ESTIMATION OF FOOD PORTION SIZES: A COMPARISON BETWEEN THE USE OF HOUSEHOLD MEASURES AND A PHOTOGRAPHIC FOOD ATLAS IN A RURAL POPULATION IN GHANA

BY

KATE OPOKU

(10247782)

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DECLARATION

I, Kate Opoku, author of this dissertation, do hereby declare that it was done by me under the supervision of Dr. Gladys Peprah-Boateng. All references cited in this work have been duly acknowledged.

Sign……. Date……..

Kate Opoku

(Student)

Sign:  Date: February 5TH, 2018

Dr. Gladys Peprah-Boateng

(Supervisor)

ABSTRACT

Background: Dietary assessment can be defined as "a comprehensive evaluation of a person's food intake". It serves as the basis for the diagnosis and management of chronic diseases. A number of dietary assessment techniques exist but the appropriateness of use depends on the purpose and food eating habits. Some examples of dietary methods are weighed food records, estimated food records and household measures, to name but a few. Household measures such as cups and spoons are most commonly used in Ghana. A photographic atlas of commonly consumed carbohydrate Ghanaian foods was developed by Peprah Boateng to aid in dietary assessment and counselling. The tool was validated among a cross section of participants in Accra and this study is focused on testing this tool in the rural area to confirm its use across the nation.

Aim: To validate a photographic food atlas of commonly consumed carbohydrates based foods with estimated food portion sizes using household measures in Asesewa, a rural community in Ghana

Method: A cross sectional study involving a three day dietary intake from individuals through face-to-face interviews using a structured pre-tested questionnaire to all males and females within the age group of eighteen (18) years and seventy (70) years who visited the Nutrition and Research center and the Asesewa Regional Hospital within the time period of collecting the data. Data collection was divided into three (3) main parts: socio-demographic and anthropometry, 24-hour recall and portion size estimation.

Results: A significantly greater proportion, 63.7% (121), of the participants underestimated the carbohydrate food ($P < 0.0001$). Twenty-nine per cent (55) of participants overestimated whilst

only 5.3% correctly estimated the portion size of carbohydrate food. There was no significant difference in gender estimations of carbohydrate foods (P= 0.295). However, a higher proportion of female participants were able to estimate correctly (7.9 %) compared to males (3.0 %). No significant differences (P>0.05) were found between the number of participants who underestimated or overestimated carbohydrate among gender. Among the age range of participants, higher proportion (69.0%) within the age range of 39 to 49 years underestimated portion size of fufu followed by those within 50 to 60 years and 17 to 27 years indicated by 62.5% and 61.7% respectively. Similarly, higher proportion (75.0%) within the age range of 39 to 49 years underestimated portion size of banku compared to the other age ranges. Boiled yam on the other hand was estimated correctly by higher proportion (66.7%) of participants within the age range of 39-49 years followed by those within 17 to 27 years and 28 to 38 years as indicated by 47.1% and 42.9% respectively. Boiled rice was highly overestimated by the participants with the 61 to 70-year range and 17 to 27-year range (65.2%). Underestimation of sugar was seen among a statistically significant percentage (P=0.041; 93.8%) of participants within the 39 to 49-year range.

Conclusion: Portion size estimation of these carbohydrate foods using the photographic food atlas and the household measures showed an overall correct estimation of 5.3%, under and overestimation of 63.7% and 28.9% respectively. Gender showed no significant effect on portion size estimation although more females estimated carbohydrate food correctly compared to the males. The effects of the different BMI categories on participants' ability to correctly estimate or overestimate were not significant. However, significant effect of BMI on underestimation of portion size in food was observed.

DEDICATION

I thank God for providing me the strength and resources to undertake this project. I also wish to show appreciation to my husband, Frank Kommey, and my lovely daughters, Earlene and Kayla, who have been a backbone to me. I also wish to express my gratitude to my parents, Mr. and Mrs. Opoku, and my brothers, Michael, Derek and Daniel, for their affection and support at every step in my life. I cannot forget the prayers and support of my favourite aunt, Ps. Evelyn Amihere, who has been a pillar to the family for all these years and my mother-in-law, Janet Arthur.

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LIST OF ABBREVIATIONS AND ACRONYMS

NCDs: Non Communicable Diseases

WHO: World Health Organization

FFQ: Food Frequency Questionnaire

GSS: Ghana Statistical Service

PSMAs: Portion Size Measuring Aids

SSA: Sub-Saharan Africa

2D PSMAs: Two dimensional Portion Size Measuring Aids

3D PSMAs: Three dimensional Portion Size Measuring Aids

USDA: United States Department of Agriculture

UMKD: Upper Manya Krobo District

BMI: Body Mass Index

CE: Correct estimation

UE: Under estimation

OE: Over estimation

FAO: Food and Agriculture Organization

DES: Daily Energy Supply

CHAPTER 1

1.0 INTRODUCTION

Dietary assessment comprises of food production and supply at the national level, food purchases at the household level and food consumption at the individual level (Thompson & Subar, 2013). Dietary assessment can also be defined as a complete evaluation of a person's food intake reported either subjectively or objectively (Shim, Oh, & Chang Kim, 2014). Subjective assessment is done by use of open-ended surveys such as dietary recalls or records or by use of close-ended surveys such as food frequency questionnaire; whereas objective assessment is done by weighed food records (Shim, Oh, & Chang Kim, 2014).

According to Boushey *et al.*, 2009 chronic diseases can be prevented and managed when adequate information is available on dietary intake. Non communicable diseases (NCDs) such as hypertension, diabetes, cardiovascular diseases, cancers and obesity contribute highly to illness, disability and deaths in Ghana (Ofori-Asenso & Garcia, 2016; Bosu, 2013; Ministry of Health, 2011). These have been linked to unhealthy dietary patterns and physical inactivity of an individual (WHO, 2014). According to (Wojtusiak *et al.*, 2011) adequate dietary intake is the basis of good health and measuring dietary intake and nutritional status is one of the most efficient and informative means of understanding the health status of a community. Peprah-Boateng (2014) observed that household measures served as the most widely used portion size estimation tools by dietitian and nutritionists in Ghana. These measures however do not usually provide uniform and comparable results, thus hampering the development of dietary policies and

guidelines. However, a photographic food atlas is a useful tool for field estimation of dietary intake with minimal average errors in portion size estimation (Harris-Fry *et al.,* 2015).

Several methods have been developed for the assessment of dietary intake, but the appropriate method to use depends on the purpose for the assessment, which include measuring nutrients, foods or eating habits (Wrieden *et al*.,2003). The dietary methods are weighed food records, estimated food records, 24-hour recall, multiple pass recall, food frequency questionnaire (FFQ) and household surveys (Wrieden *et al.*,2003). All of these methods have their advantages and disadvantages and are affected by portion size estimation in one form or the other.

Different jurisdictions employ different portion size estimation tools to assess dietary intake. Some of the tools employed are food atlas, household measures and the weighing of food. The use of any one measure is usually influenced by convenience and habit. The use of food weights generally provides more uniform results than other portion estimation tools. It is commonly used in developed countries such as the United Kingdom. However it is not widely used in Africa because of its cost implications, low levels of literacy and the fact that it is not a traditional way of estimating portion sizes.

1.1 Problem Statement

Increased rate of diet related non communicable diseases have been greatly linked to dietary habits and patterns of individuals. The World Health Organization (WHO) estimated that in 2008 majority (60%) of all deaths were as a result of NCDs and over 80% of these deaths were reported in low and middle income countries (World Health Organization, 2010).

Developing countries including Ghana are currently recording diet-related diseases at a rather fast pace (Bosu, 2010). In 2007 urban Accra reported 35% obesity and 28% overweight among adult women (Hill, 2007). The Ghana Statistical Service (GSS) also stated in 2008 that one-third of Ghanaian women were overweight or obese. Additionally, high rates of hypertension ranging between 20% and 50% has been documented (Bosu, 2010).

To help curb the high rates of NCDs, good nutrition throughout life should be prioritized by all given the correlation between diet and health. Nonetheless, most people choose foods for reasons other than their nourishing values (Anti, 2008). In addressing dietary behaviours both quantity and quality should be addressed. Quality can be ensured easily, but the amount eaten requires estimation and this continues to pose a challenge to dietitians and nutritionist. It must be emphasied that accurate and consistent measurement of dietary intake and patterns of eating behaviour is important when evaluating the effectiveness of public health interventions to improve diet and reduce obesity and other non communicable diet related diseases.

There has been an increase in the portion sizes of foods sold commercially,with evidence from a limited number of studies suggesting that the availability of larger portions is correlated with an increase in total caloric intake, which could lead to weight gain and an increased risk of non communicable diseases (World Health Organization, 2010). The increase in obesity and NCDs in Ghana calls for an effective portion size measurement aid (PSMA) that would be understood by all irrespective of gender to help control quantities of food consumed by the general public and inform dietary guidelines. A photographic atlas of commonly consumed carbohydrate Ghanaian foods was developed by Peprah Boateng to aid in dietary assessment and counseling. Although it

does not cover all the food groups it may be a good tool that targeted what Ghanaians eat in large quantites to start with. This tool was validated among a cross-section of Ghanaians in Accra and it was reported in the study that more than half (52.45%) of the participants were able to make correct estimations based on the use of the household measures and food photographic atlas. This current study sought to validate the carbohydrate photo atlas tool by Peprah Boateng (2014) in a rural setting in Ghana to confirm its use across the nation. It is expected that the findings will make it possible for Ghana to have empirical data on carbohydrate eating habits nation wide to inform policy.

1.2 Justification

The outcomes of this study will provide information on the use of the food photographic atlas as a tool in assessing portion sizes in a rural setting in Ghana. This study will also provide information that will help determine whether household measures or the photographic food atlas will be a better portion size measurement aid (PSMA) in a rural area.

Furthermore the study will seek to provide further empirical evidence and guidance in the development of a national dietary assessment framework which will help curb diet-related diseases.

1.3 Aim

The main aim of this study was to validate a photographic food atlas of commonly consumed carbohydrates based foods with estimated food portion sizes using household measures in Asesewa, a rural community in Ghana

1.3.1 Specific Objectives

1. To determine the background characteristics of the study participants.
2. To determine participant's portion sizes of commonly consumed carbohydrate foods from dietary recall using some common Ghanaian household measures.
3. To assess participants' ability to accurately pick out recalled portion sizes of carbohydrate foods from portion sizes depicted in the photographic food atlas.
4. To determine if age, gender and BMI significantly affected participants' ability to accurately select portion sizes from the photographic food atlas.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 Introduction

The complexity of food choices and understanding the reasons why people choose and eat the foods they do is very important in dietary assessment because diet has been shown to be a major lifestyle-related risk factor for various chronic diseases (Shim, Oh, & Chang Kim, 2014). Dietary intake can be assessed by subjective report and objective observation. Subjective assessment of dietary intake is possible through the use of open-ended surveys such as dietary recalls or records, or using closed-ended surveys including food frequency questionnaires. Each method has inherent strengths and limitations (Shim, Oh, & Chang Kim, 2014). Dietary assessment is needed to evaluate the nutritional status of a population so as to provide appropriate nutrition education and intervention tailored to improve dietary habits and food choices. This is to help curb under nutrition and improve nutritional status (Wunderlich, 2013). Another importance of dietary assessment is that it is helpful in the management of diet related diseases especially in older adults who are often dealing with chronic medical conditions that require multiple pharmaceuticals for therapy and as such drug-nutrient interactions are a prime concern among this population group (Wunderlich, 2013). Sub-Saharan Africa (SSA) for instance, is one of three regions with the highest risk of NCD deaths between ages 30 and 70 years. The World Health Organization's surveillance on NCD risk factors suggests that SSA is being affected at a rather fast pace (World Health Organization, 2010). It is reported that the proportion of adults with elevated blood pressure (46%) is greater in Africa than any other region. Also, almost 30% of people in SSA do not achieve sufficient physical activity. Overweight prevalence has been

reported to be rising rather rapidly in SSA (Ziraba *et al.*, 2009). Among preschool children, Africa had the highest incidence of overweight between 1990 and 2010 (de Onis, Blössner, & Borghi, 2010).

Measuring dietary intake enables the assessment of nutritional adequacy of individuals and groups and can provide information about nutrients, including energy, food, and eating habits (Burrows, Martin , & Collins, 2010)**.** One way of classifying dietary measurement methods is to group them into prospective and retrospective methods. (Johansson, 2006).

2.2 Prospective Dietary Methods

In the prospective methods foods and beverages are recorded at the time of consumption (Johansson, 2006). Examples of prospective methods are the use of Portion Size Measurement Aids (PSMAs) such as household measures and food atlases, and food records. One major advantage with the prospective methods is that they are not affected by memory since the foods and beverages are recorded at the time of consumption. Another advantage is that it provides a reasonable estimate and a detailed diet and nutrient intake of an individual (Collins, Watson , & Burrows, 2009). The disadvantage is that they often affect the quantity of foods consumed. Several studies have demonstrated that the total intake will be low and that there is a selective underreporting (Johansson, 2006).

