KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI, GHANA

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF HEALTH PROMOTION AND EDUCATION

DIETARY PATTERN IN RELATION TO OBESITY IN ADOLESCENTS IN HOHOE EVANGELICAL PRESBYTERIAN SENIOR HIGH SCHOOL (HEPSS) IN THE HOHOE MUNICIPALITY

BY

MAWUFEMOR ASHIGBIE

NOVEMBER, 2015

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MAWUFEMOR ASHIGBIE (BSC NURSING)

A THESIS SUBMITTED TO THE DEPARTMENT OF HEALTH PROMOTION AND EDUCATION OF THE SCHOOL OF PUBLIC HEALTH OF COLLEGE OF HEALTH SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN PUBLIC HEALTH (HEALTH EDUCATION AND PROMOTION)

NOVEMBER, 2015

CERTIFICATION PAGE

I hereby declare that this submission is my own work towards the MSc degree I aspire for, and that, to the best of my knowledge, it contains no previously published work by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Data available revealed that prevalence of overweight and obesity are increasing globally, more specifically in sub- Saharan Africa. Increase in weight is a risk factor for developing Non-Communicable Diseases such as hypertension, and other metabolic disorders. The objective of the study was to assess the dietary patterns in relation to obesity in female adolescent students in Hohoe Evangelical Presbyterian Senior High School in the Hohoe Municipality. A cross-sectional study of all female boarding students age 19 years and below (15-19 years) was undertaken. In all a total of 179 were enrolled in the study. Anthropometric measurement, 24-hour dietary recall and food frequency method were used to collect data. The prevalence rate of overweight and obesity was 15.6% and 3.4%, respectively, and it was highest among 17 year old adolescents. Average calories consumption was 2086 ± 465kcal/day. Nearly two-thirds (62.6%) of the female adolescents exceeds the DRI of calories intake/day whiles, 67.6%‟s protein intake was below the DRI/day. Intake of fruits and vegetables was very low as no daily consumption of fruits was recorded among the respondents. Most of the respondents whose weight was normal perceived their body size/image as normal. There was an association between only BMI and perceived body size and intake of fibre. The study revealed that the dietary pattern and lifestyle of the female students was influenced by the meals served at the dining hall. Further studies should consider the consumption of micronutrients in addition to calories and proteins.

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LIST OF ABBREVIATIONS

DRI	Dietary Reference Intake
FSH	Follicle Stimulating Hormone
GH	Growth Hormone
GnRH	Gonadotrophic-Releasing Hormone
HEPSS	Hohoe Evangelical Presbyterian Senior High School
Kcal	Kilocalories
LH	Luteinizing Hormone

MPH	Master of Public Health
RBC	Red Blood Cells
RDA	Recommended Daily Allowance
RDI	Recommended Dietary Intake
UN-DESA	United Nations Department of Economic and Social Affairs
WHO	World Health Organization

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CHAPTER ONE

1.0 INTRODUCTION

1.1: Background information

Adolescent is a person aged 10 -19 years whiles the youth are between 10 – 24 years (WHO, n.d.). Adolescents are in the process of establishing responsibility for their own health-related behaviour, including diets, and are usually open to new ideas, whilst expressing interest and curiosity (Delisle, 2005). Many habits acquired during adolescence will last a lifetime. Moreover, with growing, adolescents personal choices and preferences gain importance over eating habits acquired in the family, and they have increasingly more control over what they eat, when to eat and where these foods will be eaten (Shepherd and Dennison, 1996).

Changes in lifestyle, including food habits, are often more obvious among urban adolescents, (Ahmed *et al*., 1998), as they are usually the „early adopters" owing, among other things to their attraction for uniqueness and high exposure to commercial marketing in cities.

The life stage of childhood and adolescence is important for the establishment of eating behaviours which are often carried into adulthood (El-Gilany and Elkhawaga, 2012). Therefore, diet in the early stage of life influences health, not only during the physical development, but also later in life (Kittler & Sucher, 1998; Spear, 1996 & Parraga, 1990 cited in El-Gilany & Elkhawaga, 2012). Information on dietary patterns reflects the overall nutritional behaviour better than information on single foods or nutrients. Therefore, the analysis of dietary patterns gives a more comprehensive impression of the food consumption habits within a population.

In Ghana, as in most parts of the world, most people structure their diets around a relatively small number of starchy or carbohydrate-rich foods. Grains such as millet,

sorghum, rice, and maize (corn) and tubers such as yams and cassava (manioc), for example, form the central ingredients of the most common meals in Africa and provide the bulk of the daily caloric intake. These starchy staples are traditionally accompanied by protein-rich legumes, such as peas, beans, or peanuts, and by smaller quantities of foods that add both flavour and nutrition, such as vegetables, oils, spices, and meat or fish. These latter foods are often referred to as relishes, condiments, or sauces. This pattern of food consumption predominates in Ghana, except in the grassland north, where milk and meat play more central roles (Arthur, 2001).

Dietary patterns are frameworks that people tend to follow when making choices about what to eat. A number of factors can dictate what people eat and many of these factors overlap in various ways. These factors include nationality, culture, economic class, religion, geographical location and social norms (unpublished)

The prevalence of overweight and obesity is commonly assessed by using body mass index (BMI), defined as the weight in kilograms divided by the square of the height in metres (kg/m^2) (Hearty and Gibney, 2013). A BMI over $25kg/m^2$ is defined as overweight, and a BMI of over 30 kg/m^2 as obese (WHO, 2007b). Overweight and obesity are likely to have adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Coronary heart disease, ischaemic stroke and type 2 diabetes rise gradually with increasing body mass index (WHO, 2014). Therefore increase in BMI should be prevented early in life. The distribution of BMI is shifting upwards in many populations, and recent studies have shown that people who were undernourished in early life and then become obese in adulthood, tend to develop conditions such as high blood pressure, heart disease and diabetes at an earlier age and in more severe form than those who were never undernourished (Bosch et al., 2008).

1.2: Problem statement

The developmental transition (physical, physiology, psychological and social) during adolescence provides a context for growth, development and perpetuation of eating behaviours that are considerably different from those in other phases of life (Woods et al., 2002). After the age of 12 years, adolescent girls rarely conform to a regular pattern of three meals a day. The health of children and adolescents is dependent upon food intake to promote optimal physical growth, social and cognitive development (Monteiro, 2000; Popkin, 2005, cited in Onyiriuka et al., 2013). Healthy eating behaviour during adolescence is a fundamental prerequisite for physical growth, psychosocial development, cognitive performance and prevention of diet-related chronic diseases in adulthood (Monteiro 2000; Popkin, 2005, cited in Onyiriuka & Ibeawuchi, 2013), yet much is not documented about the eating patterns of adolescent girls in the developing world. Healthy dietary pattern is characterised by high intake of fruits, vegetables, diary, grains without added fats, mixed dishes and soups, and low intake of sweetened drinks, other sweets, fried foods and burgers (Richter et al., 2012). Dietary patterns developed during this stage may contribute to obesity, and eating disorders, may increase several important chronic diseases in later life. Heart diseases especially coronary artery disease is associated with eating habits (Dean, 1995 cited in Go et al., 2013).

Three dietary patterns were established among the adolescents in the city of Cuiaba "western", "traditional" and "mixed". "Western" diet is regarded as the high intake of energy-dense foods, fats, sugars and sodium while "traditional" dietary pattern consist of high intake of a combination of rice and beans (Rodrigues et al., 2012).

Also, six major dietary patterns "western", "sweet junks", "Asian pattern", "salty junk" and "Iranian traditional" were identified in Iran (Alizadeh et al., 2012).

Traditional Ghanaian diets include whole grain, tubers and sauce or soups (Arthur, 2001). Western dietary patterns were positively associated with metabolic syndrome risk factors such as obesity and high intake of triglycerides while traditional dietary pattern was negatively associated with metabolic syndrome risk in adolescents (Joung et al., 2012). Also, consumption of "modern foods" was linked to a higher risk of being overweight and over fat in Ouagadougou (Becquey et al., 2010). Dietary patterns were associated with differences in nutrient intake, socioeconomic status and lifestyle characteristics.

Adolescents with low socioeconomic status and boys of 16 – 17 years develop unhealthier dietary patterns; higher consumption of "take away foods", meat, confectionary and soft drinks, higher energy density, higher percent of energy from unsaturated fatty acids, lower percent of energy from carbohydrates and lower nutrient densities of several vitamins and minerals Dapi et al. (2005). Nutritional problems of adolescents, whether under nutrition or related to chronic diseases, are mainly the result of dietary inadequacies. These may be linked to a number of physiological, socio-economic and psychosocial factors. Furthermore, patterns of overweight status and nutrient and food intake were significant among adolescents" girls of low socioeconomic status (Neumark-Sztainer et al., 2002).

Psychologically, adolescents aged 13-18 years were prone to influences from peers, greater social network, family mealtime routine , media, heightened awareness of body image, eating outside the home, quality of school food/vending and coping with stress which can affect their dietary habit resulting in obesity (Esposito et al., 2009). Also, the search for identity, the struggle for independence and acceptance, and concern about appearance, tend to have a great impact on lifestyle, eating patterns among adolescents (Quatromoni, 2002 cited in Onyiriuka & Ibeawuchi, 2013). Adolescents

will also use their resources to buy clothing, make-up and other accessories to enhance their physique at the expense of their nutrition so that they can be accepted by their peers (unpublished).

Obesity varies among racial/ethnic groups. The prevalence was higher among African Americans and lowest among Asian Americans. ((Neumark-Sztainer, et al., 2002). China has some of the lowest reported prevalence rates of obesity (BMI ≥ 27) with 1.7 - 2.9% for men and 4.3% for women in the population aged 20-45 years. In Saudi Arabia, 44.0% of women in a nationally representative survey of adults over 30 years in (1995-2000) were found to be obese. Men (9.3%) and 30.1% of women (more than 15 years of age) were reported obese in 1998 in South Africa, and the prevalence of overweight among women (BMI ≥ 25) aged 15-49 was found to be 16.1% reaching 21.7% in the group aged 35-39 years old in Ghana (WHO, 2012a). Good physical and mental development and long term health is influenced by adequate provision of nutrient at the early stage of life. Poor foetal development, increased risk of complication in pregnancy, and assisted deliveries are associated with women with low BMI and short body stature. Malnourished and stunted adolescents are prone to obstetric risk; intrauterine growth restriction which leads to low birth weight (LBW), stunted and malnourished babies. More than 20% of the women in sub-Saharan Africa, south-central and south-eastern Asia have BMI less than 18.5kg/m^2 but conversely, an increase in the proportion of the women start pregnancy with BMI greater than 30kg/m^2 leading to increased risk in pregnancy as well as heavier birth weight and increased risk of obesity in children (WHO, 2012).

Despite the importance of nutrition for adolescents‟ current and future health, many adolescents consume diets that were not consistent with dietary guidelines. There was low consumption of fruits and vegetables among adolescents in southern Brazil (Rieth

et al., 2012), less desirable intakes of fruits, vegetables, dairy products, and whole grains, but higher than desirable intakes of soft drinks, confectionery, and fast foods among adolescents in the US, Europe, and Australia (Feinstein et al., 2008). Consequently, many adolescents fall short of achieving optimal nutrient intakes for good health and development.

Moore (2012) suggested that adolescents girls fail to meet the dietary recommendation in all major food groups; fruits, vegetables, diary, other meats except grains, they also have inadequacy of important micronutrients (Moore et al., 2012). These might be due to over consumption of nutrients- poor foods and excessive intake of calories from solid fats and added sugars. Adolescents in Hohoe like other adolescents who are unable to develop and conform to healthy dietary pattern may develop unhealthy weight and related chronic diseases in adulthood as discussed earlier.

There is increasing evidence that many communities in low and middle income countries are exposed to risk factors which overtime will result in a rise in prevalence and incidence of non-communicable diseases such as diabetes,

cardiovascular diseases, and cancer (Bygbjerg, 2012). This is likely to put a strain on the health system which has to cope with those diseases while they still have to address infectious diseases. It was therefore projected that non-communicable diseases will contribute to half of the disease burden in low-income countries (WHO,

2005)

Many studies on dietary patterns were concentrated on children, adults and pregnant women and were mostly done outside Ghana. It is against this background that a study is to be conducted to assess the dietary patterns of adolescents confined in educational institutions in relation to obesity.

1.3: Significance of the study

This study is conducted to find out the dietary pattern and nutritional status: obesity, overweight, normal and/or underweight of the adolescent students in HEPSS Benefits of the study are to the various sectors such as the respondents, school authority, parents/guardians of the students among others.

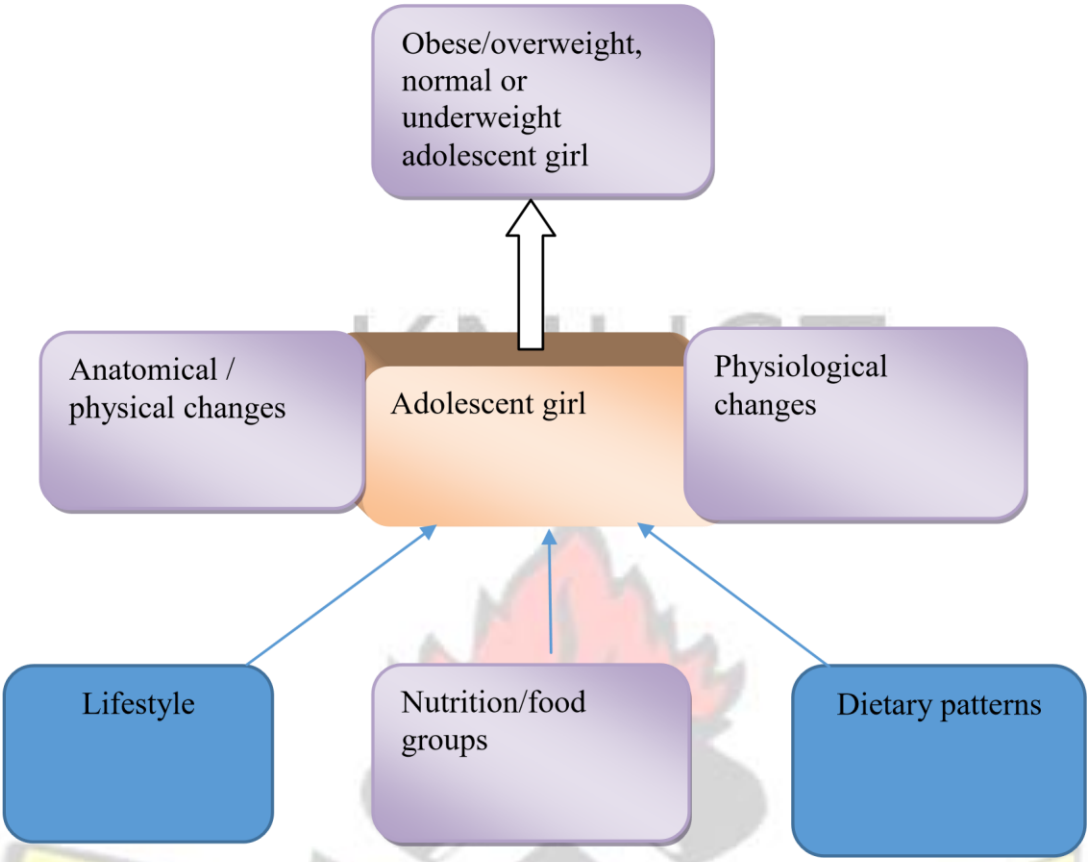
The adolescent students (respondents) are the direct beneficiaries of the study since the results of the anthropometric measurement will be communicated to them, so as to know whether their weight is above, within or below normal.

