activity may also vary by intensity. Intensity is defined as the level or amount of physiologic response for participating in physical activity. This level is usually quantified by the sum of metabolic activities performed (Marshall and Welk, 2008). Jodi (2012), mentioned that perceptual categories such as very energetic, energetic, moderate, light and very light are mostly used in research to measure the metabolic exercises, especially in large populations. This is important because it is very difficult to measure the metabolic work in larger population studies. A physical activity that is classified as "moderate" intensity is the activity that requires three to six times more energy, expended at rest. A given example is brisk walking. Physical activity requires more than seven times energy use than at rest (Sallis *et al.*, 2000). A given example is jogging.

Apart from measuring the intensity of physical activity, a list of individual's activities can be converted to metabolic equivalents. An example includes walking for 15-minutes (4 mph) that can be converted into metabolic equivalent of 6.4. The walk at 6 mph (10-minute) can be converted to metabolic equivalent of 10.0 (Jodi, 2012).

From the above-mentioned nature and characteristics of physical activity, the Center for Disease Control (CDC, 2010) adopts intensity duration and frequency in analysing physical activity and also recommends for adolescents and children. It is suggested by the CDC that on the average, an adolescent should engage in moderate-intensity physical activity for at least 60 minutes every day (Jodi, 2012). The USDHHS also

recommend adolescents should be encouraged to participate in moderate physical activity for not less than 30 minutes for five or more times in a week (USDHHS, 2011).

Physical activity has been shown as one of the main health indicators for promoting health. It is unfortunate that less than one-fifth (18.4%) of adolescents across the world achieved the guidelines mentioned by the CDC for physical activity (USDHHS, 2011). Also, closer to two-thirds of adolescents across the world do not engage in vigorous exercise (CDC, 2010). Therefore, there are opportunities that can encourage adolescents to engage in physical activities to derive increased health benefits. That is, the participation in physical activity early in adolescent is linked with active lifestyles in adulthood. Learning and adopting physical activity behaviours early in adolescence is associated with an active lifestyle in adulthood (Stensel *et al.*, 2008). This is important because the rate at which adolescents experience or suffer from hypertension is increasing. There is the need to promote adolescent participation in physical exercise in order to reduce the occurrence of hypertension. To achieve this, several factors have to be considered. These include the school, neighbourhood and community support and intra-personal factors, as depicted in Figure 2.1.

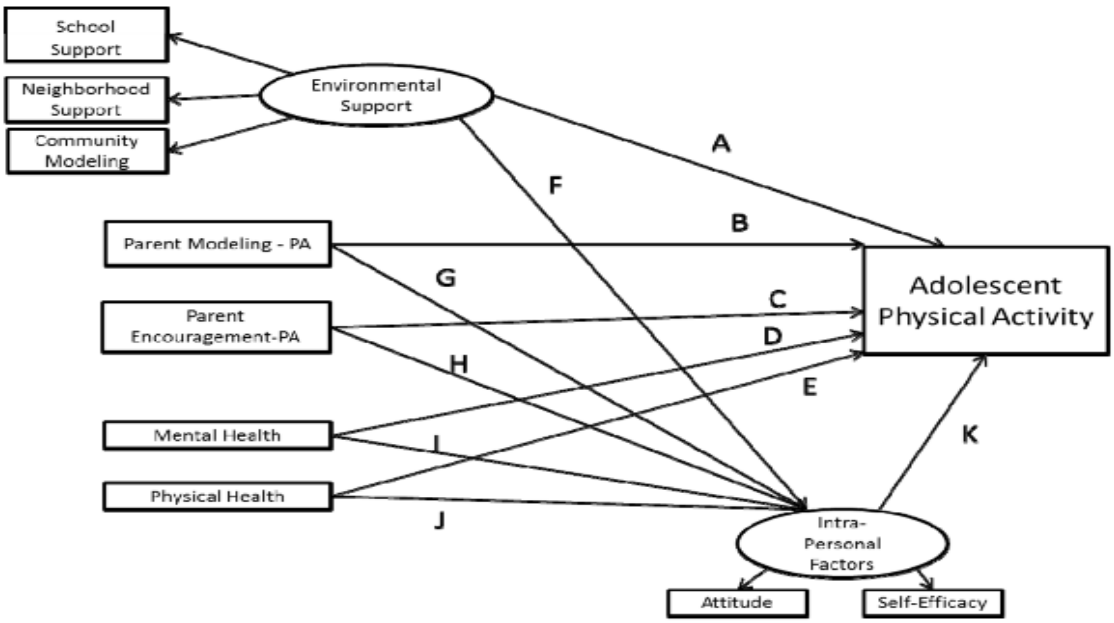

Figure 2.1: Physical Activity Models

Source (Jodi, 2012)

The physical environment can be viewed as either a potential contributor or challenge to physical activity. As a potential contributor, the availability of relevant facilities becomes an opportunity for physical activity. According to Sallis *et al.* (2000), a supportive environment can be defined as settings that include schools, worksites and neighborhoods. It can also be conceptualised as facilities that include paths, health clubs and parks. Again, supportive environment that includes teams, clubs, recreation and classes are some of the environmental factors that influence the level of physical activity. Booth *et al.* (2001), mentioned several environmental factors that have influence on physical activity. These include physical activity promotion, youth sports, physical education class training and content training, public recreation facilities, after school physical activity programs, sedentary stimuli for leisure, commercial use of school facilities and physical education class availability.

Another factor that influences physical activity is family environment. The family environment is made up of parental modeling and parental encouragement (Jodi, 2012). Parental encouragement is the verbal and non-verbal type of encouragement for physical activity. Parental modeling refers to the efforts made by parents to model an effective lifestyle for children. This effort promotes self-efficacy. That is, confidence in the children's ability to participate in physical activity and the benefits involved in such an activity. Studies have shown that parental physical activity has significant positive relationship with adolescent engagement in physical activity (Sallis *et al.,* 2000; Welk, 1999). Intra-personal factors have been conceptualised as attitude and self-efficacy (Figure 2.1). Attitude is also a factor that influences individual choice or interest in an activity. It is the individual's favourable or unfavourable examination of an activity (Hagger and Chatzisarantis, 2008). Health factors that may influence physical activity may comprise of mental and physical health elements. A person with good physical health acquires sufficient level of physical fitness and physical wellness (Jodi, 2002).

2.3.2 Physical Activity, Dietary Lifestyle and Hypertension: A Conceptual Framework

Persistent involvement in physical exercise and good diet have been proven to be effective in reducing blood pressure and amazingly ease symptoms of hypertension. It is noted that physical exercise and good diet improve the supply of growth factors from skeletal muscles into the bloodstream, invigorating angiogenesis, controlling endothelial cell proliferation, facilitating endothelial cell membrane permeability, increasing the blood supply to the brain and facilitating neurogenesis (Kaerney et al., 2005). Physical exercise promotes brain-derived neurotrophic factor (BDNF)

concentrations which appears to increase radically BP sensing neurons during hypertension (Bell *et al.,* 2014).

Clinical and epidemiological studies have shown a lower occurrence of hypertension in individuals that are physically fit, through their involvement in physical activities and are on good diet. There are positive effects of physical activities, such as exercise on blood pressure. It can reduce blood pressure and prevent age-related rise in blood pressure (Kaerney *et al*., 2005). During aerobic fitness training such as running, there is increase in systolic blood pressure in adolescents with history of hypertension, the increase in blood pressure can be more marked but diastolic pressure remains the same or increases slightly during exertion, mainly due to reduced vasodilating capacity (Park *et al.,* 2006). After engaging in vibrant physical exercises, there is a decrease in blood pressure between 10 and 20 mmHg for the next few hours, in comparison with normal resting blood pressure in individuals. This effect is termed as post-exercise hypotension.

The total physical activity, divided into smaller sessions, had a larger pressure-lowering effect than one long session (Park *et al*., 2006). It is noticed that the blood pressure-lowering in the 24 hours following physical activity is mediated mainly through a transient reduction in stroke volume and/or modulation of the sympathetic nervous tone (Gordon, 1997). The number of minutes or hours for the blood pressure to be lowered after physical exercise is influenced by the duration, frequency and intensity of the exercise.

This study focused on adolescents in the Senior High Schools and therefore these characteristics are very crucial to be discussed. As emphasised by Jodi (2012), the school environment influenced the participation of students in physical activities.

For boarding students more especially, they spend greater percentage of their time in school and therefore are greatly affected by the environment. In the school environment, it may not be easy for the adolescents to always engage in physical activities and eat good diet. This is because the population is large and therefore the preparation of good diet would be hardly possible. In case there are opportunities, not all of them would be able to participate in physical activities and consume good diet. For instance, during sporting activities, some sections of the students are given the opportunity to participate while others are left out. It may also happen that few students have the opportunity to afford fruits and vegetables at the boarding school.

The duration of the physical activity can be affected by the teaching and learning activities in the school. Since students are regulated by the timetable for teaching and learning as well as other issues, the duration in physical activity may be low. Similarly, the intensity in physical activity can also be low within the school environment. In the school environment, adolescents have their own means of exercising their body. These may include washing, playing football, walking to classroom and back to the dormitory and jogging.

The reduction in blood pressure because of regular aerobic exercise has been suggested to result from the cumulative effects of single exercise bouts rather than long-term exercise. It is suggested that a single bout aerobic exercise minimises blood pressure for 1 to 3h. As such short-term exercises in the school has implication on reducing the prevalence of hypertension (Kaerney *et al*., 2005). As pointed by Erem *et al*. (2009) inactivity is linked with increase prevalence of hypertension. The incidence of hypertension increases when the physical activity decreases. Physical activity also has a statistical relationship with pre-hypertension (Widjaja *et al.,* 2013). Other studies have shown that physical exercise prevents age-associated increase in blood

pressure. Adoption of ambulatory blood pressure measurements have shown that exercise could reduce blood glucose levels.

The core to improving or increasing dietary compliance is to enhance student's level of knowledge and apparent self-assurance in making essential lifestyle changes (Shikany *et al.,* 2009). To achieve this, it is argued that education plays a key role. Therefore, educational programmes should be delivered by the appropriate personnel with required knowledge, training and skills on dietary guidance. The educational campaign would be effective if it seeks to address individual differences and is tailored towards not only educational need or level but addressing the environmental factors in the adolescent lives. However, it must be emphasised that, effective nutritional counselling cannot be fully achieved in a single contact. Persistent follow-up, through various means would enhance results. It also offers opportunities for continued assessment of challenges to behavior change among the adolescents in boarding schools (Shikany *et al.,* 2009).

