THE DEVELOPMENT OF A PHOTOGRAPHIC FOOD ATLAS WITH PORTION SIZES OF COMMONLY CONSUMED CARBOHYDRATE FOODS IN ACCRA, GHANA

By

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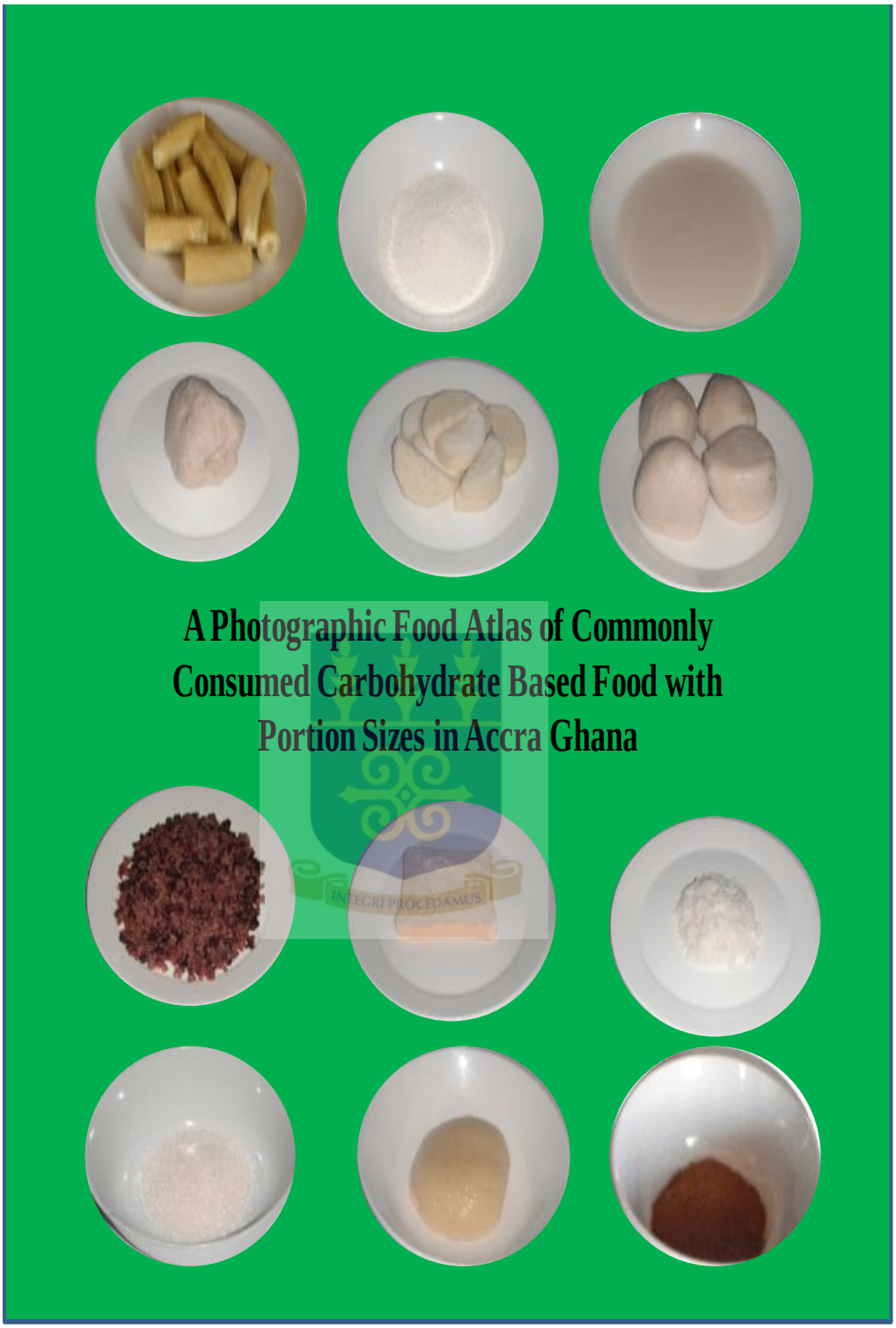
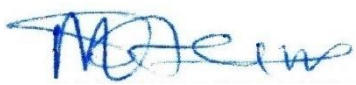


DECLARATION

I hereby declare that this thesis is the result of my own work carried out at the School of Allied Health Sciences, University of Ghana, under the supervision of Prof. Matilda Steiner Asiedu, Prof. F. K. Salia and Dr. Matilda Asante. All references to other people's work have been duly acknowledged.



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DEDICATION

I dedicate this work to the memory of my late parents, Robert Kwasi Martin-Peprah and Comfort Martin-Peprah, My husband Yaw Acheampong Boateng, my children Angela Akua Amoanimaa Boateng, Alberta Abena Serwaa Boateng and Patrick Onike Duose and all my siblings, especially my brother Richard Kwame Peprah.

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ABSTRACT

THE DEVELOPMENT OF A PHOTOGRAPHIC FOOD ATLAS WITH PORTION SIZES OF COMMONLY CONSUMED CARBOHYDRATE FOODS IN ACCRA GHANA

Background: The photographic food atlas, a portion size measurement aid has been used to estimate, quantify, educate and counsel on appropriate food portions to help improve dietary intake, and achieve a healthy change. Consumption of larger portion sizes is associated with increases in non-communicable diseases (NCDs), however; most people do not know what makes up a portion. NCDs are on the increase in Ghana. A photographic food atlas with portions sizes of commonly consumed foods in Ghana is needed to help educate and improve on portion sizes in order to control the increase risk of NCDs in Ghana.

Aim: The aim of this study was to identify commonly consumed carbohydrate based foods in Accra, Ghana, and to produce and validate a photographic food atlas with portion sizes based on gender, age and BMI.

Method: A three phased cross-sectional study was employed. This consisted of identifying, collating and categorizing commonly consumed and most commonly consumed carbohydrate foods (phase 1), developing a photographic food atlas based on data collected (phase 2) and estimating randomly selected cooked portions of most commonly consumed carbohydrate foods from the developed photographic food atlas in a pilot and a major part (phase 3). The study involved eight hundred and eight (808) participants in the first phase, fifty (50) males and females of equal distribution in the

pilot and two hundred and eighty (280) participants in the major phase. The study took place in three hundred and eighty four (384) conveniently selected households from thirty (30) randomly selected suburbs in the five (5) metropolitan areas of the four (4) income zones in the Greater Accra Region. Socio-demographic information, carbohydrate consumption, recipe collation for the first phase of the study were obtained through pretested questionnaires, three day food diaries, recipe booklets, a recipe book and on-line recipes. The commonly consumed carbohydrate foods identified were cooked in portions of between one (1) and eight (8), weighed, plated, coded, coloured photographed, cropped, captured on A-4 sheets and ring bound into a photo album. The most commonly consumed foods identified from the commonly consumed carbohydrate foods were captured in photo series.

Results: Ninety one (91) common carbohydrate foods made up of 70.3% grain and cereal group, 24.2% roots, tubers and plantain group and 5.5% of beverage and sugar group were collated. The developed photographic food atlas contained twenty four (24) foods in single portions, four (4) in portions of two (2) and sixty two (62) foods in portions of eight (8). Six thousand seven hundred and twenty (6720) estimations were made. Overall, a significantly higher proportion of participants (54.17%; (P=0.03) were able to make correct estimation of portion sizes using the food atlas. On the whole gender ($P=0.001$) and age ($P=0.018$) were positively linked to estimations with a higher proportion of females (54.48%) and participants within 55-64 age range (58.13%) better at estimation. The ability of males to correctly estimate portion sizes was affected by age ($P=0.024$). Being of a body mass indexes (BMI) of >30 kg/m² was statistically linked to overestimation ($P=0.027$). However as a group, BMI had no statistical significance on portion size estimation.

Conclusion: Generally, participants were able to estimate portion sizes correctly. Estimation was significantly affected by age and gender. However, females were better able to estimate portion sizes

than males. The results from this study suggest that the developed photographic food atlas can be used to assess portions of commonly consumed carbohydrate foods in Ghana.

APPENDICES

LIST OF TABLES

FIGURES

CHAPTER ONE

1.0 INTRODUCTION

The photographic food atlas is a single bound volume of picture compilations of commonly consumed foods specific to a particular location and usually captured in portions of three (3) to eight (8). It may also contain pictures of household measures such as cups, plates, spoons and cans of varying sizes (Turconi *et al.*, 2005; Nelson and Haraldsdottir, 1998a; Food Safety Bulletin, 1997). The photographic food atlas has been used to estimate portion sizes of foods consumed during dietary assessments (Ovaskainen *et al*., 2008), to teach portion sizes of commonly consumed foods (Marjan, 1995) and to help improve dietary intake as well as help people understand the importance of healthy dietary practices in achieving appropriate change (Small *et al.* 2009).

A portion according to Nelson and Haraldsdottir (1998a) is the amount of food that one chooses to eat at a sitting and the selected portion may be smaller or larger than the standardized serving of the food. Portion sizes which help quantify food and nutrients intake during dietary assessment (Foster *et al.*, 2008), is an indispensable aspect in nutrition and health promotion. Unfortunately, most people do not know what makes up a portion (American Institute for Cancer Research, 2000) and this has been linked to their inability to control how much they eat (Byrd-Bredbenner and Schwartz, 2004). According to Rolls *et al.*, (2004a &b) and Fisher *et al.*, (2003) bigger portion sizes at meal times leads to over consumption of food and energy leading to obesity. Obesity has been identified as one of the risk factors in the development of Non communicable diseases (NCDs) (Schwartz and Byrd-Bredbenner, 2006; Cecchini, *et al.*, 2010).

Apart from overconsumption of food portions, inadequate consumption of food portions may also lead to undesirable health consequences in certain populations. It has been linked to undernutrition in pregnant women and children up to two (2) years (Black *et al.*, 2008; Benson and Shekar, 2006). Maternal undernutrition has been associated with intrauterine growth retardation resulting in infants with low birth weight (LBW). Low birth weight infants as well as poorly nourished children are at risk of developing NCDs such as cardiovascular diseases, hypertension and diabetes in their adult life (Barouki et *al.*, 2012 and Delisle, 2002).

According to the World Health Organization (WHO), NCDs are chronic, non-contagious, noninfectious group of diseases that occur over a period of time and have been linked to unhealthy life styles such as poor dietary habits (WHO, 2011); they are the leading cause of death with an estimated death of 36 million out of 57 million deaths in 2008 (WHO, 2010). In Ghana, studies indicate that obesity has risen from 10% in 1993 to 25% in 2003 (GSS, NMIMR and ORC Macro, 2004), with female obesity rates increasing from 5% to 35% within the same period. This has led to an increase in the incidence of NCDs (De-Graft Aikins, 2007; Ofei, 2005) with a resultant death toll of 78,000 in 2008, which contributes 34% of the total annual deaths (WHO, 2011). The increase in obesity and NCDs in Ghana calls for a portion size measurement aid (PSMA) that will be used in dietary assessment and to educate the Ghanaian populace on appropriate portion sizes for optimum health.

1.1 THE PHOTOGRAPHIC ATLAS; A TOOL IN HEALTH PROMOTION

Excess consumption of food according to Huang *et al.,* (2004) and Levitsky and Youn, (2004) may be due to peoples' inability to determine portion size. Evidence in a study by Fisher *et al.,* (2007) cited in a literature review by Steenhuis and Willemijn (2009), confirmed that when offered larger portions, Hispanic and African American mothers consumed 25% extra calories over a 24 hour period. Several studies (Wansink and Kim, 2005; Fisher, *et al.*, 2003) implicate consumption of extra calories in the increased risk of obesity; one of the risks factors for dietary related NCDs (Schwartz and Byrd-Bredbenner, 2006; Cecchini, *et al.*, 2010) such as diabetes, cardiovascular diseases, hypertension and some forms of cancers (Public Health Agency of Canada, 2013). Other studies have implicated overconsumption of food to availability of larger portion sizes (Flood, *et al.*, 2006; Kral, *et al.*, 2004; Raynor and Wing, 2007). Reducing portion sizes as well as energy density of foods consumed according to a study by Rolls, *et al.*, (2006b) leads to a prolonged and accrued reductions in energy intake over time which is alleged by Hannum *et al*., (2004) to cause a reduction in obesity and therefore NCDs. The photographic food atlas has been used as a portion size measurement aid to estimate the nutritional value of commonly eaten foods and as an intervention tool to help improve dietary intake as well as to help people understand the importance of healthy dietary practices in achieving appropriate change (Small *et al.* 2009).

1.1.1 Photographic food atlas in dietary assessment

In order to determine the nutrient content as well as other food components in actual food consumed, a form of dietary assessment should be undertaken. According to Thompson and Subar (2010), 'Dietary assessment encompasses food supply and production at the national level,

food purchases at the household level and food consumption at the individual level'. Dietary assessment of individuals, groups or populations requires the estimation of the portion size of each food item consumed (Foster *et al.*, 2008) and this has been found to come with challenges like underreporting' of actual food intake (Goris, *et al.*, 2000), subject selection and recording bias (Thompson and Subar, 2008; Livingstone *et al.*, 1990) and difficulty assessing portion size (Robson and Livingstone, 2000). In assessing dietary intake, six commonly used techniques have been recognized and they are as follows: (a) 24-hour dietary recall, (b) food frequency questionnaires, (c) in-depth diet histories, (d) estimated food records,

(e) direct observation with weighed food records and (f) biomarker measurements of targeted nutrients (Fowles, *et al.*, 2007) all of which require an efficient and reliable portion size measurement aid (PSMA) to accurately estimate quantities of food consumed.

The fact that the photographic food atlas is a single bound volume makes it less cumbersome to carry and use as PSMA; the specificity of the foods to a locality and therefore to a group of people as well as the different portions captured in the food atlas help reduce subject burden during portion size estimation (Lucas *et al.*, 1995). In view of this, the photographic method of diet evaluation was described, used and validated by Bird and Elwood (1983) and Elwood and Bird (1983) respectively. This has been followed by the use of food photographs in dietary estimation by other investigators (Ello-Martin, *et al*., 2005; Godwin, *et al.*, 2004).

A photographic food atlas is defined by Nelson and Haraldsdottir, (1998a) as "a set of photograph series, usually bound together in a single volume"; it is a picture album of different portion sizes of commonly consumed foods and of household measures such as plates, spoons,

cups and cans of varying sizes (Food Safety Bulletin, 1997). The photographic food atlas may contain portion sizes ranging from 3 (Turconi *et al.,* 2005) to 8 different portion sizes of food (Food Safety Bulletin, 1997). The photographic atlas of food portion sizes has successfully been used to teach food portion sizes and to estimate and facilitate dietary recall (Brunstrom, *et al.,* 2008; Robson and Livingston, 2000; Marjan, 1995). The atlas has also been used to estimate nutrient content of some commonly consumed foods (Venter, *et al.,* 2000), as well as promote knowledge of dietary habits (Zepeda and Deal, 2008). Other investigators have used food photographs as aids to explain eating behaviours, food preferences and to describe the eating environments (Keller *et al.,* 2008).

1.1.2 The effects of portion size on caloric intake

According to Nelson and Haraldsdottir, (1998a) a portion is 'the amount eaten on any one occasion (first plus subsequent helpings)'. Research has shown that most people are unaware of what constitutes a correct portion (Seligson, 2003; Young and Nestle, 2002 and 1995) and therefore are not able to tell the difference between portions (American Institute for Cancer Research, 2000). The ability of adults to estimate portion sizes of food they consume, according to Robson and Livingstone (2000), appear to be affected by the type of food consumed, the type of measurement aid used to quantify the amount of food consumed, and consistency of their perceptions and estimation skills. In reviewing the effects of portion sizes of food on energy intake and on satiety, Ello-Martin, *et al.,* (2005) cited findings in studies by Fisher, *et al.,* (2003) and Rolls, *et al.,* (2000) which indicated that increased portion sizes presented to children older than three years was linked to increases in their food and caloric intake. Larger food portions apart from enticing subjects to eat more to Bryant and Dundes (2005) Young and Nestle, (2002)

also provide more calories especially large portions of energy dense foods (Kral, *et al.*, 2004). According to Bryant and Dundes (2005), 33% of subjects usually ate two times more than the average servings when presented with larger portion sizes. Similar studies confirmed that availability of larger portion sizes is linked to increase intake of food as well as calories (Jeffery *et al.*, 2007; Geier, *et al.*, 2006; Rolls, *et al.*, 2002; Rolls *et al.*, 2004a and Diliberti *et al.*, 2004). The following researchers have also linked increases in portion sizes of foods available at meal times to increases in the amount of food consumed and therefore, energy intake (Rolls, *et al.*, 2006a, Huang *et al.*, 2004; Levitsky and Youn, 2004). In situations where there is food insecurity, inadequate dietary intake, and therefore portion size intake is reduced (Benson and Shekar, 2006)

1.1.3 The relationship between portion size and the obesity epidemic

According to Stubbs and Lee (2004) differences in energy consumption and usage is the cause of the obesity epidemic. Consumption of larger portion sizes and its resultant increase in caloric intake have been linked to the obesity epidemic by Hamack, *et al.*, (2000). Young and Nestle (2002) claim that the increasing portions sizes of American foods to as much as 700% of the recommended standards is positively linked to increasing body weight of the population. Schwartz and Byrd-Bredbenner (2006) also alleged that, increase in portion sizes of food contributes to obesity and bigger waist lines. Portion sizes of energy dense foods such as fats, refined carbohydrates, and low fiber foods eaten at meal times are generally believed to be on the increase globally as well as in Africa (WHO, 2012a; Vorster, *et al.*, 2011; Mennen *et al.*, 2000; Popkin, 1998). Some laboratory studies by Drewnowski and Damon (2005) suggest that energy-dense foods and energy-dense diets have a lower satiating power and may result in passive overeating and therefore weight gain. These unhealthy dietary practices as well as decreased

physical activity have been linked to the development of overweight and obesity (Popkin, Adair and Ng, 2012). In 2008, these public health problems were found to have affected 1.4 billion people constituting 10% of global adult population and in 2010 to have affected 40 million children of whom 35 million were found to be overweight or obese (WHO, 2012b). Obesity, according Lewington *et al.*, (2007) reduces life span of people with a body mass index (BMI) of 30 kg/m ^{2} to 35 kg/m ^{2} by two (2) to four (4) years in and those with BMI of 40 kg/m ^{2} to 45 kg/m ^{2} by eight (8) to ten (10) years.

1.1.4 The obesity epidemic and the incidence of non-communicable diseases

The increased incidence in obesity as a result of unhealthy dietary and nutritional practices have also been linked to the increase in the development of some non-communicable diseases (NCDs) (Public Health Agency of Canada, 2013;Popkin, Adair and Ng, 2012; WHO, 2012b; Cecchini, *et al.*, 2010; Popkin and Gordon-Larsen, 2004; Amoah, 2003a; Amoah, 2003b; Reddy, 2002; Popkin, 1998). Non-communicable diseases, the highest contributors to morbidity and mortality globally (WHO, 2005) are made up of a large group of chronic diseases that progress slowly over a long period such as cancer, cardiovascular diseases and diabetes mellitus (Public Health Agency of Canada, 2013). The four major ones are cardiovascular diseases (such as heart disease and stroke), diabetes, cancer and chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) (WHO, 2005). The risk of diabetes is increased considerably as a result of weight gain (Oguma *et al.*, 2005). According to the World Health Organization's (WHO) report on NCDs (WHO, 2010) which was developed as part of the implementation of the 2008–2013

Action Plan for the Global Strategy for the Prevention and Control of NCDs, out of 57 million deaths in 2008, 36 million people (63%) died as a result of NCDs. A large proportion of these deaths occurred before the age of sixty (60). The prevalence of NCDs is rapidly increasing and by 2020, NCDs are expected to cause almost three-quarters as many deaths as communicable, maternal, peri-natal, and other nutritional diseases. The principal NCDs implicated in these deaths are cardiovascular diseases (17 million deaths, or 48% of NCD deaths); diabetes (1.3 million deaths); cancer (7.6 million, or 21% of NCD deaths); and chronic respiratory diseases (4.2 million). Eighty percent of deaths due to NCDs (29 million) happened in low-income and middle-income areas. In the report unhealthy diet among other risk factors is implicated in some cancers and 80% of coronary heart and cerebrovascular diseases. The greatest increases in NCDs according to WHO projections will be found in the South-East Asia, the Eastern Mediterranean and the WHO regions of Africa of which Ghana is one (WHO, 2010).

In Ghana, Ofei (2005) reported that the country is going through an economic and nutrition transition and experiencing an increase in the prevalence of obesity and obesity-related illness, such as CVDs, diabetes mellitus, hypertension and some forms of cancers, especially among urban dwellers. According to Bosu (2010), Ghana is experiencing a scourge of hypertension. About 78,000 Ghanaians die as a result of NCDs annually according to WHO 2010 Global status report on NCDs (WHO, 2011). The incidence of non-communicable diseases in Ghana has been on the increase since 1920 and cost/year of treatment for diabetes in 2007 was between US $ 1276.00 and US $7660.00 as compared to 2001 with a cost of US $180.00 – US $420.00 (De-Graft Aikins, 2007).While this is an issue of major concern, detailed study of the epidemiology and underlying mechanisms associated with this 'Nutritional Transition' in relation to changes in dietary patterns are hampered by limited available information on commonly consumed foods in

Ghana and their portion sizes.

1.1.5 Portion size in relation to undernutrition and incidence of NCDs

Consumption of smaller portion sizes of food than is recommended according to Black *et al.,* (2008) is one of the contributory factors to undernutrition especially among women of childbearing age and young children (Black *et al.,* 2008; Benson and Shekar, 2006). Intrauterine growth retardation, to an extent is an indicator of maternal undernutrition which has been linked to low birth weight in infants (Delisle 2002). Undernutrition during foetal development up until the age of two is known to cause some of the most devastating effect such as poor growth and reduced cognitive development (Benson and Shekar, 2006), consequences which are usually irreversible (Black *et al.,* 2008). These infants and children according to Delisle (2002) and Barouki et *al.,* (2012) are most likely to develop the metabolic syndrome. This is supported by cohort studies of pregnant women and children exposed to the 1944 to 1945 Dutch wartime famine, 1959 to 1961 famines in China and the famine during the 1968 to 1970 Nigerian civil war (Barouki *et al.,* 2012; Delisle, 2002). The International Diabetes Federation (IDF) defined metabolic syndrome as… 'a cluster of the most dangerous heart attack risk factors: diabetes and pre-diabetes, abdominal obesity, high cholesterol and high blood pressure' (Alberti, *et al.,* 2006 and 2005); all the diseases mentioned earlier are NCDs. According to the WHO's child growth programme, appropriate portion sizes is a very important requirement in feeding the moderately wasted, stunted or underweight six (6) to twenty four (24) month old children. Feeding the undernourished child the appropriate portions sizes required may ensure that adequate catch-up growth is realized during nutritional intervention strategies (Ashworth and Ferguson, 2008).

1.1.6 Portion size and the control of obesity and NCDs

Results from animal, clinical and epidemiological studies suggest an excellent positive association between specific dietary patterns and a reduced risk of specific diseases (FAO/WHO, 1996); dietary patterns which are important aspects in the prevention of NCDs (WHO, 2002b). According to Rolls, Roe, *et al.,* (2006b) a decrease in the intake of energy dense foods can add up over time. This will then lead to a reduction in energy intake over time. Hannum *et al*., (2004) claimed that when portion sizes of foods consumed are controlled, bigger losses of weight and fat is realized; this according to the researchers leads to a reduction in the risk of cardiovascular disease. Excessive weight gains, although a risk for the development of diabetes mellitus, when avoided even in lean persons reduces the risk of this disease (Oguma *et al.,* 2005).Correct portion control is therefore an important feature in weight loss success (Hannum *et al*., 2004). Measuring, weighing or estimating the amount of food consumed is necessary to determine food and nutrient quantity in dietary assessment. However, measuring and weighing of foods creates a huge burden on subjects. It requires subjects to weigh all foods eaten during the period under investigation; this includes food eaten at home and outside the home, snacks and main meals, including ingredient used in cooking. It requires subjects to weigh foods served as well as weigh plate waste. For this to be done subjects would have to carry with them scales, measuring utensils such as cups, spoons etcetera which makes the process very cumbersome. Consequently there is the need to develop a reliable and appropriate tool to facilitate the estimation quantities of food and nutrient intakes.

1.1.7 The photographic atlas as a tool for portion size control

Food pictures, utensils, volume measures, three-dimensional models such as a deck of cards, drawings of foods, abstract and generic shapes, household measures and plastic food replicas are other PSMAs that have been used to improve portion size recall (Ovaskainen *et al.*, 2008 and Steyn *et al.*, 2006).Chambers, *et al.*, (2000) claimed that life sized pictures presented the highest accuracy when used by subjects to assess food portion size as compared to the rest.

In Ghana, a handy measure booklet/tool developed by a group of dietitians with aid from the Dreyfus Health Foundation is currently the only tool in use (Owusu *et al.*, 1995). Portion size estimation aids recommended in this booklet consist of common household measures like ladles, cans, spoons, matchboxes, crockery. These PSMAs are cumbersome to use because of their bulk.

The photographic food atlas of portion sizes, a tool that has been found to help in estimating portion sizes of food has been used to teach portion estimation, facilitate dietary recall(Marjan,1995), serve as a resource for nutritionists, dietitians, and other clinicians, and provide rich qualitative data. It has also been used as a research tool in quantifying food portion size (Ovaskainen *et al.*, 2008) and nutrient intake, and in recording and validating dietary intake in epidemiological dietary surveys (Turconi *et al.*, 2005). According to Robson and Livingstone (2000) food photographs can be used to describe eating environments and behaviours, the quality of the food as well as food preferences; it has been used to estimate the nutritional value of commonly eaten foods. It has been used as an intervention tool to help increase dietary intake as well as to help people understand the importance of healthy dietary practices in achieving

appropriate change (Small *et al.* 2009). For instance, the photographic food atlas has been used with other food measurement tools to enhance dietary recall of young preschool children (Small *et al.,* 2009 and Foster *et al.*, 2008) whose accuracy and precision in using food models to recall food intake were found to be poor (Foster *et al.*,2008).

1.2 PROBLEM STATEMENT

According to Byrd-Bredbenner and Schwartz (2004), the difficulty associated with consumers' ability to control how much they eat may be as a result of the difficulty they have in accurately estimating portion sizes. Access to easy and reliable tools to estimate the quantity of food and nutrient intake will help health professionals educate and counsel individuals and groups to make healthy food choices. Changes in food production, processing, storage, and distribution techniques (WHO, 1990) as a result of the 'nutrition transition' have led to changes in the composition of diet and dietary preferences (Popkin, 2002; Popkin, 1998) of Ghanaians. According to Mennen *et al.,* (2000) and Popkin (1998), dietary preferences have moved towards an increase in the consumption of fat, refined carbohydrate and low-fibre diet and a decrease in intake of fruits and vegetables; diets that have been linked to the increase in the incidence of Non Communicable Diseases (Popkin, 2006; Amoah, 2003a, Amoah, 2003b WHO, 2002a; Reddy, 2002).

Several researches have linked increases in portion sizes of foods available at meal times to increases in the amount of food consumed and therefore, energy intake (Huang *et al.,* 2004; Levitsky and Youn, 2004). Increase in energy consumption has also been linked to the increase

incidence in obesity, a risk factor in the development of NCDs (Popkin and Gordon-Larsen, 2004; Popkin, 1997). It is therefore becoming increasingly necessary to have access to nutrition information of commonly consumed foods, their portion sizes, and an appropriate and reliable tool to assess and quantify portion sizes of dietary intakes of Ghanaians. This will enable stakeholders gain a better understanding of diet and disease of different populations in the country and be able to put in place policies that better address these problems.

Handy measure tools currently being used for nutrition evaluation and education in Ghana are cumbersome. The need for current data on commonly consumed Ghanaian foods and a tool that estimates their portion sizes and nutrient content has been emphasized by nutrition and health related authorities. These would serve as a means to aid in nutrition evaluation and education and to help in planning special diets; diets for therapeutic purposes**,** institutional diets, national food and nutrition policy, nutritional regulation of the food supply and nutrition intervention programmes. Data on commonly consumed foods in Ghana are a prerequisite in developing an appropriate and reliable tool; the photographic food atlas, which will serve as an integral part in research into nutrition and health. There is therefore the need to identify the commonly consumed carbohydrate foods and develop a photographic food atlas which will serve as baseline information for the development of a complete photographic food atlas of all commonly consumed foods in Ghana. This study therefore seeks to produce data on commonly consumed carbohydrate based composite foods in Accra, Ghana, and to develop and validate a photographic food atlas with portion sizes of the identified carbohydrate foods with portion sizes.

1.3 AIM

To develop and validate a photographic food atlas of commonly consumed carbohydrate foods with portion sizes in Accra, Ghana.

1.3.1 Objectives

1. To identify/catalog/categorize commonly consumed carbohydrate foods in Accra
1. To develop a photographic food atlas with portion sizes based on the information collected.
2. To estimate cooked carbohydrate portions against the developed food photographic atlas based on gender, age and body mass index.

1.4 JUSTIFICATION

A photographic food atlas provides important data that can be used in a variety of ways to assess food and nutrient intakes of populations. Various studies have proven the valuable use of photographic food atlas in nutrition assessment, portion size quantification and dietary recall; these include studies by Williamson *et al.*, (20003), Robson and Livingstone (2000), Cypel, *et al.,* (1997), Nelson, *et al.,* (1996), and Faggiano *et al.,* (1992). Poor portion control has been linked to an increase in the rise of NCDs. This increasing rise in NCDs linked to unhealthy diets and lack of physical activities has socio-economic implications in the form of increase disability adjusted life years (DALYs) and health care cost to the individual and the nation.

The need to intervene and reduce the incidence of these NCDs is an important programme on the government's Millennium Development Goals (MDG) four (4) and five (5) which aims at improving child and maternal health through adequate nutrition as part of interventions agenda. To achieve this it is recommended that focus be placed on intervention strategies as well as on developing early healthy lifestyle habits among the populace. One important measure of ensuring that these changes in lifestyle habits take place is through effective and reliable dietary intake recording. Assessment of food and nutrient intakes are however, fraught with difficulties; difficulties in recall, portion size measurement and recording abilities are few of these complications. Dietary aids to improve portion size and nutrient intake recalls are therefore recommended and have been in use for some time. A new policy on NCDs developed by the Ministry of Health (MOH) with the aim of preventing and controlling NCDs in Ghana (MOH, 2010) would require the integration of appropriate portion sizes to ensure the effective realization of its goals.

The use of a photographic food atlas to assist in portion size estimation has been found to be more reliable (Nelson, *et al.,* 1996). Currently, in Ghana, household measurement aids are the only dietary aids used in portion size estimation by dietitians and nutrition-related professionals. Considering the usefulness of the photographic food atlas, it is imperative that such a tool on commonly consumed local and traditional Ghanaian foods is developed and validated for use in the country.

Access to a photographic food atlas of commonly consumed Ghanaian foods will aid in data collection, nutrition education and dietary counseling. Data derived from using photographic

food atlases can be used by Ghanaian dietitians to plan and evaluate diets for patients and also to plan menus for institutional food service as being used by dietitians in other countries. The development and validation of a food atlas of commonly consumed carbohydrate foods in Ghana will serve as a baseline tool for the development of a complete food photograph of all commonly consumed foods in Ghana. The complete food photograph atlas will help dietitians and other health professionals determine the association between diet and diseases, counsel, plan and recommend the appropriate therapeutic dietary interventions and treatment. It may also be used as a nutrition intervention tool aimed at modifying commonly consumed composite dishes to improve dietary intake. Information derived from this study will also provide credible reference material for nutrition and dietetic research.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HISTORY AND DEVELOPMENT OF PHOTOGRAPHIC FOOD ATLAS

A photographic Atlas of Food Portion Sizes is a portion size estimation aid, defined as "a set of photograph series, usually bound together in a single volume" (Nelson and Haraldsdottir, 1998a). The UK Food Standards Agency also described it as a picture album of different portion sizes of commonly consumed foods and of plates, spoons, cups and cans of varying sizes (Food Safety Bulletin, 1997). The photographic food atlas may contain portion sizes ranging between 3 to 8 different portion sizes of food (Turconi *et al.*, 2005; Food Safety Bulletin, 1997).

The method of diet evaluation using food photograph was first described by Elwood and Bird (Elwood and Bird, 1983). They conducted a prospective study in which 25 participants were asked to write down their food intake. Each of the participants was given a high-speed, high-quality camera to take pre-meal and post-meal photographs, of all foods and beverages consumed within their homes. Participants achieved a standardized distance between food and camera with a piece of premeasured string. Slides of the food photographs were put beside pictures of pre-reweighed and pre-measured standard meals that consisted of food and drinks. The researchers compared pre-meal and post-meal photos to come out with estimated weights of consumed foods. According to Elwood and Bird (1983), it was a cost effective way of dietary intake assessment. Bird and Elwood (1983) conducted a validity test on data collected from

records kept by sixteen participants. The records included pre-weighed and post-weighed foods consumed for a period of four days as well as photographs of all pre-weighed and post weighed meals. Correlation coefficients calculated, ranged from 0.84 to 0.97 when data from the weighed food record and the photographic record were compared. This indicated a strong relationship between food photographs and weight of actual foods. The Bird and Elwood photographic method of dietary intake assessment had limitations which included high cost of equipment and material development, increased participant burden and lack of standardized plate size which might have altered estimated weights of foods (Small *et al.*, 2009).