Findings of the study will be communicated to the school authority. It will provide adequate knowledge to them on types of nutrients provided by each food groups, so that the right food stuff will be bought and used to prepare food for the adolescents as well as served with the right portions of food in the dining hall. In addition, the school authority will be enlightened on the intervals between meals served in the dining hall to enable them make an adjustment when necessary.

Parents/guardians are the other beneficiaries of the study. Findings will be communicated to the parents/guardians to help them to make healthy choices when they want to buy food stuff (provisions) for the children to send to school as a supplement to the food served in the dining hall.

The study can be replicated by other researchers in a larger population. Also, the outcome from the study can serve as a basis for new research.

1.4: Conceptual framework



Conceptual framework (Author and supervisor"s construct, 2014)

1.5: Research questions

1. What is the prevalence of obesity among adolescent students in Hohoe E.P Senior High School?
2. What is the dietary pattern of these adolescent?

3. What is the influence of the dietary pattern on their obesity status?

1.6: Study objectives

1.6.1: General objective

To assess the dietary patterns in relation to obesity in female adolescents in HEPSS in the Hohoe Municipality

1.6.2: Specific objectives

1. To determine the prevalence of obesity among the female adolescents in HEPSS
2. To describe the dietary patterns of the female adolescents in HEPSS
3. To examine the effects of dietary pattern on obesity

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1: The Adolescence

Adolescence is a developmental stage between childhood and adulthood which is a very crucial period; it comes with profound changes and occasionally turmoil (Feldman, 2011). It is a complex and a dynamic process which are characterised by growth and development in several aspect of life, including physical (puberty), cognitive and psychological, and social development (Rosen, 2004). The United Nations classified adolescent between the ages of 10-19 years whilst the youth fall in the age range between 15-24 years. Other schools of thought pegged adolescence period between 12 to 18 years and 13 to 19 years, but was generally accepted that the period of adolescence among the new generation is earlier than decades ago and this was attributed to good nutrition. Sanders (2013) also classified adolescents into three categories; early adolescents, middle adolescents and late adolescents. The onset of puberty marks the beginning of early adolescence that transform the body from childhood into an adult while middle and late adolescence focuses on discovering self and intimate relationship respectively (Sanders, 2013).

The period of adolescence varies among individuals and depends on many factors. It is longer when adolescents spend much time in schooling to acquire the requisite knowledge and skills for employment, especially in the Western countries and urban areas of developing countries and shortens when the adolescents drop out of school or are not in school at all (Delisle, 2005) . The period is also shorten when the adolescent girls who stopped schooling to get married and can no longer be classified as

adolescence (Delisle, 2005). Adolescence begins before the teenage years and ends after them (Feldman, 2011).

There are about 1.8 billion adolescents and youth who make up one quarter of the world population (Awasthi, 2012, United, 2010). In 2009, adolescents aged 10–19 years in the world were 1.2 billion which represents 18% of the world‟s population. The number of adolescents has doubled since 1950. The vast majority of adolescent (88%) are in the developing countries while approximately 1 in 6 adolescents live in the developed countries. In the industrialised world, adolescents accounts for only 12% of the population (Awasthi, 2012, United, 2010).

More than half the world‟s adolescents live in the South–Asia and Pacific region, each of which consist of approximately 330 million adolescents . Sub-Saharan Africa is projected to have more adolescents than any other region by 2050. Adolescent boys are more than the adolescent girls in all regions including the industrialised countries. Parity is closest in Africa with 995 girls aged 10-19 for every 1000 boys in Eastern and Southern Africa, and 982 girls per 1000 boys in West and Central Africa, while gender gap is greatest in Asian Region (United, 2010).

Report of Expert Group meeting on Adolescents, Youth and Development of UNDESA revealed that even though youth in general is the healthiest period of life, the causes of death among the youth varies among region worldwide, the international differences of mortality amongst the youth are striking. Despite this variation, the causes of death are universal which include communicable diseases such as HIV/AIDS, tuberculosis and lower respiratory tract and the non-communicable diseases which are related to behaviour problems such as motor accidents, drugs intake, risky sexual behaviour leading to early or unintended pregnancy and others. In

more developed regions, Northern Africa, Eastern Asia and Western Asia only 1 per cent or less of 15-year olds do not survive to their 25th birthday (Awasthi, 2012).

2.1.1: Changes that occur during adolescence

2.1.1.1: Physiological and physical growth and development

Puberty occurs as a result of activity of hypothalamus pituitary-gonadal axis where oestrogen and testosterone are produced in girls and boys, respectively. At the beginning of puberty, the gonadotrophic-releasing hormone (GnRH) becomes active and its secretion stimulates the secretion of Follicle Stimulating Hormone (FSH) and Luteinising Hormone (LH) from the pituitary gland. Both hormones in turn stimulate the production of sex steroids; the testes produce testosterone in boys while oestrogen is produced by the ovaries in females (Rosen, 2004). The production of the sex steroids stimulates the development of secondary sexual characteristics, speeds somatic growth, increases fertility and many other physiologic effects (Rosen, 2004). Growth hormone-releasing hormone and somatostatin are also produced in the hypothalamus which controls somatic growth during adolescence. Both hormones have opposite effect, and a balance between them stimulates the production of GH by the pituitary gland. Local tissues under the influence of GH produces somatomedin-C (insulin like growth factor) which is directly responsible for the growth of somatic tissue (Rosen, 2004).

Growth in height

The rate at which height increases during childhood reduces prior to puberty but immediately after puberty, there is sharp increase in height (height spurt) which reaches its mid-peak immediately before menarche and spermache in girls and boys, respectively. Growth in height is delayed in boys as compared to girls because girls reach puberty earlier than the boys (Rosen, 2004). Girls who have early menarche

grow faster than those whose menarches are delayed. Growth spurt also occur in boys immediately after genital development and also lasts longer than girls.

According to Rosen (2004), height of individuals is influenced by genetic make-up. In addition, diet influences the growth of an individual, especially in the first two years of the developmental stages of which effects are irreversible e.g. stunted growth which is a measure of chronic malnutrition (Rosen, 2004).

Characteristics of puberty.

The following are the features of girls during adolescence

1. Breast bud may develop as early as 8 years but full breast development occurs between 12 -18 years
2. Pubic hair, armpit hairs and hair on the legs usually begin to grow at about 9-10 years but hair reaches adult patterns around 13 -14 years
3. Concurrent maturation of the uterus, vagina and ovaries
4. Physiologic leucorrhoea proceeds menarche
5. Growth spurt peaks around eleven and half years and slow after 16 years
6. Menarche usually occurs 2 years after development of breast, and pubic hair. Menarche may occur as early as 9 years and as late as 16 years

Characteristics of boys

1. There is thinning of the scrotum and testicular enlargement. The penis begins to lengthen and reaches it adult size and shape around 17 -18 years
2. Growth of pubic hair at the pubic area, armpit, leg, chest and face starts. Hair growth begins around age 12 years and reaches adult patterns at about 17-18 years

3. Spermache followed by regular nocturnal emission (wet dreams) marks the beginning of puberty in boys. Wet dreams typically start between age 13-17 years at an average age of 14 and half years
4. Changes in voice especially deepening of voice occur simultaneously with penis growth. Nocturnal emission occurs with peak of height spurt.
5. Growth spurt in boys peaks around 13 and half years and slows around 18 years. Intense sexual feelings which causes curiosity, interest and sometimes embarrassment for both girls and boys.

2.1.2: Cognitive development

According to Jean Piaget (1905), normal intellectual development which includes thoughts, judgement and knowledge occur sequentially from childhood to adulthood with variation in age of attainment, but strictly follow the order of sensorimotor, preoperational, concrete operational and formal operational stages. Formal operational stage begins from 12 years to adulthood. Adolescents are within this period which is characterised by logical thinking, use of symbols to relate to abstract concept including abstract relationship (Lane et al., 2011). On the other hand, Sanders (2013) classified adolescent cognitive development in three main areas which include reasoning skill, abstract and operational thinking (Sanders, 2013). He suggested that adolescents who remain at the concrete thinking level has difficulty in

solving problems impeding progress in academic work. They may lack

understanding of the consequences of their action and inactions on their health, relate cause to effect on health and may not be prepared to avoid behaviours that are risky to their health such as unsafe sex, binging, alcohol and drug use. Adolescents who progress to the abstract thinking level experience personal fable and when threatened can present with stress, depression or multiple psychosomatic symptoms (Sanders,

2013).

2.1.3: Social and emotional development

Erik Erikson (1963) defined psychosocial development as a person‟s ability to understand self, others and the world around them. The fifth stage of Erikson‟s theory identifies with adolescence which is identity verses role confusion. When adolescents are able to identify their identity, they also acquire knowledge of their role as defined by the society. Those who fail to identify themselves will also inappropriately identify their roles. Adolescents become confused with the physical changes in their body and the role expected of them by the society. At one point society expects them to act like adults and at another time expects to act like children (Kendra, 2014).

Moreover, as person grows physically, certain areas of the body become important source of frustrations, pleasure or both as stated by Sigmund Freud (1905). The genital stage of Freud‟s psychosexual stages begins from puberty to adulthood where adolescents begin sexual experimentation with the opposite sex. At this stage, the adolescent is very peculiar about the body image and appearance, which is more profound in the girls. They want to appear good among their peers and the opposite sex as a form of social acceptance (Sanders, 2013). Some adolescents diet to obtain and maintain slim body stature which is perceived as the “ideal” body image by the society. The adolescent girl may also invest her money and energy in acquiring new clothing and its accessories and cosmetics to enhance her appearance and will have little money for food or eat foods that lack the necessary nutrients needed for proper growth and development.

2.2: Nutrients Needs of Adolescents

2.2. 1: Carbohydrate

Carbohydrates are made up of carbon, hydrogen and oxygen and can be abbreviated as CHO (CDC, 2012a). They are polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers having linkages of the acetyl types (FAO/WHO, 1998). Carbohydrates can be categorised either as simple sugar (monosaccharide and disaccharides) or complex (starch, glycogen and fibre). Monosaccharide carbohydrates are made up of single sugar units which are glucose, galactose and fructose while disaccharides are combination of two simple sugars; sucrose, maltose and lactose. Simple carbohydrates are found in foods such as fruits, milk, vegetables, cakes, candy etc. which provides energy but lack vitamins, minerals and fibre (FAO/WHO, 1998, Rickman and Jakicic, 2014).

Complex carbohydrates constitute numerous chains of sugar units in the form of glycogen, starch and fibre. Glycogen is made up of highly branched chains of glucose in humans and animals. Starches and fibres consist of either branched or straight chains of glucose stored in plants. Fibre escapes digestion and absorption. Soluble fibres are easily digested by bacteria in the colon; it is associated with protecting heart diseases, preventing diabetes, and lowers cholesterol and glucose levels. Complex carbohydrates provide energy and are obtained from foods such as breads, legumes, rice, pasta, and starchy vegetables e.g. carrots. One gram of carbohydrates produces 4kcal of energy (FAO/WHO, 1998, Pope, 2014, Rickman and Jakicic, 2014).

The major sources of carbohydrates in the human diets are cereals, root crops, sugar crops, pulses, vegetable, fruits and milk products which represent over 50% of all carbohydrates consumed in the developed and developing world (FAO/WHO, 1998)

but in some developing countries much of the carbohydrates are derived from a single source such as rice, cassava, plantain or maize.

High carbohydrates diets obtained from variety of sources are not associated with adverse health effects but the composition of the diet affect the proportion of excess energy that will be stored as body fat. The body‟s capacity to store carbohydrate is limited unlike fat, excess carbohydrates tends to be oxidized to be stored as fat in the body (WHO, 2012a).

During pregnancy and lactation, there is increase demand for energy and nutrients, this enable the pregnant women to meet the increase energy needs in order to ensure a healthy offspring.

Dietary Reference Intake (DRI) for protein among females between 14-18 years is 2368kcal/day which increases in pregnancy. Additional 340kcal/day in the second trimester and 452kcal to the third trimester (Whitney and Rolfes, 2008).

Importance of carbohydrates (Pope, 2014)

1. Glucose provides energy for the brain, muscles and tissues
2. Glycogen is stored glucose which serves as reserve energy
3. Glucose is immediate energy
4. Carbohydrate provides the majority of energy in the diets of most people
5. Maintains glycaemic homeostasis
6. For gastrointestinal integrity and function

2.2.2: Proteins

Protein is a main functional and basic component of all cells in the body; it is the building block of life (CDC, 2012c). The protein molecules in the diet and the body are complex and are of variation than carbohydrate and fats and contain a more variation of elements (CDC, 2012b).

Meat, poultry, seafood and fish, legumes (beans and peas), tofu/soya, eggs, nuts, seeds, milk and milk products are the main sources of protein while grains, some vegetables, and some fruits also provide minute amount of protein (CDC, 2012b). Amino acids are derived from protein after digestion and absorption and function as the building block of proteins. There are twenty (20) types of the amino acid which are further classified as essential and non-essential (CDC, 2012b). Essential amino acids are the amino acids which can be manufactured by the body, non-essential amino acids cannot be manufactured by the body and conditional amino acids are not essential , except during illness and stress which they become essential, it includes Arginine, Cysteine, Glutamine, Ornithine, Proline, Servine, and Tyrosine.