2.4 Serum Lipid Levels and Hypertension among Adolescents

Epidemiological studies have revealed that cholesterol levels are significantly higher in hypertensive patients than in age, sex and body mass index- matched normotensive patients (SrinivasPai *et al.,* 2014). The major cardiovascular disease (CVD) risk factors have been attributed to abnormalities in serum lipid (Olusakin *et al.,* 2011). They are the independent risk factors for hypertension that increase the risk of dyslipidemic hypertension. In untreated hypertensives, dyslipidemia is very common, compared with normotensives. It has been found that lipid levels rise with increase in BP. Although there is no specific pattern of dyslipidaemia among hypertensive adolescents, triglycerides (TG) and the total cholesterol (TC), as well as fractions of lipoproteins are more frequently above normal ranges, among hypertensives than in

the general population (Osuji *et al.,* 2012). It has been found that serum total cholesterol is low in black Africans and high-density lipoprotein cholesterol (HDL-C) is higher among the whites in the developed countries. In the same study, it was also found that sex, age and socio-economic status of the adolescents, as well as diet significantly affect lipid levels (WHO, 2009).

The serum total cholesterol, serum LDL cholesterol and serum triglyceride have been found to be higher in hypertensives than those in normotensives (Sarkar *et al.,* 2007). Serum HDL was found to be low in hypertensives, compared with normotensives. According to Sarkar *et al.* (2007), who studied 40 hypertensives, the number of those that received regular treatment and irregular treatment was 35% and 65% respectively. However, there was no significant relationship of the treatments on the hypertensives.

Choudhury *et al.* (2014), conducted a study on serum lipid profile and its association with hypertension in Bangladesh, using a cross-sectional study to cover 234 adolescents. These included 75 normotensive controls and 159 hypertensives, from January, 2012 to December, 2012 in the National Centre for Control of Rheumatic Fever and Heart Disease. They found that the serum levels of triglycerides (TG) and total cholesterol (TC) were higher in hypertensives. However, high-density lipoprotein cholesterol (HDL-C) was lower in hypertensive adolescents, compared with normotensives and these were statistically significant. The study also found that hypertensive adolescents had 1.1 times higher triglycerides (TG) and total cholesterol (TC). Again, hypertensive had 1.2 times higher LDL, and 1.1 times lower HDL than normotensives and these were statistically significant (Choudhury *et al.,* 2014). Another study by SrinivasPai *et al.* (2014), among 50 normal and 50 hypertensive

subjects, aged between 30 and 80 years revealed that triglycerides (TG), total cholesterol (TC) and high-density lipoprotein cholesterol (HDL-C) were higher in the hypertensives patients than those in the healthy controls.

The lessons from various studies are that majority of the hypertensive population receive irregular treatments and there were significant modifications of triglycerides (TG) and total cholesterol (TC), HDL-C and LDL-C in hypertensives who receive regular treatment. Therefore, it is recommended that there should be routine monitoring of hypertensives who do not receive regular treatment, to prevent coronary heart disease (CHD) and other consequences.

2.5 Dietary Guidance and Management

2.5.1 Behavioural Theories in Nutrition Interventions

2.5.1.1 Social Ecologic Theory

The human behaviour, according to the Social Ecological Theory, can both affect or be affected by diverse levels of influences. The theory which was developed by McElroy *et al.* (1988), explains the inter-relationship that exist between issues found across and within all types of health problems in the human system. The theory emphasises on five important levels of influence that include the following; individual factors, inte-rpersonal factors, policy factors, institutional factors and lastly, community factors (McElroy *et al.,* 1988). The individual factors explain the attributes of the human systems that include beliefs, attitude, trait and knowledge that can influence the individuals choice and the habit of eating. The inter-personal factors explain issues that include the family, friends, relatives and peers, which have influence on the dietary behaviour of the person. This occurs more especially when the person depends on others for the preparation of food (Shikany *et al.,* 2009). The institutional factors explain the policies, programmes, regulations, rules and informal

structures that encourage or discourage adequate promotion of health on the intake of diet.

Furthermore, the community level factors explain the norms and standards that influence the ability of the individual to be addicted to a particular approach for his/her dietary behaviour, which runs counter to the present norms of the society. The public policy factors explain the state or government influence on nutritional programmers or issues. The theory argues that the policy of the government in a country to make people aware of blood pressure and weight management can maximise positive focus on nutritional programmes. The theory also argues that of the various influential factors, several of the human health behaviour models centre on individual and inter-personal issues that can cause a change in human behaviour towards dietary intake (Shikany *et al.,* 2009). These forms of theories are the Stages of Change Theory and the Health Belief Model and they are elaborated as follows.

2.5.1.2 Health Belief Theory

This theory emphasises on the perceptions of individuals on the danger posed by a health problem, the possible gains of avoiding the threat and the factors that influence their decisions. The ideal principle of this theory is for an individual to adopt new health behaviour or amend his/her current health behaviour. However, this depends on four factors as proposed. These include the costs of taking action, compared against the benefits; believe they are susceptible to the condition; believe that changing their behaviour will reduce their susceptibility to the condition or its severity; and the belief that the condition will have serious consequences (Rosentock *et al.,* 1988). Health behaviour change, in this theory, is also influenced by exact elements that prompt action, such as a reminder from one's provider or when the individual is confident in his/her ability to successfully perform an action (Shikany *et al.,* 2009).

2.5.1.3 Stages of Change Theory

The Stages of Change Theory was proposed by Prochaska and DiClemente (2002) and it proposes that the changes in human behaviour seem to be a process but not an event. The theory further explains that individual's effort to change his/her behaviour is influenced by five processes. These include maintenance, pre-contemplation, preparation, contemplation, action and maintenance (Prochaska and DiClemente, 2002). With the pre-contemplation process, the individual within the period of six months has no or less intention to take any nutritional decisions or action. With the contemplation process, the individual takes nutritional actions or decisions based on foreseeable future implications. In the preparation process, the individual decides to take actions within the next 30 days. In the action process, the individual fruitfully changes his or her behaviour for a brief period of time. At the maintenance stage, the individual changes his or her behaviour for longer period; that is, at least six months (Prochaska and DiClemente, 2002).

2.6 Adolescent, Association Behaviour and Hypertension

2.6.1 Risk Factors Associated with Hypertension

Hypertension is one of the leading causes of disability across the globe. It accounted for about 10 million deaths and seven percent disability in 2011 globally (Lim *et al.,* 2010). In India, hypertension accounted for 10 % of all deaths (Patel *et al*., 2011). Amma *et al.* (2015), indicated that the significant risk factors associated with hypertension include low socio-economic status, waist circumferences, overweight/obesity, total cholesterol, high soft drink consumption, low fruit consumption and physical inactivity, family history, fasting plasma glucose and higher age (more than 45 years old) (Widjaja *et al.*, 2013). Waist circumference is used indirectly to identify abnormal adiposity. The presence of abdominal obesity can lead to the production of inflammatory adipokine which can make a person susceptible to cardiovascular diseases (Ayala *et al.,* 2014). Waist circumference above 102cm for male and 88cm for female is considered abnormal. High blood cholesterol can stimulate atherosclerosis, a risk factor of hypertension (Bergheanu *et al.,* 2017). Persistent excess blood glucose level above 7.0 mmol/L can lead to diabetes and if not monitored may result in hypertension (Wei *et al*., 2003)

According to Okasha (2013), the risk factors associated with hypertension include fasting blood sugar, type of locality, peptic ulcer disease, age, high cholesterol, sex and smoking status. Nakanishi *et al.* (2003), found among 12-19 years population that diabetes, increased white blood cell counts, hyperuricemia and hypertriglyceridemia are risk factors of hypertension. They concluded in the study that the building-up of risk factors is greatly linked with increased risk of hypertension. In Ghana, Boateng *et al.* (2015) reported that elderly Ghanaians who had been diagnosed with arthritis, angina, diabetes, and asthma were significantly more likely to be hypertensive.

Additionally, people with depression were found to be 1.22 times more likely to be hypertensive (Okasha, 2013).

2.6.1.1 Body Mass Index

A study conducted at Ajman revealed that there is 14% increased chance for hypertension due to increase in body mass index (Sreedharan *et al.,* 2010). Berenson *et al.* (1998) emphasised that a higher Body Mass Index (BMI) is associated with higher risk for hypertension in adult population. Amma (2015) observed that overweight adolescents were 5.7 times susceptible to increased risk to hypertension, compared with adolescents who are underweight. Davy and Hail (2004) explained that high blood pressure in overweight adolescents can be attributed to higher adiposity. It is also associated with increased arterial stiffness and various hemodynamic changes that may contribute to hypertension (Jannuzzi *et al.,* 2006). Kumar *et al*. (2016) found that out of those that had hypertension, about 16 % of them were underweight, while 4% were overweight. Widjaja *et al.* (2013) found a significant relationship between BMI and hypertension but no association with pre-hypertension. Furthermore, Pang *et al.* (2008), found a relationship between BMI and elevated blood pressure. It was found that individuals who are overweight and obese are likely to develop hypertension and pre-hypertension. A higher body mass index and waist circumference show excess weight and this is associated with hypertension and pre-hypertension. It is also observed that the reduction of weight invariably reduced BP (Godwin *et al.,* 2008).

2.6.1.2 Smoking and Alcohol Drinking Habit

It has been found that adolescents who smoke or have smoked before are prone to hypertension. Abed and Abu-Haddaf (2013), found a relationship between developing the habit of smoking or drinking alcohol and hypertension. Unlike other study

findings, Tadesse and Alemu (2014), found no relationship between cigarette smoking and alcohol with hypertension. Other studies such as Pileggi *et al.* (2005), Nielsen and Anderson (2003), and Monego and Jardim (2006) found no relationship between smoking and alcohol intake and hypertension.

2.6.1.3 Family History

Adolescents who have a family history of hypertension are at risk of experiencing hypertension themselves. Singh *et al.* (2006) found out that 49% of adolescent girls and 51% of boys who were hypertensive had family history of hypertension. Nakanishi *et al.* (2003) also found that adults 23-59 years who were hypertensive, similarly had family history of hypertension. Silva *et al.* (2012), in a study of 234 adolescents identified that family history of hypertension doubled the prevalence rate of hypertension. Sundar *et al.* (2013), showed a prevalence rate of hypertension to be 41.86% that was higher among adolescents' with hypertensive parents- that is, either mother or father or both.

