NUTRITIONAL QUALITY OF SNACKS IN THE SCHOOL FOOD ENVIRONMENT OF ADOLESCENTS

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BY

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DECLARATION

I, Ruby Yawa Dziedzom Addae hereby declare that except for the references which have been duly cited, the work in this thesis, **"NUTRITIONAL QUALITY OF SNACKS IN THE SCHOOL FOOD ENVIRONMENT OF ADOLESCENTS"** was done entirely by me in the Department of Family and Consumer Sciences, School of Agriculture, College of Basic and Applied Sciences, University of Ghana, Legon. This work has never been presented either in whole or part for any other degree in this University or elsewhere.

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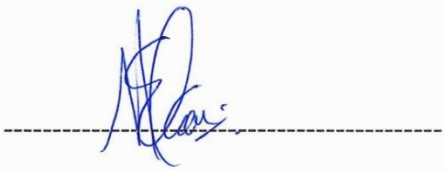

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DEDICATION

This thesis is primarily dedicated to the Almighty God, my supervisors and the Addae family. I also dedicate it to Dr. Matilda E. Laar and Prof. Christina A. Nti and friends who have always cared, supported and loved me throughout my education. May the Almighty God bless and keep you always. I finally dedicate it to all and prospective researchers and to institutions and agencies who uphold the quality of snacks in the school environments of basic school pupils.

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ABSTRACT

School food environments affect the food acquisition and consumption of pupils while they are at school, and are a major determinant of their overall nutrition and health. The prevalence of snacking among adolescents has been found, by many studies, to have increased over the years. Adolescence presents a window of opportunity for growth and development for most people. Adolescence is also a period to establish good food habits, because food habits formed at this stage are likely to be carried into adulthood. Studies in developed countries have showed that the most preferred snacks among adolescents are high in saturated fats, sodium and total calories but low in micronutrients such as iron, vitamin C and zinc. This dietary habit has contributed to the rise in obesity and cardiovascular diseases in adulthood. The Ghanaian school food environment, which has been proven to lack strict regulating policies is expected to be varied and complex. Therefore, it was imperative to study the prevailing school food environments to determine the nutritional quality of snacks consumed by adolescents and examine their snack choice drivers. It is also crucial to find out the types of snacks and specific quantities carried by snack vendors in the school environments. This may help relevant stakeholders to give interventions to mitigate the problem. The aim of the study was to determine the nutritional quality of snacks consumed by adolescents in Junior High Schools.

The study design was cross-sectional, with a quantitative approach. 400 adolescents in four selected Junior High Schools and 39 snack vendors in the immediate environment of the schools participated in the study. Dietary data and drivers of snack choice were collected using a single 24-Hour recall, a 7-day Modified Food Frequency Questionnaire

and a Snack Choice Drivers Questionnaire. Anthropometric measurements of respondents were also taken to ascertain their Body Mass Index-for-Age. A separate questionnaire was used to gather and audit available snacks from snack vendors within a 50-meter radius around each school. Data were entered into excel and analyzed with STATA, version 13.0.

Overall, respondents exceeded the recommendations for daily energy (d=322.8 Kcal), protein (difference=1g), fat (difference=33.6g) and sodium (difference=1,181.8mg) requirements, but did not meet the zinc (d=-5.3 mg) and iron (=-11.3mg) requirements in their diets.

The results showed that the most preferred snacks in both private and public schools were imported packaged snacks (68.5% vs 82.5%, p<.001) and fizzy drinks and sugar sweetened beverages (63.6% vs 77.7%, p=.02), with the least preferred being confectionaries (20.7% vs 59.4%, p<.001). There were more snack vendors in the public schools (n = 25) compared to private schools (n = 14). Fizzy drinks and sugar sweetened beverages were the most available snacks, while the least available snacks were fruits. Respondents from public schools recorded relatively higher consumption of energy (d=136.8Kcal, p=.09), protein (d=0.6g, p=0.10, fat (d=30.8g, p=.06) and sodium (d=69.8mg, p<.001) than their counterparts from private schools, who also consumed relatively more zinc (d= 0.3mg, p<.001) and iron (d=1.0mg, p<.001) during snack times. Sensory attributes (median score=100, IQR=25), familiarity (median score=66.7, IQR=33.3), weight maintenance/management (median score=66.7, IQR=66.6) and prices (median score=100, IQR= 33.5) highly influenced respondents snack choice, while ethical concerns (median score=0, IQR=66.7) was the least driver of respondents' snack

choices. There was a significant association between gender of adolescents and their frequency of consumption of imported packaged snacks ($p<.001$), fizzy drinks/sugar sweetened beverages ($p<.001$), local snacks ($p<.001$) and confectionaries ($p<.04$). There was also a significant relationship between the availability of fried snacks ($p<.001$), flour based snacks ($p=.02$) and imported snacks ($p<.001$) and their frequency of consumption.

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LIST OF ACRONYMS

ANH FEW	Agriculture, Nutrition and Health Food Environment Working Group
AWMD	Ayawaso West Municipal District
BMA	Body Mass Index-for-age
BMI	Body Mass Index
DStv	Digital Satellite Television
FFQ	Food Frequency Questionnaire
GES	Ghana Education Service
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
HIV	Human Immunodeficiency Virus
JHS	Junior High School
RDA	Recommended Daily Allowances
SES	Socioeconomic Status
VCD/DVD	Video Compact Disc/ Digital Versatile Disc
WHO	World Health Organization

DEFINITION OF TERMS

The following operational definitions were used:

Recommended Daily Allowances: The estimated amount of a nutrient or calories per day sufficient to meet the nutrient requirements of nearly all (97%-98%) healthy people, and considered necessary for the maintenance of good health.

Sugar sweetened beverages: Drinks with added sugar, including: non-diet soft drinks/soda, flavored fruit drinks, sports drinks, sweetened tea, coffee drinks, energy drinks, locally made malted and spicy drinks.

Soft drinks: Carbonated sugar-sweetened drinks.

Snacks: Foods and drinks that are eaten in between meals, not necessarily triggered by hunger and are 'light' in nature.

School food environment: The sum of all the food-related sources of energy and nutrients that surrounds the selected schools (target population).

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

The general food consumption of people is determined to a large extent by their food environments (Turner *et al.*, 2018). Swinburn *et al.*, in 2013, defined a food environment as the sum of all food related sources of energy and nutrients that surround people or an individual. The Agricultural, Nutrition and Health Food Environment Working Group (ANH FEWG) in 2016 also defined the food environment as an interface that is located on the broader food system, and ultimately impacts food acquisition and food consumption, as well as the health and nutrition outcomes of people. Food systems can be defined as all the processes, such as transportation and storage, that food undergoes from farm to fork, or even from farm to flush (ANH FEWG, 2016). The ANH FEWG (2016) also categorized the food environment into two extensive domains: the Internal/Personal food environment, which encompasses factors such as preference, affordability and accessibility that an individual can manipulate; and the External food environment, which include all the elements that an individual does not have control over with regards to how food is obtained and consumed. These elements include availability, vendor properties and product qualities (ANH FEWG, 2016). As described by Murcott, (1998), choice of food includes how an individual assorts foods from various sources in their surroundings for consumption. This assortment process is subjected to a number of factors, including competition and interaction, which further leads to reinforcement among others. Therefore, elements like the socioeconomic status (SES) of people, demographic characteristics, the religious background of people, globalization, rural-urban migration, marketing strategies and consumer behavior interact among one another to influence an individual's choice of food (Kearney, 2010).

Elements like food environments, food systems, and food choice of consumers have led to the nutrition transition, due to the constant interactivity among the aforementioned elements. This transition in nutrition has caused a deviation of the regular eating patterns of people from local staples toward a "western diet" (a classic model of a dietary practice common among people with low socioeconomic status, living in urban areas of developing countries). The sudden change of the food system from locally grown and well consumed staples toward the consumption of more processed and/or refined foods, due to their abundance and easily accessible nature is known as Nutrition transition (Aryeetey & Owusu, 2016).

Snacks are food items that are consumed among many, which contribute significantly to their nutrition and health and are particularly popular among adolescents. About 35% of the total Recommended Daily Allowances (RDA) of adolescents is consumed while they are in school (Condon *et al.*, 2009). Again, 45% of adolescents' recommended energy and nutrient intakes are contributed solely by snacks alone (Story *et al.*, 2000). Snacks can have positive or negative effects, depending on their nutritional composition (Condon *et al.*, 2009). Snacking has become a popular fashion among adolescents, thereby attracting so much attention as studies in developed countries have found that, the most preferred snacks among this population are generally high in saturated fats, energy and sodium but low in micronutrients (Poti *et al.*, 2014).

According to Qidwai *et al.*, (2010), adolescence is a period characterized by critical growth and development, with observed changes in lifestyle where new eating patterns are likely to be formed (Georgiadis & Penny, 2017). There is an upward increase in body mass during adolescence, which is often associated with increased needs for optimal nutrition. Therefore, this necessitates an action by stakeholders to encourage adolescents to form healthful eating habits during these years. Additionally, studies have indicated that unhealthy dietary practices

developed during adolescence is likely to result in prolonged health conditions, including cancer, low bone density (osteoporosis and osteomalacia), overweight and other metabolic insults during adulthood (Qidwai *et al*., 2010; Ogum Alangea *et al*., 2018).

Environmental norms can influence overconsumption of calories, while promoting the under consumption of micronutrients, which underpin social determinants of nutrition-related diseases such as overweight and obesity across the world (French *et al.*, 2003). The increased trend of overweight and obesity is fueled by the nearness of fatty meals which are low on quality to people, and people having easy access to large portion sizes while paying less, in food environments (French *et al*., 2003). The school food environment can therefore have a significant impact on adolescents' food choices.

The present study focused on six nutrients of concern in adolescents: fats, zinc, iron, sodium, energy and protein derived from snacks alone which are bought and eaten by pupils within the school premises and some defined boundaries. These nutrients are of concern because they are crucial for growth, development, and are needed to support the high metabolic rates of adolescents (Strauss *et al*., 2003). Hettiarachchi *et al.* (2006) revealed that globally, 60-80% of adolescents suffer from micronutrients deficiencies which could have long-term consequences on their health. Zinc and iron are especially important for metabolic processes, muscular growth, blood formation, brain development, attentive and retentive memory, secondary sexual characteristic maturation and biochemical processes that occur and are elevated during adolescence (Gibson & Ferguson, 2008). The prevalence of anemia among Ghanaian children is high (66%). Forty-two percent of women within the bracket of child bearing age (which includes adolescent females) are also anemic (GDHS, 2012). This is of significant health concern because iron is a crucial nutrient among school-going adolescents to support retentive and attentive

memories that are important for good academic performances (Hinton, 2014). Protein is needed for normal growth and development (FAO, 2012). Energy is required by the growing body of an adolescent in the right quantities to fuel the energetic activities and also to spare other nutrients like protein and fats from being used up (FAO, 2012).

The average Ghanaian school-age child spends about 6 -7 hours per day in school. About half (50%) of a day's recommended energy of adolescents may be consumed while they are in school, an evidence that, they may obtain half of their daily caloric needs in school (Ogum Alangea *et al*., 2018; Gleason & Suitor, 2001).

Hawkes (2017) argued that, both anecdotal and empirical evidence have pointed out the general eating patterns and snacking behaviors among adolescents. However, the specific amount of energy and nutrients contributed by snacks is not known.

Since adolescents spend more time at school than home, the ultimate way to reach them is while they are in school. In addition, snack vendors found in the immediate school food environments must be examined to evaluate associations between the school environment and the snacking habits of students (Duffy, Rivera & Popkin, 2014). Hence, there is the need to study the existing school food environment in order to better equip stakeholders' identification of possible opportunities that may present themselves, which can be useful during interventions. The present study therefore sought to understand the impact of snack on the overall nutritional quality of adolescents, and highlighting aspects of the school food environments.

1.2 Problem statement

Food environments influence the consumption of food, nutrition and health status of people. Research, mostly from developed countries, has identified snacks as food items which significantly contribute to the nutrition of many. Urban populations in developing countries have

been observed to be undergoing a nutrition transition. Thus, there has been a sudden dietary change from the consumption of local staples to highly refined, energy-dense foods that have low nutritive value. Snacking among school going adolescents has attracted much attention because it has been found to form a significant amount of the daily nutritional needs of adolescents.

Adolescence is another window period for catch-up growth for many, especially children who did not do well in their earlier life stages and is also a period of rapid growth which requires optimal nutrition. In Ghana, there is scarce empirical statistics on the dietary quality of snacks consumed among adolescents. Hence, there is a need for an investigation to ascertain the nutritional quality of snacks, key aspects of the school food environment, and the drivers of snack choices in adolescents. Optimal adolescent nutrition is important because nutrition and consequent health contributes to development at this stage and wellness in adult life.

1.3 Aim of the study

To assess the nutritional quality of snacks consumed among school going adolescents and determine their snack choice drivers.

1.4 Objectives of the study

1. To ascertain the most preferred and the most available snacks consumed by adolescents.
2. To evaluate the dietary quality of snacks adolescents, consume and compare outcomes for public and private schools.
3. To determine the snack choice drivers among adolescents.

1.5 Hypotheses

H_{O1}: There is no relationship between the gender of adolescents and the frequency of snack consumption.

H_{O2}: There is no relationship between the availability of snacks in school food environments and the frequency of snack consumption (7 days).

H_{O3}: There is no relationship between the nutritional quality of snacks consumed by adolescents and the type of school (private/public) attended by respondents.

1.6 Significance of the study

1. To provide understanding into adolescents' snack consumption, serving as blueprint for making future health extrapolations. Such information may interest stakeholders such as nutritionists, dieticians, food system analysts and health practitioners who show concern for the wellbeing of adolescents.
2. To add to the literature on elements that impact the school food environments as well as snack consumption habits of adolescents in Ghana. This will serve as reference for students, researchers and policy makers.
3. To provide understanding of the concept of quality of snack consumption among in-school adolescents

1.7 Operational definition of terms

Nutritional Quality: In the context of this study, it is used to refer to the caloric and micronutrient intakes of respondents in comparison to their Recommended Daily Allowances.

School Food Environment: It is the immediate food environments, specifically 50-meter radius around the research locations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.0 Introduction

This chapter presents the relevant literature in relation to the study objectives. The following themes were covered; conceptual framework, description of the problem, adolescents (who are they?), food environments/ school food environments, snacking, drivers of snack choices among adolescents, consequences of malnutrition among adolescents and factors affecting nutritional status of adolescents.

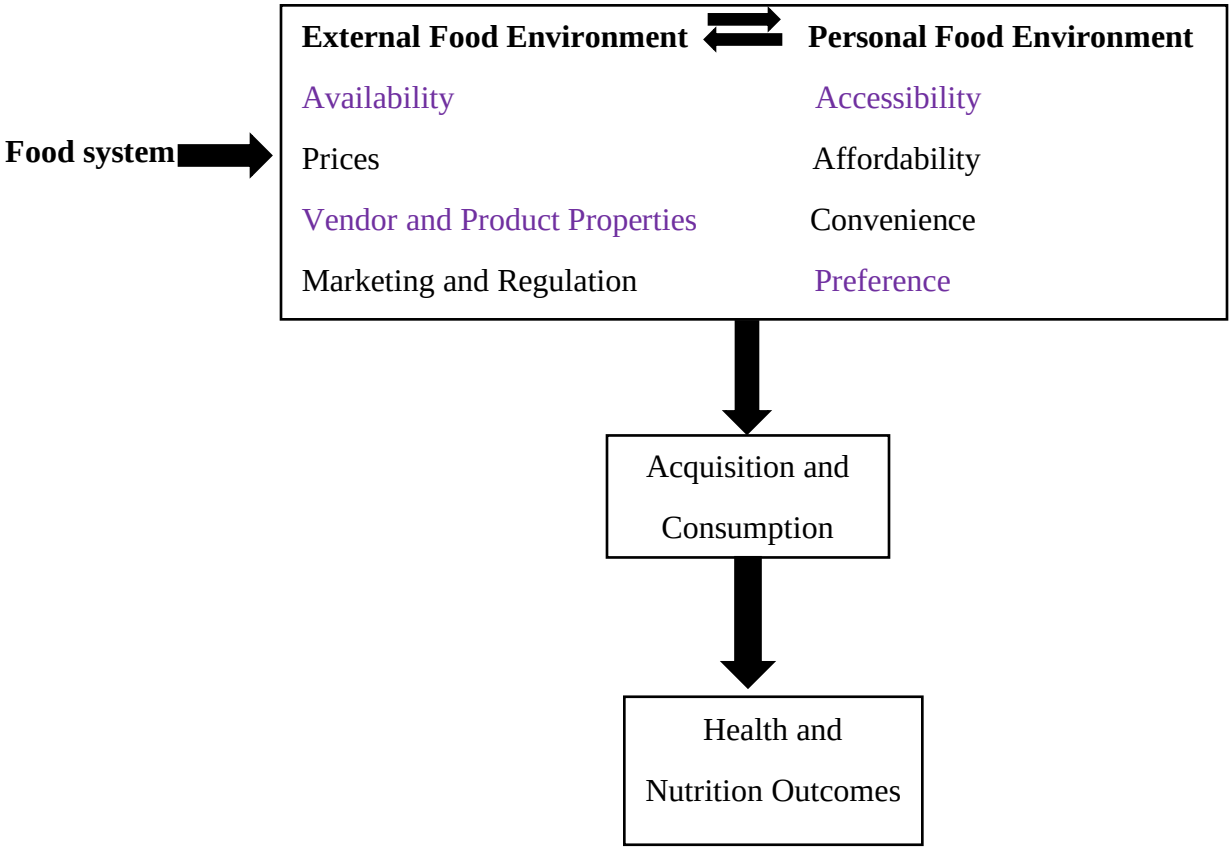

Figure 2.1 Food environment conceptual framework
(Adapted from ANH FEWG, 2016)

2.1.1 Description of conceptual framework components

The framework in Figure 2.1 above was adopted from the Agricultural, Nutrition and Health Food Environment Working Group (2016), which guided this study. The framework describes the possible association between food environments and food systems, how people acquire and consume food, and ultimately, the wellbeing and nutrition outcomes of individuals.