2.2.1 Portion Size Measurement Aids

Portion size measurement aids (PSMAs) refer to tools that facilitate the estimation of food portions or servings (Ball, 2014). Household measures such as measuring cups and spoons, bowls, glasses and plates which are commonly used to quantify food portions are classified as

portion size measurement aids (PSMAs) (Weber *et al.*, 1997). There are two (2) main types of PSMAs and these are the two dimensional portion size measurement aids (2D PSMAs) and the three dimensional portion size measurement aids (3D PSMAs). A Two Dimensional portion size measurement aid usually refers to drawings of real foods, abstract shapes and house hold measures estimating portion sizes. A three Dimensional portion size measurement aid refers to models which come in the form of actual objects such as a golf ball, tennis ball, a deck of cards, a sardine tin, just to mention a few which are used to represent portions of foods (Owusu *et al.*, 1995). In the United States of America there is a more advanced production of food models made from either plastics or Styrofoam that resemble actual foods, and these food models are classified as 3D PSMAs. Real food samples have also been categorized as 3 dimensional models in portion size estimation. Some 3 dimensional food models used in Ghana include an orange representing a ball of Ga kenkey and an egg representing corn dough (Peprah Boateng, 2014).

2.2.2 Food Records

The most common dietary assessment method for national surveys, and popular with health-service and diet-related professionals, is the use of food records. They involve the individual recording, either manually (with a pen and paper) or electronically), all food consumed in real time (i.e. at the time of consumption) over a defined number of days. (Gibson *et al.*, 2016).

2.2.2.1 Weighed Food Records

Weighed food records involve an individual or a researcher weighing every food item prior to consumption and the leftovers (Wrieden *et al.*, 2003). This method is considered to be precise, however the tiresome nature of weighed food records can alter one's intake and weighing foods is not always achievable (Gibson *et al.*, 2016). It includes a written record of actual intake of

foods and beverages consumed at the time of consumption for a specified period (usually 3, 5, 7 days). Food can be measured using a food scale for weights. Multiple days should be randomized to include a weekend to measure the actual food intake of an individual. A 7-day weighed record has been identified as a 'gold standard' against which other methods can be compared. Weighed records have the advantage of reporting precision in portion sizes and providing an accurate dietary intake of an individual (Wrieden *et al.*, 2003). However, there are some disadvantages to this method which includes a high respondent burden for both researchers and participants and requires a high motivation of respondents. Habitual eating patterns may be influenced due to inconvenience of recording, choice of foods which are easy to record, beliefs about which foods are healthy or unhealthy and requires participants to be literate and cooperative (Collins, Watson , & Burrows, 2009). Weighed foods over a long period results in respondent fatigue thereby affecting food records.

2.2.2.2 Estimated Food Record

Estimated food record is a prospective dietary method which provides detailed information on food intake. This is quite similar to the weighed food record except that the quantification of foods and drinks are estimated rather than weighed. The estimation of the foods in this method is done with the help of portion size measurement aids such as household measures with examples including cups or spoons, food photographs and food models. The portion size estimation is then converted into weights which can be used to calculate an individual's food and nutrient intake. This method of dietary assessment is widely used and has a lower respondent burden compared to the weighed food records where an individual is not required to carry a food scale to measure all food intakes. However, the only disadvantage of estimation portion sizes is that the possibility of mis-reporting is very high in terms of over estimation or under estimation of foods (Wrieden

et al.,2003). This can negatively affect appropriate dietary counseling and intervention provided by nutrition professionals.

2.3 Retrospective Dietary Methods

The commonly deployed retrospective methods are food recalls, dietary histories and food frequency questionnaires. They usually make use of food aids such as food models, rulers, and household measures. These groups of methods have the advantage of being simple and cheap. Also they are suitable for a large sample size. The main demerits of this group of methods are their reliance on the memory of people (which is fallible) and the ability to estimate quantities varies (Johansson, 2006).

2.3.1 24 hour Recall

A 24-hour dietary recall is a retrospective method of dietary assessment in which an interview is conducted to obtain detailed information on all foods, beverages and possibly dietary supplements consumed by a respondent in the past 24 hours. In a 24-hour recall, subjects are required to recall the exact food intake during the previous 24 hours or the preceding day. It includes the time of day at which the food was consumed as well as the portion size of each food and beverage recorded. A single 24 hour recall is not sufficient enough to provide an accurate estimate of long-term energy intake as diets vary considerable on a daily basis. It is therefore suggested by some researchers that multiple 24 hour recalls such as three (3), four (4) five (5) or seven (7) days are necessary to provide adequate estimate of energy intake (Yunsheng *et al.*, 2009). A 24-hour recall has a low respondent burden, requires no literacy and is suitable for a large scale survey (Wrieden *et al.*, 2003) and can be used to calculate the average dietary intake of a population (Raina, 2013). There are some limitations in the use of the 24-hour recall; one of

such limitation is the fact that it relies on memory and as such foods consumed may be forgotten by respondents. Another disadvantage is that data generated through this method may not represent long-term dietary habits of individuals (Raina, 2013).

2.3.2 Diet Histories

Diet History is a detailed retrospective dietary assessment method which is more frequently used in clinical practice than in research studies. It is used to describe usual food and nutrient intake of an individual over a relatively long period, for instance, one (1) month, six (6) months or as long as one (1) year (Fagúndez *et al.*, 2015). Diet history is considered as a traditional method of analysis of dietary intake. It traditionally consists of three (3) components that make available detailed information on the usual food consumption pattern of individual and detailed information on certain foods. The first of the three (3) constituents include an interview about the usual food intake pattern of an individual and estimation of the quantity of food consumed by means of household measures. This is followed by a questionnaire consisting of a detailed list of foods to assess the overall food intake pattern and to verify the information obtained from the first part. The final part is a 3-day food record with estimated portion sizes of the foods and beverages consumed (Fagúndez *et al.*,2015). The main advantage of the diet history is its ability to detect seasonal changes in dietary pattern. It is also efficient in obtaining data on all nutrients and to correlate well with biochemical measures. However, this method bears a high respondent burden and consequent loss of data quality (Naska, Lagiou, & Lagiou, 2017).

2.3.3 Food Frequency Questionnaire

Food Frequency Questionnaire (FFQ) refers to a limited checklist of foods and beverages common to a group of people with a frequency response section for subjects to report how often

each item was consumed over a specified period of time. The frequency response includes the number of times per day, week, month a food item is consumed. It is designed to collect dietary information from large numbers of individuals such as a hundred (100) individuals or more and is normally self-administered (Wrieden *et al.*, 2003). It can also be administered via a phone interview involving a researcher and a participant. There are two (2) of FFQs and they are semi-quantitative and non-quantitative. Semi-quantitative FFQs are designed to collect portion size information as standardized portions or as a choice of portion sizes, whereas the non-quantitative FFQs do not require portion size information (Wrieden *et al.*, 2003) It has the advantage of representing a habitual dietary intake of an individual or a group of individuals and their food patterns. It is also a preferable method of measuring intake of nutrients with very high day-to-day variability. Administration of questionnaire is significantly less expensive in comparison to food records or dietary recalls. It has a low respondent burden and as such suitable for very large scale surveys. The disadvantages of a food frequency questionnaire include a high dependence on respondents' memory, requires that a participant be literate to understand the frequency of consumption and a high possibility of over-reporting of healthy foods (Collins, Watson , & Burrows, 2009).

2.4 Portion sizes and dietary assessment

2.4.1 Portion size

A portion according to Nelson & Haraldsdottir (1998) is the quantity of food eaten at any one occasion; this selected portion may be bigger or smaller than the standardized serving of the food. A serving is a unit of measure used to describe the amount of food recommended from

each food group (USDA, 2015). "We consume much more than we think we do," says Edgar Chambers IV, Ph.D., professor of human nutrition at Kansas State University.

The rise in fast food joints, who serve cheaper foods in large portions, has been connected to the spate of obesity in the United States. The frequency of consumption of large portion of food, especially food that is high in energy density, may be a contributing factor to excess energy intake coupled with physical inactivity results in the development of obesity (Cashin-Garbutt, 2017). Over the last twenty years, the typical American diet has changed dramatically both in quantity and quality of food intake. Recent studies have shown that the average adult used to consume an average of 2,160 kilocalories per day in 1970 and has increased by 20-25 percent to 2,673 kilocalories per day in 2016. Examples given included a regular muffin weighing 1.5 ounces and French fries weighing 2.4 ounces both with a caloric content of 210 kilocalories have increased in weight and caloric content over the past twenty (20) years to 4 ounces with 500 kilocalories and 6.9 ounces with 610 kilocalories respectively (Scinta, 2016). Unfortunately, people do not see these changes and view the increased portion sizes as normal, and this is described as portion distortion.

2.4.2 Portion Distortion

Portion distortion is a term used to refer to situations where people tend to regard excessive portions as normal amounts (Faulkner *et al,* 2012). These situations are believed to contribute to unhealthy eating habits that may lead to obesity. There are increasing concerns that larger portion sizes may encourage over-eating and contribute to the high obesity rates seen across developed countries (Faulkner *et al.,* 2012); a case not too dissimilar to our situation in the developing world. The proportion of people who are obese and overweight has increased sharply

in many countries. In the US for example, the proportion has doubles since 1980 and almost a third of all adults are classified as obese (Duffey & Popkin, 2011). A cross-sectional study conducted in the US showed an increased intake of energy by both children and adults which is largely contributed by an increased portion sizes and increased eating frequency over the last three decades. (Livingstone & Pourshahidi, 2014). A study by Piernas & Popkin, 2011 compared portion sizes to physiological cues such as hunger and satiety and identified that portion sizes have more influence in the quantity consumed resulting in excess intake of high energy foods. Larger portions sizes of foods and beverages are thought to affect energy intakes at meals and promote overeating (Piernas & Popkin, 2011).

Nutritional information although may be present on packaged foods based on serving sizes, people generally do not correctly assess the amount they are eating. Often consumers are unable to tell the differences in portion size when offered different sizes on different days. After consumption of larger portions in one eating occasion, people normally compensate that by eating fewer calories during the rest of the day or the time period before or following the eating occasion. However, this in many cases is difficult for many to do because researchers found that the people who ate large portions did not notice the size difference and ate their normal amount of food at the following meal. Portion size is therefore a modifiable determinant of energy intake that should be considered in the prevention and treatment of obesity (Young & Nestle, 2012).

In order to curb the spate of high obesity rates and increasing cases of diet related NCDs there is the need to ascertain what and how much food people are consuming.

2.4.3 Portion Size Measurement Aids

Maintaining a healthy diet is necessary in preventing, treating and managing diseases such as obesity, diabetes and certain cancers. Part of this is done by becoming aware of one's portion size intake. Healthcare professionals use the portion size intake information of their patients to undertake nutritional assessment, and to educate them about specific servings and appropriate use of portion measurement aids.

Portion Size Measurement Aids (PSMAs) can be defined as tools that assist in the facilitation of food estimation (Ball, 2014). One major barrier to controlling the amount of food consumed may be the difficulty consumers have in accurately estimating portion sizes due to the fact that most people are unaware or unconscious of the amount of food eaten (Riis, 2014). The accuracy of estimating portion sizes of foods is of great importance because it can influence the quality of dietary intake data as well (Jia *et al.,* 2014). A major benefit of using portion size measurement aids (PSMAs) may improve estimation accuracy, however, it has the disadvantage of being bulky and costly and so tends to make them impractical for regular use (Brrd-Bredbenner & Schwartz , 2004).

With ever-increasing obesity rates and the commensurate rise in portion sizes, it is imperative that diet and nutrition-related professionals work with their clients to ensure accuracy in the estimation of their dietary intake. There is mis-reporting of dietary intake due to factors such as variation in food consumed from day to day, poor memory recall, inability to estimate portions resulting in over or underestimation, and inadequate knowledge of portion sizes. (Hight, 2008).

The ability to estimate portion size of food eaten appears to be affected by the food type such as foods presented in multiple units (Almiron-Roig *et al.,* 2013). Awareness of one's portion sizes

is a great step to maintaining a healthy diet and weight and portion size measurement aids (PSMAs) have been identified as being beneficial for subjects trying to accurately describe portion sizes (Chaudry, Connelly, Siek, & Welch, 2011). A number of factors play a role in reliability of aids used for estimation including the way the aids are presented to the subjects, the type of aid used for recall, the food type and shape, characteristics of the subject, and the extent to which the aid resembles the size and shape of the food (Hight, 2008).

Accurate information about oral intake of individuals and populations is particularly difficult to obtain; it is usually reliant upon self-report and can be subject to large errors. There is much controversy in literature about the value of self-reported food intake, particularly for research into energy intake and obesity (Gibson *et al.,* 2016) stresses the importance of the collection of data on the volume and kinds of different individuals and groups in clinical and educational settings in a bid to affect policies on diet and health.

