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NUTRITION AND OTHER LIFESTYLE FACTORS ASSOCIATED WITH OBESITY AND HYPERTENSION AMONG ADOLESCENTS IN THE WA MUNICIPALITY OF GHANA

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BY

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DECLARATION

I hereby declare that this thesis is the outcome of my own original research and that, it has neither in part nor whole, been presented for another degree in this university or elsewhere.

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DEDICATION

I dedicate this work to my siblings and late father Mr. Kullah Kenneth Nuogmah

ABSTRACT

Obesity and hypertension are major risk factors for increased morbidity and mortality from noncommunicable diseases. A cross-sectional study was conducted in the Wa municipality of the Upper West Region of Ghana. The main objective of the study was to establish nutrition and other lifestyle factors associated with obesity and hypertension among 14-19 years adolescents. A multi-stage cluster proportional to size sampling method was used to select 302 adolescents from thirty schools (junior and senior high schools). Anthropometrics and blood pressure were measured with recommended instruments. Dietary intake, physical activity levels and body image preference were also assessed with the aid of questionnaire, to identify risk factors for both obesity and hypertension. Statistical package for social sciences (SPSS) version 20 and World Health Organisation (WHO) anthroplus software were used for analysis. Pearson correlations were done to find out association, while multiple and logistic regression were employed to identify risk factors for obesity and hypertension. The study revealed obesity and hypertension (both systolic and diastolic) prevalence of 1% and 4.0% respectively. Additionally, 10.1% of participants were overweight, 4.7% were underweight and 10.9% had elevated isolated diastolic blood pressure, while 7.0% had elevated isolated systolic blood pressure. Family history was positively associated (OR, 1.6, p, 0.014 95% CI) with obesity and overweight. The male gender was protective against overweight and obesity (OR, 0.2, p= 0.000 95% CI), while meal skipping was weakly associated with obesity or overweight (OR, 1.2, p=0.398). Waist circumference (WC) emerged as the only independent predictor of SBP in a multiple regression analysis. Binary logistic analysis showed that the male gender was an independent predictor of systolic blood pressure with 4.0 times higher risks (95% CI: 1.2-10.0), in comparison to their female counterparts. Ideal body image preferences chosen were generally good; 76.2% chose normal nutritional status image. Physical activity level was relatively high among the studied adolescents and not significantly different between overweight and non-overweight adolescents (p=0.334). Obesity prevalence was low, while hypertension was relatively high in the studied population. Further research is warranted to ascertain the factors responsible for the prevalence of hypertension.

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ABBREVIATIONS

AIHW: Australian Institute of Health and Welfare

BMI: Body mass index (kg/m²)

BP: Blood pressure

CHD: Coronary heart disease CI:

Confidence interval

CVD: Cardiovascular disease

DMT2: Diabetes mellitus type 2

FAO: Food and Agricultural Organization

GHS: Ghana Health Services

HDL: high density lipoprotein

IR: Insulin Resistance

LDL: low density lipoprotein

MGI: McKinsey Global Institute

NCDs: Non-communicable diseases

PAL: Physical activity level

SD: Standard deviation

SRS: Simple random sampling

TBF: Total body fat

TV: Television

UNICEF: United Nations Children's Fund

US: United States
VF: Visceral fat

WC: Waist circumference

WHO: World Health Organization

YLDS: Years lived with disability

YLLS: Years of life lost

CHAPTER ONE

1.1 Introduction

One of the major public health concerns in the 21st century is excess body fat (Ezzati et al., 2002). Excess body fat also known as obesity is of developmental concern because, numerous diseases are associated with excess weight gain within populations (Wang et al., 2011). Globally, obesity is rising at an alarming rate. Prevalence of obesity and overweight in low and middle income countries have approached levels found in developed countries, often coexisting with undernutrition. Moreover, the problem is increasing across all age groups, and the health consequences are already obvious. Obesity is associated with increased cardiovascular morbidity and mortality (Amato et al., 2013; Finucane et al., 2011; Van Gaal & Maggioni, 2014). The prevalence of metabolic syndrome was 6.8 percent among overweight adolescents and 28.7 percent among obese adolescent (Cook et al., 2003).

Obesity is a central risk factor for non-communicable diseases (NCDs) which are now the leading cause of death globally and now symbolizes the biggest threat to human health and economic growth (Marrero & Adashi, 2015) and has become a key public health challenge globally (Khuwaja et al., 2011). Non-communicable diseases accounted for 63% of the 57 million deaths that occurred in 2008 (WHO, 2010) and this increased to 65% of 52.8 million deaths in 2010 (Lozano et al., 2012). Obesity and raised blood pressure are major risk factors (WHO, 2011) for NCDs mortality. Non-communicable diseases are estimated to cause four times as many deaths as infectious diseases, maternal, perinatal and malnutrition-related conditions combined, by 2030 (Mathers & Loncar, 2006). The increase of NCDs presents a global crisis in almost all countries regardless of income levels (WHO, 2005). Sadly, more than three-quarters of these deaths currently occur in low and middle income countries (Lozano et al., 2012; WHO, 2011) and in people younger than 60 years (Beaglehole et al., 2011) with limited facilities to manage them. The increase in cardiovascular diseases contributed 48% of these deaths in 2008 (WHO, 2010). The global burden of NCDs increased from 47% in 1990 to 54% in 2010 (Murray et al., 2012) contributing to poverty and is a main obstacle to achieving sustainable development (Beaglehole et al., 2011; Horton, 2013). It is estimated that deaths from chronic diseases will increase by 17% between 2005 and 2015, implying 35 million to 41 million (WHO, 2005). The World Health Organization has already indicated of increasing NCDs among adolescents as a main public health challenge (Michaud et al., 2007). However, on the face of these serious negative effects, NCDs remain the slightest recognised group of conditions that endanger the future of human health and development (Horton, 2013). Obesity is an independent risk factor for cardiovascular disease (Klein et al., 2004). Hypertension, mostly a co-morbidity is considered the key risk factor for cardiovascular diseases globally, especially in relation to stroke and heart attack (WHO, 2012).

Evidence exist the world is experiencing a decreasing trend in physical activity levels (Swinburn et al., 2011). In 2009, physical inactivity accounted for more than 3 million preventable deaths and was identified as the fourth leading risk factor for non-communicable diseases (Booth et al., 2008). This number increased to 3.2 and became the third top risk factor for non-communicable diseases according to report in 2011(WHO, 2011). Physical inactivity and dietary risk factors jointly accounted for 10·0% of global DALYs in 2010, with the top dietary risks being diets low in fruits and those high in sodium (Lim et al., 2012). Physical inactivity prevalence for Ghanaian adolescents aged 11-17 years was 87.9% as seen in global status report on NCDs, 2014 (WHO, 2014).

Adolescence characterizes a time of clear physical changes that are associated with changes in body image perception (Ramberan et al, 2006). Body image emphasizes on both how one feels about the size and shape of ones bodies and how precisely one perceives body size. One of the main determinants for the management of weight and diet among adolescents is perception towards body weight (Brener et al., 2004). Eating disorder tendencies are linked with perception of being overweight rather than actually being overweight (Rinderknecht & Smith, 2002). A study done among adolescents in Bahrain revealed that many overweight and obese adolescents failed to perceive themselves as such and many normal weight adolescents reported previous attempts for weight loss (Al-Sendi et al., 2004). Addressing body image issues are essential since body image disturbance persist through the stages of childhood, adolescence and adulthood which can result in eating disorders (Littleton & Ollendick, 2003) if not well managed.

Considering the many consequences associated with obesity and hypertension, availability of data on this age group is imperative to reversing the many negative effects associated with it.

1.2 Problem statement

Adolescent obesity and hypertension with their consequences are spreading across the globe regardless of economic growth. Adolescence is a critical stage of the life cycle, as it provides a single opportunity to nurture a healthy shift from childhood to adulthood (Cordeiro et al., late 2005- early 2006). It is described as both a time of opportunity and of risk. It is a window of opportunity because actions could be taken to address childhood problems, as well as to set a good foundation for the development of dietary choices and health behavior for adulthood. Even though undernutrition, especially micronutrients deficiencies is still a problem in some low- income countries, the effects of NCDs on the same population cannot be ignored (Swinburn et al., 2011).

Globally, there have been increases in prevalence of obesity with high income countries as frontrunners and low and middle income countries joining the pandemic since the 1980s (Finucane et al., 2011; WHO, 2002, 2008). The global rise of obesity has grave health effects. Raised BMI is a well-known risk factor for diseases such as type 2 diabetes, cardiovascular diseases, and many cancers (AIHW, 2004; Wiseman, 2008).

By 2008, an estimated 502 million adults globally were obese and 1.46 billion were overweight (Finucane et al., 2011) and increased to 2.1 billion in 2014 (MGI, 2014). Obesity is the third social burden generated by human beings after smoking and war (MGI, 2014). It is estimated that almost half of the world's adult population would be overweight or obese by 2030 if the growth rate in the prevalence of obesity continues on its present trajectory (MGI, 2014). That's nearly 2.5 times the number children and adults who are undernourished (MGI, 2014). In addition, estimated 170 million children age< 18 years were classified as obese or overweight globally (Lobstein et al., 2004). Obesity during childhood and adolescence is a major risk factor for metabolic syndrome (Weiss et al., 2004), adult obesity, NCDs and its co-morbidities (Black et al., 2013; de Onis, 2004). Adolescent obesity is a major public health concern (de Onis, 2004) associated often with a range of psycho-social (Puhl & Latner, 2007) and medical problems

(Choy et al., 2011; Vincent et al., 2012; Zhang & Wang, 2013).
Aside the major health consequences, obesity and NCDs pose a major economic burden to countries which includes; reduced earning capacity, lowered productivity, and increased household costs (Lobstein & Brinsden, 2014; MGI, 2014). The health of adolescents has mostly been ignored in global public health issues because this age group is assumed to be healthy (Gore et al., 2011) and so little research is done on them. However, the significance of this age group is that many serious

diseases in adulthood have their backgrounds in adolescence (Khuwaja et al., 2003) which makes it a critical and fertile time to intervene in order to reduce disease burden in adulthood.

The magnitude of obesity and hypertension is unknown in the study population. This makes it impossible to solve the health, economic and psychosocial consequences it carries. Adequate knowledge through research on the burden of the problem will inform decisions and actions to deal with it. This will reduce the likelihood of problems in adulthood (Lake et al., 2006) and will contribute to reducing the overall burden of obesity and its co-morbidities in the population.

1.3 Research hypothesis

1. There is an association between dietary behaviour and other lifestyle factors and nutritional status and hypertension

Null hypothesis

1. There is no association between dietary behaviour and other lifestyle factors and nutritional status and hypertension

The following research questions were asked prior to the start of the study:

1. What are the obesity and hypertension prevalence among adolescents?
2. What are the dietary and other lifestyle factors that promote excess fat deposition and hypertension?
3. What is the strength of relationship between obesity and hypertension?
4. What is the physical activity level of adolescents?
5. What is the general perception of adolescents on body image?

1.4 Main objective of study

The main objective of the study was to identify nutrition and other lifestyle factors associated with obesity and hypertension among adolescents.

The specific objectives are:

1. To determine the prevalence of both obesity and hypertension among adolescents in the study population.

2. To find out dietary intakes and other lifestyle factors that promote excess fat deposition and hypertension

3. To determine the strength of relationship between obesity and hypertension.

4. To determine the physical activity level of adolescents.
5. To determine the perception of adolescents on body image.

1.5 Justification of study

The prevalence of obesity in general and in adolescents in particular has increased across the globe especially in the last 3 decades (Ogden et al., 2006) as evident by an increased in mean BMI since 1980 (Finucane et al., 2011). According to Styne (2001), about 50-80% of obese children become obese adults. This predicts an increased possibility of obesity-related morbidity in adulthood and subsequent increase in disease burden if nothing is done to reverse the trend (Lobstein et al., 2004).

However, Ghana demographic and health and multiple indicator cluster surveys over the years did not include adolescent's nutritional assessment; only nutritional data on children less than 5 years and women of reproductive age were collected. Considering the immense importance of good health maintenance in all age groups, this research will add to the international assessment literature, bridge the research and data gap regarding prevalence and risk factors for obesity and hypertension especially in developing countries for adolescents. This would help in the development of policies and programmes, specifically targeting the youth, in order to monitor progress and reduce the global burden of obesity and hypertension among adolescents. This would contribute immensely to achieving the voluntary global target of a 25% relative reduction in mortality from cardiovascular diseases by 2025 as set by the World Health Assembly.

CHAPTER TWO

LITERATURE REVIEW

2.1 Obesity hypotheses

Historically, two competing hypotheses existed about the possible causes of obesity, the energy balance and the endocrinology hypotheses. The energy balance hypothesis as pioneered by Newburgh considers positive caloric balance as the cause of obesity. Those who believe in this hypothesis blamed obesity on either a "perverted appetite" (excessive energy consumption) or a "lessened outflow of energy" (insufficient expenditure) (Newburgh & Johnston, 1930). Endocrinology hypothesis suggested biological underpinnings of lipogenesis. The proponents of this hypothesis believe fattening can takes place even in conditions of undernutrition. These two competing hypotheses define obesity differently and combining them gives different perspectives of the possible causes of obesity and should form the basis for public health education and management of the epidemic.

2.2 Prevalence of obesity

At least 2.8 million people die each year attributable to overweight or obesity (Ogden et al., 2006). It is also a major risk factor for heart disease, stroke and type 2 diabetes (Guh et al., 2009) and increases the risk of certain cancers (WHO, 2010). Globally, the proportion of adults with body mass index (BMI) of 25 kg/m^2 or greater increased between 1980 and 2013 from 28·8% to 36·9% in men, and from 29·8% to 38·0% in women (Ng et al., 2014). Prevalence of obesity has also increased significantly in children and adolescents in both developed and developing countries; 23·8% of boys and 22·6% of girls were overweight or obese in 2013 in developed countries (Ng et al., 2014). Obesity prevalence increased significantly among both adolescents and adults between 1999 and 2004 in United States. Adolescent overweight prevalence from the National Health and Nutrition Examination Survey (NHANES) increased to 16.0% from 13.8% among females and to 18.2% from 14.0% in males adolescents from 1999-2000 to 2003-2004 respectively. In developing countries, overweight and obesity prevalence has also increased in children and adolescents to 12·9% from 8·1% in 2013 for boys and from 8·4% to 13·4% in girls between 1980 and 2013 (Ng et al., 2014).