According to Glanz *et al.*, (2007), the two main elements involved in the general meal consumption among people are the "Internal and the External" food environments. Throughout the daily routines of individuals, there are a collection of foods and products from diverse sources that frame people. The presence or absence of food products (availability) in the environment, properties of vendors and product, as well as cost are the dimensions that make up the external food environment. On the other hand, the Internal food environment comprise those dimensions that can be manipulated/controlled by the individual to some extent (United Nations System Standing Committee on Nutrition- UNSCN, 2016). This internal food environment includes elements such as nearness of food product to the end user, affordability (purchasing power), convenience and preference (Swinburn *et al*., 2013).

2.1.2 Context of conceptual framework for the study

The food environment acts on the food system to influence the acquisition and consumption of foods. For the current study, the external food environment of interest included the 'availability' and 'snack vendors and their product properties'. 'Availability' is defined as the physical presence or absence of a particular snack product in the school food environment. 'Vendor properties' included the type of vendor (hawkers, table top owners, kiosks) and the type of snack carried by each vendor in the school food environment, while the 'Product properties' included the quality and nutritional composition of the snacks carried by vendors. In terms of the personal

food environment, the physical distance (accessibility) of vendors and the desirability (preference) were of interest. All the elements of interest in the framework above were highlighted in purple in the framework above.

The researcher also looked into factors that influenced the snack choices among the target population, which to some extent drove their general snack acquisition and consumption. It is evident from the framework that the drivers of food choice influence the dietary intake of a people and thus their nutritional and health outcomes.

2.2 Adolescents: who are they?

According to the World Health Organization (WHO) in 2002, individuals within the age ranges 10 years to 19 years are often referred to as adolescents. This age bracket is also often referred to as 'children'. For instance, as documented by Delisle *et al.*, (2005), during a Convention held on the Rights of the Child as far back in the year 1989, the United Nations (UN) labeled all individuals who fell below the age of 18 years as 'children'. Adolescents are categorized into three developmental levels, according to their social, physical and psychological changes; Early adolescence, Mid adolescence and late adolescence. These groups comprise persons who are 10/13-14/15 years, 14/15-17 years, and between 17-19 years respectively (UNICEF, 2005). The various periods are uniquely marked by a steady transition from childhood to adulthood. According to Braun & Brown (2011), the onset of adolescence is generally characterized by secondary sex maturation signs, which are exhibited in physical, cognitive and social changes. These transitions and adjustments contribute to the adolescent's pressing need for good nutrition, couple with allowing the adolescent some amount of reasonable space to independently make decisions concerning to eat (Braun & Brown, 2011). The WHO/UNICEF (1995) purported that adolescents do not seem to be steady persons, especially when it comes to issues governing their

maturity, lifestyle and growth. Thus, even among a group of adolescents with the same age who live in a given geographical location, a great deal of diversity can be observed in their attitudes and other measured variables, owing to differences and variations in environmental factors.

2.2.1 Adolescent's physiology

Adolescence is marked as a transition and a stage of rapid growth spurt in physiological, sexual and behavioral changes. Physiological changes in adolescents include growth of pubic hair, broad chest in males, and enlargement of sex organs, breast development and menarche in females, just to mention but a few. A change in body composition of adolescents which manifest in diverse proportions of lean and fat body mass is caused by a rapid hormonal transition during this period (Das *et al*., 2017). Das *et al*., (2017) again stated that half a percentage of an adult's height and body weight peaks during adolescence and their bone and muscle mass also increases during this period.

The need for energy intake is crucial as body weight increases (Colbert & Wall, 1998). However, there is variation in energy requirement for both male and female adolescents due to varied levels of physical activity, differences in physiological states, sex, different metabolic rates among others (Colbert & Wall, 1998). Generally, adolescents who indulge in physical activity have higher energy requirement than those who are inactive. This is evident in males as they have a greater requirement for energy than females per unit of body weight (Colbert & Wall, 1998). A reviewed literature reported that female adolescents tend to eat minimally during this stage of their life and are therefore unable to meet their energy and nutrient requirement. On the other hand, males experience an increase in food intake which is exhibited by a high energy and nutrient requirement throughout their adolescent stage. It is very vital to know that protein needs and its utilization is dependent on adequate intake of energy.

Adolescents are susceptible to low iron reserves and iron deficiency due to increased physiological requirements for growth, high losses which mount up in menstruating female adolescents, and diets which are often low in iron (Colbert & Wall, 1998). Iron rich foods as well as supplements are encouraged to be consumed.

Timely physical changes in adolescents is backed by the consumption of energy rich foods and adequate micronutrient intake. Therefore, during this period, the dietary intake of adolescents is of significant public health concern.

2.2.2 Adolescent's metabolism

Metabolism is related to the total energy requirement of an individual and indirectly related to growth. Metabolism is also said to constitute the energy cost of growth, basal metabolic rate, and energy expenditure which are critical to adolescents' optimum health and wellbeing (Das *et al.*, 2017).

Basal metabolism is the needed energy for cell and tissue maintenance. The basal metabolic rate increases quickly at 2 years of age and becomes steady throughout adolescence (Das *et al.*, 2017). Excess intake of one's total energy may lead to overweight and obesity during adolescence (Das *et al.*, 2017). On the contrary, if an adolescent's total energy intake falls below basal metabolic rate, growth would have to be compromised which will in turn lead to growth stunting, pubertal delay, menstrual abnormalities in girls, and interference of bone mass accumulation (Das *et al*., 2017).

In adolescents, physical activity is deemed as important for the cardiovascular and musculoskeletal system as well as the effective functioning of the metabolic system. Niacin, riboflavin and thiamin are vitamins involved in energy metabolism. Hence there is need for

increased intakes for these micronutrients during adolescence. These nutrients can be met by increasing dietary intakes of bread, cereal, fruit and vegetables, low-fat dairy products and meat (Colbert & Wall, 1998).

2.2.3 Adolescent's nutritional needs

Apart from infancy, adolescence is the most crucial phase for growth and development in the human life cycle, and therefore is a stage where people are vulnerable to nutritional deficiencies (WHO, 2008). Hence, the challenges of this stage require apt nutrition (WHO, 2006). Adolescents are at a high risk of protein energy malnutrition, micronutrient deficiency as well as overweight, caused by their fluctuating lifestyle along with other primary psychosocial factors (de Onis & Borghi, 2010).

There are a number of reasons that makes adolescents very susceptible to malnutrition. And these specific reasons according to Duffy *et al*., 2014 include the high demand for energy and nutrients to support physical growth, the ever evolving eating patterns and lifestyles, their risk loving nature and their general vulnerability to several other environmental conditions. A research conducted to give insight into the impact of meal frequencies on total energy intake and the total dietary quality of individuals from low income families, found that the ideal number of meals to be consumed among children who are quite older (including adolescents) for optimal nutrition should be three meals and two healthy snacks per day (Evans *et al*., 2015).

When adolescents fail to eat the recommended portion sizes of food rich in nutrients and enough energy, there is an increased possibility that they will be malnourished (Birch *et al*., 2007).

The repercussions of an adolescent not being able to meet his or her energy and nutrient needs may lead to some irreparable conditions, including the retardation of growth and reduced

pubertal signs, even though these are health problems which may have been carried over from the early stages of life- infancy. Furthermore, Galgani & Ravussin, (2008) stated that adolescents' inability to meet their energy and nutrient needs can put both their present and future health at risk, making them vulnerable to diseases, especially when such illnesses are coupled with other adverse lifestyle patterns, no matter how long it takes for these detrimental effects manifest.

Based on age and sex, the following nutrient allowances are recommended by the World Health Organization recommends for adolescents.

Table 2.1 Recommended Dietary Allowances (RDA) for energy and selected nutrients during adolescence

	MALE		FEMALE	
NUTRIENTS	11-14yrs	15-19yrs	11-14yrs	15-19yrs
Energy (kcal)	2500	3000	2200	2200
Protein (g)	45	59	46	44
Fat (g)	50	50	50	50
Iron (mg)	12	13.5	15	15
Sodium (mg)	2,400	2,400	2,400	2,400
Zinc (mg)	15	15	12	12

Adopted from the World Health Organization (2006).

2.2.4 Nutritional problems of adolescent

Malnutrition is used to describe the overall effect of poor nutrition, and its associated major health implication on human health, including the effect poor nutrition has on people's

socioeconomic status (Pal *et al*., 2017). Malnutrition is one of the leading causes of nutritional problem, and is of major concern in the public health domain, as it seems to occur mostly in adolescents. In the sub-Saharan African region, protein-energy-malnutrition and micronutrient deficiencies underpin malnutrition (Müller & Krawinkel, 2005). There is also a rise in issues of over-nutrition. Hence, overweight and obesity in adolescents have gained great attention, particularly in countries like Ghana, still undergoing nutrition transition. Developing countries like Ghana may still be undergoing industrialization, and typical of such economies are a drastic transformation in diet away from local staples toward a more "western diet", a term known as Nutrition transition. Such "western diets" are high in fat and empty calories while local staples are meals containing complex carbohydrates, fiber as well as energy (Aryeetey & Owusu, 2016).

The center of poor nutrition studies at local, regional as well as national levels over the years, have been on early childhood, comprising only children below 5 years of age. Thus, there has been an inadequacy with regards to available statistics from adolescents in developing countries, an age bracket found to record the highest growth rate after infancy (Hawkes, 2017).

2.2.4.1 Protein Energy Malnutrition (PEM)

Protein energy malnutrition (PEM) is a group of pathological conditions caused by the coinciding lack of protein and/or energy in diet, a condition predominantly manifested as deficits in anthropometry, in varying degrees from mild to severe forms. PEM among children can also be classified in terms of children who have low weight-for-height or low height-for-age and low weight-for-age, and these indices are always compared to that of a standardized population with similar gender and age. A direct link has been established between PEM and elevated rates of childhood and infancy morbidity and mortality. PEM in early life is thought to mostly lead to micronutrient deficiency and can cause serious health effects, which may compromise the

developing immune system, which in tend increases susceptibility to infectious disease in early stages of life (Briend & Berkley, 2016). A study conducted in Haiti which examined the association between children who were fed meals low in energy and protein, against deteriorated periodontal status in adolescents who have developed permanent dentition. It was concluded more than half (57.3%) of the participants scored 3 or greater on the overall CPI test (Walson & Berkley, 2017).

Likewise, 770 school-going adolescents between the ages of 9 and 19 years living in Baham, a town in Cameroon were studied. Their protein, energy as well as their corresponding nutritional status were investigated and found no observed significant difference in the daily intakes of protein and energy among participants between the ages of 10 and 13 years. Nonetheless, for the relatively older participants, especially for persons aged 14-18 years, there was a significantly higher dietary protein intake among boys than girls. However, the prevalence of stunting and wasting was found to be immensely higher among adolescent boys than the girls. In the same study, Kenmogne-Domguia *et al.* (2016) indicated in their study that the intake of protein among the participants was significantly higher while their energy intake levels was significantly lower than their physiological needs. Hence, the body did not spare the proteins which could have been channeled into other bodily needs such as body building, instead, it was used to fuel the energy needs of the adolescents, which consequently led to a higher prevalence of wasting and stunting.

Even though there is lack of empirical data, that give a detailed representation of the physiological state of adolescents in Ghana, a cross-sectional study on 188 in-school adolescents in living in rural Ghana reported that 7% of the study sample were underweight whereas 15% were stunted (GDHS, 2012). A study in Ghana revealed that there were no observed gender-

related differences for underweight, whilst stunting was more prevalent among boys than girls. Seven percent of adolescents of the study sample were also overweight.

2.2.4.2 Micronutrients deficiency

Worldwide, almost a third of the population have been declared micronutrient deficient by the WHO in 2007. Out of two billion people, more than 200 million children are deficient in vitamin A and zinc. Others are also faced with low thyroid levels due to reduced iodine (WHO, 2007). In 2002, the WHO revealed that almost 7 million students are iodine deficient across the world.

Kazi *et al.*, (2008) reported in a study conducted in Bangladesh on Micronutrients and Anemia that about a third of the world's population are micronutrient deficient, with most of the affected persons living in developing countries. It was further stated that there may be other possible causes of anemia apart from iron deficiency.

Lindsay *et al.*, (2009) found in their study that micronutrients have the ability to cause a small but significant increase in heights or lengths of children. Another outcome from this study was that, adequate micronutrients improves the health status of a Human Immunodeficiency Virus (HIV) patient by raising their CD4 counts, thereby lowering the morbidity and mortality rates among this population. It can be inferred from this result that, adequate proportions of micronutrients are likely to improve the overall health status of adolescents, which also happens to be a critical stage in the human life cycle. Again, it was revealed that multiple micronutrient deficiencies coexist mostly in developing countries, like Ghana (Lindsay *et al*., 2009).

Studies on poor nutrition including one conducted by Alicke *et al.* in 2017 concluded that 4% of their participants were deficient in iron, and that males stood a higher chance of being malnourished than females. Some of the variables that were measured in their study sample, who

were 188 adolescent Ghanaians included socioeconomic levels, compromised cardiovascular health, infectious diseases and medical risk factors.

A survey conducted in Iran in 2013 on Dietary Diversity and Its Related Factors among Adolescents by Vakili *et al.* showed that diet diversification ensures micronutrient incorporation into meals, and also the ultimate way to achieve a balanced diet. However, some studies have also shown evidence of adolescents' attraction to high sodium, high saturated fats and energy dense foods which mostly lack micronutrients (Clark & Fox, 2009). This therefore gives a n indication that adolescents are likely to consume unbalanced diets, which may consequently lead to metabolic insults.

2.3 Food environments

Food environment is a term used to describe the circumstances that influence the selection of food and drink for consumption among people (Swinburn *et al.*, 2013). Both the school and home food environments have continuously been changing, and such changes have influenced people's choices of food. Food environments therefore can influence sources from which people obtain their energy and nutrients, including major decisions that surround their purchase and consumption (Holsten, 2009). Briefel, Wilson and Gleason (2009) indicated in his study that both home and school food environments have a correlation with an individual's dietary intakes and can influence their BMI. A documented evidence in 2016 by Global Panel showed that the immediate food environment can cause shifts in global food systems, thereby affecting processes such as how food is produced, transported, stored, transformed and retailed to local settings, where the food would reach the consumer. Compared to adults, adolescents have relatively less control over their food environments with regards to the selection of food for consumption among available options. Adolescents are also influenced to a large extent, to consume what is

readily available in their surroundings. Hence, food environments have become a great concern and have also attained much attention in recent times (Edwards, 2010). There are some environmental elements that influence eating patterns, such as the manner in which the food supply keeps evolving; people increasingly eating out; alluring food exhibitions, attractive strategies adopted in marketing products, and appropriate/enticing promotional messages; and costs of food (French, Story & Jeffrey, 2001). School going children, especially adolescents often consume what is made available and accessible to them in their surroundings, and when made available in larger amounts, they are likely to consume even more quantities. Many developed nations, like the United States have a plethora of national policies that regulate and guide food items that are sold in schools and a defined perimeter around the school compound (Cain-Bish & Ha, 2009).

Furthermore, this regulatory measures do not only promote food safety, but ensures the appropriate and permissible foods and drinks in the school food environment (Cain-Bish & Ha, 2009). However, this is not the same most developing countries in Africa, Ghana inclusive.

Popkin (2004) reported that most developing countries in Africa are undeniably undergoing urbanization, hence, they are rapidly transitioning into an industrialized economy. As such, more people are working outside the home, spending more hours of the day out of home. While away from home, people are likely to rely on fast foods and meals that are not freshly prepared. Hence, there is an increased transition in dietary patterns, coupled with increased conveniently located fast food joints and easy access to industrial products (food products low in nutritional components, but contains mainly saturated fat and calories). Another cause of nutrition transition is general affluence and high purchasing power among children, which give them the sole decision of what to buy and consume while away from home (Fernandez *et al.*, 2006).

Due to this, numerous attempts in the form of outreach/intervention programs such as making available signage with images of fruits in schools in order to inspire adolescents to cultivate the habit of patronizing and consuming fruits and vegetables, which are considered as healthier options ((Fernandez *et al.*, 2006).

Thus, in some developed countries like the United States of America and Canada, strict policies and measures have been implemented to check foods that surround schools in order to push the fruits and vegetables consumption agenda (Story *et al.*, 2000). However, not much can be said for countries who are still undergoing economic development, including Ghana.

Due to this upward increase in the rates of overweight and obesity among children in recent times, the dietary practices of children have attracted great attention throughout the world (Center for Disease Control and Prevention, 2007). The simultaneous rise in overconsumption of calories and the practice of sedentary lifestyle (lack of physical activity) among people have been directly linked with the increase in overweight and obesity occurrences. In a study by Clark and Fox (2009) almost majority (95%) of their respondents (adolescents) reported to have consumed high sodium snacks. Out of this same population, 80% agreed to have consumed snacks high in saturated fats. This as explained by Clark and Fox (2009) was an excessive consumption of energy dense, high fat snacks, a practice which may lead to a host of cardio-metabolic malfunctions.

2.4 Snacking

A snack as defined by Chamontin, Pretzer and Booth (2003) is "a light food eaten in between major meals of the day or light foods consumed at a particular point in time, and usually not necessitated by hunger, a practice popular among adolescents". According to Blaine *et al.*, (2017) snacks are "Foods and/or beverages that are consumed outside of the 3 major meals".