Other photographic food atlases have been in existence for some time. Nelson and Haraldsdóttir (1998a) identified ten (10) different photographic food atlases in their research into practical guidelines that would aid in the development of photographic atlas of food portion sizes. The atlases from seven different countries were published between the years 1985 to 1997. The number of photos per atlas varied from 15 to 245 and these food photographs were from Finland (Annoskuvakirja), United kingdom (A Photographic Atlas of Food Portion Sizes), Sweden (Atlas of Food portion Sizes) and France (Portion Alimentaires), to mention a few (Table 2.1).

Table 2.1: Some Photographic Food Atlas of Food Portion Sizes by country

Country of Reference	Year	Title	Number photo series	Colour	Portion / series	Order of presentation	Series / A4 Sheet	Instructions included	Table of content
France	1994	Portion Alimentaires	245	Yes	3	Increasing Size	3	Yes	Yes
Portugal	1996	Manual de Quantificacao d'Alimentos	110	Yes	3	Varies??	2	Yes	No
Portugal	1996	Modelos fotographico para Inquiritos Alimentares	58	Yes	4	Increasing Size	2	No	No
Portugal	1996	Registro Photografico para Inqueritos Dieteticos	71	Yes	3	Decreasing Size	2	Yes	Yes
Poland	1991	Album Porcji Produktow I Potraw	135	Yes	3	Increasing Size	3	No	No
Sweden	1997	Swedish Photographic Atlas of Food Portion Sizes	15	Yes	5	Increasing Size	5	Yes	Yes
Finland	1985	Annoskuvakirja	126	Yes	3	Increasing Size	3	Yes	No
Russia	1995	Albom portsiy Productov I Bljud	63	Yes	3	Increasing Size or Varies	1	No	No
UK	1997	Food Portion Sizes: A Photographic Atlas	98	Yes	8	Increasing Size	1	Yes	Yes
EPIC	1995	EPIC-SOFT Portion Picture Book for Estimation of Portion Size	140	Yes	4 to 6	Increasing size	1	Yes	Yes

Source: Nelson and Haraldsdottir (1998b) Public Health Nutrition 1(4): 231-137

2.2 USES OF THE PHOTOGRAPHIC FOOD ATLAS

Other researchers have, illustrated different ways in which food photographs can be used in assessing dietary intake estimation. Faggiano *et al.,* (1992) used 10 food photographs with varying food portion sizes to validate the use of portion size measurement aids (PSMAs). These photographs were used in estimating dietary intake of one hundred and three (103) participants. In their study, actual weights of foods consumed during a meal was compared to the subjects' next-day recall as they looked at developed food photographs. These pictures were of a series of Italian dishes. Nelson, *et al.,* (1996) used food photographs to determine errors in conceptualization during portion size and nutrient content estimation. A hundred and thirty - six (136) male and female subjects aged between eighteen (18) to ninety (90) years were involved in the study. There were eight (8) photographs for each food which showed portion sizes that ranged in equal increments from the 5th to the 95th percentile. Participants estimated portion sizes using visual analogue scale. The researchers realised a general overestimation of small portions and underestimation of larger portion sizes. This study concluded that age, sex and BMI are possible essential confounders in accurate estimation of food when food photographs are used in estimating the amount of food as well as nutrient consumed. The authors also concluded that a wide range of portion sizes depicted in food photographs can be used to estimate portion size. Finally, they indicated that subjects' "misclassification" of portion size and the amount of nutrient consumed per meal reduced when food photographs were used as compared with 'the average weight of the foods which the subjects had served themselves' (Nelson, *et al.,* 1996).

In another study, Robson and Livingstone (2000) evaluated the use of food photographs to quantify food intake. One of their goals was to evaluate subject error when using photographs to quantify the amount of food consumed. Food photographs used in the study were single colour prints, with the food pictured on plates, in bowls, or glasses on top of a wooden table. Correct classification of 63% to 80% of subjects into tertiles based on estimated intakes was done. The investigators reported that although some large food quantification errors occurred, single portion size food photographs were effective when used to estimate nutrient intakes at the group level (Robson and Livingstone, 2000).

In similar studies, food photographs have been used as an intervention tool to help increase dietary intake as well as help subjects understand the importance of healthy dietary intake in achieving appropriate change (Small *et al.*, 2009). They have also been used with other food measurement tools to enhance dietary recall of young preschool children (Small *et al.*, 2009; Foster *et al.*, 2008); whose accuracy and precision in using food models to recall food intake were found to be poor (Foster *et al.*, 2008).

Food photographs, utensils and volume measures, three-dimensional models, drawings of foods, abstract and generic shapes, household measures and plastic food replicas are other portion size measurement tools that have been used to improve portion size recall (Ovaskainen *et al.*, 2008; Steyn *et al.*,2006). A study by Chambers *et al.*, (2000) using four (4) different food aid measurement tools to estimate food portions concluded that life sized pictures presented the highest accuracy when used by subjects to assess food portion size as compared to the rest. McGuire *et al.*, (2001) on the other hand suggested that using "default" volumes in sorting out

sizes leads to portion estimates that have a tendency to be as accurate as or more accurate than estimates using portion size estimation aids (PSEAs) also known as portion size measurement aid (PSMA) or direct dimension estimation.

2.3 PORTION SIZE MEASUREMENT AIDS (PSMA)

Portion size measurement aids sometimes referred to as portion size estimation aids (PSEAs) by some researchers have been used to estimate food portions across the globe. Some of these include, common household measures, 2-3 dimensional objects and food atlases. The following sections give an overview of the types.

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2.3.1 Three dimensional portion size aid

Common household measures, such as cups, measuring spoons, glasses, plates and bowls are frequently used to quantify portion sizes; other models which have easily recognizable shapes have also been used in place of common household measures to demonstrate portion sizes. These models which come in the form of actual objects such as a golf ball, a tennis ball, a deck of cards (Weber *et al.,* 1997) a compact disc, a nine volt battery (Ball and Freidman, 2010), a die, a match box and a sardine tin (Owusu *et al.,* 1995), to mention a few are also classified as three dimensional Portion Size Measurement Aids (3D PSMA). Realistic plastic replicas of actual foods such as those produced by the National Agricultural Supply Company (NASCO) in the United States of America are also classified as 3D PSMA. Real food samples have also been classified as 3 dimensional models in portion size estimation. Examples of such 3 dimensional

models used in Ghana are that of an orange representing a ball of Ga kenkey and an egg representing corn dough (Owusu *et al.,* 1995).

According to Weber *et al.,* (1997) the use of food models as training tools improved portion-size estimation, especially of solid foods in cups and of amorphous foods. According to Chambers, *et al.,* (2000) the more a food model looks like the actual food; the more subjects are likely to use them to recall portion size of food because of their appeal and ease in usage. Godwin, *et al.,* (2004) conducted a study among one hundred and twenty (120) subjects of both gender aged between eighteen (18) to sixty five (65) years. The study compared subject's accuracy in reporting food intake when using two-dimensional (2D) versus three dimensional (3D) portion size estimation aids (PSEAs) also known as PSMA. The 2D- PSEAs were unshaded flat drawings of the different foods presented. The study also assessed if interviewing methods such as in person or by telephone and assisting or not assisting subjects to choose either of the PSEAs affected accuracy of portion size estimation. Subjects chose pre- weighed foods from a buffet table. Weights were taken of all waste and total amount consumed calculated. On the following day subjects estimated the amount of food they consumed. This was done by telephone or one-on-one interviews, by subjects using 2D PSEAs or 3D PSEAs, or by subjects being guided or not guided towards using either 2D PSEAs or 3D PSEAs. Apart from 3 foods for which average estimations were different for 2D PSEAs and 3D PSEAs, the average accuracy of estimation was similar. According to the research team, guiding participants to a certain PSEA did not affect accuracy of reported intake. Although the 3D PSEAs were more effective for estimating portion size as compared to the un-shaded 2D flat drawings, the researchers implied that a more representative 2D PSEA would have improved their use in estimating the food portions.

Similarly, Byrd-Bredbenner and Schwartz (2006) conducted a study in which comparisons were made between the accuracy of subjects' estimation of amorphous food like vegetables, fruits and grains when 2D PSMAs and 3D PSMAs were used and when they were not used. A life-size photograph of a tennis ball and golf ball represented the 2D PSMAs and an actual golf ball and a tennis ball represented the 3D PSMAs. Both PSMAs were labeled with their cup volume. Plated pre-weighed foods were given to one hundred and thirteen (113) young adults, aged between seventeen (17) and twenty four (24 years). There were three (3) sets of twelve (12) identical foods of different shapes, portion sizes, width and height; totaling thirty six (36). Subjects were randomly assigned into two (2) groups. Each group estimated and recorded the portion sizes of all foods either using cups, PSMAs, or no PSMA. The use of the PSMAs according to the researchers positively affected portion estimation (Schwartz and Byrd-Bredbenner, 2006).

2.3.2 Two-dimensional portion size aid

In order to envisage a 2D *PSMA* in relation to actual foods, it requires moving from solid models to paper illustrations. Two-Dimensional portion-size measurement aids are usually drawings of real foods, abstract shapes, and house hold measures. These types of measurement aids have been used in many studies as a portion-size aid (Buzzard *et al.*, 1996; Posner *et al.*, 1992). Posner *et al.,* (1992) conducted a study to validate a two-dimensional food model chart using a 24 hour dietary recall. The authors assessed its relative validity by comparing food energy and nutrient intake. Relative validity was calculated from food quantity estimates resulting from the two-

dimensional chart with those resulting from three-dimensional food models used in the first National Health and Nutrition Examination Survey (NHANES I) as the reference values. In general, differences in calculated mean energy and nutrient intakes between the two PSMAs were not statistically significant for men or women. The researchers therefore concluded that the use of two-dimensional method for estimation of serving size in nutrition research was possible

On the other hand Cypel, *et al.,* (1997) in their review of a study by Posner *et al.,* (1992) suggested that 'Comparisons of nutrients may have obscured differences between PSMAs in the subjects' estimates of recalled amounts of foods'. They indicated that when estimations of nutrient content of foods rather than estimation of individual quantities of foods are compared, significant similarities may be expected, because in assessing specific foods more difference may have been identified as compared to assessing nutrient content of groups of foods.

McGuire *et al.,* (2001) used one hundred and twenty (120) subjects (58 men and 62 women) to compare the accuracy of a 2D muffin diagram to other portion size measurement aids (PSMAs). Subjects touched and observed different sizes of four (4) muffins out of seven (7) muffins for thirty (30) seconds; the muffins were removed from sight. Subjects estimated the size of the muffins by indicating if it was a mini, small, medium, large, extra-large or jumbo size, by using PSMAs such as a ruler, bean bag, or 2D muffin diagrams or by not using any PSMA. Subjects used a five (5) point scale to describe their confidence in the portion size estimation. Ninety percent of subjects used PSMAs out of which 70% used 2D PSMAs. There were inconsistencies between the irregular appearance of the actual food (e.g., muffins) and the symmetrical and linear illustration of the two dimensional (2D) food models resulting in considerable

overestimation. These the investigators identified as reasons new PSMA should be validated (McGuire *et al.*, 2001).

2.3.3. Types of photographic food atlas

Many types of photographic food atlas are in use globally. Nelson and Haraldsdóttir (1998a) in an effort to research into practical guidelines on how to develop photographic atlases of food portion sizes identified ten (10) different photographic atlases from seven (7) countries. These atlases were published between the years 1985 to 1997 (Tables 2.1). The number of photos per atlas varied from fifteen to two hundred and forty five (15 – 245). Apart from those identified by Nelson and Haraldsdóttir (1998a) other places where photographic food atlases have been used worldwide include but are not limited to Burkina Faso (Huybregts *et al.*, 2007), Italy (Turconi *et al.*, 2005) and South Africa (Venter, *et al.*, 2000)

2.3.3.1United States of America-Portion Photos of Popular Foods

The photographic food atlas, Portion Photos of Popular Foods *(*Hess, 1997) published in the United States was designed for use in the community, clinical, research and public health setting. It is a spiral-bound book of coloured food photograph with each page measuring approximately thirty and half centimetres (30.48 cm) by thirty-eight centimetres (38.1 cm). It contains one hundred and twenty eight (128) laminated pages of life-size colour photos of more than one hundred and nine (109) commonly consumed foods in the United States. Life size photographs of three separate portions of each food on appropriate plates or in appropriate bowls were captured on each page. Some of the photographs captured came with common household silver ware. Portion sizes in the book were based on the 1997 Nutrition Facts label, Diabetic exchanges,

and the United States Department of Agriculture Food Guide Pyramid. The commonly consumed foods were presented in different serving forms and shapes. This was to help users easily recognize commonly consumed foods as well as to help increase accuracy in assessment of the foods. Some examples of the different serving shapes were a flat slice of cheese versus a block-shaped piece, a roll of bread versus a slice of bread. The book also included photos of standard food measuring equipment. It contained tables of portions in their measures, such as volume and weight in grams. The book was researched and developed through the partnership of the research and development panel of *Portion Photos of Popular Foods* (Hess, 1997), representatives from the Center for Nutrition Education at the University of Wisconsin-Stout, the National Center for Nutrition and Dietetics (NCND) established by the American Dietetic Association, the Diabetes Research and Training Center, and the Food and Nutrition board, National Academy of Sciences.

2.3.3.2. United Kingdom-Photographic Food Atlas of Food Portion Sizes

The Photographic Food Atlas of Food Portion Sizes was sponsored by Ministry of Agriculture, Forestry and Fisheries (MAFF) and produced by the Department of Nutrition and Dietetics at King's College London in collaboration with the United Kingdom Nutrition Epidemiology Group. It is made up of colour photographs of seventy-eight (78) foods commonly consumed by British adults. Each page consists of photographs showing a progression in portion sizes of each food which ranged from very small to very large. In addition, the atlas had photographs showing a range of types and sizes of single foods and also of crockery, cutlery, can sizes and fluid volumes. The Atlas also has a User's Guide which provides instructions on its use, background information on its development, data on the weights of the foods in the photographs and a

questionnaire intended for use with the photographs. It also has software to assist in the calculation of food consumption (Food Safety Bulletin, 1997).

2.3.3.3Malaysia

In Malaysia, a photographic food atlas was developed by Marjan (1995). This was to help improve the accuracy of the 24-hour recall method in the assessment of dietary intake. Two hundred and fifty (250) readymade foods as well as common Malaysian food items from the cereal, nuts and lentils, milk, fruits and vegetables and, meat and fish groups were identified and these were included in the food atlas. Meals were bought or prepared according to 'familiar serving sizes' from the identified foods and these were photographed. Edible portions of the photographed foods as well as ingredients of the bought foods were weighed and recorded. The Demeter software, a computerized version of the Nutrient Composition of Malaysian Foods was used to calculate the nutrient content of the food. The photographs were then bound into an atlas of food photograph of common Malaysian foods (Marjan, 1995). The atlas consisted of large sized food photographs, serving sizes, weight of edible portions and nutrient content of foods.

2.3.3.4 South Africa

A photographic food atlas of commonly consumed foods was developed in South Africa by Venter, MacIntyre and Voster (2000) to be used in portion size estimation during a study to evaluate the health profile of one hundred and sixty nine (169) African volunteers from clinics in the North West province of South Africa. Data on commonly consumed foods and portion sizes, recipes and methods of preparation were collected from subjects and the foods prepared by the investigators. Foods were then measured into three to four (3 to 4) portion sizes and

photographs taken of them. These photographs were enlarged and compiled in a book and validated. To validate the photographic food atlas, subjects estimated two thousand, nine hundred and fifty nine (2959) portions of pre-weighed foods by matching them to portions in the food photograph. Sixty-eight percent (68%) of food portions were accurately estimated within ten percent (10%) of actual weight. The researchers indicated that clearly defined solid foods were better estimated than amorphous foods.

2.3.3.5 Burkina Faso

In Burkina Faso in the Sahelian region of West Africa, a group of investigators, (Huybregts *et al.*, 2007) developed and validated a food photograph comprising of eight (8) food items of four (4) portions each which were to be used in a 24 hour recall dietary intake study of pregnant women aged between fifteen(15) and forty-five (45) years. This was part of a study to evaluate how effective prenatal micronutrient supplementation intervention was on birth outcomes. Each subject was offered two (2) food items weighed to the exact weight of a food depicted in one of the photographs in the morning and two in the afternoon. The foods were put in the same containers as was found in the photographs. The ability of the subjects to choose the correct photograph was evaluated by a different field worker the following day. A thousand and twenty-eight (1028) portion size estimations were made. About fifty five percent (55%) of the time, the correct photograph out of four (4) was chosen. Underestimation and overestimation among participants for each food selected were balanced except for rice and couscous. The mean difference between served and estimated food portion sizes on a group level was between -8.4% and 6.3%. Educated subjects were twice as likely to select the correct photograph.

2.3.3.6 Ghana

The photographic food atlas of portion sizes has not been developed in Ghana. Portion Size Measurement Aids (PSMAs) in use in Ghana are 3D PSMAs such as cups, ladles, sardine and milk tins and match boxes (Owusu *et al.,* 1995), and commercial plastic food replicas (NASCO, Fort Atkinson, USA) or replicas of actual food in models imported into the country from other countries. The 3 dimensional (3D) PSMAs used in Ghana are bulky, heavy and cumbersome to carry. The food models are costly to import and are usually not representative of local Ghanaian foods both in type and portion size.

2.4 VALIDATION OF PHOTOGRAPHIC FOOD ATLAS

Although, it is generally believed that portions of food consumed at a meal have been increasing and this increase is believed to be a contributory factor to the obesity epidemic (Hamack, *et al*., 2000), research has shown that most people are unaware of what constitutes an appropriate portion (Young and Nestle, 1998; Young and Nestle, 1995); some subjects are also not able to discern differences in portion sizes (American Institute for Cancer Research, 2000).

Studies have demonstrated that subjects' choice of portion sizes were considerably bigger than what is proposed (Burger, Kern and Coleman, 2007; Condrasky *et al*., 2007; Schwartz and Byrd-Bredbenner, 2006; Bryant and Dundes, 2005). Subjects' portion size choice has been known to be 30% higher than portions recommended (Wansink, Painter and North, 2005; Dilliberti *et al.,* 2004; Rolls, Morris and Roe, 2002) as standard, especially when larger portions are presented to them. Ledikwe *et al.,* (2005) indicated that there has been a corresponding link between increasing portion sizes and obesity rates and that intake of large portions of calorie dense foods

can result in higher energy intake. However, according to Rolls *et al.,* (2002) methods of serving foods as well as age, gender and BMI have no link to large portion size and energy intake. The ability of adults, according to Robson & Livingstone (2000), to estimate portion size of food eaten appears to be affected by the food type, the quantification aid used, and consistency of subject's perceptions and estimation skills.

Ovaskainen *et al.,* (2008) alleged that the photographic food atlas seems to be a useful tool for estimating portion sizes of most food items; however, its effectiveness in portion size and nutrient assessment requires that individuals be able to (a) look at foods in photographs in direct link to actual food portion; (b) Conceptualize foods (the ability to mentally envisage in abstract terms an amount of food that is actually eaten or seen in relation to the amount represented in a photograph); and (c) recollect from memory the amounts eaten (Nelson and Haraldsdóttir, 1998b). In order to assess if a developed photographic food atlas could be used as a PSMA as well as help subjects' better estimate portion sizes of foods, validation studies of the food photographs should be done.

A study by Williamson *et al.* (2003) examined the validity of digital photography in assessing food portion sizes as compared with weighed foods and with direct visual estimation. The digital photography and direct visual estimation methods were comparatively favourable in portion size estimation of food selection, food intake and plate waste; although both methods showed slight overestimations and underestimations when compared to weighed food method. Validity of both methods compared with weighed foods was tested using Bland-Altman regression analysis which indicated their high correlation to weighed food method. Williamson *et al.* (2004) in

another study compared the use of digital photography as a way of estimating actual food intake to visual estimate of food intakes. For seventy eight percent (78%) of most of the food types, the digital photography method compared with the visual estimate method in food selections, plate waste, and total food intake as well as in variability.

Although portion sizes of different foods have been developed for use by Owusu *et al.,* (1995), there has not been any research on actual perception of portion sizes of these foods when compared to food photographs. The appropriate food atlas is therefore required in relation to subject specificity such as age, gender and BMI. Validation studies are therefore needed to assess the applicability of these food photographs in estimating portions by the different population groups. Several validity studies have been undertaken for this purpose elsewhere and the need for Ghana to do the same cannot be overemphasized.

2.4.1 Influences of sex, age and BMI on validation of portion size assessment tool

Some studies have found sex, age, BMI and race to be confounding factors in the validation of portion size assessment tools. Burger, Kern and Coleman (2007) reported from their study that males' choice of portion sizes of certain foods were significantly larger. Conversely, other investigators in their studies found no effect of subject characteristics on portion size (Byrd-Bredbenner and Schwartz, 2004; Diliberti *et al.*, 2004; Kral, *et al.*, 2004; Rolls, *et al.*, 2002; Nelson and Haraldsdóttir, 1998b).

In the study by Nelson, *et al.,* (1996) to find out errors in portion size conceptualization when food photographs were used, the investigators concluded that age, gender,

BMI and portion size were all likely important confounders when food or nutrient intake estimation is done using food photographs. In this research, one hundred and thirty six (136) male and female volunteers from different socio-economic backgrounds aged between eighteen and ninety (18-90) years, assessed six hundred and two (602) portion sizes of different foods in relation to food photographs. Portion sizes served by subjects were weighed and waste after consumption also weighed. A choice of four (4) to six (6) foods from the three (3) main meals was allowed. Subjects were shown eight (8) photographs of varying portions of each food chosen, five minutes after eating and asked to indicate on a visual analogue scale the portion size consumed in relation to the photographs. A large variation between estimation of portion sizes from photographs was observed. Overestimation was identified particularly in small portion sizes whilst large portion sizes were underestimated. Overestimation was also associated with older subjects more than with the younger subjects. Subjects with higher BMI ($\geq$ 30 kg/m^2) underestimated energy and fat content of foods, whilst those with lower BMI ($\leq$ 25 kg/m^2) overestimated these nutrients.

Conversely, Turconi *et al.*, (2005) in their study to compare the validity of a colour photographic food atlas as a tool for measuring actual portion size eaten compared with weighed foods, concluded that weights of portion sizes chosen from the set of photographs were significantly associated to weights of eaten portions but were independent of age, gender and BMI. In this research, four hundred and forty eight (448) male and female subjects aged between six (6) and sixty (60) years from varied social backgrounds in northern Italy, assessed nine thousand and seventy five (9,075) lunch and dinner food portions in relation to a group of colour food photographs. The study was over a period of eight (8) weeks. The colour food photograph which

consisted of four hundred and thirty four (434) foods and beverages typical of the Italian diet was developed by taking pictures of pre-weighed cooked foods. All foods eaten at lunch and dinner were pre-weighed by trained investigators at the time of serving. Subjects were asked within 5-10 minutes after the meal to quantify food eaten in relation to one of three photographs of small, medium or large or as close to photographs as possible on a virtual scale.

In another study conducted by Higgins *et al.,* (2009) the researchers concluded that the use of photographic food records in estimating dietary intake among children compared favourably to standard food diary and that the use of photographic food records in portion size determination was less burdensome to participants and family. Twenty eight (28) healthy twelve (12) to sixteen (16) year old children were recruited for the research. For a period of three (3) days subjects consumed pre-weighed meals. All meals were photographed and recorded in standard diet diary. The weight of waste was determined and subtracted from pre-weighed meal to give actual amount eaten and this was compared to the food photographs and the food diary. Statistical analysis showed no difference between estimated nutrient intake of food, the food diary, the food photograph and the actual intake. Participants and their parents indicated their preference for the food photograph because it was fast and easy.

A study by Foster *et al.*, (2006) to evaluate the importance of age appropriate food photographs in portion size estimation by children was conducted by assessing the accuracy with which children were able to estimate food portion sizes. In this study, originals of three (3) separate data were analyzed and compared; data on the accuracy of portion size estimates by adults using food photographs, by children using adult photographs and by children using age-appropriate

photographs. The participants were made up of one hundred and thirty-five (135) adults from the ages of eighteen (18) to ninety (90) years and two hundred and ten (210) children between four (4) and eleven (11) years. The analysis indicated that children were considerably more accurate in their estimates of portion sizes using age-appropriate food photographs than when they used food photographs designed for adults. For the age appropriate photographs, they underestimated by an average of 1% as compared to 45% when adult appropriate photographs were used. Both children and adults overestimated by 18% and 5% respectively.

A study undertaken by Huybregts *et al.,* in Burkina Faso in the Sahelian region of West Africa developed and validated a food photograph made up of (4) four portions of eight (8) food items which was used in a 24 hour recall dietary intake study of pregnant women aged between fifteen (15) and forty-five (45) years. This was part of a study to evaluate the effectiveness of prenatal micronutrient supplementations intervention on birth outcomes. In this study each subject was offered for breakfast and lunch two (2) food items weighed to the exact weight of a food depicted in one of the photographs. The foods were served in identical containers as was found in the photographs. Subject's choice of food from photograph was evaluated by a different field worker the following day. Out of one thousand and twenty eight (1,028) portions size estimations were made, fifty five percent (55%) of the time the correct photograph out of four (4) photographs was selected. According to the researchers underestimation and overestimation among participants for each food selected were balanced except for rice and couscous. The mean difference between served and estimated food portion sizes on a group level was between -8.4% and 6.3%. The researchers alleged that, educated subjects were twice as

likely to select correct photograph. Portion sizes, that is small versus large, influenced the ability of subjects to estimate portion size (Huybregts *et al.,* 2007).

A lot of other factors may affect the reliability of portion size estimation aids during portion size and nutrient estimation by subjects; among these are the size, number, and colour of photos either black or white, food type and form to be estimated (Nelson, *et al.*, 1994), the type of aid used for recall, how the aids are offered, how similar the aid is to the food and the characteristics of the subject (Godwin *et al.*, 2004; Howat *et al.*, 1994).

2.5 CONSUMPTION PATTERNS OF CARBOHYDRATE FOODS

Carbohydrate is one of the macro nutrients found in foods. In food science the phrase 'carbohydrate' is usually used to describe three broad categories; foods that are rich sources of complex carbohydrate or starch, simple carbohydrates or sugars, as well as fibre. Carbohydrates can be found in a lot of foods like cereals, root crops, sugar crops, pulses, vegetables, fruits, legumes, and milk products (Harvard School of Public Health News Letter, 2012; FAO, 1998). The most consumed carbohydrate trends globally include cereals such as rice, wheat, maize (corn), barley, rye, oats, millet and sorghum, contributing to over 50% of all carbohydrates consumed. Trends in carbohydrate consumption until the last two decades fell in developed countries (FAO, 1998), however, globally, cereal consumption and therefore its contribution to energy remained relatively constant over time (WHO, 2002b). The next major carbohydrate sources are sugar crops like sugar cane and sugar beet and these contribute about 10-12% of all carbohydrate produced worldwide. Among the third largest carbohydrate food sources are root

crops such as potatoes, cassava (manioc), yams, sweet potatoes and taro followed by fruits, vegetables, plantains, pulses and oily crops like groundnuts soybeans (FAO, 1998) and milk products.

2.5.1 Consumption trends in Ghana

The main carbohydrate foods consumed in Ghana are cereals (rice, maize, sorghum guinea corn and millet) as well as starchy roots (yam, cocoyam, cassava) and plantain (FAO, 2009). "Grains, cereals, roots, and tubers dominate the total food consumption basket in Ghana for both urban and rural households" (Maxwell *et al.,* 2000). Through the manipulation of texture, various food products such as "fufu" *(*pounded cassava with plantain, cocoyam or yam), "gari "(dry heat roasted fermented cassava flour), "yakeyake" (steamed grated cassava), "agbelima" (cassava dough), "kenkey" (fermented maize dough dumplings), "koko"(porridge from sorghum/millet/fermented maize dough), "ampesei" (boiled plantain, cocoyam, cassava, or yam), "konkonte" (cooked dried cassava flour), "aboloo" (steam fresh corn meal), "tuozarfi" (a mixture of cooked cassava and corn flour), are obtained for consumption. Regional as well as urban and rural differentiations affect the types of carbohydrate foods consumed; millet, sorghum and yam are the main staples consumed in the North (Armar Klemesu *et al.*, 1995), cassava, maize, plantain and cocoyam are common in the South and West, while, maize and cassava are consumed in the dry south-eastern region. Rice is consumed throughout the country, particularly in urban areas. Starchy roots, pulses and nuts are consumed more in the rural sectors than the in urban sectors (FAO, 2009).

2.5.2 Contribution of carbohydrates to dietary energy supply in Ghana

The contribution of carbohydrates to the energy intake of Ghanaians is estimated to be seventy two percent (72%) of total energy intake. Between 2001 and 2003, the contribution of carbohydrates to total energy intake were as follows: cereals excluding beer twenty nine percent (29%) and starchy roots and tubers forty three percent (43%) (FAOSTAT, 2003). The importance of carbohydrates to the dietary energy intake of Ghanaians can therefore not be over emphasized, which further emphasizes the need for the development of a Photographic Food Atlas of carbohydrate foods consumed in Ghana. The share of the carbohydrate food groups in the Dietary Energy Supply (DES), trends in Ghana from the year 1966 to 2003 is shown in the table 2.2 below:

Table 2.2: The share of the carbohydrate food groups in the dietary energy supply (DES), trends

Food Group	**Percent of DES from 1966 to 2003**					
	1966- 68	**1973-75**	**1980 – 82**	**1987 – 89**	**1994 – 96**	**2001 – 03**
Starchy roots	43	37	37	38	43	43
Cereals (excluding beer)	26	25	25	28	30	29

Modified from Source: FAOSTAT 2003 (Trends in per capita supply of major foods groups (in g/per day)

CHAPTER THREE

3.0 METHODOLOGY

3.1 INTRODUCTION

Chapter three describes the methods used to recruit subjects, to collect material, data, and to develop and validate the photographic food atlas. This section therefore is presented in the following order: methods used in survey of commonly consumed carbohydrate foods in Greater Accra Region of Ghana; development of the photographic food atlas of the collated carbohydrate foods and finally the validation of the photographic food atlas.

3.2 ETHICAL APPROVAL

The study protocol was approved by the Ethics and Protocol Review Committee of the School of Allied Health Sciences (SAHS-ET./10325400/AA/26A/2011-2012) (Appendix I). The purpose and significance of the study were explained to participants (Research Participants Information Sheets (Appendix II) and written consent obtained (Appendix III) before inclusion in the study. Strict confidentiality and anonymity were assured. Data collection procedure was in accordance with approved protocol.

3.3 SURVEY OF CARBOHYDRATE FOODS

This study was the first phase of the study which was carried out to identify carbohydrate foods that were commonly consumed amongst the study population of three hundred and eighty-four (384) households in the Greater Accra Region. Other procedures included identification of the study sites within the Greater Accra region and collation of demographics of identified sample population within the study site.

3.3.1 Study design

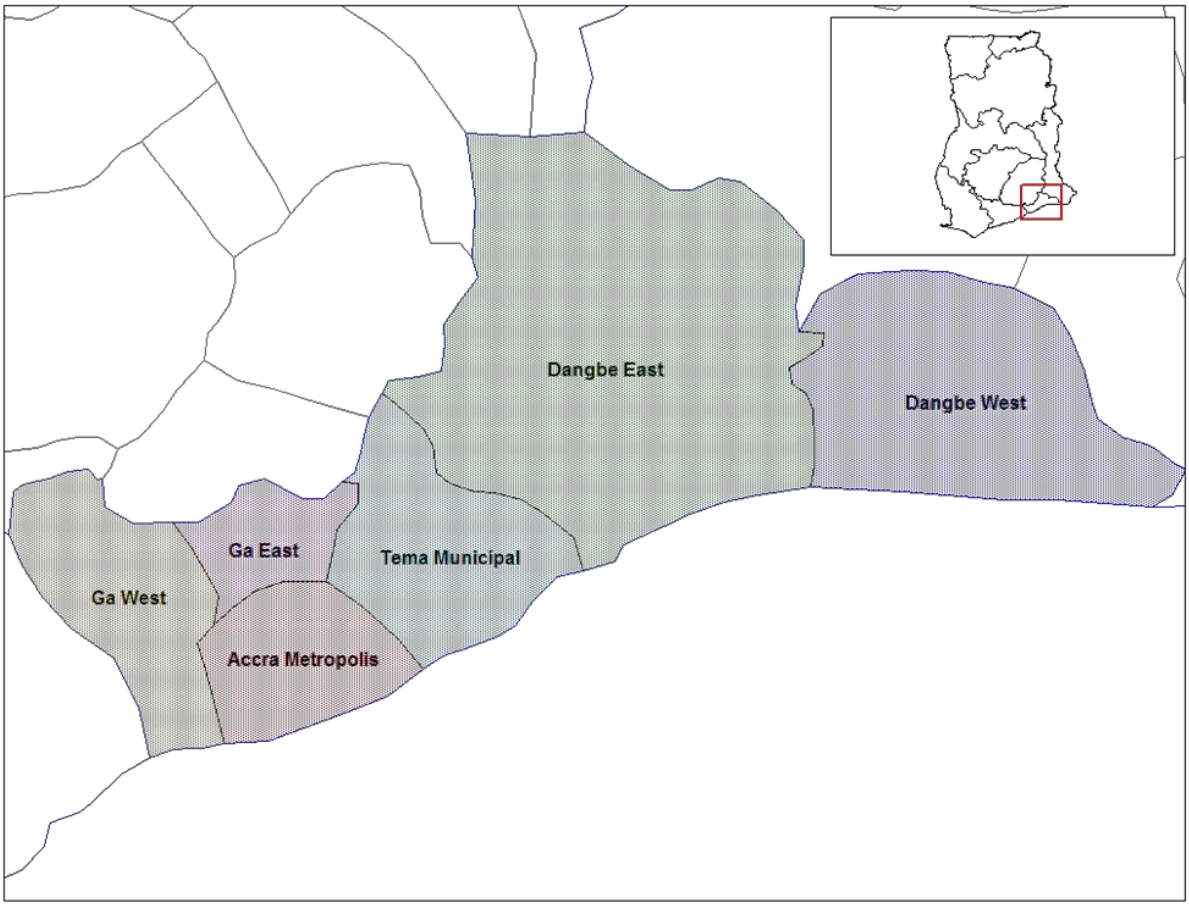
This first phase was a descriptive cross-sectional study design which was carried out in thirty (30) suburbs of the Greater Accra Region amongst eighteen to seventy (18 -70) year old residents. Data on commonly consumed carbohydrate based foods and socio-demography of participants were obtained. To be able to compare if study population in the thirty (30) suburbs were comparable and representative of target population of Greater Accra Region, socio- demographic information such as age, gender, ethnicity, and religious affiliation were collected.