Currently, it has been observed that people can estimate healthy portion sizes either by using serving size information printed on food packages or by making visual comparisons with various objects. Unfortunately, both methods present problems for low literacy populations (Gibson *et al.,* 2016). In a study done by Ollberding and Wolf (2010) it was observed that 47.2% of Americans use serving size information on food packages to consume less energy, fat and sugar (Ollberding & Wolf , 2010). However, the information on serving size on packaged foods is difficult to understand particularly for low literacy and numeracy populations (Rothman *et al.,* 2006). The other option will be for people to determine portion sizes by associating food portions with visual aids recommended by registered dietitians. For example, an appropriate portion size for pasta is ½ a cup, which is visually equivalent to a tennis ball. Such estimation aids, however, lack a standard definition (Ball & Friedman , 2010) making their general use challenging.

Moreover, people do not always eat portion sizes comparable with these aids, and hence the need to track and calculate total daily intake is not completely eliminated.

2.5 Household Measures and dietary assessment

One of the keys to maintaining weight and staying healthy is portion control, but serving sizes can be rather vague and difficult to measure exactly. Common household measures, such as cups, measuring spoons, glasses, plates and bowls are frequently used to quantify portion sizes (Peprah Boateng, 2014). These household measures are used in conjunction with other assessment methods in assessing dietary intake prospectively or retrospectively.

A good illustration of the use of household measures can be found in the United States; The United States Department of Agriculture (USDA) has come up with a dietary guide called the 'MyPlate Food Guide', which identifies daily meal proportions for the fruit, vegetable, grains, protein, and dairy food groups. It provides an illustration of appropriate portion sizes of the different food groups, with an emphasis on fruits and vegetables (constituting half the plate) (USDA, 2016).

Currently, in Ghana, household measurement aids are the dietary aids of choice in portion size estimation by dietitians and nutrition-related professionals. This, in my opinion is largely the case owing to the fact that it is easier for the sampled population to relate to these items. Inasmuch as household measures offer simplicity and universality as merits for their use, they present the challenge of being cumbersome.

2.6 Photographic Atlas

A food photographic atlas is a type of portion size estimation aid, which can be defined as "a set of photograph series of food in portion sizes, usually bound together in a single volume" (Nelson & Haraldsdottir, 1998). The photographic food atlas may contain portion sizes ranging between 3 to 8 different portion sizes of food (Turconi *et al.,* 2005). Photographs of foods are usually taken of small, medium and large portions, which are judged to be representative of the range of portion sizes actually consumed by a group of people. Individuals are asked to choose from the photographs of food the one that best reflects their usual portion size or their actual portion size. Alternatively, a food photographic atlas can contain a single photograph of the average portion size and individuals asked to estimate their own portion size as a fraction or multiple of the single photograph displayed.

The assessment of food portion sizes from food photographic atlases according to Turconi *et al.,* (2005) involves three (3) main elements: perception, conceptualization and memory. Perception refers to an individual's ability to relate a quantity of food that is present in reality to a portion or quantity of the same food depicted in a food photographic atlas. Conceptualization involves an individual's ability to make a mental picture of an amount of food that is not present in reality but is able to relate that to that quantity of food displayed in the food photographic atlas. Memory is one's ability to recall accurately the amount of food eaten over a period of time and can have an effect on the accuracy of conceptualization (Turconi *et al.,* 2005). All these three elements will be affected by a number of factors such as the number of different portion sizes, their placement in the food photographic atlas, the dimension of each photograph and the camera angle at which each of the food was taken and framed. One advantage of a food photographic atlas especially if it is colored can be used by all age groups; however, one disadvantage may be

a misreporting of portion sizes especially when compared to weighed foods (Turconi *et al.*, 2005).

Various researchers have done extensive work on the use of the photographic atlas all over the world notably work done by (Nelson & Haraldsdottir, 1998) and (Tueni *et al.*, 2012), to mention a few. In a study by (Lazarte *et al.*, 2012), a comparison was made between the use of a digital food photographic atlas and weighed food record, and it was concluded that there was no significant differences between the two methods with exception to some food categories such as rice.

In contrast, very little work has been done on the validation and use of the photographic atlas in Ghana. Pioneering studies by Peprah Boateng (2014) asserts, inter alia, that access to a photographic food atlas of commonly consumed Ghanaian foods will aid in data collection, nutrition education and dietary counseling. The findings of the validation of the food photographic atlas in Accra, Ghana by Peprah Boateng (2014) showed a statistical significance in correct estimation of portion sizes using the photographic atlas, and therefore, being a useful dietary measurement aid.

CHAPTER 3

3.0 METHODOLOGY

3.1 Study Design

This was a cross sectional study design.

3.2 Study Site

The study was carried out at Asesewa, specifically in the Nutrition Research Centre and the Asesewa Regional Hospital in the Upper Manya Krobo district (UMKD) of the Eastern Region of Ghana. Asesewa was chosen because of an ongoing project by the department of Dietetics which created a platform for easy access to recruit participants. According to the Ghana Statistical Service's Population and Housing Census for 2010 the district has a population of 72,092. Asesewa is the district capital and has an estimated population of about 20,291. The district shares boundary with the Volta Lake in the north, Fanteakwa District in the west, Asuogyaman District in east, Yilo Krobo District in the south-west and Lower Manya Krobo in the south-east. The main economic activity in the district is agriculture employing about 80% of its population, most of whom are subsistence farmers with very few commercial ones.

3.3 Study Population

The study included all males and females within the age group of eighteen (18) years and seventy (70) years who visited the Nutrition and Research center and the Asesewa Regional Hospital within the time period of collecting the data.

3.3.1 Inclusion and Exclusion criteria

Males and females within the age group of eighteen (18) years and seventy (70) years who indicated their willingness to partake in the study by filling a consent form attached to the questionnaire used in data collection.

Children under the age of eighteen (18) years and the elderly above the age of seventy (70) years were excluded from the study; this is due to their inability to accurately estimate portion sizes. Pregnant women were also excluded because of the comparison of portions size estimation based on body mass index (BMI).

3.3.2 Sample size determination

The sample size of participants recruited for the study was calculated using the total population of Asesewa from the Census Report (2010) to find a percentage of the population within the study age bracket. According to the Census Report (2010), the total population of the Upper Manya Krobo District is 72,092 and the population above eighteen (18) years is 38,509. The sample size was calculated using the formula:

$n = (z^2 (p) (1-p))/d^2$

$n = (〚1.96〛^2 (0.15) (1-0.15))/ 〚0.05〛^2$

$n = \underline{\mathbf{196}}$

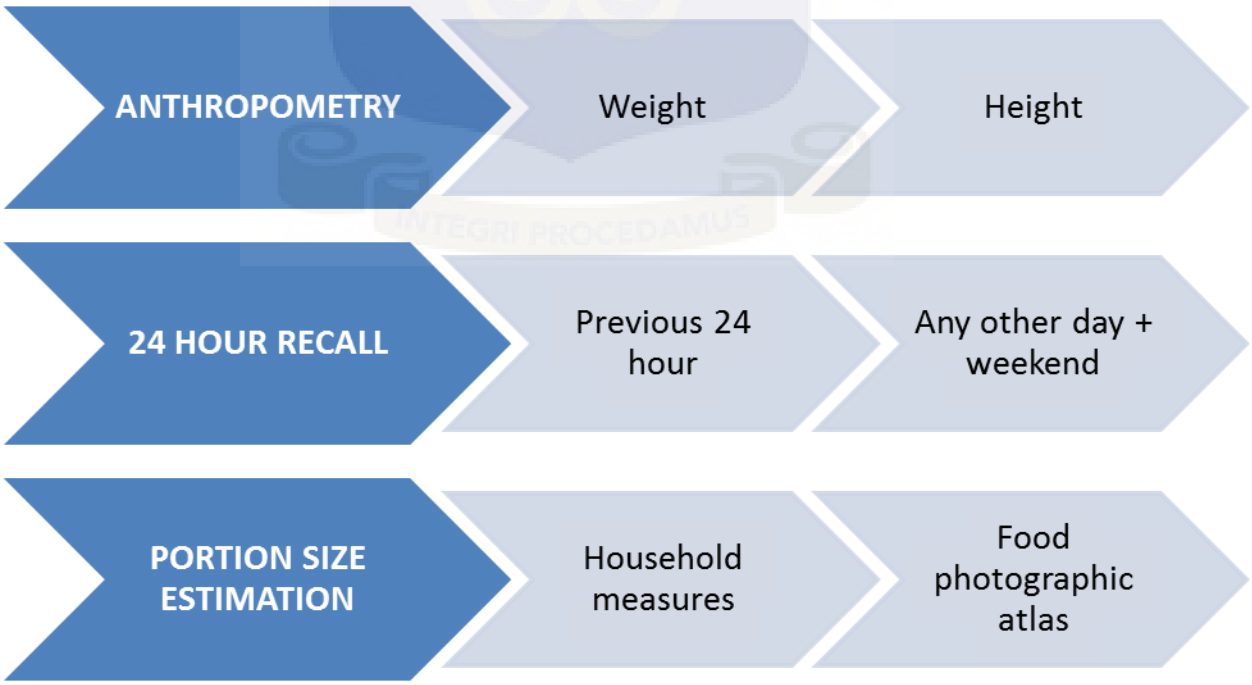
Where ‘n’ is the sample size, ‘z’ is the percentile of the required confidence interval (1.96), p is the population estimate (0.15) and‘d’ is the allowable error (0.05). A minimum sample size estimate of 196 was obtained.

3.4 Pre-testing of questionnaire

Twenty (20) people who met the criteria for this study were conveniently selected to test the questionnaire for clarity. Pre-testing of questionnaire was done in Asesewa, specifically in the Nutrition Research Centre and the Asesewa Regional Hospital in the Upper Manya Krobo District (UMKD) of the Eastern Region of Ghana but these participants did not form part of the final recruitment for the study. The questionnaire was designed to collect socio-demographic information such as date of birth, gender, marital status and educational level; anthropometric measurements such as height, weight and BMI; and a three (3) day diet history.

3.5 Data collection

Data collection was divided into three (3) main parts: socio-demographic and anthropometry, 24-hour recall and portion size estimation. A flow chart of data collection is shown below:



3.5.1 Subject recruitment

The researcher recruited and trained two (2) personnel to assist in data collection. Prior to the distribution of questionnaire, subjects were given a brief introduction of the researcher and the trained personnel and the purpose of the study was explained to them. Those who were willing to partake in the study and met the criteria were given an informed consent form to fill with the help of the researcher by translating in the local dialect where necessary. They were informed of their right to leave this study if confidentiality is broken.

3.5.2 Data collection material

A pre-tested questionnaire was used in collecting data from 196 respondents which included socio-demographic information such as age, gender, educational level, and marital status. The researcher was also required to conduct a face-to-face interview to fill out a 3-day 24-hour dietary recall of participants' intake.

3.5.3 Anthropometric measurements

Anthropometric measurements are a set of inexpensive, noninvasive, quantitative method of assessing an individual's fat and muscle composition, and can be useful in the nutritional assessment of an individual (Sánchez-García *et al.*,2007). The anthropometric measurement of interest to this study was height and weight, which were used to calculate the body mass index (BMI) of participants. The calculated BMI was compared to reference standards. For this study, the reference values were based on WHO (2012) criteria which define underweight as a BMI (<18.5kg/m2), healthy weight (18.5kg/m2 – 24.9kg/m2), overweight (25.0kg/m2 – 29.9kg.m2)

and obese (≥30.0kg/m2). Weights and heights were recorded by a researcher and trained research assistants for all participants using a stadiometer.

3.5.3.1 Weight

The weights of participants were measured by researcher and trained research assistants using a weighing scale (Seca 755). Prior to the measurement of weights, participants were asked to empty their pockets and remove jackets, scarfs, wrist watches and footwear before standing on the scale. Participants were asked to stand upright and look forward when the measurement was being recorded.

3.5.3.2 Height

The heights of participants were measured using a stadiometer (Seca 755) which was attached to a digital scale. Participants were asked to stand upright and inhale for the heights to be recorded. The values of the recorded heights and weights were used in the calculation of BMI for each and every participant and categorized according to the reference standards. For this study, the reference values were based on WHO (2012) criteria which define underweight as a BMI (<18.5kg/m2), healthy weight (18.5kg/m2 – 24.9kg/m2), overweight (25.0kg/m2 – 29.9kg.m2) and obese (≥30.0kg/m2).

3.5.4 Dietary Assessment

An interview was conducted using a 24-hour dietary recall to obtain information on participants' intake in the past 24-hours and then estimation of portion sizes of the meals listed were made using household measuring aids and a food photographic atlas. Participants were given codes

which matched their questionnaire and were either visited in their homes or returned to the nutrition research center or the Asesewa regional hospital for day 2 and day 3 dietary recalls.

Household measuring aids were used to assist portion size estimation. These included measuring spoons, measuring cups, soup ladles, stew ladles, empty small tin tomato, and empty milk can (185g), and match box. The estimation of the meals were limited to the carbohydrate foods that the researcher and research assistants identified from the list of foods provided by the participants in the previous 24-hour period. Estimation of food using food photographic atlas of the same carbohydrate foods was also required of participants with the help of the research team. The food photographic atlas contained carbohydrate foods in eight different portion sizes. Participants were asked to choose from the book how their portion sizes looked like based on the estimation made using the household measuring aids. This was repeated for the other two days.