Snacks include food items that eaten less structurally and may not be necessitated by hunger (Chaplin & Smith, 2011). Examples of snacks include confectionaries, drinks/juices, (Chaplin & Smith, 2011).

Between 2003 and 2006, a survey was conducted among school going children in the United States. The study showed that snacking was trending, and hence becoming a popular fashion compared to the periods between 1988 to1999. It was established that, snacking among children was increasing from twice a day to three times per day (Piernas & Popkin, 2010). The study revealed that a little above a quarter (27%) of a child's daily energy is contributed by snacks. The study threw more light on the fact that although the major source of calories from snacks are contributed by desserts and sugar sweetened beverages, salty snacks and candies were the most consumed (Piernas and Popkin, 2010).

The worldwide increase in habitual snacking among the paediatric age category has influenced the rates of obesity among children and adolescents, consequently leading to the prevalence of compromised metabolic health in adult life (Onyiriuka *et al.*, 2013). Consumption of meals in liquid form among adolescents, likely to be fizzy drinks and beverages have been found to cause some increase in weight among consumers, of which adolescents are not left out (Ludwig *et al*., 2013).

Rather than nutrition, taste is the major gatekeeper that influences adolescents' choice of snacks. This according to Cross *et al.*, (1994) has resulted in adolescents selecting their snacks based on sugar and their salt contents, rather than the health benefits they present. For instance, it was found in a study by Onyiriuka *et al.,* (2013) that 88.22% of their respondents who were adolescent girls chose taste as the factor that drove their snack choice, as against 37% of

adolescent girls who said they will select their snacks because they perceived that it will benefit them, nutritionally.

According to Ludwig *et al.*, (2001), due to adolescent females' affinity to fizzy drinks and liquid snacks (beverages), they mostly under consumed fruits and vegetables, thereby reducing the frequency of fruit and vegetable intake during snacking times (Cross *et al.*, 1994). Shriver *et al.*, (2017) reported that meals consumed at snack times alone contributed about 450kcal to the daily caloric intake. This value is equivalent to about 20.4% of an adolescent's recommended total daily energy intake.

A wide variation in snack consumption accounts for the different levels and snack consumption frequencies among adolescents. More than four decades ago, data on snack consumption by Bigler-Doughten and Jenkins (1987), 80% to 90% of a typical snack consuming adolescent ate not less than a snack per day, with varying frequencies, spanning between one and seven snacks each day. This trend has been on the increase ever since.

The general snacking attitudes among adolescents have been investigated into by various nations. The United States of America, Malaysia as well as India have recorded 87-88%, 62.1% and 54.1% snacking frequencies respectively, with the range of consumption frequency being between one and seven. Again, at least one snack was consumed by each respondent daily, across all the three countries.

In developing countries, food consumption patterns are steadily moving away from the usual 'three-times' daily major meals toward eating small quantities of foods that are light in nature, periodically, a term referred to as 'snacking' (Livingstone, 1991). A study by Ogum-Alangea *et al.*, (2018) among selected Ga East basic schools in Ghana showed that, snacks that are often

consumed by the participants were confectionery items, fried local snacks, imported snacks, fried and fruits. The demographics from their study revealed that the participants were predominantly school-age children (9-15 years). Hence, the study provided some background information on the snack preferences of adolescents, since some participants fell within the UN age group of early and mid-adolescence.

A study conducted on in-school Mexican adolescents showed that, a quarter (20%) of the participants attended school on empty stomach. This attitude of skipping breakfast is unhealthy, as it has led to in-school adolescents overly relying on snacks for the energy and nutrients (San Juan Fernandez, 2006). Breakfast skipping also reduces a person's activeness and attention span, ultimately lowering academic performance. This unhealthy dietary pattern led to under consumption of nutrients among pupils in some Mexican schools (San-Juan Fernandez, 2006). Therefore, it is vital for pupils, and more especially adolescents to eat healthy meals for breakfast at home, as meal quality can be impacted by where it is eaten, whether in homes or schools.

Therefore, because snacks provide an additional significant amount of energy, it is crucial that adolescents engage in healthy snacking habits that emphasize the consumption of nutrient dense snacks.

2.4.1 Nutritional qualities of snacks

Snacking in itself is not a bad practice because it has been proven to contribute significantly to the good nutrition, health and wellness among many (San-Juan Fernandez, 2006). However, snacking, especially among adolescents calls for attention when it provides added energy intake and low micronutrient intakes. Over time, statistics have pointed out the poor nature of meal quality; meals that emphasize high energy and low micronutrients, which snacks may offer (Kerver *et al.*, 2006; Drummond *et al.*, 1998). Even though snacking or eating frequency among

adolescents is a widely explored area in nutrition, its effect on the meal quality and health are imprecise, because some studies have proven the ability of snacks to contribute to good nutrition (good sources of vitamins, potassium, magnesium and carbohydrates) (Murakami, 2017).

However, as reported by Zizza *et al*. in 2007, there is a discordant association of snacking with the intake of protein and fat in American adults. A Finnish study revealed that, the general nutrient quality of meals will be lowered, in that, potassium and vitamin C levels will decrease while fructose levels will be elevated when a significant amount of a day's energy comes mainly from snacks (Zizza *et al.,* 2007). Comparably, a research by Si Hassen *et al.* (2018) on the energy and nutrient contents of snacks in the diets of French adults and it was concluded that snacking times recorded lower density of nutrient than main dishes, with the exception of those snacks consumed during the mornings and midday. Evening snacks were found to contribute mainly insignificant quantities of nutrients such as vitamins, fibre, minerals and proteins but were energy-dense and high in saturated fats (Zizza *et al.*, 2007).

2.4.2 Drivers of snack choices among adolescentsS

According to Correa-Burrows *et al.* (2017), measures have been laid down by stakeholders from private and public institutions to monitor variety of foods sold in the immediate school environment, with the aim of controlling food advertisement targeted at teenagers. Despite these attempts to regulate the surroundings schools, adolescents' may still be fall prey to high energy meals in and away from school (Fraser, 2013).

A research targeted at understanding the awareness of hearty snacking behaviors among Irish teenagers revealed that cost, sensory attributes, handiness and the unavailability of tasty, healthy snacks directed at adolescents were the main drivers of their snack choices (Crofton, Markey & Scannell, 2014). Also, a study by Rafferty *et al.,* (2018) revealed that convenience, prices of food

items, preferences, social standards, parent versus child's involvement in snack selection, balance, and time of meal consumption were the main forces that drove adolescents' choices of snack. For the purpose of this study, price, convenience, sensory attributes, health, weight control/maintenance, familiarity, ethical concerns and natural content were reviewed to understand adolescents' snack choice drivers.

2.4.2.1 Cost and convenience

The interest of public health officials among many nations have been drawn towards the prevalence and frequency of dietary-related disease burden of adolescents, and their associated cost. A study by Hartmann *et al.*, (2017) concluded that this has caused many countries to include children's dietary choice as an integral part of their policies. According to Cash *et al.* (2013), the study with regards to the importance of market price to children's food choice is a more varied one. There have been different emerging schools of thought concerning this subject because a number of studies oppose that market price (cost) might not play a significant role in childhood food purchasing choices because they have short-term financial responsibilities. Others have also argued that less market exposure and experience, less advanced cognitive capacities and impulsive buying behavior strongly influenced snack choices (Sclafana, 2001).

Likewise, a study by French *et al.* (2001) showed that when low-fat food items are promoted by retailing them at a reduced cost by 10%, 25%, and 50% led to higher sales as compared to high-fat snacks in school environment. The findings of Brown and Tammineni (2009) on the relevance of market prices on food selection habits showed that children's food budgets are lower while they are in school. Therefore, they are easily attracted to cheaper snacks, and that adjustment of market prices of food items can lead children on, into impulsive purchasing habits (Kocken *et al.*, 2012).

Moreover, Onyiriuka *et al.*, (2013) studied the snacking behaviors among in-school Nigerian adolescent girls and concluded that, out of all the respondents who snacked during break time, slightly above a three-quarter (76%) of them confessed to have skipped breakfast while at home. Thus, students may be motivated to purchase snacks from convenient outlets because they did not eat breakfast. They typically purchase snack products that are high in fat, sodium and energy such as beverages and pastries from convenient outlets close to their schools during recess.

2.4.2.2 Sensory appeal and pupils' preference

Fatehi and Hall, (2015) stated that the human senses can impact the selection and/or avoidance of food. They further established that human senses enable people to make decisions regarding food selection. A cross sectional study by Murimi *et al.* (2016) on elements found to influence students' choices of food revealed that, irrespective of an individual's race or grade, taste was the leading determinant in settling on what food to select or keep away from, out of all the focused groups conducted. It was also concluded that aside taste, the aroma and general appearance of food was a crucial gatekeeper, which all participants made reference to during focus groups. Clearly, this finding points to the fact that sensory appeal influences choices and contributes to how adolescents select or avoid foods and snacks.

Another major influencer of food and snack choice among adolescents is familiarity (Murimi *et al.*, 2016). According to Murima *et al.*, (2016) participants' familiarity with a food was also a gatekeeper in their choice of food, which represents another internal level influence in snack selection. The study further revealed that foods that participants or their friends had ever tasted were more appealing to them, and influenced their food and snack acquisition and consumption.

2.5 Consequences of malnutrition among adolescents

Hitherto, malnutrition is one of the leading underlying roots of disease burden in African since 2015, mostly affecting children between the ages of 9 and 17 (Adeyeye *et al.*, 2017). This therefore calls for a collective action among all stakeholders who are concerned about the welfare of this group, considering the host of adverse effects poor nutrition presents. Not only does poor nutrition degrade cognitive function ability of children, but it also affects their overall academic output (Oldewage Theron & Egal, 2010).

Undernourished children are at a greater risk of experiencing prolonged and more severe diseases and record higher disability and mortality rates compared to those who are adequately nourished (Barry, 2008). Also, the health consequences of malnutrition can be grievous to the extent that, it can linger into adulthood. Therefore, people who were malnourished during their childhood battle diminished work capacity and experience impaired reproductive performance (Barry, 2008).

2.5.1 Physical growth (stunting and wasting) and health consequences

Stunting among children has been proven by many studies to be the most common indicator of malnutrition (de Onis *et al.*, 2010). As far back in 1967, a cohort study was conducted by Dreizen *et al.*, on nutrition and human growth at the Nutrition Clinic, Hillman Hospital, Birmingham, Alabama. The study which lasted twenty-five years showed that, prolonged undernutrition can slow bone maturation and menstrual onset as well as delaying the epiphyseal fusion in the skeletal system. The irreversible cognitive and physical damage caused by stunting and wasting poses great threats such as increased chances of chronic diseases later in life and reduced neurocognitive performance (de Onis & Branca, 2016). Some growth trajectories have shown that adolescence presents another opportunity for catch-up growth for many and could

potentially restore good health and reverse poor nutritional status (Prentice *et al.*, 2013; Georgiadis & Penny, 2017). Hence there is the need for optimal nutrition during this period.

2.5.2 Psychosocial consequences

A research aimed at investigating how a positive balance between good nutrition and physical activity impacts people's health and wellness showed that, linguistic intelligence during the early stages of adulthood and neurocognitive health are among the benefits reaped by physically active persons who practiced good nutrition during their early life stages (Jackson & Beaver, 2015).

Good nutrition is likely to improve an individual's cognitive output on speech as well as memory performance during childhood. However, people stand a higher risk of showing deficiencies in neurocognitive functions when their meals are consistently inadequate in nutrients and energy (Liu, *et al.*, 2003).

Prolonged undernutrition patents during childhood and is commonly linked to slower rates of development of cognitive abilities and other health problems later in life (Srivastava *et al.*, 2012). Nyaradi *et al.*, (2013) reported that reduced cognitive functioning and impaired development in pupils is a consequence of malnutrition, which can further lead to late behavioral development and the social skills acquisition.

2.5.3 Educational or academic consequences

According to Stuber (2014), nutrition has the tendency to affect students' cognition, intelligence, behavior, attentiveness and retention, all of which form a greater part of their educational output. Also, diets that are high in trans fats and saturated fatty acids negatively impact memory and learning capacities. Thus, deficits in nutrients during the early stages in life ultimately affect

cognitive development in early life. Nonetheless, proper nutrition improves students' cognition, concentration, and boosts their energy levels in during studies (Mireku *et al.*, 2015).

Li and O'Connell (2012) found that regular consumers of fast food among grade 5 students performed poorly on a math and reading test than the participants who did not. Also, a study among fifth graders showed that, individuals from poorer homes, who fed on meals that are low in nutrients did not perform well in a standardized literary assessment (Mireku *et al.*, 2015).

Likewise, Belot and James (2009) studied a school which did not permit unhealthy foods and made available only nutritious and freshly prepared school meals to its pupils. It was concluded at the end of their study that, pupils who submitted fully to the course of the healthy eating campaign reaped benefits, such as scoring higher grades in tests compared to non-participants of the campaign. This is a clear indication that a student's academic performance is largely dependent on good nutrition, especially when it is made accessible in their immediate food environments. Therefore, good nutrition must be prioritized among this age group in order to ensure and sustain good academic performance among them.

2.6 Factors affecting nutritional status of adolescent

2.6.1 Nutritional factors

It has been proven by studies that dietary habit and intake, having easy access to nutrition information and general good dietary practices are linked to attaining full growth potential, cognitive development, appropriate body composition among other health benefits during the adolescence period (Pařízková, 2000). Studies have pointed to the fact that dietary intake can have direct impact on the nutritional status of an individual and a group of people. Protein-energy-malnutrition among adolescents is largely caused by inadequacy of nutrients in diets,

alongside compromised gut health, leading to abnormalities in food absorption (Nti, 2008; Pařízková, 2000).

2.6.2 Dietary behavior

Dietary behaviors are everyday choices that people make about food and their respective reasons for choosing them (Allafi *et al.*, 2013).

Researches have proven that there are some dietary behaviors that are common among adolescents, but are detrimental to their physical health and overall wellbeing, such as the limited consumption of fruits and vegetables, frequent breakfast skipping, while consuming large quantities of fast foods and beverages (Allafi *et al.*, 2013).

Birch *et al.*, (2007) have also indicated in their study that dietary habits formed during early life stages are likely to be carried into adolescence and throughout an individual's life. A research conducted on physical activity, sedentary behaviors and dietary habits among adolescents in Kuwait revealed that, males consume more of vegetables, dairy and dairy products, sugar sweetened beverages, energy drinks, and junks compared to female (Allafi *et al.*, 2013). Nevertheless, the female adolescents of this study consumed more sweets than their male counterparts. Furthermore, it was established in the study that 49% and 15% of female adolescents in Abha and Jeddah were found skipping breakfast, respectively. Adolescents who performed poorly on the food choice scale were habitual consumers of foods low in micronutrients, but high in carbohydrates and fats, consequently leading to excessive weight gain and its associated health problems.

2.6.3 Dietary intake

Sufficient dietary intake is pivotal to the provision of nutrients, which influences overall health, growth, boosts cognitive development and promotes academic performance during adolescence (Ochola *et al.*, 2014). Hence, allowable daily dietary intake cannot be underestimated, especially for an adolescent to attain the ideal level of physiological growth. Inadequacy of daily dietary intake is directly proportional to overall nutritional status and poor health (Mwaniki & Makokha, 2013). It is worthy of note that consuming variety or practicing dietary diversification is essential to guarantee sufficiency and ensuring balance in food intake, even though daily dietary intake plays a major role in ensuring optimum growth and development (Burchi *et al.*, 2011).

Despite the fact that adolescents living in countries still undergoing development do not practice dietary diversification, they usually consume meals from plant sources, with limited fruits and vegetable consumption levels (Burchi *et al.*, 2011). Also, even though adequate intake of energy and nutrients are crucial at the adolescence stage, those living in developing countries recorded insufficient energy and micronutrient intake. Concurrently, studies have shown that there is a changing fashion in diet, where there are elevated consumption rates of energy dense snacks and sugar sweetened beverages among adolescents with low socioeconomic status, who predominantly live in urban regions of developing countries.

Similarly, a study on the nutritional status and dietary intake among adolescent girls living in an Iranian suburb, Semnan, revealed that the intakes of energy, zinc, folate, calcium, vitamin B12, and fiber were not adequate among female adolescents in comparison with the recommended values (Doustmohammadian *et al.*, 2013). Researching into the nutritional status of adolescent females in Mandlenkosi High School, a suburb of Durban in South Africa, Silangwe (2012)

concluded that high carbohydrates intake was prevalent and this impacted their Body Mass Index-for-age Z-scores positively.

2.6.4 Nutritional knowledge

Making available information on nutrition, thereby promoting nutrition knowledge among adolescents can positively impact their choice of food and health. According to Essien *et al.*, (2014), when adolescents are able to select healthy foods for consumption, it can increase their ability to play and study normally. Having adequate nutrition knowledge and practicing good dietary behavior in early life can impact growth and disease occurrences that last throughout a person's lifetime. Thus, good eating habits must be emphasized during childhood, as there are empirical data that have shown that the quality of dietary intake can decline as a child matures (Sharma *et al.,* 2008). A typical adolescent may not prioritize healthy eating and as such bad snack choices may put them at a greater risk for health problems (Puhl & Heuer, 2010).

2.6.5 Environmental factors

An individual's environment has the tendency to influence his or her dietary choice and ultimately their overall health status. The immediate environmental factors have the ability to affect an individual's dietary habit, intake and meal quality.