Clear, consistent and convincing evidence show that obesity increases the risk of morbidity, mortality and reduces the quality of life of all people (Klein et al., 2004). Increase in obesity prevalence has the potential of adding significantly to the future health burden of cardiovascular and metabolic diseases. Researches done in Ghana and Nigeria in 2012 showed that obesity prevalence among adolescents was high; 10.9% and 9.4% respectively (Mohammed & Vuvor, 2012; Oduwole et al, 2012).

2.3 Drivers of the obesity epidemic

A driver of the global obesity epidemic is defined as an environmental factor that has changed significantly during the past 40 years, is global in nature (affecting almost all countries with enabling economic conditions), and is quickly transmissible (Swinburn et al., 2011). Changes in the food system; evident by increased supply of cheap, energy-dense and relatively tasty foods seems to be the main driver of the epidemic in the last 3-4 decades (Cutler et al., 2003).

2.4 The consequences of obesity

Some of the consequences of obesity include the following; development of metabolic syndrome, cancers, diabetes type 2, hypertension, hyperlipidemia and stroke.

2.4.1 Health consequences

2.4.1.1 Metabolic syndrome

Metabolic syndrome is defined by a cluster of interconnected factors that directly increase the risk of coronary heart disease (CHD), other forms of cardiovascular atherosclerotic diseases (CVD), and diabetes mellitus type 2 (DMT2). Its major components are dyslipidemia (elevated triglycerides and apolipoprotein B (apoB)-containing lipoproteins, and low high-density lipoproteins (HDL)), elevation of arterial blood pressure (BP) and hyperlipidemia. Abdominal obesity and/or insulin resistance (IR) have gained increasing attention as the core manifestations of the syndrome (Zimmet et al., 2007). However, recently non-alcoholic fatty liver disease, chronic proinflammatory and prothrombotic states, and sleep apnea are other conditions that have been added as part of metabolic syndrome (Kassi et al., 2011). Diagnosing metabolic syndrome in children and adolescents requires the presence of central obesity plus any two or more of these other four factors; elevated triglycerides, low high-density lipoprotein (HDL)cholesterol, high blood pressure, and elevated plasma glucose (Zimmet et al., 2007). Globally, metabolic syndrome which is connected with poor health outcomes is a growing problem (Schlaich et al., 2015). The prevalence of metabolic syndrome was 6.8 percent among overweight adolescents and 28.7 percent among obese adolescents as reported in a research done in 2003 (Cook et al., 2003). A similar research revealed that metabolic syndrome increases with increasing severity of obesity and reaches 50% in severely obese youngsters (Weiss et al., 2004). Glucose intolerance and insulin resistance are common in obese children and adolescents and lead to a significant increase risk for type 2 diabetes, hypertension and cardiovascular diseases (Invitti et al., 2003). Another study found out that one third of obese children and adolescents have insulin resistance syndrome (Viner et al., 2005), while in another, prevalence of 23% of metabolic syndrome was recorded in obese adolescents in whom measurements of nontraditional cardiovascular disease risk factors were available (Invitti et al., 2006).

2.4.1.2 Type 2 diabetes

The growth in obesity prevalence contributes significantly to the current epidemic of type 2 diabetes (Scheen & Van Gaal, 2014; Wilborn et al., 2005). Abdominal adiposity, which is a feature of ectopic fat syndrome, is associated with various metabolic disturbances including silent inflammation and abnormal hormone secretion (Scheen & Van Gaal, 2014). This

contributes to insulin resistance and insulin secretory defects, with type 2 diabetes as the result. It then induces deadly pattern that leads to cardiovascular disease, cancer and liver pathologies (Scheen & Van Gaal, 2014).

2.4.1.3 High blood cholesterol

Obesity effects on cholesterol and blood pressure can account for about 45% of the increased risk of coronary heart disease (Bogers et al., 2007). An increased risk of coronary heart disease remains even for moderate overweight, independent of traditional risk factors (Bogers et al., 2007); which means the global increase of overweight and obesity may increase the incidence of coronary heart disease (CHD)

2.4.1.4 High blood pressure

Raised blood pressure was projected to cause 7.5 million deaths, about 12.8% of all deaths globally (WHO, 2010). It is the leading risk factor for mortality worldwide (WHO, 2010). All income groups are affected similarly but it is generally high in low-income populations (WHO, 2010). The positive correlation of obesity with high blood pressure in both adolescents and adults has been demonstrated by several studies (Akis et al., 2007; Choy et al., 2011; Leung et al., 2011; Moser et al., 2013; Muntner et al., 2004; Schommer et al., 2014; Silva et al., 2012). A study in china found that the risk ratios of hypertension were significantly higher, 2.8 and 8.7 in overweight, and obese adolescents respectively after adjusting for age, sex, and height (Cao et al., 2012) relative to those with normal body mass index. In Africa, a study revealed a relative risk of 14.7 for hypertension among obese adolescents compared with normal weight after adjusting for family history (Salman et al., 2010).

2.4.1.5 Cancer

Research show that each additional 5 kg/m^2 in BMI increases a man's risk of oesophageal cancer by 52%, colon cancer by 24%. Particularly, in women, endometrial cancer and gall bladder cancer by 59% and postmenopausal breast cancer by 12%. The association is strongest in women of the Asia–Pacific region (Renehan et al., 2008).

2.5 Dietary behaviour and obesity and hypertension

2.5.1 Sugar-sweetened beverages and obesity and hypertension

In one study, fructose intake as compared with glucose was associated with increased fasting and postprandial plasma triacylglycerol concentrations in men and not women (Bantle et al., 2000). A positive relationship exists between soft drink intake and global overweight, obesity, and diabetes as indicated by (Basu et al., 2013), in a cross-national analysis of 75 countries. The consumption of highly-processed energy-dense foods, unlike low energy foods such as fruits and vegetables, promotes obesity (Parry et al., 2011). Similarly, sugar-sweetened beverages intake is linked to increased rates of obesity and diabetes (WHO/FAO, 2003). This is reflective in both childhood and adulthood obesity (Basu et al., 2013; Loos et al., 2004; Malik et al, 2006) and cardiovascular disease (Hu & Malik, 2010). Consumption of ultraprocessed foods and drinks contributes to more than 18 million deaths yearly (Bloom et al., 2011; Lim et al., 2012). It does that by causing deaths through high blood pressure (9·4 million), high fasting blood glucose (3·4 million), high body-mass index (3·4 million), and high total cholesterol (2·0 million). The significant increase in the consumption of ultra-processed products (WHO/FAO, 2003) has corresponded and contributed to the increase in obesity and its comorbidities (WHO, 2010) especially in low-income and middle-income countries (Basu et al., 2013; WHO/FAO, 2003).

2.6 Waist circumference and cardiovascular risk

Waist circumference is an indirect measure of central obesity (Lobstein et al., 2004). It is well documented the strong correlation between central obesity and risk for cardiovascular disease (Ross et al., 1996). Research done indicates that waist circumference (WC) is increasing across each BMI in all age groups (Popkin & Slining, 2013). This may account for an increase in cardiovascular disease prevalence across all age groups globally. Current evidence suggests that, for Caucasians adults, waist circumferences greater than 80 cm in women and greater than 94 cm in men indicates significantly increased risk for cardiovascular disease (WHO 2002). No worldwide cutoffs exist for adolescents, however studies done indicate increased cardiometabolic risk with increasing waist circumference (Choy et al., 2011; Leung et al., 2011). Another study reported that WC is a predictor of hypertension in adolescents (Zhang & Wang, 2013) while Choy et al. (2011) correlated WC with blood pressure in both children and adolescents. Spolidoro et al. (2013) and Yin et al. (2012) reported a positive correlation of waist circumference with metabolic syndrome among children and adolescents. Many researchers have reported that abdominal obesity, defined by waist circumference (WC) measurement, is a better predictor of many cardiovascular diseases and type 2 diabetes in comparison to traditional obesity definition, based on body mass index (BMI) measurement, (Folsom et al., 2000; Janssen et al., 2002, 2004; Rexrode et al, 2001; Zhu et al., 2002).

2.7 Physical activity and obesity and hypertension

Globally, the fourth leading cause of death is physical inactivity, making it a public health priority (Kohl et al., 2012). In 2009, the global prevalence of physical inactivity was 17%
(WHO, 2009). Globally, physical inactivity causes about 3.2 million people to die each year (WHO, 2010) Insufficiently physically active people have a 20% to 30% increased risk of allcause mortality (WHO, 2010). The short and long term benefits of regular physical activity for adolescents are undisputable (Hallal et al., 2012). There is strong evidence that regular physical activity has a lot of benefits including; muscle strength, flexibility, bone strength, improved cardiorespiratory system, insulin sensitivity, improved lipid profile, mental health, and selfconfidence in children and adolescents (MEDICINE, 2013). Yet globally, approximately 80% of adolescents do not get the suggested 60 min daily of moderate-to-vigorous physical activity (Hallal et al., 2012). However, boys are more active than girls, and about two-thirds of young people spent at least 2 hours per day watching television (Hallal et al., 2012).

2.8 Metabolic indicators

Visceral fat, percentage total body fat and metabolic age were the metabolic indicators measured in this study. Waist circumference predicts abdominal visceral adiposity (Rankinen et al., 1999) and cardiovascular risk (Dobbelsteyn et al., 2001). Excess abdominal fat/tissues accumulation seems to be a key element of central obesity playing an active role in the development of the metabolic syndrome. For instance, excess VAT is accompanied by elevated triglycerides, reduced high-density lipoprotein (HDL) cholesterol, elevated blood pressure, and/or elevated fasting plasma glucose (Despres, 2007). Thus, it is not all about the fat mass, the pattern of fat distribution has an immerse influence on cardiometabolic risk (Amato et al., 2013). The strong correlation between visceral abdominal tissue and cardiovascular risk has been established in the Framingham Heart Study (Rosito et al., 2008). In other study, visceral fat in comparison with waist circumference was significantly related with cardiovascular risk factors after adjusting for BMI (Chiba et al., 2007). It is indicated that body fat % may be more efficient in identifying individuals with early stage CVD risk accumulation than BMI in a study among Japanese men (Yamashita et al., 2012).

2.9 Systematic review

2.9.1 Purpose

To understand the evidence or current knowledge on obesity and hypertension in adolescents, a systematic review of relevant literature was carried out. This helped to identify research gaps and formulation of unbiased hypotheses.

2.9.2 Methods

A search on Cochrane, Pubmed and Google scholar databases generated the data for the review. The search was done from 3rd June, 2013 to 3rd July, 2013

2.9.3 Data extraction

Relevant publication accessible through Cochrane, Pubmed and Google scholar databases on obesity and hypertension around the world were searched. Key words used were dietary factors and obesity and adolescents, obesity and adolescents, hypertension and adolescents, lifestyle and obesity among adolescents. A total of 489 references were generated but eventually 27 papers met the criteria for inclusion for the review.

2.9.4 Exclusion/inclusion criteria

Study Population- human population of the age brackets for adolescents. However, few studies included children especially cohort studies. All meta-analysis and systemic reviews were excluded. The study design for inclusion into systematic review was both observational and interventional. Out of the 27 papers reviewed, 13 were observational, 9 were interventional and 5 were others design. The outcome measures for inclusion into the review included; Body Mass Index (BMI), blood pressure, gender, race, percentage body fat, waist circumference, family history, smoking, alcohol intake, sedentary lifestyle, salt intake, social class, eating/ snacking habits

2.9.5 Summary of risk factors in papers reviewed.

The categories of risk factors identified in the studies reviewed are behavioural, dietary, environmental, and metabolic in nature.

1. Obesity: Diet and physical activity level, gender and maternal obesity, daily time spent on viewing TV, pubertal state, high socio-economic background, meals skipping especially, breakfast.
2. Hypertension: Obesity and overweight, alcohol and saturated fat intake, smoking, family history, salt intake, sedentary lifestyle like video game playing,