Protein diets are classified according to the number of amino acid it contains. A protein is considered complete if it has all the amino acids. Some complete proteins are meat, fish, poultry, milk, egg, soy and cheese which are basically of animal origin except soy which is the only plant source. Incomplete proteins do not contain all the essential amino acids. Such foods include legumes, nut butters, grain and originate from plant source (CDC, 2012b). It is however suggested by Zieve *et al.*, (2011) that the quality of protein is measured by its amino acid content, digestibility and ability to support growth. Animal proteins are 90 -99% absorbable, plant protein are 70 -90% absorbable, and that of soy and legumes are 90%.

Dietary Reference Intake of protein for females aged 14-30 years is 0.8g/kg/day thus averagely 46g/day, also 10-35% of kcal/day (Whitney and Rolfes, 2008). One gram of protein produces 4kcal of energy (CDC, 2012c; Pope, 2014).

Excess or deficient protein intake can be harmful to health. High protein intake, especially animal based proteins have been related to several chronic diseases and condition such as high blood cholesterol, gout, heart diseases, some cancers, increase

calcium excretions leading to osteoporosis, weight gain and stresses the kidney (Rickman and Jakicic, 2014). It is believed that animal proteins have high contents of saturated fats, and must be consumed in moderations. Low intake lead to acute and chronic malnutrition especially in children.

Importance of protein according to (Pope, 2014)

1. Hormones e.g. insulin regulating body processes
2. Facilitate anabolic and catabolic chemical reaction
3. Regulates fluid balance thus maintaining the composition of body fluids
4. Acid-base regulation ; acts as buffers
5. Transporters of lipids, vitamins, minerals and oxygen in the body
6. Antibodies; fights antigens (bacterial and viruses) and provides immunity
7. Aid in blood clotting

2.2.3: Lipids

Lipid is a family of components that includes triglycerides (fats and oils), phospholipids and sterols (cholesterols). Fats are lipids that are solid at room temperature while oils are lipids that are liquid at room temperature. Triglyceride makes up 95% of dietary lipid and is the major form of lipid in food and in the human body. Triglycerides are found in the form of glycerol, fatty acids; saturated, monounsaturated (MUFA), polyunsaturated (PUFA; omega 3 and omega 6) (Rickman and Jakicic, 2014). Saturated fatty acids are found in animal foods such as meat, poultry, and dairy products and topical oils such as palm oil, palm kernel oil and coconut oil. Cheese and butter are also high in cholesterol. Unsaturated fatty acids are found in foods of both plants and animal sources. Sources of MUFA includes olive oil, canola oil and peanut while sunflower oil, safflower oil, soybeans oil and fatty fish

(salmon) are very rich in (PUFA). Linoleic acid (omega 3) and linolenic acid (omega 6) are the only essential fatty acids (WHO/FAO, 1993)

Phospholipids have hydrophobic phosphate head and hydrophobic fat soluble tail e.g. lecithin. Sterols are manufactured and stored in the body for a variety of purposes. Sterols are found in only animal products. Sterols include vitamin D, cholesterol, bile and sex hormone. Sterols are deposited in artery wall which leads into plague building up and heart disease. The components of cholesterol in some selected food are egg yolk – 42%, meat-36%, milk and milk products-15% and fat 5% (Rickman and Jakicic, 2014). Trans-fatty acids are created by hydrogenation which causes some of the double bond to become saturated. Hydrogenated fats are found in margarine, shortening, and baked goods (pastries/groceries). Trans-fatty acids increases blood cholesterol level and increases cardiovascular disease.

Importance of lipids (Pope, 2014)

1. Energy source especially for muscles and energy reserve. One gram of fat produces 9kcal of energy
2. Nourishes hair and skin
3. Fat pads body organs, insulates the body from extreme temperatures
4. Contribute to texture, taste, mouth feel flavour, and aroma of foods
5. Carry fat soluble vitamins and essential fatty acids

2.2.4: Vitamins

Vitamins are organic compounds essential in the diet. Vitamins are micronutrients which cannot be synthetized by the body and failure to consume causes specific diseases. Vitamins do not provide energy. They serve as components of body tissues and magic bullets of all diseases (CDC, 2011).

2.2.4.1: Classification of vitamins

1. Fat soluble- vitamins A, D, E and K
2. Water soluble includes the B vitamins: thiamine B1, riboflavin B2, Niacin B3, Pyridoxine B6, folate, vitamin B12, Biotin, Pantothenic acid and vitamin

Importance of vitamins (CDC, 2011, Rickman and Jakicic, 2014)

1. Acts as regulators in the metabolism of proteins, carbohydrates and fats into energy
2. Acts to build and maintain bones, muscles, and red blood cells
3. Cure diseases caused by their absence

Table 2. 1: Characteristics of the fat soluble and water soluble vitamins

Processes	**Fat soluble vitamins: Vitamins A,D,E,K**	**Water soluble vitamins: B vitamins and vitamin C**
Absorption	Absorbed like fats, first into the lymph, then the blood	Absorbed directly into the blood
Transport and storage	Must travel with protein carriers in watery body fluids; stored in the liver and fatty tissues	Travel freely in watery body; most are not stored in the body
Excretion	Not readily excreted; tend to build up in the tissues	Readily excreted in the urine
Toxicity	Toxicities are likely from supplements but occur rarely from food	Toxicities are unlikely but possible with high doses from supplements
Requirement	Needed in periodic doses because the body can draw from its stores	Needed in frequent doses because the body does not store them to any extent

Source: © Cengage learning cited in cousera nutrition e-learning (Rickman and Jakcic, 2014)

While each vitamin has its unique functions and features, there are few generalizations about fat soluble and water soluble vitamins.

2.2.4.1a: Fat soluble vitamins-functions, deficiencies and toxicities

Vitamin A (Retinol, Retinoic acid)

Chief function in the body: Good **v**ision, growth of bone and tooth reproduction, immunity and beta-carotene antioxidant. .Deficiency is Hypovitaminosis/night blindness.

Significant source**:** Retinol; fortified milk, cheese, cream, butter, fortified margarine, eggs, liver. Beta-carotene; spinach and other dark, leafy green; broccoli, deep orange fruits (apricots) and vegetables (winter squash, carrots, sweet potatoes and pumpkins)(Rickman and Jakicic, 2014).

Table 2.2: Vitamin A: Location in the body and Deficiency and Toxicity symptoms

System/organs	Deficiency symptoms	Toxicity symptoms
Blood/circulatory system	Anaemia	Red blood cells breakage, cessation of menstruation, epistaxis
Bone/teeth	Cessation of bone growth, painful joints, impaired enamel formation, cracks in teeth, deficiency toward tooth decay	Bone pain, growth retardation, increased pressure inside skull, headaches, bone abnormalities
Digestive system	Diarrhoea, changes in intestinal and other body linings	Abdominal pain, nausea, vomiting, diarrhoea, weight loss
Immune system	Frequent infections	Over reactivity
Nervous/muscular system	Night blindness (retinal), mental depression. Keratinization, corneal degeneration leading to blindness, rashes	Blurred vision, uncoordinated muscle, fatigue, irritability, loss of appetite
Skin and cornea	Kidney stones, impaired growth	Dry skin, rashes, loss of hair, cracking and bleeding lips, brittle nails and hair loss
Other		Liver enlargement, liver damage, birth defects

Source: © Cengage learning cited in (Rickman and Jakcic, 2014) cousera nutrition elearning

Vitamin D (calciferol, cholecalciferol)

Chief functions in the body: Mineralization of bones (raises calcium and phosphorous via blood absorption from digestive tract and by drawing calcium from bones and stimulating retention by the kidneys- regulation of calcium and phosphate metabolism. Deficiency is Rickets in children and osteomalacia in adults.

Significant sources: Self synthesis with sunlight, fortified milk and other fortified foods, liver, sardines, salmon (Rickman and Jakicic, 2014)

Table 2.3: Vitamin D: Location in the body and Deficiency and Toxicity symptoms

Systems/organs	Deficiency symptoms	Toxicity symptoms
Blood/circulatory system		Raised blood calcium, calcification of blood vessels and heart tissues
Bones/teeth	Abnormal growth, misshapen bones (bowing of legs), soft bones, joint pain, malformed teeth	Calcification of tooth soft tissues, thinning of tooth enamel
Nervous/muscular system	Muscle spasm	Excessive thirst, headaches, irritability, loss of appetite, weakness, nausea
Other		Calcification and harm to soft tissue (kidneys, lungs, joints),heart damage

Source: © Cengage learning cited in cousera nutrition e-learning (Rickman and Jakicic, 2014)

Vitamin E (Alpha-tocopherol, Tocopherol)

Chief functions in the body: Antioxidant, stabilization of cell membranes, support of immune function, protection of polyunsaturated fatty acids, normal nerve development and also aids in the formation of red blood cells and the use of vitamin K**.** Deficiency disease is rare and has no name.

Significant sources: Polyunsaturated plants oils (margarine, salad dressings, shortenings), green and leafy vegetables, wheat germ, whole grain products, nuts, seeds (CDC, 2011).

Table 2.4: Vitamin E: Location in the body and Deficiency and Toxicity symptoms

Systems/organs	Deficiency symptoms	Toxicity symptoms
Blood/circulatory system	Red blood cell breakage, anaemia	Augment the effects of anticlotting medication
Digestive system		General discomfort, nausea
Eyes		Blurred vision
Nervous/muscular system	Nerve degeneration, weakness, difficulty walking, leg cramps, lesions in muscles and nerves(rare)	Fatigue

Source: © Cengage learning cited in cousera nutrition e-learning (Rickman and Jakicic, 2014)

Vitamin K (Phylloquinone, Naphthoquinone)

Chief function in the body: Synthesis of blood clotting proteins and proteins important for bone mineralization. Deficiency symptoms include haemorrhage and poor skeletal mineralization whilst interference with anticlotting medication is a symptom of toxicity.

Significant source: Bacterial synthesis in the digestive tract; green leafy vegetables, cabbage type vegetables, soybeans, vegetable oils (Rickman and Jakicic, 2014)

2.2.4.1b: Water-soluble vitamins – functions, deficiencies and toxicities

Vitamin C (Ascorbic acid)

Chief function in the body: Collagen synthesis (strengthens blood vessel walls, forms scar tissue, matrix for bone growth), antioxidant, restore vitamin E to active form,

hormone synthesis, support immune cell functions, helps in the absorption of iron. Deficiency results in scurvy

Significant source**:** Citrus fruits, cabbage types vegetables, dark green vegetables, peppers, lettuce, tomato, potato, papayas and mango.

Table

2.5: Vitamin C: Location in the body and Deficiency and Toxicity symptoms

System/organs	Deficiency symptoms	Toxicity symptoms
Digestive system		Nausea, abdominal cramps, diarrhoea, excessive urination
Immune system	Immune system suppression, frequent infection	
Mouth, gum, tongue	Bleeding gum, loosen teeth	
Nervous/muscular system	Muscle degeneration and pain, depression, disorientation	Headache, fatigue, insomnia
Bones	Bone fragility, joint pain	Aggravation of gout
Skin	Pinpoint haemorrhage, rough skin, blotchy bruises	Rashes
Other	Failure of wounds to heal	Interference with medical test; kidney stones in susceptible people

Source: © Cengage learning cited in cousera nutrition e-learning by Rickman and Amy (2014)

Thiamine (Vitamin B1)

Chief function in the body: Part of a coenzyme needed in energy metabolism, supports normal appetite and nervous system function. Deficiency results in both dry and wet Beriberi.

Significant sources include all nutritious foods in moderate amount; pork, ham, bacon, liver, whole and enriched grains, legumes, seeds.

Table

2.6.1: Vitamin B1: Location in the body and Deficiency and Toxicity symptoms

System/organ	Deficiency symptoms	Toxicity symptoms
Blood/circulatory system	Oedema, enlarged heart, abnormal heart rhythms, heart failure	(no symptoms reported)
Nervous/muscular system	Degeneration, wasting, weakness, pain, apathy, irritability, difficulty walking, loss of reflexes, mental confusion, paralysis	
Other	Anorexia, weight loss	

Source: © Cengage learning cited in cousera nutrition e-learning by Rickman and Amy (2014)

Riboflavin (Vitamin B2)

Chief functions in the body: Part of coenzyme needed in energy metabolism, supports normal vision and skin health. Deficiency is Ariboflavinosis accompanied by cracks at corners of the mouth, smooth magenta tongue; sore throat, hypersensitivity to light, reddening of cornea and skin rashes.

Significant sources are milk, yogurt, cottage cheese, meat, liver, leafy green vegetables, whole-grain or enriched breads and cereals.

Niacin (Nicotinic acid/Nicotinamide/Niacinamide/Vitamin B3)

Chief functions in the body: Part of coenzymes needed in energy metabolism. Deficiency results in Pellagra. Niacin is obtained from milk, eggs, meat, poultry, fish, whole-grain and enriched breads and cereals, nuts, and all protein-containing foods.

Table

2.6.2: Vitamin B3/Niacin: Location in the body and Deficiency and Toxicity symptoms

System/organ	Deficiency symptoms	Toxicity symptoms
Digestive system	Diarrhoea, vomiting, abdominal pain	Nausea, vomiting
Mouth, gums, tongue	Black or bright red swollen smooth tongue	
Nervous system	Irritability, loss of appetite, weakness, headache, dizziness, mental confusion progressing to psychosis or delirium	
Skin	Flaky skin rash on areas exposed to sun	Painful flush and rash, sweating
Other		Liver damage; impaired glucose tolerance; vision disturbances

Source: © Cengage learning cited in (Rickman and Jakicic, 2014) cousera nutrition e-learning

Folate (Folic acid, Folacin, Pteroyglutamic acid)

Chief functions in the body: Part of coenzyme needed for new cell synthesis. Significant sources include asparagus, avocado, leafy green vegetables, beets, legumes, seeds, liver, enriched breads, cereal, pasta and grains

Table 2.6.3 Folate: Location in the body and Deficiency and Toxicity symptoms

System/organs	Deficiency symptoms	Toxicity symptoms
Blood/circulatory system	Anaemia , elevated homocysteine	Masks vitamin B12 deficiency
Digestive system	Heartburn, diarrhoea and constipation	
Immune system	Suppression, frequent infections	
Mouth, gums, tongue	Smooth red tongue	
Nervous/muscular system	Increased risk of neural tube birth defects. Depression, mental confusion, fatigue, irritability, headache	Depression, mental confusion, fatigue, irritability, headache

Table

Source: © Cengage learning cited in cousera nutrition e-learning (Rickman and Jakicic, 2014)

Vitamin B12 (Cytocobalamin)

Chief functions in the body: Part of coenzyme needed for new cell synthesis, helps maintain nerve cells. Toxicity symptoms include anaemia, smooth tongue, and fatigue, nerve depredation progressing to paralysis and tingling or numbness. Animal products (meat, fish, poultry, milk, cheese, eggs) are good sources.