Verstraeten *et al.* (2016) investigated personal and environmental elements that groom adolescents' dietary behavior and reported that the higher the accessibility of healthy foods are in a community; the more likely adolescents are to consume them. In the same population, adolescents who live in such environments had the perception that healthy foods contributed towards good health. The study again showed that children who have strict parents had higher self-efficacy for healthy snack choices, ultimately leading to fewer perceived barriers and built better and healthier eating habits. On the other hand, adolescents whose parents were relatively

more permissible built less healthy food habits, as they were allowed to make their own food choices, instead of being guided. Schools that offer immense support, by providing their pupils with only healthy choices and empowered adolescents with nutrition knowledge observed healthy eating habits among the population (The Centers for Disease Control and Prevention, 2011).

2.6.5.1 Socioeconomic factors

There is an association between a family's income level and their nutritional status, as it impacted the health of children positively (Patimah *et al.*, 2016). De (2017) studied the correlation between the socioeconomic status of pupils in India and the prevalence of malnutrition. In this population, there was a relatively higher prevalence of malnutrition among children whose mothers have had formal education (literate) compared to those whose mothers are illiterate (42.3% and 20% respectively). Again, it was reported that the likelihood that malnourished children belonging to low socioeconomic backgrounds will mature into unhealthy adults with low levels of education and economic instability was high compared to those from wealthy homes.

Children who come from large family sizes, with many younger siblings are most likely to become malnourished, as resources in such families are not adequate to cater for the need of each child equally. Hence, resources are distributed among the younger ones with less attention given to older children or adolescents (Poda *et al.*, 2017; Tekile, Woya & Basha, 2019).

According to the FAO (2006), nearly 800 million of such persons come from the middle to low income countries, whereas 34 million come from developed countries. In 2007, it was stated by the Disease Control Priorities Project that, it is possible to eradicate almost a third (32%) of the

world's disease burden when issues concerning malnutrition are duly tackled and put under control.

The unavailability or scarcity of food is not the only cause of undernutrition, and neither is it exclusive to only poor populations but can also affect the affluent (Chapman, 2006).

2.6.5.2 Food security and hunger

To live a healthful life, it is important to keep to dietary adequacy, in terms of quality and quantity, (Chinnakali *et al.* 2014). The peak result of food insecurity is malnutrition, accompanied by plethora of economic problems and health issues on households and also at the community level. As defined by FAO (2013), food insecurity is "a state that exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary requirements and food preferences for an active and healthy life". Household level food insecurity have led to nutritional deficiencies among children. These deficits in nutrition have been made evident by the poor outcomes of academics, caused by truancy, the inability to retain and sustain school enrollment, which have also led to great losses in productive years in adult life (Alderman *et al.*, 2006).

Chinnakali's study on the causes of household food insecurity prevalence in some parts of Northern India in 2014 revealed that, the harmful effect of food insecurity in itself does not have a direct impact on individual households. However, in an effort to attain food security, a heavy economic toll may be experienced by affected households. This is even worse when households must spend a greater portion of their monetary income on food acquisition. This further exposes such affected households to psychosocial dysfunction, which pre exposes children from these homes to a wide array of nutritional and health issues (Pereira & Hodge, 2015). Over the years, studies have shown the detrimental effects of insufficient nutrient intakes among children, and

the magnitude to which it can cause them to deviate from the normal growth curves (stunting and wasting) (Taras, 2005).

2.6.6 Disease and infections

There is a synergistic relationship between malnutrition and disease. Calder and Jackson (2000) demonstrated that undernutrition can compromise good health, by making it simpler for microbes to access the body, thereby contending the body's resistance to diseases and infections. They also mentioned that compromised barrier function may ultimately affect an individual's ability to fight pathogens. Hence, malnutrition increases risks of disease. Consequently, disease can also cause a defect in the way nutrients are absorbed, alter nutrients requirements and loses of endogenous nutrients. This is prevalent among the pediatric age, worldwide.

Helminth infections, malaria and micronutrient deficiencies contribute highly to infections (GDHS, 2012). The Ghana Statistical Survey in 2014 also reported that infection/disease and malnutrition are constantly in an unending vicious cycle which could lead to high mortality and morbidity rates (GDHS, 2012).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This section sets out the research techniques, which were used in collecting, analyzing and presenting the research data of this study. The analysis focused on the nutritional quality of snacks consumed by adolescents in school, and it mapped their immediate food environments and identified the drivers of adolescents' snack choice in four selected schools.

3.2 Study design

The study was conducted with a cross-sectional study design using a quantitative approach to understand the nutritional quality of snacks available in the immediate surroundings of both private and public junior high schools (JHS). The above design suited the current study because it allowed the analyses of data collected from a particular population, at a fixed point in time. Again, this study design was chosen because it is less expensive and requires a relatively shorter period of time. This study design also enabled the researcher to collect primary data on specific variables studied during the time period.

3.3 Study location

The study was conducted in four schools, all located within the Ayawaso West Municipal District in the Greater Accra region. The Ayawaso West Municipal district has a land area of 20km^2 and encompasses communities such as Kissieman, East Legon and Achimota. According to the 2010 population and housing census the district's population stands at 219,000.

Within each community, two schools were randomly selected to participate in the study. These schools were located in East Legon and Achimota. Two public schools and two private schools were selected for the study. The private schools were Grace Preparatory school and Destiny Child school located in East Legon and Achimota respectively. The public schools on the other hand were the La Bawaleshie Presbyterian JHS and Anunmle JHS located in East Legon and Achimota respectively.

3.4 Target population

The target population of this study included all junior high pupils who were adolescents and attending the selected public and private school in the study communities, as well as all snack vendors within a 50-meter radius around each school (East Legon and Achimota). The inclusion criteria for participation were:

1. Adolescent aged 10 to19 years old.
2. Willingness of the adolescent to participate in the study by signing an informed consent form.
3. Adolescent should have been enrolled in the selected public and private schools for at least one term prior to the start of the study.
4. The adolescent was not sick or absent from school in the preceding day.

3.5 Sample and sampling procedure

3.5.1 Sample size calculation

The minimum sample was determined using the prevalence study formula (Amoh & Appiah-Brempong, 2017)

$$n = \frac{z^2(pq)}{d^2}$$

$z =$ the value for confidence interval, placed at 95%, set at 1.96

$p =$ prevalence of snacking among adolescents, assumed to be at 35%

$$q = 1 - p$$

$d =$ the margin of error set at 0.07

Since

$$n = \frac{z^2(pq)}{d^2}$$

Therefore,

$$n = \frac{1.962\ (0.35)(0.65)}{0.072}$$

Hence, the Sample size = 178.4

Ten percent of the sample size, representing 18 respondents was added to sample size calculated to account for non-responses.

Therefore, sample size = **196.4**

Even though the estimated sample size for this study was 196.4, this figure was approximated to 200. Hence, 200 pupils each from private and the public schools, making a total of **400** respondents (pupils) participated in the study.

For the snacks vendors, a total enumeration was done. A total of **39** vendors who were present and willing at the time of data collection participated in the study.

3.5.2 Sampling procedure

A multistage approach was employed to select the respondents. The Ayawaso West Municipal district was conveniently selected because of ease of logistics and proximity to the researcher. Researcher obtained information on the list of all the JHS within the Ayawaso West Municipal District and their corresponding population sizes from the Basic Unit of the Ghana Education Service. There were a total of 97 basic schools with JHS being part of their school stream out of 369 schools found within the district. Thirty-eight of the schools were public (government-owned), with the remaining 59 being private. In each community, public and private schools with similar population sizes were paired. Two pairs (four schools) were randomly selected using the 'Ballot' method. The above method of sampling was used in order to give all the schools equal opportunity of being selected and to minimize researcher bias. The proportionate sampling method was used to select the number of respondents to be selected from each school and the number of respondents from each form (class or level of study). At the classroom level, the random sampling approach was used to select the individual respondents. Here, the researcher used a "Yes/No" balloting method to select the participants. It was ensured that the number of ballot papers with 'Yes' tallied with the estimated sample size for each class.

A total enumeration was applied in selecting snack vendors within 50-meter radius around each school.

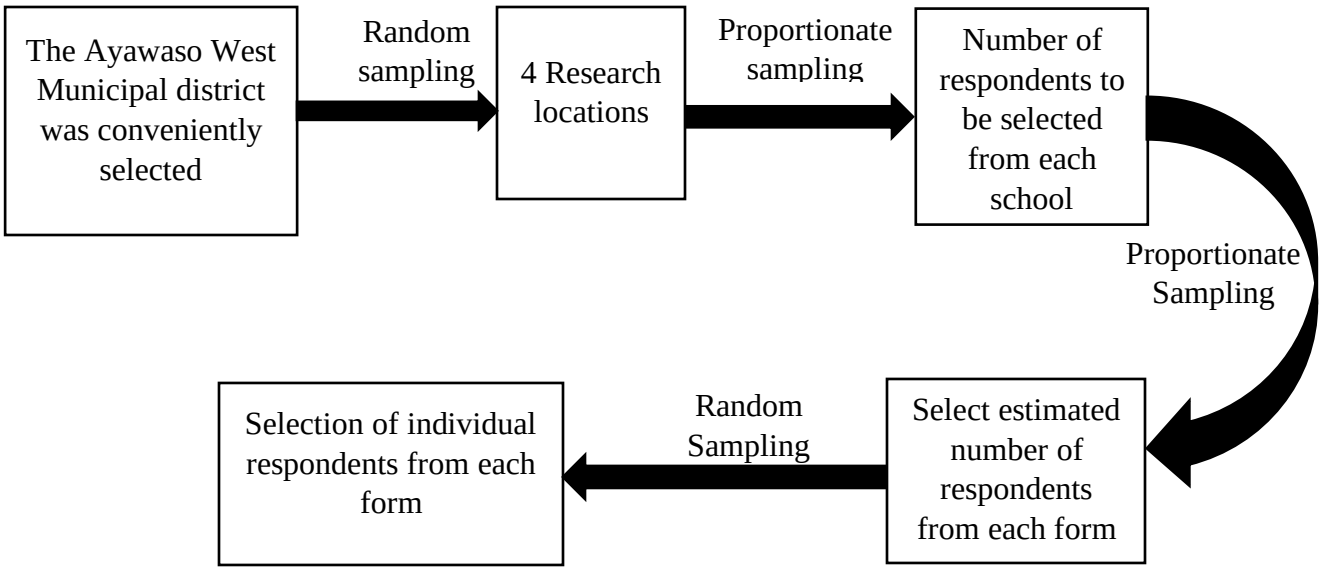

Figure 3:1 A flowchart diagram of the multistage approach used in selection of respondents

Tables 3.1 and 3.2 below summarize the procedure followed by the researcher in estimating number of respondents that were represented in each school.

Table 3.1 Sample size of pupils and vendors

School	Population of J.H.S in school	Sample size = JHS population/ sum of population of schools (by administration type) x 200	Number of snack vendors
Anunmle JHS	116	116/241 X 200 = 96.3	10
La Bawaleshie Presby JHS	125	125/241 X 200 = 103.7	15
Destiny Child School	120	120/235 X 200 = 102.1	9
Grace Preparatory School	115	115/235 X 200 = 97.9	5
Total	**476**	**400.0**	**39**

Table 3.2 Sampling of respondents from each class

School	Number of Persons from each class $= \frac{\text{number of persons in a class} \times \text{the number of persons needed}}{\text{overall JHS population size in the school}}$		
	JHS 1	**JHS 2**	**JHS 3**
Anunmle JHS	50/116 X 96.3= 41.5	41/116 X 96.3= 34	25/116 X 96.3= 20.8
La Bawaleshie Presby JHS	46/125 X 103.7= 38.2	41/125 X 103.7= 34.0	38/125 X 103.7= 31.5
Destiny Child School	53/120 X 102.1= 45.1	39/120 X 102.1= 33.2	28/120 X 102.1= 23.8
Grace Preparatory School	44/115 X 97.9= 37.5	39/115 X 97.9= 33.2	32/115 X 97.9= 27.2
Total	**162.3**	**134.4**	**103.3**

3.6 Data collection tool

3.6.1 Instruments for data collection for the pupils

A structured questionnaire (open and close-ended questions) divided into three sections was used to collect information from the pupils on the following seven items.

1. **The demographic characteristics of respondents**: Section A of the questionnaire sought to gather information such as the age, sex, religion and gender of the respondents. There were ten questions in all, with questions 9 and 10 specifically aimed at collecting

information regarding menstruation, and as such, these questions were restricted to females only.

2. **Respondents' Socioeconomic Status (SES)**: The section B of the questionnaire gathered information that was used to assess the SES of respondents. Filmer and Prichette (2001) stated in their study that, to accurately determine the SES of people, questions asked should be asset-based rather than income-based. In Ghana, Ogum Alangea *et al.*, (2018) adopted the Filmer and Prichette approach, and out of twelve asset-based questions that were asked, eight variables adequately measured the SES of their respondents. Therefore, the current study adopted those eight questions in assessing SES of respondents. The questions that were asked are:
    a) Whether or not respondents' parents/guardian owned a vehicle.
    b) Whether or not respondents' parents/guardian owned satellite dishes such as DSTV/MULTI-TV.
    c) The type of house ownership of the respondents' parents or guardians.
    d) Whether or not respondents' parents/guardian owned a television set
    e) Whether or not respondents' parents/guardian owned an electric/gas cooker
    f) Whether or not respondents' parents/guardian owned a VCD/DVD player.
    g) Whether or not the respondents' parents/guardian owned an air conditioner
    h) Whether or not the respondents' parents/guardian owned a refrigerator/deep freezer.
3. **The third section of the questionnaire comprised three different tools**. They were:
    a) A Single 24-hour Meal Recall Questionnaire: - This method was used to collect information on all foods, beverages and supplements, except water consumed by respondents within the preceding 24 hours. Prices of snacks that were reported to

have been purchased from food vendors within the schools' food environment were also captured. Additionally, information regarding the

- Time of meals/snack consumption,
- Estimated quantity of consumed main meals/snacks (household measures) and
- Weights of estimated quantities were recorded.
- Detailed information on the cooking method, the source of the food and where the food was consumed were collected.
- For the respondents who reported to have purchased and consumed snacks within school food environments, the exact amount of the snack were bought and measured to obtain weights using a food weighing scale.
- With the aid of household measures and food models, participants were asked to estimate the actual quantities of food consumed (sizes and weights of food).

The 24-hour meal recall was used because it has been found to be particularly useful in describing food/snack brands, portion sizes and detailed description of contents, and is also especially recommended for collecting dietary information in school pupils such as the participants of this study.

b) A 7-Day Modified Food Frequency Questionnaire (FFQ): - This questionnaire was adopted from a study conducted in Ghana by Ogum Alangea *et al.*, (2018) to determine the usual intakes or patterns of snack consumption among school age pupils in the Ga East municipality in the Greater-Accra region. A pre-determined list of nine snack categories was presented to respondents. The snack groupings (fizzy drinks/sugar sweetened beverages, imported packaged snacks, local snacks, fried

snacks, flour based snacks, confectioneries, fruits, fruit juices and meat/meat products) were based on their nutritional contents.

Respondents were to indicate whether or not they had consumed snacks from the nine snack groupings within the past seven days.

The FFQ also gathered data on the brand/type of snacks as well as their frequency of consumption within the past one week. The FFQ was adopted for this study because it collects data for the usual intakes and frequency of snack consumption among respondents and is particularly useful in establishing dietary patterns in populations. However, one flaw of this method is that, it is poor at estimating actual intakes, which the single 24-hour recall is likely to complement.

c) Dietary practice: - This section on dietary practices collected information on usual habits associated with meal consumption pattern and frequency including meal skipping at a particular time of the day and snacking. Where necessary, open-ended questions were employed to obtain data on where the food was consumed and place of purchase for certain dietary habits.

d) A 36-Item Snack Choice Questionnaire. It is a tool developed by Stepttoe *et al.*, (1997) and has since been used by several nutritionists and researchers across the globe to ascertain the drivers of snack choices among various populations. The 36 questions asked were sub divided under nine groups. These groups were health, ethical concerns, price, convenience, natural content, weight control/maintenance, mood, sensory attributes and familiarity. These questions were aimed at collecting data on the snack choice drivers of adolescents.

Pictures of pre-determined snacks were printed and laminated on cardboards and shown to respondents to stimulate their memories (Ogum Alangea *et al.*, 2018).

A digital weighing scale (Seca) and a portable stadiometer (Seca 213) were used in measuring respondents' weights (kg) and standing heights (cm) respectively. Body Mass Index-for- Age z-scores (BMA) was calculated from heights and weights of students.

3.6.2 Instrument for data collection of the vendors

A separate structured questionnaire with open and close-ended questions was used to audit snacks available in a 50-meter radius around the schools. Information on the stock available, type of snacks available, and the vendor characteristic and their exact locations were collected. The vendor characteristic in this study refers to the type of vendor, physical structure and arrangement of the snack store. For instance, whether the snack vendor is a hawker, owns a retail outlet (kiosk, stall, corner store) or operates within the schools' canteen.

The Epi Info Nutrition App was used to collect coordinates of the specific locations of snacks vendors in the school food environments. Prior to the collection of coordinates, the Epi Info Nutrition App was used to determine the 50-meter radius around each selected research location, in order to guide researcher in sampling the snack vendors.

3.6.3 Pretest

The instruments for data collection were pretested on ten adolescents (JHS pupils) each from the University of Ghana Basic School and University of Ghana Staff Basic schools. The pretesting of the instruments was done in order to determine the clarity of questions, to check the

consistency in the interpretation of questions by the respondents and to identify ambiguous items.

After pretesting, all the ambiguous, misleading and wrongly interpreted questions were revised to improve the clarity of the questions.

3.7 Data collection method

3.7.1 Pupils' Data Collection Method

3.7.1.1 Self-administered

Data was collected by the use of a self-administered questionnaire for Section A (demographics) and Section B (SES).

3.7.1.2 Researcher-administered (face-to-face)

However, Section C which comprised the 7-day modified Food Frequency Questionnaire (FFQ), a Single 24-hour Meal Recall and the 36-item Snack Choice Questionnaire as well as the Anthropometric measurements was researcher-administered.