2.6.1.4 Socio-Economic Factors

Socio-economic factors, such as educational status, income, social class, employment status and increasing age have been mentioned as risk factors associated with hypertension. Numerous studies have found a relationship between socio-economic factors and the prevalence rate of hypertension among the adolescent population across the globe. A study in India revealed that high- and intermediate-level educational status and upper-middle and high socio-economic status were risk factors of hypertension (Mishra and Kumar, 2011). Tee *et al.* (2010), also reported that in Malaysia, a logistic regression analysis showed that age and educational background of adolescents correlated with the prevalence of hypertension. These risk factors are

comparable to those reported by Mishra and Kumar (2011) and Yadav *et al.* (2008), in India. Spruill (2010) confirmed that the prevalence of hypertension was higher among adolescents who have low socio-economic background due to high stress and poor living conditions. However, Sundar *et al.* (2013), did not find a significant relationship between adolescent with low socio-economic status and the risk of hypertension.

2.7 Empirical Review and Implications to this Research

In this section, published articles have been reviewed to show the effects of adolescents' involvement in physical activities and dietary intake on the prevention of hypertension. The purpose of the study, research design, sample size and tools for analysing data have been reviewed.

2.7.1 Physical Activity and the Effects on Risk Factors Associated with Hypertension

Numerous studies have been done on the effects of physical exercises on lowering hypertension among adolescents in Chennai. Sundar *et al.* (2013) conducted a study to estimate the prevalence of hypertension among school children, between the ages of 13 and 17 years. The study used the cross-sectional survey to cover 400 adolescent students from government and private schools. In the study, food habits, physical activity, demographic data, family history and anthropometric measurements were recorded. The study showed no relationship between physical activity and hypertension.

Alsairafi *et al.* (2010) conducted a study to investigate the effects of physical exercise on the prevention of hypertension in Kuwait. A cross-sectional survey was used in the study to cover 240 participants who were hypertensive patients for more than one

year. The participants were those that visited the primary care centre for regular follow-up. A structured questionnaire was used in the study to collect data on socio-demographic characteristics of participants, diet and their engagement in physical activities. It was found in the study that the prevalence of uncontrolled hypertension among the sample was 44.4 %. The participants who failed to engage in regular physical exercise had uncontrolled hypertension, compared with 33% of those who engaged in exercise.

Multiple regression analysis showed that the body mass index, age and diet were the independent significant risk factors in preventing hypertension among the adolescents. The study further found that the risk of uncontrolled hypertension is 2.50 times among adults and 3.88 times among younger age group. It also found the risk was 4.97 times among older age groups, 7.79 times among patients who are not on diet and 8.34 times among patients who exercise less than 3 days per week. They concluded in their study that physical activity is very important in preventing hypertension and therefore should become the concern of health workers (Alsairafi *et al.,* 2010).

Silva *et al.* (2012), did a study on physical activities and hypertension among 234 Portuguese adolescents, between 16 and 19 years of age, using the cross-sectional survey. The study found a hypertension prevalence rate of 12% in females and 34% in males. In the study data on alcohol consumption of participants, gender, smoking, exercise and family history were recorded. The study found that increased body mass index of adolescent was linked with higher risk of experiencing pre-hyertension and hypertension.

Among those with family history of hypertension, the study found that the prevalence of hypertension and pre-hypertension doubled. The study further revealed that there

was no significant relationship between regular exercise, smoking and alcohol consumption and hypertension. They concluded that the prevalence of pre-HTN and HTN in the study population was high. Out of the many factors, obesity, gender and family history of hypertension showed significant relationship with hypertension. With a family history of hypertension, the prevalence of hypertension and pre-hypertension approximately doubled (Silva *et al.,* 2012).

Fagard and Cornelissen (2007) conducted an epidemiological study on the effects of physical exercise on hypertension. A meta-analysis of randomised controlled trials involving dynamic aerobic endurance training or resistance training was done during the study. The meta-analysis on endurance training involved 72 trials and 105 study groups. The reduction in resting blood pressure was more pronounced in 30 hypertensive study groups. There was reduction of 7.1% in systemic vascular resistance and reduction by 29% in plasma norepinephrine. Also, the plasma renin activity reduced by 20 %. Further, it was found that the waist circumference was reduced by 2.8 cm, body fat was decreased by 1.4 % and body weight decreased by 1.2 kg through participants' engagement in physical activities. Homeostasis model assessment, the index of insulin resistance was reduced by 0.31 units and high-density lipoprotein cholesterol was increased by 0.032 mmol/l, through physical exercise.

Mahfouz *et al.* (2012), did a study to explore the prevalence of hypertension and how it differs between males and females in southwestern Saudi Arabia. This was across-sectional study and covered a sampled population of 1869 adolescents. The selected population was assessed, based on their diastolic blood pressure, height and systolic blood pressure. The study revealed that there was high prevalence of hypertension

among adolescent males and females. The study found that physical inactivity was significantly higher among the females, compared with the males. Behavioural risk factors included inadequate low consumption of fruits and vegetables, physical inactivity, and smoking. The logistical regression indicated that gender and obesity made significant contribution to high blood pressure among adolescents.

Pramanike *et al.* (2015) conducted a study on the prevalence of hypertension among school going children in suburban area of West Bengal. The study also aimed at estimating the risk factors associated with hypertension. The cross-sectional survey was used in the study to cover 1361 participants, between the ages of 10 and 17 years, from public schools. Questionnaires were used to collect data from participants on physical activity, food habit and family history of hypertensives. The study revealed a significant relationship between hypertension and physical exercise. It also revealed significant relationship between blood pressure and body mass index, height, body fat percentage and fat mass index.

Moussa *et al.* (2016) did a study on the effects of physical activities on hypertension among adolescents, aged 13 and 19 years in the Port-Said and Damietta University. The sample size covered in the study was 2,029 students, from the two Universities. The study found a prevalence rate of hypertension to be 26.5% among students in Damietta University and 18.1% among students in Port-Said University. Using logistic regression analysis, it was found that there was significant relationship between physical activities and the reduction of hypertension. Also, univariate analysis showed an association between hypertension and age, sex, body mass index (BMI), nutritional status, stress, physical activity, family history and smoking pattern. They concluded in the study that blood pressure values increased with associated risk

factors (age, sex, body mass index, smoking, stress, physical activity and family history).

However, other studies have shown no similar results on the relationship between physical activities and hypertension (Kumar *et al.,* 2016; Zarchi and Gahangiri, 2010). Kumar *et al.* (2016) showed no meaningful reduction in blood pressures among adolescents who engaged in physical activities. According to Zarchi and Gahangiri (2010), physical activity is not statistically linked with the incidence of pre-hypertension in adolescents.

2.7.2 Dietary Intake and Hypertension

A study was conducted among nursing students at the Tatale University by Essa and El-Shemy (2015), on lifestyle and its related risk factors for non-communicable diseases and the effects on the health condition of the participants. The study adopted the cross-sectional survey research design, to cover 495 participants, consisting of more females (355) than males (140). The participants were selected, using the stratified sampling procedures. The study showed that slightly more than one-third (33.7 %) of the participants were at risk of developing hypertension (pre-hypertension). The study also found that the students' dietary practices concerning breakfast and the number of meals per day were unhealthy and a large number of them were exposed to smoking.

Geleijnse *et al.* (2004) investigated the contributions of dietary factors on the occurrence of hypertension in the developed world. The study areas were the United States of America (USA), Finland, United Kingdom (UK), Italy and the Netherlands. Data were obtained from a nationwide survey from 1966 to 2001 among the Western population, on effects of risk factors associated with hypertension. The study revealed

that risk factors such as overweight made the greatest contributing factor to hypertension. In Italy, it contributed 11%, while in the USA, it was 25%. The impact of other lifestyle factors, such as intake of alcohol was small in the four countries. The intake of foods containing calcium was between 2% and 8%; magnesium was between 4% and 8%; coffee was between 0 and 9 % and fatty acid was between 3% and 16%. The study concluded that lifestyle factors and dietary intake make significant impact on the prevalence of hypertension in the Western countries.

Another study by Geleijnse *et al.* (2005), on the impact of lifestyle and dietary factors on the occurrence of hypertension showed similar results. The study areas included the United States of America (USA), Finland, United Kingdom (UK) Netherlands and Italy. The result was that overweight among the adolescent population was between 11 and 17%. Sodium intake was between 9 and 17%, while potassium intake was between 4 and 17%. It was also found out that intake of fish oil was between 3 and 16% ; calcium was between 2 and 8% and magnesium was between 1 and 9%. Geleijnse *et al.* (2005), described the consumption of fish oil, magnesium and the consumption of calcium as low. However, the consumption of alcohol was 2-3% and coffee, 1-9 %. It was concluded in the study that the lifestyle and diet have greater impact on the prevalence of hypertension in the Western societies.

A study was done by Desai and Kavishwar (2009) on effects of lifestyle factors on the prevalence of hypertension. The study was carried out from August, 2004 to September, 2005, using cross-sectional survey to cover 1493 participants. The study revealed that the prevalence of hypertension was high in the males, compared with the females. It was also found in the study that the prevalence of hypertension was higher among those that were overweight; those that consumed mixed foods, compared with

vegetarians. Hypertension was higher among smokers, compared with non-smokers; higher among those that consumed alcohol compared with non-alcoholic people.

In Nigeria, Ibrahim *et al.* (2014), investigated the dietary pattern, nutritional status and the prevalence of hypertension. The cross-sectional survey was used, involving 390 participants, selected, using the multi-stage sampling procedure. The study revealed that more than half (50.7%) of the participants ate their largest meal at dinner. Also, about 50% of them ate snack on daily basis, while more than two-thirds (66.7%) ate fatty foods. Again, about 27 % drank fruit juice, while 33% took in carbonated drinks thrice every week or even more. Moreover, 56 % of them ate fruit and 59 % ate vegetables less than three times per week or not at all. It was found that about 51% lived a sedentary lifestyle and 5 % smoked cigarette, while 11% took alcohol within the past 30 days. They concluded in the study that unhealthy eating habits among the participants increased the risk of experiencing hypertension.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

The study was conducted in three second cycle educational institutions in three Metropolitan/ Municipal areas in the Ashanti Region of Ghana (Figure 3.1).