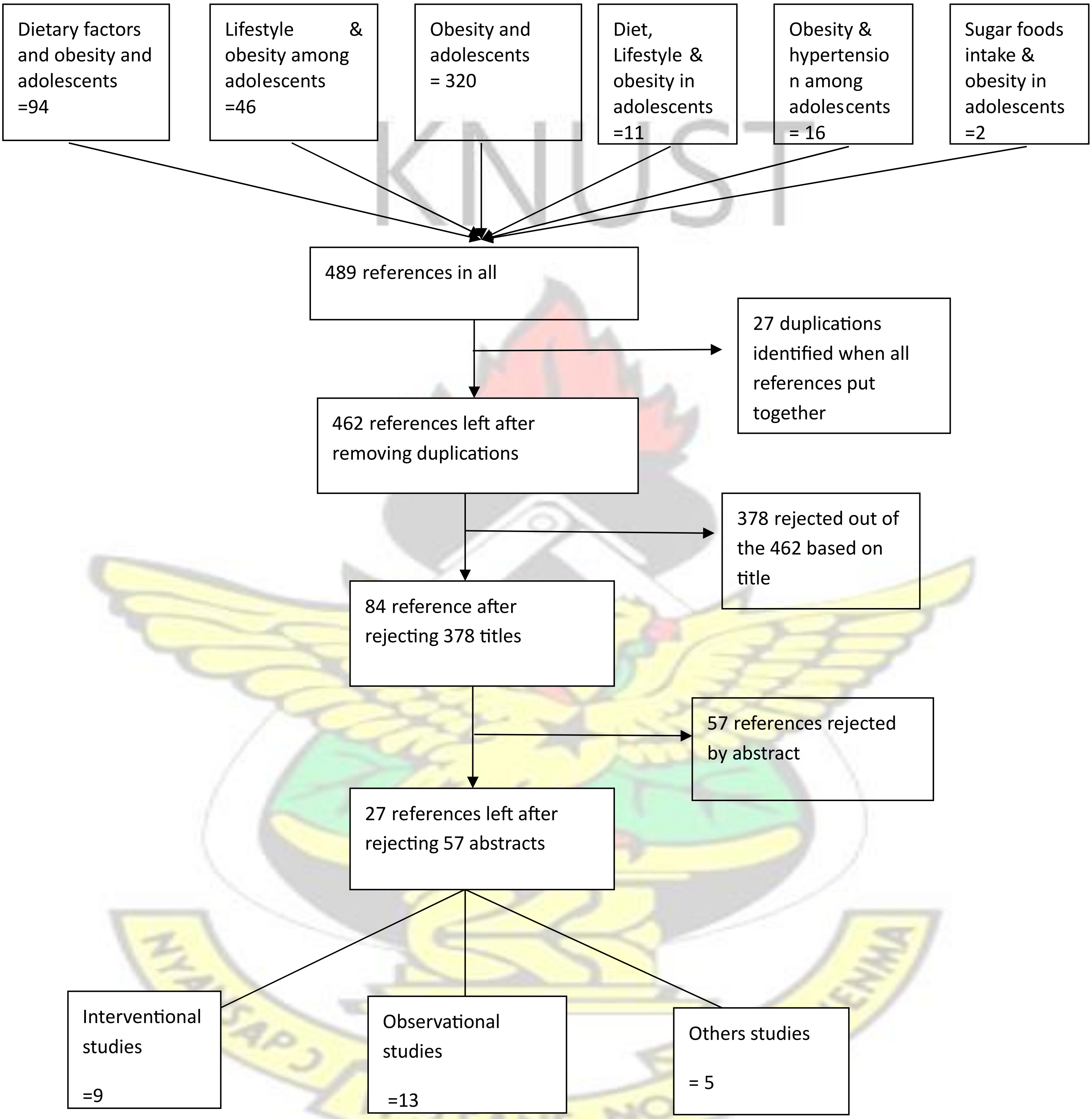

Figure 2.1 Outline of search for systemic review

2.9.6 Summary of search results

The search in the databases identified a total of 489 papers for evaluation (figure 2.1). Out of the total number of papers searched, 27 papers reviewed. Four papers measured hypertension and their associated factors, while three papers measured gender, smoking and physical activity level as risk factors. Two papers measured alcohol intake as risk factor. One paper each measured video game playing, saturated fat intake and low level of adiponectin as risk factors for hypertension. One of the papers measured social class and salt intake as risk factors for hypertension. On obesity, the search identified six studies on obesity/overweight only. Two studies measured obesity and hypertension/ elevated blood pressure. Five studies measured risk factors for both hypertension and obesity. Five studies also explored perception/self-perception and community based interventions. Two papers measured waist circumference as a risk factor for hypertension. Four papers measured age, family history and BMI as risk factors. An over 123523 adolescents with sample size ranging from a smallest of 13 to highest of 88974 were included in this review. In total, 27 studies met the inclusion criteria and were reviewed. Refer to appendix for details

2.9.7 Blood pressure measurement and reference methods

Trained personnel measured blood pressure. Except for two studies, all blood pressure measurement were taken at a single visit. Out of the measurements taken at a single visit, a minimum of two readings was normally taken with 10 minutes as the maximum interval between two or three readings (table 2.1). A mean blood pressure was normally used for analysis in all multiple readings. Two studies used manual mercury sphygmomanometer, while four studies used automated sphygmomanometers. Six out of seven studies took measurements when subjects were in a sitting position, while five out of seven indicated taking measurement on the left arm.

All reported definition for blood pressure cutoffs except two studies. Three studies used the cutoffs from the fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents (Akis et al., 2007; Leung et al., 2011; Silva et al., 2012). Two studies (Brambilla et al., 2013; Oduwole et al., 2012) used national high blood pressure Education Program working group on high blood pressure in children and adolescents as criteria. One study (Leung et al., 2011) used the WHO criteria, while Cao et al. (2012) used the reference cut-offs for Chinese children.

Table 2.1 Blood Pressure measurement

Study reference	Personnel taking BP	Initial rest time (mins	Number of visits	Interval between multiple readings	Reading used in analysis	Posture	Part of body on which BP taken	Device	BP definition
(Silva et al., 2012)	Nr	Nr	1	10 minutes	Mean of three readings	Resting (sitting)	right arm	Omron M4 digital sphygmomanometer	SBP and/or DBP ≥P95
(Akis et al., 2007)	Doctors and health sphymomanometer	Nr minutes	2	5 three percentile to <	Mean of arm automatic 99	Resting DBP >	Right 90 officer	Omiron 705 readings	IT SBP and or percentile
(Leung et al., 2011)	Trained research staff	5	3	1	All 3 reading s	Resting	nr	Accutorr Plus monitor	(SBP) or diastolic blood pressure (DBP) ≥95th centile
(Soudarssanane et al., 2006)	Nr	nr	1	3	Average of 2 readings	nr	nr	Nr	nr
(Brambilla et al., 2013)	Nr	5 minutes	1	3-5 minutes	Mean of 3 readings	Sitting	arm	aneroid sphygmomanometer	SBP and or DBP ≥ 95th centile
(Oduwole et al., 2012)	Trained investigator	Nr	1	5 minutes	Mean of 2 readings	sitting	arm	standard mercury sphygmomanometer	SBP and or DBP ≥95th percentile
(Cao et al., 2012)	Train pediatrician	5 minutes	1	Not reported	Mean of 3 readings	sitting	arm	mercury sphygmomanometer	nr

2.9.8 Study population, sample size and prevalence of hypertension

The study population was generally adolescents with age range between 5 to 19 years for six studies and one followed children from 7 months to 15 years (Niinikoski et al., 2009). A total number of 10711 adolescents were involved in this review for hypertension studies only. Sex composition is as follows with males leading, 5393 (50.3%) and 5134 (47.9%) for females. Out of the seven studies, six stated the sex composition of the adolescents (Akis et al., 2007; Chaput et al., 2011; Leung et al., 2011; Niinikoski et al., 2009; Silva et al., 2012; Soudarssanane et al., 2006) and one study did not state the sex composition of the subjects (Brambilla et al., 2013) and one study involved only males (Chaput et al., 2011). Five studies were cross-sectional (Akis et al., 2007; Brambilla et al., 2013; Leung et al., 2011; Silva et al., 2012; Soudarssanane et al., 2006) and two were randomized (Chaput et al., 2011; Niinikoski et al., 2009). Most of the studies were done in developed countries with none in Africa. The average sample size of the studies was 1480 adolescents, ranging from 22 (lowest) to 6193 (highest). The number of studies reviewed revealed prevalence of hypertension ranges from 1.44% to 42.5% with male leading. The average hypertension prevalence among males is 18.8%, while that of females' is 12.1% (Cao et al., 2012).

2.9.9 Prevalence of obesity and overweight and risk factors identified

Several of the studies looked at obesity/overweight prevalence and associated risk factors. Five studies measured obesity prevalence and gender as a risk factors (Fu et al., 2004; Mohammed & Vuvor, 2012; Nguyen et al., 2013; Peltzer & Pengpid, 2011; Yang et al., 2013). The average obesity and overweight prevalence among boys is 9.1% and 18.6% and that of girls is 7.9% and 15.9% respectively. Out of the five, three studies reported higher obesity prevalence in boys (Fu et al., 2004; Nguyen et al., 2013; Yang et al., 2013) and two reported higher overweight prevalence in girls (Mohammed & Vuvor, 2012; Peltzer & Pengpid, 2011). The age range was from 11 to 18 years. Two studies significantly associated the male gender as a risk factor for overweight and obesity (Fu et al., 2004; Nguyen et al., 2013) while one study significantly associated the female gender as a risk factor p=0.001 (Mohammed & Vuvor, 2012). One of the studies (Nguyen et al., 2013) indicated a significant decreasing effect of overweight as age increases for both sexes ($p < 0.007$ for boy and $p < 0.001$ for girls). Maternal education but no father's educational and economic level was found to be significantly associated with both overweight and obesity status among adolescents in one study (Mohammed & Vuvor, 2012). Smoking was also identified by a study as a risk factor for obesity and overweight in both sexes, while inadequate fruits intake was associated with increased risk for obesity and overweight among girls only (Peltzer & Pengpid, 2011). Consumption of breakfast was found to be associated with less overweight and obesity and with healthier dietary and physical activityrelated behaviors in a dose-dependent manner (Arora et al., 2012). Exercising for 30 minutes a day at home was significantly protective and having one overweight parent and engaging in sedentary activities for > 4 hours a day were independent risk factors for childhood overweight and obesity in one study (Bhuiyan et al., 2013). Decrease in TV viewing hours and lower BMI ≥ score at a 1-year follow up among adolescents not adults (French et al., 2012). According to Patrick et al. (2004), insufficient vigorous physical activity was the only risk factor for higher BMI for both sexes. One study correlated intake of fruits and vegetables to biomarkers of dietary indices and cardiovascular status among adolescents (Truthmann et al., 2012). A study done on obese adolescents in Ghana revealed three things: preference of high caloric foods was directly related, while fruits and vegetable intake was inversely related to obesity among the adolescents (Steiner-Asiedu et al., 2012). Again, physical activity was low and time spent on the screen was high (Steiner-Asiedu et al., 2012). Two studies, both in USA measured obese/overweight adolescents perception/knowledge. In one of the studies, overweight/obese girls selected larger ideal body figures than the others,$p < 0.001$. However, overweight/obese boys and girls apparently have a better food choice intentions and food self-efficacy than their non-obese counterparts (Chen & Wang, 2012). One study elucidated the need for proper educational package specific for adolescents, as level of knoweledge and effects of obesity is limited among the male adolescents studied (Ashcraft, 2013).

2.9.10 Prevalence and risk factors for hypertension identified

Several factors were measured in the several studies done on adolescents. Four studies found statistically significant association between age, family history, BMI and hypertension (Akis et al., 2007; Leung et al., 2011; Silva et al., 2012; Soudarssanane et al., 2006). However, two studies did not find significant association between alcohol intake, smoking and physical activity level and hypertension (Silva et al., 2012; Soudarssanane et al., 2006). Two out of three studies stated the male gender as a higher risk factor for hypertension (Silva et al., 2012; Soudarssanane et al., 2006) while one indicated the female as a risk factor (Akis et al., 2007). Waist circumference was identified as an independent risk factor (p value= 0.022) while increased physical activity as protective p value= 0.007 in another study (Leung et al., 2011). Increased salt intake was also identified by one study as major risk factor for hypertension with an increased odds ratio of 1.86 (Soudarssanane et al., 2006). Two studies (Cao et al., 2012; Oduwole et al., 2012) identified overweight and obesity as risk factors for both pre-hypertension and hypertension, either SBP or DBP (systolic or diastolic blood pressure). One study also identified girls to be of higher risk for SBP and lower risk for DBP in both pre-hypertension and hypertension (Oduwole et al., 2012) while the other study identified boys to have significant higher PHTN and HTN across all age groups (Cao et al., 2012).

2.9.11 Conclusion

The risk factors for obesity and hypertension prevalence among adolescents can be broadly classified as either environmental or genetic and appeared varied across countries and continents. The enviromental factors are generally fuelled by changes in lifestyle and dietary habits. Limited data on hypertension and obesity and risk factors exist in developing countries especially in West Africa as shown by the evidence in the systematic review. More research to identify country-specific risk factors is warranted for a reduced noncommunicable disease burden . Summary of systematic review can be found on appendix A-I

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study design

This study is a cross-sectional descriptive and analytical which is an example of observational study. Cross-sectional studies are carried out at one time point or over a short period. They are usually done to estimate the prevalence of the outcome or disease of interest for a defined population, mostly for public health planning purposes. Information on individual characteristics can also be collected, both exposure to risk factor and outcome are collected together. In this way cross-sectional studies provide a 'snapshot' of both the outcome and exposure, at a specific point in time (Levin, 2006). The obvious advantages of cross-sectional study include the following; prevalence of outcome of interest can be estimated and many risk factors and outcomes can be assessed at the same time.

However, there are inherent disadvantages too with the use of cross-sectional studies. Causal inference cannot be established, as such a study can only provide a snapshot of the problem. The prevalence is influenced by the time frame of the study. These which are some of the disadvantages (Levin, 2006).

3.2 Study site

Wa municipality of Upper West Region in Ghana was the project site.

3.3 Study subjects

The subjects for the study were students in junior and senior high schools. This level of education has the age category interested in the research. An adolescent is described by WHO as anybody within the ages of 10-19 years.

3.4 Study area population characteristics

3.4.1 Municipality profile

The Wa Municipality is one of the eleven administrative areas (District Assemblies) that make up the Upper West Region (UWR) of Ghana. It shares administrative boundaries with the Nadowli District Assembly to the North, the Wa East District Assembly to the East and South and the Wa West District Assembly to the West and South. It lies within latitudes 1º40‟N to 2º45‟N and longitudes 9º32‟ to 10º20‟W. It has a total land mass of 234.74 sq km (ASSEMBLY, 2013)

3.4.2 Demographic characteristics

The 2010 population census recorded Wa Municipal total population of 107,214 with 52,996 males and 54218 females (GSS, 2010). The adolescent population, 10-19 years proportion of total population (%) is 22% which is 23588 as indicated by UNICEF in a document titled "At a glance:

Ghana". Wa Municipality has 132 communities with 1 paramouncy, 4 Area councils and 1 Urban council.

3.4.3 Ethnic groups

Walas and Dagaabas are the major ethnic groups in the municipality. Other tribes in the minority include Dagombas, Sissalas, Frafra.

3.4.4 Geo-climatic Conditions

The municipality lies in the savannah high plains with one of the shortest rainy seasons that is from May to October each year. The erratic nature of the rainfall impacts negatively on crop production and subsequently on food and nutrition security. Temperatures are lowest in the early parts of the dry season (December/January and highest in the latter part of the dry season (March/April) with average monthly maximum of 38.5ºC and a daily highest temperature of 43ºC in March (ASSEMBLY, 2013). The vegetation of Wa municipality is guinea savannah grassland, made up of shrubs of varying heights and short trees, with grass ground cover during wet season. Shea-trees, baobab, cashew, mangoes and dawadawa are the common economic trees.