3.7.2 Vendors' Data Collection Method

The questionnaire for the vendors was researcher- administered.

Information on the most common snacks available in the school food environments of basic schools was obtained from a study by Ogum Alangea *et al.* (2018). Thus, this information guided the researcher to create a pre-determined checklist of snacks for auditing snacks among all snack vendors in the research locations.

The auditing was carried out by counting and recording the number of individual units of a particular snack item present at the time of data collection.

The Epi Info Nutrition app was downloaded unto a smart phone and the Geographic Positioning System (GPS) coordinates were collected.

3.8 Data analysis and presentation (pupils)

Data were entered into excel, cleaned and later analyzed with Stata, version 13.0. Frequency distributions were generated and summarized in tables and charts, where applicable.

3.8.1 Statistical tests (pupils)

The T-test and Pearson's Chi-square statistics were used to test the demographic differences between schools at 5% level of significance. The Wilcoxon Ranksum statistic was used to test the differences in nutrient intakes between public and private schools. Respondents were grouped under 3 socioeconomic statuses (high, middle and low SES) using the Filmer and Pritchett (2001) approach

3.8.2 24 Hour meal recall

The analysis of the single 24-hour meal recall was done by coding the foods and their portion sizes, after which the estimated quantities of foods and snacks were converted into weights (grams and milligrams where appropriate).

The nutrients of concern were computed using the RIING Database and Microsoft Access software version of the Ghana Food Composition table. Nutritional quality of snacks was determined by comparing caloric and micronutrient intakes with the Recommended Daily Allowances (RDA) for adolescents.

To analyze data obtained from the 24-hour meal recall, descriptive statistics were used to describe the socio-demographic and background characteristics of participants. Means and

standard deviations were calculated for continuous variables while proportions and frequencies were computed for categorical variables.

Principal Component Analysis was used to reduce the eight questions asked on asset, ownership and occupational background of parents into one dimension, and thereby making it possible to group respondents into low, middle and high SES.

3.8.3 Anthropometric data

Z-score cut offs were the indicators for determining the Body Mass Index-for-age (BMI-for-age) of respondents using WHO Anthro Plus software (2007). Respondents were grouped into 'underweight', 'normal' and 'obese' using WHO (2007) standards for adolescents' BMI-for-age. The Pearson Chi-square test was used to determine whether the type of school attended was related to the nutritional status (BMA) of the individual.

Table 3:3 Classification of Malnutrition using BMI-for-Age Z-score

Classification	Principal cut-off points (Z-Score)
Overweight	>+ 1
Obesity	>+ 2
Underweight	>- 2
Normal	>- 1 to + 1

3.8.4 Data analysis and presentation (vendors)

The GPS coordinates of vendor locations from the Epi Info Nutrition app were used to determine the various locations and clustering of snack vendors present at the time of data collection and for mapping. Data on types of available snacks in the food environments were grouped into 9 categories according to their nutritional contents (Ogum Alangea *et al.*, 2018).

Table 3:4 Snacks groupings with examples

Snack categories	Examples
Fizzy drinks/sugar sweetened beverages	Coca cola, fanta, pepsi, royal apple, storm energy drink, kalyppo, juice
Imported packaged snacks	Pringles, pocky, cheese popcorn, crunchips
Local snacks	Roasted plantain and yam, sobolo, Burkina
Fried snacks	Fried yam, fried plantain, 'bofrot', Kelewele
Flour based snack	Meat/fish pie, bread, cakes, chips
Confectionaries	Biscuits, Chocolates, ice creams, Pebbles, candies
Fruits	Banana, Apple, Pineapple, Mango, Orange
Fruit juices	Ceres, smoothies, cranberry, pure heaven, Tropicana
Meats and Meat products	Beef, chicken wings, boiled egg, sausages

Table 3.4 above presents the examples of snack items under the various snack categories based on their nutritional content/composition (Ogum Alangea *et al.*, 2018). The first group of snacks was Fizzy drinks/sugar sweetened beverages, which are predominantly empty caloric liquid-based snacks that are energy-dense but low in micronutrients.

The second group is imported packaged snacks which were high fat, energy- dense and salty. Local snacks included all snacks that were prepared using locally grown foodstuff, which are likely not to be over processed and less costly. Fried snacks include mainly traditional snacks that were prepared by frying in oil, and are likely to be high in saturated fats and energy. Flour-based snacks are made from white flour, and are likely to be high in carbohydrates but less in fiber and micronutrients. Confectionaries are snack items which were high in saturated fats and

carbohydrates and included snacks such as chocolates, biscuits, gummy toffees, candies and ice creams.

Fruits are generally healthy and are ideally recommended as better snacking options for many, because they contribute fiber, energy and are nutrient dense. Examples include soursop, pineapple, apple, mangoes, pawpaw and grapes.

Like fruits, fruit juices are highly nutritious and generally considered healthier as compared to fizzy drinks and sweetened beverages. However, unlike fruits, fruit juices have low fiber contents.

Meats and meat product are rich in protein, fat and some micro nutrients. Some examples include boiled eggs, fried, fish, soya kebab among others, which are important for normal growth. However, the high trans and saturated fat contents of processed meats like sausages and some other fatty meats may contribute to overweight.

3.9 Ethical consideration

3.9.1 Ethical approval from College of Basic and Applied Sciences, Ghana Education Service and study areas

The research protocol was reviewed and approved by the Ethical Committee of the College of Basic and Applied Sciences of University of Ghana. Additionally, approval was sought from the Metro Director of Ghana Education Office and Basic Education Unit of the Ghana Education Service (GES). Letters of introduction were obtained from the Department of Family and Consumer Sciences and delivered to the heads of all the selected schools. Prior permission was sought from the schools' sub metro supervisors in the research locations, after which suitable

dates and times were set for official meetings between researcher, class teachers and school heads to discuss favorable times and dates for data collection.

3.9.2 Recruitment and training of Research Assistants

Two research assistants who had knowledge and skills in using the research instruments were recruited and trained to collect data using the aforementioned tools.

3.9.3 Informed consent

Pupils were informed about the purpose for which the study was being conducted, and were each asked to seek verbal consent of parents before the actual data collection began, while the class teachers signed an informed consent form.

3.9.4 Data collection duration

Data collection lasted for a period of three months, specifically from December 2018 to March, 2019.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter presents the findings, interpretation and discussions of the study. The results are presented in tables and figures. In addition, the results are discussed and summarized under the following main headings:

1. The socio demographic and economic characteristics of the respondents.
2. Preference of snacks among the adolescents.
3. The availability of snacks in the school food environment of the respondents.
4. The accessibility of snack vendor types within the school food environment of the respondents.
5. The nutritional quality of the three main meals and snacks consumed by the respondents within the preceding 24 hours.
6. The drivers of snack choices among the respondents of the study.
7. The relationship between gender of the adolescents and their frequency of snack consumption.
8. The correlation between the snack availability and their consumption frequency among the respondents.
9. The association between snack nutrient quality and the type of school attended by pupils (private and public schools).

4.1 Baseline characteristics of respondents

Table 4.1: Age of the respondents

Age (Years)	Private Schools	Public Schools	Both	p-value
Mean	13.4	14.9	14.1	**<0.001**
SD	1.9	1.5	1.8	

The average ages of respondents of the study is shown in Table 4.1.

It can be inferred from Table 4.1 that respondents from the public schools were relatively older than those from the private schools, with the mean ages of the respondents being 14.5 and 13.4, respectively. There was a significant difference (p<.001) between the ages of respondents from public and private schools. Similarly, a comparative study on the nutritional status of adolescents from public and private schools conducted in Ibadan in Nigeria by Kola-Raji, Balogun and Odugbemi (2017) showed that most of the private school respondents (46.9%) were between these ages. Hence, respondents from the private school were generally younger as compared to majority (71.7%) of those from public schools who fell within the age ranges of 13 and 15 (p<.001). Likewise, a school-based cross-sectional comparative study on the nutritional status among adolescents by Gebreyohannes *et al.*, (2014) in Addis Ababa also revealed that, private school respondents were relatively younger (34.2% vs 47.5%, p<.001) than those from the public schools. In the same study, it was found that adolescents attending public schools were relatively older (65.8% vs 52.5%, p<.001) than their counterparts from the private schools.

Table 4.2: Gender of adolescents

Gender	Private Schools	Public Schools	Both School types	p-value
Male, N (%)	99 (50.0)	97 (48.0)	196 (49.0)	**0.692**
Female, N (%)	99 (50.0)	105 (52.0)	204 (51.0)	

Table 4.2 presents the gender of the adolescents who participated in the study. There was no significant difference in the gender distribution of private and public schools.

Table 4.3: Ethnicity of Respondents

Ethnic Group	Private School N (%)	Public Schools N (%)	Both N (%)	p-value
Akan	77 (38.5)	91 (45.5)	168 (42.8)	
Northern	37 (18.5)	33 (16.5)	70 (17.8)	**0.192**
Ewe	39 (19.5)	50 (25.0)	89 (22.7)	
Ga-Adangbe	39 (19.5)	27 (13.5)	66 (16.8)	

In terms of ethnic backgrounds, Table 4.3 indicates that, approximately 43% of respondents were Akans, with the least represented tribe being Ga/Adangme (16.8%). The second highest

represented ethnic group was Ewes, followed by Northerners. This finding was consistent with a study on adolescent pregnancy in an urban community in Ghana by Baafi (2015), who reported Akans as the most dominating ethnic group (47.3%), followed by the Mole-Dagbanis (37.1%). According to the 2000 Housing Census in Ghana, Akans (49.1%) are the predominant ethnic group in Ghana, followed by the Mole-Dagbanis (16.5%), Ewe (12.7%) and Ga-Adangmes (8.0%).

Table 4.4: Socio economic status of respondents

SES	**Private Schools**	**Public Schools**	**Both**	**p-value**
	N (%)	**N (%)**	**N (%)**	
Low	21 (10.5)	119 (59.5)	140 (35.0)	
Middle	106 (53.0)	68 (34.0)	174 (43.0)	**<0.001**
High	73 (36.5)	15 (7.5)	88 (22.0)	
Total	**200**	**200**	**400**	

Table 4.4 illustrates the socioeconomic status of the respondents of the study.

The socioeconomic background of respondents from public and private schools was significantly different ($p<0.01$). It can be inferred from table 4.4 that there were relatively more private school respondents in the high and middle SES categories, whereas there were more public school than private school respondents who belonged to the low SES category. The selection of adolescents from both public and private schools according to Ceschini *et al.*, (2009) is likely to give a

representation of various SES as well as demonstrating other factors such as comparing nutritional status among the respondents. A study by Nascente *et al.*, (2016) in Brazil revealed that most respondents from private schools belonged to the middle and high SES (43.5% vs 31.2%, p<0.001) as compared to those from the public schools, who were also mostly found within the low SES (52.5% vs 63.4%, p<.001). A study by Ferreira *et al.*, (2015) in Brazil showed that 12.1% of public school respondents reported to have spent less than USD2 on food as compared to 0.0% of those from the private schools who also reported to have spent not less than two US dollars on food daily, while at school. The findings of the current study as well as that of Ferreira *et al.*, (2015) therefore highlights the fact that most people belonging to affluent families are likely to be enrolled in private schools while those from relatively poorer homes are likely to attend public schools.

Table 4.5: Fathers' occupation of the respondents

Occupation	Public Schools N (%)	Private Schools N (%)	Both Schools N (%)	p-value
Professionals	27 (26.0)	77 (74.0)	104 (29.9)	
Artisans	68 (81.9)	15 (18.1)	83 (23.9)	
Office workers	16 (38.1)	26 (61.9)	42 (12.1)	**<0.001**
Traders	21 (26.9)	57 (73.1)	78 (22.4)	
Unemployed	15 (100.0)	0 (0.0)	15 (4.3)	
Others	16 (63.5)	10 (36.5)	26 (7.47)	

N stands for the number of responses, 5% (0.05) significance level, and a multiple response option table, summation of figures and p-value was computed according to rows.

Table 4.5 illustrates the occupation of the fathers of the participants of this study. None of the private school students had unemployed fathers. Majority (74.0%) of students from private schools had fathers who engaged in professional work in the formal sector. The types of

professional work included medical doctors, lawyers, police officers and other high rank security officers. On the other hand, more than half of the respondents from the public schools had fathers who were artisans (carpenters, mechanics, barbers and masons) which are typically low earning jobs.

Table 4.6: Occupation of respondents' mothers.

Occupation	Public Schools N (%)	Private schools N (%)	Both Schools	p-value
Professionals	25 (30.5)	57 (69.5)	82 (22.6)	
Artisans	43 (82.7)	9 (17.3)	52 (14.3)	
Office workers	12 (16.0)	63 (84.0)	75 (20.7)	
Traders	80 (63.0)	47 (37.0)	127 (35.0)	**<0.001**
Unemployed	17 (89.5)	2 (10.5)	19 (5.3)	
Others	3 (37.5)	5 (62.5)	8 (2.2)	

N stands for the number of responses, 5% (0.05) significance level, and a multiple response option table.

Table 4.6 shows the occupation of the mothers of the respondents of this study. About 11% of the private schools' students had unemployed mothers and majority (89.5%) of students from the private schools had their mothers being professional workers.

Most (82.7%) students from public school had mothers who were artisans, that is semi-formal sector workers, employed in bead making, hairdressing, dressmaking among others. Sixty-three percent of the respondents from the public schools had mothers engaged in petty trading, while 37.0% of mothers of private school pupils engaged in trading. There was a significant difference ($p<.001$) in the occupation of mothers of students from the public schools versus private schools.

Even though Filmer and Prichette (2001) proposed that asset-based questions ultimately lead to the optimum classifying SES of people, others including Fujishiro *et al.*, (2010) argued that occupation is also one way to accurately measure SES as it is mostly found to reflect one's level of education and level of income. In the current study, it was found that respondents, who were mostly from the private schools had their parents being professionals and office workers as compared to their counterparts from the public schools who had their parents mostly being artisans and traders, with relatively more public school respondents' parents being unemployed than the respondents from private schools' parents. It is therefore evident from this finding that, the respondents whose parents were formal sector workers (professionals and office workers) were likely to have higher education, were more affluent and were more likely to send their wards to private schools. On the other hand, parents who were artisans and traders were more likely to have semi-formal education, less affluent and therefore were more probable to enroll their children in public schools. The trend whereby individuals working within the formal sector are mostly found to be relatively affluent as compared to their counterparts in the semi to informal sectors, especially in developing countries according to Macdonald (2009) is because of employment and/or cash inflow stability.

Figure 4.1 shows the BMI-for-Age of the respondents of the study sample. The two-sample test of proportions was used to determine the relationship between the various BMI-for-Age categories of the respondents.

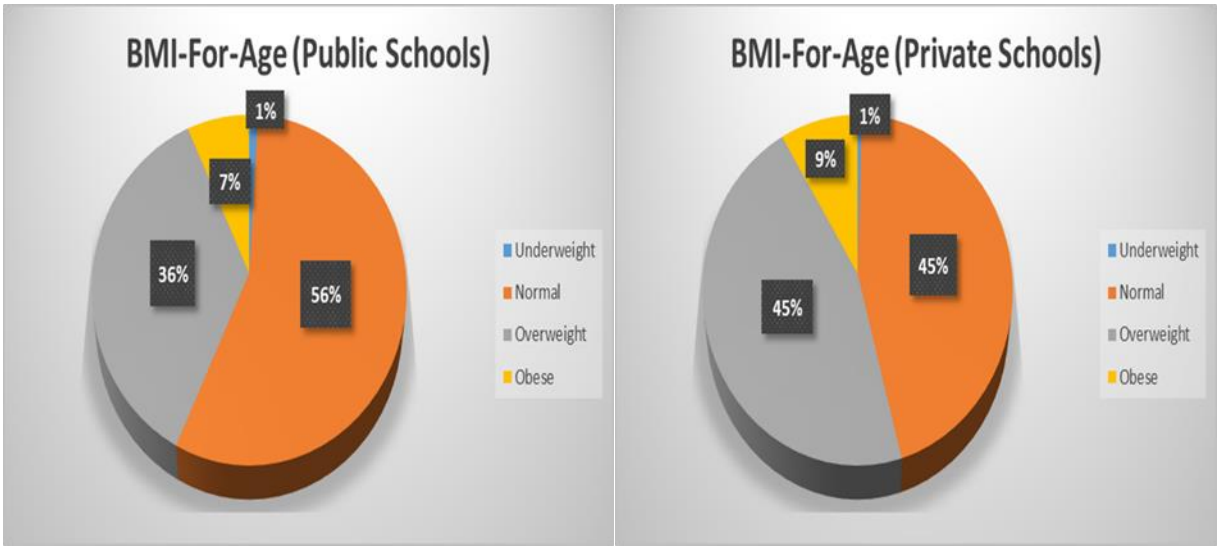

Figure 4.1: Respondents' BMI-for-Age

Overall, there was no significant difference (p=.21) between the BMI-for-Age of respondents from both school types. One per cent each of both the respondents from the public and private schools were underweight, whilst 7% and 9% (p<.001) of the respondents were obese, respectively. Thirty-six percent and 45% of students who fell in the overweight category were from the public and private schools, respectively.

There was no significant difference between the proportions of students who were overweight in both school types. Fifty-six percent of the public school students had normal BMI, whereas 45% of the private school participants belonged to the normal BMI category. There was a significant difference between the proportion of public school and private school students who were normal (p = 0.03).