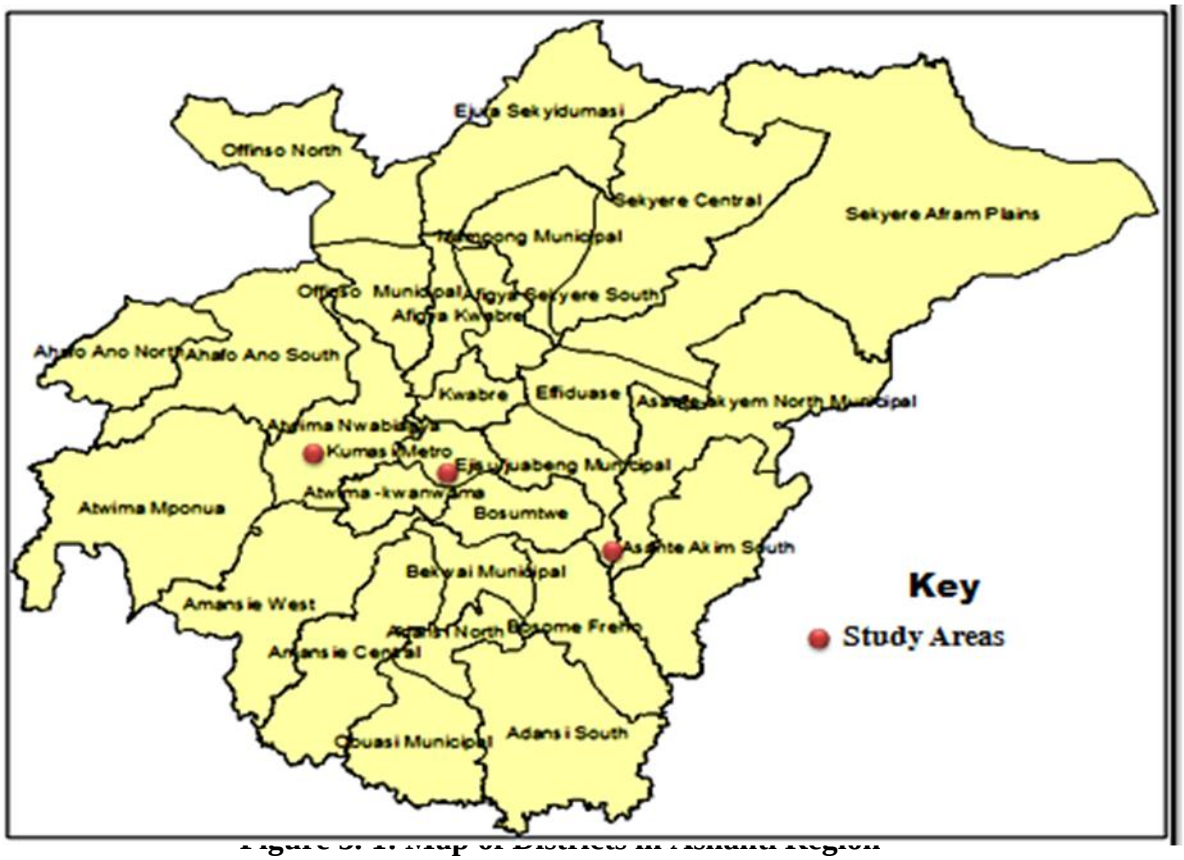

Figure 3. 1: Map of Districts in Ashanti Region

Source: GSS (2014)

The three districts are the Asante Akim Central Municipality (Konongo), Kumasi Metropolis (Kumasi) and the Ejisu- Juaben Municipal (Ejisu). The Bonwire SHS (BOSS) is located in the Ejisu-Juaben Municipality, the Konongo Odumase SHS (KOSS), in the Asante Akim Central Municipality and the Anglican SHS (KASS) in the Kumasi Metropolis, as shown Figure 3.1 The Ejisu-Juaben Municipality, has over

448 schools (including a university), comprising 270 public and 178 private institutions (GSS, 2014a). There are four public SHSs, six private SHS and three Vocational/Technical schools. The public Senior High Schools include Ejisuman SHS, Bonwire SHS, Ejisu Secondary Technical School and Juaben SHS (GSS, 2014a).

Asante Akim Central Municipality has 138 kindergartens, 135 Primary Schools, 90 Junior High Schools and 4 Senior High Schools. The Municipality also has two institutions which provide technical and vocational education. A total of 27,545 of the Municipal population are currently attending school with 47.6% in primary school followed by JHS/JSS (19.4%), and kindergarten (15.9%) (GSS, 2014b). The Kumasi Metropolis can boast of 919 pre-schools, 967 primary schools, 597 Junior High Schools, 52 Senior High Schools and 10 tertiary institutions. The Kwame Nkrumah University of Science and Technology, the nation's premier science and technology university, is in Kumasi (GSS, 2014b).

3.2 Research Design

The study was a survey type which is very much used in social psychology to find how people influence, and are influenced by their social environment (Leedy and Ormrod, 2001). This study was a cross-sectional survey. The cross-sectional survey design involved data collection at one point in time to find out the prevalence of hypertension in the adolescents.

3.3 Study Areas and Subjects

The Anglican Senior High School (KASS), the Bonwire Senior High School (BOSS) and the Konongo Odumase Senior High School (KOSS) were selected for this study, based on simple random technique. First, a multi-stage sampling was used; the 29

districts in the Ashanti region were grouped into three, using the number of schools in each district as the basis. Using this criterion, the Ejisu-Juaben Municipality, the Asante Akim Central Municipality and the Kumasi Metropolis were randomly selected. A school was then selected from each of the districts. The schools were selected, based on the location (such as being a well-known area), the condition of the boarding facilities and the number of students who were in the boarding house. The study population was made up of adolescents in the three SHSs. The students were both males and females at all the levels/stages of education in the school. That is, the students comprised of those who were in the first year up to third year. The reconnaissance survey to the school revealed that the three SHSs had a student population of 7,036. This was made up of 3246 in KASS, 2803 in the KOSS and 887 in BOSS.

3.4 Sampling Methods and Procedures

A mathematical method known as the "Cochrane" formula was used in this study to calculate the sample size. The formula is shown as follows;

$$\text{n} = \frac{Z^2 p(1-p)}{e2}$$

Where;

n = the sample size,

p = estimated proportion

z is the confidence level (usually 1.96 for 95% confidence level)

e is the desired level of precision.

p is the estimated proportion of an attribute present in the population (prevalence)

The 95% confidence level was used in this study because it is the most common interval used in the behavioural sciences to indicate that "a finding is good enough to

be believed" (Young and Bolton, 2009). The current hypertension rate among adolescents in Ghana is estimated to be 28.55% (Nyarko, 2016). Using this value, the sample size of patients was calculated as follows;

$\frac{n= 1.96x1.96x0.2855(1-0.2855)}{0.05x0.05}$ =313 participants

The sample size of 313 is regarded as large enough which therefore provides a good estimate of the population and reduces the effect of outliers or extreme observations.

3.4.1 Inclusion criteria.

The inclusion criteria were students who were boarders.

Students found within the age bracket (14-19 years)

Students without physical deformities, who consented to be part of the study.

3.4.2 Exclusion criteria

Students who are not boarders and outside the age bracket, as well as those with physical deformities. A sample population of 909 students was selected for the initial screening in October 2016.

Students whose BP measurement ≥ 120/80 mmHg were re-screened in March 2017, to determine the prevalence of hypertension and associated risk factors. The number of the students, according to the three SHS, is shown in Table 3.1.

Table 3.1: Participants Selected for Screening

Screening/School	Anglican SHS	Konongo SHS	Bonwire SHS	Total
First Screening	376	342	191	909
Rescreened	60	62	20	142

Source: Author's Construct, 2017

Initially, 204 participants had raised blood pressure above 120/80mmHg but those who

consented to take part in the study were 142.

3.5 Type and Source of Data

Data collected included demographic characteristics, anthropometric and blood pressure reading for the first screening. Data collected for the rescreening include demographic characteristics, blood pressure, blood sampling for biochemical analysis, nutritional status and anthropometrics.

3.5.1 Blood Pressure Measurement

Blood pressure was taken by trained personnel using a mercury sphygmomanometer and stethoscope. Measurements were taken from the left upper arm after subjects had been sitting for >5 min. Participants were asked to sit on a chair for five minutes. Different cuff sizes were used for different body sizes and placed to cover the left arm at the heart level. Systolic and diastolic blood pressure were taken three times, with at least 5 minutes interval, using a digital sphygmomanometer. The average of the three readings was used for the analysis.

3.5.2 Physical Activity Data

Data on physical activity level was taken by adopting the WHO Global Physical Activity Questionnaire (GPAQ), version 2. Data on vigorous, moderate activity and sedentary behaviour were collected. Amount of time in (minutes) each participant spent in moderate and vigorous intensity activities was determined. The activities were given intensity, relating to the criteria provided in the WHO GPAQ, version 2 standards. Moderate intensity was assigned for activities such as brisk walking,

sweeping and mopping. Vigorous intensity was assigned for activities such as carrying heavy load, running and skipping.

3.5.3 Data on Dietary Practices

The dietary practices of the participants were assessed using the 24-hour dietary recall and analysed with the West African Food Composition Table (Stadlmayr, 2012). Food frequency questionnaire which contained a list of common foods was used to assess, the dietary pattern. The food frequency was categorized into five (daily to never).

3.5.4 Anthropometric data

Anthropometry is the measurement of weight, height (measured without shoes) and mid-upper arm circumference (MUAC). The Omaron Body composition monitor (BF511, UK) was used to take measurement from each respondent, by entering their age, sex and height. Respondents were asked to take off any heavy clothing and step on the monitor bare-footed. After weight was measured to the nearest 0.1 kg, they continued to stand on the monitor with hands on the monitor's horns and held at waist level, at right angles to their bodies until the total body fat, Body Mass Index (BMI), visceral fat and muscle mass were automatically calculated and displayed digitally. A metric measuring tape was tied around the abdomen at the level of the umbilicus, while subject stood straight to measure the waist circumference. Hip circumference was taken around the maximum part of the buttocks. The waist circumference (cm) was divided by the hip circumference (cm) to estimate the waist to hip ratio.

3.5.5 Biochemical data

Participants had 3ml of fasting venous blood sample collected from them; 1ml into EDTA tubes for hematological analysis and 2ml into gel-activated tubes for serum

biochemical analysis. Blood samples were collected in gel clot activator vacuum tubes (Channel Med, England). The activator vacuum tubes were left to stand for 30 minutes and centrifuged (Heraeus Christ-labofuge A, Germany) to obtain serum. The serum was then analysed for Lipid profile, blood glucose, ALT, urea, creatinine and electrolytes to check for blood lipid levels, liver and kidney function. Reagents used were manufactured by Fortress Diagnostic (UK). All analyses were performed following manufacturers' instruction. Analysis including RBC, MCV, MCHC, RDW-SD, MPV and P-LCR were done to check for anemia and inflammation. Hematological parameters were done using Sysmex Autoanalyser (UK).

3.6 Ethical Approval and Informed Consent

Ethical clearance for the study was obtained from the Committee on Human Research Publication and Ethics (CHRPE) of the School of Medical Sciences, KNUST, Kumasi (CHRPE/AP/491/16) and consent was sought from the selected schools. All participants (909) of this study signed an informed consent form, in accordance to the CHRPE regulations, before answering the questionnaire and taking blood samples.