3.3.2 Study site

The study site was the Greater Accra region, a densely populated metropolis. The site comprised of the five districts of the Greater Accra Region with six hundred and twenty six thousand, six hundred and eleven (626,611) households covered in the 2000 population and housing census (Ghana Population Census, 2000). These districts were considered as the study site because the

socio-demographic information and household distribution on the ten (10) metropolitan and municipal areas for the 2010 population and housing census was not available. The five districts were the Accra Metropolitan Area which made up 57.2%, Tema Municipal Area 17.4%, Ga District (made up of Ga East and Ga West) 18.9%, Dangme West District 3.3% and Dangme East District 3.2% of the total Greater Accra population respectively (Figure 3.1)

Figure 3.1: A Map of Greater Accra Region showing the Districts



Source: Google images; Greater Accra Districts

The households to be used for the study were conveniently selected from thirty (30) randomly selected suburbs which were considered as clusters, in the Greater Accra Region (Greater Accra,

Districts in region, 2006).When cluster sampling is used instead of simple random sampling, a loss of effectiveness is realized and this is known as the design effect (Shackman, 2001); this design effect allows for correlations among clusters of observations and may be considered as a measure of the efficiency of the actual design (Rowe *et al.*, 2002). For a given sample size, the selection of more clusters imply a lower design effect and a greater precision, however, a larger number of clusters often require substantial additional costs because travel between clusters may be difficult or involve long distances. Thirty (30) clusters were chosen because several studies have demonstrated that, less than twenty-five (25) to thirty (30) clusters may lead to a high design effect and an unacceptable loss of precision, whereas more than thirty (30) clusters often does not increase the precision enough to justify the additional cost (WFP and CDC, 2007). The suburbs selected were also based on the four designated income zones of the Accra Metropolitan Area (Greater Accra, Districts in regions, 2006) adopted by the AMA and gazetted in the local Government Bulletin of the Assembly in January 2002. The suburbs were Neghelli Barracks, East Cantonment, Teshie Nungua Estate, Community Three, Community 1, Spintex Road, North Kaneshie, Dansoman, Accra New Town, Nungua, Kwashieman, Ayi-Mensah, Kwabenya, Haatso, Big Ada, Nima, Bubuashie, Maamobi, Ashiaman Lebanon, Teshie Old Town, Ayikuma, Burma Camp, Abelemkpe, Mataheko, Madina, Osu Ako-Adjei, Kakasunanka, South Shiashie, Santa Maria, and Awoshie (Table3.1).

A household is defined as "a person or group of persons living together in the same house or compound, sharing the same housekeeping arrangements and being catered for as one unit" (WFP/CDC, 2007). A sample size of three hundred and eighty-four (384) households was calculated from the total number of households in the Greater Accra region using the online

Raosoft sample size calculator (Raosoft, 2004). The three hundred and eighty-four (384) conveniently selected households were made up of single family households as well as randomly selected households from multiple family households who accepted to be part of the study and met the inclusion criteria (section 3.3.3.1). The number of households chosen by the researcher to be studied in each of the five (5) districts was calculated based on percent population distribution for each district. The number of households studied in the districts was as follows: Accra Metropolitan Area (AMA), 219 (57%), Tema Municipal Area 67 (17.4%), Ga Municipal Areas 73 (18.9 %), Dangme East 12(3.2%), and Dangme West, 13 (3.3%) totaling three hundred and eighty-four (384) households (100%).

Table 3.1: Description of suburbs, metropolitan/municipal area, income zones and number of participants

Income Zones	Metro Area	Community	Number of Households	Number of Participant
First Class (IZ01)	AMA	Neghelli Barracks	21	40
		East Cantonments	11	21
		Teshie Nungua Estate	11	24
		Burma Camp	22	39
	TMA	Community Three	17	38
		Spintex Road	19	40
		Community One	14	30
Total		***8***	***115***	***232***
Second Class (IZ02)	AMA	North Kaneshie	12	26
		Dansoman	14	30
		Accra New Town	12	28
		Nungua	13	28
		Kwashieman	12	28
		Mataheko	12	25
		Abelemkpe	11	23
		Osu Ako-Adjei	10	22
	Ga Metropolitan Area	Ayi-Mensah	10	18
		Kwabenya	11	21
		Haatso	14	22
		Santa Maria	15	25
		Madina	11	24
		Awoshie	12	16
	Dangme East Metropolitan Area	Big Ada	12	26
Total		***14***	***181***	***362***

Table 3.1 continued: Description of suburbs, metropolitan/municipal area, income zones and number of participants

Income Zones	Metro Area	Community	Number of Households	Number of Participant
Third Class (IZ03)	AMA	Nima	9	31
		Bubuashie	14	26
		South Shiashie	9	22
		Maamobi	15	32
	TMA	Ashiaman Lebanon	7	20
		Kakasunanka	9	29
Total		***6***	***63***	***160***
Fourth Class (IZ04)	AMA	Teshie Old Town	12	27
	Dangme West Metropolitan Area	Ayikuma	13	27
Total		***2***	***25***	***54***
Grand Total		**30**	**384**	**808**

3.3.3 Study population

The study population were households in the Greater Accra region, a densely populated area with an estimated number of three million, nine hundred and nine thousand, seven hundred and sixty four (3,909,764)(Ghana Statistical Service, 2012) people comprising of 50.4% females and 49.6% males. The major ethnic groups were made up of 39.8% Akans, 29.7% Ga-Dangme and 18% Ewe. With regards to religion 83% were Christians, 10.2 % Muslims and 1.4% were practicing traditional religion (Greater Accra, Culture and social structure, 2006). All selected subjects aged between eighteen and seventy (18 to 70) years in the three hundred and eighty-four (384) households were included in the study.

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3.3.3.1 Inclusion and exclusion criteria

Eighteen (18) to seventy (70) year old male and female residents of the selected study sites with at least basic reading and writing skills but with no formal education in portion size control, and who were neither pregnant, nor on a therapeutically modified diet were included. Nutritionists, caterers, dietitians, professionals with knowledge in portion size control, pregnant women and those on therapeutically modified diets were excluded. The participants were either excluded or included in the study based on direct responses to verbal questions asked by the researcher in relation to the above criteria.

3.3.3.2 Sample size determination and sampling technique

The sample size of participants to be recruited from the three hundred and eighty four (384) previously calculated households for the first phase of the study (the survey phase) was calculated using the formula:

$$n = z^2 \frac{(p)(1-p)}{d^2}$$

(WFP and CDC, 2007)

Where 'n' is the sample size, 'z' is the percentile of the required confidence interval (1.96), p is the population estimate (0.6) and'd' is the allowable error (0.05). A minimum sample size estimate of 368 was obtained. A 10% non-respondent effect was used to comprehend the sample size,

=0.10 x 368 = 36.8

= 368 + 36.8 = 404.8

Using the default design effect (*deff*) of 2.0 (to achieve the same reliability that a simple random sample (*SRS*) would produce), the sample size was therefore calculated as:

404.8 × 2.0 = 809.6.
n= 810
(WFP/CDC, 2007)

Eight hundred and eight (808) participants participated. Males made up 401 (49.6%) and females 407 (50.4%). Simple random selection of suburbs and economic zones (Table 3.1) was done. Convenience sampling method was used for the selection of households and participants (Table 3.1). A structured pretested questionnaire (Appendix IV) was used to collect demographic data. The questionnaire requested participants to indicate their willingness to participate in a validation study. A three day food diary (Appendix V) was given out to participants to record foods consumed during two (2) week days and one (1) weekend. After this, recipe booklets were given to volunteers who opted to provide recipes (Appendix VI) for the carbohydrate foods consumed.

3.3.4 Pre-testing of questionnaire

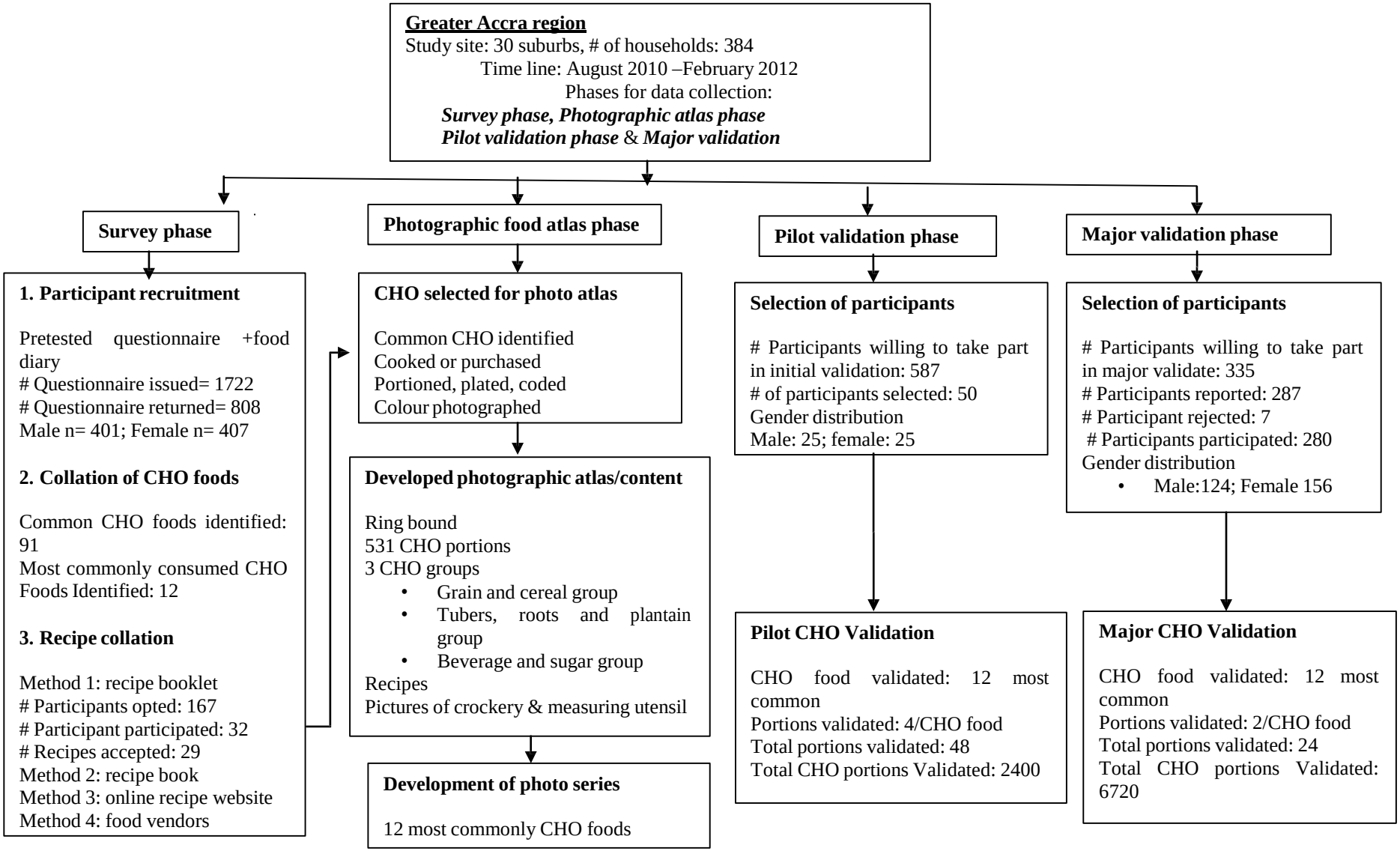
The socio-demographic questionnaire was tested among five (5) males and five (5) females conveniently selected to meet the study criteria from Kanda, a suburb identical to the selected suburbs. The questionnaire requested from the participants their socio-demographic information such as age, gender, ethnicity, religion, marital status, education level, health status, assessment of food aid; anthropometric measurements; height, weight and BMI. One participant had a problem with the question on food supplement. The participant was not sure if food supplement meant food given by health workers to children or mineral and vitamin supplement. The rest of

the participants indicated that they had no difficulty understanding the questionnaire. The question on food supplement was modified to read "Food aid". The questionnaire was adopted for use. Questionnaire was tested in June 2010.

3.3.5 Data collection

Data collection for this phase of the study took place between August and November of 2010 and was carried out in 30 suburbs of the Greater Accra Region within three hundred and eighty four (384) households. This phase of the study looked at methods used in subject recruitment, collation of commonly consumed carbohydrate foods and as well as recipes. It analyzed the types and percent distribution of carbohydrates identified and collated recipes to be used in the development of the photographic food atlas. A flow chart of data collection is shown below in Figure 3.2.

Figure3.2: FLOW CHART FOR DATA COLLECTION



3.3.5.1 Subject recruitment

The researcher recruited and trained ten (10) personnel made up of five (5) diet cooks and five (5) Senior high school graduates, one hour each day for a period of five days in July 2010. They were trained in interviewing skills to aid in data collection. Five (5) dietitians who either lived in or near some of the selected suburbs were also recruited as part of the research team that assisted in the recruitment of participants. These trained research assistants, together with the researcher and the five (5) dietitians formed the sixteen (16) member group that recruited the participants. The researcher sought the help of opinion leaders, assembly men and colleagues familiar to the selected suburbs to aid in the convenient selection of households. Prior to the distribution of the questionnaire, subjects were educated on the purpose of the study. Those who willingly opted to participate in the study and met the inclusion criteria were given informed consent forms to sign.

Four hundred (400) households were initially identified. An initial one thousand one hundred and two (1102) copies of the structured pretested questionnaires were given to participants by the researcher and trained research assistants from the beginning of August, 2010 to the end of September 2010. Questionnaires were left with participants for 10 days. Among the households that were conveniently selected, three percent (3%) of the households could not be contacted because they had moved, twenty eight percent (28%) of the selected households either did not complete the forms, or had their forms rejected by the researcher and the assistants due to repeated omission in the recording of eating occurrences or because they had misplaced them. Six hundred and fifty-three (653) questionnaires were completed and returned by volunteers from two hundred and seventy six (276) households representing 69% of selected households. In October of the same year another set of six hundred and twenty (620) questionnaires were distributed to participants in two hundred and eighty (280) conveniently selected households

within the same suburbs by the researcher and the trained research assistants. One hundred and fifty-five (155) questionnaires were completed and returned by volunteers from 108 households. A total of 808 questionnaires were completed by 384 households. Questionnaires were collected at the weekends to ensure that a larger number of participants were available. At least one member of each household selected was the main food preparer except for eight (8) households with a total of fifteen (15) members where none of the participants cooked but food was purchased for all their meals.

3.3.5.2 Data collection instrument

All eight hundred and eight (808) participants completed a pre-tested questionnaire which required socio-demographic information such as age, gender, educational level, and ethnicity, sources of income, religious affiliation, occupation, and mental health status. The questionnaire required participants to indicate their willingness to take part in the validation process (third phase of the study). Five hundred and eighty-seven (587) participants accepted to be part of the validation study.

3.3.5.3 Anthropometric measurement

Anthropometry is the single most universal inexpensive, noninvasive method used to assess the size, proportion and composition of the human body and is a reflection of inadequate or excess food intake among other parameters (WHO, 1995). The anthropometrical parameters measured for the portion size determination and the validation phases of the study included weight in kilograms, height in meters and BMI as a measure of weight in kilograms divided by the height in metre squared. The anthropometric measurements were compared to reference standards. For this study, the reference values were based on WHO (2012c) criteria which define underweight

as a BMI ($\leq$18.5kg/m^2), healthy weight (18.5 – 24.99 kg/m^2), overweight (25 – 29.99 kg.m^2) and obese ($\geq$30kg/m^2). Weights and heights were recorded by researcher and trained research assistants for all participants.

3.3.5.3.1 Weight

The weights of participants were measured by the researcher and trained research assistants at the time of questionnaire distribution in duplicate to the nearest 0.1 kg, using a Seca 767 electronic scale (Vogel, Hamburg, Germany), with participants standing erect. Participants were in light clothing, and were asked to remove jackets, shoes and all other heavy objects including phones before standing on the scale.

3.3.5.3.2 Height

The heights of participants were measured also at the time of questionnaire distribution in duplicate to the nearest 0.1 cm with a portable stadiometer attached to a Seca 767 electronic scale. Participants stood upright against the stadiometer with the back of their heels and occiput touching the wall of height measure. The body mass index was calculated for each participant using their height and weight data collected.

3.3.6. Collation of commonly consumed carbohydrate foods

The commonly consumed carbohydrates foods were collated based on the following three groups: cereals and grains group, roots, tubers and plantain groups and the sugar and beverage group. The researcher defined commonly consumed carbohydrate foods as carbohydrate based foods that were consumed at least two times during the two week-day and one week-end when meals were recorded. Any carbohydrate based food that did not fit this criterion was not included in the Photographic Food

Atlas.

3.3.6.1Assessment of carbohydrate foods

In order to collate the types of carbohydrate based foods consumed by the participant, a method of dietary assessment must be employed. Dietary assessment methods can be prospective or the assessment can be retrospective in nature. Six commonly used techniques that aid in assessing dietary intake, have been recognized and they are as follows: (a) 24-hour dietary recall, (b) food frequency questionnaires, (c) in-depth diet histories, (d) estimated food records, (e) direct observation with weighed food records and (f) biomarker measurements of targeted nutrients (Fowles, et al., 2007).

The 24 Hour Recall method of dietary assessment is interview based and requires participants to report all food and beverages consumed during the day before the interview. The interview may either be in-person or by telephone (Casey et al., 1999; Buzzard et al., 1996) or computer assisted (USDA, 2010) or self-administered electronic based (Arab et al., 2011; Arab et al., 2010; Sallis and Owen, 2002). This method requires the interviewer to have extensive knowledge in nutrition and diet. The 24 hour recall is a better representation of the consumption patterns of populations. This method, however, has been found to have problems with interview skills, knowledge in diet and memory and these have led subjects to under-report or over-report (Thompson and Subar, 2010).

The Food Frequency Questionnaire (FFQ) is an inexpensive usually self-administered method of dietary assessment that requires subjects to record the frequency of consumption of different foods for a particular time frame. Information on food characteristics such as food combinations and methods of preparation and sometimes portion sizes are not requested for (Thompson and Subar, 2010). According to Prentice *et al.*, (2011), Preis *et al.*, (2011) and Kipnis *et al.*, (2003) this method of dietary assessment is fraught with a huge amount of measurement errors due to lack of portion sizes estimation.

The Diet History is either a one-on-one interviewer based (Thompson and Subar, 2008) or a computer based method of dietary assessment which may or may not require an interviewer (Murtaugh *et al.*, 2010; Preis, *et al.*, 2001). This method of dietary assessment requires participants to provide information on details of the types of foods consumed, their preparation methods and frequency of consumption over a long time frame. It is a costly method of dietary assessment which has been found to be difficult to reproduce (Thompson and Subar, 2010).

The Food Record approach to dietary assessment requests participants to give in detail the types and amounts of all foods and beverages consumed over one or more days. These multiple day records are usually done consecutively. Records that exceed four days have been found to increase participants' burden and therefore reduce accuracy. The food record is to be done at time of eating. Quantities consumed are required to be given in household measures, weights, models or as portions. The food record is likely to provide accurate information on quantities of food consumed, however, it requires that respondents be literate (Thompson and Subar, 2010).

In dietary assessment, Nutritional Biomarkers according to Potischman and Freudenheim (2003) '… can be any biological specimen that is an indicator of nutritional status with respect to intake or metabolism of dietary constituents. It can be a biochemical, functional or clinical index of status of an essential nutrient or other dietary constituent'. These biomarkers reflect the current or long term characteristics of nutritional status and so cannot be seen as a direct link between current food consumption and biomarker value. Because nutritional biomarkers are explicit to particular nutrients, it becomes costly and therefore is not the best choice for dietary assessment (Thompson and Subar, 2010).

The most accurate technique also known as the 'gold standard' for assessing food intake is the weighed food method. However, the weighed food method and biomarker measurements of targeted nutrients have been found to be expensive, cumbersome, time consuming and increase subjects' burden (Fowles, *et al.,* 2007;Turconi *et al.,* 2005).

Although the estimated food diary, a prospective method has its limitations with some of the weaknesses as mis-reporting (Thompson *et al.,* 2010; Thompson and Subar, 2008) and high participant burden (Wrieden *et al., 2003*), this method of dietary assessment was selected because it best satisfied the purpose of this part of the study. It is a written record that includes actual intake of foods and beverages recorded at the time of consumption. It is usually for periods of 3, 5, or 7 days and weights of foods are estimated using household measures (such as cups, ladles, and spoons), food models or picture. The multiple days estimated food record which is considered as a more representative measure compared to a single day record (Thompson and

Subar, 2008) was selected. This method is likely to provide accurate information on portions sizes of food consumed (Thompson and Subar, 2008).

Participants were each given a food diary (Appendix V) and were also educated on how to use the food diary by the researcher and her assistants. Participants recorded all carbohydrate based foods eaten on two week-days and one week-end in the food diary. They also indicated in the food diary if the food was prepared or bought. Also recorded in the food diary was the identity of the person who prepared the food or the area/shop where the food was bought. Foods recorded in the food diary excluded special occasion foods but included descriptions of brand names if applicable and for mixed dishes, the main carbohydrate ingredients in the recipe. The three day period of recording which included 2 weekdays and one weekend was chosen because the degree of participant's burden increased with number of record days. This was also to ensure that differences in food intake between the days of the week were accounted for (Thompson and Subar, 2008)

3.3.6.2 Recipe collection

One hundred and sixty-seven (167) of the participants accepted to provide recipes and were given recipe booklets (Appendix VI) after they had been educated on how to complete them. Participants were shown a variety of household measures that had been identified by Owusu *et al*, (1995) as sources of measuring aids for a variety of carbohydrate foods. Participants were then asked to use whichever utensil they found appropriate as a source of measure, in recording their recipes. Thirty-two participants completed and returned recipe booklets. Three (3) recipe booklets were rejected because recipes did not have measure or were incomplete. Some

participants used kitchen scales whilst others used the household measures to estimate quantities of the ingredients used in preparing their carbohydrate based foods. These included:

Cups for oil, flour, water, soft drinks

Sardine tin size for yam, bread, kenkey

Egg size for corn dough, potato,

Small tomato-puree tin size for gari, flour, plantain

Soup ladles for porridges, soups, and oils

Orange size for Banku, Tuozarfi, Fufu

Stew spoons for Stews, Rice,

Tea spoon, dessert spoon and table spoon for sugar, jam, jelly

3.4 DEVELOPMENT OF THE PHOTOGRAPHIC FOOD ATLAS

This phase of the study looked at the development of the Photographic Food Atlas. Materials and methods used for carbohydrate selection, the determination of number of portions per carbohydrate selected, the preparation of selected foods, the picture taking process and the development of the photographic food atlas are discussed under this section. Information on the type of crockery selected for the plating of the cooked food is also included.

3.4.1 Carbohydrate selection

The carbohydrate based foods selected for the photographic food atlas were those identified as commonly consumed by the researcher. A total of ninety one (91) carbohydrate foods were identified. Sixty seven (67) of the selected foods had the following characteristics:

- Foods with differing portion sizes that ranged from very small to very large and were difficult to distinguish between portion sizes, or those that had irregular shapes or sizes and were not marketed in specific amounts.
- Carbohydrates that were similar in appearance but had different ingredients and or shapes and therefore affected macronutrient content.

3.4.2 Preparation of food for picture development

Three (3) each of all the carbohydrate based food identified in the food diary were purchased from three (3) different parts of Accra Metropolitan area, namely Accra central, 37/Nima and Spintex Road or cooked by the researcher in her house. A total of nine (9) purchases were made for each carbohydrate food and the average weight of the nine (9) foods was calculated (Appendix VII). This average weight served as the standard weight from which weights of initial portion sizes were determined. Recipes collected (Appendix VIII) from participants, food vendors, on-line (Recipes, 2010) and recipe book by Amoako-Kwakye, (2010) were used to cook the food. Measuring utensils used were identical to those used in the collated recipes.

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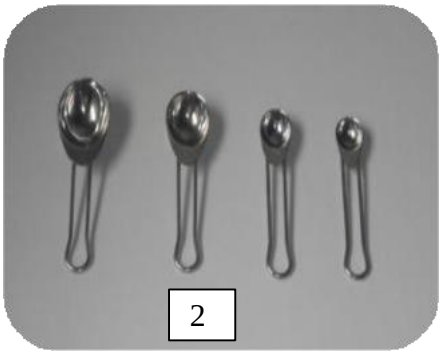
3.4.3 Portion size determination

Sixty-two (62) of the ninety one (91) foods were portioned into eight (8) different portion sizes each, as fewer photographs have resulted in loss of accuracy (Nelson *et al.*, 1996). The

remaining twenty nine (29) foods had twenty four (24) of the foods captured in single portions, four (4) captured in two (2) different portions and one (1) represented in three different portions. Measuring utensils (Figure 3.3) such as soup ladles, stew spoons, measuring cups of different volumes, measuring spoons of different volume, empty sardine tin, empty tomato puree tin were the utensils used to measure out the portion sizes or used as standards by which portion sizes were measured. The researcher's selection of measuring utensils was based on measuring utensil used by participants in recording their three (3) day food intake. Each portion was weighed three (3) times with a Beurer KS52 (BEURER GmbH, Germany) wall kitchen scale of 5 kilogram capacity and 1 gram graduation and the mean calculated and recorded as the weight for that portion.

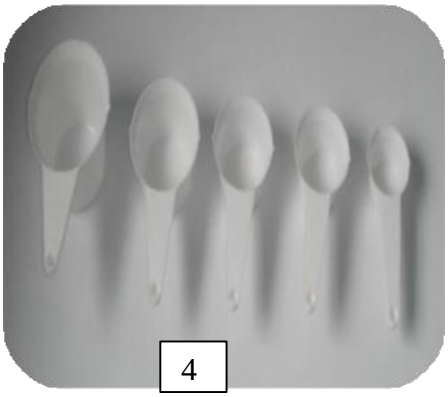
Figure 3.3: Measuring Utensils

1



2

3



4

5

Each set of measuring utensils are labeled from left to right

1. Stewing Spoon and Ladle
2. Table spoon, Dessert spoon, Teaspoon, Half teaspoon
3. Sardine tin (125 mls), tomato puree tin (70 grams)
4. 1 Cup (250 mls), ½ cup, ⅓ cup, ¼ cup, ⅛ cup
5. Beurer Scale

In Ghana, recommendations of healthy dietary guidelines for Ghanaians that allow for nutrient standards, based on Recommended Dietary Allowances (RDA) of food groups, are not available. The availability of these recommendations would make it easier for comparisons of nutrient and caloric content of similar foods and therefore the development of appropriate "serving size" of the various foods for the Ghanaian populace. These serving sizes would then aid in the determination of portion sizes. Due to the lack of these guidelines and therefore standard serving sizes, the initial portion sizes of the various foods were based on portion sizes from the Food Weights/Handy/Measures Tables booklet (Owusu *et al*., 1995), Food exchange lists of local foods in Nigeria, (Fadupin, 2009) and The Exchange List for Meal Planning (Mahan and Escott-Stump, 2008). For some amorphous foods not found in any of the references indicated above, portion sizes were either of the food as sold or fractions of food as determined by the researcher. From the initial portion size, each subsequent portion size was increased by one portion size. All foods were cooked in the kitchen of the researcher.

3.4.4 Interval size determination for photographs

The interval between images according to Nelson and Haraldsdottir, (1998a) should be the …'product of the range divided by the number of images'. The interval size of food portions was calculated based on the formula below:

$$A = \frac{N\ xM}{X} = \frac{1\ x8}{8} = 1,$$

Where N = initial range (1), M = last range (8) X = number of images and A = Interval (Nelson and Haraldsdottir, 1998a). Each food portion was placed in appropriate crockery such as on a

white dinner plate, cereal bowl, fufu bowl, sugar bowl or in a 420 milliliter Willy plain drinking glass. The dimensions of utensils used are shown in Table 3.2

Table 3.2: The dimensions of the plates and bowls

Utensils	Upper diameter (centimeters)	Lower diameter(centimetres)	Depth (centimetres)
Glass	24	19	14
Flat dinner plate	27	20	1
Cereal bowl	23	10	6
Fufu bowl	28	14	6
Sugar bowl	11	6	5

3.4.5 The taking of food photographs and development of photographic food atlas

Individual food portions were plated in their appropriate crockery (Figure 3.7). Each plated food portion was then placed in the middle of a square white topped table with a width of 90 centimeters. The camera was positioned at a distance of 72.8 centimeters from the food source and a height of 66.8 centimeters from top of table. Coloured photographs were taken from the top of the food at an angle of 47.5 degrees with a Fujifilm FinePix 270, compact camera with 12 megapixel resolution and Fujinon 5x optical zoom lens, F4.0 (Wide) - F4.8 (Telephoto). The angle was calculated using Cleave books right angle on line calculator, version 1.4 (http://www.cleavebooks.co.uk/scol/calrtri.htm). The pictures taken were put on a computer and photographs were captured, cropped and formatted. Eight (8) coloured pictures that made up the different portion sizes of each carbohydrate food were put on one A4 page (210 x 297 mm) as it provided the largest amount of useful information in the least amount of space (Nelson and Haraldsdottir, 1998a). Single portion foods such as a biscuits that were sold in defined units, two

portion foods such as tatale and three portion foods such as sausage rolls that were prepared using the same recipes but had different shapes were each captured on a single A4 sheets (Figure 3.4, 3.5 and 3.6)

Figure 3.4: Biscuit in single portions

Figure3.5: Tatale in two portions

Figure 3.6: Sausage rolls in three portions

A total of ninety one (91) carbohydrate based foods were identified. Sixty-two (62) of the carbohydrate foods were captured in eight (8) portions, twenty four (24) in single portions, four (4) as two portions, and one (1) as 3 portions. A total of five hundred and thirty one (531) carbohydrate portions were captured in the photographic food atlas. All food photographs captured on A4 sheets were coded (Appendix IX), laminated and ring bound into an album, the **Photographic Food Atlas** (Addendum I). Included in the photographic food atlas are coloured pictures of crockery and measuring utensil, captured and laminated on A4 sheets. The twelve most commonly consumed carbohydrate based foods identified from the ninety one (91) coded carbohydrate foods were also captured in colour in portions of eight (8) each, and laminated on A4 sheets and used as photographic series for validation. A most commonly consumed carbohydrate food was defined by the researcher as any of the ninety one (91) carbohydrate foods identified which made up 10% or more of the breakfast, lunch or supper meals at the end of the three day recording period.

Figure 3.7: Crockery

Cereal Bowl

Fufu Bowl

Flat Plate

Sugar Bowl

Glasses

A sample photographic series is shown in Figures (3.8) and Figure (3.9).