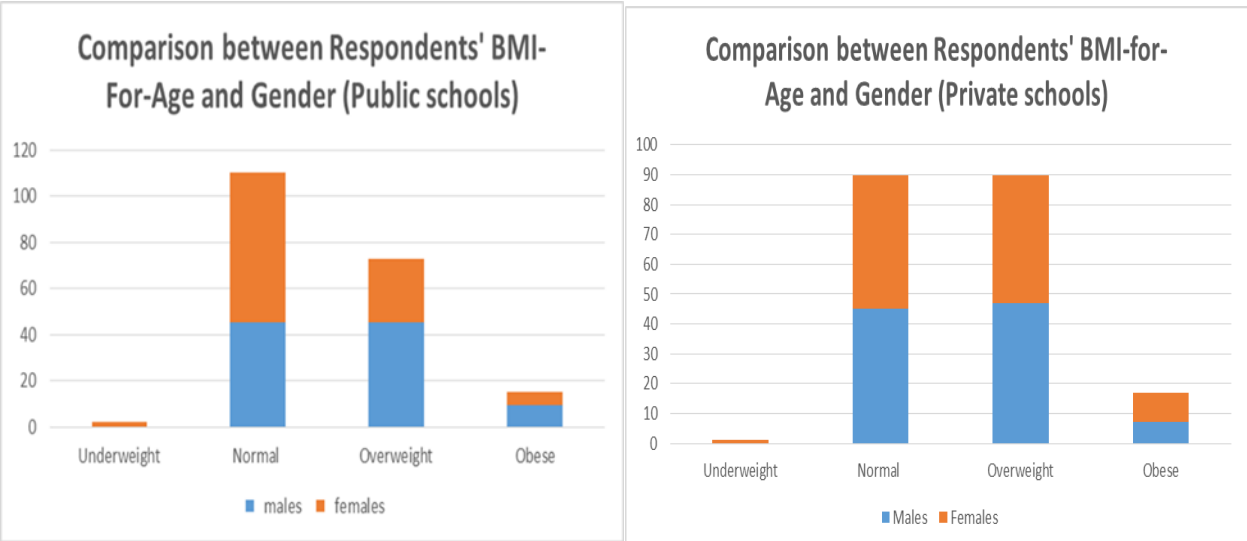

Figure 4.2: Respondents' BMI-for-Age against their Gender

The comparison between the BMI-for-Age of the respondents and their gender is presented in Figure 4.2. It can be inferred from the figures above that no males in both school types were underweight, whilst 41.2% (n = 10) and 68.4% (n =13) females from the private and public schools were obese respectively.

About 50% of males and females from the private schools were of normal weight. Fifty-one percent of males were overweight whereas 49.2% of females from the private schools were overweight. Meanwhile, for the public school students, 42% of males and 58% of females had a normal BMI for their age, respectively.

Table 4.7: Respondents' BAZ against their Gender

Respondents' BMI-for-Age	Gender		P-Value
	Males	Females	
Underweight	0	1.5	<0.001
Normal	45.4	55.4	0.045
Overweight	46.4	35.3	0.025
Obese	8.2	7.8	1.000

Figures represent the overall BAZ categories in percentages, Pearson chi square = 7.9094, p-value = 0.048, Fisher's exact = 0.042, two-sample t test of proportions was used to determine the statistical relationships between the BAZ and gender at 5% (0.05) significance level

Table 4.7 presents the respondents' BAZ against their gender. Generally, there was no significant difference (p=.05) between respondents' gender and BAZ. However, it was found in the study that there were more overweight (46.4%) males than females (35.3%). Contrary to this finding, the Ghana Demographic Health Survey (2014) reported that more females in their reproductive ages were overweight and obese as compared to their male counterparts. The reported findings could be because the male study participants reported consuming high portion sizes. Consumption of energy in excess of one's requirements over an extended period of time could lead to accumulation of fats and overweight (Ogum Alangea, 2018).

In the normal BMI group, respondents' gender and BAZ was marginally significant (p=.045). There was no significant difference between obese respondents and gender (p=1.000).

The underweight males' BAZ was significantly different (p<0.001) from the female participants. This finding was consistent with a study by the Global School-Based Student Health Survey

(2017), which reported that about 4% of girls between the ages of 13 to 15 years are underweight.

A longitudinal study on the worldwide trends in BMI-for-age between 1975 and 2016 showed that, there has been increase in adolescents' age-standardized mean BMI globally (The Lancet, 2017). It was also reported that in there was a 0.40 kg/m^2 and 0.32 kg/m^2 increase per decade among adolescent males and females respectively (The Lancet, 2017).

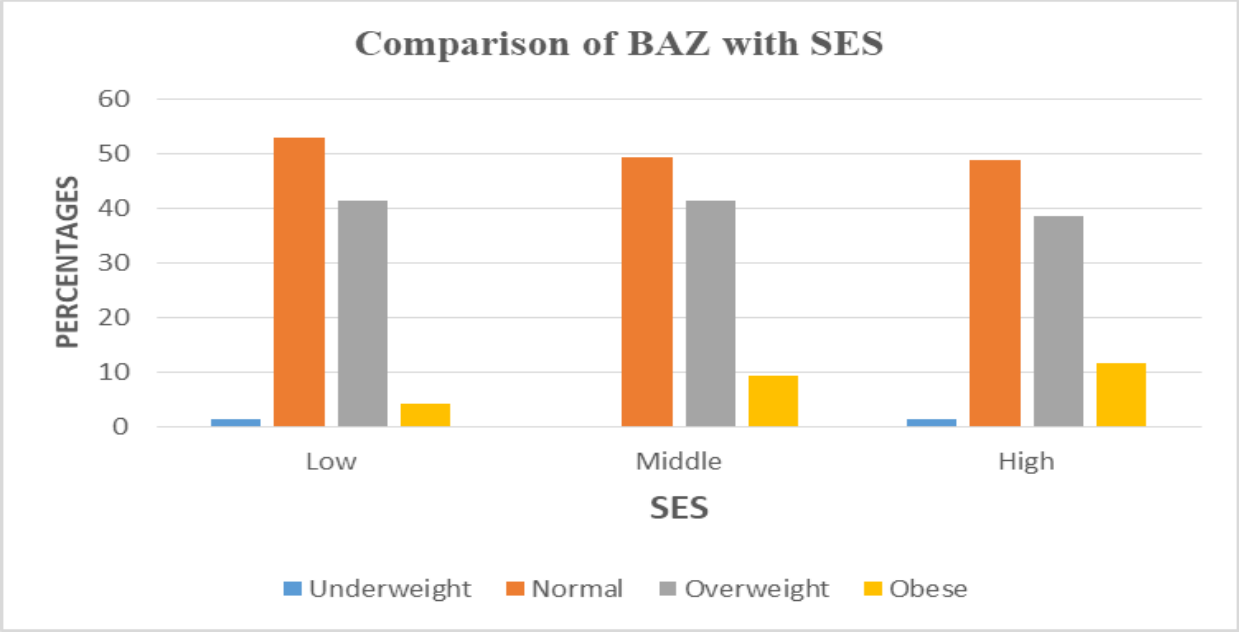

Figure 4.3: Comparison of respondents' BAZ with SES

Figure 4.3 indicates the nutritional status (based on BMI-for-Age z-scores) of respondents compared to their socioeconomic status. Overall, there was no significant difference X^2 (6, N=400) =6.713, p=0.348 between respondents' BAZ and SES. 41.3% of the respondents who belonged to the middle SES were overweight, with 9.3% and 49.4% who belonged to the middle SES being obese and normal respectively. None of the respondents in the middle SES category was underweight. However, regardless of the SES of respondents, the percentage of overweight

individuals was still high. Meanwhile, over half (52.9%) of the low SES students were normal, and 41.4% of them were overweight.

48.9% of the high SES students were normal, whilst 38.6% of them were overweight. There were more (11.7%) obese high SES students as compared to middle (9.3%) and low (4.3%) SES. Silva *et al.*, (2016) found in their study that pupils in Brazil who belonged to a high SES were 1.63 times more likely to be overweight and 2.88 times more likely to be obese than their middle to low SES peers. A study on the prevalence of overweight and obesity among high SES and low SES secondary school adolescents in a peri-urban Nigeria town by Duru, Arslan and Balkis, (2016) showed that 67.5% of the respondents within the high SES category were overweight and obese. Again, it was found that pupils in the high SES were more likely to be schooling in private schools, were overweight and obese as compared to their peers in the lower SES, who were mostly found in public schools (Duru *et al.*, 2016). The study further revealed that 11.6% and 1.5% of pupils in private schools as compared to 5.7% and 1.0% ($p<.01$) of the pupils from public schools were overweight and obese respectively (Duru *et al.*, 2016). Perhaps, the higher chances of obesity and overweight among pupils who belonged to the high SES is due to relatively higher levels of sedentary lifestyle as compared to an active lifestyle among low SES (who were mostly public school pupils) (Ojofeitimi *et al.*, 2011). Similar to the findings of the current study, Zare, Kokiwar and Kokiwar *et al.*, (2018) found that underweight among Indian school going adolescents have decreased, with slightly higher cases found among the low SES respondents (public school pupils) as compared to the high SES pupils (private school respondents) (5.4% vs 1.03%).

Snack Preference of Respondents

Table 4.8: The most preferred snacks among the respondents

Snack Groups	Private School N (%)	Public School N (%)	Both N (%)	p-value
Meat/meat products	170 (86.3)	172 (87.3)	342 (86.8)	**0.766**
Imported packaged snacks	134 (68.9)	165 (82.5)	299 (75.3)	**<0.001**
Fizzy drinks & sugar sweetened beverages.	126 (63.6)	157 (77.7)	283 (70.8)	**0.002**
Fried snacks	125 (63.1)	128 (63.4)	253 (63.3)	**0.961**
Local snacks	122 (60.6)	145 (73.5)	267 (66.8)	**<0.001**
Flour-based snacks.	104 (52.5)	164 (81.2)	268 (67.0)	**<0.001**
Fruits	78 (39.4)	156 (77.2)	234 (58.5)	**<0.001**
Fruit juices	78 (39.4)	66 (33.2)	144 (36.3)	**0.197**
Confectioneries	41 (20.7)	120 (59.4)	161 (40.3)	**<0.001**

N stands for the number of responses, P-values computed were according to respondents' school types, multiple response table, significance level was set at 5% (0.05), and the two-sample t test of proportions was used to determine the statistical relationships

Table 4.7 shows the preference of snack groups among the students. Generally, the students preferred meat/meat products most. However, there was no statistical significant difference (p=0.766) in the preference of this snack group among public and private students. A study by Galbete *et al.*, (2017) on the dietary patterns of Ghanaians living in Europe and their compatriots in Ghana, found that nutrition among urban Ghanaians was highly dominated by animal-based products. Meats/meat products contribute significantly to the protein needs of many, especially adolescents, and therefore a high preference and consumption is likely to lead to meeting one's

RDA, and ultimately, good nutrition. WHO (2004) also indicated that adolescents should consume enough proteins because of the rapid growth and development that their bodies are undergoing. Again, the iron needs of these adolescents are elevated during this time (Beard, 2000). Hence, protein which forms the "globulin" component of haemoglobin is very essential and is needed to bind to iron in red blood cell formation, and more especially for females who may be menstruating (Gibson *et al.*, 2007). Nutrients of concern in adolescence such as protein, fats and zinc are important for muscle and skeletal tissue formation, brain development, secondary sexual maturation and building of immune system (Kawade, 2012).

Imported packaged snacks ($p<.001$) were also highly preferred snacks among the respondents, indicating that there was a significant difference in their preference between the public and private students. According to Ogum Alangea *et al.*, (2018), imported packaged snacks are relatively costly as compared to local snacks and fruits, and are likely to be purchased by pupils who are affluent. However, our study revealed that, the pupils from the public schools, who had 59.5% belonging to low SES purchased more imported packaged snacks. This could be due to reasons including the more affluent private students bringing packed snacks from home. On the other hand, public school students may be less likely to bring snacks from home but get money to buy a snack from school. The high purchases of imported snacks by the public school students could be due to the convenience and easy access (physical distance and number of snack vendors) to snacks in the school food environment, peer influence and busy schedules (Kubik *et al.*, 2003). In addition, a typical portion of imported snack was found to be cheaper (price per serving) on average than the cost of snacks such as fruits (price per serving), meats (price per serving) and fruit juices (price per serving). One characteristic of these cheap imported packaged

snack is that they are high in energy, saturated fats and low in micronutrients (Kubik *et al.*, 2003).

Approximately 71% percent of all respondents preferred fizzy and sugar sweetened beverages, even though respondents from the public schools preferred them more than those from the private schools. A p-value of 0.02 implied that there was a significant difference in the preference of fizzy drinks and the type of school a respondent attends. Amoh and Appiah-Brempong (2017) investigated the prevalence of obesity and overweight among 306 adolescents in the Adansi North district of Ghana. Findings from this study showed that adolescents generally consumed and preferred soft drinks and sweetened beverages. He further stated that, the high level of preference of this snack group is likely to be a risk factor to obesity because of their high energy value. Ang and Foo (2002) conducted a study among young adult students in Singapore and reported that certain observed eating habits of respondents, including; snacking on cheap, energy dense foods and beverages occur during their adolescent stage. This eating habit is of concern because, adolescents are likely to carry these unhealthy snacking habits into adulthood. Meanwhile, fruits, fruit juices and local snacks recorded relatively less preference. This finding is similar to San Juan Fernandez (2006) report of adolescents between the ages of 12 to 17 years in Mexico being less likely to consume fruits, even though they were healthier options.

Local snacks according to Ogum Alangea *et al.*, (2018) are rich in micro nutrients, which aid in energy metabolism and build the immune systems of adolescents. Local snacks preferred by the respondents of this study were mostly made from local staples such as corn, beans, millet, herbs and some tubers. The aforementioned local staples are nutrient dense and are therefore likely to

provide the adolescent consumers with good nutrition. It is worthy of note that preference may not necessarily translate into actual consumption among the respondents.

Confectioneries ($p<0.001$) recorded the least preferred snacks among the Private schools' respondents of this study sample, even though there was a significant difference in their consumption among public and private school students. This finding was rather surprising because one would think that children, especially adolescents would snack on toffees, gum, chocolates among others as compared to fruits and fruit juices (Ogum Alangea, 2018). Confectioneries are popular among children because they are mostly used as a means of rewarding and reinforcing good behaviors by parents. Hence, it was expected that the respondents of the current study would have shown preference for confectioneries due to familiarity.

Figure 4.4 shows the distribution of snack vendors within 50-meter radius in the school food environment of the participating schools.

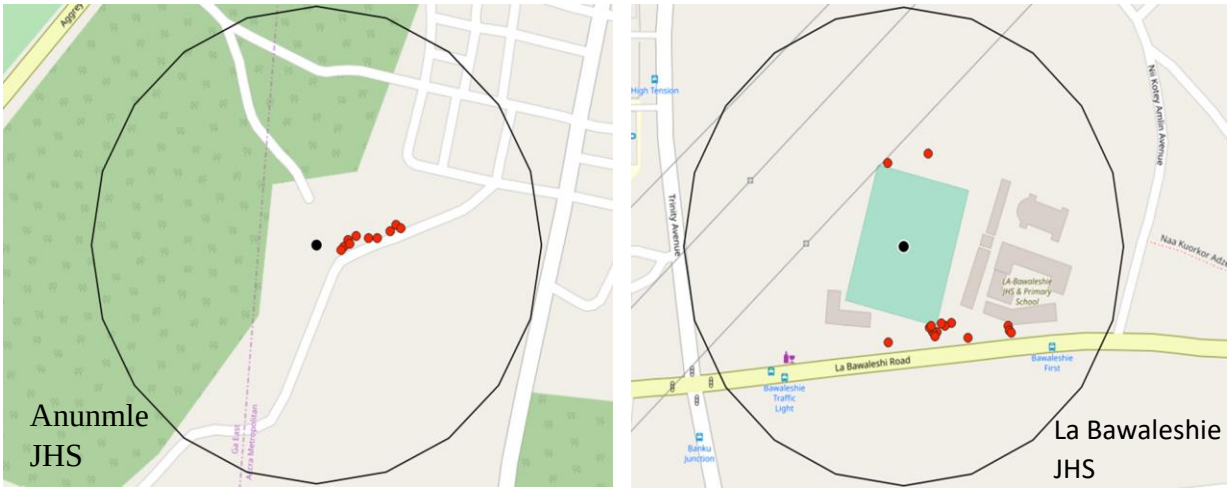

Figure 4.4: Clustering of snack vendors in Public Schools

represents the 50-meter radius around the school food environment

the focal point/center of each school

the available snack vendors at the time of data collection

Figure 4.4 shows the clustering of ten snack vendors within the school food environments of the public schools at the time the data was collected. Each vendor carried snacks from at least, two snack categories.

Figure 4.5 illustrates the distribution of the available snack vendors and their various positions as at the time of data collection. The study found that, there were fifteen snack vendors in the school food environment of La Bawaleshie Presbyterian Junior High school.