3.6 Data Analyses

Analyses and statistical procedures were carried out using the Statistical Package for Social Sciences program (SPSS, version 21.0 for Windows). Results were expressed as means ± SD. Pearson's Chi-square tests and one-sample t-test were used to compare individual and overall carbohydrate estimation by male and female participants. For all statistical comparisons, a P-value of <0.05 was considered as statistically significant. Pictorial representations are provided where applicable.

3.7 Ethical approval

Approval for the study was obtained from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences for approval. Permission was sought from the health directorate and the Regional Hospital of Asesewa and any protocol observed. The purpose

and significance of the study was explained to participants. Research Participants Information Sheets and written consent were obtained before commencement of data collection. Strict confidentiality and anonymity were assured by including a confidentiality clause in the written consent form to reassure participants and also served as a reminder to the researcher of her professional duty to the respondents. The questionnaire used in data collection required participants to indicate their willingness to partake in the study by filling a consent form. Data collection procedure was in accordance with approved protocol.

CHAPTER 4

4.0 RESULTS

4.1 Background profile of participants

Out of the one hundred and ninety-six (196) participants recruited for the study, six (6) participants had their questionnaire rejected because they failed to fill some portions of the questionnaire. Out of the remaining, one hundred and ninety (190) participants, 53.2% (101) were males and 46.8% (89) were females with majority within the age bracket of 18 – 38 representing 63.1% (120). Ninety-two (48.4%) of the respondents were married or cohabiting, seventy-nine (41.6%) were never married and six (3.2%) were divorced or separated (Table 4.1). Most of the respondent (42.6%) had some form of education with majority having middle/Junior secondary school education and only few (11.6%) had no formal education (Figure 4.1)

Most participants had monthly income levels ranging from below two hundred (200) to five hundred (500) Ghana cedis. Forty-nine percent (49.0%) of participants had monthly income below two hundred Ghana cedis (₵200) followed by approximately thirty-five (34.7%) with a monthly income between two hundred Ghana cedis (₵200) and five hundred Ghana cedis (₵500). Only a few (6.1%) recorded a monthly income level of over one thousand Ghana cedis (Figure 4.2).

Table 4.1: Socio-demographic characteristics of respondents N= 190

Variable	n (%)
Gender	
Male	101 (53.2)
Female	89 (46.8)
Age	
18 – 28	70 (36.8)
29 – 39	50 (26.3)
40 – 50	39 (20.5)
51 – 61	24 (12.6)
62 – 70	7 (3.7)
Marital status	
Never married	79 (41.6)
Married/ Co-habiting	92 (48.4)
Separated/Divorced	6 (3.2)
Widowed	13 (6.8)

Figure 4.1: Educational Level of Participants

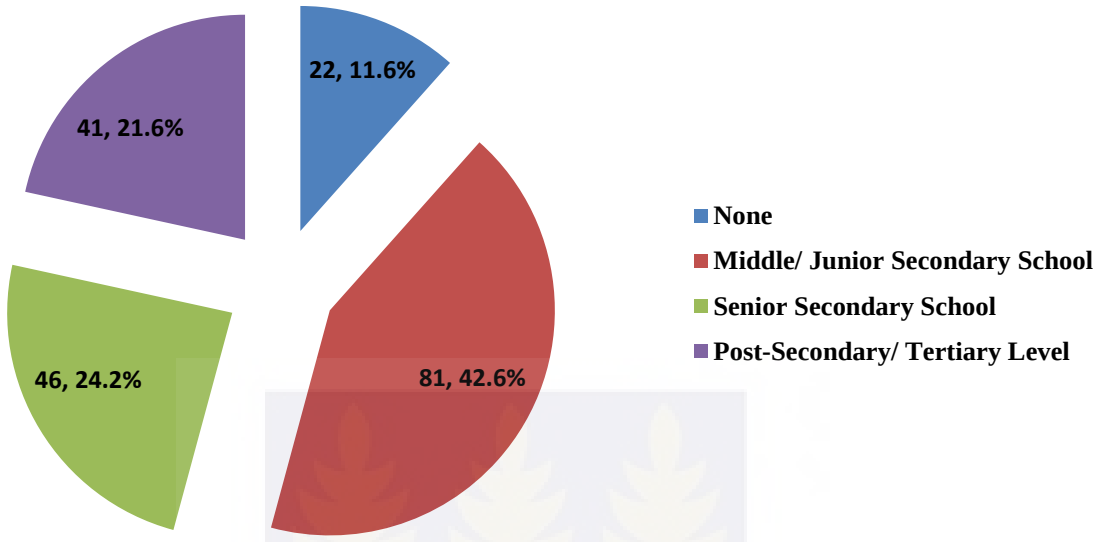
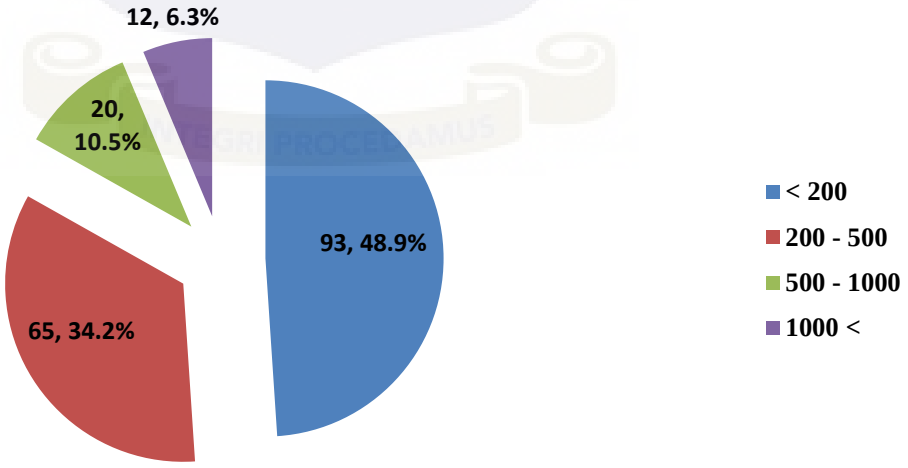


Figure 4.2: Average monthly income of Participants



4.2 Anthropometric assessment of Respondents

The mean height of all the respondents was 1.62 meters; however, the males with a mean height of 1.65 meters were taller than the females with a mean height of 1.58 meters (p-value < 0.001). The mean weight was 65.5kg with the females having a higher weight than the males. The mean Body Mass Index (BMI) was 24.96kg/m^2. The mean BMI for the females was higher than that of males (p-value < 0.0001) (Table 4.2).

Figure 4.3 shows the BMI classification of participants. A large proportion (53.7%) of the respondents had normal BMI, followed by 31.1% who were overweight with very few (2.6%) (3 females and 2 males) being underweight. However, a higher proportion of females were obese as compared to their male counterparts (Figure 4.4). The age range of 18 – 28 years reported the highest number of normal weight individuals (68; 35.8%) as well as overweight individuals (39; 20.5%) as displayed in figure 4.5

Table 4.2: Distribution of mean height, weight and Body Mass Index among respondents

Category	Mean height ± SD.	P-value	Mean weight ± SD.	P-value	Mean BMI ± SD.	P-value
Male	1.65 ± 0.089	<0.001	65.12±9.610	<0.001	24.37±4.475	<0.001
Female	1.58 ± 0.061	<0.001	65.93±11.757	<0.001	25.63±4.157	<0.001
Total	1.62 ± 0.084	<0.001	65.5±10.648	<0.001	24.96±4.363	<0.001

One sample T-test; statistical significance P-value<0.001

Figure 4.3: BMI classification of Participants

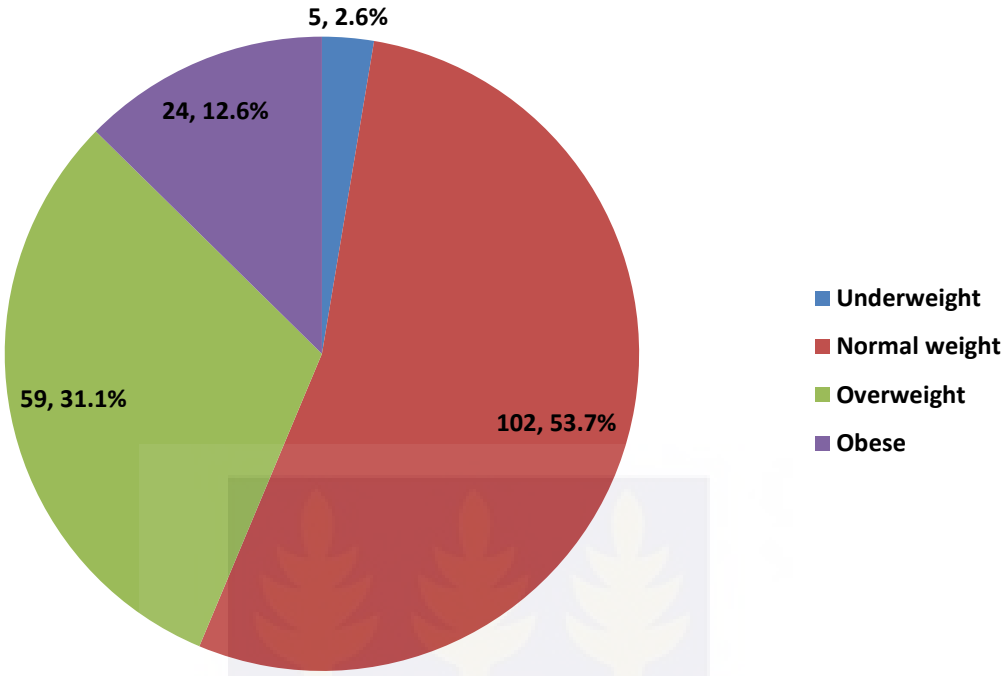


Figure 4.4: BMI distribution based on gender

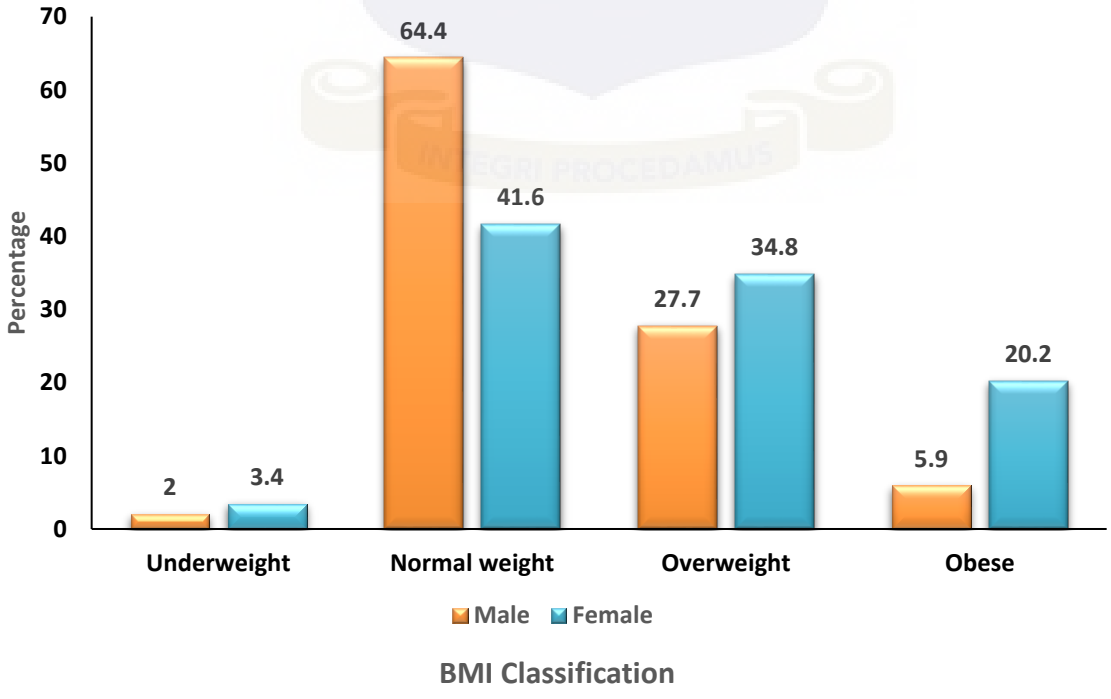
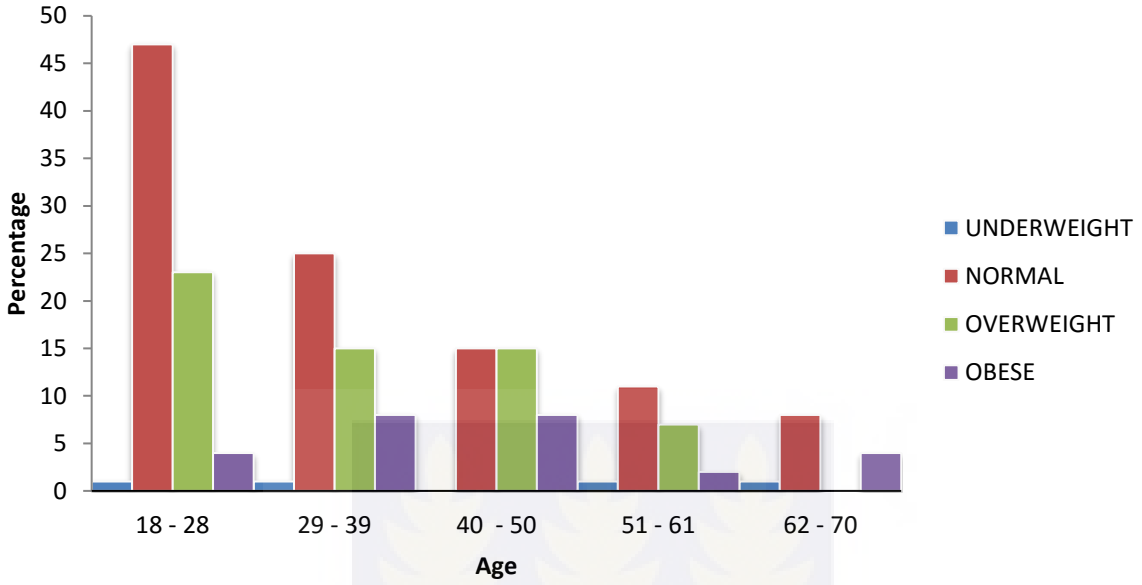


Figure 4.5: BMI distribution of participants based on age groups



4.3 Commonly consumed carbohydrate foods

From the three day 24-hour food recall, fifty-four (54) commonly consumed carbohydrate foods were identified. These were grouped into three (3) main categories: the cereal and grain category (61.2%), the roots, tubers and plantain category (30.5%), and the sugar group (8.3%) as displayed in table 4.3. Based on Peprah Boateng's study (2014) the foods that were considered as most commonly consumed carbohydrates foods made up 5% or more of the frequency of the total carbohydrate foods consumed within the three days, using a 24 hour food recall. There were five (5) foods that were identified as being commonly consumed and these are: Banku forming 19.0%, Fufu (13.8%), Boiled rice (7.5%), Boiled yam (5.7%) and Sugar (granulated) forming 8.2%.