Vitamin B6 (Pyridoxine, Pyridoxal, Pyridoxamine)

Chief function in the body: Part of coenzyme needed in amino acid and fatty acid metabolism, helps convert tryptophan to niacin and to serotonin, and helps make red blood cells. Deficiency can be presented in a form of anaemia, depression, confusion, abnormal brain wave pattern; convulsion and rashes; greasy, scaly dermatitis. Toxicity symptoms include bloating, depression, fatigue, impaired memory, irritability, headaches, and numbness, damage to nerves, difficulty, walking, and loss of reflexes, restlessness, convulsions and skin lesions.

Good sources include meats, fish, poultry, liver, legumes, fruits, potatoes, whole grains, and soy products.

Vitamin B5 (Pantothenic)

Chief functions in the body: A coenzyme needed in energy metabolism. Deficiency can be presented as vomiting, intestinal distress, insomnia, fatigue, hypoglycaemia and increased sensitivity to insulin whilst toxicity can lead to infrequent water retention. It can be obtained from variety of foods.

Vitamin B7 (Biotin-or coenzyme R)

Chief functions in the body: A cofactor for several enzymes needed in energy metabolism, fat synthesis, amino acid metabolism and glycogen synthesis.

Deficiency of vitamin B7 can be manifested as abnormal heart action, loss of appetite, nausea, depression, muscle pain, weakness, and fatigue, numbness of extremities, dry around eyes, nose and mouth. Sources include many foods.

Table 2.7: Minerals and chief functions in the body

Major minerals	Deficiency symptoms	Toxicity symptoms	Significant sources
Calcium			
The principal mineral of bones and teeth. Also acts in normal muscle contraction and relaxation, nerve functioning, regulation of cell activities, blood clotting, blood pressure and immune defences	Stunted growth in children; osteoporosis in adults	High blood calcium; abnormal heart rhythms; soft tissue calcification; kidney dysfunction; interference with absorption of other minerals; constipation	Milk and milk products, oysters, small fish (with bones), calciumset tofu (beans curd), broccoli
Phosphorus			
Mineralization of bones and teeth; important in cell‟s genetic materials, in cell membrane as phospholipids, in energy transfer, and in buffering systems	Loss of appetite, bone pain, muscle weakness, impaired growth, and rickets in infants	Calcification of non-skeletal tissues, particularly the kidney	Foods from animal sources, and some legumes
Magnesium			
A factor involved in bone mineralization, the building of protein, enzyme action, normal muscular function, transmission of nerve impulses, proper immune function and maintenance of teeth	Low blood calcium, muscle cramps, confusion, impaired vitamin D metabolism; if extreme seizures, bizarre movements, hallucinations, and difficulty in swallowing. Growth failure in children	Excess magnesium from abuse of laxatives causes diarrhoea, nausea, and abdominal cramps with fluid and electrolyte and pH imbalances	Nuts, legumes, whole grains, dark green vegetables, seafood, chocolate, cocoa
Sodium			
Sodium, chloride and potassium (electrolytes) maintain normal fluid balance in the body. Sodium is very	Muscle cramps, mental apathy, loss of appetite	Hypertension	Salt, soy sauce, seasoning mixes, processed foods, condiment, fast foods

critical to nerve impulse transmission			

Source: © Cengage learning cited in (Rickman and Jakicic, 2014) cousera nutrition e-learning

Table 2.7: Minerals and chief functions in the body cont'd

Major minerals	Deficiency symptoms	Toxicity symptoms	Significant sources
Potassium			
Potassium facilitates reactions, including the making of protein; the maintenance of fluid and electrolyte balance; the support of cell integrity; the transmission of nerve impulses, including the heart.	Deficiency accompanies dehydration; causes muscular weakness, paralysis and confusion; can cause death	Causes muscular weakness; triggers vomiting; if given into vein, can stop the heart	All whole foods: meats, milk, fruits, vegetables, grains, legumes
Chloride			
Chloride is part of the hydrochloric acid found in the stomach, necessary for proper digestion. It helps maintain normal fluid and electrolyte balance	Growth failure in children; muscle cramps, mental apathy, loss of appetite, can cause death.	Normally harmless (the gas chlorine is a poison but evaporates from water; can cause vomiting	Salt, soy sauce; moderate quantities in whole, unprocessed foods, large amounts in the processed foods
Sulphate			

A contributor of sulphur to many important compounds, such as certain amino acids, antioxidants, and the vitamin biotin and thiamine; stabilizes protein shape by forming sulphur-sulfar bridges	None known; protein deficiency would occur first	Would occur if only sulphur amino acids were eaten in excess,	All protein containing foods
Trace minerals			
Chromium			
Associated with insulin; needed for energy release from glucose	Abnormal glucose metabolism	Possibly skin eruption	Meat, unrefined grains, vegetable oils
Copper			
Helps form haemoglobin and collagen; part of several enzymes	Anaemia; bone abnormalities	Vomiting, diarrhoea, liver damage	Organ meats, seafood, nuts, seeds, whole grains, drinking water

Source: © Cengage learning cited in (Rickman and Jakicic, 2014) cousera nutrition e-learning

Table 2.7: Minerals and chief functions in the body cont'd

Trace minerals	Deficiency symptoms	Toxicity symptoms	Significant sources
Iodine			
A component of the thyroid hormone thyroxin, which helps to regulate growth, development, and metabolic rate	Goitre, cretinism	Depressed thyroid activity, goitre like thyroid enlargement.	Iodized salt, seafood, bread, plants grown in most parts of the country and animal fed those plants
Iron			
Part of the protein haemoglobin which carriers oxygen in the blood ; part of the protein myoglobin in muscles, which makes oxygen available for muscles contraction; necessary for the use of energy	Anaemia; weakness, fatigue, pale skin and mucous membranes, pale concave traits, headache, inability to cognitive function (children) lowered cold tolerance	Iron overload; fatigue, abdominal pain, infections, liver injury, joint pain, skin pigmentation, growth retardation in children, bloody stools, shock	Red meats, fish, poultry, shellfish, eggs, legumes , green leafy vegetables, dried fruits

Zinc			
Associated with hormones; needed for many enzymes involved in making genetic material and proteins, immune cell activation, transport of vitamin A, taste perception, wound healing, the making of sperm, and normal foetal development.	Growth failure in children, dermatitis, sexual retardation, loss of taste, poor wound healing	Nausea, vomiting, diarrhoea, loss of appetite, headache, immune suppression, decreased HDL, reduced iron and copper status	Protein-containing foods; meat, fish, shellfish, poultry, grains, yogurt.
Selenium			
Assist a group of enzymes that defend against oxidation	Predisposition to a form of heart disease characterised by fibrous cardiac tissue (uncommon)	Nausea, diarrhoea, nail and hair changes: joint pains, nerve, liver, and bone damages	Seafood, organ meats, other meats, whole grains, and vegetables depending on soil content
Fluoride			
Helps form bones and teeth; confers decay resistance on teeth	Susceptibility to teeth decay	Fluorosis (discolouration) of teeth, skeletal fluorosis (weak, malformed bones), nausea, vomiting, diarrhoea, chest pain, itching	Drinking water if fluoridecontaining or fluoridated, tea, seafood

Source: © Cengage learning cited in (Rickman and Jakicic, 2014) cousera nutrition e-learning

2.3: Anthropometric measurements

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2) (WHO, 2014).

Table 2.8: The International Classification of adult underweight, overweight and obesity according to BMI

Classification	**BMI(kg/m^2)**	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

Body Mass Index-for-age (z-score)

The WHO 2007 recommended BMI-for-age as the indicator for assessing thinness, overweight and obesity in children of 5-19 years (WHO, 2007a). The cut-offs for the assessment is as below:

Obesity	>+2SD (equivalent to BMI 30kg/m^2)
Overweight	>+1SD (equivalent to BMI 25kg/m^2)
Normal	1SD z-score -2SD
Thinness	2SD
Severe thinness	3SD

2.4: Obesity/overweight and undernutrition in the adolescents

Obesity occurs as a result of imbalance between energy intake and energy expenditure, that is when energy intake exceeds energy used (Hall et al., 2011). Overweight and obesity are attributed to increased consumption of energy dense, nutrient poor foods with high levels of sugar and saturated fats combined with reduced physical activity (WHO, 2003). Energy intake, especially among adolescents increase with increased age and then peaks between 12-15 years to approximately 1992kcal (8325kJ), then decline slightly between 16-19 years of age. In a study by Troiano *et al.*, (2000) it was observed that energy intake was higher in males than females. According to D"Addesa *et al.,* (2010), adolescents" whose weight were normal consumed high amount of calories compared to those who were overweight (D"Addesa et al., 2010; Garaulet et al., 2000). Carbohydrate and fat consumption were also higher in overweight/obese adolescents compared to their counterparts (Nasreddine et al., 2010).

There are more than 1 billon overweight adults globally of whom at least 300 million of them are obese (WHO, 2003). The prevalence of obesity in adolescent girls and women was increasing particularly in persons living in low income countries, and countries with economies revolving rapidly, such as China, Brazil and Egypt where there was increased access to inexpensive, tasty and convenient foods which were

energy dense, high in salt, fat, sugar and contained no or little micronutrient (WHO, 2012b). Frequency of overweight and obesity was high among South African children and adolescents which were dependent on age, gender and population (Rossouusw et al., 2012). Findings from studies carried out in Nigeria and other countries vary; the prevalence of overweight was 20.3% among adolescent school girls of 9-16years in Benue State (Musa et al., 2012), 24.5% and 2.5% prevalent rate of overweight and obesity among adolescent students in Benin city of Nigeria and higher among girls who skipped meals compared to their counterparts (Onyiriuka et al., 2013) but lower values of 1.8% and 6.3% of obesity were recorded in Port Harcourt, Nigeria (Adesina et al., 2012). Meanwhile , 12% and 6% of overweight and obesity were found among Palestinian adolescents with a prevalence rate of 7% each for stunting and underweight (Massad et al., 2012). A high prevalent rate

24.7% of overweight and 11.1% of obesity was also found in Bongonese children (Gualdi-Russo et al., 2007). Comparing adolescent boys and girls in relation to overweight and obesity, Italian male adolescents were more overweight/obese (37%) than their female (31%) counterpart (D"Addesa et al., 2010), 48.2% and 30.7% overweight was recorded among adolescents males and females respectively in Torre Pacheo (Murcia) Spain (Garaulet et al., 2000). Moreover, the prevalence of obesity in Ghana in people aged 18years and above was 5.5% which varied across regions and socio-demographic characteristics. By ethnicity, obesity was highest among the Ga-Adangbe, Ewes and Akans' representing 14.6%, 6.6% and 6.0%

respectively (Biritwum et al., 2005).

Undernutriton in adolescent was high; 9% in rural Bangladesh and more prevalent in early and late adolescents thus 31% at age 13, 20% at 15 years and 33% at 18 years (Alam et al., 2010). Underweight is more prevalent in girls and overweight in males.

In Uganda, even though the prevalence of obesity was 10.4 % among the adolescents, underweight was more common (Christoph et al., 2014).

Results of many research conducted between adolescents‟ obesity and associated risk factors were inconsistent. The energy density of fruits and vegetables is low because of its high water and low energy contents, when fruits and vegetables are added to foods, they increase the amount of the food thereby decreasing the overall energy density of the food (Tohill, 2005). According to Musaiger *et al.,* (2003), association among fruits intake, size of burger, sweets intake, hours spent watching TV and obesity among adolescents was significant in males and not females in Bahram (Musaiger et al., 2014). Most adolescents consumed less than three servings of fruits and vegetables a day but consumed about five servings of rice and beans in a day (Reith et al., 2012). In India, almost 80% of the adolescents consumed foods like rice, chapatti and vegetables which included green leafy vegetables on regular basis (Kotecha et al., 2013) whereas Ortiz-Hernandez and Gómez-Tello (2008) stated that only one-third each of Mexican adolescents consumed fruits and vegetables daily, drinks soft drink daily and one-fifth eats salty and sweet snacks daily (OrtizHernández and Gómez-Tello, 2008). Intake of diary and grains as well as combination of fruits and vegetables were associated with lower levels of central body fat among children (5-11 years) particularly in the adolescents (12-16 years) in the United States (Bradlee et al., 2009). Nevertheless, according to Peltzer and Pengpid (2011) and Tohill (2005), consumption of fruits and vegetables may have no or no influence on body weight (Peltzer and Pengpid, 2011; Tohill, 2005).

However, smoking cigarette and feeling lonely were associated with overweight and obesity among adolescents‟ girls (13-15 years) in Ghana and Uganda (Peltzer and Pengpid, 2011).

Studies revealed that adolescents who took regular breakfast had significantly lower body weight and waist circumference compared to those who take infrequent breakfast (Nurul-Fadhilah et al., 2013). However, approximately 60% of Indian adolescents eat daily while 13% ate breakfast 3 to 4 times in a week. In addition, 16% had their breakfast once or twice a week and 12% never had breakfast (Kotecha et al., 2013). Kosti *et al.*, (2008) also suggested that female adolescents who ate breakfast more than five times per week especially cereal contents had lower BMI compared to their counterparts, it was therefore concluded that, half of overweight adolescents consumed breakfast on daily basis (Kosti et al., 2008).

Obese adolescents males and females were less active, had unfavourable dietary habits such as lower intake of breakfast, fruits and milk but consumption of sugarsweetened drinks and sweets/chocolates were lower compared to the non-obese counterparts in Saudi Arabia (Al-Hazzaa et al., 2012). Louie *et al* (2011) reported from a systematic review of cohort studies of relationship between diary consumption and overweight/obesity among children and adolescents age 2-14 years were inconsistent which revealed no significant association, protective association and increased risk between diary consumption and overweight/obesity (Louie et al., 2011). Meanwhile, Portuguese adolescents who took high amount of milk had lower proportion of abdominal obesity compared with those who took low amount, notwithstanding their activity level either high or low, adolescents whose milk/diary intake were high had high levels of energy, total calcium and protein level. Furthermore, adolescents who were active physically had lower proportion of abdominal obesity (Abreu et al., 2014).