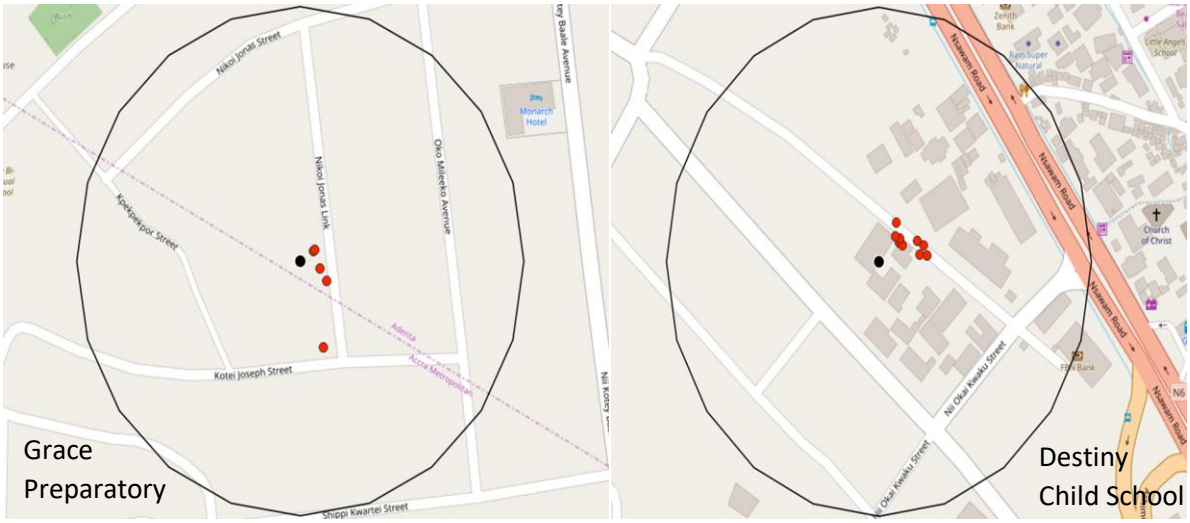

Figure 4.5: Clustering of the snack vendors at private schools

Figure 4.5 shows the distribution of the snack vendors in Grace Preparatory school and Destiny Child School at the time of data collection. It can be inferred from Figure 4.5 that there were five snack vendors present in the school food environment of Grace Preparatory school, while there were nine snack vendors present within 50-meter radius around Destiny Child School in Achimota. Two of the five snack vendors in Grace Preparatory school were located in the school compound, while the remaining three were within the immediate environs but outside the walls of the school. The snacks that vendors carried in the school food environment of Destiny Child School were quite varied as compared to those in Grace Preparatory School. In Grace Preparatory school, there was one snack bar vendor, one table top vendor and two hawkers.

There were two supermarkets, four hawkers and two table top snack vendors in the immediate environment of Destiny Child School.

Table 4.9: The available snacks carried by vendors in the school food environment.

Snack groups	Public schools			Private schools		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Fizzy drinks/ Sugar sweetened beverages.	100.5	57.0	146.0	174.7	106.0	202.0
Imported Packaged Snacks.	59.1	56.0	62.0	23.0	11.0	28.0
Confectioneries	51	25	64	68.5	33	90
Fried snacks	28.4	0	58.0	79.4	52	109
Flour based snacks	23	7.0	31	35	19	44
Meats/meat products	20.8	13	29	23.2	18	28.0
Fruit juices	5.1	0	10	19.2	0	37
Fruits	3.5	0	7	6.2	0	12
Local snacks	0	0	0	25	0	49

Table 4.9 shows the average number of snacks carried by vendors in the school food environments of the participants of this study. It can be inferred from the table that fizzy drinks and sugar sweetened beverages were the most available snacks among both the public and private school vendors. Buxton (2014) reported that, most school pupils, including adolescents prefer soft drinks as snacks. Hence it was not surprising that vendors had large quantities in stock in the school food environments studied. These snacks are mostly empty calories and do not

contribute the needed micronutrients to promote health and wellness of adolescents (Ashakiran & Deepthi, 2012).

Another study revealed that urbanized areas in developing countries were likely to be affected by nutrition transition, and that those who are mostly affected were people with low SES (Galbete *et al.*, 2017). Highly processed snacks are cheap and thus, easily accessible to low SES households (Galbete *et al.*, 2017).

Fruits recorded the least available snacks carried by vendors. This could be explained by their low demand. Similar to this finding, a study in Mexico by San Juan Fernandez (2006) revealed that adolescents were less likely to consume fruits while at school. This is a major problem because adolescents spend relatively more time of the day in school than at home and are also frequent snackers. Again, during school hours, adolescents are found to mostly consume what is available within their food environments and are likely to even consume more if made easily accessible (cheaper). When fruits are scarce in the school food environment, the likelihood that adolescents will consume fruits while they are in school may be low.

Meat and meat products are generally costly as compared to most of the other snacks in the school food environment. The high perishability snacks require careful handling and cold storage to maintain quality and safety. This could explain why snack vendors did not carry more of fruits and meats products in the school food environments. A study by Correa *et al.*, (2017) in Southern Brazil revealed that people in urban communities of developing countries have limited access to cheap, perishable and fresh foods like fruits and that they have to travel far to do so. This finding by Correa *et al.*, (2017) could explain the limited availability and prices of fresh fruits in the schools.

Even though local snacks and flour based snacks were preferred by respondents from both school types ($p<.001$)), it appears that they were not available in their school food environments. Perhaps, the respondents who reported to have consumed these group of snacks either purchased them outside the 50-meter radius or from hawkers who were not part of the study participants (vendors). It is worthy of note that even though respondents reported to prefer meat/meat products most, this did not reflect in the snacks carried by vendors.

Table 4.10: The nutritional intakes from snacks and three main meals of respondents

Total Energy/Nutrients	Reference RDA	Mean (%) for Main Meals only	Mean (%) for snacks only	Total Daily Intakes
Energy (Kcal)	2,500	1,875 (75.0)	947.1(37.8)	2,822.8 (108.6)
Protein (g)	51.5	49.4 (95.9)	3.1 (6.0)	52.5 (102.0)
Fat (g)	50	58.4 (116.8)	25.2 (50.4)	83.6 (167.2)
Zinc (mg)	13.5	6.5 (48.1)	0.3 (2.2)	6.8 (50.4)
Sodium (mg)	2,400	1,645.3 (68.5)	1,937.5 (80.7)	3,582.8 (149.3)
Iron (mg)	13.5	1.5 (11.1)	0.7 (5.2)	2.2 (16.3)

Table 4.10 showed the respondents' nutritional intakes from snacks and three main meals they consumed.

The study revealed that on the average, the daily meals consumed contributed relatively higher average energy, fats and sodium, while their snack contributed relatively lower zinc, protein and

iron. The total daily consumption of sodium was higher than the amounts recommended for a day. Over consumption of sodium is dangerous to health, and especially contributes significantly to high metabolic morbidities among persons of all age groups (Poti *et al.*, 2014).

Sodium has been found often to cause metabolic insults such as stroke, hypertension and many other cardiovascular conditions.

Respondents of this study consumed almost 1,000Kcal of energy higher than the RDA for their ages. Over consumption of energy is also a high risk factor for overweight and obesity. Indeed, only a day's meal was used to ascertain levels of consumption for this study, but the anthropometric data collected validates the assertion that the intakes of respondents reflected typical diets which involved high intakes. This is because 45% each of the respondents from both public and private schools were overweight. If this dietary pattern is followed, it could lead to overweight and obesity during early adulthood.

Protein is a crucial nutrient in adolescence, nonetheless, only 6.0% of the reference RDA was met by snack consumption averagely. This shows that the snacks that were consumed do not contribute enough protein which is needed to support optimal health, growth and development in adolescents.

Zinc needs are at peak during adolescence. Zinc is essential for secondary sexual maturation, brain development and to support growth during adolescence. Respondents of the study did not meet their daily recommended intake. Even though the respondents consumed relatively higher levels of Zinc as compared to the private school respondents, general consumption was very low. Perhaps, the higher local snack preference and consumption among the public school respondents contributed to higher zinc intake in public school adolescents. Most of these local

snacks were prepared from legumes, roots and other local staples, which were likely to have been rich in zinc.

Iron needs of adolescents are elevated during this period due to increase in blood volume to support growth and development (Mesias *et al.*, 2013). The respondents of the study failed to meet their daily recommended intakes of iron.

Most importantly, iron needs are essential for the sample of this study because 50% were females, among which most had started menstruating. Therefore, the need for iron among this group cannot be overestimated. Perhaps, the respondents were found to have over consumed energy, protein, fats and sodium because there were more snack vendors in their school food environments who carried processed snack products.

Table 4.11: Nutritional quality of snacks consumed by the adolescents by school type.

Total Energy/Nutrients	Reference RDA	Snack consumption in Public schools, Mean (%)	Snack consumption in Private schools, Mean (%)
Energy (Kcal)	2,500	730.2 (29.2)	593.4 (24)
Protein (g)	51.5	17.5 (34)	16.9 (31.1)
Fat (g)	50	51.4 (103)	20.6 (41.2)
Zinc (mg)	13.5	0.4 (2.3)	0.7 (5.2)
Sodium (mg)	2,400	1,988.5 (82.9)	1,918.7 (80.0)
Iron (mg)	13.5	0.5 (3.7)	1.5 (11.1)

Table 4.11 indicates the nutritional quality of snacks consumed by respondents according to their school type (public or private).

From Table 4.11, it can be inferred that the respondents from the public schools consumed relatively higher energy, protein and fats as compared to those from the private schools. This finding is consistent with a study by Poti *et al.*, (2014), who found that adolescents were likely to under consume micronutrients while they over consumed sodium and energy. Sodium was over consumed by the public school respondents and zinc and iron were consumed in higher quantities among respondents from the private schools. It was worrying to find out that respondents' consumption of fruits and fruit juices in all both schools was very low. This is because fruits are likely to contribute significantly to respondents' micronutrients needs. Fruits and vegetable consumption within the right proportions contribute to adequate fiber intakes which bind and rids Low density lipoproteins (harmful cholesterols) from the body (Roehrs & Roth, 2008). Fizzy drinks and sugar sweetened beverages were popular in both schools. Over

consumption of fizzy drinks and sugar beverages puts adolescents at risk of metabolic dysfunctions like abnormal blood sugar levels (Lobstein, 2014).

High energy intakes, especially among those from the public schools, may be due to higher portion sizes reported to have been consumed by respondents. Even though the respondents from the public schools consumed more energy as compared to those from the private schools, 36% of public school students versus 45% of private school students were overweight, respectively. This could be as a result of lower physical activity levels among the adolescents from the private schools. Students in private schools are more affluent and are mostly driven to and from school, while students from public schools usually walk to and from school. A study on the obesogenic determinants among school pupils in the Ga East municipality showed that private school students did not indulge in physical activity (such as playing football and running around during break times) as much as students from public schools (Ogum Alangea, 2018). Some of the reasons why private school students were less physically active included smaller size or nonexistence of school playgrounds (Ogum Alangea, 2018).

Half of the respondents of this study were females who were of reproductive ages, and for them to have under consumed zinc, protein and iron could lead to future health problems, especially during pregnancy and post childbirth. Adolescents who continue with this dietary pattern are likely to grow into adulthood deficient in zinc and iron. This condition could also influence their reproductive performance and health status of their future children (Gibson, 2008). Iron influences attention and retentive memory and thus, academic performances (Asmare *et al.*, 2018). In addition, iron is needed for blood formation and its deficiency in the mother could lead to still birth, anemia, impaired cognitive development and some birth defects such as spina bifida and anencephaly in the infant (Gibson, 2008).

Figure 4.6 shows the distribution of snack choice drivers of respondents. The y-axis shows the median score for the various variables, while the x-axis shows the variables that drove their snack choices.

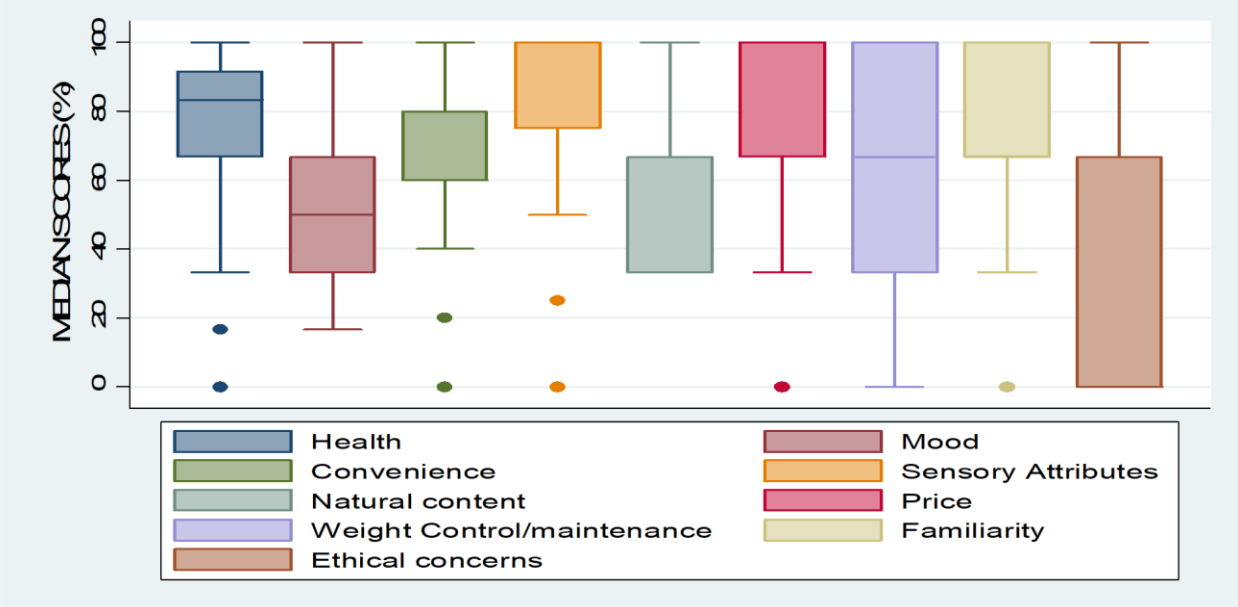

Figure 4.6: Respondents' snack choice drivers

The factors that highly drove respondents' snack choices included sensory attributes (median score=100, IQR=25), health (median score=83.3, IQR=25), familiarity (median score=66.7, IQR=33.3) and prices (median score=100, IQR= 33.3). Ethical concerns (median score=0, IQR=66.7) were less considered among the students when choosing snacks. Videon & Manning (2003) as well as Pearson *et al.* (2008) found that familiarity with snacks mostly influence consumption among the youth.

In this study, the other factors that influenced adolescents' snacking choices included convenience (median score=60, IQR=20), weight control/maintenance (median score=66.7, IQR=66.6), natural content of snack (median=33.3, IQR=33.3) and mood (median score=50,

IQR=33.3). Similarly, a study by Foo (2010) revealed that adolescents in France, especially females were preoccupied with having an ideal body figure, have a busy schedule and therefore patronized convenience foods. Hence, adolescents habitually snacked. A study by Allen, Kuiper and Taylor (2007) in the United States showed that adolescents are not likely to consider health when selecting food for consumption. However, this study found that the students' snack choices were highly driven by health.

The least snack choice driver among the adolescents were Ethical concerns. This could be because adolescents according to Poti *et al.*, (2014) have a busy schedule and may care less about a factor such as ethical concern. Ethical concerns include factors surrounding the production, safety, quality and country of origin of a product which influences how consumers perceive a product (French *et al.*, 2002). A study by Steptoe *et al.*, (1997) has proven that awareness of ethical concern influences selection and consumption of products ethically among consumers.

The dissemination of appropriate messages to parents and guardians to raise awareness of the need to limit the availability of fizzy and sugar sweetened beverages and replace these with water and reduced fizzy drinks is important for optimal health during adolescence (Hebden *et al.*, 2013).

Table 4.12: Relationship between Gender of Adolescents and their Frequency of Snack Consumption.

Snack Groups	Public schools (P-Values)	Private schools (P-Values)	Both School types
Fizzy drinks/ sugar sweetened beverages	0.13	*0.03	*0.001
Imported Packaged snacks	*<0.001	*0.02	*<0.001
Local snacks	*0.01	*0.02	*<0.001
Fried snacks	0.99	0.35	0.27
Flour based snacks	0.18	0.43	0.33
Confectionaries	0.14	0.16	*0.04
Fruits	0.21	0.35	0.33
Fruit Juices	0.08	0.05	0.63
Meats/Meat products	*0.02	0.18	0.29

***** indicates significant relationships, multiple response table, significance level was set at 5% (0.05)

The relationship between the gender of respondents and the frequency of their snack consumption is shown in Table 4.12.

For the private school respondents, the frequency of consumption of fizzy drinks and sugar sweetened beverages (p=.03), imported packaged snacks (p=.02) and the local snacks were significantly different between males and females.

However, in the case of the public school respondents, the consumption of imported packaged snacks (p<.001), local snacks (p=.01) and meat/meat products (p=.02) were significantly different between males and females.

Overall, consumption of fizzy drinks and sugar sweetened beverages (p=.001), imported packaged snacks (p<.001) and confectioneries (p=.04) were significantly different between males and females.

Table 4.13: Relationship between the availability of snacks and frequency of respondents' snack consumption within a week

Snack Group	Correlation Coefficient	P-Values
Fizzy drinks/ sugar sweetened beverages	0.0168	0.777
Imported Packaged snacks	0.3452	*<0.001
Local snacks	0.1624	0.079
Fried snacks	-0.3624	*0.001
Flour based snacks	-0.1400	*0.022
Confectioneries	0.0219	0.782
Fruits	-0.0061	0.936
Fruit juices	-0.1497	0.073
Meats/meat products	-0.0741	0.172

*shows the correlations that were significant.

Table 4.13 indicates the relationship between the availability of snacks and how often respondents consumed snacks in a week.

The Spearman's correlation coefficient and the correlation between snacks availability and the frequency of their consumption among the respondents of this study are shown in Table 4.13. The strength of the correlations was classified as low |.10-.29|, moderate |.30-.49| and high |.50-1.0| (Cohen, 1988, as cited in Pallant, 2011, p.134)

For fried snacks ($r = -0.36$, $p=.001$), imported packaged snacks ($r =0.35$, $p<.001$) and flour-based snacks ($p=.02$), there was a significant correlation between snack availability and their frequency of consumption among students in junior high schools. However, for flour based snacks, there was a weak positive correlation between their availability and consumption ($r=-0.1400$, $p=.022$) which suggests that students may be consuming snacks from outside the school food environment measured (which could be from home or other vendors outside 50m radius).