3.7 Statistical Analysis

Data was analysed using IBM SPSS 22.0 (Chicago). For continuous variables, means and standard deviations were calculated, while percentages were calculated for categorical variables. Significant differences in the categorical variables were ascertained using the chi-square test, while independent t-test was used to determine the statistical significance between mean values. A p-value of less than 0.05 was reckoned as being statistically significant.

CHAPTER FOUR

4.0 RESULTS

4.1 Prevalence of Hypertension among SHS students

This section presents data on the prevalence of hypertension among SHS students. It comprises students who took part in the preliminary study in all the three (3) selected schools. Participants with BP ≥ 120\80 mmHg were recruited for the second part of the study.

Majority of the students, 601 (66.10%) were classified as normotensive, based on their blood pressure. Students from KOSS had the highest prevalence followed by KASS and BOSS. There were significant differences ($p < 0.05$) in the BP of the students of the 3 schools (Table 4.1).

Table 4.1: Distribution of Blood pressure among KOSS, KASS and BONWIRE Students

SHS Students	Blood Pressure Groups			Total	X^2	df	P-value
	Hypertensive	Pre-hypertensive	Normotensive				
KOSS	19	82	241	342			
(%)	5.60	24.00	70.50	100			
KASS	57	82	237	376			
(%)	15.20	21.80	63.00	100	32.993	4	0.000
BOSS	7	61	123	191			
(%)	3.70	31.90	64.40	100			
Total	83	225	601	909			
	9.10	24.80	66.10	100			

4.2 Prevalence of hypertension within 142 respondents

The prevalence of hypertension was determined using the systolic and diastolic blood pressure measurements taken during the anthropometric studies. It was found out that 7.75% were hypertensive, whereas 43.66% were found to be pre-hypertensive and 48.59% were normotensives. Considering the sex distribution, 10.6% of the male participants were diagnosed to be hypertensive with 46.6% and 42.6% as pre-hypertensive and normotensives respectively. The females recorded 4.48%

hypertensive participants, 40.3% pre-hypertensive and 55.2% normotensives.

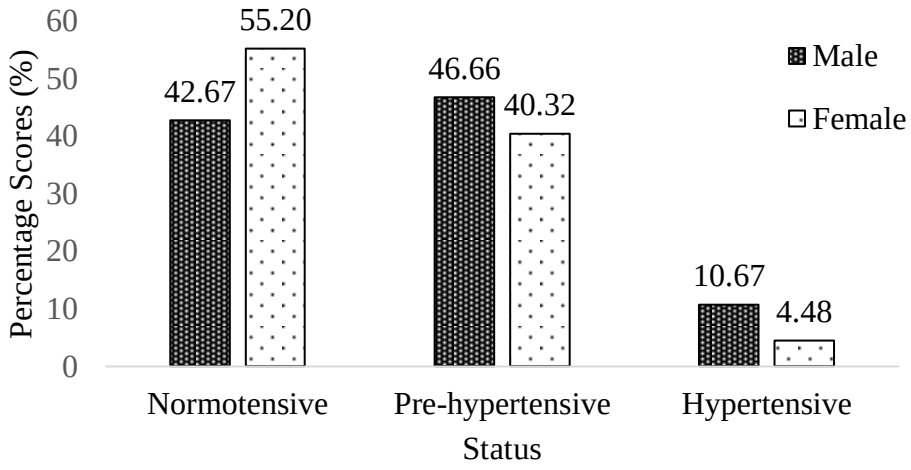

Figure 4.1 Hypertension status of participants after rescreening using systolic and diastolic measurements

From Table 4.2, the occupational status of the parents and the hypertensive status of the participants showed no significant difference ($p>0.05$) with the majority of the detected cases being associated with the self-employed parents.

Table 4.2 Socio-demographic Distribution of Participants

Parameter	Normotensive n (%)	Pre-hypertensive n (%)	Hypertensive n (%)	Total n (%)	P value
1. Gender					
Male	32 (42.6)	35 (46.6)	8 (10.6)	75(52.8)	0.20
Female	37 (55.2)	27 (40.3)	3 (4.5)	67(47.1)	
2. Mothers occupation					
Civil servant	3 (50.0)	3 (50.0)	0 (0.0)	6 (4.2)	0.83
Public Servant	7 (46.6)	7 (46.6)	1 (6.6)	15 (10.5)	
Unemployed	1 (20.0)	3 (60.0)	1 (20.0)	5 (3.5)	
Self employed	58 (50.0)	49 (42.2)	9 (7.7)	116(81.6)	
3. Fathers occupation					
Civil Servant	11 (47.8)	9 (39.1)	3 (13.0)	23 (16.2)	0.95
Public Servant	11 (47.8)	10 (43.4)	2 (8.7)	23 (16.2)	
Unemployed	2 (50.0)	2 (50.0)	0 (0.0)	4 (2.8)	
Self employed	45 (48.9)	41 (44.5)	6 (6.5)	92 (64.7)	

4.3 Age, Anthropometric and Body Composition Data and Hypertension Prevalence of respondents

The age, waist circumference, BMI, body fat, muscle mass and visceral fat were determined and evaluated for their correlation with the hypertensive status of the participants. The ages of the participants who were categorized as hypertensive were averagely 17.91±1.14 years with that of the pre-hypertensive participants being 17.45±1.71, followed by the normal participants being 17.12±1.39 in a decreasing order, though the difference is not statistically significant at $p>0.05$. The waist

circumference was averagely about 74 cm and not statistically significant (p>0.05). The BMI recorded no significant differences between the groups. The hypertensive class recorded BMI of averagely 20.66±6.99, followed by the pre-hypertensive and the normotensive group recording 18.88±8.56, which is the least. Muscle mass and visceral fat measurements also followed same pattern with the hypertensive class recording the highest and the normotensives recording the least but the differences not being statistically significant (Table 4.3).

Table 4.3 Age, Anthropometric and Body Composition of Normotensive, Pre-hypertensive and Hypertensives.

Parameter	Normotensive	Pre-hypertensive	Hypertensive	p-value
Age (years)	17.12±1.39	17.45±1.71	17.91±1.14	0.461
WC (cm)	74.42±8.09	74.18±7.50	74.27±7.72	0.450
BMI	18.88±8.56	20.02±7.41	20.66±6.99	0.847
Body Fat (%)	23.88±12.60	22.07±12.72	20.79±12.42	0.501
Muscle mass (%)	36.46±8.10	36.75±8.39	39.14±8.52	0.416
Visceral Fat	1.43±1.87	1.66±2.13	2.73±1.90	0.195

Values are Means±SEM

4.4 Calorie intake influence on blood pressure

From the study, students classified as pre-hypertensive recorded the highest mean current energy intake (1828.7 ± 793 kcal), followed by students classified as normotensive (1761.43 ± 627.4 kcal). Students classified as hypertensive recorded the least (1759.7 ± 883 kcal) of current energy intake. Students blood pressure rating did not have any significant effect (p > 0.05) on current energy intake (Figure 4.2)

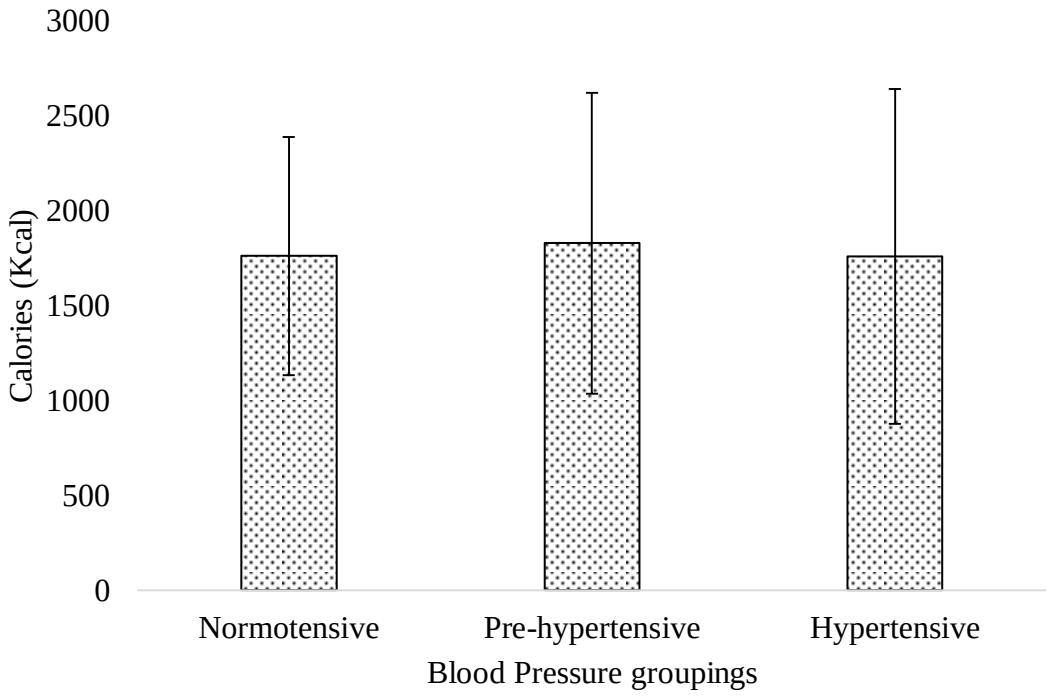

Figure 4.2 Comparison of mean calories intake of normotensive, pre-hypertensive and hypertensive SHS students. ± = Standard deviation

4.5 Correlation of Current Energy intake on Blood Pressure among SHS students

From the study, current energy intake had negative and very weak and non-significant correlation ($r = -0.039$, $p > 0.05$) with diastolic blood pressure. However, current energy intake had positive and very weak correlation ($r = 0.063$) and insignificant effect ($p > 0.05$) on systolic blood pressure.

Table 4.4 Correlation between calories intake and blood pressure of respondents

Blood pressure	r	P-value
Systolic	0.063	0.460
Diastolic	-0.039	0.649

Correlation coefficient (r).

4.6 Physical activity and hypertensive status of participants

According to Table 4.5, 72.73% of the participants diagnosed as hypertensive did not undertake any routine exercise or physical activity. The result also indicated 57.97% of the normotensive students were sedentary, likewise 40.32% of the pre-hypertensive.