The onset of puberty in adolescents result in physical changes primarily growth in height for both sexes; genital development in boys and breast development in girls. Physical growth also affects social and psychological make-up of the adolescents

which becomes sources of worries to them (Rosen, 2004). As part of the psychosocial development, adolescents are concerned of how they appear to others and are accepted by their peers (Sanders, 2013). In view of this, adolescents do everything to keep up with the standards of their peers and this is dependent on how adolescents perceived their body image/weight. Alwan *et al.*, (2011) stated that weight perception was associated with weight loosing behaviours (Alwan et al., 2011). Inaccurate perception of body image/weight by adolescents may result in undue stress which may be harmful to their health. Studies revealed that both overweight and obese adolescent boys and girls underestimate the their body weight; to be within normal weight (Alwan et al., 2011, Kurth and Ellert, 2010), those who were underweight overestimated themselves (Kurth and Ellert, 2010) and a proportion of those within normal weight perceived themselves too thin (Alwan et al., 2011). Contrarily, according to Gualdi-Russo *et al* (2007) adolescents adequately perceived their body image; accurately perceived by girls because girls were more conscious of their body image. In fact, only 5.7% and 8.8% of girls overweight boys and girls did not adequately classified their body image/weight (Gualdi-Russo et al., 2007). Therefore, females tried to reduce weight compared to their male counterparts whether they perceived themselves overweight/obese or normal or were actually normal weight or obese (Alwan et al., 2011).

Physical activity has great impact on the body weight. It is an important behaviour that can have an independent effect on health. Physical activity and nutrition may interact to maximize the health benefits of individuals including the adolescents. Adolescent boys (12-19 years) in Malaysia were more active than their female counterpart, they indulge in higher daily physical activities which was related to low body fat therefore

reducing their risk for developing overweight and obesity compared to the female who had less daily physical activities (Teo et al., 2014).

2.5: Health Effects of obesity/overweight and undernutrition in the adolescents

Overweight and obesity pose major risk for serious diet related chronic disease including type 2 diabetes, cardiovascular diseases, hypertension, stroke and certain forms of cancers, especially hormonally related, large bowel cancers, gall bladder diseases, high cholesterol and triglycerides which reduces the quality of life and can cause premature death (WHO, 2003). Other health problems associated with overweight and obesity which are nonfatal include respiratory difficulties, chronic musculoskeletal problems, skin problems and infertility (WHO, 2003). When overweight and obese adolescents become adults, they are twice likely to develop cardiovascular diseases and the risk for developing atherosclerosis increases seven times (PAHO, 2012).

Growth and development is generally slower in the undernourished compared to the well-nourished, as well as delayed menarche (FAO/WHO, 1998). Stunting is an indicator of chronic malnutrition; mainly caused by infection and inadequate dietary intake, especially during foetal life and preschool years. Undernutrition increases the risk of obstructed labour as a result of immature pelvis. Anaemia, the main nutritional problem in the adolescent is estimated to be 27% and 6% in the developing and industrialised countries, respectively (WHO, 2012a).

Adolescents who were retarded at birth tend to put on more weight during the adolescence growth spurt. Adolescents normally entered pregnancy with reduced nutritional stores which increases their risk for nutritional deficiency with a higher risk in under malnourished (FAO/WHO, 1998).

2.6: Methods used to reduce weight in adolescents

Mostly, adolescents who were not satisfied with their body image/weight normally experience low self-esteem, additionally, they diet to enhance body image or and to reduce body weight (Findlay et al., 2004), but those who diet were at increased risk of gaining excess weight over a time period. A cohort study among Brazilian adolescents born in Pelotas, Rio Grande de Sul State in 1993 revealed losing weight through dieting was more common in girls than boys but found no association between type of food consumed by these adolescents and weight loss dieting (Madruga et al., 2010). Also, according to Baker *et al* (2012), disordered eating such as dieting and purging were not influenced by developmental process (puberty) in adolescents in Sweden. However, there was a significant relationship between dieting in late adolescent and disordered eating. Cultural and biological factors such as genetic and high reproductive hormones were linked to disordered eating during the developmental stages (Baker et al., 2012).

The prevalence of unhealthy weight control behaviour among the adolescents remain constant and through to early young adulthood. More adolescent girls‟ diet compared to boys. Beige eating increased in both boys and girls, but the prevalence is higher in girls. Older adolescents aged 12-15 years were more accurate in perceiving their body weights compared to the younger ones (8-11 years) and those who perceived themselves as overweight/obese were more likely to engage in unhealthy weight reduction processes such as dieting (cutting on food quantity or omitting food intake

(Chung et al., 2013).

CHAPTER THREE

3.0 METHODOLOGY

3.1: Study type

The study was a cross-sectional study carried out at EP Senior High School

3.2: Study variables

3.2.1: Dependent variables

The dependent variables were obesity, total energy and protein intake.

3.2.2: Independent variables

1. Demographic characteristics of the adolescents: age, marital status, religion and ethnicity
2. Weight
3. Height
4. Nutritional status
5. Main sources of carbohydrates, proteins, fats and oil, vitamins and minerals
6. Pattern of food intake/ eating habit

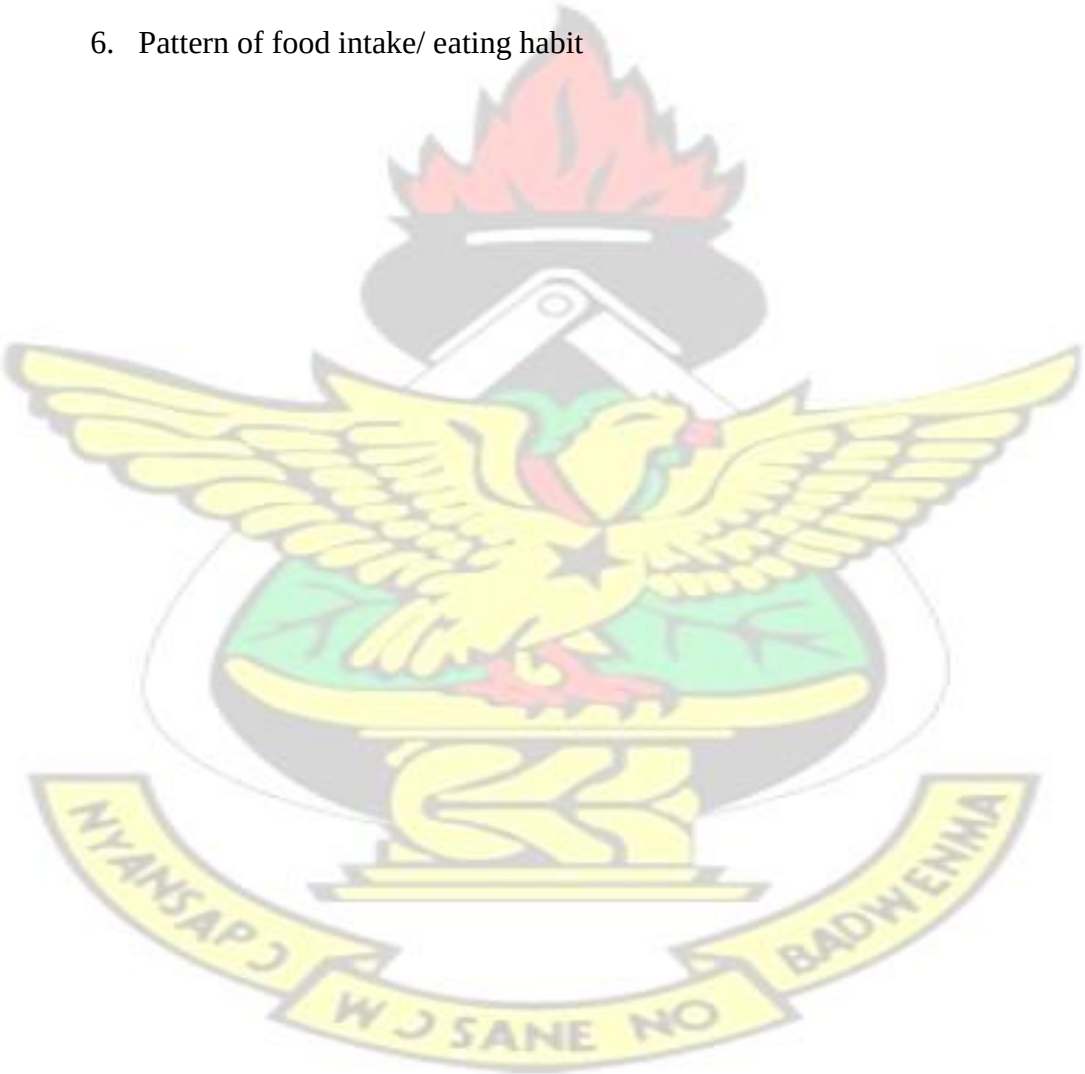


Table 3.1: Variable table

Conceptual definition of variable	Operational definition	Indicators	Indicators
Age	Age at the last birthday approximately to the nearest year in whole numbers. 19 year and below	Age	Continuous
Ethnicity	As reported by the respondent	Ewe, Akan, Guan, Kotokoli etc.	Nominal
Religion	The service and worship of God or the supernatural	Christianity, Islam, Hindu, Buddhist, Traditional, others	Nominal
Marital status	Expressed in terms of legal status	Married, single	Nominal
Height	Height in centimetres (cm) measured with a standiometre. Respondents will take off their shoes, put their feet and heels together, stand straight and look forward. The back, head and heels touching the wall. Also, the respondents must look ahead		Continuous
Weight	Weight measured with calibrated weighing scale, recorded in kilograms (kg) and approximated to the nearest 0.5kg. respondents will only put on under wears, foot wears taken off and head raised before the measurement is taken		Continuous

Nutritional status	BMI-for-age (z-score). Weight(kg)/ height (m) squared: kg/m^2 compared to the WHO 2007 Reference curve	Obesity >+2SD (equivalent to BMI 30 kg/m^2 at 19 years Overweight >+1SD (equivalent to 25 kg/m^2 at 19 years Normal 1SD-zscore-2SD Thinness 2SD Severe thinness 3SD	Ordinal

Table 3.1: Variable table cont'd

Conceptual definition of variable	Operational definition	Indicators	Scale of measurement
Main source of carbohydrate in the diet	Main type of staple food eaten; maize (corn), millet, rice, cassava, plantain, sorghum, yam, cocoyam, sweet potato	Source and frequency of intake	Nominal
Main source of protein in the diet	Main type of protein eaten, either animal or plant based protein	Source and frequency of intake	Nominal
Main source of minerals and vitamins	Main type of fruits and vegetables consumed. Fruits; oranges, banana, apple, pineapple and vegetables such as carrot, cabbage, kontommire	Source and frequency of intake	Nominal
Eating habit	Number of times respondents eat within a day (breakfast, snack, lunch, snack, supper and snack)	once, twice, three times, four times, five times, six times, etc. in a day	Ordinal
Total energy intake	Total calories of food consumed within 24 hours	Calories consumed	Continuous
Food groups	Classification of foods into the major groups depending on their function; energy giving, body building and protective functions	Food group	Nominal

3.3: Data collection techniques and tools

Prior to data collection, the headmaster was reminded of the data collection process since a formal permission was sought from him earlier. The questionnaires were coded before they were administered to the respondents.

The questionnaire was divided into three categories:

1. Background information
2. Dietary patterns (85 food item FFQ, frequency of food intake, types of meals, snacks etc.) of the adolescents.
3. Anthropometric measurements and calculation of body mass index (BMI-forage/ z-score).

Structured questionnaires were administered to each respondent to fill. The researcher and the research assistants had one–on-one interview with the respondents to collect information on the foods taken the previous day from morning to night (24 hour food recall). Anthropometric measurements were also done on each respondent.

3.3.1: Background information

Information collected includes age, marital status, religion and ethnicity of the respondents.

3.3.2: Dietary intake assessment

The matron delegated the chief cook and the dining hall prefects to assist in measuring the meals eaten from the dining hall at each section, i.e. breakfast, lunch and supper. At each section, three female students‟ foods were randomly selected from any table after they were served with their food portion. These selected foods were measured by the researcher and recorded, the empty cups or plates of these students were measured after the dining section to obtain the actual weight of food served. The measurement

of the food was done for one week to cover the menu taken by the students. The Camry Kitchen Manual scale was used to estimate the weight of the foods, whilst a measuring jug was used to measure the liquid foods as well. The volume and weight of liquid foods/meals were also estimated, and by means of a conversion factor developed for each meal, the estimated quantity of food consumed in grams was obtained.

The weights of the observed food were added up and divided by the number of observations made to estimate the average amount of food served to each female students per section in the dining hall. All food items sold at the school‟s canteen were bought for three conservative times on different days in the week and weighed. During the data collection, the research team carried along food items such as nido, cowbell, milo, sugar, oranges, gari, sardines, corn flakes, and various types of biscuits. This assisted students in estimating foods taken from their "chop boxes" outside the dining hall.

An eighty-five (85) food item qualitative FFQ (Food Frequency Questionnaire) was used to assess the frequency of food consumed by the respondents. The foods were categorized according to the major function they performed. They were grouped into energy-giving foods, protective foods and body-building foods on the questionnaire. During the analysis, these foods were re-grouped according to their nutritive components using the "nutrient analysis template 2" into 13 major groups such as cereals, drinks/beverages, fruits, milk/diary products, and roots/tubers. The remaining were egg, fish/sea foods, pulses and beans, fats and oil,

meat/poultry/insect, sugar, green leafy vegetables and other vegetables. Cereals were composed of , wheat, cream crackers, short bread, macaroni, rice/rice porridge, millet/Hausa porridge, corn/white porridge, ekwegbemi, breads, buff loaf, pie, banku/akple/tuo-zaafi, soda milk crackers, Fante/Ga kenkey, rice and beans/waakye,

malt and milk biscuit, McVities biscuits and boiled/roasted corn/maize. Fruits were watermelon, apple, pineapple, banana, coconut, oranges, Tampico, pawpaw, pear, Africa star apple. Root/tubers include cooked/boiled plantain/plantain chips, potato, yam, cassava/ cassava & plantain fufu/gari/kokonte, cocoyam and mpotompoto. Drinks and beverages were tea, malt, orange juice, Lipton, Fanta/Miranda, cokes, ice cream, juvita, and kalypo. Yogurt, milks (nunu, peak, ideal, carnation, cowbell, and nido), fan milk/fanice and cheese were categorised as milk/diary products. Fish/sea food was made up of tilapia, sardine, *kpanla,* mackerel, and salmon. The remaining were meat/poultry/insect (meats (chivon/mutton, cow/beef, lamb/chivon , bush meat, chicken, kyebab), Pulses and nuts (koose, agaw, beans/beans stew, groundnut/groundnut soup), Fats and oils (butter, margarine and palm oil) green leafy vegetables (soup for tuo-zaafi, palaver source, kotombire) and other vegetables include pepper for kenkey, shito, garlic, light soup, palmnut soup, stew/sauces (tomato, garden eggs, vegetables, agushie, okro) and carrots.