The correlation between availability of snacks and consumption of local snacks ($r=0.16$, $p=.08$) was not significant. There was a positive weak correlation between the availability of local snack vendors and the consumption of local snacks, indicating that an increase in local snacks within the environment could lead to a possible high consumption among students. Even though local snacks were relatively not available in the school food environments (especially in the public school), their preference was high. Similarly, a study by Abizari & Ali (2019) in Tamale showed that adolescents consumed local snacks more when they were made available.

Table 4.14: Relationship between nutritional quality of snacks consumed by pupils from private schools and those from public schools.

Energy/Nutrients	Reference RDA	Public Schools Median	Private Schools Median	P-Value
Energy (Kcal)	2,500	192.3	174.9	0.09
Protein (g)	51.5	1.5	3.9	0.10
Fats (g)	77.5	5.6	4.8	0.06
Zinc (mg)	13.5	0.1	0.8	<0.01
Sodium (mg)	2,400	63.2	108.8	<0.01
Iron (mg)	13.5	0.2	0.6	<0.01

Table 4.14 shows the relationships between the consumption of energy, micro nutrients of concern and the school administrative type of the respondents.

There was a significant difference between the respondents' school administration type and their consumption of sodium ($p<.01$), zinc ($p<.01$) and iron ($p<.01$), which means that irrespective of the type of school administration type (private or public), the consumption levels of sodium, zinc and iron were not similar. Szczepanska *et al.*, (2016) conducted a study in Poland to evaluate the intake of vitamins and minerals among adolescents and found that the dietary intakes of zinc and iron among their respondents were relatively low, with sodium however exceeding 99.5% of the daily requirement. Similarly, even though the 2010 Dietary Guidelines for Americans recommend limiting sodium intake to 1,500mg in order to lower blood pressure and reduce cardiovascular morbidities in adulthood, it has been reported that the daily sodium intake among adolescent females is 3,000mg and 4,000mg among adolescent males. According to Mesias

(2013), one of the reasons why adolescents are unable to meet their zinc and iron needs is because they consume monotonous and unbalanced diets.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the major findings. From these major findings, conclusions were made regarding this study and its application to the quality of snacks in the school food environments of adolescents and their snack choice drivers in the Ayawaso West Municipal District. It also gives recommendations for future research.

5.2 Summary

This study was carried out to assess the nutritional quality of snacks in the school food environments of adolescents and to find out the snack choice drivers among the same in the Ayawaso West Municipal District. The objectives of the study were to find out the most available and the most preferred snacks among adolescents, assess the nutritional quality of snacks consumed among adolescents and to ascertain the snack choice drivers of adolescents, comparing the outcomes for private and public schools. A cross-sectional study, using a quantitative approach was adopted to provide an understanding of the issue under study. Two separate questionnaire were used to gather information from students and snack vendors within 50-meter radius around research locations. The data collection tools for students used were a structured questionnaire, which comprised a: single 24-hour food recall questionnaire, a 7-day modified food frequency questionnaire and a 36-item food choice questionnaire. A digital weighing scale and a stadiometer were used to measure anthropometrics of the adolescents.

Other tools used were pictures of snacks on laminated cardboards, household measures, wooden and plastic food models and aids. A structured questionnaire was used to audit snacks in all the

research locations. Multi-stage sampling technique was used in selecting pupils, while a complete enumeration was applied in selecting snack vendors. The Pearson chi-square test, the Wilcoxon Ranksum statistic, Spearman's correlation coefficient was conducted to understand relationships between selected variables to answer the research questions.

Respondents from the public schools were relatively older than those from the private schools. The most represented ethnic group among the respondents were Akans (42.3%), with the least ethnic group being Ga/Adangme (16.8%). 10.5% of respondents from the private schools as compared to more than half (59.5%) of those from public schools belonged to the low SES. There were more respondents from private schools (36.5%) with high SES than those from the public schools (7.5%).

The results further revealed that the most preferred snacks among respondents were meats and meat products (86.6%) and imported packaged snacks (75.3%), with the least preferred being confectionaries (40.3%). There were more snack vendors in the public schools (25) as compared to private schools (14). Fizzy drinks and sugar sweetened beverages were the most available snacks, while the least available snacks were fruits. Respondents from public schools recorded relatively higher mean consumption of energy (d=136.8Kcal), protein (d=0.6g), fat (d=30.8g) and sodium (d=69.8mg) than their counterparts from private schools, who also consumed relatively more zinc (d=.3mg) and iron (d=1.0mg) during snack times. Overall, respondents exceeded their requirements for energy (d=322.8 Kcal), protein (d=1g), fat (d=33.6g) and sodium (d=1,182.8mg), but under consumed zinc (d= -5.3mg) and iron (d= -11.3mg) in their diets. However, there was a difference between consumption of all micronutrients ($p<0.001$) of concern but no significant difference in consumption of energy ($p=0.09$), protein ($p=0.10$) and fat ($p=0.06$) between respondents from public and private schools. Sensory attributes (median

score=100, IQR=25), familiarity (median score=66.7, IQR=33.3), weight maintenance/management (median score=66.7, IQR=66.6) and prices (median score=100, IQR= 33.5) were identified as the most dominant factors that influenced respondents, while ethical concerns (median score=0, IQR=66.7) were the least drivers of respondents' snack choice. There was a significant difference between gender of adolescents and their frequency of consumption of imported packaged snacks ($p<.001$), fizzy drinks/sugar sweetened beverages ($p<.001$), local snacks ($p<.001$) and confectionaries ($p<.04$). There was also a significant difference between public and private schools' availability of fried snacks ($p<.001$), flour based snacks ($p=.02$) and imported snacks ($p<.001$). There was a significant difference in the availability of imported packaged snacks ($r =0.35$, $p<.001$), flour based snacks ($r=-0.1400$, $p=.022$) and fried snacks ($r = -0.36$, $p=.001$) and their frequency of consumption among the study sample.

5.3 Conclusion

Based on the findings of the study, it is concluded that, the most preferred snacks among respondents were meat and meat products and imported packaged snacks, with the least preferred being confectioneries. More snack vendors were found in the public schools as compared to the private schools. Fizzy drinks and sugar sweetened beverages were the most available snacks, while fruits were the least available snacks. Although, there was a difference between consumption of micronutrients of concern, there was no significant difference in the consumption of energy, protein and fat between respondents from public and private schools. Respondents from public schools recorded relatively higher mean consumption of energy, protein, fat and sodium than their counterparts from private schools, who also consumed relatively more zinc and iron during snack times. Sensory attributes, familiarity, weight

maintenance/management, and prices were identified as the dominant factors that influenced respondents, while ethical concerns were the least drivers of respondents' snack choices.

5.4 Recommendations

The following recommendations were made based on the study.

1. The adolescents exceeded their sodium requirement, a micronutrient whose high consumption underpins many metabolic morbidities, such as hypertension and many other cardiovascular diseases. Therefore, nutrition education on the consequences of sodium consumption should be emphasized among adolescents.
2. The school food environment of private schools was well regulated, hence there were fewer hawkers of snacks and less of fizzy drinks/sugar sweetened beverages (empty caloric drinks) as compared to those in the public schools. Therefore, the School Health Education Programme (SHEP) under the GES, and other entrepreneurs (food product developers) should spearhead communications with stakeholders in health to design different snacks with healthier options to ensure snack diversification in schools. There should also be a ban on unhealthy snacks and facilities with healthier options be set up in the school food environment.
3. Most of the respondents overconsumed energy but under consumed all micronutrients, except for sodium. Therefore, the Ghana Health Service (GHS) should collaborate with the GES to set up policies to regulate the diet of adolescents while they are at school. There is a need for collaboration with relevant food regulation agencies to set up regulations on the marketing and sale of snacks and beverages in the school food environment

4. The study revealed that diets and snacks consumed among adolescents were iron deficient. Adolescent girls fall in the bracket of women in their reproductive years, and there is the need to promote adequate iron consumption during this critical period of growth. Hence, the adolescent female should be empowered through nutrition education about the consequences and important role of iron at the basic school level by teachers. Awareness about Ghanaian foods and snacks rich in iron should be emphasized. A long term policy of supplying the school going adolescent with iron supplements quarterly by a joint collaboration between GES and GHS should be considered.

5. Almost half (45%) of the respondents were overweight, and could likely be due to the obesogenic exposure in their school food environments. The GES in conjunction with the GHS should strengthen nutrition education and awareness efforts in adolescents by providing in schools teaching and learning materials promoting healthy lifestyles that pupils can adopt. These materials can be displayed on the walls, school signage boards and canteens for pupils. These tools would sensitize pupils on the importance and the need to eat healthy snacks, which is likely to help them to form good eating habits. In addition, physical activity should be encouraged through the physical education curriculum to help students to expend excess energy and maintain healthy body weights.

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APPENDICES

APPENDIX A: Structured Questionnaire

I.D: ……

NAME: ……..

DATE OF COLLECTION: ……

SECTION A: DEMOGRAPHIC PROFILE

Kindly share some demographic characteristics about yourself by responding to the following. Please tick [√] and provide answer (s) where appropriate.

1) Age (years): …..……
2) Gender: Male [ ] Female[ ]
3) Name of school: …….
4) School type: [ ] Private [ ] Public
5) Form: ……..
6) Ethnicity: [ ]Akan [ ]Northerner [ ]Ewe [ ]Ga-Adangbe

Others (specify) ……..

7) Religion: Christianity [ ] Islam [ ] Traditional [ ]

Others (specify) ……

8) Interest/ Hobby: …….

NEXT TWO QUESTIONS FOR GIRLS ONLY

9. Have you started menstruating? 1. Yes 2. No

10. If yes, when did you start menstruating? ……..

I.D: …….

DATE OF COLLECTION: ……

NAME: ……

SECTION B
SOCIOECONOMIC STATUS/BACKGROUND OF PARTICIPANTS

1. Occupation of Parents

Occupation	Father	Mother	Guardian
Professional (e.g. Lawyer, teacher, accountant etc.)			
Artisan (e.g. carpenter, hairdresser, seamstress etc.)			
Office Worker (e.g. secretary)			
Trading			
Unemployed			
Others			

2. Do you have a television set at home? Yes [ ] No [ ]
3. Residential status: [ ] Own house [ ] Rented house [ ] Family house

   [ ] Company/Mission house [ ] Government house [ ] Caretakers
4. Do your parent(s)/guardian(s) own a saloon car or any other vehicle?

   [ ] Yes [ ] No
5. Do your parent(s)/guardian(s) own a Refrigerator/Deep freezer? [ ] Yes [ ] No
6. Do your parent(s)/guardian(s) own a Gas/electric cooker? [ ] Yes [ ]No
7. Do your parent(s)/guardian(s) own a Video deck/VCD/DVD player? [ ] Yes [ ]No
8. Do your parent(s)/guardian(s) own an air conditioner? [ ]Yes [ ] No
9. Do your parent(s)/guardian(s) own a Satellite dish/ DSTV/ Multi TV? [ ] Yes [ ] No

I.D: ……

DATE OF COLLECTION: …….

NAME: ……..……

SECTION C: DIETARY PATTERNS OF PUPILS

1. How many times do you eat a day?

   a. Once b. twice c. three times

   b. d. four to five times e. More than five times

2. Which meal of the day do you normally skip?

   a. [ ] Breakfast

   b. [ ] Lunch

   c. [ ] Supper

   d. [ ] None of the above

3. Do you normally eat breakfast at home or school?.....

   a. If you eat breakfast at home, what do you usually have for breakfast?

…….

   b. If you normally consume breakfast in school, what do you usually eat?

……..

4. Where do you usually buy food when in school?

   a. Canteen

   b. Hawkers

   c. Snack Bar

   d. Table top

   e. Others (specify) …….

I.D: …….

DATE OF COLLECTION: ……

NAME: ……..

Please tell me whether you ate any of the following foods during the past one week while at school, and how often.

Food item	**Frequency of Consumption**			**Brand Name/ Type**
	Past one week (Yes/No)	**Number of times per week**	**Where did you get it from?**	
1. Fizzy drinks/ Sugar sweetened beverages				
2. Imported packaged snacks				
3. Local snacks				
4. Fried snacks				
5. Flour based snacks				
6. Confectioneries				
7. Fruits				
8. Fruit juices				
9. Meats				
10. others (specify)				

I.D: ……

NAME: ……..

SINGLE 24 HOUR MEAL RECALL QUESTIONNAIRE

1. Date of interview: …….

Type of meal	**Time of meal**	**Food item**	**Estimate of quantity consumed (household measures)**	**Weight of estimated quantity**
Breakfast				
Snack				
Lunch				
Snack				
Supper				
Snack				

FOOD CHOICE QUESTIONNAIRE

I.D: …….

DATE OF COLLECTION: …….

NAME: ……..

Please choose what influences your food choices, especially the snacks you often consume. Tick in the boxes provided, if you consider the following when purchasing and consuming food.

1. Contains lots of vitamins and minerals [ ]
2. Keeps me healthy [ ]
3. It is nutritious [ ]
4. Contains enough proteins [ ]
5. It is good for my skin/nails/hair etc. [ ]
6. It is high in fibre and roughage [ ]
7. Helps me cope with stress [ ]
8. Helps me relax [ ]
9. Helps me cope with life [ ]
10. Helps keep me awake/alert [ ]
11. Cheers me up [ ]
12. Makes feel good [ ]
13. Smells nice [ ]
14. Looks nice [ ]
15. Has a pleasant texture [ ]
16. Tastes good [ ]
17. Contains no additives [ ]
18. Contains natural ingredients [ ]
19. Contains no artificial ingredients [ ]
20. It is low in calories [ ]
21. Helps me control my weight [ ]
22. It is low in fats [ ]
23. It is what I usually eat [ ]
24. It is familiar [ ]
25. It is like the food I ate when I was a child [ ]
26. It is easy to prepare [ ]
27. Can be cooked very easily [ ]
28. Takes no time to cook [ ]
29. Can be bought in shops close to where I live/school [ ]
30. It is easily available in shops or supermarkets [ ]
31. It is not expensive [ ]
32. It is cheap [ ]
33. It is good value for money [ ]
34. Come from countries I approve of, politically [ ]
35. Has the country of origin clearly marked [ ]
36. It is packed in an environmentally friendly way [ ]

SECTION D

This section is an instrument for vendors of snacks within the school food environment and 250-meter radius from selected schools.

Date of interview: ……

Name of school: ……

Name of Vendor: ……..

School type: Public [ ] Private: [ ]

Codes for items sold: 1. Sugar sweetened beverages/Fizzy drinks 2. Imported Packaged snacks

3. Local snacks (roasted plantain/corn/nuts etc.) 4. Fried snacks (e.g. sausages, yam etc.) 5. Flour based snacks (Pastries) 6. Confectioneries (Toffees, candies, lollipops, ice cream) 7. Fruits 8. Fruit juices 9. Meats (Khebabs, boiled eggs etc.) 10. Others (Specify)

VENDOR TYPE, NUMBER OF SNACK VENDORS AND STOCK OF SNACKS SOLD WITHIN THE SCHOOL

Item code	**Hawkers** (n=)			**Canteen** (n=)			**Snack Bar** (n=)			**Table Top** (n=)			**Other stores** (n=)		
	H	Stock	Cost	C	Stock	Cost	SB	Stock	Cost	TT	Stock	Cost	OS	Stock	Cost
	H_1			C_1			SB_1			TT_1			OS_1		
	H_2			C_2			SB_2			TT_2			OS_2		
	H_3			C_3			SB_3			TT_3			OS_3		
	H_4			C_4			SB_4			TT_4			OS_4		
	H_5			C_5			SB_5			TT_5			OS_5		
	H_6			C_6			SB_6			TT_6			OS_6		
	H_7			C_7			SB_7			TT_7			OS_7		

1. Based on items that you have, which specific ones are part of your usual stock?

……
……

2. In your own opinion, what are the most preferred snacks among adolescents and why do you think they prefer those snacks?

……
……

3. How often in a week do pupils (adolescents) purchase snacks?

……
……..

Date of interview: ……

Name of school: ..……

Name of vendor: ……..

TYPES AND NUMBER OF SNACK VENDORS 250 METRE RADIUS AROUND THE SCHOOL

Item Code	**Hawkers**		**Food Service Outlets**		**Snack Bar**		**Table Tops**		**Convenient Stores (e.g. Kiosks, Containers, Homes)**	
	Stock (available snacks)	**Cost**	**Stock (available snacks)**	**Cost**	**Stock (available snacks)**	**Cost**	**Stock (available snacks)**	**Cost**	**Stock (available snacks)**	**Cost**

1. Based on items that you have, which specific ones are part of your usual stock?

……..

2. In your own opinion, what are the most preferred snacks among adolescents and why do you think they prefer those snacks?……..……

3. How often in a week do pupils (adolescents) purchase snacks? .....……

APPENDIX B: Picture Guide

FIZZY DRINKS/ SUGAR SWEETEND BEVERAGES

LOCAL DRINKS

CONFECTIONARY ITEMS, IMPORTED PACKAGED SNACKS & PASTRIES

FRUITS AND VEGETABLES








APPENDIX C: Consent Information

Dear Parent/Teacher,

My name is Ruby Yawa Dziedzom Addae, a Master of Philosophy student from the Department of Family and Consumer Sciences, University of Ghana, Legon. I am conducting a research on the topic **NUTRITIONAL QUALITY OF SNACKS IN THE SCHOOL FOOD ENVIRONMENT OF ADOLESCENTS.** This research is purely academic and it is geared towards obtaining information on the dietary patterns, snack consumption and food choice drivers of adolescents. I would be grateful if you could respond to the questions. I assure you that all information provided will be treated with utmost confidentiality; no names are required. Thank you for your willingness to participate.