Table 4.5 Physical activity profile of participants and hypertension status

Physical activity	**Normotensive n (%)**	**Pre-hypertensive n (%)**	**Hypertensive n (%)**	**P-value**
None	40(57.97)	25(40.32)	8(72.73)	
Once per week	3(4.35)	8(12.90)	1(9.09)	
Twice weekly	12(17.39)	16(25.81)	1(9.09)	0.045
Thrice	7(10.14)	6(9.68)	1(9.09)	
Four times per week	7(10.14)	6(9.68)	0(0)	
Five times per week	0(0)	1(1.6)	0(0)	
Total	69 (100)	62 (100)	11 (100)	

4.7 Impact of Blood Pressure on Lipid profile of SHS students

Blood pressure rating of respondents did not have any significant effect on the blood lipid profile (HDL, LDL, Tchol and Trig) ($p>0.05$). The highest mean values of HDL (1.65 ± 0.06mmol/L), LDL (1.90 ± 0.18mmol/L) and Tchol (4.02 ± 0.20mmol/L) were recorded by hypertensive students, whereas the highest value of Trig (1.02 ± 0.04mmol/L), was recorded by pre-hypertensive students. The least value of LDL (1.73 ± 0.08mmol/L) was recorded by normotensive students and pre-hypertensive, whereas the least of Tchol (3.83 ± 0.12mmol/L), was recorded by pre-hypertensive students. Also, the least mean value of TG (0.89 ± 0.06mmol/L), was recorded by hypertensive students, whereas the least value of HDL (1.60 ± 0.03mmol/L), was recorded by both pre-hypertensive and normotensive students (Table 4.6).

Table 4.6 Comparison of lipid profile of respondents on different blood pressure ratings

Blood Pressure Rating	**HDL (mmol/L)**	**LDL (mmol/L)**	**TCHOL (mmol/L)**	**TG (mmol/L)**
Normotensive	1.60±0.03	1.73±0.08	3.97±0.18	0.97±0.04
Pre-hypertensive	1.60±0.03	1.73±0.11	3.83±0.12	1.02±0.04
Hypertensive	1.65±0.06	1.90±0.18	4.02±0.20	0.89±0.06
F-ratio	0.252	0.264	0.269	0.971
Df	2	2	2	2
P-value	**0.777**	**0.768**	**0.765**	**0.381**

The values are Means ± S.D.

4.8 Kidney and Liver Functions

From Table 4.7, blood pressure of respondents did not have any significant effect on kidney function (urea, creatinine and electrolyte) and liver function (ALT) ($p > 0.05$). The highest mean values of urea (3.71 ± 0.10 mmol/L) and creatinine (56.90 ± 1.03 µmol/L) were recorded by students classified as normotensive, whereas the least values of urea (3.43 ± 0.15 mmol/L) and creatinne (56.64 ± 2.02 µmol/L) were recorded by hypertensive students. The highest values of ALT (14.36 ± 1.11U/L) as a marker of liver function, was recorded by hypertensive students, whereas pre-hypertensive students recorded the least (12.06 ± 0.65U/L).

Table 4.7 Effects of blood pressure ratings on kidney (urea, creatinine) and liver (ALT) functions of respondents.

	KIDNEY FUNCTION		LIVER FUNCTION
Blood Pressure Rating	UREA (mmol/L)	CREATININE (µmol/L)	ALT (U/L)
Normotensive	3.71±0.10	56.82±1.05	13.14±0.85
Pre-hypertensive	3.50±0.10	56.90±1.03	12.06±0.65
Hypertensive	3.43±0.15	56.64±2.02	14.36±1.11
F-ratio	1.459	0.005	0.930
Df	2	2	2
P-value	**0.236**	**0.995**	**0.397**

The values are Means ± S.D.

From Table 4.8, there was no significant difference in blood electrolytes (Na^+, Cl^- and K^+) ($p > 0.05$) among the participants. The highest values of Na^+ (140.31 ± 0.20 mmol/L), Cl^- (100.74 ± 0.21 mmol/L) and K^+ (4.05 ± 0.05mmol/L) were recorded by

pre-hypertensive, normotensive and hypertensive students respectively. Also, the least values of Na^+ (139.77 ± 0.18mmol/L) and K^+ (4.04 ± 0.02mmol/L) were recorded by normotensive students, whereas pre-hypertensive students recorded the least values of Cl^- (99.02 ± 1.61 mmol/L).

Table 4.8 Effects of blood pressure ratings on electrolytes (Na^+, Cl^-, K^+) of respondents.

Blood Pressure Rating	Na^+ (mmol/L)	Cl^- (mmol/L)	K^+ (mmol/L)
Normotensive	139.77±0.18	100.74±0.21	4.04±0.02
Pre-hypertensive	140.31±0.20	99.02±1.61	4.05±0.03
Hypertensive	140±0.38	99.91±0.48	4.05±0.05
F-ratio	2.099	0.665	0.131
Df	2	2	2
P-value	**0.126**	**0.516**	**0.878**

The values are Means ± S.D

Table 4.9 Comparison of correlation coefficients for blood pressure with Biochemical Parameters of respondents.

Biochemical Parameters	Systolic	Diastolic
Tchol	0.02	0.048
Trig	0.048	0.014
HDL	0.05	0.15
LDL	0.017	0.012
UREA	-0.113	-.175
CREAT	0.043	-0.125
ALT	-0.084	-0.03
Na^+	0.105	-0.095
K^+	0.084	0.0
Cl^-	-0.09	-0.111

Tchol=total cholesterol; Trig=triglycerides; HDL=high density lipoprotein; LDL=low density lipoprotein; ALT=alanine aminotransferase; Na^+ *=sodium;* K^+ *=potassium;*

Cl^- *= chloride*

Table 4.9 shows the correlation coefficient of the relationship between the biochemical parameters and blood pressure. The correlation coefficient were very low and were not significant ($p > 0.05$).

4.9 Hematological Profile

Table 4.10 shows the hematological profile of participants stratified by their blood pressure classification. It was observed that, WBC, RBC, HGB, HCT, MCH, PLT, RDW-CV, PDW and PCT did not differ significantly ($p > 0.05$) among the students based on their blood pressure classification. However, MCV, MCHC, RDW-SD, MPV and P-LCR differ significantly ($p < 0.05$). The highest values of WBC (5.98 ± 1.60), RBC (5.03 ± 0.47), HGB (13.33 ± 1.36), HCT (43.13 ± 4.21), MCH (26.56 ±

1.96) and MCHC (30.94 ± 1.14) were recorded by students classified as hypertensive, whereas MCV (89.69 ± 5.46), PLT (261.49 ± 71.13), RDW-SD (48.04 ± 3.94), PDW (15.02 ± 3.11), MPV (11.70 ± 1.28), P-LCR (38.57 ± 10.46) and PCT (0.30 ± 0.07) were recorded by students classified as normotensive. The highest value of RDW-CV (14.53 ± 2.92) was seen in the pre-hypertensives.

Table 4.10 Mean Hematological parameters (± S.D)of study population.

	Hypertensive 11 (7.75%)	**Pre-hypertensive 62 (43.66%)**	**Normal 69 (48.59%)**	**p-value**
WBC	5.98 ± 1.60	5.91 ± 1.73	5.69 ± 1.30	0.661
RBC	5.03 ± 0.47	4.86 ± 0.58	4.68 ± 0.59	0.080
HGB	13.33 ± 1.36	12.49 ± 1.67	12.35 ± 1.43	0.147
HCT	43.13 ± 4.21	42.72 ± 7.93	41.91 ± 4.83	0.704
MCV	85.85 ± 4.95	85.15 ± 9.92	89.69 ± 5.46	0.004
MCH	26.56 ± 1.96	25.49 ± 2.93	26.48 ± 2.12	0.064
MCHC	30.94 ± 1.14	29.74 ± 1.78	29.37 ± 1.83	0.024
PLT	239.18 ± 54.66	261.18 ± 80.48	261.49 ± 71.13	0.638
RDW-SD	43.25 ± 2.90	46.54 ± 6.46	48.04 ± 3.94	0.012
RDW-CV	13.35 ± 0.52	14.53 ± 2.92	14.10 ± 1.60	0.226
PDW	13.45 ± 1.20	14.22 ± 2.45	15.02 ± 3.11	0.097
MPV	10.80 ± 0.79	11.21 ± 1.04	11.70 ± 1.28	0.012
P-LCR	31.43 ± 6.25	34.77 ± 8.85	38.57 ± 10.46	0.017
PCT	0.26 ± 0.05	0.29 ± 0.09	0.30 ± 0.07	0.201

The data are presented as Means ± S.D. *WBC=white blood cell; RBC=red blood cell; HGB= haemoglobin; MCV=mean corpuscular volume; MCHC=mean corpuscular hemoglobin concentration; PLT=platelet; RDW_SD=red cell distribution width_*

standard deviation; PDW=platelet distribution width; MPV mean platelet volume; P_LCR=platelet large cell ratio; PCT=plateletcrit ; HCT=hematocrit

Table 4.11 Comparison of correlation coefficient of Hematological indices and Blood Pressure variables (n= 142)

Haematological Parameter	Systolic	Diastolic	MBP
WBC	0.002	-0.004	0
RBC	0.146	-0.086	0.053
HGB	0.14	-0.076	0.054
HCT	0.104	-0.091	0.023
MCV	**-.230****	**-.183***	**-.243****
MCH	-0.091	0.038	-0.041
MCHC	**.171***	**.256****	**.240****
PLT	-0.067	-0.107	-0.098
RDW_SD	**-.182***	**-.201***	**-.220****
RDW_CV	0.012	-0.041	-0.013
PDW	-0.149	-0.088	-0.142
MPV	**-.197***	-0.152	**-.205***
P_LCR	**-.185***	**-.167***	**-.205***
PCT	-0.135	**-.175***	**-.176***

******. Correlation is significant at the 0.01 level (2-tailed)*
******. Correlation is significant at the 0.05 level (2-tailed)*
WBC=white blood cell; RBC=red blood cell; HGB= haemoglobin; MCV=mean corpuscular volume; MCHC=mean corpuscular haemoglobin concentratio; PLT=platelet; RDW_SD= red cell distribution width_ standard deviation; PDW=platelet distribution width; MPV= mean platelet volume; P_LCR=platelet large cell ratio; PCT=plateletcrit ; HCT=hematocrit ; MBP=mean blood pressure

Table 4.11 shows the correlation of hematological parameters with BP measurement. From the study, systolic blood pressure had significant ($p < 0.05$) negative correlation (r=-0.230, -0.197 and -0.185) and positive correlation (r=0.171) with hematological parameters; MCV, RDW-SD, MPV, P-LCR and MCHC, respectively. Similarly, diastolic blood pressure has a significant ($p < 0.05$) negative correlations (-0.183, -0.0201, -0.167 and 0.175) and a positive correlation (r=0.256) with hematological

parameters, MCV, RDW-SD, P-LCR, PCT and MCHC, respectively. Also, mean arterial blood pressure had a significant ($p < 0.05$) negative correlation (r=-0.243, -0.220, -0.205, -0.176) with MCV, RDW-SD, MPV, P-LCR and PCT respectively and positive correlation (r=0.240) with MCHC.