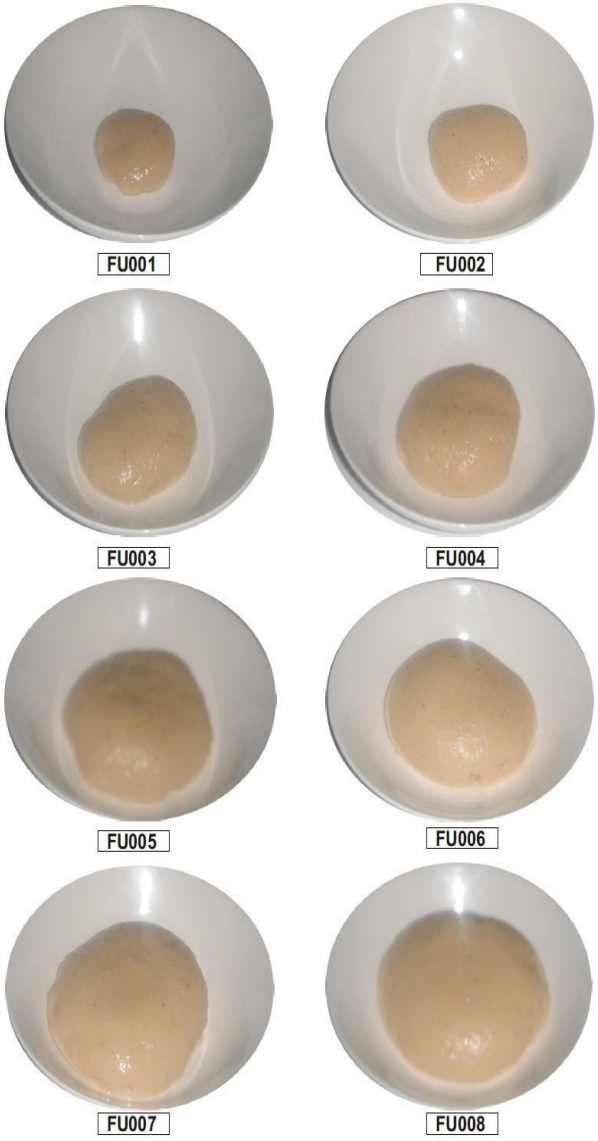


Figure 3.8: Photo Series of Fufu

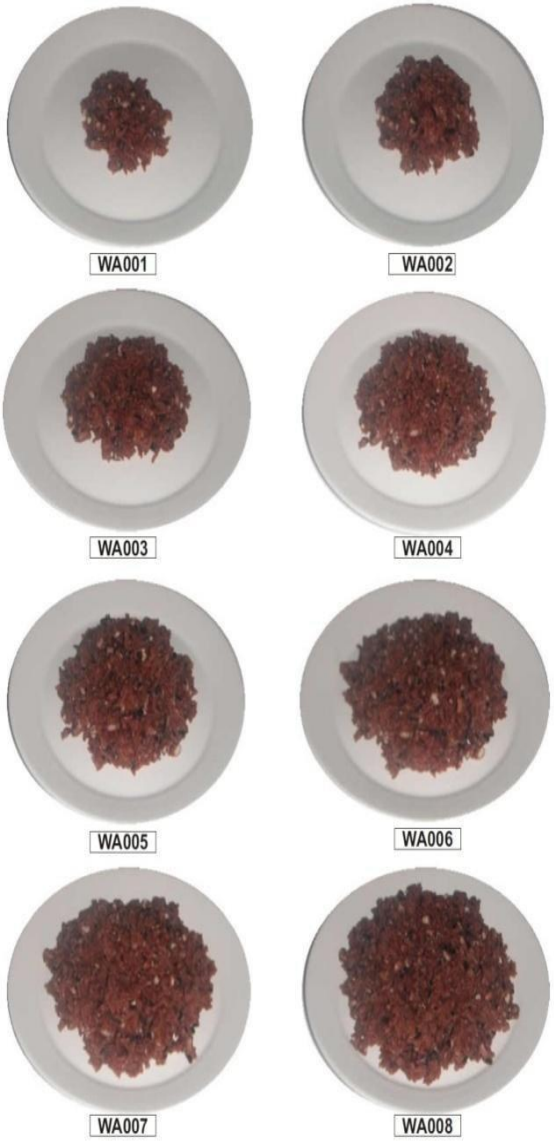


Figure 3.9: Photo Series of Waakye

3.5 VALIDATION OF THE PHOTOGRAPHIC FOOD ATLAS

A pilot study of the photographic food atlas which involved 50 participants comprising of 25 males and 25 females was undertaken prior to the major validation study. This section looks at the processes involved in the pilot study.

3.5.1 Pilot validation-background

The aim of the pilot study was to pre-test the study protocol designed and to assess the statistical viability of the protocol devised to validate the major study. The study saw the participants identifying from the photographic food series; selected plated portion sizes of the twelve most commonly consumed carbohydrate based foods. Records of the plated foods and the selected corresponding portion size in the photographic food atlas were kept. The feasibility of the photographic food atlas as a PSMA based on age gender and BMI was assessed through statistical analysis. Statistical analyses were performed using SPSS software, version 17 for windows (Statistical Package for Social Sciences, Chicago Illinois, USA). Frequency distribution, percentiles and standard deviations were used to summarise categorical and continuous variables (age, gender, BMI, Age range, most commonly consumed carbohydrate based foods, estimation of most common carbohydrate based foods). Pearson's Chi-square tests and two-sample t-test with equal variances were used to compare individual and overall carbohydrate estimation by male and female participants. The study was a cross-sectional one among survey participants. It was carried out in the third week of May 2011.

3.5.1.1 Subject selection

Subjects in this study were selected from the five hundred and eighty seven (587) participants from the first phase of the study who agreed to take part in this arm of the study. To reduce burden of travel on participants to the validation venue, subjects were selected from Neghelli barracks (37 Military Hospital) and Maamobi. A 'Type A' validation study which is useful in developing photographic series (Nelson and Haraldsdottir, 1998b) was employed. Twenty five (25) male and twenty five (25) female subjects were conveniently selected because according to Nelson and Haraldsdottir, (1998b) "as a rule of thumb (in order to obtain adequate diversity in subject characteristics and abilities" at least 50 subjects with equal gender distribution should be part of a 'Type A' validation study as this would ensure that the selected subjects represent the population for whom the photo atlas was intended. A 'Type A' study according to the researchers is useful especially in developing a photo series. The selection of participants was also based on the percentage to sex ratio indicated from the demographic data collected.

3.5.1.2. Selection and preparation of carbohydrate foods for validation

Four (4) portions sizes out of eight (8) portions were randomly selected for each of the twelve (12) most commonly consumed carbohydrate foods (Table 3.3). Each selected portion was weighed to correspond to the weight of identical portion in the food photographs. The weighed foods were then placed in crockery identical to those in the food atlas for which similar foods were plated. Codes were inscribed under each of the plated portion. These codes corresponded to codes ascribes to identical food portions in the photographic food atlas. Each set of four (4) plated portions of identical foods were placed on one table. This brought the total number of carbohydrate portions for validation to forty-eight (48) and number of tables to twelve (12).

Different codes from those inscribed under the plates were placed in front of each plated carbohydrate portion (Appendix X) to avoid bias in portion estimation. On a different table the researcher placed two (2) identical photo series. Each photo series had pictures of the displayed foods in eight (8) portions. The table with the photo series was placed opposite the table with its corresponding displayed food. This trend was repeated for all foods. A total of twenty-four (24) photo series were placed on twelve (12) tables.

Table 3.3 Selected portion sizes of carbohydrate based foods for pilot validation

Carbohydrate Based Foods	Portion size	Portion size	Portion size	Portion size
Chocolate drink	1	2	5	8
White bread	2	3	5	8
Boiled rice	1	5	6	8
Ga kenkey	1	3	5	8
Granulated sugar	1	3	5	6
Corn porridge	2	4	6	7
Waakye	2	3	5	6
Gari	1	4	7	8
Boiled yam	1	2	3	4
Boiled plantain	1	2	5	6
Banku	3	5	6	8
Fufu	2	4	6	7

3.5.1.3 Validation Procedure for Photographic Series

The validation took place in a big house at Cantonments a suburb of the Greater Accra region. Tents were erected under which carbohydrate based foods and photo series were displayed for validation. Tents were also erected and chairs provided for participants to sit and wait their turn for validation. Some researchers had had carried out similar studies in laboratories (Brunstrom *et al.*, 2008; Foster *et al.*, 2006), school cafeterias (Williamson *et al.*, 2004) and in homes

(Elwood and Bird, 1983). On the day of validation all fifty (50) participants reported to the designated venue. The participants were again educated on the reasons for the validation and instructed on the procedure to use in the study. They were then given the option to participate or withdraw from the study. . All participants opted to stay. The weight and height of participants were recorded as done in the first phase of the study. They were then issued with Pilot Participant's Validation Record Forms (Appendix XI). Each participant had to first assess one plated carbohydrate portion at a time. The code for the assessed food was then written in its corresponding column on the Validation Record Form by the participant. The participant then validated the assessed portion against the photographic series. This the participant did by choosing the portion in the photo series which the participant believed best represented the portion of the plated carbohydrate food assessed. The corresponding code in the photo series were recorded by the participant in its assigned column on the Validation Record Form. The participant repeated this process for all carbohydrate portions. Thirty-two (32) of the participants representing 64% claimed that the number of validations they had to make made them tired. This they alleged might have affected their perception in the estimation of the portion sizes. Based on data analysis of results obtained, (section 4.6) from the pilot study the photographic food atlas was deemed statistically viable to be used as a PSMA. A major study to further validate the photographic food atlas was undertaken.

3.5.2 Major validation

This phase of the study was a follow up to the pilot study that validated the photographic food series. It reported on a larger validation study using the photographic food atlas. The study assessed the feasibility and efficacy of the developed Photographic Food Atlas as a PSMA when

gender, BMI and age were considered. Data collected were statistically analyzed to assess the viability of the photographic food atlas as a portion size measurement aid. Categorical variables were summed up as in pilot validation. The one-way analysis of variance (ANOVA) was used to determine the significant differences between sex-specific age profile, sex-specific BMI profile and BMI profile and estimation of carbohydrates. The study was carried out on 11th February 2012. All participants from the thirty (30) suburbs who volunteered to participate in the validation study were recruited by phone or in person.

3.5.2.1 Subject Recruitment

Five hundred and thirty-seven (537) participants from the survey study who opted to be part of the validation study but did not take part in the pilot validation study were either invited through phone calls or personal visits. Three hundred and thirty-five (335) participants accepted the invitation to participate. On the day of the validation two hundred and eighty seven (287) participants reported. One hundred and ninety-three (68.93%) of those who reported were from the Accra Metropolitan Area. Seven (7) participants were excluded because they did not meet the inclusion criteria as stated earlier (section 3.3.3.1); of the seven (7) participants excluded, three (3) were pregnant and four (4) were on therapeutic diets. One hundred and twenty-four (124) males and one hundred and fifty-six (156) females were recruited. Although selection was to be based on the percent male and female ratio and age to sex ratio indicated from the demographic data collected, more female subjects reported on the day of validation than males.

3.5.2.2 Selection and preparation of food for validation

The twelve (12) most frequently consumed common carbohydrate foods collated from food diaries and used for the pilot validation were selected for use in the major validation of the photographic food atlas. In order to reduce the burden of tiredness expressed by the participants in the pilot validation, two portion sizes were randomly selected from the four (4) portions selected for the pilot validation (Table: 3.3) bringing the total to twenty four (24) portions instead of forty eight (48) portions (Table: 3.4).

The carbohydrate based foods were either purchased or cooked as done in the pilot validation study. Each of the selected portions was weighed, plated, coded as done in the pilot validation. On a table two (2) different portions of one type of carbohydrate food was placed. This brought the total number of carbohydrate food to twelve (12) and the number of portions to twenty-four (24) portions. A set of photographic series depicting a selected carbohydrate food for validation was placed on a table identical to that used for the cooked food portions. The table with the photographic series was then placed opposite the corresponding table with portions of its identical cooked food. This was repeated until all food portions displayed had their corresponding photographic series. Each photographic series had eight coded carbohydrate portions. Coding of plated foods was done as in the pilot validation study (section 3.5.1.2). This arrangement was repeated three times for both displayed foods and photo series to facilitate accessibility of food portions and photo series to participants. This was done to prevent queues and therefore reduce participants' burden.

Table 3.4 Selected portion sizes of carbohydrate based foods for major validation

Carbohydrate food Item	Selected Portion	Selected Portion
Banku	3	6
Bread (white)	3	5
Chocolate Drink	8	1
Corn Porridge	7	4
Fufu	6	4
Gari	4	1
Kenkey (Ga)	5	1
Plantain (boiled)	2	6
Rice (boiled)	5	1
Sugar (granulated)	5	6
Waakye	6	5
Yam (boiled)	3	2

3.5.2.3 Validation of photographic food atlas

The researcher recruited all the five dietitians and four of the previously trained research assistants for this phase of the study. Participants were instructed on procedure for validation after which each participant was given a Major Study Validation Record Forms (Appendix XII). Each participant's age, gender, and anthropometrics were recorded by the researcher and her research assistants on participant's Major Study Validation Record Forms. The anthropometric parameters measured for this phase of the study were done as in the pilot validation. Procedure for validation was again explained to participants by the researcher and her assistants, after this each participant was issued with his/her Major Study Validation Record Forms on which the participant's code number, age, gender, height, weight and BMI had been recorded. Each participant assessed all plated food portions of each carbohydrate food one at a time. The code for each plated food was recorded by participants on the Major Study Validation Record Forms

immediately after assessment. After each assessment, participants moved to the table with the sets of photographic series, assessed and recorded on the Major Study Validation Record Forms, the code of the portion in the series that the participants thought was identical to the plated food portion previously assessed. Participants were given breaks of 3-5 minutes if they so wished. Participants were not allowed to discuss their perceptions of food portions and validation results with other participants. The researcher rented the premises of the Warrant Officers' and Sergeants' Mess of the 37 Military Hospital for the validation which took place from 9:00am in the morning to 5:00pm in the evening.

CHAPTER FOUR

4.0 RESULTS

This section reports on results obtained on participants' socio-demographs and use of food aids. It also reports on results obtained for the pilot and major validations.

4.1 BACKGROUND CHARACTERISTICS OF PARTICIPANTS

A total of 808 participants of which 49.60% (401) were males and 50.40% (407) were females were recruited into the study. Seventy three percent (581)) of the participants were aged 25-54years: 27.60% (223) were within age range 25-34); 216 (27.00%) within 35-44 years and 17.50% (142) were aged 45-54. Three hundred and eighty-six (47.8%) were married whiles 61% (6.9%) were widowed. All participants had some form of education; the majority of them (338; 41.8%) had post-secondary/tertiary education and 56 (6.9%) had post tertiary education. Most participants (634; 78.46%) were Christians, 94 (11.63%) were Muslims, 34 (4.21%) traditionalist and 46 (5.69%) participants practiced other religions. Three hundred and twenty one 39.73%) of the participants were Akans, 225 (27.85%) were Ga/Dangme, 138 (17.08%) were Ewes, 59 (7.30%Mole/Dagbani, 18 (2.23%) Guan and 47 (5.81) were from other ethnic groups (Table: 4.1).

Most participants had monthly income levels between two hundred (200) and one thousand five hundred (1,500) Ghana cedis. Approximately, twenty nine percent (29.46%) of participants had monthly income ranging between two hundred (200) and five hundred (500) Ghana cedis followed by 24.80% with income between five hundred and one (501) to one thousand (1,000) Ghana cedis. Just a little over eighteen percent (18.10%) of the study population recorded an income level of one thousand and one (1,001) to one thousand five hundred (1,500) Ghana cedis. A few (9.70%) of participants had monthly income levels above one thousand five hundred (1,500) Ghana cedis (Figure 4.1).

All the participants (808, 100%) reported that they had good mental status. About half of the participants 412 (51%) stated that they had excellent mental status, 372 (46%) had good mental status and 24 (3%) indicated that they had fair mental status. (Figure 4.2).

Table 4.1: Socio-demographic characteristics of participants in survey study

VARIABLE	FREQUENCY (n=808)	PERCENTAGES
Gender		
Male	401	49.6
Female	407	50.4
Age Group (Male)		
15-24	42	10.5
25-34	94	23.4
35-44	118	29.4
45-54	90	22.4
55-64	43	10.7
> 64	14	3.5
Age Group (Female)		
15-24	64	15.7
25-34	129	31.7
35-44	98	24
45-54	52	17.5
45-54	52	17.5
Marital Status		
Never Married	266	32.9
Currently Married	386	47.8
Separated/Divorced	100	12.4
Widowed	56	6.9
Highest Education		
Middle/Junior High	228	28.2
Secondary/Senior High	186	23
Post-Secondary/Tertiary	338	41.8
Post Graduate	56	6.9
Religion		
Christian	634	78.47
Moslem	94	11.63
Traditionalist/No religion	34	4.21
Others	46	5.69
Ethnicity		
Akan	321	39.73
Ga-Dangme	225	27.85
Ewe	138	17.08
Mole/Dagbani	59	7.3
Guan	18	2.23
Others	47	5.81
Food Aid		
Yes	10	1.24
No	790	98.76

Figure 4.1: Distribution of income levels for participants in Ghana cedis

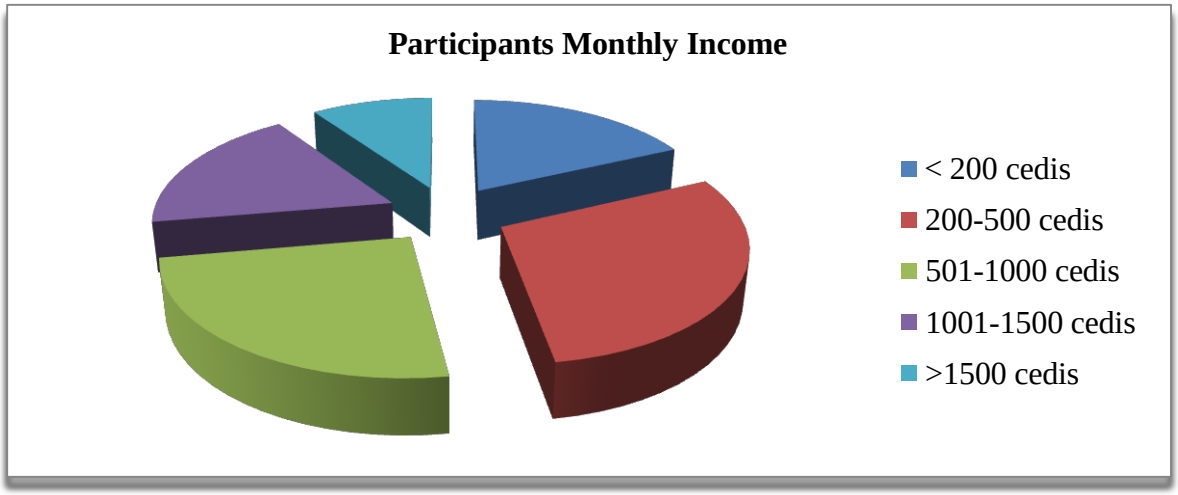
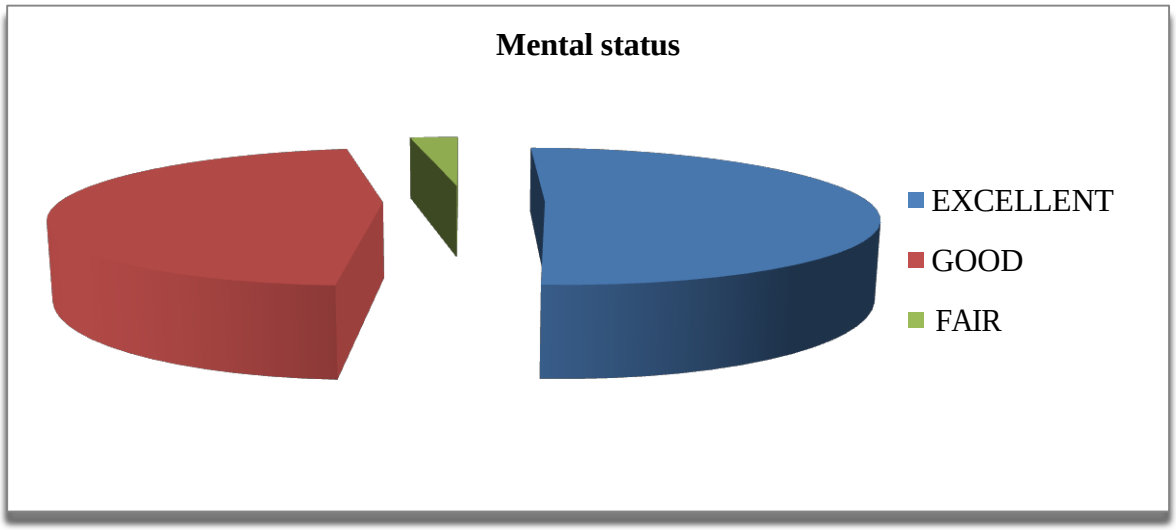


Figure 4.2: Mental status profile of participants



4.2 ANTHROPOMETRIC MEASUREMENT AND AGE PROFILE OF PARTICIPANTS

The mean height of all participants was 1.69 metres, mean weight was 74.50 kilograms and BMI was 26.15 kg/m². On average, males were taller and heavier (height, 1.72; weight, 76.51 kg) than females (height, 1.65cm; weight 72.50kg). The average BMI for females was higher (26.50kg/m²) than that of the male participants (25.79 kg/m²). The average age for males was 44.07 years and that of females was 43.99 years (Table 4.2).

None of the male participants was underweight however, one female participant was underweight. The highest proportion of males with normal weight (47; 11.72%) was found within the 25-34 year range. The most overweight (71; 17.70%) and obese (7; 1.75%) males were found within the 35-44 age range and 45-54 age range respectively (Table 4.3). The age range with the least number of normal weight (4; 0.99%) and overweight (10; 2.49) male participants was the over 64 year range. The only underweight female participant (1; 0.25%) was recorded in the 15-24 year range. The highest proportion of normal weight (52; 12.77%) and overweight (69; 16.95%) females were in the 25-34 year range with the highest number of obese individuals (14; 3.44%) recorded in the 35-44 year range. Participants aged over sixty four (64) years had the least normal weight (4; 0.98%), overweight (14; 3.44%) and obese (4; 0.98%) individuals (Table 4.4). The differences between the weights of females (mean=72.50±2.97kg; *P=0.001*) and the BMI for both gender (male, mean=25.79 kg/m^2; *P=0.001* and female, mean=26.5 kg/m^2; *P=0.001*) were statistically significant, however, mean height for both genders were not (Table 4.2). BMI categories for the age ranges were statistically significant for both genders (Male, P = 0.039; Females P= 0.001).

Table 4.2: Distribution of mean height, weight and BMI among participants

Categories	Mean Height ± STDEV	P-value	Mean weight ± STDEV	P-value	Mean BMI ± STDEV	P-value
Male	1.72 ± 0.015	0.203	76.50 ± 1.15	0.217	25.79 ± 0.715	0.001
Female	1.65 ± 0.007	0.865	72.49 ± 2.97	0.001	26.49 ± 1.030	0.001
Overall	1.68 ± 0.039		74.50 ± 3.00		26.14 ± 0.92	

ANOVA: BMI classification (WHO, 2012) BMI < 18.5 kg/m² (underweight), 18.5 kg/m² – 24.99 kg/m² (normal) 25 kg/m² – 29.99 kg/m² (overweight), ≥30 kg/m². Height (meters), weight (kilograms), BMI (kg/m²)

Table 4.3: Distribution of height, weight and BMI for age range and gender

Age Groups	n (%)	Ht (m) mean±sd	Wt (kg) mean±sd	BMI (kg/m2) mean±sd
		Male (n=401)		
15-24	42 (10.5)	1.75± 0.09	76.10 ± 8.84	24.97 ± 2.81
25-34	94 (23.4)	1.73 ± 0.08	74.37 ± 7.51	24.84 ± 2.12
35-44	118 (29.4)	1.72 ± 0.09	76.99 ± 8.72	25.93 ± 2.49
45-54	91 (22.7)	1.71 ± 0.09	76.81 ± 8.30	26.19 ± 2.15
55-64	42 (10.5)	1.71 ± 0.09	77.25 ± 9.08	26.53 ± 2.58
> 64	14 (3.5)	1.72 ± 0.08	77.52 ± 5.89	26.30 ± 2.09
P-value		*P= 0.203*	*P= 0.217*	**P= 0.000*
		Female (n=407)		
15-24	66 (16.2)	1.65 ± 0.07	67.64 ± 9.72	24.86 ± 3.06
25-34	127 (31.2)	1.65 ± 0.06	70.05 ± 8.09	25.59 ± 2.58
35-44	98 (24.1)	1.66 ± 0.06	74.45 ± 8.59	26.98 ± 2.69
45-54	52 (12.8)	1.65 ± 0.06	74.05 ± 10.67	27.10 ± 3.65
55-64	42 (10.3)	1.66 ± 0.07	75.18 ± 10.12	27.49 ± 3.30
> 64	22 (5.4)	1.64 ± 0.07	73.61 ± 8.82	26.97 ± 2.46
P –value		*P= 0.865*	**P= 0.000*	**P= 0.000*

ANOVA *P < 0.05 significantly different when compared among age range Ht = height (meters); Wt = weight (kilograms); BMI classification (WHO, 2012c). BMI < 18.5 kg/m² (underweight), 18.5 kg/m² – 24.99 kg/m² (normal), 25 kg/m² – 29.9 kg/m² (overweight), ≥30 kg/m²

Table 4.4: Sex specific age profile by BMI categories

Age Groups	n (%)	BMI (Mean±sd)	Under weight n (%)	Normal weight n (%)	Over weight n (%)	Obese n (%)	P -value
			Male (n=401)				
15-24	42 (10.5)	24.97 ± 2.81	0(0.00)	21(5.24)	1 9(4.74)	2 (0.50)	***P*=0.039**
25-34	94 (23.4)	24.84 ± 2.12	0(0.00)	47(11.72)	45 (11.22)	2 (0.50)	
35-44	118 (29.4)	25.93 ± 2.49	0(0.00)	41(10.22)	7 1 (17.70)	6 (1.49)	
45-54	91 (22.7)	26.19 ± 2.15	0(0.00)	26(6.48)	58 (14.46)	7 (1.75)	
55-64	42 (10.5)	26.53 ± 2.58	0(0.00)	10(2.49)	29 (7.23)	3 (0.75)	
>64	14 (3.5)	26.30 ± 2.09	0(0.00)	4(0.99)	10 (2.49)	0 (0.0)	
			Female (n=407)				
15-24	66 (16.2)	24.86 ± 3.06	1(0.25)	35(8.6)	25 (6.14)	5(1.23)	
25-34	127 (31.2)	25.59 ± 2.58	0(0.00)	52(12.77)	69 (16.95)	6(1.47)	
35-44	98 (24.1)	26.98 ± 2.69	0(0.00)	22(5.40)	62 (15.23)	14(3.44)	***P*=0.000**
45-54	52 (12.8)	27.10 ± 3.65	0(0.00)	16(3.93)	27 (6.63)	9(2.21)	
55-64	42 (10.3)	27.49 ± 3.30	0(0.00)	9(2.21)	23 (5.65)	10 (2.45)	
> 64	22 (5.4)	26.97 ± 2.46	0(0.00)	4(0.98)	1 4(3.44)	4 (0.98)	

Pearson's chi square *P < 0.05: statistically significantly when compared. BMI classification (WHO, 2012c) BMI < 18.5 kg/m² (underweight), 18.5 kg/m² – 24.99 kg/m² (normal) 25 kg/m² – 29.9 kg/m² (overweight), ≥30 kg/m²

4.3 COMMONLY CONSUMED CARBOHYDRATE BASED FOODS

Ninety-one (91) commonly consumed carbohydrate based foods were identified. Carbohydrate based foods collated from the three day food diary were divided into 3 groups mainly the grain and cereal group, the tubers, roots and plantain, and the beverage and sugar group. The grain and cereal group formed70.30%, roots, tubers and plantain 24.20% with the beverage and sugar

group contributing 5.5% of total carbohydrates based foods identified. Individual foods under each group are shown in Table 4.5.

Table 4.5: Commonly consumed carbohydrate based foods

Grains/Cereals Group	Tubers, Roots And Plantain Group	Beverage and Simple Sugar Group
Aboloo	Cassava (boiled)	Chocolate drink
Agidi	Cocoyam (boiled)	Honey
Banku	French fries	Jam
Biscuit (chocolate chips)	Fufu	Soft drink
Biscuit (digestive)	Gari	Sugar
Biscuit (ginger snaps)	Gari ball	
Biscuit (rich tea)	Gari fortor	
Biscuits (cream crackers)	Kakro	
Bread (butter)	Kelewele	
Bread (roll)	Konkonte	
Bread (tea)	Mpotompoto	
Cake (cup)	Plantain (green boiled)	
Cake (sponge)	Plantain (ripe boiled)	
Corn (boiled)	Plantain (ripe fried)	
Corn (roasted)	Plantain (ripe roasted)	
Corn porridge	Plantain chips	
Cornflakes	Potato (boiled)	
Crisp (Pringles)	Tatale	
Croissant	Yakeyake	
Dough nuts (party type)	Yam (Mashed)	
Doughnut (glazed)	Yam (boiled)	
Doughnuts (holed)	Yam (fried)	
Doughnuts (jam filled)		
Doughnuts (loaf type)		
Doughnuts (traditional)		

Table 4.5 continued: Commonly consumed carbohydrate based foods

Grains/Cereals Group	Tubers, Roots And Plantain Group	Beverage And Sugar Group
Doughnuts (twisted)		-
Fula		
Kenkey (Fante)		
Kenkey (Ga)		
Macaroni		
Meat pie (cocktail type)		
Meat pie (vendor 1)		
Meat pie (vendor 2)		
Meat pie (vendor 3)		
Millet porridge (bagged)		
Millet porridge (plated)		
Muesli		
Oats		
Oblayoo		
Omotuo		
Pasta		
Pastry chips (cubed)		
Pastry Chips (flat)		
Pastry Chips (strips)		
Pizza		
Popcorn		
Rice (boiled)		
Rice (fried)		
Rice (Jollof)		
Rice porridge		
Rock Buns		
Saabo		
Sausage roll (cocktail)		
Sausage roll (large)		
Sausage roll (medium)		
Shredded wheat		
Spaghetti		
Spring Rolls (large)		
Spring Rolls (medium)		
Spring Rolls (small)		
Tom brown		
Tuozaafi		
Waakye		
Weetabix		

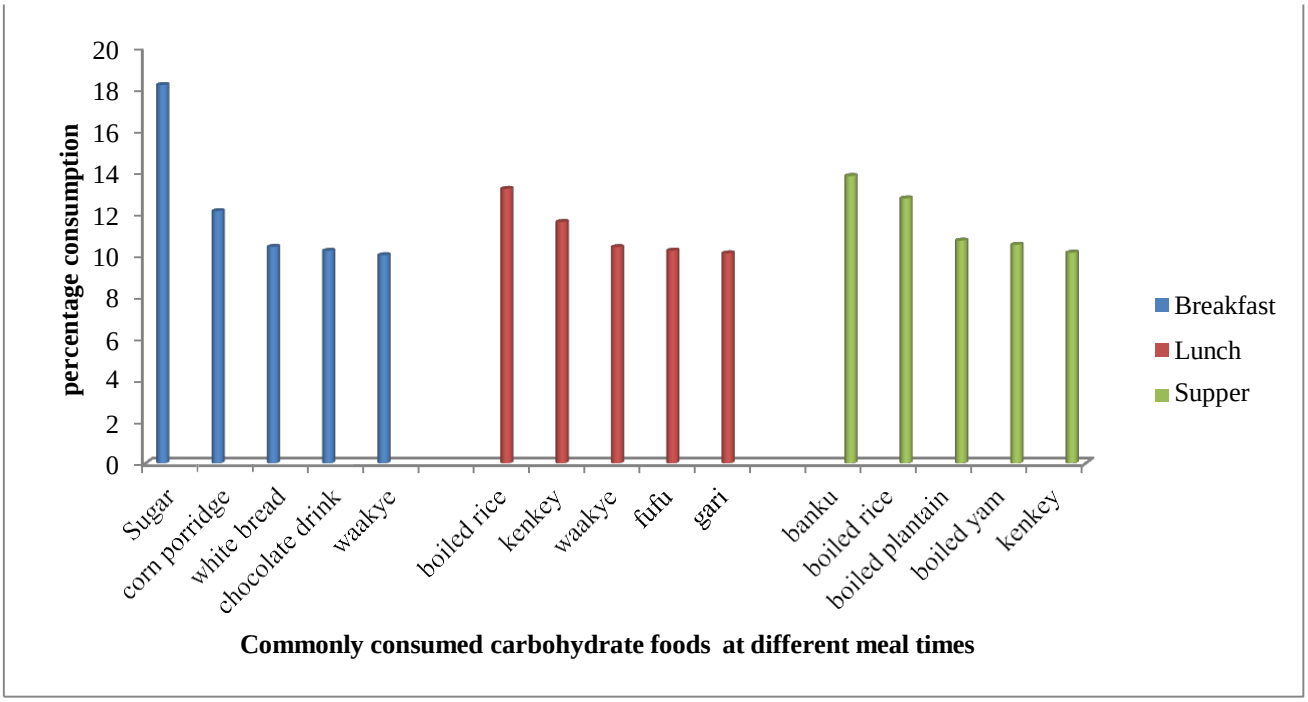
4.3.1 Consumption pattern of most commonly consumed carbohydrate foods

Two thousand one hundred and eighty-eight (2188) carbohydrate foods were consumed at breakfast, two thousand one hundred and eighty-seven (2187) at lunch, three thousand seven hundred and fifty-eight (3758) at supper and four hundred and eight (408) at snack by participants over the study period. The study investigated the most commonly consumed carbohydrates based foods at breakfast, lunch, supper and snack. Any commonly consumed carbohydrate food that made up 10% or more of the total carbohydrate at any of the three (3) meal times during the study period, was considered as a 'most commonly consumed carbohydrate food'. Twelve (12) were identified from the ninety-one (91) commonly consumed carbohydrate based foods. The most commonly consumed carbohydrate foods identified were bread, sugar (granulated), chocolate drink (cocoa based beverages), corn porridge, boiled rice and waakye, boiled plantain, boiled yam, banku, fufu, gari and kenkey. Chocolate drink was identified as a carbohydrate food because the first two ingredients in the different types of cocoa beverages collated were sugar and malt. The beverages identified as cocoa drink in the study were Milo, Bournvita, Chocolim, Ovaltine and Richoco. The most commonly consumed carbohydrate foods by participants contributed 60.97% to breakfast, 55.53% to lunch, and 57.90% to supper. The rest of the carbohydrate foods contributed 39.03% to breakfast, 44.47% to lunch, and 42.09% to supper consumption trend. Common carbohydrate snacks were white bread (9.4%), sugar (9.62%), chocolate powder (9.31%), soft drinks (8.54%) and pastry (7.80%). Other types of carbohydrate based foods contributed 55.33% to snack foods. (Appendix XIII).