Table 4.3 Commonly Consumed Carbohydrate Based foods

Cereals and Grains	%	Roots, Tubers and Plantain	%	Sugars	%
Abolo	0.2	Boiled yam	5.7	Sugar	8.2
Agidi	0.3	Cocoyam (boiled)	0.5		
Banku	19.0	Fried potato	0.1		
Boiled corn	0.5	Fried ripe plantain	1.0		
Boiled rice	7.5	Fried yam	0.7		
Bread roll	2.6	Fufu	13.8		
Butter bread	1.9	Gari	2.7		
Corn flakes	0.2	Gari foto	0.1		
Corn porridge	4.0	Kakro	0.1		
Crackers	0.4	Kelewele	0.2		
Digestive biscuits	0.1	Kokonte	1.6		
Doughnut	1.1	Plantain chips	0.5		
Fante kenkey	0.4	Ripe plantain (boiled)	0.1		
Fried rice	0.2	Roasted Plantain	0.2		
Fula	0.3	Unripe Plantain (boiled)	3.6		
Ga Kenkey	4.2				
Hausa Koko	3.2				
Jollof rice	0.8				
Meat pie	0.5				
Millet porridge	0.1				
Oats	0.5				
Oblayo	0.7				
Omutuo	0.8				
Pastry chips	0.1				
Pop corn	0.3				
Rice porridge	0.8				
Roasted corn	0.9				

Rock buns	0.1
Saabo	0.1
Spaghetti	0.4
Sugar bread	0.4
Sweetened biscuits	0.1
Tea bread	3.2
Tom brown	0.7
TZ	0.8
Waakye	3.5
Wheat bread	0.1
Yakeyake	0.1

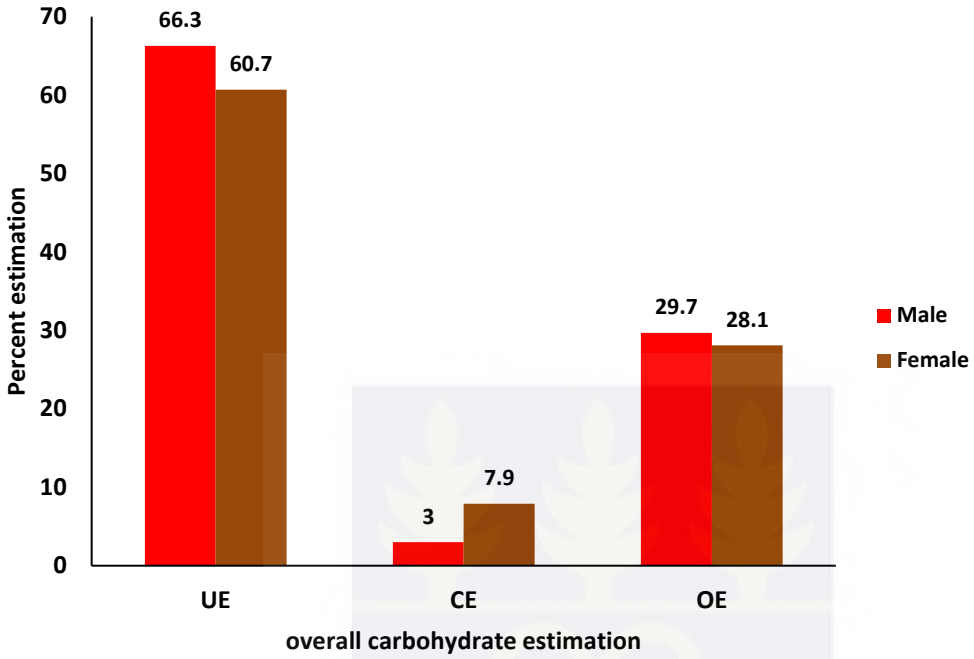
4.4 Participants' estimation of common carbohydrate foods

This section presents results on estimation of common carbohydrate foods by the participants. It further illustrates estimation by gender, age and BMI. Overestimation in this study implies that the participant's selection of portion size from the food atlas exceeds that of the portion size of an identical food presented using the household measuring aids. Correct portion size estimation is when a participant's choice of a food portion from the food atlas is identical to that presented by the household measuring aids. Underestimation is indicated by the choice of a lower portion size than that using the household measuring aids.

4.4.1 Overall carbohydrate estimations by gender

There was no significant difference in gender estimations of carbohydrate foods (P= 0.295). However, a higher proportion of female participants were able to estimate correctly (7.9 %) compared to males (3.0 %). No significant differences (P>0.05) were found between the number of participants who underestimated or overestimated carbohydrate among gender (Figure 4.6)

Figure 4.6: Overall carbohydrate estimation by gender

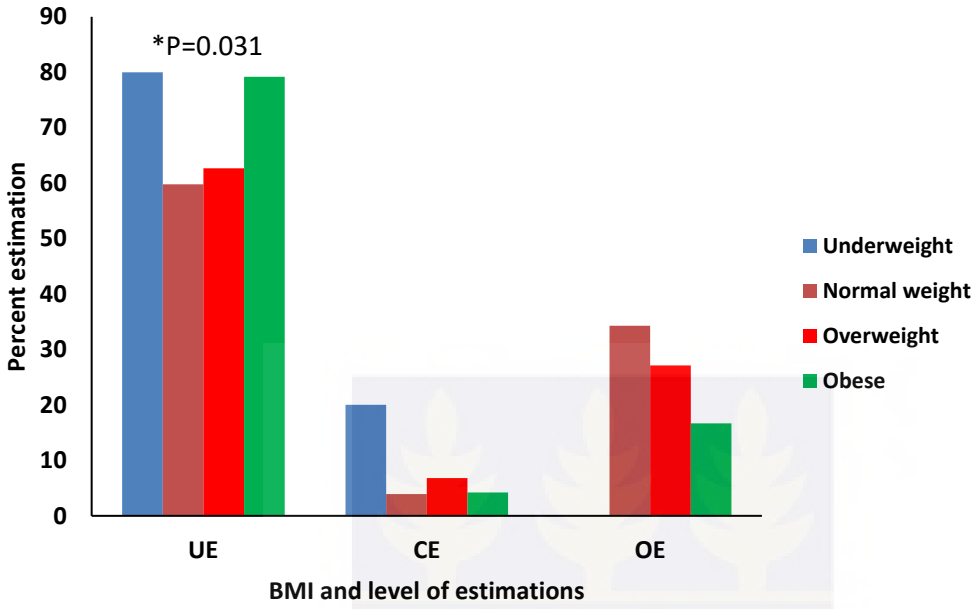


Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.2 Carbohydrate foods estimation by BMI categories

A significantly higher proportion (80.0%; P=0.031), of participants that were underweight underestimated portion sizes (Figure 4.7). However, the effects of the different BMI categories on participants' ability to correctly estimate or overestimate were not significant.

Figure 4.7: Participants' BMI and overall portion size estimation

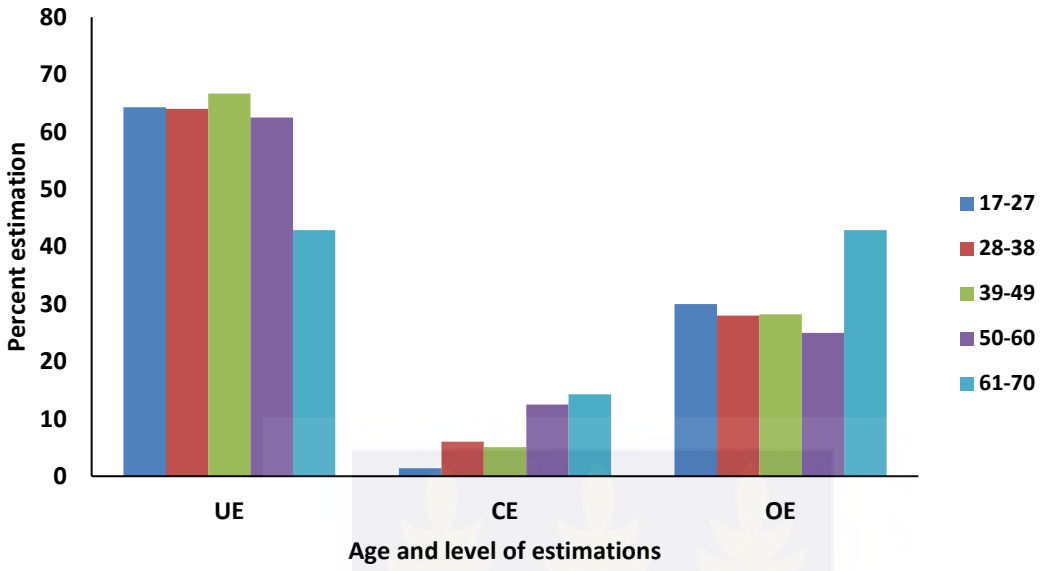


Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.3 Age assessment of carbohydrate foods estimation

Overall carbohydrate estimations by participants was not statistically significant for age (P=0.640). A high proportion, (66.7%), found within the 39-49 year range underestimated portion sizes of the carbohydrate food. Correct portion sizes estimation was observed in higher proportions of participants aged between 61-70 years. However, the age group of 61-70 years showed a higher proportion of overestimation. (Figure 4.8)

Figure 4.8: Age range of participants and portion size estimation

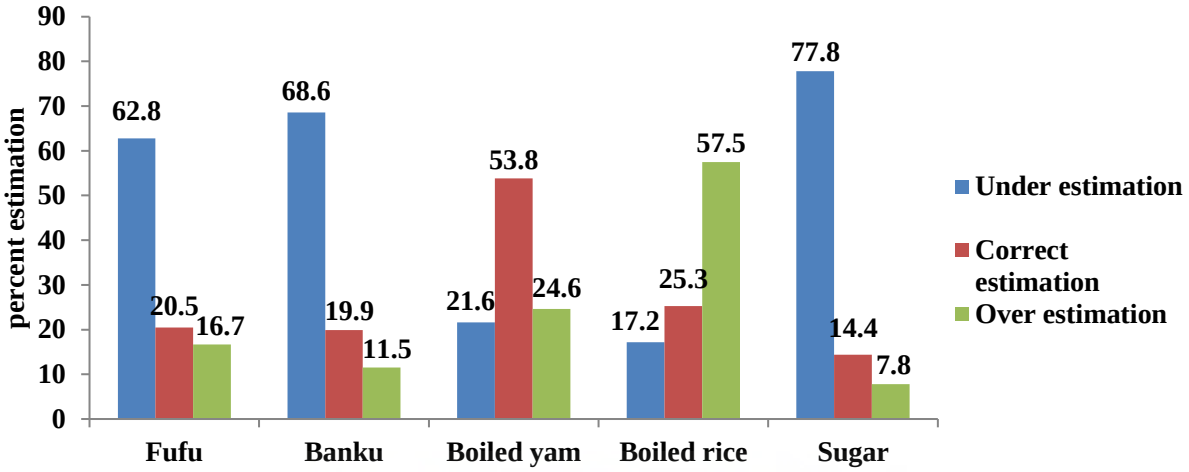


Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.4 Estimation of the types of carbohydrate foods identified