4.10 Comparison of Mean Macronutrient and Micronutrient Intake of Participants.

Protein, total fat, carbohydrate, fibre, calcium, phosphorus, potassium and sodium did not have any significant effect ($p > 0.05$) on blood pressure of respondent. The highest mean values of protein (47.29 ± 2.5 g), and sodium (3180.31 ± 175.1 mg) were recorded by normotensive students, whereas the highest values of total fat (51.97 ± 9.8 g), carbohydrate (322.48 ± 61.5 g), calcium (301.92 ± 68.9 mg), fibre (22.08 ± 4.6 g) and phosphorus (935.96 ± 155.6 mg) were recorded by hypertensive students. The highest mean value of potassium (3615.32 ± 1952.0 mg) was recorded by pre-hypertensive students. The least values of protein (45.38 ± 3.0 g), total fat (46.07 ± 3.2 g), carbohydrate (263.55 ± 17.1 g) and phosphorus (867.95 ± 57.7 mg) were recorded by pre-hypertensive students, whereas the least of calcium (301.92 ± 68.9 mg), potassium (1884.84 ± 280.4 mg) and sodium (2777.88 ± 611.2 mg) were recorded by hypertensive students. Also, the least value of fibre (20.47 ± 1.5 g), was recorded by normotensive students.

Table 4. 12 Comparison of Mean Macronutrient and Micronutrient Intake of Participants.

Blood Pressure Rating	Protein (g)	Total fat (g)	Carbohydrates (g)	Fibre (g) (total dietary)	Calcium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)
Normal	47.29±2.5	46.75±2.9	268.87±13.5	20.47±1.5	414.09±29.2	914.70±46.8	1847.23±142.6	3180.31±175.1
Pre-hypertensive	45.38±3.0	46.07±3.2	263.55±17.1	21.43±3.5	439.89±40.1	867.95±57.7	3615.32±1952.0	3071.71±171.5
Hypertensive	46.71±7.8	51.97±9.8	322.48±61.5	22.08±4.6	301.92±68.9	935.96±155.6	1884.84±280.4	2777.88±611.2
F-ratio	0.122	0.255	0.962	0.051	1.171	0.246	0.520	0.384
Df	2	2	2	2	2	2	2	2
P-value	0.885	0.775	0.385	0.950	0.313	0.782	0.596	0.682

Nutrient intakes analysed from a 24-hour dietary recall. Data presented as Mean ± S.E

S.E= standard error

CHAPTER FIVE

5.0 DISCUSSION

Results from the initial screening` showed prevalence of hypertension among adolescents in the selected schools was 9.1%, whilst 24.8% of them were pre-hypertensive. This prevalence of hypertension was significantly different among the schools, KOSS (5.6%), KASS (15.2%) and BOSS (3.7%) (p value = 0.000). Similar but higher prevalence of hypertension among adolescents was found in a study by Kumar *et al*. (2016). On the other hand, another study by Tadesse and Alemu (2014) in Ethiopia found slightly lower prevalence of hypertension (7.7%) among adolescents.

Considering the location of these schools, it could be deduced that hypertension was more prevalent in the urban adolescents (KASS), compared to rural adolescents (BOSS). An observed high prevalence of pre-hypertension and hypertension among school going adolescents raises alarm that this disease is no longer found in adults, but is emerging among adolescents.

High prevalence of hypertension among adolescents would affect the public health system in Ghana, if appropriate measures are not put in place. According to Amma *et al.* (2015) and Widjaja *et al.* (2013), hypertension was associated with low socio-economic status, waist circumference, overweight/obesity, high soft drinks consumption, low fruit consumption and physical inactivity. It could also be that the listed associated risk factors might be present in these adolescents, hence contributing to high prevalence of hypertension.

Out of the 142 participants 116 (81.6%) of them have parents who are self-employed, which is a key factor to note. Self-employed persons tend to dedicate much time to their business, thus have little time for themselves and their families. This mostly results in their wards eating from fast food joints and resorting to other seemingly unwholesome and unhealthy eating patterns, such as late-night eating as they report home late from work. The data showed that 81.6% of the mothers, who are primarily responsible for the diet of their families were self-employed with extended working hours, leading to poor eating patterns in their households. However, there is no statistical significance in the link between the parents' occupation and the hypertensive status of their wards ($P>0.05$) as indicated in Table 4.2. Age did not have a significant effect on blood pressure (Table 4.3).

There was higher prevalence of hypertension in males than females, though not statistically significant (Table 4.2). The higher prevalence in males is similar to the finding by Goncalves *et al*. (2016), where they realized a prevalence of 9.3% in males as against 6.5% in females. Moselakgomo *et al*. (2012) also reported a higher prevalence of 4.1% in males, as opposed to 2.8% in females. They attributed the cause of the increasing prevalence of the condition to the changing lifestyles of the population, following the rural-urban drift, particularly in sub-Saharan Africa with the primary causes being diet, salt intake and physical inactivity. They also observed that the socio-economical and environmental conditions the children were exposed to from childhood to adolescence were the risk factors to the development of the condition.

The high prevalence of hypertension in males, as opposed to females could be attributed to the higher tendency of males to eat more and resort to unhealthy lifestyle practices, such as alcoholism and smoking (Babwah *et al*., 2006). Studies have shown

that sedentary lifestyles, use of tobacco and alcohol, lack of physical exercises, and unhealthy diet are mostly found among adolescents with 67 % of premature death and 33 % of disease burden being associated with these lifestyles (McNiece *et al.,* 2007). They found that men who consumed more alcohol had significant increase in metabolic syndrome. However, there was no significant relationship with alcohol intake among females (Steyn *et al*., 2004). This could account for the similar observation made in this study with higher population of males being diagnosed as hypertensive and pre-hypertensive, whereas a higher population of the females were normotensives

(Table 4.2).

Considering the correlation between the anthropometric measurements and the hypertensive status of the participants, it was discovered that the age and waist circumference did not affect the condition significantly (P>0.05) as seen in Table 4.3.

The waist circumference is used as an indicator for diagnosing abdominal obesity which is a risk factor in metabolic syndrome diagnoses of which hypertension is a part (Halley *et al*., 2007). However, in this study, the waist circumference did not contribute significantly (P>0.05) to the hypertension status of participants (Table 4.3). The BMI on the other hand, showed a trend which was however not significant statistically but could be considered as a risk factor of hypertension.

The participants diagnosed as hypertensive and pre-hypertensive recorded higher BMIs (20.66±6.99 and 20.02±7.41, respectively), while the normotensives recorded a BMI of 18.88±8.56 (Table 4.3). The BMI obtained in the study supports the findings of Moselakgomo *et al*. (2012), where a BMI of 21.1±5.3 was found to be associated with a prevalence of hypertension of 4.1%. A study by Danasekaran and Vinoth

(2015), showed a positive correlation between BMI ($p<0.001$) and family history ($p=0.03$) in adolescents with hypertension.

The population of hypertensive adolescents identified in the study was relatively small which could account for the statistical insignificance of the BMI of the subjects under study. Similar trend as observed for the BMI was also seen with the visceral fat assessment, where the hypertensive participants recorded the highest visceral fat level (Table 4.3). Goran and Gower (1999) reported of the relation between visceral fat and the risk of cardiovascular disease in children and adolescents, where hypertensives recorded a higher visceral fat.

It is said that an active lifestyle is required for one to stay healthy and prevent conditions like obesity and related complications such as hypertension (Eriksson *et al*., 2005).

According to Diaz and Shambo (2013), one of the recommended guidelines in preventing the risk of hypertension is by increasing physical activity level. This implies sedentary lifestyle may be associated with risk of hypertension. A study by Buenza *et al*. (2007) showed that sedentary behaviour was associated with likelihood of developing hypertension, independent of leisure-time physical activity.

This makes the activity profile of the participants an essential component of the study in establishing the link between hypertension and the level of activity. The results obtained from the study showed a very low activity profile which can be a predisposing factor to hypertension. It was found that 72.73% of the participants with raised blood pressure had a lifestyle of no physical activity (Table 4.5), while 57.97% and 40.32% of the nomotensive and pre-hypertensive participants also had no active

lifestyles. There was significant ($p<0.05$) difference between the categories (hypertensive, pre-hypertensive and normotensives).

Physical activity and exercise are known to demand energy and thus the rapid utilization of blood glucose and the breakdown of glucose resulting in the reduction of body and visceral fat. This reduces the risk of atherosclerosis by fat deposits and ultimately reducing the risk of cardiovascular diseases (Durrani and Fatima, 2015). The study showed very low activity levels with only 1.6% of the participants having the highest recorded profile of five times weekly exercise sessions. This means that majority of the adolescent population were not physically active and this might have influenced the prevalence of hypertension. Physical inactivity is a risk factor for developing hypertension. This could be due to lack of understanding of the benefits of an active lifestyle.

This warranted an investigation into the probable toll the condition might be having on the body and some organ of the participants. The target organs were the liver and kidneys. Tedla *et al. (*2011) showed that hypertension can be directly or indirectly related to Chronic Kidney Disease (CKD).

From Table 4.6, a comparison of lipid profile and the different ratings of hypertension shows no significant difference among normotensive, pre-hypertensive and hypertensive ($p> 0.05$). Additionally, a correlation between total cholesterol, triglyceride, high density lipoprotein cholesterol, low density lipoprotein cholesterol, and systolic and diastolic blood pressure showed no significant association. Although prevalence of hypertension was high among the adolescent population, it did not have any influence on the lipid profile, representing cardiovascular risk factors. The

concern however is that, hypertension is a chronic disease which progresses gradually to cause damage to heart, as duration of hypertension increases. Hence, early detection of hypertension in adolescents,timely dietary and lifestyle management are helpful to avoid future complications.

Hematological indices are important in routine clinical practice, as they help in detecting anemia and inflammatory conditions. Red cell distribution width (RDW), Mean Corpuscular Volume (MCV) and Platelet (PLT) have been assessed in various studies, to ascertain their relationship with cardiovascular diseases.

A study by (Toneli *et al*., 2008), on relationship between red blood cell distribution width and cardiovascular diseases showed a strong correlation between blood pressure levels and RDW. Another study by Young and Bolton (2009) also showed increase in packed cell volume by 7% and increased platelet count and mean platelet volume, affecting whole blood viscosity increase by 21%. At this percentage (21%), arterial pressure rose from 126/69mmHg to 139/87 at six hours of mild surface cooling.

From Table 4.11, MCV had weak, inverse association with systolic and diastolic blood pressures. This means low MCV levels could increase the systolic and diastolic blood pressures of adolescent population. Low MCV means red blood cells might be microcytic, and this is sometimes linked to microcytic anemia. Additionally, there was weak, direct significant relationship between MCHC, and systolic and diastolic blood pressures ($p< 0.05$, $p< 0.01$, as shown in Table 4.11). This implies that an increase in MCHC levels in blood could increase systolic and diastolic blood pressures of adolescent hypertensive population. Also, RDW-SD had weak, inverse significant association with systolic and diastolic blood pressures ($p <0.05$).