Granulated sugar (18.2%) was recorded as the most commonly consumed breakfast carbohydrate followed by corn porridge (12.13%), white bread (10.41%), chocolate drink (10.22%) and

waakye (10.01%). Among lunch foods, boiled rice was the most commonly consumed carbohydrate food (13.20%), followed by kenkey (11.61%), waakye (10.40%), fufu (10.23%) and gari (10.10%). Banku (13.82%) appeared as the most commonly consumed carbohydrate food for supper, followed by boiled rice (12.74%), boiled plantain (10.71%) boiled yam (10.51%) and kenkey (10.13) (Figure 4.3).

Figure 4.3: Consumption pattern of commonly consumed carbohydrate food as percentages



4.4 CHARACTERISTICS OF FOOD PHOTOGRAPH

Coloured photographs of the ninety-one (91) carbohydrate based foods identified were taken. Sixty-two (62) of them were captured in eight (8) portions with the remaining twenty-nine (29) captured as three (3) portions or two (2) portions or as single portions. The twenty-nine (29) foods that were not captured in eight (8) portions were either sold in the various portions indicated or were sold in different molds and shapes. An example is doughnut which came in seven (7) different shapes.

The order of photographs is in two ways; portion sizes are either arranged in descending order with the smallest portion at the top (Figures 3.8 and 3.9) on some pages or in ascending order on other pages (Figure 4.4 and figure 4.5). This was to reduce the tendency of small and large eaters automatically selecting from the smaller or larger end respectively of the spectrum of food photographs. The food photographs in the photographic food atlas have been arranged in three parts according to the carbohydrate groups identified. The first section of the photographic food atlas is made up of pictures of the grain and cereal group, the second section is made up of the tubers, roots and plantain group and the beverage and sugar group makes up the third section. Pictures in each carbohydrate group are arranged alphabetically in relation to codes ascribed to them. Included in the food atlas are pictures of containers used as measuring utensils and crockery used to serve the food. A table of the weights and macro nutrients content of single portions of some selected foods (Appendix XIV) are captured in the thesis. The photographic food atlas also contains recipes (Appendix VIII). Codes (Appendix IX) for the various portion sizes of carbohydrate foods are also included in the food atlas. The photographs are captured on

A4 sheets, laminated and spiral ring bound into a book.

Figure 4.4: Portions of White Bread

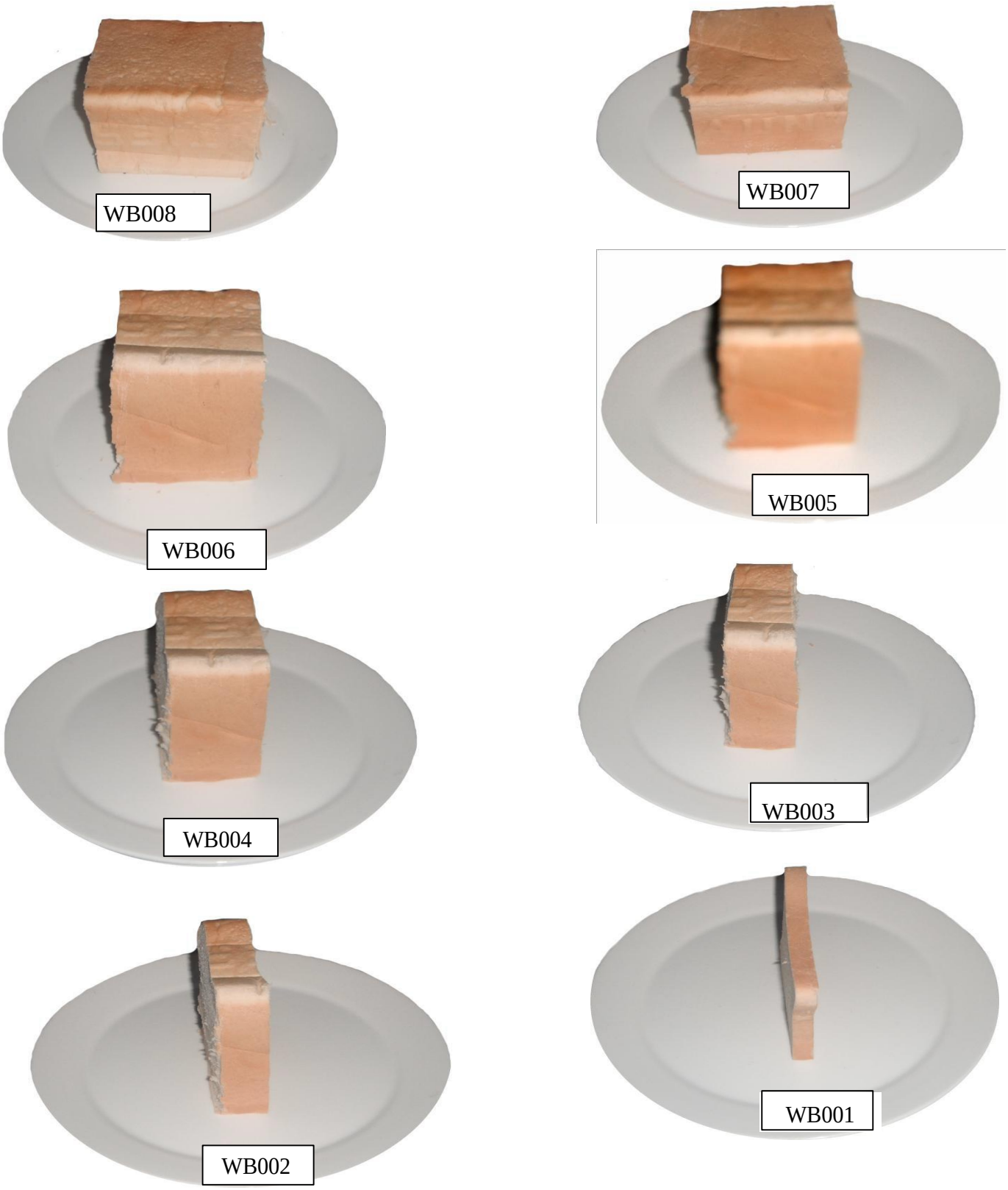
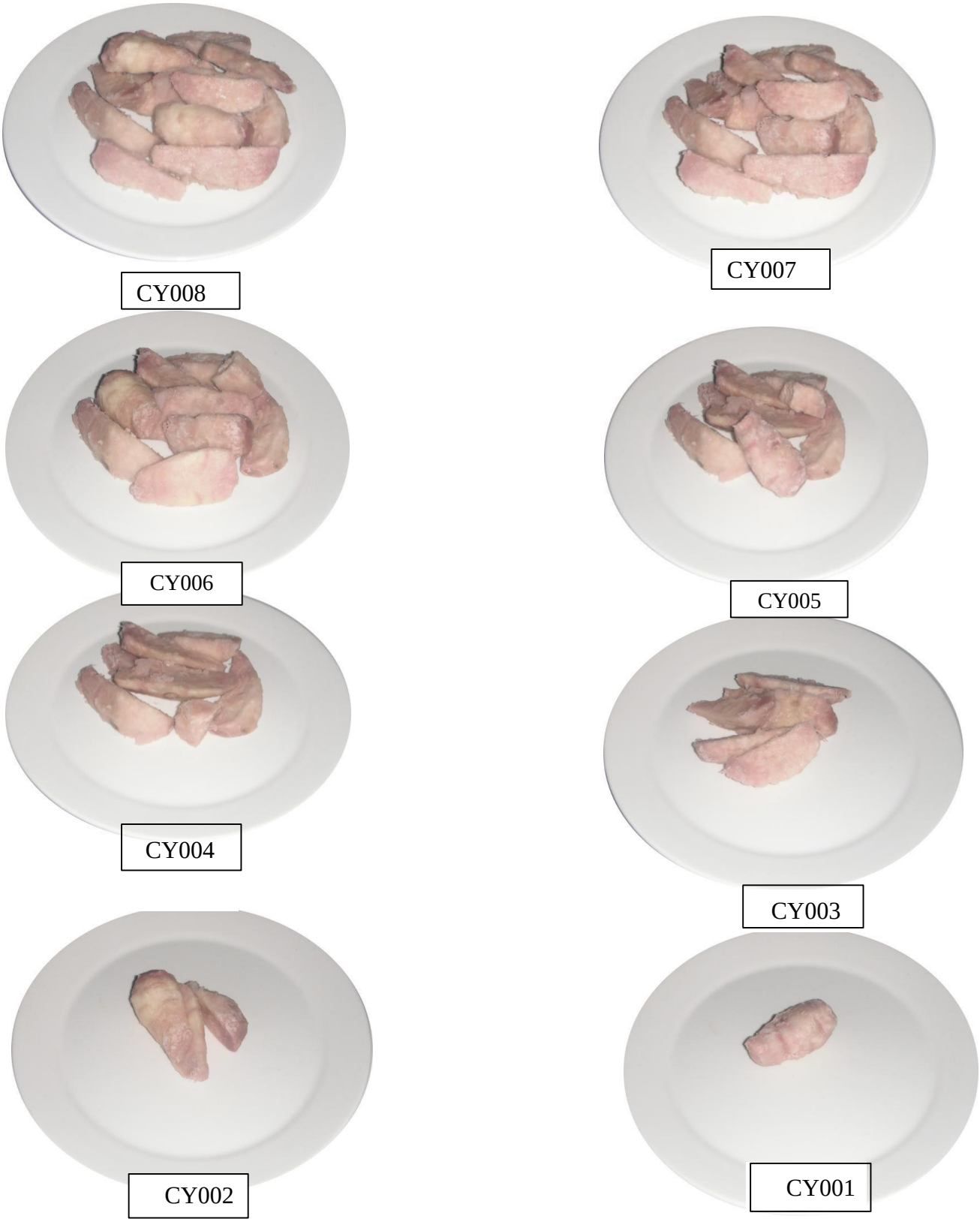


Figure 4.5: Portions of Cocoyam



4.5 PILOT STUDY

Prior to the major validation of the photographic food atlas, a pilot validation of fifty (50) participants was undertaken. An equal distribution of twenty five (25) males and twenty five (25) females took part in this arm of the study which was carried out in the third week of May 2011. The majority of the participants (28%) fell within the 25-34 year range with the highest number of male and female participants found within the 35-44 year range and 25-34 year range respectively. The least number of participants for both genders fell within the > 64year range (Table 4.6). The average age of participants was 38.9 years, with average height, weight and BMI at 1.73 meters, 76.2 kilograms and 25.73 kg/m² respectively(Table 4.7)

Table 4.6: Distributions of participants for validation by age

AGE RANGE	NUMBER OF PARTICIPANTS	
Years	**Male =25: n (%)**	**Female =25 n (%)**
15-24 years	3 (12%)	4 (16%)
25-34 years	6 (24%)	8 (24%)
35-44 years	7 (28%)	6 (24%)
45-54 years	5 (20%)	3 (12%)
55-64 years	3 (12%)	3 (12%)
>64 years	1 (4%)	1 (4%)

Table 4.7: Mean age, height, weight and BMI of participants

Category of participants	Mean Age (yrs)	Mean Height (m)	Mean Weight (kg)	Mean BMI (kg/m2)
All participants (n=50)	38.9 ±12.13	1.73 ± 0.096	76.2 ± 15.04	25.73 ± 5.72
Female (n=25)	37.84 ± 12.83	1.66±0.065	77.26±16.48	28.11±6.04
Male (n=25)	39.96 ± 11.55	1.79±0.072	75.13±13.72	23.35±4.32

4.5.1 Estimation of carbohydrate foods

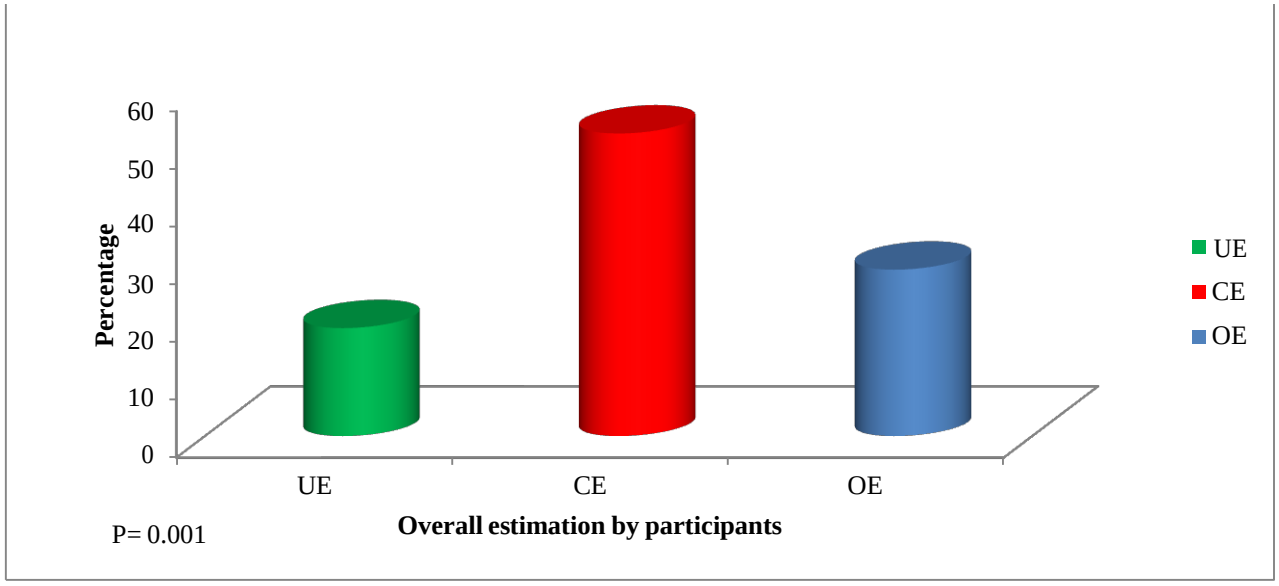
A total of 2400 estimations were made by participants; 52.45% (1,259) were correct estimations, 28.84% (692) were overestimations and 18.71% (449) were under estimations. A statistically significant higher proportion of the estimations were correct (*P= 0.001*) (Figure 4.6).

Among gender, a significantly higher proportion of females (680; 56.67%) than males (507; 42.25%) (*P*=0.001) correctly estimated portion sizes. Underestimations was seen among a significantly higher proportion of males (297; 24.75%) than females (163; 13.58%) *(P=0.001).* There was no significant association between gender and over estimation of all foods; (*P* = 0.374) (Figure 4.7).

No significant differences were observed in under estimations *(P= 0.787),* correct estimations (*P= 0.442*) and over estimations *(P= 0.915)* of carbohydrate foods by participants from all age age-groups (Figure 4.8).

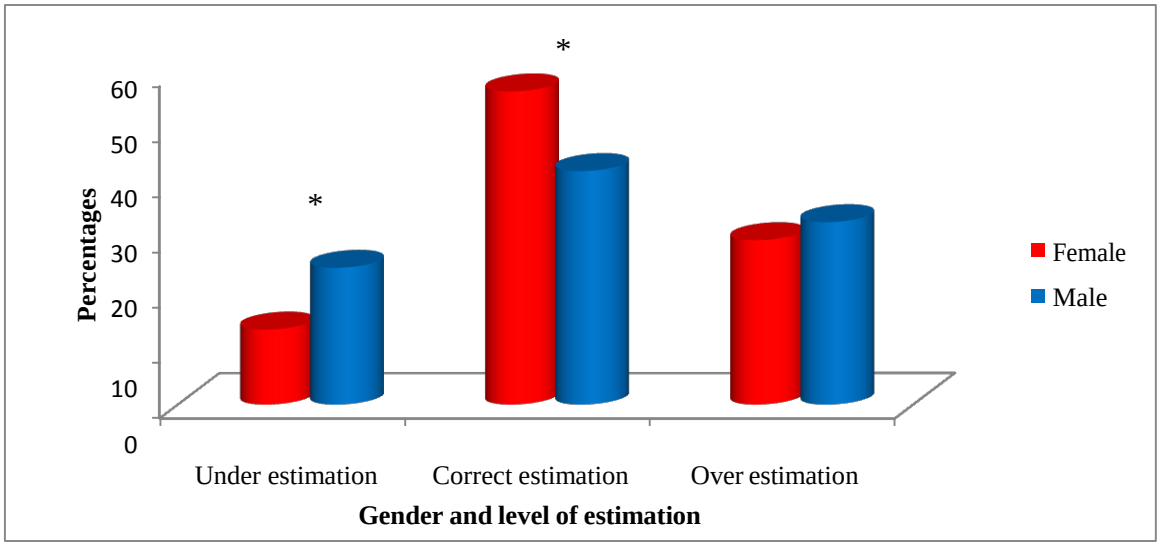
There were no significant difference in all estimations by participants in all BMI categories; correct estimation (*P*= 0.064), under estimation (*P*= 0.130) and over estimation (*P*= 0.365) (Figure 4.9).

Figure 4.6: Overall estimation of common carbohydrate foods by participants



CE-Correct estimation; UE-Underestimation; OE- overestimation

Figure 4.7: Percent estimation of all carbohydrate foods by gender



***** Statistically significant at $P<0.05$: Two sample T-test with equal variance; *Underestimation= t (48) =3.88, P=0.001; Correct estimation= t (48) = -5.81, P=0.001

Figure 4.8: Overall Portion Size estimation by age range

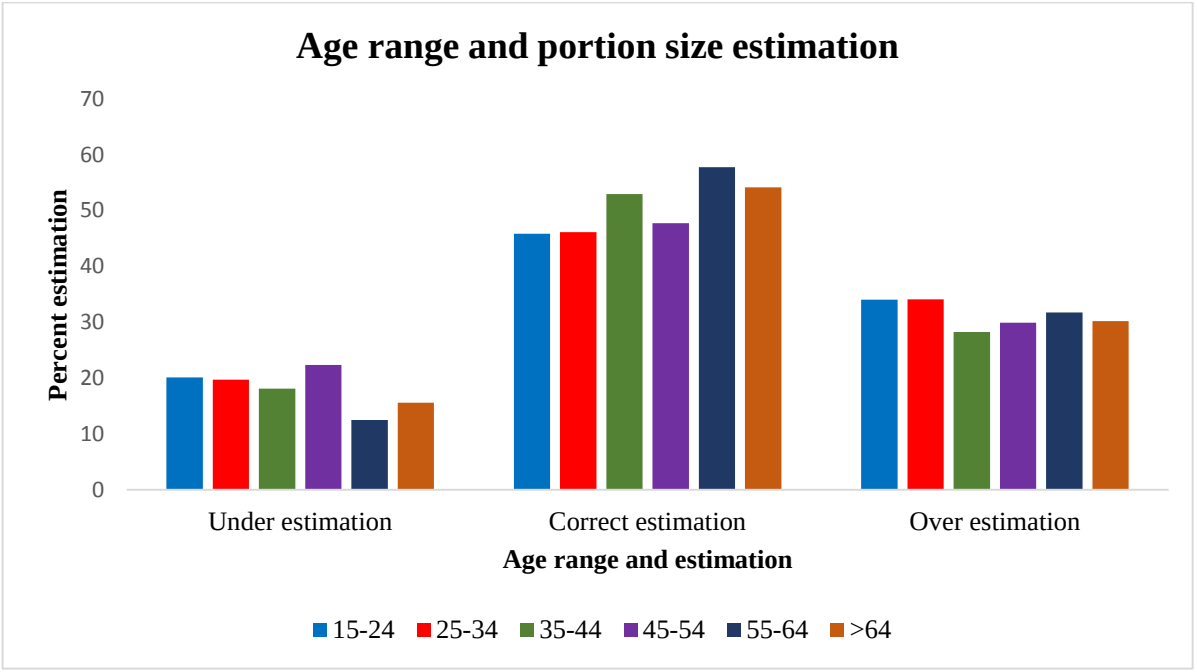
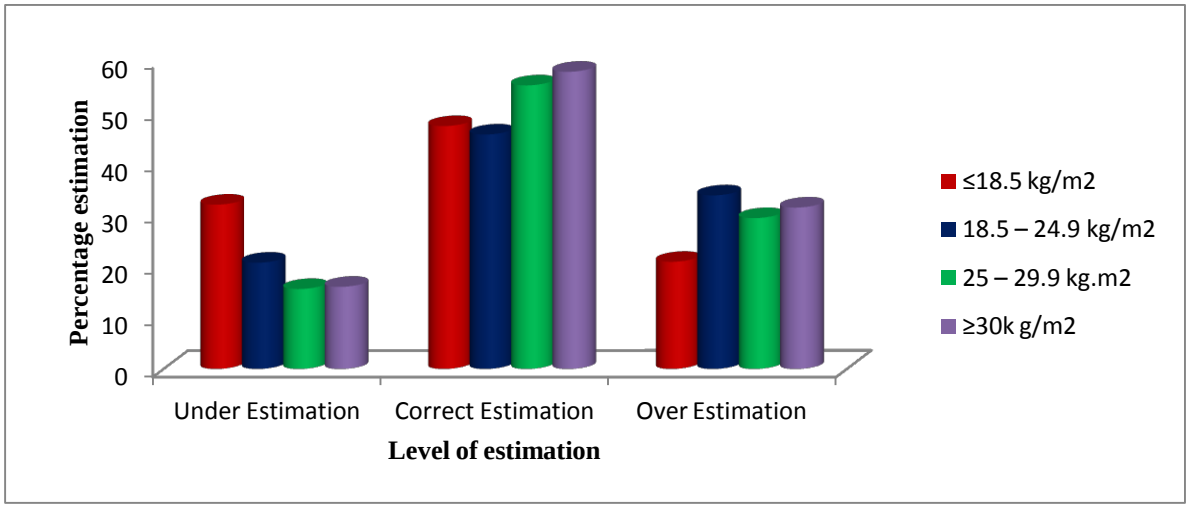


Figure 4.9: Percent estimations of all carbohydrate foods by BMI categories



ANOVA *statistically significant at $P < 0.05$: Under estimation- $P = 0.13$ correct estimation- $P = 0.06$; over estimation- $P = 0.36$

4.6 MAJOR STUDY

This section presents the results of the major validation study. It presents the statistical analysis of the relationship between participants' gender, BMI and age and their ability to validate the photographic food atlas as a PSMA.

4.6.1 Background characteristics of participants

The two hundred and eighty participants in the main study were made up of males (124, 44.30%) and females (156, 55.70%). The mean age of participants was 37.65±13.14. The mean heights of male and females were 1.77±0.72 and 1.65±0.06 respectively. Participants had an overall mean

height of 1.7±0.91. Females were heavier than males with a mean BMI of 26.15±5.46 whilst that of males was 22.73±3.75 (Table 4.8).

Table 4.8: Mean distribution of age, height, weight and BMI of participants

Gender (n)	Age (Mean±sd)	Height (Mean±sd)	Weight (Mean±sd)	BMI (Mean±sd)
Male (124)	38.37±13.41	1.77±0.72	71.67±12.77	22.73±3.75
Female (156)	37.97±18	1.65±0.06	72.43±14.96	26.15±5.46
All(280)	37.65±13.14	1.7±0.91	72.0914.03	24.97±5.17

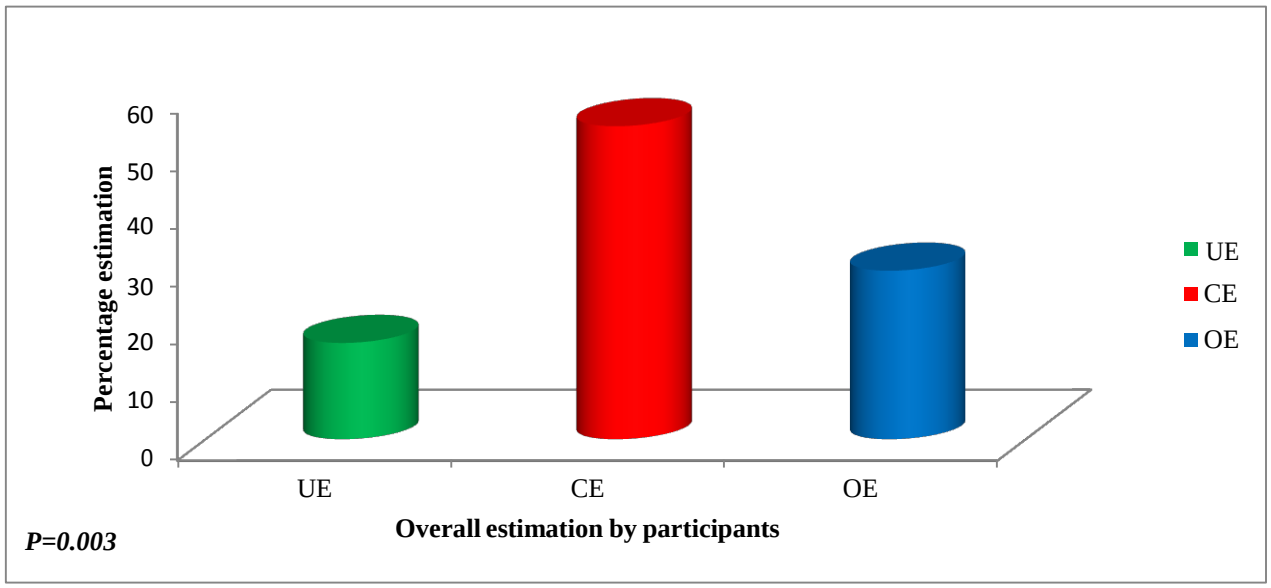
4.6.2 Participants' evaluation of common carbohydrate foods

Results presented include overall estimation by participants, estimation by gender, age and BMI. A subject is said to have overestimated in this study when the subject's selection of portion size from the food atlas exceeds that of the portion size of an identical food presented on a plate or in a bowl. Portion size estimation is said to be correct when a participant's choice of a food portion from the food atlas is identical to that of the plated food. Underestimation is indicated by the choice of a lower portion size than that of an identical plated food.

4.6.2.1 Participants' general estimations of carbohydrate foods using the photographic atlas

A significant higher number of participants (151; 54.17 %) were able to estimate correctly *(P=0.003).* Twenty-nine percent (83) of participants overestimated whilst 46 (16.66%) underestimated. (Figure 4.10)

Figure 4.10: Overall estimation of carbohydrate foods by participants

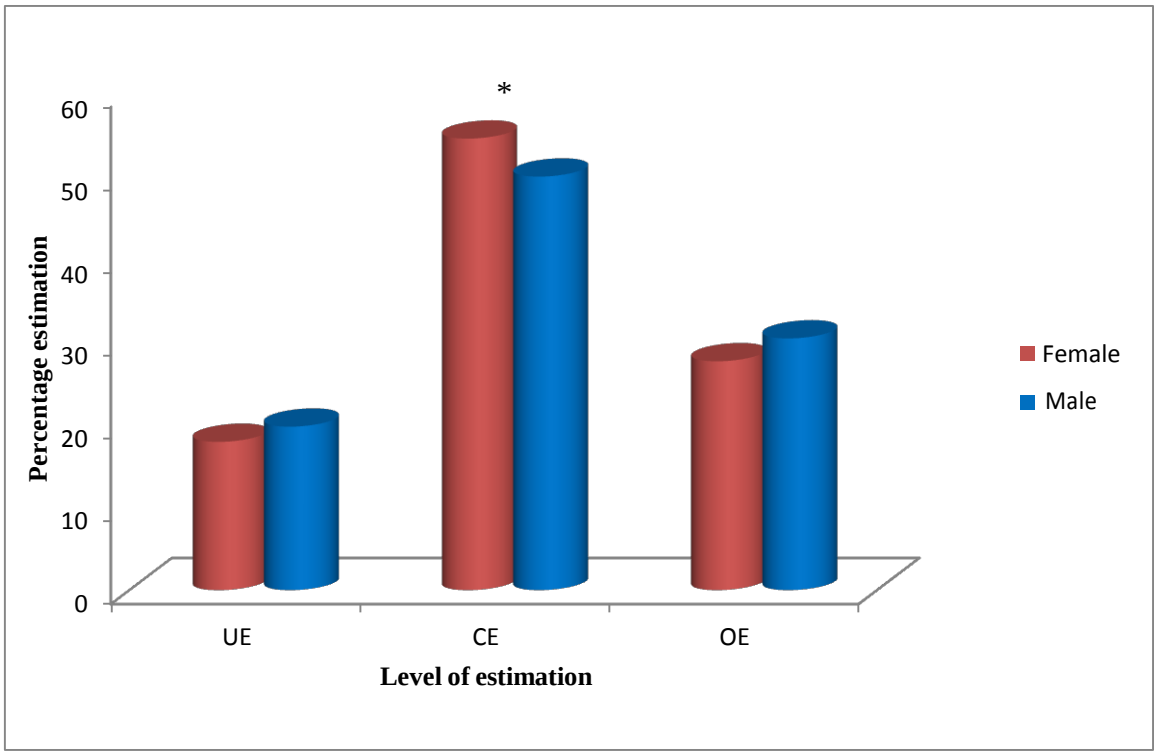


UE= underestimation, CE= correct estimation, OE= overestimation

4.6.2.2 Overall carbohydrate estimations by gender

There was a significant difference in gender estimations of carbohydrate foods (*P*= 0.001). A significant higher proportion of females participants were able to estimate correctly (54.49 %) compared to males (49.90 %). No significant differences were however found between the number of participants who underestimated (*P = 0.112*) or overestimated foods (*P = 0.057*) among gender (Figure 4.11).