According to Whitney and Rolfes (2008), the RDI of calories/day of active female adolescent between 14-18 years was 2368 kcal. The total quantity of energy consumed was categorised into three; below RDI, within normal RDI and above RDI.

3..3.3: Anthropometric assessment

A weighing scale with standiometre which was calibrated by the Ghana Standard Board was collected from the Hohoe Municipal hospital and used to measure respondents‟ anthropometric variables. Heights were measured in centimetres and

approximated to the nearest 0.1 cm while weights measurements were done in kilograms.

Before the heights were measured, respondents were asked to remove their foot- wear, put their feet together, stand straight, and look forward with their backs, heads and the heels touching the pillar of the standiometre. The weight was measured first followed by the height.

BMI-for-age (z-score) was calculated using WHO AnthroPlus (5 years -19 years). WHO AnthroPlus is software for the global application of the WHO Reference 2007 for 5-19 years to monitor the growth of school-age children and adolescents. To show the continuity with the WHO Child Growth Standards for 0-5 years (WHO, 2009), and the classification was done according to the WHO 2007 Reference chart for 5-19 years for females (WHO, 2007b).

3. 4: Training of research assistants

The research assistants were trained for a day. The training included how to read the measurement on the food weighing scale, the body weighing scale and the standiometre. They were also trained on how to adjust the scale and how to record data obtained from the students especially the foods eaten outside the dining hall.

The questionnaires were codes before they were administered to the respondents.

3.5: Pre-testing of questionnaire

The data collection instrument was pre-tested at Kumasi Midwifery and Nursing Training College. Ten questionnaires were administered and retrieved. This helped in amending some of the questions which became clearer to the respondents.

3.6: Study population

Female adolescent students aged 19 years and below, who were in the boarding house in HEPSS during the period of study were included in the study. Female adolescent students of the same age who were day students were excluded from the study.

3.7: Sampling

The total student population of the school for the 2013/2014 academic year was 837 including both boys and girls of which the females were 375. The population of the female boarders were only 200 made up of 61, 74 and 65 in the first, second and third year, respectively. All female student borders 19 years and below were eligible and were enrolled in the study. They all had equal chance in participating in the study. Excluded from the study were three Muslim girls who were fasting but those Muslims who were not fasting were included in the study. In addition, four students declined participation therefore 193 female borders participated in the study.

3.8: Data analysis

Answered questionnaires were checked for completeness and consistency. Four incomplete questionnaires were excluded from the analysis, 193 subjects participated in the study. All the answered questionnaires were not used. Excluded were eight (8) whose ages were 20 years and above, and four partially filled questionnaires. Data collected was collated into categories according to the study variables and entered into Microsoft excel 2010 version. Stata intercool version 11.1 was used for the analysis.

3.9: Profile of the study area

The Hohoe Municipality is one of the twenty-six (26) districts/municipalities in the

Volta Region and it is located in the central part of the region. It is bounded by Jasikan District to the North, North-west by Biakoye District, West and South-west by Kpando Municipality, south by Afadjato South District and east by Republic of Togo.

The Municipality consists of ninety-two (92) communities with a population of 187,028 (National Housing and Population Census, 2010, Hohoe Municipal Assembly) with a population growth rate is 2.4%. The district has multi tribes which include the Ewes, Likpes, Akpafus, Lolobis and Santrokofis, and harbour many religious groups predominantly Christianity, Islamic and traditional beliefs. The municipality is divided into seven (7) Health Sub-municipalities and has a total of twenty-one (21) health institutions including a hospital with a research Centre and the Midwifery Training School.

Hohoe is the administrative seat of the municipality. An urban town which has several sub-towns with lots of facilities such as markets, chapels, mosques, recreational facilities, hospitality industries, banks, telecommunications, water and electricity supply with bad road networks. Hohoe has several basic and junior high schools which are both privately and government owned and one government senior high school.

Hohoe Evangelical Presbyterian Secondary School (HEPSS) was established on September 28, 1961 by the E.P Church, Ghana as a private school. It was later absorbed into the public educational system in 1965. The motto of the school is TOLLE LEGE which literally mean PICK and READ. Six programmes are currently offered in the school. The total student population of students for 2013/2014 academic year was 837 of which 375 were girls.

Hohoe is chosen as the study area because of its strategic position. The school is located in the middle belt of the region making it easily accessible to people from the Volta Region, Eastern Region, Greater Accra Region and the Northern Region. This may

contribute to a vast number of people with different ethnic, cultural and religious background.

3.10: Ethical consideration

Approval was granted by the Committee on Human Research and Publication Ethics of KNUST. Permission was also granted by the headmaster of the Hohoe E.P Senior High School. All respondents were made aware that participation was voluntary without sanction. The questionnaires had no column for names but had reference numbers which helped in easy retrieval of the questionnaire.

CHAPTER FOUR

4.0: RESULTS

From the 193 questionnaires administered/respondents interviewed, 191 filled questionnaires were retrieved and 179 completed questionnaires were included in the analysis. This was because eight (8) respondents were twenty (20) years and above which was above the cut-off points for the respondent‟s age and four (4) of the questionnaires filled were about 50% incomplete and were therefore disregarded during the analysis.

4.1: Socio-Demographic characteristics of respondents

Table 4.1: Socio-Demographic data of respondents		
Variables	**N(179)**	**%**
Age (years)		
15	11	6.2
16	22	12.3
17	71	39.7
18	52	29.1
19	23	12.6
Religion		
Christian	170	95.0
Hindu	4	2.2
Islam	5	2.8
Ethnicity		

Akan	20	11.2
Dagomba	1	0.6
Ewe	134	74.9
Frafra	1	0.6
Ga/Adangbe	5	2.8
Guan	13	7.3
Kokomba	2	1.1
Others	3	1.7
Marital status		
Single	179	100

The study sampled only female adolescent boarding students. The mean and modal ages of the respondents were 17.3 ± 1.04 and 17 years, respectively. Christians and Ewes were the respective dominant religion and ethnic group, though other religious and ethnic groups were also represented.

Table 4.2: Mean, weight, and height of respondents		
Variable	**Mean**	**Std. Dev.**
Height(cm)	162.1	7.4
Weight(kg)	58.1	9.1

Table 4.2 shows that the mean weight and height were 58.1±9.1kg and 161.2±7.4cm, respectively.

4.2: Anthropometric measurements to determine prevalence of overweight and obesity of respondents

Table 4.3: Distribution of Obesity among respondents on the basis of BMI-for-age (z-score)		
Classification	N (179)	%
Obese (>+ 2 SD, equivalent of BMI 30kg/m2)	6	3.4
Overweight (>+ 1 SD, equivalent of BMI 25kg/m2)	28	15.6
Normal (± 1 SD, equivalent of BMI < 25kg/m2)	145	81
Total	179	100

The prevalence of overweight and obesity among the student population was 15.6% and 3.4%, respectively as indicated in table 4.3.

4.3: Present dietary pattern of the adolescents

Table 4.4a: Distribution of Present Dietary Pattern of the adolescents in HEPSS		
Frequency of breakfast		
	N(179)	%
Everyday	117	65.4
Rarely/Never	1	0.6
Sometimes	61	34.0
Frequency of meals per day		
1	1	0.6
2	16	8.9
3	130	72.6
4	19	10.6
5	8	4.5
6	5	2.8
Frequency of snacks		
0	47	26.3

1	61	34.1
2	52	29.0
3	15	8.4
4	4	2.2
Calories consumed (kcal/day)		
Below RDI	21	11.7
Normal RDI	112	62.6
Above RDI	65	25.7
Total calories taken/day	Mean=2086.0	SD= 465.2
Protein Intake(g/day)		
Normal Protein RDI	53	29.6
Above Protein RDI	5	2.8
Below Protein RDI	121	67.6
Time of food		
Before breakfast: before 9.30am	24	3.8
Breakfast: 9.30 – 9.50am	159	25.2
Brunch: 10 – 12.29pm	9	1.4
Lunch 12.30 – 12.50pm	162	25.7
Between lunch and super: 1.00-4.59pm	22	3.5
Super: 5.00-5.30pm	165	26.1
After super after 5.30-10.00pm	90	14.3

From table 4.4a, nearly two-third (65.4%) of the respondents ate breakfast each day. Moreover, 72.6% took three meals in a day while 2% of the respondents ate six meals a day. Additionally, 2.2% of the adolescent girls consumed snacks four times a day on regular basis while 26% of them did not take snack at all. For more than half of the respondents‟ total calories consumed was within the normal range. Mean total energy intake per day was 2086 (± 465.2) kcal. More than a tenth (14.3%) of them ate after super, mostly between 9.30 pm-10 pm thus after prep.

Table 4.4b: Distribution of the adolescents on the basis of consumption of diets rich in fibre weekly.

	N(179)	%
High fibre diet		
No	59	33.0
Yes	120	67.0
Fibre foods consumed on weekly basis	**N (199)***	**%**
Africa apple star	1	0.5

Apple	5	2.5
Banana	13	6.5
Cabbage	1	0.5
Carrots	1	0.5
Guava	2	1.0
Kotommire	1	0.5
Mango	6	3.0
Oat	19	9.6
Orange	101	50.8
Pawpaw	6	3.0
Pineapple	22	11.1
Sour sop	2	1.0
Vegetables	3	1.5
Watermelon	2	1.0
Wheat	14	7.0

NB; Fibre foods consumed on weekly basis – multiple responses

Table 4.4b suggested that, two-third of the respondents made conscious effort to eat foods that are high in fibre, which included oranges, pineapples, oats, wheat and banana. More than 90% of the respondents mentioned fruits as their source of high fibre intake and oranges were the most common fruits consumed.

Table 4 4c: Frequency of food consumption of selected foods by adolescents in HEPSS.

Selected Foods		Daily	Once a week	2-3 times in a week	> 3 times a week	Once a month	> 1 a month	Seldom
Other Vegetables	N(179)	1	2	39	5	74	57	1
	%	0.6	1.1	21.8	2.8	41.3	31.8	0.6
Green Vegetables	N(179)	1	5	15	5	89	32	32
	%	0.6	2.8	8.3	2.8	49.7	17.9	17.9
Fruits	N(179)	0	4	30	37	45	29	34
	%	0	2.2	16.8	20.7	21.1	16.2	19
Cereals	N(179)	0	7	33	45	80	14	0
	%	0	3.9	18.5	25.1	44.7	7.8	0
Egg	N(179)	66	20	6	1	1	28	57

	%	36.9	11.2	3.3	0.6	0.6	15.6	31.8
Pulses and Nuts	N(179)	0	28	2	43	47	45	14
	%	0	15.7	1.1	24	26.3	25.1	7.8
Milk and Diary	N(179)	31	3	5	18	19	57	46
	%	17.3	1.7	2.8	10.1	10.6	31.8	25.7
Tubers	N(179)	0	1	3	51	82	42	0
	%	0	0.6	1.7	28.5	45.8	23.4	0
Meat/ Poultry/ insect	N(179)	0	0	31	5	29	68	45
	%	0	0	17.3	2.8	16.2	38	25.7

It can be observed from the table that, daily consumption of fruits and green leafy vegetables was seldom for 19.0% and 17.9%, respondents, respectively. However, respondents who consumed the green leafy vegetables 2-3 times per week increased to 8.3%, whilst fruits were also eaten by 20.7% of the respondents more than three times within a week.

Table 4.5: Distribution of Food related habits among the adolescents

	N(179)	%
Food taboos (cultural)		
No	141	78.8
Yes	38	21.2
Food taboos (religion)		
No	159	88.8
Yes	20	11.2
Perceived body size/image		
Obese	8	4.5
Overweight	34	19.0
Underweight	18	10.0
Normal weight	119	66.5

Respondent's desire to lose weight		
No	99	55.3
Yes	80	44.7
Weight loosing methods		
Dieting	21	26.3
Exercising	59	73.7

In response to how the adolescents perceived their body size/ weight in relation to obesity, 23.5% (42) said they were obese or overweight. Even though 23.5% perceived themselves to be overweight or obese, Table 4.5 indicated that 19% (34) were actually overweight/obese. Furthermore, 73.7% were trying to lose weight through exercising. Meanwhile, 21% and 11% avoided food on cultural and religious grounds. Rice with stew, jollof rice and banku with hot pepper with tilapia were the favourite foods mentioned. The main reasons for favourite foods were availability both in the dining hall and the school canteen, tastes good and easy to prepare.

4.4: The effect of dietary pattern on overweight/obesity

Table 4.6: Association between BMI-for-age (z-score) and energy intake, protein intake, and high fibre diets

BMI-for-age (z-score)	**Obese**	**Overweight**	**Normal**	**Total**	χ^2	**Pvalue**
Energy intake						
	N (%)	N (%)	N (%)	N (%)		
Below RDI	2 (9.5)	5 (23.8)	14 (66.7)	21 (100)	4.93	0.294
Normal RDI	1(1.8)	15(13.4)	95(84.8)	112(100)		
Above RDI	2 (4.3)	8(17.4)	36(78.3)	46(100)		
High fibre diets						
No	1 (1.7)	8 (13.6)	50 (84.7)	59 (100)	1.12	0.57

Yes	5 (4.2)	20 (16.7)	95 (79.1)	120 (100)		
Protein Intake						
Normal	2 (3.8)	9 (17.0)	42 (79.2)	53 (100)	0.39	0.98
Above Protein RDI	0 (0.0)	1 (20)	4 (80)	5 (100)		
Below Protein RDI	4 (3.3)	18 (14.9)	99 (81.8)	121 (100)		

The study measured the relationship between BMI of the female adolescent students in-relation to energy intake per day, protein intake per day and weekly consumption of high fibre diets. The study revealed that, two third (62.6%) of the adolescent students met the RDI of energy while one-quarter‟s (25.7%) intake was above the RDI of energy intake per day. Among those whose daily energy consumption were within the RDI, 85.0% of the respondents BMI fell within the normal range while 22.0% were overweight/obese. Also, among the 25.7% (46) of the respondents whose energy consumption exceeded the RDI, 21.7% (10) were obese/overweight while 78.3% (36) of them had normal BMI.