3.4.5 Socio-Economic Environment

Most of the settlements (about 80%) are rural, with the exception of Wa. The people mainly engage in subsistent farming and small-scale livestock and poultry rearing. Agricultural production is mainly rain-dependent during a short period of rainy season (May – October), followed by a prolonged dry season. Shea butter extracting, local soap manufacturing, pito brewing, weaving, dress/smock making, carpentry, masonry etc. are done on small scale and mainly around Wa. The formal sector offers employment for public/civil servants, teachers, nurses etc. Construction and hostel/hotel services are economic activities for a few. There is high poverty rate in the municipality, at the individual, household and community levels. There is empirical evidence that the Upper West Region has one of the highest proportions of poor people with 86% of the population falling below the U.N accepted poverty line (ASSEMBLY, 2013) . Currently, nine (9) out of every ten are said to be poor (ASSEMBLY, 2013). Road transport system is the main means within the Municipality. The road network is about 385km, comprising 256km laterite roads and 129km, surfaced roads (trunk tarred roads). The Municipality has four (4) trunk roads links to Kumasi and Tamale, Dorimon/Burkina Faso, Lawra-Hamile and Tumu/Leo. Wa Municipality has over 300 commercial/private vehicles population and experiences over 200 vehicles passage per day. The service providers are dominantly private operators: GPRTU, Metro Mass transport, STC, OA and Private Alliance Transport. The most predominant means of transport is the use of motor cycle. This lessens traffic situations but causes accidents in the town (ASSEMBLY, 2013)

Figure 3.1 Map of Upper West Region with Wa Municipal highlighted

3.5 Definition of obesity and hypertension

WHO Reference 2007 for children and adolescents aged 5-19 years was used as the criteria for definition of nutritional status. Obesity was defined as body mass index (BMI) for age z-score

>+ 2 standard deviations above the WHO growth standard median. Overweight as BMI for age Z-score > +1 standard deviation above the WHO growth standard median and underweight as BMI for age < 2 standard deviations below the WHO growth standard median. Normal- blood pressure of 120 or 80 mmHg or below for systolic or diastolic blood pressure respectively. Prehypertension- blood pressure of 121 to 139 mmHg for systolic and 81 to 89 mmHg for diastolic blood pressure. Hypertension- blood pressure 140/ 90 mmHg or greater.

3.6 Selection of subjects

3.6.1 Inclusion criteria

Any student within the age bracket from the thirty schools selected out of the total number of 61schools (55 junior high and 6 senior high schools) in the municipality and willing to partake in the study was included.

3.6.2 Exclusion criteria

Any student outside the age brackets and those with physical deformities that could compromise the accuracy of anthropometric measures were excluded; e.g. hunchback, cripples.

3.7 Sample size determination

Sampling indicates the selection of a part of group or an aggregate with a view of obtaining information about the whole. Sample size determination using proportionate to population size (PPS) sampling method. Proportionate to population size sampling refers to a type of multistage cluster sample in which clusters are selected not with equal probability but with probability proportionate to their size. Thus a cluster with a higher population has a higher chance of been selected. Within each cluster, however a fixed number of respondents are selected. This method of sampling is appropriate for clusters of greatly differing sizes. This was the case for the population of the adolescents in the various schools. n_{pps} □ deff □ n_{srs} Where srs=simple random sampling

Deff= design effect, which is the ratio of the variance, calculated assuming PPS divided by the variance calculated assuming simple random sampling (SRS):

Formula for calculating the design effect (deff)

$$d\hat{e}ff \;\square\; \frac{va\hat{r}(\hat{p}_{pps})}{va\hat{r}(\hat{p}_{srs})}$$

Based on the assumption of prevalence of obesity in similar studies in Ghana =10.9%, with a desired 95% confidence interval and a standard error margin of 5%, the sample size is calculated with

$$n_{pps} \;\square\; deff \;\square\; \frac{1.96^2\,\hat{p}\hat{q}}{d^2}$$

Where deff= design effect for cluster for anthropometry measures is estimated to be 2

P= 10.9% estimated obesity prevalence in Ghana from similar studies

Q= 89.1%

D= desired absolute precision, 5%

Where sample size = $2\times(1.96^2\times0.109\times0.89)/0.05^2$

= 2×149.069
=298.1

3.8 Sampling technique

A multi-stage sampling technique was employed for the purpose of this study. Multi-stage sampling is a complex form of cluster sampling which contains two or more stages in sample selection.

Cluster sampling is a technique in which clusters of participants that represent the population are identified and included in the sample. In this research, the sampling was at three stages. In the first step, the total number of junior and senior high schools was obtained from the District Education Directorate office with student populations. There were 6 senior high schools and 55 junior high schools. Then thirty schools were selected (24 junior schools and six senior high schools), using WHO STEPS sampling tool. Simple random sampling technique was used to select both the class and ten students for inclusion in the study per school. The rationale of the study was then explained to the selected students and those who agreed to partake in the study were given a consent form to fill.

3.9 Data collection and instruments

Both qualitative and quantitative techniques were used to collect data. Anthropometric indicators of weight and height were measured with a Tanita BC-533 glass inner scan body composition monitor and S0114400 height rod wall, respectively. Additionally, percentage total fat, visceral fat and metabolic age were measured with the inner scan body composition monitor. However, the body composition monitor can only measure percentage visceral fat and metabolic age for adolescents aged 18-19 years. A structured questionnaire developed was used to gather information on dietary behaviours, perception of respondents on obesity and physical activity level of respondents. Habitual dietary behaviours of respondents were also assessed using same questionnaire.

3.10 Data collection procedure

3.10.1 Anthropometric measurements

Anthropometry is defined as the use of body measurements such as weight, height and midupper arm circumference (MUAC), in combination with age and sex, to measure growth or failure to grow

(UNICEF, 2012). Changes in body proportions reflect the overall health and well-being of individuals and populations. Anthropometry is used broadly; it is cheap and noninvasive measure to monitor growth and the general nutritional status of an individual or a population group (Cogill, 2001). The four building blocks normally used to undertake anthropometric assessment are; age, sex, height and weight. When they are used together they can offer relevant information about a person's nutritional status. When two of these variables are used together they are called an index. Anthropometry is useful in predicting performance, fitness and survival of individuals and also mirror the economic and collective well-being of populations.

3.10.2 Height measurement

Height was measured to the nearest 0.1 cm, using a S0114400 height rod wall.

The height rod wall was fixed appropriately to a wall and subjects were asked to remove their shoes, heavy clothes and hair accessories. Subjects were then asked to stand with their back straight, and arms hanging loose by their sides with feet flat, buttock, shoulder blades and head touching the wall. Head piece of the height rod wall was then lowered to the vertex of the head and reading recorded.

3.10.3 Weight measurement

Body weight was measured to the nearest 0.1 kg using tanita BC-533 glass innerscan body composition monitor. The body composition monitor was placed on a flat surface and turned on for it to display 0.0 kg. Participant data; age, height, sex, physical activity level were inputted into scale and waited till 0.00 appeared on scale. Participants were asked to remove their footwear (shoes, slippers, sandals, etc) and socks. Each participant stepped onto scale with one foot on each side of the scale. Participant were asked to: stand still, face forward, place arms on the side and wait until asked to step off. Weight, metabolic indicators (Total % body fat, percentage visceral fat and metabolic age) figures that appeared on the screen were recorded in the space provided on the questionnaire. However, metabolic age and percentage visceral fat could be measured for subjects aged 18-19years.

3.10.4 Waist circumference

Waist circumference was measured by the researcher, at the level midway between the lower rib margin and the iliac crest. The subjects were asked to breathe out gently during the measurement. The tape was held firmly in horizontal position. The procedure used for measuring was as follows; The researcher stood at one side of the participant and located the last palpable rib and the top of the hip bone with the help of the subjects. Participants were asked to wrap the tension tape around them and then positioned the tape at the midpoint of the last palpable rib and the top of the hip bone, making sure to wrap the tape over the same spot on the opposite side. Then participants were asked to stand with their feet together with weight evenly distributed across both feet; hold the arms in a relaxed position at the sides. Subjects were asked to breathe normally for a few breaths, then make a normal expiration. Waist circumference measurement was read on the tape to the nearest 0.1 cm, making sure to keep the measuring tape snug but not tight enough to cause compression of the skin. The measurement in centimeter was written in the space provided on the questionnaire

3.10.5 Blood pressure measurement

Blood pressure measurement was taken with a WHO approved beurer blood pressure monitor (model number BM 19, made in Germany) after the respondent had rested for least 5 minutes. Two measurements were taken and the mean of the two readings recorded as the BP measurement. Those found to have elevated blood pressure for the average of the two readings were classified as having elevated blood pressure. Blood pressure measurements were done in the mornings between 7:00am-11:00 am.

To measure the blood pressure, adolescent was asked to sit comfortably on a chair for least 5 minutes. Large cuff for the bladder was sufficiently and comfortably placed to completely cover the left arm at heart level. The final blood pressure value used was the average of two readings taken on a single occasion at approximately 15-minute intervals, the first one taken before filling the questionnaire and second one taken after filling the questionnaire.

3.10.6 Questionnaire administration

The questionnaire was in various sections, including the following, demography data, assessment of physical activity, assessment of body image perception, use of food frequency table to assess dietary pattern of respondents. Sample questionnaire is in appendix A-1

3.11 Statistical analysis

Statistical Package for Social Sciences (SPSS) software (version 20) and World Health Organization (WHO) anthroplus were used to analyze the data. The WHO anthroplus software was used to generate z-score and percentile values for each student. These values were then entered into SPSS for further analysis. Chi-square was used to test association between categorical variables. Descriptive statistics for age, height, weight, WC, BMI, SBP, DBP, %TBF, %VF and were calculated by sex and displayed as the mean ± SD. Multiple regression analysis was employed to identify risk factors for hypertension and obesity and logistic regression analysis done to identify independent predictors of hypertension. Mann Whitney test was used to identify difference in mean percentage of total body fat between normal weight and overweight/obese subjects. Significant level was defined by $p < 0.05$.

3.12 Ethical approval

The study was approved by the School of Medical Sciences/Komfo Anokye Teaching Hospital Committee on Human Research, Publication and Ethics (Ref CHRPE/AP/178/14).

CHAPTER FOUR

4.1 RESULTS

4.1 Personal information of respondents

Table 4.1 Demographic data of respondents

Characteristics	Frequency (n=302)	Percentage (%)
Age		
14	19	6.3
15	76	25.2
16	66	21.9
17	63	20.9
18	52	17.2
19	26	8.6
Gender		
Male	135	44.7
Female	167	55.3

Religious affiliation		
Christians	116	38.4
Muslims	184	60.9
Missing	2	0.7
Ethnic group		
Waala	142	47
Dagaabas	102	33.8
Sissalas	12	4
Akan	10	3.3
Others	36	11.9
Educational stage		
Junior high	243	80.5
Senior high	59	19.5

Table 4.2 Age, anthropometric, blood pressure, % total body fat, % visceral fat of subjects

Variable	Boys		Girls		Mean ± SD	p-value
	Number	Mean ±SD	Number	Mean ± SD	Total	
Age (years)	135	16.4±1.3	167	16.5±1.5	16.4±1.4	0.592
Height (cm)	135	168.0±7.3	167	160.8±10.4	164.0±9.8	0.000*
Weight (kg)	135	56.5±9.0	166	56.7±8.0	56.6±8.5	0.873
WC(cm)	135	69.8±5.1	167	72.7±6.0	71.4±5.8	0.000*

SBP (mmHg)	135	123.1±15.6	167	120.2±11.3	121.5±13.4	0.067
DBP (mmHg)	135	78.3±9.2	167	80.0±9.1	79.2±9.2	0.107
BMI (kg/m²)	135	20.0±2.5	166	21.7±2.7	20.9±2.8	0.000*
% TBF	135	10.1±4.2	164	24.1±6.2	17.8±8.8	0.000*
%VF	22	1.1±0.3	40	1.6±0.9	1.3±0.6	0.029*

WC-waist circumference BMI-Body mass index SBP-systolic blood pressure DBP-Diastolic blood pressure TBF-total body fat VF-visceral fat SD-standard deviation. * indicate significance difference between boys and girls

More adolescents, 68% were in the age range of 15-17 years, while 32% were distributed among the other ages. The dominant ethnic group was Waala, followed by Dagaabas, as shown in Table 4.1. According to Table 4.2 all variables show statistically significant difference between males and females except age, DBP, SBP and weight. %TBF is obviously different as regards sex; females' %TBF was more than twice that of males as indicated in Table 4.2. Again, from Table 4.2 height, waist circumference, BMI, percentage total body fat and percentage visceral fat were the parameters that significantly differed between males and females.

4.2 Nutritional status of adolescents

Table 4.3 Nutritional status by body mass index-for-age z-score classification

Sex	Severe thinness	Thinness	Normal	Overweight	Obese
Male	0 (0.0%)	12 (9.0%)	117(97.3%)	3(2.2%)	2(1.5%)
Female	1 (0.6%)	1 (0.6%)	131(80.9%)	28 (17.3%)	1(0.6%)
Total	1 (0.3%)	13(4.4%)	248 (83.8%)	31 (10.1%)	3(1.0%)

Table 4.4 Nutritional status of respondents by body mass index classification

Sex	Underweight	Normal	Overweight	Obese	p-value
Male	34 (25.2)	98 (72.6%)	2 (1.5%)	1 (0.7%)	0.000

Female	19 (11.4%)	122 (73.5%)	25 (15.1%)	0 (0.0%)
Total	53 (17.6%)	220 (73.1%)	27 (9.0%)	1 (0.3%)

According to Table 4.3, using WHO BMI-for-age z-score classification, 1.0% of the population were obese, while 10.1% were overweight. Obesity was higher in males, while overweight was higher in females, as shown in Table 4.3. As indicated in Table 4.4, more males were underweight and obese than females, but females were more overweight than males.