Figure 4.11: Percent overall carbohydrate estimation by gender

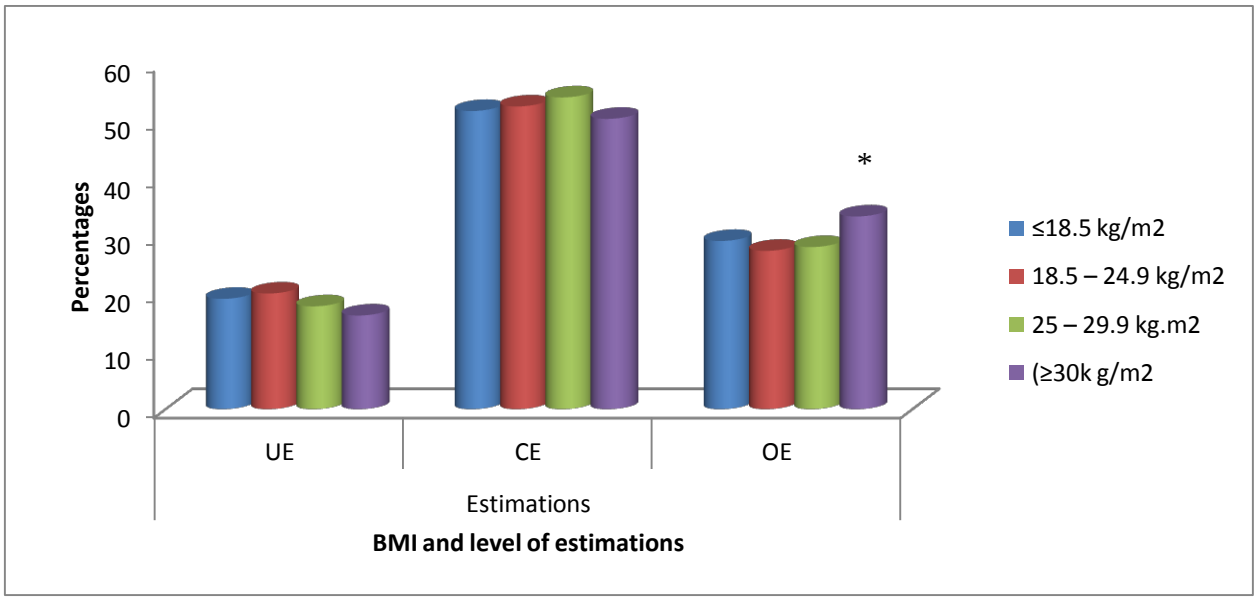


Two sample T-test: ***** statistically significant at $P < 0.05$: UE = under estimation, CE = correct estimation, OE = over estimation. CE: $P = 0.001$

4.6.2.3 General assessment of all carbohydrate foods by BMI categories

The effect of the different BMI categories on participants' ability to correctly estimate (*P=0.245*) or underestimate (*P=0.088*) were not significant, however, a significantly higher proportion (33.42; *P=0.027*), of participants in the ≥ 30 kg/m² overestimated portion sizes. (Figure 4.12)

Figure 4.12: Participants' BMI and overall portion size estimation

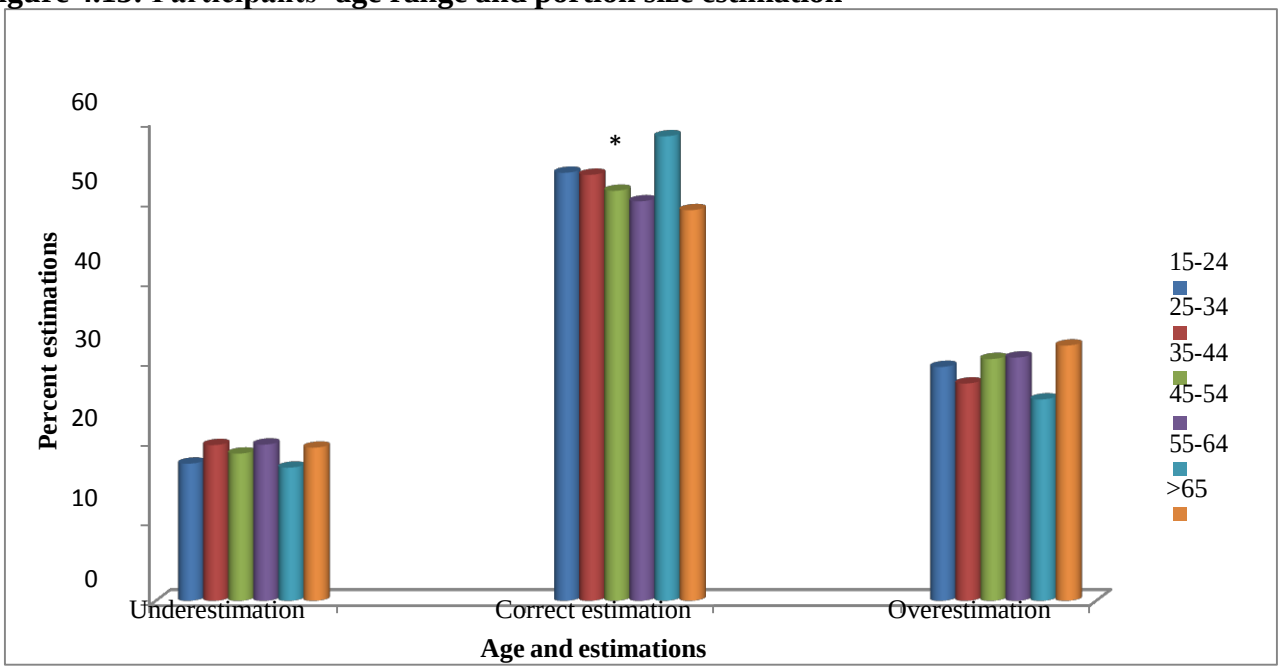


ANOVA; ***** statistically significant at p< 0.05: **P*-value for OE for BMI ranges = 0.027. UE = under estimation, CE = correct estimation, OE = over estimation

4.6.2.4 General assessment of all carbohydrate foods by age range

Overall correct estimations of the different types of carbohydrate foods by participants' was statistically significant for age (*P=0.018)* with a highest proportion found within the 55 to 64 (58.13%) year range. All other estimations were not statistically significant (underestimation: *P= 0.067* and overestimation *P= 0.269*) (Figure 4.13)

Figure 4.13: Participants' age range and portion size estimation

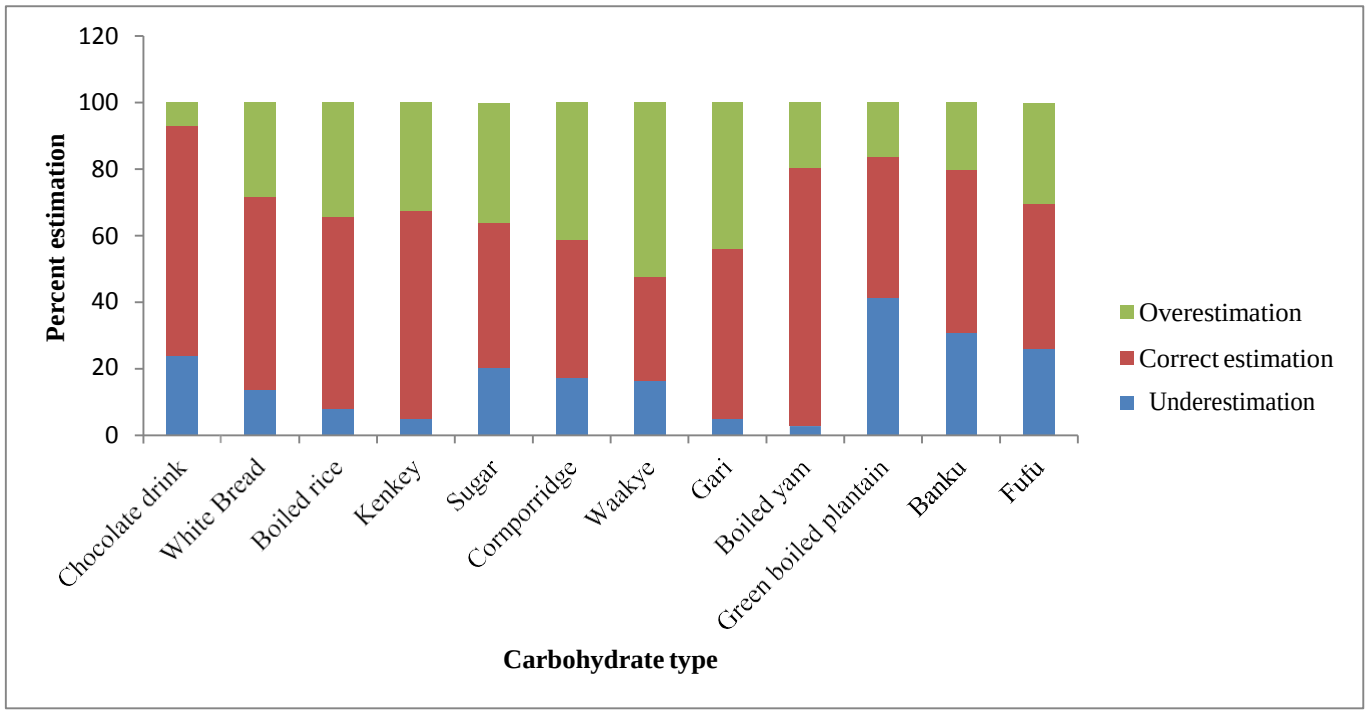


ANOVA; ***** statistically significant at $P < 0.05$: *Correct estimation, $P = 0.018$

4.6.2.5 Participants general estimation of the different types of carbohydrate foods

Further analysis was done to assess the accuracy/differences of estimations of the different types of carbohydrate foods. Approximately seventy seven percent (77.38 %) of participants were able to correctly estimate portion sizes of yam, followed by chocolate drink (69.21%), kenkey (62.33%) and white bread (58.04%). Participants' correctly estimated boiled rice and sugar by 57.35% and 50.83% respectively. Boiled green plantain was highly underestimated by 41.34% of participants. A higher percentage of participants (52.52%) overestimated waakye. (Figure 4.14)

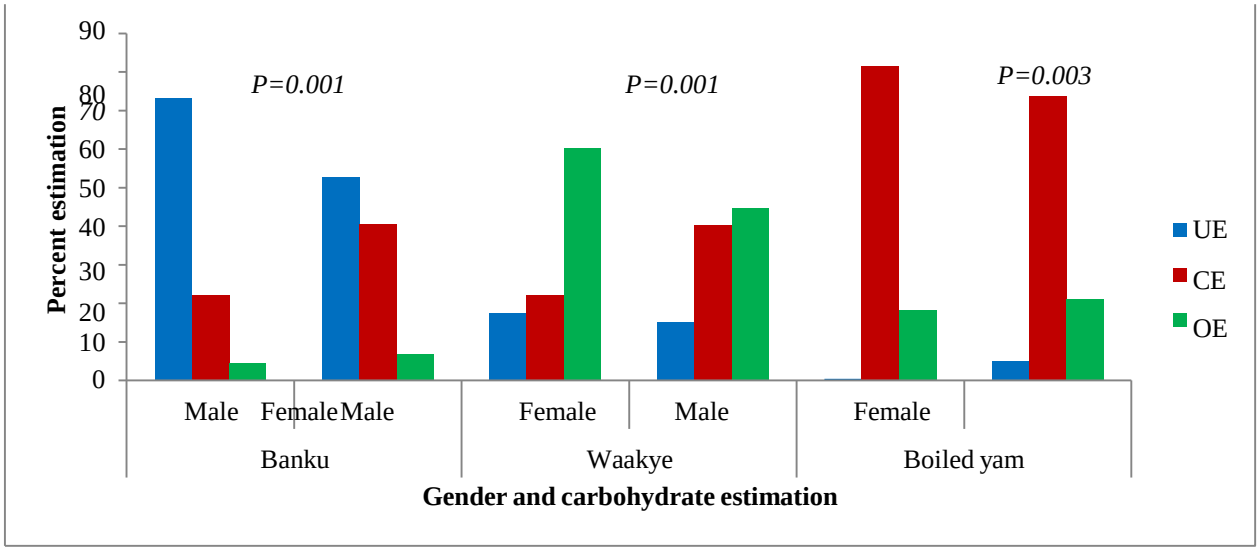
Figure 4.14: Percent estimation of different types of carbohydrate foods by participants



4.6.2.6 Gender specific validation of the different carbohydrate foods

Among gender, a statistically significant higher proportion of males (81.38%) correctly estimated boiled yam compared to females (73.80%) *(P=0.003).* Banku on the other hand was underestimated by a statistically significant higher proportion of males (73.28%) compared to females (52.70%) (*P=0.001*), whilst a statistically significant number of males 52.52%) overestimated waakye compared to females (49.90%) (*P=0.001*). (Figure 4.15) All other estimations were not significantly different between genders. (Table 4.9)

Figure 4.15: Gender specific estimation of the different types of carbohydrate foods



Pearson's Chi square: * significant at P < 0.005

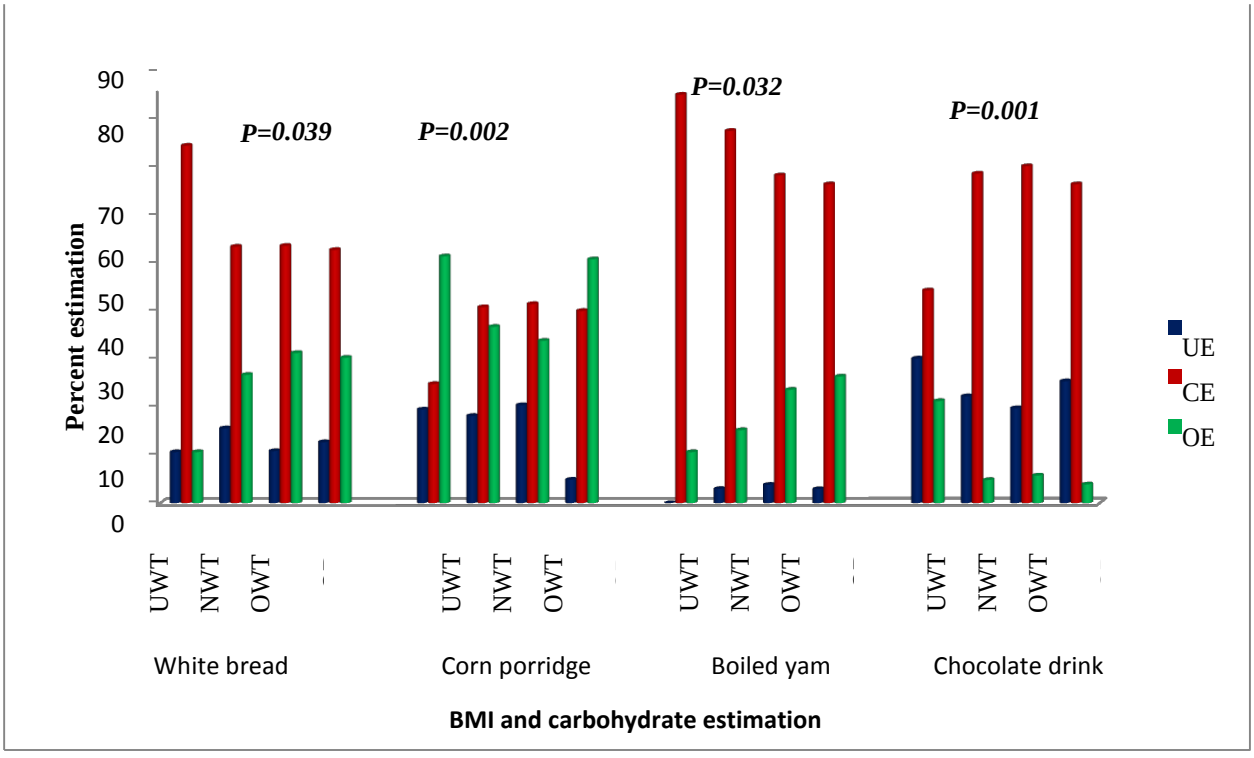
Table 4.9: Gender specific estimation of the different types of carbohydrates

Carbohydrate foods	Gender (n=280) (male=124: female= 156)	Estimations (n %)			
		Underestimation	Correct estimation	Overestimation	P value
White bread	Male	11.34	58.3	30.36	0.238
	Female	15.91	54.51	26.52	
Corn porridge	Male	18.62	40.89	40.49	0.752
	Female	16.29	41.21	42.49	
Fufu	Male	27.13	42.29	29.96	0.783
	Female	24.6	43.77	31.63	
Gari	Male	6.48	46.96	46.56	0.101
	Female	3.51	54.31	42.17	
Kenkey	Male	5.67	59.11	35.22	0.310
	Female	4.15	65.18	30.67	
Boiled Plantain	Male	8.5	57.89	33.6	0.329
	Female	9.58	62.62	27.8	
Boiled rice	Male	8.1	55.87	36.03	0.739
	Female	8.31	58.79	32.91	
Chocolate drink	Male	23.08	68.42	8.5	0.350
	Female	24.6	69.97	5.43	
Sugar	Male	37.25	42.51	20.27	0.781
	Female	34.82	45.37	19.81	

4.6.2.7 Assessment of the different carbohydrate foods between BMI ranges

Participants BMI was significantly associated with correct estimations of white bread (*P=0.039*), chocolate drink *(P=0.001)* and boiled yam (*P=0.032*).The highest proportion of participants who correctly estimated (77.78%) white bread and boiled yam (88.89%) were found among those with BMI <18.5 m/kg² (underweight category) with highest proportion (73.33%) of overweight participants correctly estimating chocolate drink. There was a statistically significant link between BMI of participants and overestimation of corn porridge (*P=0.002*) with a higher percentage (25.93%) of participants within the underweight category (<18.5 m/kg²) overestimating. (Figure 4.16) Estimations between BMI ranges for all other carbohydrate foods were not statistically significant. (Table 4.10)

Figure 4.16: BMI specific estimations of the different types of carbohydrates foods



P: significant @ P=0.05, UWT=underweight, NWT= normal weight, OWT= Over weight, OB= obese, UE= underestimation, CE= correct estimation, OE = overestimation

Table 4.10: Estimations of the different carbohydrate types by BMI categories

Carbohydrate foods	BMI categories	Underestimation	Correct estimation	Overestimation	P-value
Banku	UWT	59.26	37.04	3.70	0.839
	NWT	64.73	29.84	5.43	
	OWT	58.67	35.33	6.00	
	OB	60.20	32.65	7.14	
Fufu	UWT	24.07	50.00	25.93	0.068
	NWT	28.68	41.86	29.46	
	OWT	26.00	47.33	26.67	
	OB	18.37	37.76	43.88	
Gari	UWT	3.70	44.44	51.85	0.494
	NWT	6.59	52.71	40.70	
	OWT	3.33	51.33	45.33	
	OB	3.06	50.00	46.94	
Kenkey	UWT	7.41	62.96	29.63	0.778
	NWT	5.04	60.85	34.11	
	OWT	2.67	65.33	32.00	
	OB	6.12	62.24	31.63	
Boiled Plantain	UWT	11.11	59.26	29.63	0.944
	NWT	9.69	59.69	30.62	
	OWT	8.00	64.00	28.00	
	OB	8.16	58.16	33.67	
Boiled rice	UWT	9.26	62.96	27.78	0.964
	NWT	7.75	57.75	34.50	
	OWT	8.67	56.67	34.67	
	OB	8.16	55.10	36.73	
Waakye	UWT	12.96	24.07	62.96	0.212
	NWT	17.83	32.95	49.22	
	OWT	18.00	35.33	46.67	
	OB	10.20	30.61	59.18	
Sugar	UWT	38.89	40.74	20.37	0.507
	NWT	39.15	42.64	18.22	
	OWT	31.33	49.33	19.33	
	OB	32.65	41.84	25.51	

4.6.2.8: Evaluation of the different carbohydrate foods by age ranges

Between age range, a statistically significant higher proportion of participants (*P*=0.042; 57.14%;) within the age range of 15 to 24 years were able to correctly estimate portion sizes of fufu when compared to the other age ranges. Correct estimation of waakye was seen among a statistically significant percentage (*P*=0.037; 50%) of participants within the 55 to 64 year range.

Table 4.11: Estimation of the 12 common carbohydrate foods between age-range

			Estimations (n %)			
Carbohydrate food	Age range years	n	UE	CE	OE	P-value
Banku	15-24	84	59.52	38.10	2.38	0.578
	25-34	186	62.37	30.65	6.99	
	35-44	114	61.40	35.09	3.51	
	45-54	104	60.58	33.65	5.77	
	55-64	42	61.90	28.57	9.52	
	>64	30	70.00	20.00	10.00	
White bread	15-24	84	9.52	70.24	20.24	0.097
	25-34	186	15.05	55.91	29.03	
	35-44	114	11.40	58.77	29.82	
	45-54	104	13.46	49.04	37.50	
	55-64	42	23.81	57.14	19.05	
	>64	30	16.67	63.33	20.00	
Chocolate drink	15-24	84	26.19	64.29	9.52	0.268
	25-34	186	27.96	65.05	6.99	
	35-44	114	21.93	71.05	7.02	
	45-54	104	25.00	70.19	4.81	
	55-64	42	9.52	88.10	2.38	
	>64	30	16.67	73.33	10.00	
Corn porridge	15-24	84	10.71	44.05	45.24	0.103
	25-34	186	24.19	40.86	34.95	
	35-44	114	12.28	42.98	44.74	
	45-54	104	17.31	35.58	47.12	
	55-64	42	9.52	47.62	42.86	
	>64	30	23.33	36.67	40.00	
Fufu	15-24	84	15.48	**57.14**	27.38	***0.037**
	25-34	186	22.04	47.85	30.11	
	35-44	114	32.46	33.33	34.21	
	45-54	104	28.85	39.42	31.73	
	55-64	42	28.57	45.24	26.19	
	>64	30	36.67	26.67	36.67	

**P* Statistically significant at *P*<0.05: Fufu (*P*=0.037), Waakye (*P*=0.042). CE=correct estimation, UE= underestimation, OE= over estimation.

Table 4.11 continued: Estimation of the 12 common carbohydrate foods within age range

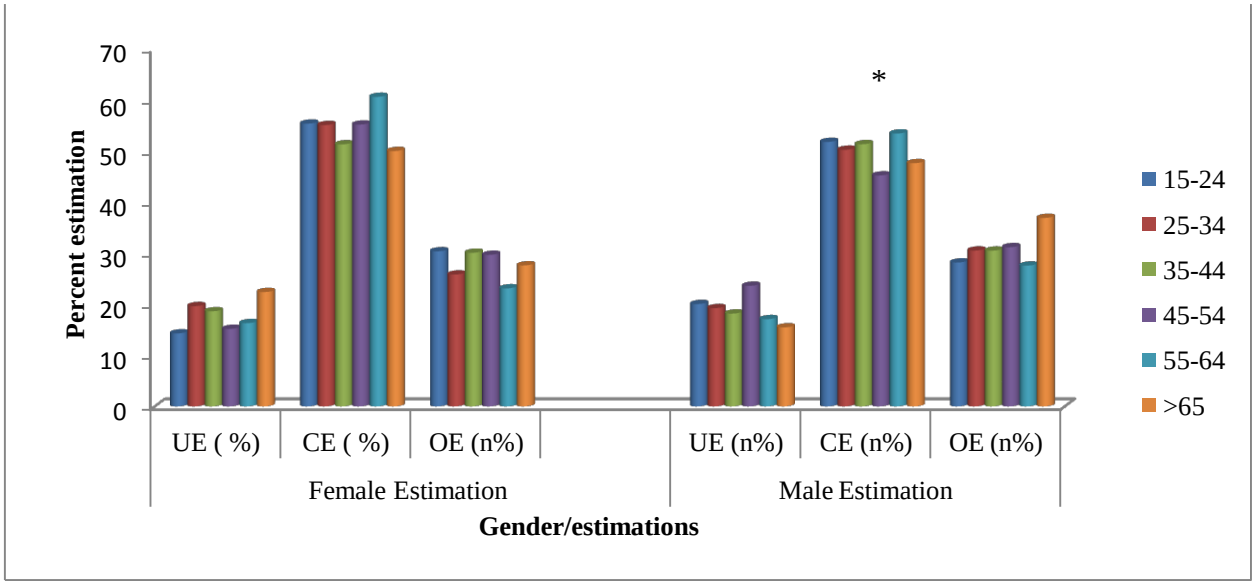
			Estimations (%)			
Carbohydrate food	Age range(years)	n	UE	CE	OE	P-value
Gari	15-24	84	8.33	44.05	47.62	0.214
	25-34	186	4.30	58.60	37.10	
	35-44	114	4.39	46.49	49.12	
	45-54	104	5.77	49.04	45.19	
	55-64	42	0.00	57.14	42.86	
	>64	30	3.33	40.00	56.67	
Kenkey	15-24	84	4.76	58.33	36.90	0.471
	25-34	186	3.23	63.98	32.80	
	35-44	114	7.89	64.91	27.19	
	45-54	104	6.73	57.69	35.58	
	55-64	42	0.00	71.43	28.57	
	>64	30	3.33	60.00	36.67	
Boiled plantain	15-24	84	9.52	61.90	28.57	0.477
	25-34	186	6.99	60.75	32.26	
	35-44	114	10.53	62.28	27.19	
	45-54	104	14.42	55.77	29.81	
	55-64	42	2.38	69.05	28.57	
	>64	30	6.67	53.33	40.00	
Boiled rice	15-24	84	9.52	51.19	39.29	0.295
	25-34	186	7.53	61.83	30.65	
	35-44	114	5.26	53.51	41.23	
	45-54	104	8.65	54.81	36.54	
	55-64	42	11.90	59.52	28.57	
	>64	30	13.33	70.00	16.67	
Sugar	15-24	84	39.29	42.86	17.86	0.319
	25-34	186	36.56	45.16	18.28	
	35-44	114	35.09	44.74	20.18	
	45-54	104	35.58	45.19	19.23	
	55-64	42	35.71	47.62	16.67	
	>64	30	26.67	30.00	43.33	
Waakye	15-24	84	13.10	25.00	**61.90**	***0.042**
	25-34	186	19.35	32.80	47.85	
	35-44	114	12.28	27.19	60.53	
	45-54	104	17.31	38.46	44.23	
	55-64	42	14.29	50.00	35.71	
	>64	30	16.67	23.33	60.00	
Boiled yam	15-24	84	0.00	85.71	14.29	0.078
	25-34	186	4.30	76.34	19.35	
	35-44	114	6.14	75.44	18.42	
	45-54	104	0.96	71.15	27.88	
	55-64	42	2.38	76.19	21.43	
	>64	30	0.00	86.67	13.33	

***** Statistically significant at $p<0.05$: Fufu ($p=0.037$), Waakye ($p=0.042$). CE=correct estimation, UE= under estimation, OE= over estimation

4.6.2.9 Gender specific between age range and estimation

Among gender, males' ability to estimate portion size had a statistically significant association with age. A statistically significant higher percentage (53.42%; *P = 0.024*) of males within the 55-64 year range correctly estimated portion size when compared to females (54.58%; *P = 0.119*). Underestimations for males (18.93%; *P = 0.136*) and females (17.73%; *P = 0.1272*) and overestimations for males (30.80%; *P = 0.575*) and females (27.77%; *P= 0.268*) were not significant. (Figure 4.17)

Figure 4.17: Gender specific by age range and estimation



ANOVA *= *P*-value =0.024 CE: Significantly different when compared among gender is statistically significant when compared. **P*-value for CE for male gender *P*= 0.0245
UE = under estimation, CE = correct estimation, OE = over estimation

4.6.2.10 Gender specific estimations between BMI categories

The study showed that correct estimation by both gender was statistically linked to being underweight (*P*=0.001) or normal weight (*P*=0.027). A significant higher proportion of underweight (54.63%) and normal weight (55.68%) females correctly estimated portion sizes when compared to males. Over estimation by gender in the underweight category was statistically significant (P=0.002). An equal proportion of males (29.17%) to females (29.17%) overestimated portion sizes with statistical significance.

. (Table 4.12)

Table 4.12: Gender specific BMI profile and estimation

BMI (kg/m²)	Gender	(n)	UE (n %)	P-value (UE)	CE (n %)	P-value (CE)	OE (n %)	P-value (OE)
	Female	9	16.2		54.63		29.17	
≤18.5	Male	18	20.6	0.407	50.23	***0.001**	29.17	***0.002**
	Female	55	19.39		55.68		24.92	
18.5 – 24.9	Male	74	20.55	0.470	50.11	***0.027**	29.34	0.673
	Female	47	17.64		57.18		25.18	
25 – 29.9	Male	28	18.15	0.911	48.81	0.368	33.04	0.767
	Female	45	16.67		50.19		33.15	
>30	Male	4	11.46	0.320	52.08	0.364	36.46	0.858

ANOVA: BMI classification (WHO, 2012) BMI: < 18.5 kg/m² (underweight), 18.5 kg/m² – 24.99 kg/m² (normal) 25 kg/m² – 29.9 kg/m² (overweight), ≥30 kg/m². ***** = P <0.05 statistically significant when compared.

4.6.2.11 Participants estimation of the different portions of identical carbohydrate foods

Smaller portions of identical carbohydrate foods were estimated better by a higher number of participants except for corn porridge (CP) and waakye (WA) where bigger portions were better estimated (CP007; 42.53% and CP004;39.55%) and (WA006; 33.18%; and WA005; 29.39%). The study results also showed that apart from sugar (SU) and boiled yam (BY) where smaller portions were highly underestimated, (SU006; 34.01% and SU005; 37.63%)and (BY003; 1.92% and BY002; 3.61%), participants highly underestimated bigger portions of other foods. Overestimation on the other hand was not consistent with any portion size (Figure 4.18).

4.6.2.12 Estimation of the different portions of identical carbohydrate foods by gender

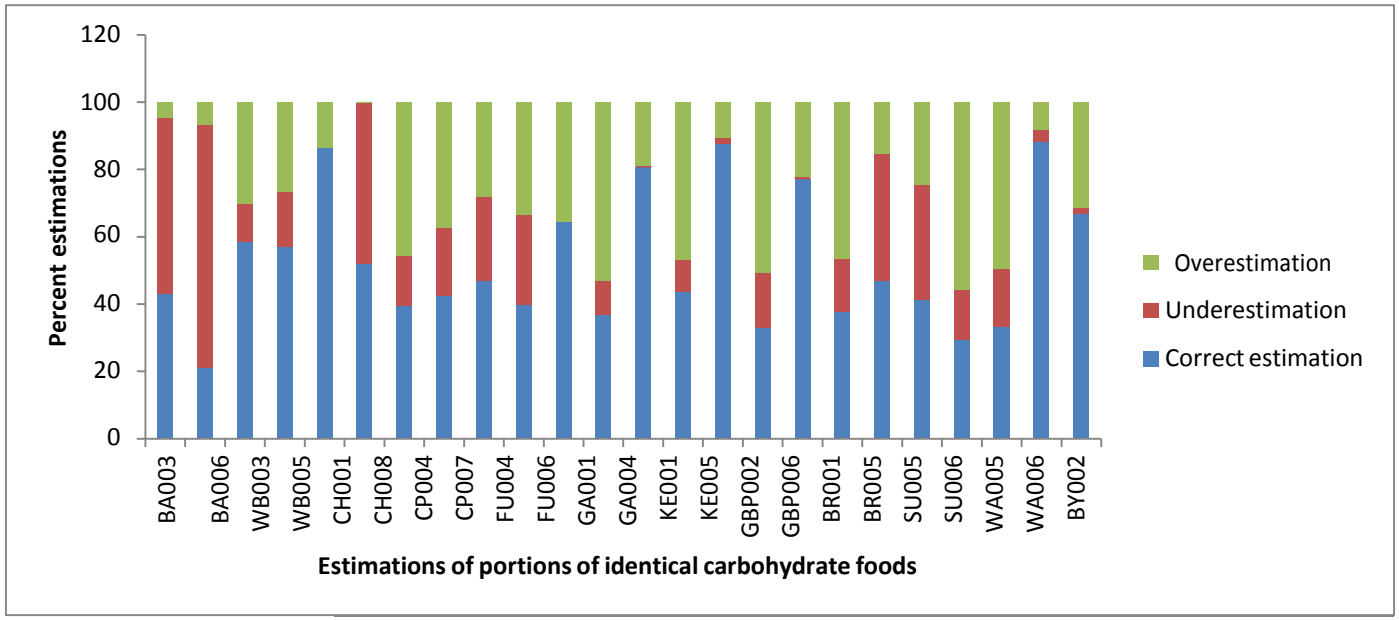
Both males and females had higher correct estimations for smaller portions of carbohydrate foods except for corn porridge where both genders estimated bigger portion better than smaller portions: males, (CP007, 42.74%; CP004, 38.71%) and females (CP007, 42.31%; CP004, 40.38%). Bigger portions of waakye and fufu were also better estimated by males, (WA006, 26.61%; WA005, 17.74% and FU006, 47.58%; FU004, 37.92%).

A statistically significant higher proportion of females correctly estimated the following portions sizes: BA006 (52.56%, P=0.001) and BA006 (28.85%, P=0.003) than males (43.21%, P=0.001) and (12.2 %, P=0.003) respectively. Both portions of waakye (WA006 and WA005) were better estimated by a significant higher percentage of females (39.74% and 41.03%, P=0.001) than males (26.61% and 17.74%) respectively. Smaller portions of boiled yam (BY002) and kenkey (KE001) were correctly estimated by a significant percentage of males (91.94%, P=0.045 and 44.35 %, P= 0.001) respectively when compared to females (84.62%

and 42.95%).