Likewise, the study revealed that 67.7% (121) of the respondents did not meet the RDI of protein. Surprisingly, more than 82.0% ( ) of them had normal BMI while less than a quarter; 18.2% (22) of them were obese/overweight.

In addition, out of the 67.0% (120) of the respondents who made conscious efforts to include high fibre in their diet weekly, only one quarter; 20.9% () of them were obese/overweight while 79.1% () had normal BMI.

Generally, the study did not find relationship between BMI and Energy intake, protein intake and consumption of high fibre.

CHAPTER FIVE

5.0 DISCUSSION

This study was conducted among female students who were in the boarding facility in HEPSS. These students were fed by the school authority three times a day mostly with cereal based foods between 9.30 am to 5.30 pm. Students complement the dining hall foods with foods mostly obtained from the school‟s canteen and or from their “chop boxes” and occasionally, from town or home when permission was sought (exeat) from the school authority.

5.1: Socio-Demographic characteristics

All the respondents were single with a mean age of 17.3 ± 1.0 years. Christians (95%) and Ewes (74.9%) form majority of the respondents. The ethic affiliation was almost representative of the profile of the Municipality and the location of the school in the country.

5.2: Anthropometric measurement to determine prevalence of overweight and obesity of respondents

BMI-for-age (z-score) was computed for each respondents with WHO 2007 AnthroPlus software (WHO, 2009) and was categorised into underweight, normal weight, overweight and obese according to the cut-off of WHO 2007 Reference. Consistent with some studies (D"Addesa *et. al*., 2010; Garaulet *et. al*., 2000), the findings from this study seemed to have recorded higher prevalence of overweight and obesity among the respondents than most studies (Adesina *et al*., 2012; GualdiRusso *et al*., 2007; Massad *et al*., 2012; Musa *et al*., 2012). The study also revealed higher prevalence between 17 and 18 year old adolescents. Meanwhile, there was no association between overweight/obesity and age, energy consumed, protein intake and high fibre diet. Fortunately, underweight was not recorded among the adolescent students at HEPSS.

The overweight and obese respondents are at risk of developing health conditions associated with their weights, especially the NCDs such as hypertension, type 2 diabetes and metabolic disorders among others (PAHO, 2012; WHO, 2003) and anaemia especially during pregnancy (Delisle, 2005). There is therefore the need to help these adolescent girls to obtain and maintain healthy weight in order to live healthy lives and also to reduce the risk levels stated above.

5.3: Present Dietary Patterns of the respondents

Fruits and vegetable intake

The finding from the study revealed that daily consumption of fruits and vegetables by the respondents was very low, but the frequency increased gradually to more than once in a week. For instance, 21.8% ate other vegetables 2-3 times a week while fruits were consumed by 16.8% of the respondents more than 3 times a week. The result was consistent with intake among adolescents in Mexico, Brazil, US, Europe and Australia (Feinstein et al., 2008; Ortiz-Hernandez and Gómez-Tello, 2008; Reith et al., 2012). Fruits and vegetables are good sources of micronutrients, especially the water soluble vitamins (B vitamins and vitamin C) which are vital for protein, carbohydrate and fats metabolism, production of RBCs, builds and maintain bones and muscles and also cure diseases that are caused by their deficiencies (CDC, 2011;

Rickman and Jakicic, 2014) and are sources for magnesium and potassium (CDC, 2011). Even though, majority of the respondents have their weight within the normal range, low intake of fruits and vegetables may result in micronutrient deficiencies and other health problems which may affect their health in general including reproductive health in the future thereby reproducing unhealthy children.

Frequency of meal

Result of the study suggested that, approximately, three quarters of the respondents ate regular meals (thrice) a day while only 9.5% of them ate less than three times a day. Regular intake of meals by the majority of the respondents may have occurred as a result of the students being fed by the school authority thrice a day between 9.30 am and 5.30 pm with already prepared foods. Meals served included breakfast, lunch and super. Surprisingly, 17.9% of them ate more than three meals per day which was

consistent with other studies (Kaisari et al., 2013). Globally, researchers suggested that most adolescents skipped breakfast (Kovács *et. al*., 2010; ThompsonMcCormick *et. al.*, 2010) which were consistent with the findings of the study that only 65.0% (117) of the respondents ate breakfast regularly. Meanwhile, 25.0%

(159) of the adolescents took breakfast as recorded during the 24hour food recall. Contrary, 34.0% of them consumed breakfast sometimes. Skipping of breakfast was significantly associated with increased BMI which predisposes to the development of NCDs therefore predisposing the adolescents in the study to such.

Consumption of calories

The mean calories consumed by the respondents were 2086 ± 465.2kcal/day. Only half of the respondents met the normal DRI of energy consumption (Whitney and Rolfes, 2008) and 11.7% of them consumed less than the DRI for a day. Approximately four-fifth of the adolescents whose BMI-for-age were within normal range had adequate calories/per day which was inconsistent with (D"Addesa *et al*., 2010; Garaulet *et al*., 2000). There was no significant association between BMI-forage and calories consumed/day.

Consumption of protein, cereals and high fibre diets

Protein is required by the body to perform functions such as production of hormones, antibodies, regulation of metabolism among others (Pope, 2014). Whether consumed in excess or less will result in health problems (Rickman and Jakicic, 2014). In view of this, protein is necessary in the growth and development of children and adolescent, especially in girls. Animal proteins are basically good sources of iron, when consumed adequately prevents the occurrence of iron deficiencies, anaemia and other micronutrient deficiencies (CDC, 2012b) but the study indicated that nearly two-third

of the respondents‟ daily requirements for protein was low. But surprisingly, 36.9% ate egg each day, 17.3% also consumed milk and dairy products daily whereas another 17.3% consumed meat/poultry/insect two-three times a day. Whereas consumption of diary was associated with normal body weight and lower levels of central body fats especially in the adolescents (Braddle, 2009). The quantity of cholesterol in egg can predisposed them to develop high blood cholesterol in the blood. Association between BMI-for-age and specific protein foods (egg, fish, meat) were not assessed in this study but no association was found between BMI-for-age and protein consumed a day. Generally, the low protein intake among the respondents might also have implications on their health which was not assessed in this study.

Cereals were the major foods served to the students by the school authority, hence it was very surprising that less than half (43.6%) of the adolescents ate cereal products more than twice a week but not daily and might have depended on drinks/beverages which were energy dense and may have contributed to overweight/obesity status among them which was found in this study.

Association between BMI-for-age and intake of high fibre diet was not found in the study. Meanwhile, those who said they made conscious effort to eat high fibre diet, 79% of them had normal weight. Likely, the high fibre diet that were consumed were mainly fruits and vegetables especially oranges, pineapples and banana which were adequate sources of water soluble vitamins, iron and phosphorus and will therefore prevent micronutrient deficiencies among the adolescents.

Food-related habits among the adolescents

Either preference or avoidance of food(s) can influence the choices of food eaten, thereby directly affecting the amount of calories and nutrients of the individuals. As

indicated in the study, majority of the respondents were not restricted to any food either on religious or cultural grounds. No further explanations were given by the respondents to that effect. They also mentioned rice with stew, jollof rice and banku with hot pepper and tilapia/okro soup for favourite foods. According to them, these foods were available both in the dining hall and school canteen, they taste good and are easy to prepare.

Perceived body image/size and weight loosing

Approximately 87.0% of the adolescents whose weight were normal accurately perceived their body weight as such, likewise about half of the respondents who had normal weight perceived themselves to be overweight. In addition, 94.0% of the adolescent girls whose weight were normal perceived themselves underweight, and only 38.2% of the overweight accurately perceived themselves to be overweight in consistence with Alwan *et al.,* (2011). On the contrary, none of the respondents was underweight from the study. Meanwhile, half of the respondents with normal weight were trying to lose weight, whereas 12.5% of underweight adolescents were also trying to lose weight. Fortunately, none of the adolescents tried loosing weight with drugs. Nearly three-quarter of them were exercising whereas the remaining onequarter were dieting to reduce weight in consistence with Chung *et al*., (2013). Physical activity level of the respondents was not assessed in this study but they were all assumed to be moderately active. This was because they were all housed in the school and may perform same activities such as sweeping, mopping, fetching of water, washing and walking. No sporting activities or dancing occurred during the period of the study.

5.4 Effects of dietary pattern on overweight/obesity of respondents

Proteins are very important components of the meal especially for children and adolescents because of the various roles it plays during the developmental stages Pope (2014). Rickman and Jakicic (2014) suggested that high intake of protein especially animal products may lead to several chronic diseases such as heart diseases, some cancers, weight gain among others while low consumption may result in acute or chronic malnutrition including micronutrient deficiency such as anaemia. Moreover, the study revealed that, two-thirds (67.6%) of the adolescent girls did not meet the RDI of the protein which may be a risk factor to develop acute or chronic malnutrition, low immunity, anaemia among others which may affects their reproductive life and their unborn children.

Carbohydrates, also, are the main and primary sources of energy production in the body Pope (2014). It is therefore important that adolescents should meet the RDI of energy per day, since either low or high consumption may expose them to health risk factors. According to WHO (2012), the human body has limited capacity to store excess carbohydrate, hence, excess carbohydrates are stored as fats in the adipose tissue thereby increasing body weight with its associated health risks (WHO, 2012a).

Studies conducted by PAHO (2012) and WHO (2003) revealed that obesity was a risk factor for the development of chronic non-communicable diseases such as diabetes and metabolic disorders, hypertension and some cancers among others, therefore, the proportion 34 (19.0%) of adolescents from this study who were obese/overweight are more likely to develop such health conditions in the future.

Whole grain (corn/maize, unpolished rice, wheat etc) fruits and vegetables are good sources of fibre. FAO/WHO (1998) and Rickman and Jakicic (2014) suggested that, the presence of fibre in the diet helps protect individuals from heart disease, prevents diabetes, lowers blood cholesterol and glucose thereby promoting health. It was therefore good, that the present study revealed that majority of the adolescents made conscious efforts to include fibre in their diet.

This study did not find an association between BMI and energy consumption, protein intake and intake of high fibre diet. Moreover, the effects of micronutrients were not measured in this study.

CHAPTER SIX

6.0: CONCLUSIONS AND RECOMMENDATIONS

6.1:Conclusions

This study was carried out among female adolescents aged 15-19 years of the Hohoe Evangelical Presbyterian Senior High School. All the respondents were in the boarding house, fed three times a day; breakfast, lunch and super from the school kitchen between 9.30 am and 5.30 pm. The students complement the dining hall food with foods purchased from the school‟s canteen and or from their chop boxes.

All the respondents were single with a mean age of 17.2 ± 1.0 years. Majority of the respondents were Christians and Ewes with other religion or ethnicity in minority. The prevalence of overweight and obesity was 15.6% and 3.4% respectively, highest among 17 years adolescent girls. Intake of fruits and vegetables was very low as no daily consumption of fruits was recorded among the respondents while only 0.6% consumed vegetables daily. Three-quarters consumed regular meals (three times) daily, whilst 65.0% ate breakfast daily but 34.0% skipped breakfast sometimes. Average calories consumption was 2086 ± 465kcal/day. Nearly two-thirds of the respondents exceeded the DRI of calories although, 37.0% said they ate egg daily, protein intake was very low, because 67%‟s protein intake was below the DRI/day. Two-thirds of the respondents made conscious effort to consume diets rich in fibre. Also, majority did not have restrictions foods on either cultural or religious reasons. Most of those whose weight was normal accurately perceived their body size/image as such, whilst some perceived themselves inaccurately. Among the respondents whose weight was normal, half of them were trying to lose weight.

In relation to the energy consumption, two third (62.6%) of the adolescent students met the RDI of energy while one-quarter‟s (25.7%) intake was above the RDI of energy intake per day. Also, among the 25.7% (46) of the respondents whose energy consumption exceeded the RDI, 21.7% (10) were obese/overweight while 78.3% (36) of them had normal BMI. Similarly, 67.7% (121) of the respondents did not meet the RDI of protein. Furthermore, out of the 67.0% (120) of the respondents who made conscious efforts to include high fibre in their diet weekly, only one quarter;

20.9% (25) of them were obese/overweight while 79.1% (95) had normal BMI.

6.2:Recommendations

The following recommendations were based on the findings from the study

1. It has been observed that the period between breakfast and lunch was too short, (9.30 am -12.30 pm), whilst from super to breakfast was too long (5.00 pm to 9.30 am), thus making it possible for many of the students to eat in the night and early in the morning before breakfast. It is therefore recommended that breakfast should be served at 7.00am before classes begin, so as to break the long fasting period and also lengthen the period between breakfast and lunch to enhance proper digestion to occur.
2. The portion size of protein should be increased since nearly two-third of the respondents did not meet the DRI of protein. Protein is very important for their growth and development as future mothers to reproduce healthy children.
3. The school should involve the health personnel especially the nutritionist, PH personnel and or health promoters to educate and promote the consumption of fruits and vegetables, regular meals especially breakfast and avoid skipping of meals. They should also be educated on healthy methods of losing weight.
4. The study should be replicated on a larger student population, including both sexes. In addition, further studies on micronutrient deficiencies should also be assessed.

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APPENDICES

Appendix 1 : Questionnaire

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (KNUST) DEPARTMENT OF COMMUNITY HEALTH

TOPIC: DIETARY PATTERN IN RELATION TO OBESITY IN ADOLESCENTS IN HOHOE EVENGELICAL PRESBETERIAN SENIOR HIGH SCHOOL IN HOHOE MUNICIPAL

Questionnaire on dietary intake Reference code----------
Instruction: Fill in the spaces provided or tick when appropriate please

PART 1: 100 SOCIO-DEMOGRAPHIC DATA

101 Age _____

102 Marital status

1. Single [ ]

2. Married [ ]

103 Religion

1. Christian [ ]
2. Buddhist [ ]
3. Hindu [ ]
4. Islam [ ]
5. Traditional [ ]
6. Others (specify)……..

104 Ethnicity

1. Ewe [ ]
2. Guan [ ]
3. Akan [ ]
4. Others (specify)…….

PART 2: 200 EATING PATTERN

201 How often do you eat breakfast?

1. Every day [ ]
2. Sometimes [ ]
3. Rarely/ never [ ]

202 How many meals do you eat each day? _____ 203 How many snacks do you eat each day? _____

204 Do you make conscious effort to eat foods that are high in fibre?

1. Yes [ ] 2. No [ ]

205 List some foods that are high in fibre which you consume!

……

206 Are you trying to lose weight? 1. Yes [ ] 2. No [ ] 207 If yes, what method(s) are you using?

1. Exercising [ ]
2. Dieting [ ]
3. Drugs [ ]
4. Others (specify)_____

208 How do you consider yourself with respect to obesity?:

1. Obese [ ]
2. Overweight [ ]
3. Within normal weight [ ]
4. Underweight [ ]

209 Is there any food (s) you do not eat for cultural reasons?

1. Yes [ ] 2. No [ ]

210 Is there any food (s) you do not eat for religious reasons?

1. Yes [ ] 2. No [ ]

211 Please tell me which foods you avoid and give reasons

Food item	**Reasons for avoidance**

	Religious	Cultural

212 Please tell me your favourite foods and give reasons

Food items	Reason for preference

PART 3: 300 ANTHROPOMETRIC MEASUREMENTS

I would like to measure how tall you are. To measure your height I need you to please take off your shoes/ sandals. Put your hip and fit together, stand straight and look forward standing with your back, head and heels touching the wall. Look straight ahead.