This finding is contrary to the study by Yanagisawa *et al*. (2016) who rather found elevated RDW in hypertensive and concluded that elevated RDW was linked with cardiovascular diseases and sometimes used as differential diagnosis of anemia. MPV had weak, inverse significant association with systolic and mean blood pressure (MBP). This means a decrease in mean platelet volume (MPV) levels could lead to an increase in systolic and overall mean blood pressure. A study by Yanagisawa *et al*. (2016) found higher MPV levels were associated with hypertension with target organ damage, such as stroke and myocardial infarction, compared to non-hypertensive. This is because mean platelet volume is biomarker of size of platelet and its activation, hence, raised levels of platelet denotes functionally large platelet (Yanagisawa *et al*., 2016). However, the inverse association found was so weak to have any negative influence on participants' target organs. There was very weak, inverse significant association with diastolic pressure and MBP blood pressures ($p < 0.05$).

There is no significant difference ($p>0.05$) in dietary intake of protein, total fat, carbohydrate, fibre, calcium, phosphorus, potassium and sodium among hypertensive pre-hypertensive and normotensive adolescents (Table 4.12). A Spearman's rank correlation between dietary intake of protein, carbohydrate, fat, fibre, calcium, phosphorus, potassium, sodium and systolic and diastolic blood pressure did not show any significant difference ($p > 0.05$). This could imply that dietary intakes of these nutrients might not have influenced their systolic and diastolic blood pressure.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Prevalence of pre-hypertension (24.8%) and hypertension (9.1%) was high among school going adolescents. Dietary intakes of macronutrients and some micronutrients were adequate among normotensive, pre-hypertensive and hypertensive adolescents, and did not have any effect on their hypertensive status. Generally, majority of the adolescent population were not active. Despite the prevalence of pre-hypertension and hypertension among adolescent population in the study, it did not have any effect on their kidney and liver. The hematological parameters assessed have not been affected by their hypertensive status. In conclusion, appropriate diet and lifestyle management are needed to prevent the progression of the pre-hypertension and hypertension to stages where they can cause target organ damage.

6.2 Recommendation

The prevalence of adolescent hypertension is increasingly becoming a global problem. It is therefore recommended that routine health screening should be undertaken by Ghana Health Service in various Senior High Schools, where such study has not been conducted.

It is also recommended that studies will be done on the type of physical activity undertaken by adolescents in various schools.

6.3 Limitations of study

In the first place, the study determined the prevalence of hypertension and associated risk factors among adolescents in selected Senior High Schools, instead of the general population. In addition, schools chosen were few due to time and other limited

resources. Food frequency questionnaire which was also used had a disadvantage of not giving actual estimated dietary intakes of individuals which might have affected the strength of association between dietary intake and hypertension. Blood pressure reading were taken on two occasions with 5 minutes break between each readings and averages were used. Ideally the blood pressure readings were supposed to be taken three times, as established by the golden rule of World Health Organization (2003). As a result, there may be the possibility of misclassification of adolescent hypertension.

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APPENDIX

CONSENT FORM

Statement of person obtaining informed consent:

I have fully explained this research to……..

and have given sufficient information about the study, including that on procedures, risks and benefits, to enable the prospective participant make an informed decision to or not to participate.

DATE:……NAME:……

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with interviewer to my satisfaction.

I understand that my participations is voluntary (no compulsory).

I know enough about the purpose, methods, risks and benefits of research study to decide that I want to take part in it.

I understand that I may freely stop being part of this study at any time without having to explain myself.

I have received a copy of this information leaflet and consent form to keep for myself.

NAME:……

DATE:……SIGNATURE/THUMB

PRINT:……

Statement of person witnessing consent (Process for Non-Literate participant):

I ……. (Name of Witness) certify that information given to……. (Name of Participant), in the local language, is a true reflection of what I have read from the study Participant Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate)……

MOTHER'S SIGNATURE (maintain if participant s under 18 years)……

MOTHER'S NAME: ……

FATHER'S SIGNATURE (maintain if participant is under 18 years): ……

FATHER'S NAME: ……..……...……

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF SCIENCE

DEPARTMENT OF BIOCHEMISTRY AND BIOTECHNOLOGY

Study Title: Prevalence of Hypertension and its Associated F actors among Adolescents in some selected Senior High Schools in Ashanti Region.

PERSONAL DATA OF RESPONDENTS

Age:……

Date:……..

Telephone No.:……..

Code:……....

Part A: Background

1. Sex of Respondent Male ☐ Female ☐
2. Class (year) of respondent 1. First year ☐ 2. Second ☐ 3. Third ☐ year
3. Which area do you live? 1. Non-residential area ☐ 2. Public Servant ☐ 3. Unemployed ☐ 4. Self ☐ employed
4. Occupation of father 1. Civil servant ☐ 2. Public Servant ☐ 3. Unemployed ☐ 4. Self ☐ employed

5. Occupation of mother 1. Civil servant ☐ 2. Public Servant ☐
3. Unemployed ☐ 4. Self employed ☐

6. Educational background of mother 1. Primary/Secondary ☐ 2. Tertiary ☐
3. MSLC ☐ 4. Non-formal ☐

7. Educational background of father 1. Primary/Secondary ☐ 2. Tertiary ☐
3. MSLC ☐ 4. Non-formal ☐

8. How many siblings do you have? ……

B) Physical Activity

International Physical Activity Questionnaire

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

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

.....Days per week.

If no vigorous physical activities, please skip to question 3

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

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

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

.....Days per week.

If no moderate physical activities, please skip to question 5

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

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

5) During the last 7 days, how many days did you walk for at least 10 minutes at a time?

Days per week. If No walking, please skip to question 7

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

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

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

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

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

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

Part C: Dietary record

1. Are you on any special or regulated diet? 1. Yes ☐ 2. No ☐
2. If yes what are they

……

……

3. Are you involved in any weight loss programme(s)? 1. Yes ☐ 2. No ☐
4. If Yes, State: ……

Part D: Anthropometric Data

1. Blood Pressure

	Systolic	**Diastolic**	**Pulse**
1			
2			
Mean			

2. FBG……mmol/L Height:……..cm

3. Waist:…….cm Hip:…….cm

4. Waist to hip…… cm Weight……kg

5. BMI:……..kg/m^2 Body Fat:…….%

6. Muscle Fat:…….……..% Visceral Fat……..…%

7. Energy:……..……..Kcal

Part E: Food Table (24 hour food recall)

Write or Tick [√] where applicable

	List of Food	**Quantity**	**Time**	**Grams**
BREAKFAST				
SNACK				
LUNCH				
SNACK				
SUPPER				
BED TIME SNACK				

DIETARY QUESTIONNAIRE

Questions about what you usually eat and drink

Instructions: This questionnaire is about your usual eating habits over the past 3 months.

Where possible give only one answer per question for the type of food you eat most often.

Please tick (√) the correct answer

Times you have eaten		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
		Never	**Occasionally**	**1 time**	**1 time**	**1 time**	**2-3 times**	**4 to 6 times**	**Daily**
				Per month	**Per 2 weeks**	**Per week**			
CEREAL FOODS, BREAD & SNACKS									
Cornflakes	A1								
Corn porridge, rice porridge	A2								
Wheat porridge, oats	A3								
Pasta, noodles	A4								
Kenkey (corn dough), banku (corn & cassava dough)	A5								
Waakye (rice and beans)	A6								
Plain rice, jollof rice, fried rice	A7								
White sugar bread	A8								
Wheat bread	A9								
Butter bread	A10								
White tea bread	A11								
Pizza	A12								
Chocolate	A13								
Groundnut paste	A14								
Margarines	A15								
Butter	A16								
Jam, marmalade, honey or syrups	A17								
Cakes, jam rolls,	A18								

sweet biscuits, doughnuts									
Meat/fish turnover (pies)	A19								
Spring rolls	A20								
DAIRY PRODUCTS, MEATS, FISH & SUBSTITUTES									
Cheese	B1								
Yogurt	B2								
Ice-cream	B3								
Fried beef	B4								
Boiled beef	B5								
Fried chicken	B6								
Boiled, grilled chicken	B7								
Pork	B8								
Lamb	B9								
Boiled goat meat	B10								
Fried fish	B11								
Boiled, grilled fish	B12								
Tinned fish (salmon, tuna, sardines, etc.)	B13								
Fried egg	B14								
Boiled egg	B15								
Sausage, hot dogs	B16								
Beans stew	B17								

Times you have eaten		1	2	3	4	5	6	7	8
		Never	Occasionally	1 time	1 time	1 time	2-3 times	4 to 6 times	Daily
				Per month	Per 2 weeks	Per week			
BEVERAGES									
Coffee	C1								
TEA (Lipton™, green tea etc.)	C2								
Milo™, Chocolim™, Richoco™, Cocoa Powder drinks	C3								
Flavoured milk drinks (Cowell™, MilkoTM, etc.)	C4								
Soya milk drinks (Vitamilk™, etc).	C5								
Carbnoated soft drinks (Coca ColaTm, Fanta™, etc.)	C6								
Alvaro™	C7								
Malta Guinness™ and other malt soft drinks	C8								
TUBERS & PLANTAIN									
Boiled sweet potatoes	D1								
Fried potatoes (potatoes chips)	D2								
Fried yam	D3								
Boiled, masted yam	D4								
Boiled cocoyam	D5								
Fried cocoyam, cocoyam chips	D6								
Fufu (pounded boiled cassava & plantain)	D7								
Gari (grated, fried & roasted cassava)	D8								
Plantain chips	D9								
Boiled plantain	D10								

Fried ripe plantain	D11								
Roasted ripe plantain	D12								
FRUITS & VEGETABLES									
Fruit juice (any kind)	E1								
Oranges or other citrus fruit	E2								
Apples	E3								
Pineapple	E4								
Banana	E5								
Pears	E6								
Watermelon	E7								
Pawpaw	E8								
Mango	E9								
Grapes	E10								
Garden eggs stew	E11								
Kontomire (cocoyam leaves) stew	E12								
Fresh soup Kontomire									
Light soup (tomatoes Soup)	E13								
Palm nut soup	E14								
Groundnut soup	E15								
Okro stew, okro soup	E16								
Raw tomatoes	E17								
Cabbage stew	E18								
Salad	E19								
Raw carrots	E20								
Raw cucumbers	E21								
Raw onions	E22								
Boiled beans	E23								

Please write down foods and drinks you usually consume that are not captured above

Thank you