The smaller portion of fufu (FU004) was better estimated by a greater percentage of females, (55.77%; *P=0.012*) whilst a higher proportion of males correctly estimated the bigger portion of fufu (FU006, *P=0.017*). (Tables 4.13)

Figure 4.18: Percentage estimation between the different portions of identical carbohydrate



100
1 KE001 – Kenkey portion 1
6 KE005 – Kenkey portion 5
BR001 – Boiled Rice portion 1
.2 BR005 – Boiled Rice portion 5
.5 BA003 – Banku portion 3
.8 BA006 – Banku portion 6
!1 GA001 – Gari portion 1
!4 GA004 – Gari portion 4

102
103 GBP002 - Green Boiled Plantain portion 2
107 GBP006 - Green Boiled Plantain portion 6
110 CH001 – Chocolate Drink portion 1
113 CH008 – Chocolate Drink portion 8
116 CP004 – Corn Porridge portion 4
119 CP007 – Corn Porridge portion 7
122 WB003 – White Bread portion 3
125 WB005 – White Bread portion 5

104
105 FU004 – Fufu portion 4
108 FU001 – Fufu portion 1
111 SU005 – Sugar portion 5
114 SU006 – Sugar portion 6
117 WA005 – Waakye portion 5
120 WA006 – Waakye portion 6
123 BY002 – Boiled Yam portion 2
126 BY003 – Boiled Yam portion 3

Table 4.13: Percentage estimation between the different portions of identical carbohydrate by gender

Estimation	CARBOHYDRATE FOODS											
	BA003	BA006	WB003	WB005	CH008	CH001	CP007	CP004	FU006	FU004	GA004	GA001
	Female n=156 {n% (n)}											
UE	41.67(65)	63.46(99)	13.46(21)	18.59(29)	49.36(77)	0.00(0)	16.03(25)	16.67(26)	27.56(43)	21.15(33)	7.05(11)	0.00(0)
CE	52.56(82)	28.85(45)	58.33(91)	57.05(89)	50.00(78)	89.74(140)	42.31(66)	40.38(63)	32.05(50.00)	55.77(87)	39.10(61)	69.23(108)
OE	5.77(9)	7.69(12)	28.21(44)	24.36(38)	0.64(1)	10.26(16)	41.67(65)	42.95(67)	40.38(63)	23.08(41)	53.85(84)	30.77(48)
	Male n=124 {n %(n)}											
UE	52.14(81)	81.54(101)	8.87(11)	13.71(17)	45.97(57)	0.00(0)	24.19(30)	12.90(16)	25.81(32)	29.03(36)	12.90(16)	0.00(0)
CE	43.21(39)	12.9(16)	58.87(73)	57.26(71)	54.03(67)	83.06(103)	42.74(53)	38.71(48)	47.58(59)	37.92(47)	34.64(43)	59.68(74)
OE	3.32(4)	5.65(7)	32.26(40)	29.03(36)	0.00(0)	16.94(21)	33.06(41)	48.39(60)	26.61(33)	33.06(41)	52.42(65)	40.32(50)
p-value	***0.001**	***0.003**	0.437	0.455	0.555	0.101	0.157	0.562	***0.017**	***0.012**	0.241	0.096

Pearson's chi square: *= P-value <0.05

Table 4.13 continued: Percentage estimation between the different portions of identical carbohydrate by gender

Estimation	CARBOHYDRATE FOODS											
	KE005	KE001	GPB002	GPB006	BR005	BR001	SU005	SU006	WA006	WA005	BY003	BY002
	Female n=156 {n& (n)}											
UE	8.33(13)	0.00(0)	1.92(3)	17.31(27)	15.38(24)	1.28(2)	36.54(57)	33.33(52)	11.54(18)	18.59(29)	3.85(6)	6.41(10)
CE	42.95(67)	87.18(136)	87.18(136)	38.46(60)	42.95(67)	74.36(116)	48.72(76)	41.67(65)	39.74(62)	41.03(51)	63.46(99)	84.62(132)
OE	48.72(76)	12.85(20)	10.90(17)	44.23(69)	41.67(65)	24.36(38)	14.74(23)	25.00(39)	48.72(76)	40.38(63)	32.69(51)	8.97(14)
Total	100(156)	100(156)	100(156)	100(156)	100 (156)	100(156)	100(156)	100(156)	100(156)	100(156)	100(156)	100(156)
	Male n=124 {n% (n)}											
UE	10.48(13)	0.81(1)	1.79(5)	15.32(19)	16.13(20)	0.00(0)	38.71(48)	34.68(43)	23.29(29)	11.29(14)	0.00(0)	0.81(1)
CE	44.35(55)	74.19(92)	87.90(109)	27.42(34)	32.26(40)	79.84(99)	45.16(56)	41.13(51)	26.61(33)	17.74(22)	70.16(87)	91.94(114)
OE	45.16(56)	25.00(31)	10.48(13)	57.26(71)	51.61(64)	20.16(25)	16.13(20)	24.19(30)	50.00(62)	70.97(88)	29.84(37)	7.26(9)
p-value	0.755	***0.016**	0.974	0.081	0.167	0.301	0.836	0.971	***0.01**	***0.001**	0.067	***0.045**

Pearson's chi square: *= P-value <0.05

CHAPTER FIVE

5.0 DISCUSSION

This portion of the study discusses the results obtained from the three main phases of the study:

1. The survey phase
2. The development of photographic atlas phase
3. The validation phase (pilot and major validation)

5.1 THE SURVEY PHASE

This phase discusses the population profile, body size and the collated carbohydrate food.

5.1.1 Population Profile

Although the distribution of male participants (49.6%; 401) in the survey study was slightly higher than that of the 2010 PHC (48.33%), they were comparable; the same can be inferred from comparing the distribution of female participants (50.40%; 407) in the survey group to the 2010 PHC (51.66%) (GSS, 2012). Christians and Muslim made up 78.47% and 11.63% of the study population respectively; these results were lower than the 83.25% and 11.86% summary report of the final results of the 2010 census (GSS, 2012), they are, however, comparable. The ethnic distribution put the Akan population in Greater Accra at 38.12%, Ga-Dangme at 26.34% and the Ewe at 19.33%, (GSS, 2012), however, the results obtained from this study put the Akan and Ga- Dangme populations higher at 39.73% and 27.85% respectively, whilst the Ewe population was

lower at 17.08%. The difference in ethnic distribution may be explained by the convenience selection of the suburbs which may have leaned towards suburbs with higher concentration of Akan and Ga-Dangme group

5.1.2 The survey phase: body size

The mean BMI for males (25.79 kg/m²) and for females (26.45 kg/m²) in the survey study group was higher than the mean BMI for males (22.6 kg/m²) and females (25.8 kg/m²) reported by Amoah, (2003b). The differences in the BMIs of this study and that of Amoah, (2003b) reflect the increase in obesity in Ghana from 25.5 % in 2003 to 35% in 2008 (Dake, *et al.*, 2011).

5.1.3 Common carbohydrates foods

The main carbohydrate foods identified in the survey were products from the cereals and grain group (70.3%), the tubers, roots and plantain group (24.2%) with the sugar group forming the minority (5.5%). Common foods identified in the cereal group were rice, maize, millet, wheat and wheat products, whilst yams, cocoyam, cassava, potato and plantain were identified as commonly consumed foods in the roots, tubers and plantain group. Similar findings were reported by the Nutrition and Consumer Protection Division of the Food and Agricultural Organization (FAO, 2009) and Nti, (2008), as carbohydrate consumption patterns of Ghanaians. Chocolate drink, jam, honey, soft drink and sugar were common foods identified in the simple sugar and beverage group.

The choice of carbohydrate based foods for the development of the photographic food atlas in the study was based on various factors. The Ghanaian diet is composed mainly 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).

Standard portion sizes of foods do not exist in Ghana; for most of these foods, portion sizes are quantitatively measured in relation to price. Due to the absence of recognizable defined portion sizes for carbohydrate based foods, weight of similar foods differ for the same price depending on where the food is purchased. Carbohydrate based foods in Ghana have an array of external characteristics and these were captured in the photographic food atlas and can be seen in the different types of molds and shapes, width and thickness of some foods such as Ga kenkey, Fante kenkey, banku, pies found in the photographic food atlas. These external characteristics make them difficult to describe without the use of PSMA. Like the current study, Nelson, *et al.,* (1996 and 1994) chose to include in their photographs commonly consumed foods with certain characteristics which they claimed might make them difficult to describe without the help of some type of PSMA. According to the researchers different external characters such as 'depth of pieces or mounds on a plate; number and size of pieces; area and thickness of slices; and depth in a bowl', can influence portion size estimation. On the other hand some researchers chose to include in their photographic food atlas, foods based on energy content (Ovaskainen *et al.,* (2008) and not on external characteristics.

5. 2 DEVELOPED PHOTOGRAPHIC FOOD ATLAS

Foods included in the atlas are carbohydrate based foods recorded in the participants food diaries and identified as commonly consumed by the researchers definition. Some of the foods identified had portion sizes which ranged from very small to very large; portion sizes that were difficult to distinguish between and portion sizes which had irregular shapes or sizes and were not sold in precise amounts. According to Nelson and Haraldsdottir, (1998a) these are some of the properties of foods to include in the development and use of the photographic food atlas. Furthermore, they noted that peoples' perception of portion sizes when using food photographs as PSMAs has been found to be affected by the type, depth, shape and spread of the food. Carbohydrates that are similar in appearance but have different ingredients and or shapes and therefore affect macronutrient content were also identified among the most common carbohydrate foods. These contributed to the variety of carbohydrate foods identified. In all a total of ninety-one (91) carbohydrate based foods were identified in this study.

The size of each picture in the food photograph is approximately six (6) centimeters x eight (8) centimeters. This falls within the range of picture size guidelines suggested by Nelson and Haraldsdottir, (1998a) a format, which the researchers claim provides the largest amount of useful information in the least amount of space. Other size ranges of pictures in some food photographs have been reported by some researchers and they are, 20 cm x 29 cm to 6 cm x 8 cm (Nelson and Haraldsdottir, 1998a); 160 mm by 100mm (Huybregts *et al.,* (2007) and 100mm x

150 mm (Robson and Livingstone, 1999). Venter, *et al.,* (2000) in their study to develop and test food portion photographs for use in an African population, enlarged the size of their food photographs to 21 x 29.5 centimeters in order to get them as close to life size as possible. Venter, *et al.,* (2000), cited in their paper, a study by Kirkcaldy- Hargreaves *et al., (*1980) where life size pictures were also used in food photographs. In his study to evaluate food photographs as a tool for 24-hour recall, Marjan (1995) also used life size photographs which according to him were to help improve the accuracy of the recall. Life size photographs are photographs that are of the actual size of the food portion depicted.

Nelson and Haraldsdottir, (1998a) suggested that the methodical way to help in selecting the range of portion sizes to be depicted in food atlases, should be based on the 5^{th} to 95^{th} percentile of adult serving sizes as reported in surveys. However, due to the lack of recommended dietary guidelines for carbohydrate foods as well as standard serving sizes in Ghana, it is difficult to compare the caloric and nutrient content of similar foods and therefore establish portion sizes in relation to serving sizes. In view of this the researcher chose the initial portion sizes of the various foods and compared them with portion/serving sizes from the Food Weights/Handy/Measures Tables booklet (Owusu *et al.,* 1995), Food exchange lists of local foods in Nigeria, (Fadupin, 2009) and The Exchange List for Meal Planning (Mahan, and Escott-Stump, 2012). For some amorphous foods which were not found in any of the references indicated above, portion sizes were either of the food as sold or fractions of food as sold. The increments in portion sizes by the addition of single portions to previous portions help to reduce the similarities in picture appearance because according to Nelson and Haraldsdottir, (1998a) smaller differences in pictures sizes have been found to affect portion size estimation. This, the

researchers alleged may be due to the difficulty, frustration and reduced attention experienced by participant in trying to estimate portion sizes that are very close to being similar in appearances. Turconi *et al.,* (2005) indicated that some portion size photographs are depicted in three portions, small, medium and large and these according to the researchers have been found to represent the range of portions usually eaten. Majority of the foods presented in the food atlas are in eight portions. Sixty-two (62) of the ninety one (91) foods were each portioned into eight (8) different portion sizes; this is because as indicated by Nelson and Haraldsdottir, (1998a) fewer photographs have been known to result in loss of accuracy. The remaining twenty nine (29) foods in this study had twenty four (24) represented as one (1) portion, four (4) as two (2) portions and one (1) as three (3) portions. According to Nelson and Haraldsdottir, (1998a) people's ability to estimate portions sizes in fractions when single portions are represented in food atlases have been known to be fraught with difficulties. Foods depicted in odd numbers may also cause people to pick the central image when estimating portion sizes. The researchers implied also that an even number of portions in food photographs may be a better option (Nelson and Haraldsdottir, 1998a).

On the other hand, the number of food portions depicted by Huybregts *et al.,* (2007) in their food photographs was four. Except for three foods which were in portions of four, Venter, *et al.,* (2000) had photographs of each food in three portions in their study. Nelson and Haraldsdottir, (1998b), reported that the 1997 Food Portion Sizes Photographic Atlas of the United Kingdom has eight (8) portions per food. Other photographic food atlases have also reported different number of portions per series; The 1997 Swedish Photographic Atlas of Food Portion Sizes has five (5) portions per food; the 1995 EPIC-SOFT Picture Book for Estimation

of Food Portion Sizes of the United Kingdom has four to six (4-6) portions per food and the 1997 Portion Photos of Popular Foods has three (3) portions per food (Nelson and Haraldsdottir, 1998b). In developing portion size photographs as a means to improve self-administered dietary assessment for adults, Probst *et al.,* (2010) had portion sizes that ranged between two (2) to eight (8) portions per food item. Subar *et al.,* (2010) alleged that food photographs with eight (8) portions are better estimated than food photographs with four (4) portions.

Pictures in the photographic food atlas in this study are either presented in ascending order or descending order. This has been done to reduce the tendency of small and large eaters automatically selecting from the smaller or larger end of the range of food photographs. According to Nelson and Haraldsdottir, (1998a) pictures arranged only in ascending order or in descending order in food photographs have the tendency to influence small eaters to select from the smaller portions and larger eaters to select from the larger portions. They further indicated that randomly ordering portion size presentations in food photographs may be the best method as it may prevent against the biases indicated above. However, a photographic food atlas that is randomly ordered, according to the researchers may come with an increase in participant burden because participants would have to search through the randomly ordered pictures to select a portion. The researchers implied that organizing some pictures in ascending and others in descending orders may help reduce the problems of selection bias and participants burden.

The photographic food atlas ‘The 1996 Manual de Quantificacao de Alimentos of Portugal’, is randomly ordered; whereas, these food atlases ‘The 1994 Portions Alimentaires of France’, ‘The 1997 Swedish Photographic Atlas of Food Portion Sizes’ and ‘The 1997 United Kingdom Food

Portion Sizes: Photographic Atlas' are all ordered in increasing portion sizes. 'The 1996 Registro Fotográfico para Inquéritos Dietéticos of Portugal' is ordered in decreasing portion size (Nelson and Haraldsdottir, 1998a).

Different numerical and alphabetical codes from those given to portion in the food photographs were assigned to plated foods of identical portions for validation to prevent participants from routinely selecting foods with identical codes which would have led to bias. Codes for the cooked food were placed in front of the plated food to prevent obscurity. This agrees with Nelson and Haraldsdottir, (1998a) recommendation that suggests that instead of names and sizes of the foods, food photographs should be labeled with numbers or letters and that the labels should not hinder the appearance of the pictures. This format has been exhibited in some photographic food atlases (Foster, *et al.*, 2012a; Foster, *et al.*, 2012b; Foster, *et al.*, 2012c).

In order to make the foods in the photograph stand out, pictures were taken against an ordinary white background on white crockery. The pictures in the food atlas like that of Huybregts *et al.* (2007) did not have reference objects like spoons, forks, and knives. Reference objects were not included to prevent confusion in portion size estimation; standards for cutlery are virtually nonexistent in Ghana and this is supported by Owusu *et al.*, (1995) who identified in their study as many as thirteen (13) teaspoons with measures ranging from 2.55 to 5.5 milliliters (mls). Reference objects were again not added as most Ghanaian traditional carbohydrate foods are eaten with the fingers. However, Nelson and Haraldsdottir, (1998a), stated that background objects such as knives, forks and spoons should be added to food photographs to help subjects

relate to the sizes of the pictures in real life situations. This they believe would help facilitate correct estimations. It is important to note that the contrast between the present study and the view from Nelson and Haraldsdottir, (1998a), may best fit within cultural contextual factors.

Turconi *et al.,* (2005) in their research to evaluate the use of photographic atlas as a PSMA in dietary surveys, depicted their photographs on white crockery against a white background. Nelson, *et al.,* (1994) also depicted food photographs in white plates on a white background. On the other hand Huybregts *et al.,* (2007) depicted the pictures in their photographic album in crockery available to the village where the study took place. According to Nelson and Haraldsdottir, (1998a), food photographs should have backgrounds which are inconspicuous and do not detract from the pictures.

The photographic food atlas in the study was depicted in colour as a better indication of the actual food consumed and also because according to Nelson *et al.,* (1994) a better rapport and concentration have been observed in subjects during long interviews When coloured photographs were used because according to them, subjects reported in a previous study that coloured pictures were more interesting to look at. The photographic food atlas used by Turconi *et al.,* (2005) to evaluate the effectiveness of food photographs on portion size quantification in epidemiological surveys was coloured and so was the photographic food atlas by Huybregts *et al.,* (2007) to validate portion size estimation in Burkina Faso. Foster *et al.,* (2005) and Marjan (1995) also depicted their food photographs in colour. The 1994 'Portions Alimentaires' of France, the 'Food Portion Sizes: A photographic Atlas' of UK (Nelson and Haraldsdottir, 1998a), and the photographic food atlas 'Portion Photos of Popular Foods *(*Hess, 1997)' of the USA are among some of the food atlases that are coloured. Nelson, *et al.,* (1994) on the other hand used black

and white photographs as well as coloured photographs in the photo series to assess subjects' perception of food portions in relation to food photographs.

To allow for a wider range of food portions to be displayed, portions of different carbohydrate foods were not combined on a plate. The various portions sizes of carbohydrate foods were placed on individual plates for the majority of the food, except for identical foods that came as single portions but had different shapes. Foods that could be grouped as one, and came as already portioned size such as biscuits but had different shapes were placed on a single plate as seen with the pictures of biscuits depicted in the photographic food atlas. In contrast, the photographic series, 'Registro Fotográfico para Inquéritos Dietéticos' of Portugal according to Nelson and Haraldsdottir, (1998a), displayed more than one type of food per plate. The researchers implied that combining a number of foods on a single plate limited the range of portion sizes that could be displayed and might also confuse subjects especially if the combined foods do not represent what the subject usually consumed.

5.3 VALIDATION OF THE PHOTOGRAPHIC FOOD ATLAS

The number of subjects selected (Nelson and Haraldsdottir, 1998a) their age and gender were based on selected demographic data of the survey participants in order to ensure that participants for the major validation were representative of the population for whom the atlas is intended. The photographic food atlas of commonly consumed carbohydrate foods is the first photographic food atlas developed for use in Ghana. To ensure that the validated photographic atlas is representative of the intended population, the age and gender distribution of selected participants were based on demographic data of the survey participants. The target populations for all the

studies were adults of both genders from the Greater Accra region of Ghana. Some researchers chose children for validation (Foster *et al.*, 2008; Lillegaard *et al.*, 2005), whilst other chose both adults and children (Frobisher and Maxwell, 2003). Other researchers studied portion size validation among the elderly (Ervin and Smiciklas-Wright, 2001; Godwin and Chambers, 2003). 'Perception is the subject's ability to relate the amount of food which is present in reality to the amount depicted in a photograph', (Venter, *et al.*, 2000). This is one of three (3) courses of action which occurs when photographs are used as PSMA (Nelson, *et al.*, 1994). The use of food photographs as PSMA to estimate portion sizes of actual foods by participants (perception) was assessed in this study.

5.3.1 Pilot validation

The pilot study of 50 subjects of equal gender was undertaken to establish the feasibility of the methodology intended for use in the validation study. 'A hundred percent assessment was completed by all subjects in the pilot study. A total of 2400 estimations were made. All foods assessed were amorphous foods except bread. The study recorded a statistically significant higher percentage of participants correctly estimating portion sizes (52.45%) with a 28.84% overestimation, and 18.71% underestimation *(P=0.001).* Results also showed that a significant (*P=0.001*) higher proportion of females (56.67%) were able to estimate better compared to males' (42.25%). A significant higher proportion of males (24.75%) underestimated when compared to females (13.58%) (*P=0.001*). The study did not record any statistical significant association between, gender and age and gender and BMI. With a statistically significant number of participants correctly estimating portion sizes in the pilot study; the photographic food atlas was considered a feasible tool for portion size estimation in the major study.

5.3.2 Major: General estimation

The number of subjects selected, their age and gender were based on selected demographics of the survey participants; this was in order to ensure that participants for the major validation were representative of the population for whom the atlas is intended (Nelson and Haraldsdottir, 1998b). A hundred percent assessment was completed by all subjects. Six thousand seven hundred and twenty (6720) estimations were made. Controlling for gender, age and BMI, further analysis was done to test participant ability to generally estimate overall carbohydrate foods presented. The results showed that a statistically significant number of participants (54.17%) correctly estimating portion sizes, with 29.16% underestimating and 16.67% overestimating *(P=0.003).*

Overall correct estimations ranging from 40% to 70% have been reported in other studies (Lucas *et al.,* 1995; Haraldsdottir, *et al.,* 1994; Nelson, *et al.,* 1994). The study by Venter *et al.,* (2000) in which a book of food portion photographs was developed and validated among a South African populace, also recorded a higher percentage (68%,) of correct estimation. In a study by Kirkcaldy-Hargreaves, *et al.,* (1980) which compared life-size colour pictures, three-dimensional life-size black and white drawings, food models and abstract shapes as a PSMA, the researchers recorded a 63% correct estimation for the life size coloured pictures. Ovaskainen *et al.,* (2008) reported a 50% correct estimation in their study.

An earlier study by Karvetti and Knuts (1985) also showed a tendency of subjects to underestimate more than to overestimate. However, in contrast with the study results, Ovaskainen *et al.,* (2008) claimed a tendency for subjects to overestimate more than underestimate. The researchers also cited other studies by Hernandez *et al.,* (2006), Turconi *et al.,* (2005) and Frobisher and Maxwell, (2003) which according to them recorded a higher level

of overestimates than underestimation.

With the exception of bread, ninety-two percent of the foods validated in this study were amorphous in shape. According to Venter, *et al.*, (2000), compared to some amorphous foods, solid foods with fixed shapes and depth are better estimated. Their study examined the ability of subjects to estimate weights of foods before and after training sessions. The researchers cited studies undertaken by Weber *et al*., (1997), Howat *et al.*, (1994) and Yuhas *et al.*, (1989) with similar results. The reason given to this was that because amorphous foods have different shapes and can also change shapes, the clear signs such as depth, spread etc by which participants could relate actual foods to that in food photograph are absent in amorphous foods. Amorphous foods in this study which could easily change shape and depth are sugar, boiled rice, waakye, gari corn porridge and cocoa beverages. These foods occur either in powder form or as grains or tiny crystals. The slightest movement of the container in which these foods are served, might cause them to spread, which might lead to change in depth and mound. However, in this study although most of the foods estimated (92%) were amorphous in shape, overall correct estimations (54.17%) were higher when compared to underestimation and overestimation. Apart from waakye with an overestimation of 52.52%, individual carbohydrate foods were also better estimated (Figure 4.14). The participants' ability to better estimate amorphous foods in this study may be due to several reasons. In Ghana, most foods do not come in packages or specific units; most foods are molded or served in various shapes and forms as determined by the person cooking or serving the food. The frequent consumption of amorphous foods by participants' indicated their consumption patterns (section 4.3.1) may have contributed to their ability to better estimate the foods in the study. Correct estimation of waakye by a lower proportion of participants in this present study (31.12%) may be as a result of the differences in

crockery used in the food photographs compared to those usually used for serving the same food as well as the traditional way of serving waakye in Ghana. Waakye is usually bought from street vendors and served in colourful plastic plates, leaves and sometimes plain plastic bags. It is also usually not served as a single carbohydrate food but served with other carbohydrate foods like gari, fried ripe plantain, spaghetti or macaroni in the same plates. A study by Wansink and Van Ittersum (2003), reported that container shape has an influence on portion size perception and estimation. The absence of these other carbohydrate food as part of the validated waakye could have affected estimation. According to Nelson and Haraldsdottir, (1998a), people's perceptions are affected when number of food displayed does not represent what is usually consumed. Waakye is one of the carbohydrate foods usually eaten together by a group of people directly from one bowl. This traditional practice could have affected subjects' ability to correctly estimate portion size (Hudson, 1995). Apart from waakye all other types of carbohydrate foods were better estimated.

The ability of participant's to correctly estimate amorphous foods differ in different studies. Studies by Lillegaard, *et al.*, (2005) and Venter, *et al.,* (2000) showed varying results for estimation of amorphous foods. In the study by Lillegaard, *et al.*, (2005), mashed potatoes, pizza, meat sauce, salad and cornflakes were better estimated than fat spread on bread and fried potatoes. Nelson, *et al.*, (1996) on the other hand reported in their study a higher estimation for cornflakes as compared to mashed potatoes, spaghetti and chips.

Participants' estimation of the different portion sizes of identical carbohydrate foods was also assessed. Smaller portion sizes of the same type of carbohydrate foods were better estimated by a higher proportion of participants, except for corn porridge and waakye, when bigger portion sizes were better estimated. This is consistent with results by Ovaskainen *et al.,* (2008). Similar to results by Huybregts *et al* (2007, underestimation was seen with bigger portions than with smaller portions, except for sugar and boiled yam (Figure 4.19). Overestimation on the other hand was not consistent with any portion size. Some studies observed a flat slope syndrome with subjects overestimating smaller portions and underestimating bigger portions (Huybregts *et al* (2007), Venter, *et al.*, (2000), Robinson *et al.*, (1997), Nelson, *et al.*, (1994) and Faggiano *et al* (1992).

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5.3.2.1Gender and estimation

When BMI and age were controlled, overall gender estimation of all carbohydrate foods recorded a statistically significant (*P=0.001*) correct estimation between gender for carbohydrate foods. A significant proportion of females (54.4%) better estimated than males (49.9%). Overall, underestimation and overestimation of portion sizes had no statistical significance to either gender. Studies by other researchers support this conclusion (Yuhas, et al., 1989).

The significantly higher proportion of correct estimations by females, according to Ovaskainen *et al.,* (2008), who cited the 2006 'time use survey of families of Finland', 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; do not go grocery shopping and do not cook. These may have contributed to their reduced ability to correctly estimate portion size. On the other hand a study by Ovaskainen *et al.,* (2008) to assess the validity of food photographs among 146 participants, had males being better at correctly estimating all food servings (51%) than females (49%). Researchers, Lara, Scott and Lean stated that women tended to intentionally underestimate food portions (Lara, *et al.,* 2004).

According to this current study overall underestimation by males although not statistically significant (19.72%: *P=0.112*), was higher than females (17.89%), confirming studies by Ovaskainen *et al.,* (2008) and Nelson, *et al.,* (1994) who also claimed in their studies that men tended to underestimate food portions when compared to women. Although males (30.37%) in this study had a tendency to overestimate more than females (27.61%), this was also statistically insignificant. This, however, conforms to a study by Burger, Kern and Coleman (2007) who claimed that overestimation of certain foods is seen more in males than females. A study by Nelson, *et al.,* (1994) on the other hand alleged that females had the tendency to slightly overestimate portions sizes; however, it was statistically insignificant.

Other studies by different researchers, however, found no effect on portion estimation by subject characteristics such as gender (Turconi *et al.,* 2005; Diliberti *et al.,* 2004; Kral *et al.,* 2004;

Robson and Livingstone, 2000; Venter *et al.,* 2000; Faggiano et al, 1992). The researchers, Turconi *et al.,* (2005) assessed the validity of photographic food series as a PSMA in estimating quantity of foods eaten by four hundred and forty eight (448) volunteers for eight (8) weeks. Both female and male volunteers consumed lunch and dinner from five (5) different cafeterias. The subjects estimated their intake with one of three food photographs. The researchers found an association between weight consumed and weight selected from food photographs, but no association between gender and estimation.

A higher percentage of females ranging between 54.49% and 73.72% correctly estimated seven (7) of the twelve (12) different carbohydrate types presented. Males, on the other hand were able to correctly estimate only six (6) carbohydrate types. The female genders' ability to correctly estimate portion further reinforces the previous explanations given.

Correct estimations of the different portions sizes of identical carbohydrates foods by bigger numbers of both genders was geared towards smaller portions except for corn porridge, waakye,

boiled yam and sugar. The study results also showed underestimation of bigger portions of foods by a higher proportion of male and female participants again except for corn porridge, waakye and sugar. Overestimation, once again did not follow any trend. Although the above trends of estimations were observed in the study, significant differences in portion size estimation by a larger percentage of gender was reached only for both portions of banku, fufu, waakye and the smaller portions of kenkey and yam. Among gender, a significantly higher proportion of females correctly estimated smaller portions of banku, waakye, fufu and kenkey when compared whilst the smaller portion of boiled yam was correctly estimated by a significant higher proportion of males (Table 4.13). Underestimation and overestimation of both portions of waakye and banku were observed a significant higher proportion of males (Table 4.13). The shape and number of actual banku presented on plates were different from those in the food photograph, although both photographs and plated foods had identical weights. The shape and number of banku presented for portions five (5) to portions eight (8) in the photograph were different from those plated; combinations of different pieces of banku were used to portray the portions in the food atlas, whereas the plated foods for validation portrayed just one piece. According to Lucas *et al* (1995), subjects underestimated portion sizes when portions sizes presented were larger and less numerous and overestimated when portions were smaller and more numerous. The different ways of presenting the banku might have contributed to the poor estimations by males because males usually do not cook or serve banku, which is usually cooked and served as one big portion by females.

Lillegaard *et al.*, (2005) reported similar experiences in their study when the shape of pizza served differed from that of the food photograph; a lower percentage of correct estimations was

realized. Lucas *et al.*, (1995) also concluded that participants had difficulties correctly estimating portion sizes when the actual food differed in number of portion sizes, thickness (shape) and distribution on a plate from that in the food photographs. These results are, however, contradicted by Robson and Livingstone (2000). The results in their study suggested that there was little evidence to show that food shape and other external characteristics influence the extent of over and under estimations.

Waakye was overestimated possibly because it is usually served with other carbohydrate foods such as gari, spaghetti, fried ripe plantain on the same plate and this usually contributed to the volume of the served food. This traditional way of serving waakye might have affected participants' perception.

5.3.2.2 Body Size and estimation of portion size

The BMI for the major validation study for males (22.73 kg/m²) and females (26.15 kg/m²) varied slightly from the survey group. The BMI variations especially for the male gender may be partly due to the fact that gender distribution of participants for validation was not the same as that of the survey group. It might also be further explained that the survey study did not record any underweight male participants whilst the major validation study recorded 14.52% underweight males.

In assessing participants' ability to generally estimate overall carbohydrate foods presented, the current study showed that correct estimations and under estimations of all carbohydrate foods by

BMI categories when gender and age were controlled were statistically insignificant even though correct estimation ranged between 50.34% and 54.06%. Overestimation was identified among a statistically higher proportion (33.42%, *P=0.027)* of obese participants (BMI =≥ 30.00 kg/m²) when compared to the other BMI categories (BMI; < 18.5 kg/m² to 29.99 kg/m²

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Bliss and Ginsburg, (2009), Ovaskainen *et al.*, (2008) and Turconi *et al.*, (2005) found no statistical significance between BMI levels and estimations of food portion sizes. Brunstrom *et al.*, (2008) also found no positive association between BMI and portion size. According to the researchers, apart from rice, where BMI was significantly inversely related statistically to portion size consumed, BMI was not significantly linked to portion sizes of all other foods tested.

Contrary to results by these researchers, findings from other studies (Okubo and Sasaki, 2004; Nelson, *et al.*, 1994; Forbes, 1993; Lichtman *et al.*, 1992; Bandini *et al.*, 1990; Prentice *et al.*, 1986; Zegman, 1984 and Lansky and Brownell 1982), reported an association between BMI and portion size estimated or consumed claiming that obese participants highly underestimated portion sizes. Some of these researchers alleged that, the highest levels of underreporting of food are found among individuals with higher body mass indexes, because on any given day, subjects with bigger BMI will probably be dieting (Lansky and Brownell, 1982, and Zegman, 1984). According to Lara, Scot and 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. An 8% increase in portion size underestimation

by participants with BMI greater than 30kg/m², was also reported in the study by Nelson, *et al.,* (1994) explaining that heavier participants perhaps feel the need to underreport their portion sizes because they normally consume larger portions than average.

In West Africa people with high BMI are seen as beautiful, privileged, wealthy (Brooks, 2006; Song, 2006) and to have a good life (Adedoyin *et al*., 2005). Dake, *et al.,* (2011) in their study to assess the socio-demographic correlates of obesity among Ghanaian women, concluded that obesity and overweight were more prevalent in wealthy households as well as among women who were highly educated. Although from the present study results, overall estimation of carbohydrate foods was not significantly dependent on BMI, the higher proportion of overweight (54.06%) and obese (50.34%) people correctly estimating food portions maybe because these participants did see any reason to underestimate their portion sizes because of their belief in the above socio-cultural concepts.

In the study, correct estimation was geared towards females, with a statistically significant ratio of underweight (54.63%) and normal weight (55.68%) females correctly estimating portion sizes when compared to males. An equal proportion (29.17%) of males to females over estimated portion sizes with statistical significance (*P= 0.027)*. Contrarily to the study results, some previous studies indicated that underweight individuals had the inclination to overestimate their food intake (Vinai, 2011) as indicative of patients with anorexia nervosa. These participants tend to unusually exaggerate their food intake (Milos *et al.,* 2012) due to their reported weight problems. In 1994 Nelson, Atkinson and Darbyshire reported that the "lightest" participants in their study overestimate portion sizes probably as a result of their eating habits. The researchers again reported findings that indicated that participants within the normal and underweight BMI range

overestimated portion sizes between actual foods and food photographs by 5% to 10% (Nelson, *et al.*, 1994).

Male participants within all BMI categories in this study exhibited a higher percentage of underestimation with the exception of those in the ≥30 kg/m^{2}BMI 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.*, 2008) and so they perceived the actual portion size presented as small when compared to their usual intake and that of the photographic food atlas.

In assessing participants BMI specific estimation of the different carbohydrate foods when age and gender were controlled, it was observed that a significantly higher proportion of underweight participants correctly estimated white bread (77.78%, *P=0.039*), and boiled yam (88.89%, *P=0.032*). Correct estimation for chocolate drink was seen among a significantly higher proportion of (73.33, *P=0.001*) of overweight participants. Corn porridge was however, overestimated by a significantly higher proportion of (53.70%, *P=0.002)* of overweight participants There was no significant association between participants' BMI and the other foods. It is difficult to find reasons for these observations.

5.3.2.3 Age and estimation

A statistically significant higher proportion of participants (58.13%), *P*=0.018 within the 55-64 age range of correctly estimated portion sizes. Fifty five to sixty four year olds may have had a longer period to either grocery shop, cook, serve food or observe these actions being done (Ovaskainen *et al.*, 2008). Least correct estimation was found among participants aged sixty

five years and over (≥65). A study by Ervin and Smiciklas-Wright (2001) which looked at older adults' capacity to approximate portion sizes of foods as well as remember the amount concluded that "elderly people do not retain precise mental images of portion sizes but have general concepts of the amounts". Participants aged sixty five (65) years and older in this study highly overestimated portion sizes. This is in line with a study by Nelson, *et al.*, (1996) who concluded that portion size overestimation on average was significantly higher for over 65 year old men. Over estimation and underestimations were not significant statistically.