4.3 Hypertension status

Table 4.5 Diastolic blood pressure by sex

Sex	Normal	Pre-hypertensive	Hypertensive
Male	79(58.5%)	42(31.1%)	14(10.4%)
Female	85(50.9%)	63(37.7%)	19(11.4%)
Total	164(54.3%)	105(34.8%)	33(10.9%)

Table 4.6 Systolic blood pressure by sex

Sex	Normal	Pre-hypertensive	Hypertensive
Male	59(43.7%)	60(44.4%)	16(11.9%)
Female	81(48.5%)	81(48.5%)	5(3.0%)
Total	140(46.4%)	141(46.7%)	21(7.0%)

Diastolic hypertension and prehypertension were both higher in females than in males. Systolic hypertension was higher in males than in females, while prehypertension was higher in females as shown in Tables 4.5 and 4.6. Percentage of subjects who had both elevated systolic and diastolic blood pressure was 3.97%

4.4 Dietary habits

Table 4.7 Respondents habitual food intake practices

	More than once/day	Once/day	2-3 times/week	Seldom	Never

Bread, tubers cereals, rice,	180 (59.6%)	98 (32.5%)	24 (7.9%)		
Meat, fish, poultry	57 (18.9%)	147 (48.7%)	64 (21.4%)	27 (8.9%)	7 (2.3%)
Dry beans, groundnut, soy, bambara beans	8 (2.6%)	49 (16.2%)	148 (49.0%)	82 (27.2%)	15 (4.9%)
Eggs	2 (0.6%)	21 (6.9%)	82 (27.2%)	163 (54.9%)	31 (10.3%)
Dark green leafy or deep orange Vegetables	6 (2.0%)	45(14.9%)	168 (55.6%)	69 (22.8%)	14 (4.6%)
Sweets e.g biscuits, toffees	8 (2.6%)	50(16.5%)	49(16.2%)	130(43.0%)	64(21.5%)
Salty snacks: e.g popcorn, pie	5(1.6%)	26(8.6%)	55(18.5%)	154(50.9%)	61(20.2%)
Alcohol (beer, wine, etc.)				14(4.6%)	288(95.4%)
Fast foods e.g. fried rice.		8(2.7%)	23(7.61%)	152(50.3%)	119(39.40%)
Coffee, tea	2(0.6%)	131(43.7%)	75(24.9%)	69(22.8%)	24(7.9%)
Soft drinks	1(0.3%)	20(6.6%)	78(25.8%)	156(51.7%)	47(15.6%)

From to Table 4.7, food consumption practices, as indicated by respondents are as follows; carbohydrates intakes were high. About 60 % take it more than once per day, while 32.5% consume it once per day and 7.9% consume it 2-3 times per week. Soft drinks, coffee, tea and fast foods intake are relatively low. High proportion of students eat protein-based foods, as indicated above, 48.7 % take any of them once per day, while 18.9% take them more than once per day. Vegetable intake was as follows; 55.6% take it 2-3 times per week, while 14.9% consume vegetables once per day. Refer to Table 4.8 for detailed dietary practices. Table 4.8 Dietary behaviour of respondents

Sex	Less than 3 meals	3 meals	More than 3 meals		p-value
Meals frequency					
Males	22 (16.3%)	92 (68.1%)	21 (15.6%)		0.434
Females	21 (12.6%)	125 (74.9%)	21 (12.6%)		
Total	43(14.2%)	217 (71.9%)	42 (13.9%)		
Timing of last meal					
	Before 6:00pm	Between 6-8 pm	After 8 pm	After 11pm	
Males	13 (9.65)	99 (73.3%)	22(16.3%)	1(0.7%)	0.145
Females	28(16.8%)	120 (71.9%)	19 (11.4%)	0 (0.0%)	
Total	41 (13.6%)	219 (72.5%)	41 (13.6%)	1 (0.3%)	
Meal skipping behavior of respondents					
	Yes	No			
Males	59 (43.7%)	76 (56.3%)			0.499
Females	71(42.5%)	96 (57.5%)			
Total	130(43.0%)	172 (57.1%)			
Meals type skipped					
	Breakfast	Lunch	Supper		0.158
Males	27 (46.6%)	27 (46.6%)	4 (6.9%)		
Females	29 (40.8%)	27 (38.0%)	15 (21.1%)		
Total	56 (43.4%)	54 (41.9%)	19 (14.7%)		

From Table 4.8, less than 50 % of both sexes (43.3% of males and 42.5% of females) skip meals, while 56.7% of males and 57.5% of females do not skip meals. Breakfast is the frequently skipped meal, while supper is the least skipped meal. Again, on Table 4.9, about three-quarters (71.9%) of respondents eat three meals, while a smaller percentage eat more than 3 meals per day. It is also clear from the table that few respondents eat after 8pm. The difference in behaviour between males and females in above-mentioned dietary practices are not significant.

Table 4.9 Odd ratio of obese/overweight and non-obese/overweight on meals skipping

Meal skipping	OR	95% CI	P-Value
Yes No	1.2	0.82-1.70	0.398
	0.9	0.61-1.23	

*p- value is for yes response for meal skipping

Table 4.10 Meals frequency association with obesity/overweight status

Status	Less than 3 meals	3 meals	More than 3 meals	p-value
Obese/overweight	5 (14.7%)	23 (67.6%)	6 (17.6%)	0.785
Non-obese/overweight	38 (14.5%)	189 (72.1%)	35 (13.4%)	

Table 4.11 Odd ratio of family history of obesity/ overweight

Family history	OR	95% CI	P-Value
Yes	1.6	1.15-2.11	0.014
No	0.6	0.41-0.98	

Those who skipped meals have a 1.2 times higher risk of being obese or overweight, compared to those who do not skip meals as indicated. However, this is not significant, as shown in Table 4.9. In Table 4.10, number of meals eaten per day does not carry any additional risk of obesity or overweight. Those with family history of obesity or overweight carry 1.6 times higher risk and this is statistically different between the groups, as displayed in Table 4.11. Alcohol intake was very low among the respondents.

Table 4.12 Risk of obesity/overweight by sex category

Male/female	OR	95 % CI	p-value
Odds ratio for sex	0.2	0.07-0.47	0.000*
Obese/overweight	0.2	0.08-0.52	
Non-obese/overweight	1.2	1.08-1.27	

Table 4.13 comparison of various indicators between obese/overweight and nonobese/overweight

Nutritional status	Number	Median % TBF	P-value
Obese/overweight	34	31.00	0.000*
Non obese/overweight	260	15.75	
		Median systolic blood pressure	P-value
Obese/overweight	34	125.00	0.009*

Non obese/overweight	260	120.50	
		Median diastolic blood pressure	P-value
Obese/overweight	34	82.00	0.345
Non obese/overweight	260	79.5	

Tables 4.12 show that the male gender was protective against being overweight, while being a female increased the risk slightly. The median %TBF of obese/overweight was twice of nonobese/overweight as indicated in Table 4.13. Median systolic blood pressure was also different between obese/overweight and non-obese/overweight which is statistically significant but median diastolic blood pressure failed to show significant difference.

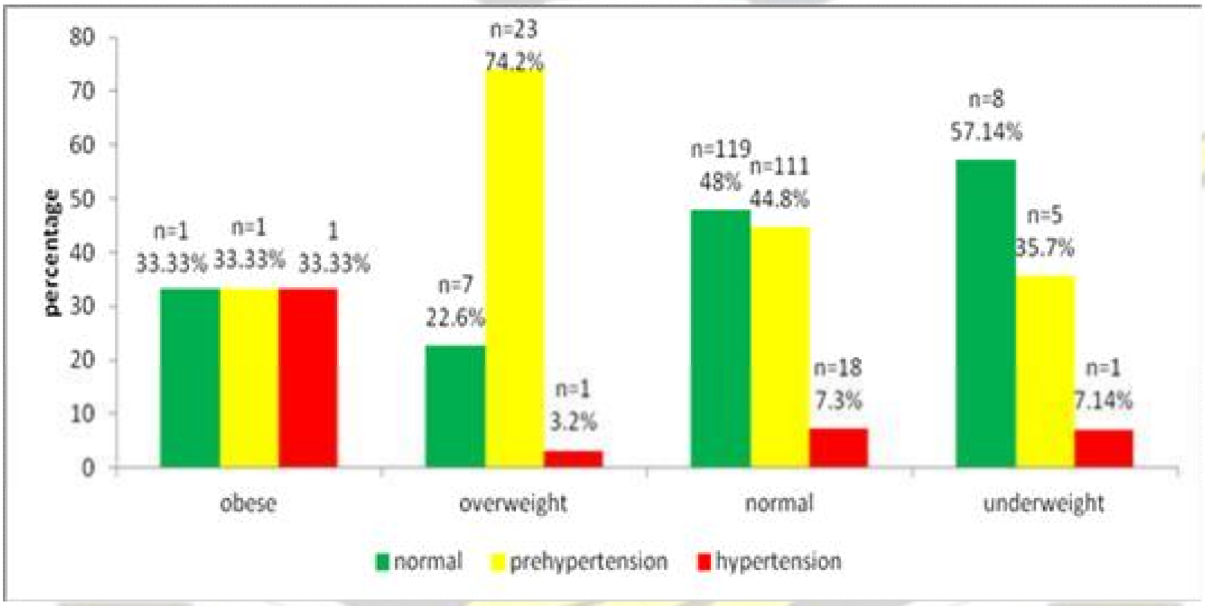

Figure 4.1 Systolic hypertension by nutritional status

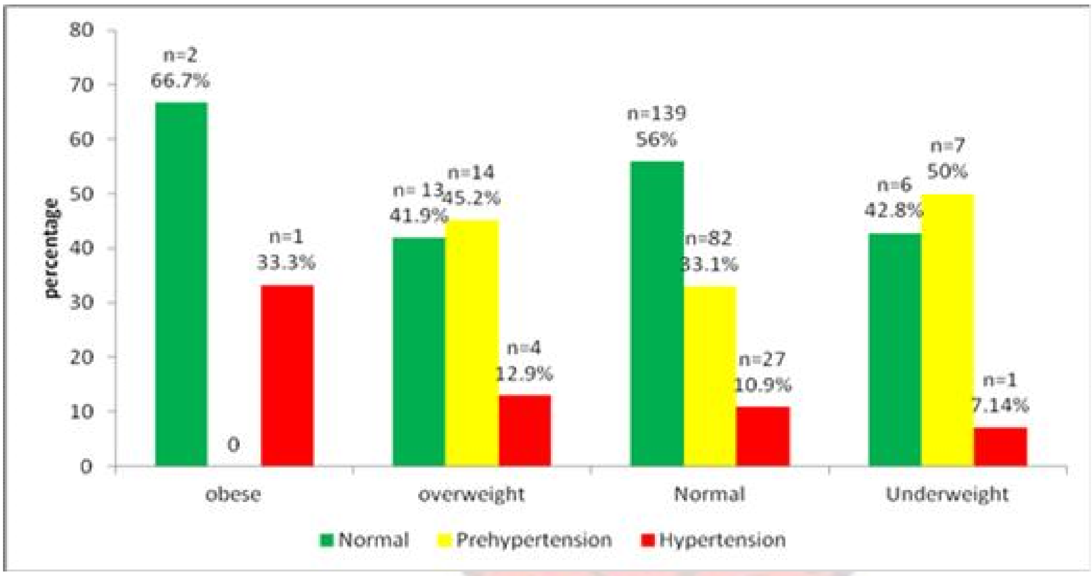

Figure 4.2 Diastolic hypertension by nutritional status

From Figure 4.1, being underweight represents the lowest risk for hypertension and prehypertension and presents the highest percentage of adolescents having normal blood pressure. Being obese carried the highest risk for systolic hypertension. Overweight carried the greatest risk of systolic hypertension and prehypertension combined, as shown in Figure 4.2.

Table 4.14 Hypertension risk by sex

	OR	95% CI	p-value
Male /female ratio	1.1 1.0		0.780
Normal diastolic blood pressure	0.9 0.2		
Hypertensive	0.9	0.5-2.3 0.9-1.1	
Male /female ratio (systolic)	4.0	0.5-1.8 0.1-0.6	0.003
Normal systolic blood pressure		0.9-1.0	
Hypertensive		1.5-10.5	

As shown in Table 4.14, male gender had 4 times higher risks for developing systolic blood pressure than female. However, risk of diastolic blood pressure was not influenced by gender.

4.5 Interrelationship of various variables measured

Table 4.15 Bivariate correlation of the various variables

Variable	SBP	DBP	Wt	Ht	Age	BMI	BMI-forage zsc	BMI-forage p	WC	Metabolic age	% TBF	%VF
SBP	1.00	.587*	.313*	.157*	.01'	.246*	.241*	.239*	.167*	.233'	.066'	.38'
DBP		1.00	.107'	.2'	-.44'	.098'	.093'	.124'	.067'	.041'	.163*	-.39'
Weight			1.00	.502*	.294*	.799*	.72*	.686*	.751*	.559*	.394*	.598*
Height				1.00	.209*	-.11'	-.15'	-.193*	.124'	-.011'	-.301*	-.086'
Age					1.00	.192'	.26'	-.006'	.222*	.264'	.062'	.319'
BMI						1.00	.941*	.931*	.78*	.619*	.673*	.552*
BMIfor-zscore							1.00	.96*	.721*	.605*	.692*	.53*
BMI-for-age per								1.00	.717*	.631*	.695*	.55*
WC									1.00	.595*	.572*	.472*
Metabolic age										1.00	.765*	.893*
% TBF											1.00	.548*
% VF												1.00

*p< 0.01 'P≥0.0

4.5.1 Correlation of variables with SBP and DBP

From the Table 4.16, both waist circumference and BMI-for-age z-score correlated positively and significantly with SBP but not DBP. However, BMI-for-age z-scores correlated more with SBP than DBP. The only variable that correlated significantly with DBP is %TBF.

4.5.2 Variables correlation with BMI-for-age z-score and BMI

Waist circumference (WC) is best predictor of high BMI-for-age z-score and BMI among the variables. However, metabolic age, %TBF and % VF also significantly correlated with BMI-forage z-score.