Presented in figure 4.9 is the estimation of portion sizes in fufu, banku, boiled yam and rice and sugar. Overall estimations of the different types of carbohydrate groups were not significant. Majority of the participants, 77.8%, underestimated the portion size of sugar, followed by banku (68.6%) and fufu (62.8%). Approximately fifty-four (53.8%) of the participants estimated the portion sizes of boiled yam correctly, followed by boiled rice (25.3%), fufu (20.5%) and banku (19.9%). Overestimation was greater in boiled rice (57.5%), followed by boiled yam (24.6%) and less in fufu (16.7%). (Figure 4.9)

Figure 4.9: Estimation of common carbohydrate food

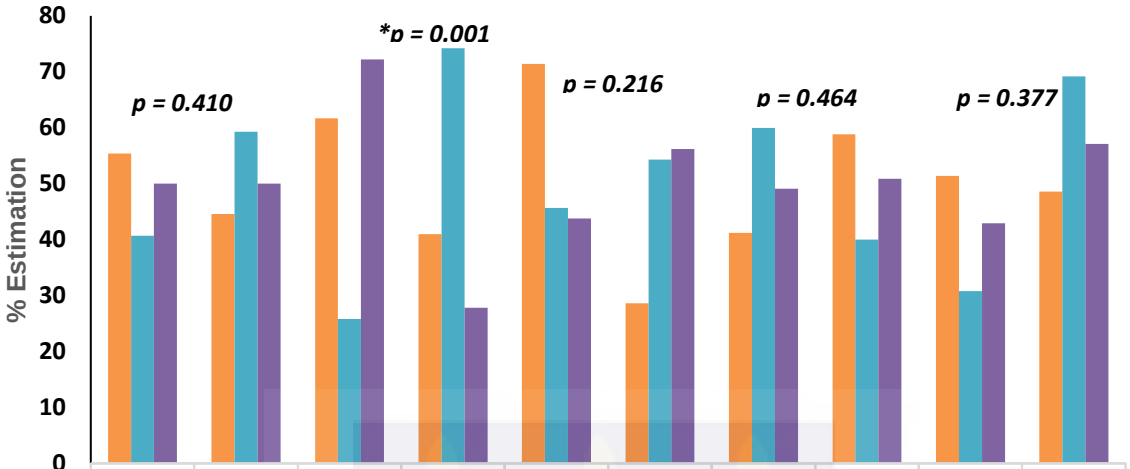


4.4.5 Gender related estimation of the different types of carbohydrate foods

Figure 4.10 shows gender specific estimation of portion sizes in some common carbohydrate foods. Except for the estimation of banku, the other estimations were not significantly different between genders (P> 0.05).

In estimating the portion sizes, higher proportion of males (55.4%) underestimated fufu compared to females (44.6%) whilst higher proportion of females (59.3%) correctly estimated fufu compared to the males (40.7%), however this was not statistically significant (P = 0.410). Among gender, a statistically significant higher proportion of females (74.2%) correctly estimated banku compared to males (25.8%) (P=0.001). Boiled yam on the other hand was underestimated by higher proportion of males (71.4%) compared to females (28.6%), whilst 60% of males correctly estimated boiled rice compared to females (40.0%) (P=0.464). Similarly, sugar was correctly estimated by 69.2% males and 30.8% females (Figure 4.10).

Figure 4.10: Gender specific estimation of the different types of carbohydrate foods



	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Fufu		Banku		Boiled yam		Boiled rice		Sugar	
UE	55.4	44.6	61.7	41	71.4	28.6	41.2	58.8	51.4	48.6
CE	40.7	59.3	25.8	74.2	45.7	54.3	60	40	30.8	69.2
OE	50	50	72.2	27.8	43.8	56.2	49.1	50.9	42.9	57.1

Pearson's Chi square: *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.6 BMI related estimation of the different types of carbohydrate foods

The BMI of the participants were not significantly associated with correct estimations of fufu (P=0.425), banku (P= 0.854), boiled yam (P= 0.818), boiled rice (P=0.275) and sugar (P=0.795). However, the highest proportion of participants who underestimated fufu and sugar (100%) were found among those with BMI <18.5 m/kg² (underweight category) with proportion 23.8% and 26.1% of overweight participants correctly estimating fufu and banku respectively. Although there was no statistically significant association between BMI of participants and correct estimation of boiled yam, a higher percentage (57.1%) of participants within the underweight category (<18.5 kg/m²) and 53.8% within the obese category (≥ 30 km/kg²) correctly estimated (Table 4.4). Higher proportion (66.7) of the participants within the normal weight category

overestimated boiled rice followed by 48.5% and 45.5% within the overweight and obese categories respectively.

Table 4.4: BMI specific estimations of the different types of carbohydrates foods

	BMI	N	Under estimation	Correct estimation	Over estimation	P-value
Fufu	Underweight	2	100	0.0	0.0	0.425
	Normal weight	69	56.5	20.3	23.2	
	Overweight	42	66.7	23.8	9.5	
	Obese	19	73.7	15.8	10.5	
Banku	Underweight	5	80	20	0	0.854
	Normal weight	86	70.9	17.4	11.6	
	Overweight	46	60.9	26.1	13	
	Obese	19	73.7	15.8	10.5	
Boiled yam	Underweight	2	0	100	0	0.818
	Normal weight	30	23.3	46.7	30	
	Overweight	21	19	57.1	23.8	
	Obese	12	25	53.8	24.6	
Boiled rice	Underweight	1	0.0	100	0	0.275
	Normal weight	54	11.1	22.2	66.7	
	Overweight	16	24.2	27.3	48.5	
	Obese	5	27.3	27.3	45.5	
Sugar	Underweight	1	100	0	0	0.795
	Normal weight	47	72.3	19.1	8.5	
	Overweight	33	81.8	12.1	6.1	
	Obese	9	88.9	0	11.1	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.7 BMI and gender evaluation of the different types of carbohydrate foods

The results presented in table 4.5 showed that correct estimation of fufu by both gender was not statistically associated with BMI. A higher proportion of overweight (69.6%) and obese (83.3%) males underestimated portion sizes of banku when compared to females. A significantly (p=0.047) higher proportion of overweight females correctly estimated portion sizes of yam (63.6%) compared to males ((40.0%)., Correct estimation was significantly higher among normal weight males (24.2%) compared to females (19.0%) for boiled rice (0.047). Over estimation of boiled rice by gender was higher in the females in both overweight (45.0%) and obese (50.0%) categories compared to the males. Sugar on the other hand was also highly underestimated by males in the overweight and obese categories. Among normal weight participants, more females (33.3%) than males (8.9%) correctly estimated portion sizes of banku (p=0.015) (Table 4.5)

In table 4.6, 78.3% and 65.0% malnourished males and females respectively underestimated portion size of fufu. Malnutrition, in this context, relates to individuals who are within the overweight and underweight categories. Banku was also highly underestimated by 74.2% malnourished males compared to females (59.0%). Similarly, sugar was also highly underestimated by 87.5% and 81.5% malnourished males and females respectively. However, 60.9% and 58.3% malnourished females and males correctly estimated portion sizes of boiled yam respectively (Table 4.6). Significant overestimation of boiled rice was observed in the malnourished females (P=0.044).

Table 4.5: BMI and gender specific estimations of the different types of carbohydrates foods

			% Estimation			
	BMI	**Gender**	**UE**	**CE**	**OE**	**P-value**
Fufu	Underweight	Male	1 (100)	0 (0.0)	0 (0.0)	-
		Female	1 (100)	0 (0.0)	0 (0.0)	
	Normal weight	Male	28 (62.2)	8 (17.8)	9 (20.0)	0.425
		Female	11 (45.8)	6 (25.0)	7 (29.2)	
	Overweight	Male	13 (72.2)	3 (16.7)	2 (11.1)	0.636
		Female	15 (62.5)	7 (29.2)	2 (8.3)	
	Obese	Male	4 (100)	0 (0.0)	0 (0.0)	0.405
		Female	10 (66.7)	3 (20.0)	2 (13.3)	
Banku	Underweight	Male	2 (100)	0 (0.0)	0 (0.0)	0.361
		Female	2 (66.7)	1 (33.3)	0 (0.0)	
	Normal weight	Male	43 (76.8)	5 (8.9)	8 (14.3)	**0.015**
		Female	18 (60.0)	10 (33.3)	2 (6.7)	
	Overweight	Male	16 (69.6)	3 (13.0)	4 (17.4)	0.12
		Female	12 (52.2)	9 (39.1)	2 (8.7)	
	Obese	Male	5 (83.3)	0 (0.0)	1 (16.7)	0.405
		Female	9 (69.2)	3 (23.1)	1 (7.7)	
Boiled yam	Underweight	Male	0 (0.0)	2 (100)	0 (0.0)	-
		Female	0 (0.0)	2 (100)	0 (0.0)	
	Normal weight	Male	6 (28.6)	9 (42.9)	6 (28.6)	0.580
		Female	1 (11.1)	5 (55.6)	3 (33.3)	
	Overweight	Male	4 (40.0)	5 (50.0)	1 (10.0)	**0.047**
		Female	0 (0.0)	7 (63.6)	4 (36.4)	
	Obese	Male	0 (0.0)	2 (100)	0 (0.0)	0.424
		Female	3 (30.0)	5 (50.0)	2 (20.0)	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

Table 4.5 continued: BMI and gender specific estimations of the different types of carbohydrates foods

Carbohydrate food	BMI	Gender	% Estimation			p-value
			UE	CE	OE	
Boiled rice	Underweight	Male	0 (0.0)	1 (100)	0 (0.0)	0.580
		Female	0 (0.0)	1 (100)	0 (0.0)	
	Normal weight	Male	5 (15.2)	8 (24.2)	20 (60.6)	**0.047**
		Female	1 (4.8)	4 (19.0)	16 (76.2)	
	Overweight	Male	2 (15.4)	4 (30.8)	7 (53.8)	0.424
		Female	6 (30.0)	5 (25.0)	9 (45.0)	
	Obese	Male	0 (0.0)	2 (66.7)	1 (33.3)	0.216
		Female	3 (37.5)	1 (12.5)	4 (50.0)	
Sugar	Underweight	Male	1 (100)	0 (0.0)	0 (0.0)	0.227
		Female	1 (100)	0 (0.0)	0 (0.0)	
	Normal weight	Male	22 (81.5)	3 (11.1)	2 (7.4)	0.794
		Female	12 (60.0)	6 (30.0)	1 (10.0)	
	Overweight	Male	11 (84.6)	1 (7.7)	1 (7.7)	0.571
		Female	16 (80.0)	3 (15.0)	1 (5.0)	
	Obese	Male	2 (100)	0 (0.0)	0 (0.0)	0.377
		Female	6 (85.7)	0 (0.0)	1 (11.1)	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

Table 4.6: Gender and BMI association with carbohydrate food estimations

	Gender	BMI	UE	CE	OE	P-value
Fufu	Male	Normal	28 (62.2)	8 (17.8)	9 (20.0)	0.369
		Malnourished	18 (78.3)	3 (13.0)	2 (8.7)	
	Female	Normal	11 (45.8)	6 (16.2)	7 (29.2)	0.125
		Malnourished	26 (65.0)	10 (25.0)	4 (10.0)	
Banku	Male	Normal	43 (76.8)	5 (8.9)	8 (14.3)	0.963
		Malnourished	23 (74.2)	3 (9.7)	5 (16.1)	
	Female	Normal	18 (60.0)	10 (33.3)	2 (6.7)	0.986
		Malnourished	23 (59.0)	13 (33.3)	3 (7.7)	
Boiled yam	Male	Normal	6 (28.6)	9 (42.9)	6 (28.6)	0.385
		Malnourished	4 (33.3)	7 (58.3)	1 (8.3)	
	Female	Normal	1 (11.1)	5 (55.6)	3 (33.3)	0.918
		Malnourished	3 (13.0)	14 (60.9)	6 (26.1)	
Boiled rice	Male	Normal	5 (15.2)	8 (24.2)	20 (60.6)	0.465
		Malnourished	2 (11.8)	7 (41.2)	8 (47.1)	
	Female	Normal	1 (4.8)	4 (19.0)	16 (76.2)	**0.044**
		Malnourished	9 (32.1)	6 (21.4)	13 (46.4)	
Sugar	Male	Normal	22 (81.5)	3 (11.1)	2 (7.4)	0.853
		Malnourished	14 (87.5)	1 (6.2)	1 (6.2)	
	Female	Normal	12 (60.0)	6 (11.1)	2 (10.0)	0.227
		Malnourished	22 (81.5)	3 (11.1)	2 (7.4)	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.8 Evaluation of the different carbohydrate foods by age ranges

Apart from sugar which had a significant proportion of participants within the age range of 39 to 49 years underestimating portion sizes (P=0.041; 93.8%), all other estimations were within age ranges were not statistically significant. Although not significant, a higher proportion of participants, (69.0%) within the age range of 39 to 49 years underestimated portion size of fufu followed by those within 50 to 60 years and 17 to 27 years indicated by 62.5% and 61.7% respectively. Similarly, higher proportion (75.0%) within the age range of 39 to 49 years underestimated portion size of banku compared to the other age ranges. Boiled yam on the other hand was estimated correctly by higher proportion (66.7%) of participants within the age range of 39-49 years followed by those within 17 to 27 years and 28 to 38 years as indicated by 47.1% and 42.9% respectively. Boiled rice was highly overestimated by the participants with the 61 to 70-year range (100%) and 17 to 27-year range (65.2%). (Table 4.7)