301 Measured height in centimetres

1_____centimeters ..... (Metres) ..... (M^2)

2. Refused 3.Not able

Now we would like to measure your weight, could you please keep your shoes off and step on the scale. . Put your hip and feet together, stand straight and look forward.

302 Measure weight in kilograms

1. _____in kilograms
2. Refused 3. Not able

303 Body mass index_____kg/m^2

PART 4: FOOD FREQUENCY QUESTIONNAIRE
Instruction: how often do you take the following foods? Tick as appropriate

Energy giving foods	**Daily**	**Once a week**	**2-3 times in a week**	**> 3 times a week**	**Once a month**	**> 1 a month**	**Seldom (irregular in the year)**
Fufu							
Cassava and plantain							
Yam							
Cocoyam							
Others (specify)							
Boiled tubers (Ampesi)							
Cocoyam							
Plantain							
Sweet potatoes							
Yam							
Cassava							
Others(specify)							
Rice and beans(waakye)							
Spaghetti/pasta/macaroni							
Gari							
Tuo-zaafi							
Banku							
Akple							

FOOD FREQUENCY QUESTIONNAIRE CONT

Energy giving foods	**Daily**	**Once a week**	**2-3 times in a week**	**> 3 times a week**	**Once a month**	**> 1 a month**	**Seldom (irregular in the year)**
Kokonte/abeti							
Mpotompoto							
Plain rice(white)							
Plain rice(brown)							
Fried rice							
Jollof rice							
Vegetable rice							
Omo-tuo							
Ekwegbemi							
White porridge							
Hausa koko							
Tom brown							
Buff loaf							
Tea bread							
Sugar bread							
Wheat bread							
Butter bread							
Wheat bread							

FOOD FREQUENCY QUESTIONNAIRE CONT

Body building foods	**Daily**	**Once a week**	**2-3 times a week**	**>3 times a week**	**Once a week**	**>1 a month**	**Seldom (irregular in the year)**
Ground nut soup							
Palm nut soup							
Light soup							
Kotombire Stew							
Okro soup/okro stew							
Fantefante (fresh fish soup)							
Other soup(s) specify							
Tomato stew/gravy							
Palaver sauce							
Beans stew							
Agusi stew							
Garden egg stew							
Other stew(s) specify							
Egg							
Iced cream							
Fanice							
Fan yoghurt							
Nunu Milk							

FOOD FREQUENCY QUESTIONNAIRE CONT

Body building foods	**Daily**	**Once a week**	**2-3 times a week**	**>3 times a week**	**Once a week**	**>1 a month**	**Seldom (irregular in the year)**
Peak milk							
Ideal milk							
Carnation							
Other milk(s) specify							
Condensed milk							
Cheese							
Beef							
Goat meat							
Sheep meat							
Chicken							
Duck meat							
Grass cutter meat							
Rabbit meat							
Cat meat							
Dog meat							
Other meat(s) specify							

FOOD FREQUENCY QUESTIONNAIRE CONT

Protective foods	**Daily**	**Once a week**	**2-3 times a week**	**>3 times a week**	**Once a month**	**>1 a month**	**Seldom(irregular in a year)**
Fruits							
Oranges							
Tangerine							
Banana							
Pawpaw							
Mango							
Pineapple							
Apple							
Watermelon							
Grapes							
Coconut							
Avocado pear							
Sour sop(evo)							
Guava							
Black berries							
Ground nuts							
Africa apple star(alasa)							

FOOD FREQUENCY QUESTIONNAIRE CONT

Other fruits(specify)							

Protective foods	**Daily**	**Once a week**	**2-3 times a week**	**>3 times a week**	**Once a month**	**>1 a month**	**Seldom (irregular in a year)**
Fruit juice (specify)							
Vegetables							
Cabbage							
Carrot							
Lettuce							
Other vegetable(s) specify							

FOOD FREQUENCY QUESTIONNAIRE CONT

PART 5 FORM A: 24 HOUR DIETARY INTAKE/ FOOD INTAKE RECORD

Time of day (a)	Food items/ingredients(b)	Amount served(c)	Amount left (d)	Amount consumed(c-d)

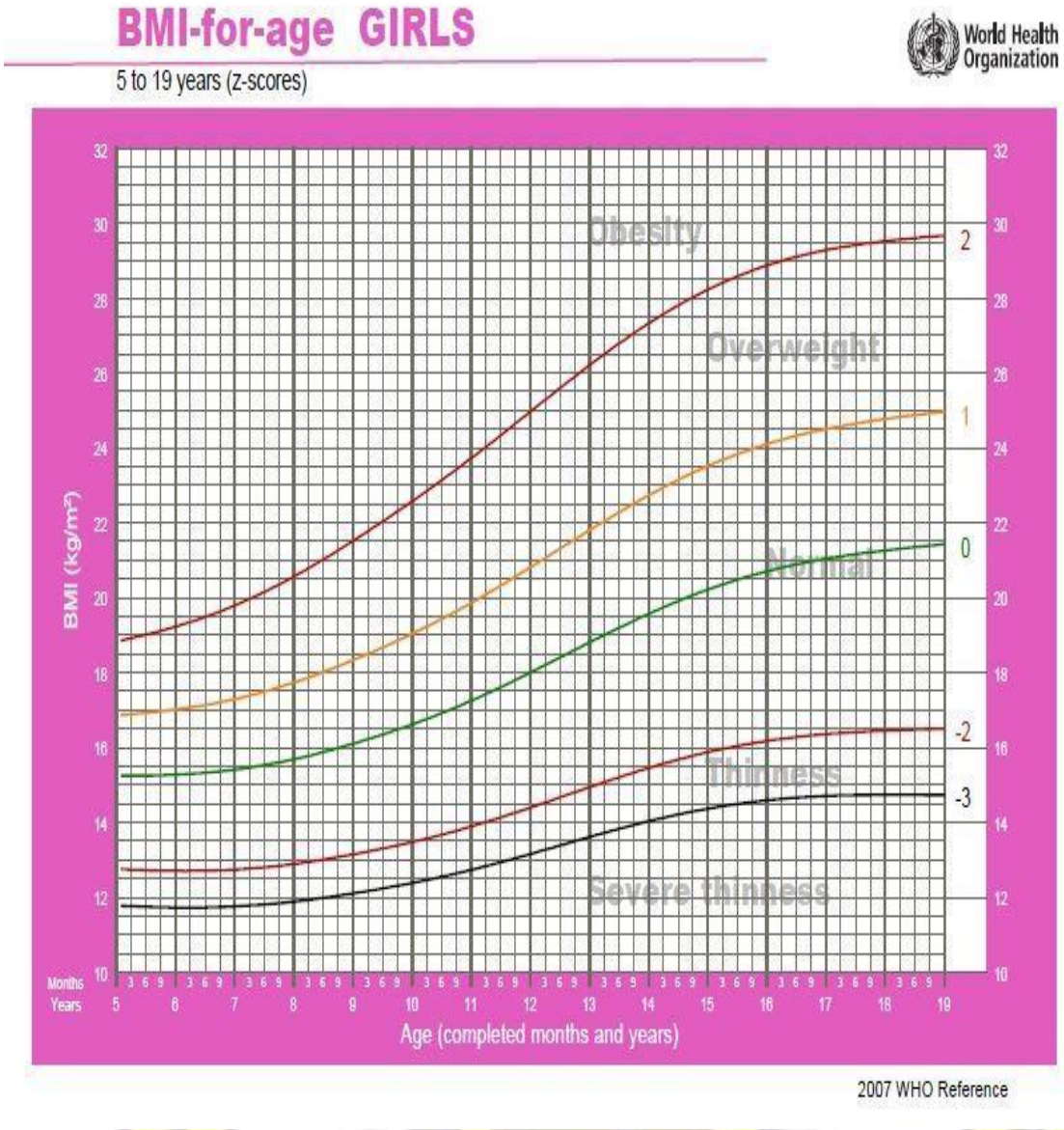
FORM B: FOOD CONSUMPTION DATA

Time of day	Food item/ingredients	Amount or volume consumed	Conversion factor	Amount in grams

FORM C: ENERGY/ NUTRIENT INTAKE DATA

Food items/ingredients	Amount consumed	Total Energy intake (kcal/day)	Protein intake (g/day)

Appendix 2: BMI-for-age (5-19 years) z-score



Appendix 3: SUMMARY OF CONTENTS OF THESIS

Title page

Certification page

Abstract

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Acknowledgement

Introduction

Literature review

Results

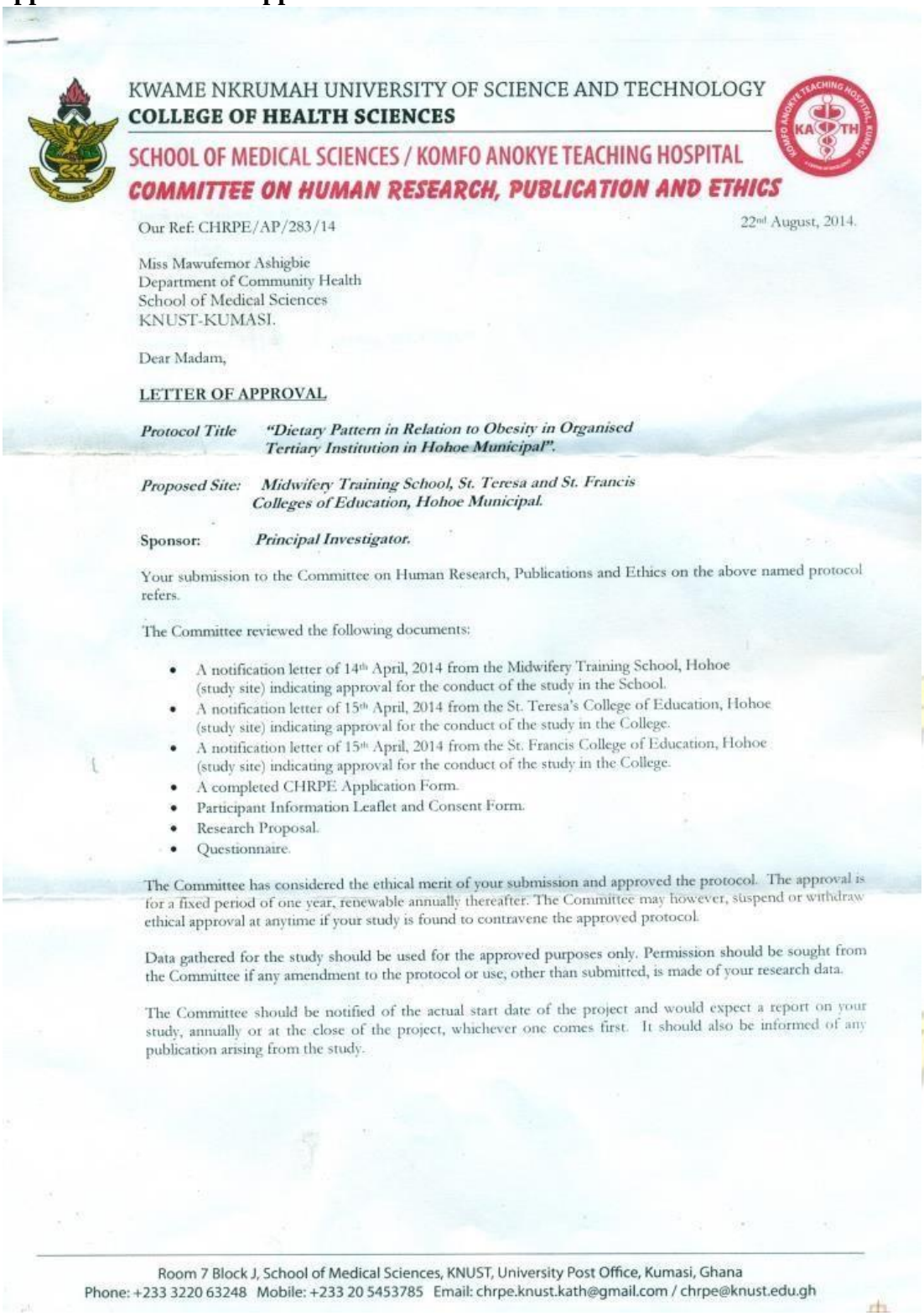
Discussions

Conclusions and recommendations

References

Appendices

Appendix 4: Letter of approval



KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/283/14

22nd August, 2014.

Miss Mawufemor Ashigbie
Department of Community Health
School of Medical Sciences
KNUST-KUMASI.

Dear Madam,

LETTER OF APPROVAL

Protocol Title *"Dietary Pattern in Relation to Obesity in Organised Tertiary Institution in Hohoe Municipal".*

Proposed Site: *Midwifery Training School, St. Teresa and St. Francis Colleges of Education, Hohoe Municipal.*

Sponsor: *Principal Investigator.*

Your submission to the Committee on Human Research, Publications and Ethics on the above named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 14th April, 2014 from the Midwifery Training School, Hohoe (study site) indicating approval for the conduct of the study in the School.
- A notification letter of 15th April, 2014 from the St. Teresa's College of Education, Hohoe (study site) indicating approval for the conduct of the study in the College.
- A notification letter of 15th April, 2014 from the St. Francis College of Education, Hohoe (study site) indicating approval for the conduct of the study in the College.
- A completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Proposal.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, renewable annually thereafter. The Committee may however, suspend or withdraw ethical approval at anytime if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

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Phone: +233 3220 63248 Mobile: +233 20 5453785 Email: chrpe.knust.kath@gmail.com / chrpe@knust.edu.gh

Thank you Madam, for your application.

Yours faithfully,

Osomfior Prof. Sir J. W. Acheampong MD, FWACP
Chairman