Table 4.16 Multiple regression models of predictor variables for hypertension

Model Predictor variables	R	r^2	Adjusted r^2	p-value
Weight	0.34	0.12	0.101	0.818
Height				0.636
Body mass index				0.696
BMI-for-age Z-score				0.482
Waist circumference				0.042*

* Higher waist circumference was the only predictor variable in the model that was significant

Table 4.17 Multiple regression models of predictor variables for obesity/overweight

Model Predictor variables	r	r^2	Adjusted r^2	p-value
Weight	0.83	0.685	0.655	0 .003*
Waist circumference				0 .107
% Total fat				0.000*
% Visceral fat				0.328
Metabolic age				0.109

*Weight and % TBF were significantly related to higher BMI-for-age z-score. Also, from the model, 68.5% of the variation in obesity/overweight are caused by the above five factors measured.

Table 4.18 Independent predictor of systolic blood pressure identified in logistic regression analysis

Independent predictor of systolic blood pressure	p-value	Adjusted OR	95% CI
Male gender	0.019	4.0	1.23-10.07

4.5.3 Variables correlation with waist circumference

The best predictor of higher waist circumference is weight among single measured variables. Others that significantly relates with it are metabolic age, percentage total body fat and percentage visceral fat. WC correlates strongly with metabolic age.

4.5.4 Variables correlation with percentage total body fat and percentage visceral fat

Waist circumference correlates more with percentage total body fat, while weight correlates more with percentage visceral fat, though both significantly relates with percentage total body fat and percentage visceral fat.

4.6 Physical activity level of respondents

Table 4.19 Best description of physical activity for the last seven days

	Frequency of physical activity for the last 7 days				
	Little or no time spent on PE	Sometimes (1-2 times last week) did PE during free time	Often (3-4 times last week)	Quite often (5-6 times last week)	Very often (7 or more times last week)
Males	21(15.6%)	65 (48.1%)	27 (20.0%)	11 (8.1%)	11 (8.1%)
Females	43 (25.7%)	86 (51.5%)	29 (17.4%)	4 (2.4%)	6 (3.0%)
Total	64 (21.2%)	151(50.0%)	56(18.5%)	15(4.9%)	17(5.6%)

The physical activity level of the students was high in both sexes. However, males exercise more frequently relative to females

Table 4.20 Frequency of various types of exercises for the respondents

Type of exercise	No exercise	1-2 times last week	3-4 times last week	5-6 times last week	7 or more times last week
Walking	65 (21.5%)	55(18.2%)	50(16.6%)	44 (14.6%)	88 (29.1%)
Skipping	267 (88.4%)	26(8.6%)	4(1.3%)	2(.7%)	3(1.0%)
Bicycling	137 (45.4%)	63(20.9%)	37(12.3%)	21(7.0%)	44(14.5%)
Aerobics	195(64.6%)	81(26.8%)	18(6%)	3(1%)	5(1.7%)
Ampe	249 (82.5%)	33(10.9%)	10(3.3%)	6(2%)	4(1.3%)

Football	178(58.9%)	75(24.8%)	21(7%)	12(4%)	16(5.3)
volleyball	265(87.7%)	23(7.6%)	8(2.6%)	1(.3%)	5(1.7%)
Running	91 (30.1%)	122(40.4%)	48(15.9%)	20(6.6%)	21(6.9%)

Walking and running are among the best form of physical activities, while skipp ng and ampe were the least forms of exercise for the respondents

Table 4.21 Exercise at other times

	None	1 times	2-3 times	4 times	5 times or more
After school	179 (59.1)	35 (11.6%)	56 (18.5%)	7(2.3%)	25 (8.3%)
Evening	173 (57.3%)	35(11.6%)	50(16.6%)	15(5%)	29(9.6%)
Last weekend	124 (41%)	82(27.2%)	89(29.5%)	2(.7%)	5(1.7%)

Last weekend was the best time respondents' exercised more than the others.

Table 4.22 Relationship between level of physical activity and obesity/overweight status

Status	All or most free time spent did little PE	Sometimes (1-2 times last week) did PE during free time	Often (3-4 times last week)	Quite often (56 times last week)	Very often (7 or more times last week)	pvalue
Obese/overweight	6(17.6%)	17(50.0%)	4(11.8%)	4(11.8%)	3(8.8%)	0.334
Non-obese/overweight	56(21.4%)	132(50.4%)	51(19.5%)	11(4.2%)	12(4.6%)	

Frequency of physical activity was not significantly associated with obesity status.

Table 4.23 Relationship between hypertension and frequency of physical activity

Hypertension Status	all or most free time spent little PE	sometimes (1-2 times last week) did PE during free time	often (3-4 times last week)	quite often (56 times last week)	very often (7 or more times last week)	p-value
Normal systolic	60 (21.8%)	139 (49.5%)	54 (19.2)	12(4.3%)	15(5.3%)	0.334
Hypertensive systolic	3 (14.3%)	12 (57.1%)	2 (9.55)	3(14.3%)	1(4.8%)	
Normal diastolic	61(22.7%)	132(49.1%)	52(19.3%)	11(4.1%)	13(4.8%)	0.124
Hypertensive diastolic	3(9.1%)	19(57.6%)	4(12.1%)	4(12.1%)	3(9.1%)	

Frequency of physical activity was not statistically associated with either systolic or diastolic blood pressure.

4.7 Body image perception

Table 4.24 Current body image grading

	Male		Female		Total		p-value
	No	%	No	%	No	%	0.841
Slim	30	22.4	36	21.6	66	21.9	
Normal	98	73.1	118	70.7	216	71.8	
Overweight	6	4.5	11	6.6	17	5.6	

Obese	0	0.0	2	1.2	2	0.7
Total	134	100.0	167	100.0	301	100.0

Table 4.25 Respondents ideal body image grading

	Male		Female		Total		p-value
	Frequency	%	Frequency	%	Frequency	%	0.009
Slim	17	12.6	18	10.8	35	11.6	
Normal	112	83.0	118	70.7	230	76.2	
Overweight	4	3.0	23	13.8	27	8.9	
Obese	2	1.5	8	4.8	10	3.3	
Total	135	100.0	167	100.0	302	100.0	

More females chose larger body image (obese and overweight) 7.8 % as against 4.5% of males, as displayed in Table 4.25. Higher percentage of females preferred larger body image as ideal than males, while higher males percentage preferred smaller body images. This is statistically significant, as indicated in Table 4.25.

Table 4.26 Respondents' current body image perception grading in relation to actual weight status (BMI-for-age z-score)

BMI-for-age grading→	Thinness/severe thinness	Normal	Overweight	Obese	p-value

Current look ↓					0.000
Underweight (males)	6(20.6%)	23 (76.7%)	1(3.3%)		
Females	2(5.6%)	32 (88.9%)	2(5.6%)		
Normal (males)	6 (6.2%)	89 (91.85)	2(2.15)		
Females		94 (82.5)	20(17.5%)		
Overweight (males)		5(71.4%)		2 (28.6%)	
Females		4(40%)	5(50%)	1(10%)	
Obese (males)					
Females		1 (50%)	1(50%)		

According to Table 4.26, out of three obese adolescents, two graded themselves as overweight. Out of the twenty-eight females who were overweight 71.4% graded themselves as normal weight and out of three overweight males, two graded themselves as overweight and one as underweight. This can have implication on eating habits.

Table 4.27 Researcher's body image grading in relation to actual weight status (BMI-for-age zscores)

BMI-for-age grading→	Thinness/severe thinness	Normal	Overweight	Obese	p-value
Current look ↓					0.000
Underweight (males)	8(26.7%)	22(73.3%)			
Females	1 (2.4%)	40 (97.6%)			
Normal (males)	4 (3.9%)	95(93.1%)	3(2.9%)		
Females	1 (0.8%)	90 (93.1%)	27 (22.9%)		

Overweight (males)			
Females	1 (50%)	1(50%)	
Obese (males)			2 (100%)
Females			1 (100%)

From Table 4.27, the researcher was able to grade all obese adolescents as obese but could only grade 3.2% of overweight individuals as overweight based on observation.

Table 4.28 Wish of body image grading of opposite sex

	Male		Female		Total		pvalue
	frequency	%	Frequency	%	Frequency	%	0.026
slim	7	5.2	30	18.0	37	12.3	
Normal	122	90.4	124	74.3	246	81.5	
Overweight	6	4.4	10	6.0	16	5.3	
Obese	0	0.0	3	1.8	3	1.0	
Total	135	100.0	167	100.0	302	100.0	

Table 4.28 shows that no male wished females to be obese and few wished females to be overweight, while females wished males to be overweight and obese.

CHAPTER FIVE

5.1 DISCUSSION

Obesity was classified by WHO BMI-for-age z-score. The prevalence of obesity and overweight in this study was 1.0% and 10.1% respectively. The median BMI-for-age z-score between obese/overweight and non-obese/overweight was significantly different, as shown by the Whitney u test. The main contributor to excess weight is fat not muscle. This is supported by the positive correlation between weight and percentage total fat as indicated in Table 4.17.

The prevalence of obesity/overweight is low, relative to similar studies done in Ghana, Nigeria and China (Mohammed & Vuvor, 2012; Oduwole et al., 2012; Zhu et al., 2015). This study revealed higher overweight prevalence among females but higher obesity prevalence in males. However, females have higher prevalence for combined obesity/overweight prevalence as indicated in Tables 4.3 and 4.4. Female higher obesity/overweight prevalence is in line with a study done in Ghana, though with a different category of adolescents. Another study done in China revealed higher prevalence among the male gender for both obesity and overweight (Zhu et al., 2015). The difference of prevalence of obesity among adolescents across studies can be explained by the methodology used, definition criteria and the age categories within adolescent age used as study subjects. For instance, the study done in Accra- Ghana only used adolescents from one school in Accra, while this study included students from thirty (Junior high and senior high schools) across the Wa municipality.

Obesity is a major culprit to the global burden of disease; thus, the contribution of obesity to the global burden of disease; years of life lost (YLLs) and years lived with disability (YLDs) in the study population if the observed prevalence is maintained. The lower prevalence suggests possible low prevalence of comorbidities of obesity. This implies that the presence of obesityrelated morbidities would be low in the adult population in some years to come, if the factors leading to the low prevalence are identified and encouraged or maintained.

The prevalence of high blood pressure in this study was high relative to similar studies (Cao et al., 2012; Leung et al., 2011) while some other studies recorded higher prevalence (Akis et al., 2007; Silva et al., 2012). Elevated blood pressure was more likely to be diastolic than systolic. Those with isolated elevated systolic blood pressure were higher in males, while elevated isolated diastolic blood pressure was higher in females. However, 3.97% of the respondents had both systolic and diastolic blood pressure elevations with males having the higher value for both systolic and diastolic, 2.6% while that of females was 1.3%. This is in conformity with a similar study in Portugal (Silva et al., 2012).

The difference in prevalence across the various studies can be accounted for by the difference in definition criteria for hypertension and age difference within the adolescent age range of study subjects. The male gender has a higher risk for systolic blood pressure (OR=4.0, p= 0.003). Thus the males have 4.0 times higher chance of getting systolic blood pressure, compared with their female counterpart. While health education on hypertension prevention should include obesity, others dietary practices like excessive salt, and trans fats intake should be emphasized as part of the education to take care of the risk factors of hypertension.

Obesity is now a critical global health issue, requiring a comprehensive knowledge within sexes and age groups, in order to inform rolling out of intervention strategies at all levels. It is a composite, systematic issue with no simple solutions (MGI, 2014) but we need to know the factors responsible in order to reverse the increasing obesity trend.

This study also explored factors associated with obesity. The study revealed higher prevalence among females as did a similar study at China (Yang et al., 2013) but in contrast to another study which reported a higher prevalence among males in Vietnam (Nguyen et al., 2013), suggesting sex as a necessary risk factor for obesity and overweight. Much of the excess weight of the female was fat. This implicates either energy balance or endocrinology hypothesis or both. The difference in obesity and overweight prevalence between males and females can partly be explained by the low physical activity level of females relative to males, as indicated in the difference in physical activity levels. Regardless of the gender-specific vulnerability, emphasis should be placed on the modifiable risk factors as they play an active role in the full manifestation of the non-modifiable risk factors.

Family history was also found to be positively associated with obesity/overweight in this study as shown by a similar study in Bangladesh (Bhuiyan et al., 2013). This was statistically significant with an increased odd of 1.6 as indicated in Table 4.12. The possible reasons for the positive relationship between family and obesity/overweight status could be environmental, genetic or both. The dietary habits of parents might be what children take after, knowingly or otherwise. Holistic approach to health education with emphasis on modifiable risk factors is needed to disconnect this association. Genetic factors play an active role but the genotype need favourable environmental factors for expression; i.e., genetic factors are necessary but not sufficient for obesity manifestation in the population.

From Tables 4.9 and 4.10, the difference in meal skipping and frequency among overweight/obesity and normal weight individuals was not statistically different, though meal skipping slightly increased respondents risk by 1.2 times for overweight/obesity. A study done in Portuguese adolescents aged 13-17years (Mota et al., 2008) showed that an additional meal has a beneficial effect of reducing BMI. However, a study in Germany established an inverse relation between meals frequency and obesity in childhood (Toschke et al., 2005). This finding adds up to the evidence that meal skipping not just breakfast as indicated by some studies increases the risk for obesity and overweight among adolescents (Arora et al., 2012) and adults (Watanabe et al., 2014).

Higher weight and % TBF were the predictors of higher BMI-for-age z-score in a multiple regression analysis as shown in Table 4.17. It is also clear from Table 4.17 that 68.5% of the variation in obese/overweight status among subjects are caused by the five factors used in the multiple regression model.

A study indicated that overweight children and adolescents have low physical activity level and inadequate exercise on a regular basis (Giammattei et al., 2003) and a 10% relative reduction in prevalence of insufficient physical activity is one of the global NCDs target, so physical activity levels were assessed. This study revealed a relatively high physical activity levels across both sexes as indicated in Table 4.20 and 4.21 and this could contribute to the low obesity prevalence observed in the study population relative to other studies, as indicated in the systematic review.