Table 4.7: Age specific estimations of the different types of carbohydrates foods

	Age	N	UE	CE	OE	P-value
Fufu	17-27	47	61.7	25.5	12.8	0.913
	28-38	36	58.3	22.2	19.4	
	39-49	29	69.0	13.8	17.2	
	50-60	16	62.5	18.8	18.8	
	61-70	4	75	0.0	25	
Banku	17-27	57	68.4	22.8	8.8	0.193
	28-38	40	68.4	22.8	8.8	
	39-49	32	75	10	15	
	50-60	21	71.9	15.6	12.5	
	61-70	6	50	16.7	33.3	
Boiled yam	17-27	17	29.4	47.1	23.5	0.694

	28-38	14	35.7	42.9	21.4	
	39-49	15	6.7	66.7	26.7	
	50-60	15	20	53.3	26.7	
	61-70	4	0	75	25	
Boiled rice	17-27	46	15.2	19.6	65.2	0.226
	28-38	24	12.5	25	62.5	
	39-49	15	20	40	40	
	50-60	11	36.4	36.4	27.3	
	61-70	3	0	0	100	
Sugar	17-27	41	63.4	22	14.6	**0.041**
	28-38	26	92.3	7.7	0	
	39-49	16	93.8	0	6.2	
	50-60	7	71.4	28.6	0	
	61-70	0	0	0	0	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

4.4.9 Evaluation of the different carbohydrate foods by age ranges and gender

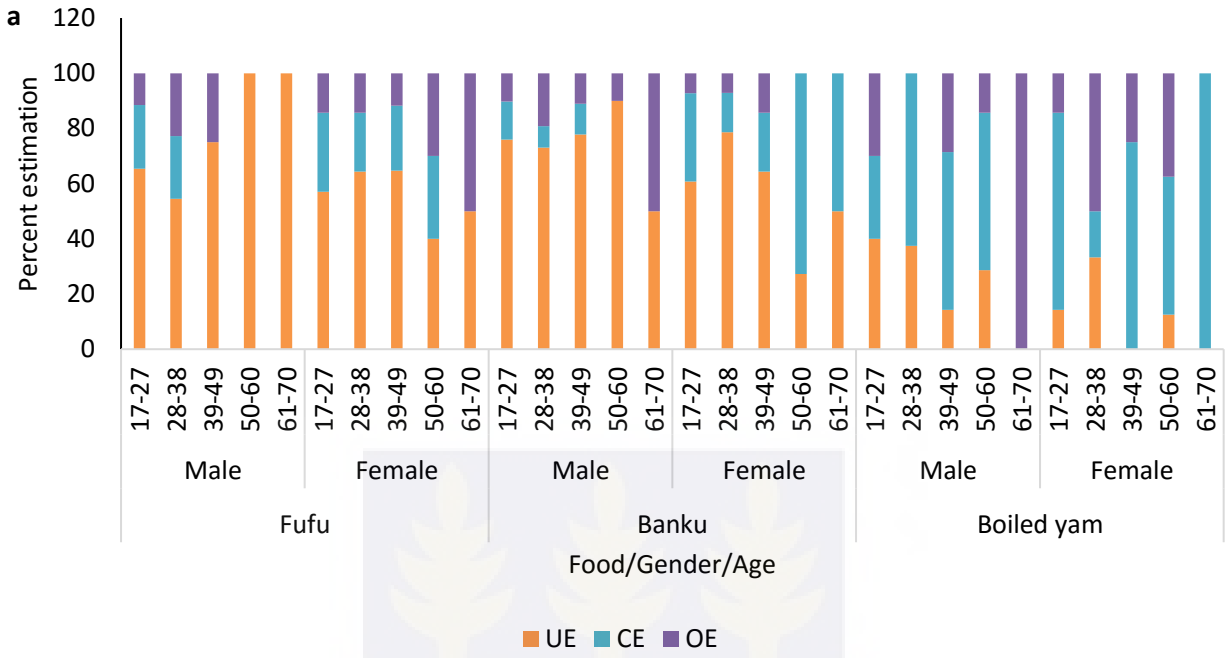
Among the age range of participants, all males within the age range 50 to 60 years and 61 to 70 years underestimates portion sizes compared to females in the same years range. The males within the age range 39 to 49 years and females within the age range of 28 to 38 years highly underestimated portion size of banku compared to the other age ranges. Boiled yam on the other hand was estimated correctly by higher proportion (62.8%) of male participants within the age range of 28 to 38 years and females (75.0%) within the age range of 39 to 49 years (Figure 4.11a).

Boiled rice was highly overestimated by the male (100%) and female (100%) participants with the 61 to 70-year range followed by 17 to 27-year range (68.2%) for males and 28 to 38 year

range for females. Underestimation of sugar was seen among a statistically significant percentage (P=0.041; 100%) of female participants within the 28 to 38-year range compared the males of same age range (Figure 4.11b).

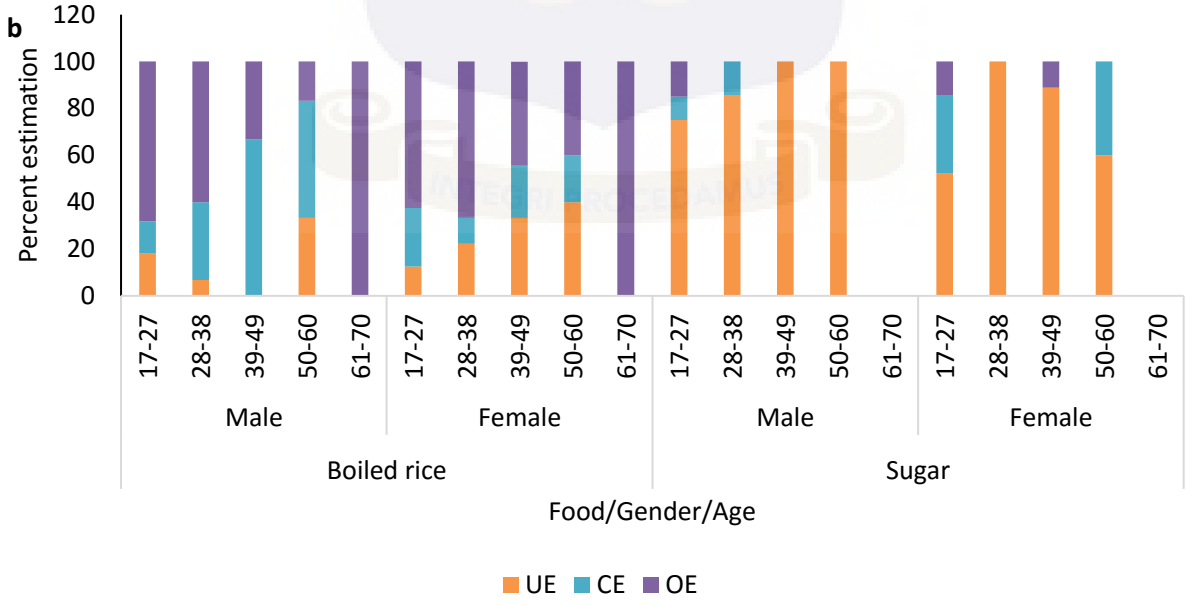
Table 4.8 shows that higher proportion of young adult (76.9%) and older adult (55.2%) males underestimated portion size of fufu with no significant association (P = 0.231). Young adults refers to participants within the age bracket of 17 – 49 years, and older adults within the ages of 50 – 70 years. Similarly, higher proportion of young and older adult males underestimated portion size of banku with no significant association for young adult (P = 0.059) but significant for old adults. Portion size of boiled yam was correctly estimated by 54.5% young females and 70.0% old females with no significant association. Boiled rice on the other hand was overestimated by 62.2% young adult females and 70.8% older adult males. Approximately 83% and 84% of young and older adult males underestimated portion size of banku with no significant association (Table 4.8).

Figure 4.11(a) Age and gender specific estimations of the different types of carbohydrates foods



Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

Figure 4.11(b) Age and gender specific estimations of the different types of carbohydrates foods



Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

Table 4.8: Age and gender specific estimations of the different types of carbohydrates foods

	Age categories	Gender	UE	CE	OE	P-value
Fufu	Young Adult	Male	30 (76.9)	5 (12.8)	4 (10.3)	0.231
		Female	28 (59.6)	11 (23.4)	8 (17.0)	
	Old Adult	Male	16 (55.2)	6 (20.7)	7 (24.1)	0.756
		Female	9 (52.9)	5 (29.4)	3 (17.6)	
Banku	Young Adult	Male	40 (75.5)	5 (9.4)	8 (15.1)	0.059
		Female	29 (61.7)	13 (27.7)	5 (10.6)	
	Old Adult	Male	26 (76.5)	3 (8.8)	5 (14.7)	0.003
		Female	12 (54.5)	10 (45.5)	0 (0.0)	
Boiled yam	Young Adult	Male	7 (35.0)	7 (35.0)	6 (30.0)	0.36
		Female	4 (18.2)	12 (54.5)	6 (27.3)	
	Old Adult	Male	3 (23.1)	9 (69.2)	1 (7.7)	0.14
		Female	0 (0.0)	7 (70.0)	3 (30.0)	
Boiled rice	Young Adult	Male	3 (11.5)	12 (46.2)	11 (42.3)	0.12
		Female	6 (16.2)	8 (21.6)	23 (62.2)	
	Old Adult	Male	4 (16.7)	3 (12.5)	17 (70.8)	0.44
		Female	4 (22.2)	5 (13.9)	23 (63.9)	
Sugar	Young Adult	Male	20 (83.3)	2 (8.3)	2 (8.3)	0.668
		Female	25 (73.5)	5 (14.7)	4 (11.8)	
	Old Adult	Male	16 (84.2)	2 (10.5)	1 (5.3)	0.274
		Female	9 (69.2)	4 (30.8)	0 (0.0)	

Pearson Chi-Square *Statistically significant at P<0.05; CE: Correct estimation; UE: underestimation; OE: Overestimation

CHAPTER 5

5.0 DISCUSSION

5.1 General profile of the participants

5.1.1 Demographics

Although the distribution of male participants (53.2%; 101) in the study as compared to the study carried out in Accra by Peprah Boateng (2014) (49.6%; 401) was higher, they were comparable due to the smaller sample size in this study. However there is a slightly higher male population (50.6%; 36,500) in the entire Upper Manya Krobo District as compared to the female population (49.4%; 35,592). Majority of the study population were in their youthful years and had some level of formal education thus had a fair knowledge and understanding of the purpose of the study when explained to them by the researcher.

5.1.2 Anthropometric measurement

The females showed higher weight than the males. Similarly mean BMI for the females was higher than that of males indicating that the average female among the study participant was overweight and the average male was within the normal range of BMI. Obesity was observed in a greater proportion of females as compared to their male counterparts. Participants within the age group of 18 – 28 years reported the highest number of normal weight individuals as well as overweight individuals. Birirtwum, Gyapong, & Mensah (2005) reported in their study that obesity trends were highest in the Greater Accra region as compared to the other regions in the country, and this could have accounted for the differences in the mean BMI of this study which recorded an average of 24.94 kg/m² in relation to the study done in Accra by Peprah Boateng (2014) of an average BMI of 26.14 kg/m².

5.2 Common carbohydrates foods consumed by the participants

The Ghanaian diet is mainly composed of carbohydrate based foods; starchy roots (43%) and cereals excluding beers (29%) providing almost three- quarters (72%) of the daily energy expenditure (FAO, 2009).This huge contribution of carbohydrates in the daily energy supply (DES) of Ghanaians indicates the important role starchy roots and cereals play in the Ghanaian diet. Although according to (FAO, 2009) sugar contributes only 3% of DES it has been linked to the incidence of NCD's and therefore its inclusion in the collation of the common carbohydrate foods (FAO, 2009). The study identified Banku, Fufu, boiled rice, boiled yam and Sugar (granulated) as commonly consumed carbohydrate foods. The foods identified vary from the study conducted in Accra where a larger pool of carbohydrate foods was used. This is indicative of varied tastes of the sampled population. In comparison to the study that was done in Accra, the foods that were considered as commonly consumed carbohydrates foods made up 5% or more of the frequency of the total carbohydrate foods consumed within the three day 24-hour recall.