This findings is in contrast with the 97.9% prevalence of physical inactivity prevalence for Ghanaian adolescents aged 11-17 years, as seen in the global status report on NCDs, 2014 (WHO, 2014). From Table 4.22, this study could not find a statistically significant association between physical activity levels and obesity/overweight risk (p=0.334). Again, this study failed to show significant association between physical activity level and risk of diastolic and systolic blood pressure (p= 0.124 and 0.334 respectively) (Table 4.23). However, in a clinical review, exercise was significantly associated with reduction in both systolic and diastolic hypertension (Wallace, 2003). This may be because physical activity levels were assessed by questionnaire rather than an accelerometre which could possibly affect accuracy of estimation and hence association.

A holistic approach of healthy lifestyle should be encouraged across all age groups and social settings, taking into account the identified risk factors for targeted groups in order to arrest the social influence on dietary behaviour and physical activity. Both alcohol and soft drinks intakes were low, relative to other places across the globe. Evidence exist that high intake of soft drinks positively correlates with obesity (Basu et al., 2013; Hu & Malik, 2010). It is believed intake of soft drinks contribute greatly to weight gain by virtue of high added sugar content, low satiety, and incomplete compensation for total energy (Malik et al., 2006). Alcohol intake was not shown to influence obesity status in this study, as did in a similar study in Ghana and Uganda (Peltzer & Pengpid, 2011). With respect to this study, family history, female gender and meal skipping are the causes of obesity.

Raised blood pressure is the leading cause of death from NCDs globally, hence the need to identify the possible risk factors, in order to mitigate its effect. Waist circumference was also measured and its association with obesity and high blood pressure explored. Waist circumference is a measure of central obesity. It is well documented that it has a role in weight gain, especially central obesity, hypertension and other morbidities among adolescents (Cao et al., 2012; Choy et al., 2011; Janssen et al., 2002; Leung et al., 2011; Zhang & Wang, 2013). A significant positive correlation was seen between waist circumference and systolic but not diastolic blood pressure in this study (correlation coefficient =0.167). BMI and BMI-for-age zscore correlated more with SBP than WC. However, waist circumference predicted systolic blood pressure more than any of the factors in a multiple regression analysis, as indicated in Table 4.16. This means that as the waist circumference increases, it increases adolescent's chances of getting systolic blood pressure. The association between waist circumference and systolic blood pressure predicts an increase in prevalence of systolic blood pressure in the adolescent and adult population if nothing is done to reverse the observed link.

Health education on the need to reduce weight in general and central obesity in particular should be the message, as obesity is associated with many cardiovascular diseases. A binary logistic regression analysis revealed the male gender as the main predictor of systolic blood pressure, as shown in Table 4.18. Waist circumference measurement, which is simple, noninvasive method of estimating risk for cardiovascular diseases, should be encouraged in health facilities. Being obese carried an average increased risk for hypertension. This is indicated by the increase in percentage of obese individuals who had hypertension in Figures 4.1 and 4.2 relative to those that were overweight, normal weight or underweight. Overall, obesity, waist circumference, and male gender are the reliable predictors of hypertension in this study.

Metabolic age is a reflection of physical health. It compares the basal metabolic rate to the age associated with the level of metabolism. A metabolic age greater than the actual age suggests an imbalance between players of health; principally physical activity and food intake. This study revealed a positive relationship between metabolic age with both visceral fat and WC. It points to an imbalance between food intake and physical activity level of the respondents. This study measured the type and duration of physical activity but not amount of food intakes; it is possible the variance of visceral fat and waist circumference between obese/overweight and normal individuals is contributed by the difference in the quantity of food intake between them. This is because this study could not find any difference in physical activity levels between obese/overweight and normal individuals. It suggests WC is a crude measure of physical health especially in relation to metabolic syndrome and should be used in situations where instrument for measuring visceral fat accurately is absent.

Generally, body image perception was good among the study participants. It was found that 22.4 % of males and 21.6% of females selected underweight figures as current body size as shown in Table 4.24. In comparison with actual weight status, both sexes in the underweight were prone to consider themselves as normal, while overweight/obese participants under-estimated their category; thus choosing normal category as shown in Table 4.26. This misjudgment of current body image, compared with actual nutritional status persisted with the grading by researcher, though reduced as shown in Table 4.27. The misjudgment means there is a possibility of individuals consciously doing nothing to either increase nutrient intake or increase energy expenditure relative to what their actual nutritional status might imply. This has implications on food choices, healthy habits and subsequently nutritional and health status. Thus, adolescents who are overweight and underweight individuals who considered themselves as normal will not reduce food intake/ increase energy expenditure or food intakes with respect to reducing weight and increasing weight respectively.

Symptoms of diseases that normally are associated with overweight may not be noticed early, in order to intervene and which can lead to early onset of complications. However, more than 83% of males as against 70.7% of females chose normal body figures as ideal body image as shown in Table 4.25. About 71% of overweight females chose normal body image, while 100% of obese males chose overweight as current body image as indicated in Table 4.26. This is in conformity with a study done in Dubai among 12-17years adolescents in which 56.9% of obese males and 46.4% females considered themselves as average weight (Musaiger et al., 2012).

Perceived body image relative to objective nutritional status by the adolescents could contribute to the obesity/overweight prevalence observed since many of those who were obese/overweight considered themselves as normal. This has implications on conscious efforts on weight management as overweight/obese adolescents think they are normal.

Anthropometric measurement is the objective measure of the nutritional status relative to perceived nutritional status and this measures cardiovascular risk and so should be encouraged periodically and interpreted appropriately.

On the measure of ideal body image, more females wished larger body image for themselves relative to their male counterparts in this study. This is a reflection of knowledge deficits on the consequences of bad body image. The choice of smaller body image by females for males reflects the liking of smaller body image by females for males, while males want females to be on the normal body image range. This has a potential to impact positively on nutritional status. Males do not like heavy body images for their female counterparts which have a health potential for females as this can compel females to adjust behaviour to fit body images preferred by males. The difference in body image preference for males and females is significant (p=0.026). This has telling effects on how adolescents are perceived and subsequently treated by the opposite sex.

The perception of body image may influence dietary behaviours and physical activity levels. This can have either negative or positive consequences, depending on which body image chosen because it comes with conscious efforts to maintain that particular body image.

5.2 Limitations of study

Firstly, this study tried to describe obesity and hypertension and associated risk factor only; causal relationship was not established as it is a cross-sectional study. Secondly, the use of food frequency questionnaire to collect dietary habits has an inherent disadvantage of not correctly estimating dietary intakes. This also affected the strength of association established of diatary factors on obesity and hypertension. This study also took blood pressure reading as the average of two measurements, which were taken after a rest and separated by at least 5-minute, but on one occasion only but which is not the gold standard (the gold standard for definition of high blood pressure should be based on blood pressure measured on at least three separate occasions). Thus, the possibility of misclassification of adolescents as having high blood pressure or normal blood pressure cannot be ruled out.

CHAPTER SIX

6.1 CONCLUSION

This study sought to find the prevalence of obesity and hypertension in the Wa Municipality. Dietary behaviours, perception about obesity and physical activity level were also explored. The study attempted to identify the relationship between these factors and obesity and hypertension. From this study, the prevalence of obesity and overweight was 1% and 10.1% respectively. Hypertension prevalence for respondents who had both systolic and diastolic blood pressure was 4.0%. Those with isolated systolic or diastolic pressure were 7.0% and 10.9% respectively. Dietary practices that encouraged weight gain such as soft drinks and fatty foods intakes are low in this study.

Physical activity level of participants was relatively high, as 79% of study participants exercise between 1-7 times each week. Family history was positively associated with obesity/overweight by an odd ratio of 1.6, while that of meals skipping was 1.2. The male gender was protective against obesity/overweight by a factor of 0.2. Male gender was an independent predictor of systolic blood pressure by 4.0 times higher risk, while % TBF and weight are significantly associated with higher BMI-for-age z-score.

Considering the environmental factors identified as risk factors for obesity and hypertension, an increased prevalence and associated co-morbidities are expected in adolescents and adult population if nothing is done about them.

6.2 RECOMMENDATIONS

For health promotion

Although the prevalence of obesity is relatively low, if the potential group; overweight is added the figure become 11.1% which is high as this is a measure of increasing risk for disease especially cardiovascular diseases and some cancers. If attention is not paid to this group, they would become obese in the near future since those obese now were once overweight. Hence, health programs for obesity prevention should be promoted continuously in both junior and senior high school.

It is recommended that healthy living programs be introduced in all schools to facilitate early detection and prevention of development of obesity and hypertension.

Waist circumference measurement should be included in health screening protocol in order to help identify high risk adolescents for cardiovascular diseases for timely intervention.

Further study on obesity, hypertension and associated factors should be carried out continuously so that the real magnitude of the problem is identified for appropriate intervention. A larger sample size should be selected and anthropometry of father and mother of subjects measured to establish parental association with obesity. Lipid profile and fasting blood sugar should be measured for further biochemical correlation with cardiovascular risk to be established.

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APPENDICES A-I

SECTION A: BACKGROUND INFORMATION

1. Cluster No (School ID) ………………………….. 2. Name of school……………………….

3 Stage 1. Junior high [ ] 2.Senior high [ ] 4. Adolescent ID…………………………

5. Sex 1. Male [ ] 6.Female [ ]

7. Ethnicity 1. Dagao 2.Sissala 3.Akan 4. Waala 5. Others (specify)………………

8.Religion 1. Christianity [ ] 2.Islam [ ] 3.Traditional [ ] 4. Others (specify)……………………

9 .Contact details Phone No………………………………………………………….

SECTION B PHYSICAL ACTIVITY LEVEL (PAL)

We are trying to find out about your physical activity level from the last 7 days (in the last week). This includes sports, dance or anything that make you sweat or make your legs feel tired, or games that make you breathe hard, skipping, running, soccer, and others

Remember:

This is not a test-There are no right and wrong answers

Please answer all the questions as honestly and accurately as you can — this is very important

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Walking for exercise	○	○	○	○	○
Skipping	○	○	○	○	○
Bicycling	○	○	○	○	○
Aerobics	○	○	○	○	○
Ampe	○	○	○	○	○
Football	○	○	○	○	○
Volleyball	○	○	○	○	○
Running /jogging	○	○	○	○	○
Dancing	○	○	○	○	○
Others ………………..	○	○	○	○	○

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

1. I don't do PE………………………………………… ○
2. Hardly ever ………………………………………… ○
3. Sometime …………………………………………… ○
4. Quite often………………………………………….. ○
5. Always ……………………………………………….. ○

3. In the last 7 days, what did you normally do at break time (besides eating lunch)? (Check one only.)

1. Sat down (talking, reading, doing school work)…….. ○
2. Stood around or walked around…………………….. ○
3. Ran or played a little bit……………………………… ○
4. Ran around and played quite a bit…………………… ○
5. Ran and played hard most of the time………………. ○

4. In the last 7 days, on how many days right after school, did you do sports, dance, or play game in which you were very active? (Check one only.)

   1. None………………………………………………………
   2. 1 times last week…………………………………….
   3. 2 to 3 times last week………………………………..

4. 4 times last week……………………………………

5.5 times or more last week……………………………………………

5. In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active? (Check one only.)

1. None……………………………………………………
2. 1 time last week…………………………………..
3. 2 or 3 times last week…………………………….
4. 4 last week…………………………………..
5. 5 or more times last week…………………………….
6. On the last weekend, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

1. None……………………………………
2. 1 time…………………………………
3. 2-3 times……………………………….
4. 4 times…………………………………..
5. 5 or more times…………………………..

7. Which one of the following describes you best for the last 7 days? Read all five statements before they decide on the one answer that describes you.

F. All or most of my free time was spent doing things that involve little effort……………………………………………………………………. Physical

G. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played football, went running, bike riding, did aerobics)………

H. I often (3 — 4 times last week) did physical things in my free time…………

I. I quite often (5 — 6 times last week) did physical things in my free time…….

J. I very often (7 or more times last week) did physical things in my free time….

8. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

1.None 2. little bit 3. medium 4.often 5. very often

Monday ……..
Tuesday………..
Wednesday……..
Thursday……….
Friday…………..
Saturday………..
Sunday…………..

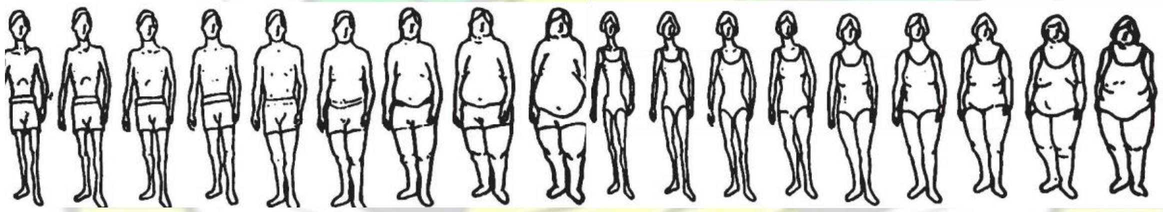
9. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes…………………………………………
No……………………………………..........

If yes, what prevented you?...

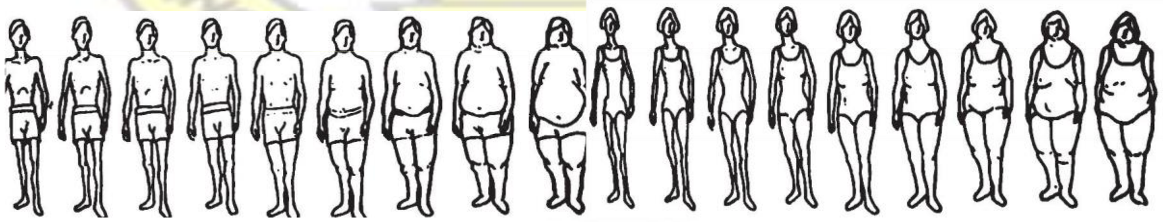
SECTION C: ASSESSMENT OF BODY IMAGE PERCEPTION.