5.3 Overall estimation of carbohydrate food

Accurate information about intake of individuals and populations is particularly difficult to obtain; it is usually reliant upon self-report and can be subject to large errors. Currently, it has been observed that people can estimate healthy portion sizes either by using serving size information printed on food packages or by making visual comparisons with various objects. Unfortunately, both methods present problems for low literacy populations (Gibson *et al.*, 2016). The other option will be for people to determine portion sizes by associating food portions with visual aids recommended by registered dietitians (Brrd-Bredbenner & Schwartz , 2004). In Ghana, household measurement aids are the dietary aids of choice in portion size estimation by

dietitians and nutrition-related professionals. An overall correct estimation of foods has been reported in other studies to range from 40% to 70% (Lazarte C. , 2013, Nelson *et al.*, 1994). The findings in this study shows that a statistically significant number of participants (63.7%) underestimated portion sizes, with 28.9% overestimating and 5.3% correctly estimating (P< 0.0001). This outcome is contrary to the findings of the study done in Accra by Peprah Boateng (2014) which showed that a statistically significant number of participants (54.17%) correctly estimated their portion sizes, with 29.16% underestimating and 16.67% overestimating with a P-value of *0.003.* The difference between the results from the two studies may lie in the fact that this study relied on the participants' ability to recall portion sizes with household measures against the food photographic atlas which is in contrast to that of Peprah Boateng (2014) where the actual foods were present for participants to pick from. The differences furthermore highlight the findings of Subar *et al.*, (2010), that portion size estimation is affected by perception, conceptualization and memory. Perception refers to one's ability to relate an amount of food present in reality to the amount of the same food presented by the portion-size aid. Conceptualization can be defined as the ability to create a mental picture of a food portion which may not be present by the aid of a portion size estimation tool, and is dependent on memory. Memory is one's ability to recall accurately the amount of food eaten over a period of time (Subar *et al.*, 2010)

Ovaskainen *et al.*, (2008) also reported a 50% correct estimation in their study. However, in contrast with the study results, Ovaskainen *et al.*, (2008) claimed a tendency for subjects to overestimate more than underestimate. Studies by Hernandez *et al., (*2006), Turconi *et al.*, (2005) and Frobisher & Maxwell, (2003) recorded a higher level of overestimates than underestimation.

5.3.1 Gender and carbohydrate food estimations

According to this current study overall underestimation by males although not statistically significant (66.3%), was higher than females (60.7%), confirming studies by Ovaskainen *et al.*, (2008) and Nelson *et al.*, (1994) who also claimed in their studies that men tend to underestimate food portions when compared to women. Although males (29.7%) in this study had a tendency to overestimate more than females (28.1%), this was also statistically insignificant. This, however, conforms to a study by Burger *et al.*, (2007) who claimed that overestimation of certain foods is seen more in males than females.

Ovaskainen *et al.*, (2008), observed that, significantly higher proportion of females correctly estimated food portions. This is somewhat similar to the finding in this study, where 7.9% of the females correctly estimated the food portions compared to the 3.0% of males. This can be attributed to females' experience in cooking resulting in a better knowledge of food items and portion sizes. The Ghanaian female subjects' knowledge in shopping and cooking obviously may have had an effect on their ability to correctly estimate portion sizes of a variety of foods. Males on the other hand, in a typical Ghanaian society are served their meals; hardly go grocery shopping and rarely cook. These may have contributed to their reduced ability to correctly estimate portion size (Peprah Boateng, 2014).

The study results also showed underestimation of bigger portions of foods by a higher proportion of male and female participants except for banku and sugar. Among gender, a statistically significant higher proportion of females (74.2%) correctly estimated banku compared to males (25.8%) (P=0.001). Boiled yam on the other hand was underestimated by higher proportion of males (71.4%) compared to females (28.6%), whilst 60% of males correctly estimated boiled

yam compared to females (40.0%). A significantly higher proportion of males either underestimated or overestimated banku and fufu. The different sizes in which these foods are molded might have contributed to the poor estimations by males because males usually do not cook or serve themselves; these foods are usually cooked and served as one big portion by females.

5.3.2 Body Size and estimation of portion size

The current study showed that BMI categories were not significantly associated with correct estimations and under estimations of all carbohydrate foods. Underestimation was identified among a statistically higher proportion (80%, $P<0.05$) of underweight participants (BMI < 18.5 kg/m^2) when compared to the other BMI categories. In comparison to the study carried out in Accra by Peprah Boateng (2014) there was also no statistical significance in correct and under estimations of carbohydrate foods based on BMI categories, however a record of a significantly higher proportion of obese participants overestimated. Contrary to results of this study, findings from other studies such as Okubo & Sasaki (2004) reported an association between BMI and portion size estimated or consumed stating that obese participants highly underestimated portion sizes. Wasink (2007) in his book, wrote that even people of normal weight underestimate their food intake by about 20 per cent and those who are overweight, can underestimate what they eat by more than 50 per cent. The reason he gave was that it was possible for people to be easily fooled into consuming more than they believe they have eaten due to what he termed as 'portion creep' which simply refers to the gradual increase of food portion sizes over the years. This might somewhat account for the higher underestimation (79.2%) among obese participants. Correct estimation although not significantly related to food portion sizes, was higher in underweight (20.0%) participants followed by overweight participants (6.8%). According to

Lara, Scott, & Lean, (2004) overweight people may possibly under-report food recall over and over again to avoid feeling embarrassed. Vinai (2011) asserted that overweight and obese individuals were inclined to underestimate their portion sizes more than normal weight people. Although from the present study results, overall estimation of carbohydrate foods was not significantly dependent on BMI, the higher proportion of overweight (3.9%) and obese (4.2%) people correctly estimated food portions.

In assessing participants BMI specific estimation of the different carbohydrate foods in the study, obese females tended to underestimate fufu as did normal weight males. An equal proportion (100%) of males to females underestimated portion sizes of fufu with no statistical significance. Contrarily to the study results, some previous studies indicated that underweight individuals had the inclination to overestimate their food intake as indicative of patients with anorexia nervosa (Vinai, 2011). These participants tend to unusually exaggerate their food intake (Milos *et al.,* 2012) due to their reported weight problems.

Male participants within all BMI categories in this study exhibited a higher percentage of underestimation of fufu and banku with the exception of boiled yam, boiled rice and sugar where portion sizes were overestimated. In the obese (≥30 kg/m2) category, when compared to females however, this was not statistically significant. The male participants' underestimation of portion sizes may be because males have been known to consume more food than females (Jeffrey *et al.,* 2007) and so they perceived the actual portion size presented as small when compared to their female counterparts.

5.3.3 Age and food portion size estimation

Findings form the study shows higher proportion of participants aged between 61 to 70 years to correctly estimated portion sizes. Participants with this age range have probably had a longer period to either grocery shop, cook, serve food or observe these actions being done as stated by Ovaskainen *et al.*, (2008). Least correct estimation was found among participants aged 17 to 27 years. Participants aged 61-70 years old in this study highly overestimated portion sizes. This conforms with a study by Nelson *et al.,* (1996) who concluded that portion size overestimation on average was significantly higher for over 65year old men. Over estimation and underestimations were not significant statistically.

Underestimation of sugar was seen among a statistically significant percentage (P=0.041; 100%) of female participants within the 28 to 38-year range. This is because it is said that women have higher cravings to sugar and sugary products such as chocolates and pastries whereas men would rather choose meat and meat products over sugary products (Wiseman, 2010).

CHAPTER 6

6.1 Conclusion

The demographic profile showed more males than females across the ages of 1 to 70 years with majority of the participants aged between 18 – 38 years. Majority of the participants had middle/Junior secondary school education. Forty-nine percent of participants had monthly income below two hundred Ghana cedis (₵200). Anthropometric measures showed a higher population within overweight and obesity category representing 31.1% and 12.6% respectively. Obesity was prevalent among participants within the age brackets of 61-70 years (28.5%) and 39-49 years (25.6%).

The study identified Banku, Fufu, boiled rice, boiled yam and Sugar (granulated) as commonly consumed carbohydrate foods. Portion size estimation of these carbohydrate foods using the photographic food atlas and the household measures showed an overall correct estimation of 5.3%, under and overestimation of 63.7% and 28.9% respectively.

Gender showed no significant effect on portion size estimation although more females did estimate carbohydrate food correctly compared to the males.

The effects of the different BMI categories on participants' ability to correctly estimate or overestimate were not significant. However, significant effect of BMI on underestimation of portion size in some foods was observed.

Age association showed no significant effect on portion size estimation of carbohydrate food.

6.2 Limitations

A number of factors that could not have been effectively controlled during the study may have had an effect on a participant's ability to correctly estimate portion sizes, hence the resulting differences in portion size estimations.

These factors include:

- Participants reported that they had difficulty in estimating portion sizes of some of the foods in the photographic atlas because the pictures were not clear.
- The use of household measures in estimating portion sizes of some carbohydrate foods were different to the type used in the food photographic atlas.

6.3 Recommendations

The following recommendations to be made:

1. The pictures of portion sizes should be clear enough to make correct estimations.
2. The household measure used in the portion sizes of the study should correspond to household measures used in the development of the photographic food atlas.
3. The food photographic atlas should be used together with the house hold measuring aids in diet counseling.
4. In order to help curb the rising NCDs in Ghana, appropriate portion size education should be incorporated into nutrition intervention programs.

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APPENDIX 1

Research Participant Information Sheet

DEPARTMENT OF NUTRITION AND DIETETICS

SCHOOL OF ALLIED HEALTH SCIENCES

COLLEGE OF HEALTH SCIENCES UNIVERSITY OF GHANA

Title of study: "A comparative study between house hold measures and food photographic atlas in dietary assessment in a rural area in Ghana"

Kate Opoku, MSc. Student and Dr. Gladys Peprah Boateng of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences are conducting a research project titled "A comparative study between house hold measures and food photographic atlas in dietary assessment in a rural area in Ghana." The main aim of the study is for participants to provide a 3 day dietary history using house hold measures and identify their food portions from the food photographic atlas. The information will then be used to analyze the nutrient intakes of participants using these two methods.

We would like to invite you to participate in this study. This study is not expected to cause any medical or social risk to you. The information gathered will be kept strictly confidential and any reports of the findings of this research will not contain your name or any other identifying information. Your participation in this project is completely voluntary. If at any time you wish to withdraw from this research, you may do so without coercion or prejudice. Just inform any of the researchers. Once the study is completed, the analyzed findings would be available to you upon

request. Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researchers or research advisors.

Dr. Gladys Peprah Boateng on telephone number: 024-4265-4436: email-nitramharpep@yahoo.com

APPENDIX II

Research Participant Informed Consent Form

DEPARTMENT OF DIETETICS

SCHOOL OF ALLIED HEALTH SCIENCES

COLLEGE OF HEALTH SCIENCES UNIVERSITY OF GHANA

I …… understand that my participation in this study is strictly voluntary and I may discontinue my participation at any time without prejudice. I understand that the purpose of this study is to provide a 3 day dietary history using house hold measures and identify food portions from the food photographic atlas, which will be used in analyzing nutritional intakes. I further understand that any information about me that is collected during this study will be held in the strictest confidence and will not be part of my permanent record. I understand that in order for this research to be effective and valuable, some demographic information will need to be collected. I also understand that the strictest confidentiality will be maintained throughout this study and that only the researchers will have access to information that I supply on surveys or in interviews. I understand that at the conclusion of this study all records will be destroyed. I am aware that I will not be waiving my or any legal or human rights by agreeing to this participation. By signing below, I verify that I am 18 years of age or older, in good mental and physical condition, and that I agree to and understand the conditions listed above.

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Participant's Signature Date

---------- ----------

Witness's Signature Date

APPENDIX III

Socio-economic Demographic Information

Participant's ID: _____ Date: _____

	DEMOGRAPHIC INFORMATION	RESPONSE
1	Gender	Male ☐ Female ☐
2	Date of Birth	
3	Current Marital Status	Never married ☐ Married/ Co-habiting ☐ Separated/ Divorced ☐ Widowed ☐
4	What is your highest level of education?	None ☐ Middle/ Junior Secondary School ☐ Senior Secondary School ☐ Post-Secondary/ Tertiary Level ☐
5	Over the past year, what has been your average monthly income?	< GH ₵200.00 ☐ GH ₵200.00 to GH ₵500.00 ☐ GH ₵500.00 to GH ₵1000.00 ☐ GH ₵1000.00 > ☐
6	Recorded Height	
7	Recorded Weight	
8	Calculated BMI	

APPENDIX IV

Dietary History Form

Please record all food, drink, vitamin, mineral/ supplemental intake using specific amounts with product brands for the next three (3) days. Include at least one (1) weekend day if possible.

Day 1:

Participant's ID: _____ Day/Date: _____

Gender: Male☐ Female☐ Age: _____

Meal/ Snack	Food Item	Amount (in handy measures)	Corresponding amount in food atlas	Estimation
Breakfast/ morning				
Mid-morning				
Lunch/ Afternoon				
Mid-afternoon				
Supper				
Before Bedtime				
supplements				

Day 2:

Participant's ID: _____ Day/Date: _____

Gender: Male☐ Female☐ Age: _____

Meal/ Snack	Food Item	Amount (in handy measures)	Corresponding amount in food atlas	Estimation
Breakfast/ morning				
Mid-morning				
Lunch/ Afternoon				
Mid-afternoon				
Supper				
Before Bedtime				
supplements				

Day 3:

Participant's ID: _____ Day/Date: _____

Gender: Male☐ Female☐ Age: _____

Meal/ Snack	Food Item	Amount (in handy measures)	Corresponding amount in food atlas	Estimation
Breakfast/ morning				
Mid-morning				
Lunch/ Afternoon				
Mid-afternoon				
Supper				
Before Bedtime				
supplements				