10. Researcher grading of respondent



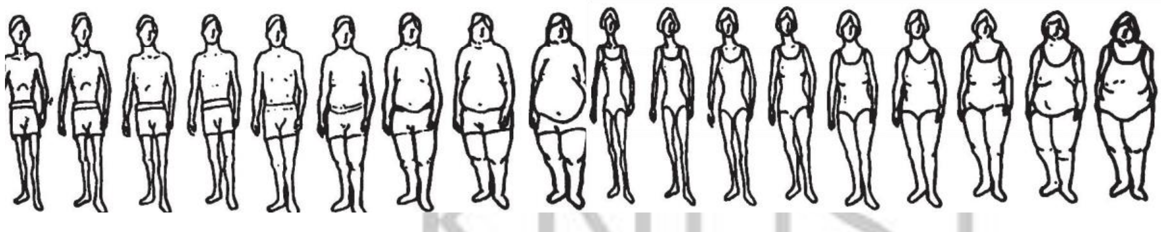
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9

11. Which figure best represent how you currently look?



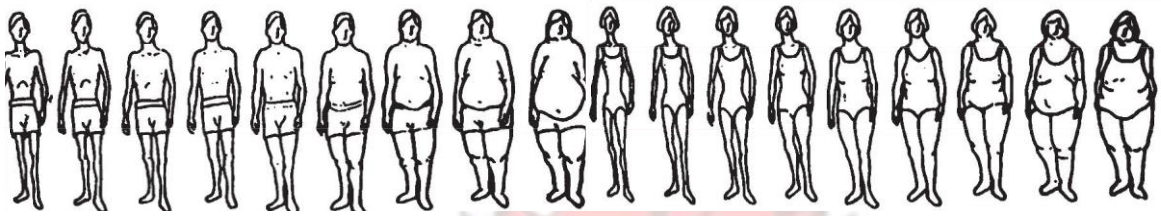
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9

12. Which figure best describes how you ideally wish to look



1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9

13. Which figure best describes how you ideally wish your opposite sex to look



1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9

SECTION D: DIETARY BEHAVIOURS

14. How many meals do you usually eat each day?

    1. < 3 meals ☐ 2. 3 meals ☐ 3. >3 meals ☐

15. What time do you usually eat the last meal of the day?

    1. Before 6:00 pm ☐ 2. Between 6-8 ☐ 3.After 8 ☐ 4. After 11 ☐

16. Do you skip meals? 1. Yes [ ] 2. No [ ]

17. If yes which of them 1. Breakfast 2. Lunch 3. Supper

18. Do you eat in between meals? 1.Yes [ ] 2.No [ ]

19. If answer to above, is yes, what type of food do you take? 1. Rice [ ] 2 T.Z [ ] 3.Biscuit [ ] 3.chocolate [ ] 4.soft drinks [ ] 5.chips or popcorn [ ] 7 Others specify ……..

20. Do you drink alcohol 1. Yes 2. No
21. Do you smoke 1.Yes 2. No

22. If yes to above, what do you smoke……………………………………………………

SECTION E: FAMILY HISTORY

23. Is your father or mother diagnosed hypertensive? 1. Yes 2. No 88. Do not know
24. If yes, which of them 1. Mother 2. Father
25. Is your father or mother heavy? 1. Yes 2. No
26. If yes, which of them 1. Mother 2. Father
27. Are you hypertensive? 1. Yes 2. No
28. If yes, are you on any medication? 1.yes 2.No
29. What kind medication? 1. Orthodox 2. Herbal/local 3. other

SECTION G: FOOD FREQUENCY QUESTIONNAIRE

	More than once/day	Once/day	2-3 times/week	Seldom	Never
Bread, tubers cereals, rice,					
Meat, fish, poultry					
Dry, beans, groundnut, soy, banbara beans					
Eggs					
Dark green leafy or deep orange vegetables					
Other fruits,					
vegetables,					
Sweets e.g biscuits, toffees					
Salty snacks: e.g popcorn, pie					
Alcohol (beer, wine, etc.)					
Fast foods e.g. fried rice.					
Coffee, tea					
Soft drinks e.g Fanta, coke, juices					

SECTION H. ANTHROPOMETRY/BP/BODY COMPOSITION MEASUREMENT

Interview date………………………… Date of birth dd/mm/yr Age (in years)……….........

I. Average BP value [ ][ ] mmHg 2nd BP Value 1st heart beat value……………

II. Height of adolescent cm 2nd heart beat value…………..

III. Weight of adolescent kg

IV. Percentage Total body fat %

V. Metabolic age yrs

VI. Waist circumference cm

Summary of systematic review

Hypertension findings

Authors	Title	study type	Country	sample size	prevalence/main findings	p-value	main risk factor/s identified/measured
(Silva et al., 2012)	Prevalence of hypertension in Portuguese adolescents in Lisbon, Portugal	Crosssectional	Portugal	234	34%-hypertensive, 12%-pre-hypertensive	p=0.001	Family history, obesity, alcohol intake, smoking and exercise level.
(Brambilla et al., 2013)	Adiponectin and Hypertension in Normal-Weight and Obese Children	crosssectional	Germany	186	Hypertension is inversely related to serum levels of AD. Serum AD was lower in OB–HT than in NW–NT	P < 0.02	obesity
(Leung et al., 2011)	Prevalence and risk factors for hypertension in Hong Kong Chinese adolescents: waist circumference predicts hypertension, exercise decreases risk	Crosssectional	China	6193	hypertension prevalence was 1.44%	not seen	Obesity

(Akis et al., 2007)	Prevalence and risk factors of hypertension among schoolchildren aged 12-14 years in Bursa, Turkey	crosssection al	Turkey	2478	14.1% prehypertension,5.4% - 1.6% -malign hypertension	p=0.003	family history, sedentary lifestyle, obesity
(Chaput et al., 2011)	Video game playing increases food intake in adolescents: a randomized crossover study	random ized crossov er	Denmar k	22	Heart rate, systolic and diastolic blood pressures, sympathetic tone, and mental workload were significantly higher during the video game play condition than during the resting condition (P< 0.05)	P< 0.05	`video games playing
(Niinikoski et al, 2009)	Blood Pressure Is Lower in Children and Adolescents With a LowSaturated-Fat Diet Since Infancy: The Special Turku Coronary Risk Factor Intervention	prospec tive random ized	Finland	925	Systolic and diastolic blood pressures were 1.0 mm Hg lower (95% CI for systolic: 1.7 to -0.2 mm Hg; 95% CI for diastolic: -1.5 to- 0.4 mm Hg) in intervention group than control	(P< 0.001)	saturated fat intake

	Project						
(Soudarssanane et al., 2006)	Key Predictors of High Blood Pressure and Hypertension among Adolescents: A Simple Prescription for Prevention	crosssectional	India	673	hypertension prevalence of 8.5%	$P < 0.05$	Social class, salt intake, parental history of hypertension, weight, height and BMI, with higher salt intake and BMI as independent predictors.

AD= Adiponectin,OB-HT= obese hypertensive, NW-NT= normal weight, normotensive PHTN=Prehypertension HTN=hypertension

Summary of obesity and hypertension and associated factors

Author(s)	Title	study type	Country	sample size	prevalence/main findings	p-value	main risk factor identified/outcome measured	population
(Yang et al., 2013)	Prevalence of obesity and overweight among Chinese children with attention deficit hyperactivity disorder: a survey in Zhejiang Province, China	outpatient department	China	158	obesity, overweight, and combined obesity/overweight prevalence were 12.0%, 17.1%, and 29.1%, respectively	not stated	ADHD, onset of puberty were at a higher risk of becoming obese or overweight.	6+ years

(Arora et al., 2012)	Association of breakfast intake with obesity, dietary and physical activity behavior among urban school-aged adolescents in Delhi, India: results of a crosssectional study	crosssectional	India	1814	It was dose–response relationship obesity prevalence between regular, sometimes and never consuming breakfast.	$p<0.05$ for trend	Breakfast consumption was associated with greater physical activity vs. those who never consumed breakfast	8th and 10th grades
(Nguyen et ta., 2013)	High prevalence of overweight among adolescents in Ho Chi Minh City, Vietnam	crosssectional	Vietnam	1,989	Overweight and obesity prevalence were 17.8% and 3.2%, respectively.	$p<0.001$	children from wealthy home	11-14 years
(Bhuiyan et al., 2013)	Risk factors associated with overweight and obesity among urban school children and adolescents in Bangladesh: a case–control study	casecontrol	Bangladesh	198	Exercising ≥ 30 minutes a day at home was a protective factor p = 0.02).	p = 0.02- Activity level p = 0.001-at least, one overweigh parent	one overweight parent at least, p = 0.001 and sedentary activities engagement for >4 hours a day, p = 0.02	10–15 years

(Mohammed &	Prevalence of childhood overweight /obesity in	crosssection	Ghan	270	obesity prevalence --10.9%	0.001	high socioeconomic	5-15
Vuvor, 2012)	basic School in Accra	al	a				background	years
(SteinerAsiedu et al., 2012)	Lifestyle and Nutrition Profile of Overweight and Obese School Children in the Ga-East District of Ghana	crosssectional	Ghana	475	generally, participants have poor dietary and physical activity behaviours	not applicable	generally, participants have poor dietary and physical activity behaviours	8-18 years
(Peltzer & Pengpid, 2011)	Overweight and Obesity and Associated Factors among School-Aged Adolescents in Ghana and Uganda	Secondary analysis	Ghana & Uganda	5,613	A prevalence of overweight or obesity for boys= 3.2% and 0.5% and girls=10.4% and 0.9% was found	Not seen	Physical activity and sedentary behaviour	13-15

(Oduwole et al., 2012)	Obesity and elevated blood pressure among adolescents in Lagos, Nigeria: a study	crosssectional	Nigeria	885	overweight and obesity prevalence were 13.8% and 9.4%, respectively	P < 0.05	P < 0.05 in all cases	A=10-13 and B=14-17 years
(Cao et al., 2012)	Blood Pressure and Obesity Among Adolescents: A SchoolBased Population Study in China	crosssectional	China	88,974	PHTN- 7.2% and HTN- 3.1%	P < 0.001	overweight and obesity	
(Fu et al., 2004)	Prevalence of Overweight Adolescents and Associated Factors in Hualien City	crosssectional	Taiwan	1,724	obesity prevalence was 20.0% of the boys and 11.0% of the girls, while prevalence of overweight was 28.5%, with 35.4% for the boys and 21.8% for the girls	not stated	gender and overweight mother	12-13 years

(Shrewsbury et al., 2011)	Short-term outcomes of community-based adolescent weight management: The Loozit® Study	Randomised controlled trial	New Zealand	130	Time spent watching TV and participating in non-screen sedentary activities decreased ($P < 0.05$). reduction in BMI, BMI z-score WHtR ,total cholesterol, low-density lipoprotein cholesterol	$P < 0.01$	not applicable	13-16 years
(Truthmann et al., 2012)	Associations of dietary indices with biomarkers of dietary exposure and cardiovascular status	not stated	Germany	5,198	Folate was positively associated with the HFD, the HuSKY, and fruit/vegetable intake for both boys and girls	not seen	homocysteine decreased across increasing quintiles of the HFD, the HuSKY, and the	12-17 years
	among adolescents in Germany				and with IFI for boys.		IFI.HuSKY (p=.007) and the IFI (p=.027)	
(Patrick et al., 2004)	Diet, Physical Activity, and Sedentary Behaviors as Risk Factors for Overweight in Adolescence	crosssectional	USA	878	Reduced risk of being AR+O as minutes per day of vigorous physical activity increased	(OR=0.93; 95% CI, 0.89-0.97) as physical activity increased	Insufficient vigorous physical activity was the only risk factor for higher BMI for both sexes	11- 15 years

(Vandewater et al., 2004)	Linking obesity and activity level with children's television and video game use	not found	USA	2831	Television use was not related to children's weight status while video game use was.	not stated	video game use was related to children's weight status	1–12 years
(French et al., 2012)	Decrease in Television Viewing Predicts Lower Body Mass Index at 1Year Follow-Up in Adolescents, but Not Adults	Randomized intervention trial.		153= adults 72=adolescents	Reduction in TV viewing may be effective in preventing excess weight gain in adolescents	P < .02	Television viewing	12-17 years
(Ashcraft, 2012)	African American Adolescent Males	hermeneutic	USA	13	Need for educational present critical information about	not stated	not applicable	13 – 17
	Living With Obesity	phenomenological			obesity and the effects of obesity in a manner that is relevant to adolescents.			years.

(Bjelland et al., 2011)	Changes in adolescents' intake of sugar sweetened beverages and sedentary behaviour: Results at 8 month midway assessment of the HEIA study - a comprehensive, multicomponent school-based randomized trial	Randomized control	Norway	1465	No of hours spent watching TV/DVD (borderline, p = 0.05) and computer/gameuse during week days (p = 0.01) for the total sample	p= 0.01 p=0.05	time spent on TV/DVD and computer was lower among girls in intervention group than in control	11years
(Y. Wang et al., 2006)	Obesity prevention in low socioeconomic status urban African-American adolescents : study design and preliminary findings of the HEALTH-KIDS Study	Randomized intervention trial	USA	Over 450 children and their families	29% reported spending ≥5 hrs each day watching TV, playing video games, or using	not stated	Averagely, 55% consumed fried foods ≥2 times/day over the past 7 days; regarding soft drinks, 70% reported consuming ≥2 times/day.	Not seen

(Chen, 2013)	Is ideal body image related to obesity and lifestyle behaviors in African-American adolescents?	Randomized intervention trial	USA	402	Overweight and obese boys and girls seem to have better food choice plans and food self-efficacy than their nonoverweight peers	P< 0.001	Overweight/obese girls selected larger ideal body figures than the others (trend test: P< 0.001).	10-14 years
(Balagopal et al, 2005)	lifestyle-only intervention attenuates the inflammatory state associated with obesity: a randomized controlled study in adolescents	Randomized controlled		21	Small lifestyle-only change in formerly sedentary obese adolescents redistributes the parameters of body. Composition in the lack of weight loss and reverses, at least in part, the inflammatory state in association with a progress of insulin resistance.	P = .02 (control gained weight while the intervention group maintained weight)	Physical activity and diet	Not seen