Among gender, was a significantly higher of percentage (53.42%, *P=0.024*) of males within the 55 -64 year range correctly estimated portion size. No significant associations were found with female gender and age. A higher proportion of males aged between 55- 65 years had the highest correct estimation; this may be because at this age the participants might have had longer experience of serving themselves as well as observed foods being served and this might have influenced their estimation ability. Results from this study suggests that although a higher proportion of females in all age ranges correctly estimated portion sizes they were not statistically significant *(P=0.117).*

When portion size estimation was assessed for the different carbohydrate foods, estimation of waakye and fufu were significantly associated with age-range. Apart from the participants in the 35 to 44 year range and those aged 65 years and over, statistically significantly proportions of participants within the other age ranges correctly estimated fufu. The least proportion of participants (26.67%) who correctly estimated portion sizes were found among participants whose age exceeded 64 years. Correct estimation of waakye was seen among a significantly higher percentage of participants within the 55 to 64 year range. Overestimation of waakye was found

among a statistically significant higher proportion of 15 to 24 year old participants. Participants' ability to significantly estimate portion sizes of fufu correctly may be due to the fact that this is the staple food of the Akans who constituted 39.8% of the total population in this study, fufu is also eaten by all ethnic groups in Ghana. The lowest correct estimation, overestimation and underestimation for fufu found among the >64 year range may be because the elderly participants were not able to keep mental images of the actual foods presented to be able to compare it with the photograph but rather relied on what they conceived as the right portions (Ervin and Smiciklas-Wright, 2001). Waakye is not a dish usually prepared at home. It is usually bought at chop bars (eateries), restaurants, and from table top sellers; it is served in plates, bowls or leaves ready to be eaten. This method of food service does not provide participants the opportunity to assess the number of portions that are served them; as such, might have contributed to their inability to correctly estimate portion sizes.

CHAPTER SIX

6.0 CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

This section looks at the findings of the study, and makes the appropriate conclusions and informed recommendations with respect to the objectives of the study. The limitations that were encountered in this study, and thus may have affected the results will also be explored in this section.

6.1 CONCLUSION

This study identified, cataloged and categorized commonly consumed carbohydrate foods in Accra, Ghana, developed a photographic food atlas based on identified food and validated the atlas developed based on gender age and BMI status of participants. Standardized recipes based on information gathered from participants' three day food diaries, recipe book, on-line recipes and vendors were captured in the thesis. Among the socio-economic variables the study acknowledged that ethnicity, BMI, gender and religion of study population were reflective of those recorded in other research studies and census reports in Ghana. The participants' ability to perceive portion sizes of foods in the photographic food atlas and that of actual food shown were assessed with their ability to conceptualize and recall forming a lesser assessment.

The study identified ninety one (91) commonly consumed carbohydrate foods of which twelve were identified as the most commonly consumed. A coloured photographic food atlas depicting ninety-one (91) identified commonly consumed carbohydrate foods captured in portions of 1, 2, 3, and 8 in either ascending or descending order was produced and validated. A significant higher proportion of correct estimation

(54.17%; P= 0.03) by participants was recorded using the photographic food atlas with females better at estimating portions sizes than males. Overall correct estimation of portion sizes by age range was significant (P=0.018).

The study results show that:

- Males' ability to correctly estimate portion sizes was affected by their age.
- Underweight and normal weight male and female participants' ability to correctly estimate food portion sizes was statistically linked.

However in general, BMI had no effect on portion size estimation. On the other hand, gender and age were positively associated to portion size estimation in relation to the developed photographic food atlas. Females were better able to estimate portions size than males. Regardless of the discrepancies seen in this study, the results from this study suggest that the developed photographic food atlas as a PSMA can be used in assessing portions of commonly consumed carbohydrate foods.

6.2 LIMITATIONS

There are certain confounding factors that may have had an effect on participants' abilities to correctly estimate portion sizes. However, they could not be effectively controlled for in this study and thus may influence the proportions of the different degrees of estimation reported.

These factors are outlined below:

- Data on commonly consumed foods was self-reported and could have been subjected to bias.
- Foods were represented in crockery different from what is traditional to Ghana and this might have affected estimation abilities.
- The absence of reference objects (spoons, knives, forks) which in other studies are placed beside foods in food photographs could also have affected perception of some subjects who use these items;

although in Ghana traditional carbohydrate foods are not usually eaten with these.

- Hunger has been linked to a person's ability to estimate portion size. In this study hunger was not assessed although validation lasted eight hours
- Unavailability of serving sizes of carbohydrates foods for the Ghanaian populace makes it difficult to come out with appropriate portion sizes based on number of servings required by an average adult Ghanaian.

6.3 RECOMMENDATIONS

The following are some of the recommendations to be made:

- Foods to be assessed in future studies should be made up of a fair proportion of amorphous, solid and liquid foods for a better representation of the common carbohydrate foods consumed in greater Accra region.
- Other validation procedures or a modification of the current validation procedure should be investigated into to help improve the estimation of traditional foods usually eaten together or where the photographic food atlas was seen to be unsuitable for portion size estimation.
- Additional research is required to assess carbohydrate consumption patterns of the other regions of Ghana and where appropriate include new foods in the photographic food atlas for validation and use as a PSMA.
- More work should be done to include other food groups in the photographic food atlas to make it more comprehensive and to meet the standards of similar works done in countries such as South Africa, UK and USA. This would make the photographic food atlas an invaluable PSMA.

- Further research to come out with appropriate serving sizes of the different carbohydrate foods commonly consumed in Ghana as well as other foods based on daily energy requirement of the average Ghanaian adult is needed
- Other studies should be done to include fat, protein, vegetables and fruits in the photographic food atlas to make it more comprehensive and to meet the standards of similar works done in countries such as South Africa, UK and USA. This would make the photographic food atlas an invaluable PSMA.
- Appropriate portion sizes should be an integral part of any government policy that aims at improving the nutritional status and therefore the health of the Ghanaian populace.
- Health care workers should seek the input of spouse or caregiver when assessing and counseling men on portion sizes.

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SCHOOL OF ALLIED HEALTH SCIENCES

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My Ref. No. SAHS/10325400

Your Ref. No.

P O Box KB 143
Korle-Bu
Accra
GHANA

11th April, 2011

Ms. Gladys Peprah Boateng,
Dept. of Dietetics,
SAHS.

Dear Mrs. Peprah Boateng,

ETHICAL CLEARANCE

Ethical Identification Number: SAHS – ET./10325400/AA/26A/2011-2012

The Ethical Review Committee of the School of Allied Health Sciences, at its meeting held on **Thursday, 14th March, 2011** unanimously approved your research proposal as follows:

TITLE OF RESEARCH PROPOSAL: **"A photographic food atlas with portion sizes of commonly consumed carbohydrate foods in Accra, Ghana".**

PRINCIPAL SUPERVISOR: **Dr. Matilda Steiner-Asiedu**

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Ethical Review Committee at the completion of the study. The Committee may observe or cause to be observed, procedures and records of the study during and after implementation.

Please note that any significant modification of this project must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this study to the Ethical Review Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this study. You will therefore, be required to furnish the Committee with any manuscript for publication.

Please always quote the ethical identification number in all future correspondence in relation to this protocol.

Thank you.

Yours sincerely,

M. M. Addae
(Chairperson, Ethical Review Committee)

CC: Dean

Appendix II: Research Participant Information Sheet

DEPARTMENT OF DIETETICS

SCHOOL OF ALLIED HEALTH SCIENCES

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

Title of study: "The Development of a Photographic food atlas of commonly consumed carbohydrate based foods with portion sizes in Accra, Ghana."

Gladys Peprah Boateng, a PhD student in the School of Allied Health Sciences, Dietetic Department, Prof. Matilda Steiner-Asiedu, head of Department of Nutrition and Food Sciences, Prof. K.S. Salia, Department of Nutrition and Food Sciences, and Dr. Matilda Asante, PhD, head of Dietetic Department, School of Allied Health Sciences are conducting a research project titled "Photographic food atlas of commonly consumed carbohydrate based foods with portion sizes in Accra, Ghana." The purpose of the study is to collect information on common carbohydrates foods consumed in the greater Accra region, develop and validate a photographic food atlas. You have been randomly selected and we would like to invite your participation 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 stop participating in this research, you may do so without coercion or prejudice. Just inform the researcher. 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 researcher or research advisors.

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

Prof. Matilda Steiner-Asiedu on telephone number: 0245447874: email- tillysteiner@gmail.com

Prof. F.S. Salia on telephone number: 0547802413: email- nfs@ug.edu.gh

Dr. Matilda Asante on telephone number: 0540683892: email- matildaasante@chs.edu.gh

Appendix III: 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 collect information on common carbohydrates based foods consume in Accra, develop and validate a photograph food atlas of these foods. 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.

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

Participant's Signature Date

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

Witness's Signature

Date **Appendix 1V: Socio-Demographic Information Form**

Partieipant's ID: □□ □□ □□□□

DEMOGRAPHIC INFORMATION		
Questions		Response
1	Sex (tick male or female)	Male:1 □ Female:2 □
2	What is your date of birth	Day: □□ Month: □□ Year: □□□□
3	How old are you?	----------
4	What is your ethnic background?	Akan 1 Ga/Dangme 2 Ewe 3 Guan 4 Mole /Dagbani 5 Hausa 6
5	What is your current marital status?	Never married 1 Currently married or cohabiting 2 Separated/divorced 3
6	What is the highest level of education you have completed?	Middle/junior high school 1 Secondary /Senior secondary school 2 Post-secondary/tertiary level completed 3
7	Over the past year, what has been the average monthly income from all sources?	< GH CEDIS 200.00 1 GH Cedis 200.00 to less than GH Cedis 500.00 2 GH Cedis 500 to less than GH Cedis 1000 3 GH Cedis 1000 to less than GH Cedis 1500 4

8	Recorded height	cm
9	Recorded weight	kg
10	Religious affiliation	Christian 1 Moslem 2 Traditionalist 3
11	Any food aid?	Yes 1 No 2
12	Would you like to be a part of the validation process?	Yes 1 No 2

Appendix V: A Three Day Food Diary

Participants ID---------- **Date----------**

Time	Type of meal	Description of food (Each food item should be entered on a different line)	Amount in handy measure or weight	Who prepared food	Code (for official use)

A Sample Three Day Food Diary

Participant's ID---------- **Date----------**

Time	Type of meal	Description of food (Each food item should be entered a different line)	Amount in handy measure	Who prepared food	Remarks (for official use)
7.45 am	Breakfast	Millet porridge	5 ladlefuls	Bought	
		Sugar	3 teaspoonfuls heaped		
		Groundnuts roasted	1 small tin tomato full		
		Koose	3 large egg sized		
1.00 pm	Lunch	Roasted ripe plantain	2 fingers of	Bought	
		Roasted groundnuts	1 small tin tomato full		
		Orange	2 small		
6.30 pm	Supper	Banku	2 large orange sized	Daughter	
		Okro stew	3 soup ladlefuls		
		Smoked tuna	3 match box sized		
9.30 pm	Bed time snack	Milo drink	1 sachet	Myself	
		Cowbell milk	1 sachet		

Appendix VI: Recipe Booklet

Department of Dietetics

School of Allied Health Sciences

College of Health Sciences

University of Ghana

Participant's or food preparer's code number_

Gender _____

Age _____

Phone number_____

The purpose of the recipe booklet

This booklet is for the purpose of recording the recipes of all carbohydrate foods cooked and eaten by you as a participant, or cooked for a participant. The foods should be recorded for three days, inclusive of two weekdays and one weekend. Please do not change the way you usually prepare your carbohydrate foods; prepare foods the way you usually do. All information provided will be kept as confidential.

Your participation in this programme is greatly appreciated.

How to use Recipe Booklet:

- Start each recipe on a new page and use as many pages as need.

All ingredients should be weighed with a food scale or measured with a handy measure after it has been prepared (that is: peeled, chopped, trimmed etc.) before cooking.

Describe all preparation methods you go through before starting to cook the food.

Describe in detail all steps you take in making or cooking the food

Record the time spent in cooking each ingredient where appropriate.

An example of how to record your recipes is shown below.

Example of recorded recipe

Please enter each ingredient on a new line and each recipe on a new page. Name of carbohydrate food: Tatale or Tatar (plantain fritters)

Ingredients	**Weight in grams / handy measure**
Overripe fingers of plantain (apantu)	4 medium
Wheat flour	1 cup or 200 grams
Onions	2 small egg sized
Ginger	4 thumb sized
Pepper ground	2 teaspoonfuls
Salt	2 teaspoonfuls
Palm oil	1 soup ladle

Method	**Preparation time (minutes)**
Pound plantain to paste	Approximately 2 minutes
Mix in ginger, pepper onion	Approximately 1 minute
Mix in flour	Approximately 1 minute
Allow mixture to stand	60 minutes (1 hour)
Heat frying pan on fire and add palm oil	1 tablespoonful
Add a ladleful of mixture to hot oil	
Cook on one side till slightly brown on medium heat	Approximately 3 minutes
Turn and cook on other side until slightly brown	Approximately 1 ½ minutes

Please enter each ingredient on a new line and each recipe on a new page. Name of carbohydrate food:

Ingredients	Weight in grams / handy measure

Appendix VII: Common carbohydrates foods, area purchased/cooked, handy measure, mean weight & weight/single portion

Carbohydrate Foods	Source			Average Wt Of All Samples (gm)	Handy Measure	Standard portion	Weight/portion (grams)
	37 Area/ Nima (weight/sample)	Accra Central (weight/sample)	Spintex Road (weight/sample)				
Aboloo	(129) (125) (132)	(129) (133) (125)	(121) (115) (127)	(126.22) = 126	As Sold (Whole)	1	126
Agidi	(267) (271) (263)	(273) (269) (277)	(275) (272) (278)	(271.6) = 272	As Sold (Whole)	¼	68
Banku	-	-	(51) (50) (52)	51	Large Egg Size	1	51
*Biscuit (chocolate chips)	(9)(9)(9)	-	(9)(9)(9)	9	1 piece	1	9
**Biscuit (cream crackers)	(10)(10)(10)	-	(10)(10)(10)	10	1 piece	1	10
*Biscuit (digestive)	(16)(16)(16)	-	(16)(16)(16)	16	1 piece	1	16
*Biscuit (ginger snap)	(10)(10)(10)	-	(10)(10)(10)	10	1 piece	1	10
*Biscuit (rich tea)	(8)(8)(8)	-	(8)(8)(8)	8	1 piece	1	8
*Biscuit (Oreos)	(11)(11)(11)	-	(11)(11)(11)	11	1 piece	1	11
Bread Butter	(35) (32) (34)	(34) (35) (33)	(34) (34) (34)	33.8 = 34	Slice (1/2 Inch Thick)	1	34
Bread Roll	(68) (72) (64)	(65)(70)(60)	(63)(60)(66)	65.3 = 65	As Sold (Whole)	1/2	33
Bread Tea	(155) (145) (162)	(143) (140) (146)	(153) (161) (145)	150	As Sold (Whole)	1/4	37.5
Cake Cup	136)(134)(130)	136)(142)(138)	(136)(140)(136)	136.4 = 136	As Sold (Whole)	1/2	68
Cake Sponge	-	-	(52)(51)(52)	(51.6) = 52	Slice (1/2 Inch Thick)	1	52
Cassava Boiled	-	-	(52)(56)(55)	(54.3) = 54	Small Tin Tomato Size	1	54
Cocoa Powder	-	-	(6)(6)(7)	(6.3) = 6	Tablespoon	1	6
Cocoyam (boiled)	-	-	(54)(54)(55)	(54.3) = 54	Med Egg Size	1	54
Corn Boiled	-	-	(275) (224) (195)	(231.3) = 231	Whole	1/2	116

Biscuits:* brand name Mcvites; **Bisca

Appendix VII continued: Carbohydrates foods, where purchased or cooked, handy measure, weight per sample and weight per portion

Carbohydrate Foods	Source			Average Wt Of All Samples (gm)	Handy Measure	Standard portion	Weight/portion (grams)
	(weight/sample) 37 Area/ Nima	(weight/sample) Accra Central	(weight/sample) Spintex Road				
Corn Porridge	-	-	(117)(115)(115)	(115.8) = 116	Ladle	1	116
Corn Roasted	(192)(178)(182)	(193)(180)(182)	(182(188)(175)	(183.5) = 184	Large Size	1/3	61.3
Cornflakes (Kellogg)	-	-	(30)(31)(30)	(30.3) = 30	Cup (250 Mls)	1	30
Crisps (Pringles)	-	-	(25)(25)(25)	25	Serving Per Container	1	25
Croissant	(72)(76)(72)	(72)(78)(72)	(72)(76)(70)	(73.3) = 73	As Sold (Whole)	1/2	37
Doughnuts (traditional)	(98)(95)(99)	(100)(98)(96)	(96)(96)(92)	(96.7) = 97	As Sold (whole)	1/2	49
Doughnuts (Loaf Type)	(158)(161)(155)	(157)(161)(152)	(159)(160)(156)	(157.6) = 158	As Sold (whole)	1/4	40
Doughnuts (Party Type)	(16)(18)(!4)	(16)(14)(17)	(16)(16)(15)	(15.7) = 16	As Sold (Whole)	1	16
Doughnuts (glazed)	(154)(147)(161)	-	-	154	As Sold (Whole)	1	154
Doughnuts (holed)	(118)(116)(114)	-	-	116	As sold (whole)	1	116
Doughnuts (jam filled)	(118)(118)(119)	-	-	118.3=118	As sold (whole)	1	118
Doughnuts (twisted)	(72)(72)(72)	-	-	72	As Sold (Whole)	1	72
French Fries	-	-	(82)(84)(85)	(83.6) = 84	10 pieces	1	84
Fufu (Neat Powder)	-	-	(62)(63/)(61)	62	Large Egg Size	1	62
Fufu (Plantain and cassava)	-	-	(92)(92)(92)	92	Large Egg Size	1	92
Fula	(76)(78)(74)	(75)(78)(81)	(81)(79)(77)	(77.7) = 78	Large Egg Size	1	78
Gari	(61)(64)(63)	(61)(61)(62)	(60)(61)(60)	(61.4) = 61	Cup (250 Mls)	1/2	61
Gari ball	-	-	(52)(52)(52)	52	Large egg size	1	52
Gari fortor	-	-	(886)(90)(88)	88	Ladle	1	88

Appendix VII: continued: Carbohydrates foods, where purchased or cooked, handy measure, weight per sample and weight per portion

Carbohydrate Foods	Source			Average Wt Of All Samples (gm)	Handy Measure	Standard portion	Weight/portion (grams)
	37 Area/ Nima (weight/sample)	Accra Central (weight/sample)	Spintex Road (weight/sample)				
Honey	(9)(9)(10)	(9)(10/)(10)	(9)(11)(10)	(9.67) = 10	Teaspoon	1	10
Jam	-	-	(15)(15)(16)	(15.3) = 15	Teaspoon	1	15
Kakro (small)	-	-	(43)(40)(38)	40.33=40	Small egg size	1	40
Kakro (medium)	-	-	(73)(71)(69)	71	Large Egg Size	1	71
Kelewele	-	-	(64)(63)(66)	(64.3) = 64	Small Tin Tomato Size	1	64
Kenkey Fante	(368)(353)(383)	(386)(378)(370)	(376)(365)(354)	(370.33) = 370	As Sold (Whole)	1/4	93
Kenkey Ga	(306)(312)(300)	(290)(316)(312)	(286)(318)(314)	306	1 large egg size)	1/3	102
Konkonte	-	-	(262)(268/)(267)	265.67) = 266	Small Orange Size	1	266
Meat pie (cock tail)	-	-	(35)(37)(42)	38	Whole	1	38
Meat pie (type 1)	(89)(98)(107)	(93)(99)(102)	(96)(99)(99)	98	Whole (Large)	1	98
Meat pie (type 2)	(71)(59)(62)	(66)(61)(65)	(69)(58(65)	64	As Sold (Whole)	1	64
Meat pie (type 3)	(79)(86)(81)	(78)(86)(83)	(78)(85)(83)	(82.1) = 82	As Sold (Whole)	1	82
Millet Porridge (bagged)	-	-	(112)(114)(113)	113	Soup Ladle	1	113
Millet Porridge (plated)	-	-	(112)(114)(113)	113	Soup Ladle	1	113
Muesli	(16)(17)(15)	-	-	16	Cup	¼	1
Oblayoo	-	-	(125)(119)(122)	165	Soup ladle	1	1
Oats	-	-	(131)(130)(130)	(130.33) = 130	Ladle	1	130
Omo Tuo	-	-	(79)(77)(82)	(79.3) =79	Large Egg Size	1	79
Pastry Chips (Cubed)	(44)(43)(42)	(43)(43)(45)	(43)(43)(44)	(43.3) = 43	Cup (250 Mls)	1/2	22

APPENDIX VII: continued: Common carbohydrates foods, area purchased/cooked, handy measure, mean weight and weight per single

Carbohydrate Foods	Source			Average Wt Of All Samples (gm)	Handy Measure	Standard portion	Weight/portion
	37 Area/ Nima	Accra Central	Spintex Road				(grams)
	(weight/sample)	(weight/sample)	(weight/sample)				
Pastry Chips (Party Type)	-	-	(26)(25)(26)	(25.67) = 26	Cup (250 Mls)	1/2	26
Pasty chips (strips)	-	-	(19)(18)(18)	18.33	Cup (250)	1/2	18
Plantain Chips	(104)(97)(101)	(102)(101)(96)	(102)(97)(101)	(100.1) = 100	Cup (250 Mls)	1/2	50
Plantain Green Boiled	-	-	(82)(103)(94)	(93	As Sold (1 Finger)	1	93
Plantain Ripe Boiled	-	-	(64)(60)(62)	62	Small Tin Tomato Size	1	62
Plantain Ripe Fried	-	-	(57)(55)(55)	(55.67) = 56	Small Tin Tomato Size	1	56
Plantain Ripe Roasted	-	-	(72)(72)(74)	(72.67) = 73	Small Tin Tomato Size	1 ½	73
Pizza	-	-	(81)(77)(79)	79	⅛ of a 12 inch size	1	79
Pop Corn	-	-	(6)(7)(6)	(6.33) =6	Cup (250 Mls)	1/2	6
Potato (Boiled)	-	-	(63)(60)(64)	(62.33) = 62	Med Egg Size	1	62
Rice (Boiled)	-	-	(58)(59)(58)	(58.3) = 58	Stewing Spoon	1	58
Rice (Jollof)	-	-	(61)(62)(62)	(61.67) = 62	Stewing Spoon	1	62
Rice (Porridge)	-	-	(134)(137)(133)	(134.67) = 135	Soup Ladle	1	135
Rice (fried)	-	-	(74)(69)(67)	71	Stewing spoon	1	71
Rock buns	(98)(103)(93)	(103)(95)(96)	(89)(99)(105)	98.11 = 98	As sold	1	98
Saabo	(170)(182)(185)	-	(176)(190)(171)	179	As sold	1	179
Shredded wheat	-	-	(40)(41)(40)	(40.33) = 40	Cup	1	1
Soft Drink	(162)(164)(160)	-	-	162	Cup (250 Mls)	1	162
Spaghetti	-	-	(73)(76)(71)	(73.3) = 73	Soup Ladle	1	73

Appendix VII: VI continued: Common carbohydrates foods, area purchased/cooked, handy measure, mean weight and weight per single

Carbohydrate Foods	Source			Average Wt Of All Samples (gm)	Handy Measure	Standard portion	Weight/portion (grams)
	37 Area/ Nima (weight/sample)	Accra Central (weight/sample)	Spintex Road (weight/sample)				
Spring Roll (small)	(29)(30)(32)	(31)(31)(28)	(30)(27)(34)	30.22=30	As Sold (Whole)	1	30
Spring Roll (medium)	(48)(50)(47)	(51)(47)(51)	(52)(46)(48)	(48.89) = 49	As Sold (Whole)	1	49
Spring Roll (large)	(75)(70)(74)	(66)(75)(80)	(73)(78)(68)	73.22=73	As sold	1	73
Sausage Roll (cocktail)	-	-	(38)(36)(39)	37.67=38	Whole	1	38
Sausage Roll (medium)	(75)(68)72)	(65)(66)(69)	(71)(69)(68)	69.22=69	Whole	1	69
Sausage Roll (large)	(89)(96)(92)	(91)(99)(95)	(95)(90)(97)	93.78=94	Whole	1	94
Sugar (Granulated)	(5)(5)(5)	-	-	5	Teaspoon	1	5
Sugar (Rounded)	(8)(8)(8)	-	-	8	Teaspoon	1	8
Tatale (small)	-	-	((29)(33)(37)	33	Small lemon slice	1	33
Tatale (medium)	-	-	(71)(67)(72)	71	slice of Medium orange	1	71
Tombrown	-	-	(151)(153)(152)	122.33 = 122	Soup ladle	1	121
Tuo Zaafi	-	-	(74)(76)(74)	(74.67) = 75	Large Egg Size	1	75
Waakye	(67)(65)(66)	(68)(66)(63)	(65)(65)(67)	(65.79) = 66	Stewing Spoon	1	66
Weetabix	-	-	(44)(44)(43	(43.67)= 44	Pieces	2	44
Yakeyake	(100)(104)(105)	(103)(103)(100)	(101)(98)(102)	(101.78) = 102	As Sold	1	102
Yam Boiled	-	-	(133)(141)(135)	(136.33) = 136	Sardine Tin	1	136
Yam Fried	-	-	(82)(83)(80)	(81.67) = 82	Sardine Tin	1	82
Yam Mpotompoto	-	-	(83)(82)(82)	(82.3) = 82	Soup Ladle	1	82
Yam (mashed)	-	-	(46)(47)(50)	(47.67) = 48	Ladle	1	48

Appendix VIII: Recipes for Common Carbohydrate Based Foods

RICE PORRIDGE

INGREDIENTS	WEIGHT (g) / HANDY MEASURE
Raw rice	150g / 1 cup
Water	1.5 liter /6 cups

METHOD

Put rice in a cooking pot. Add the 6 cups of water, and bring to boil; stir occasionally to prevent the rice from sticking to bottom of pan. Lower heat and cook till rice is mushy approximately 30 minutes to 45 minutes. *Recipe from participant*

COOKED SPAGHETTI

INGREDIENTS	WEIGHT (g)/HANDY MEASURE
Spaghetti (Gino brand)	200 g / 1 packet
Water	2 liters / 8 cups
Salt	6g / 1 teaspoonful
Vegetable oil	15 mls / 1 tablespoonful

METHOD

Bring water to boil in a sauce pan, add spaghetti and stir to prevent sticking to bottom of pan. Cook for 3 minutes (until tender but not mushy) Drain off water. *Recipe from original food packaging*

PORRIDGE CORN

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Corn dough	192g / 3 large egg size
Water	1.5 liters / 6 cups
Salt	6g / 1 teaspoonful

METHOD:

Mix corn dough with 2 cups water. Bring 4 cups water to boil in a sauce pan and lower heat so that water simmers. Whilst stirring, gradually add corn dough and water mixture to simmering water. Stir until mixture thickens and turns a light grey colour. *Recipe from participant*

COOKED OATS

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Oats (jungle oats brand)	75g / 1 cup
Water	720 mls / 3 cups
Salt	To taste

METHOD

Put 1 cup jungle oats into a sauce pan and add salt to taste. Add 3 cups warm or boiling water to oats. Whilst stirring bring the oats and water mixture to boil; lower heat and let simmer for 3 minutes. *Recipe from original food packaging*

BOILED (STEAMED) RICE

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Rice	150g / 1 cup
Water	360 mls / 1 ½ cups
Salt	To taste

METHOD

Rinse rice in a few changes of cold water. Drain off water from rice (you may use a sieve)

Put rice and water in a heavy bottom sauce pan with a tight fitting lid and bring to boil. Lower heat and simmer until all water is absorbed (about 15 minutes). Rice should be tender to bite. Rice can be cooked in a rice cooker. *Recipe from participant*

JOLOFF RICE

INGREDIENTS	WEIGHT (g)/HANDY MEASURE
Rice	300g / 2 cups
Tomato puree	45g / 3 tablespoonful
Tomatoes	304 g / 4 large egg sizes
Onion	12 2g / medium egg size
Vegetable oil	30mls / 2 tablespoonful
Pepper	To taste
Water	1 liter / 4 cups
Salt	To taste
Spices	To taste

METHOD:

Wash, peel and chop onions; grind tomatoes. Rinse rice in a few changes of cold water and drain off water from rice (you may use a sieve). In a heavy bottom sauce pan heat cooking oil and add chopped onions. Stir until onion becomes translucent. Add ground fresh pepper and cook for 1 minute. Add ground tomatoes. To the tomato paste add 3 tablespoonful water and mix. Add tomato paste to mixture in sauce pan and cook to make tomato stew. This may take about 10 minutes. Stir occasionally to prevent stew from burning. Add rest of water and rice o stew and bring to boil. Lower heat and cook until all excess water is absorbed and rice is tender to bite (You may replace part of water with stock) *Recipe from participant*

WAAKYE

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Rice	150g // 1 cup
Beans (red)	105g // ½ cup
Water	Enough to cook beans
Water	360 mls / 1½ cups (to cook rice with beans)

METHOD

Clean and wash beans thoroughly. In a heavy bottom sauce pan put beans and enough water to cover to about 3-4 inches above beans in pan. Add baking powder or kawe (salt petre). Cook beans until it is soft but not mushy. Rinse rice in a few changes of cold water and drain off water from rice (you may use a sieve.). Add the rice to the cooked beans. Add enough water to cover rice and beans (about 1-1 ½ inches above rice and beans in pan) and cover with tight fitting lid.

Cook on low to medium heat until all excess water is absorbed and rice and beans mixture becomes soft. *Recipe from sellers*

MPOTOMPOTO

INGREDIENTS	**WEIGHT (g) /HANDY MEASURE**
Yam	210g / 2½ sardine tin size
Onion	61g / 1 medium egg size
Tomato	76g / 1 large egg size
Palm oil	45 mls / 3 tablespoonful
Water	750 mls / 3 cups
Pepper	To taste
Salt	To taste

METHOD

Peel and wash yam thoroughly in cold water. Grate half portion of the yam and dice the other half portion. Wash, peel and chop onion and tomatoes. Grind pepper. In a sauce pan heat palm oil slowly; add onion and cook for 1 minute. Add fresh pepper, cook and add chopped tomato. Stir whilst cooking until it becomes tomato stew. Add water and diced yam to sauce. Cook gently until yam becomes soft, stirring occasionally to prevent food from burning. Add grated yam and cook on low heat, stirring occasionally, until cooked. Mixture will become mushy with little lumps off yam. You may add smoked fish, shrimps or meat to food if you want to.

Recipe from participant

OTO

INGREDIENTS	WEIGHT (g)/HANDY MEASURE
Semi-ripe plantain (apantu)	189 g / 1 medium
Onion	61g / 1 medium egg size
Palm oil	20 mls / 2 tablespoonfuls
Pepper	To taste
Salt	To taste

METHOD

Peel and break plantain into small tin tomato size (do not cut with knife, plantain will absorb water). Wash, peel and chop onions. Put plantain and fresh pepper into a saucepan of boiling water and cover. Cook plantain until a knife inserted into it comes out clean; about10 minutes. In an earthenware bowl, grind the pepper, onion and salt. Add hot cooked plantain one at a time to onion and pepper mixture and mash whilst adding palm oil gradually. Cover the rest of the plantain to keep it hot during the mashing process; this will ensure that mashed plantain is not lumpy. You may add groundnut paste or roasted groundnuts to the "oto". *Recipe from participant*

FUFU (FROM NEAT PLANTAIN FUFU POWDER)

INGRDIENTS	WEIGHT (g) HANDY MEASURE
Fufu powder (Neat brand)	130g / 1 Cup
Water	360 mls / 1½ cups

METHOD

Mix 1 cup neat fufu powder to 1 ½ cups water in a sauce pan. Cooked over medium heat, knead thoroughly with a wooden spoon until mixture becomes pliable. Add extra hot water to mixture on fire whilst kneading until right consistency is obtained. Mould into balls

Recipe from original packaging

FRIED YAM

INGREDIENTS	WEIGHT (g)/HANDY MEASURE
Yam	166g / 2 sardine tin size
Vegetable oil	½ liter / 2 cups
Salt	To taste

METHOD

Cut yam into big chunks and peel the skin off the yam. Cut yam into long strips. Rinse yam thoroughly to remove all dirt. In a deep fat fryer or sauce pan put enough oil for deep fat frying (enough to cover yam pieces completely). Slowly heat up oil. (It should be hot enough to form bubbles on an inserted knife). Place yam strips in hot oil and fry until slightly golden brown. (A skewer should come out clean). Remove from oil and drain off any excess oil in a sieve

Recipe from participant

YAKEYAKE

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Grated cassava dough	456g / 3 margarine tin full
Corn flour	50g / 1 stewing spoonful

Water	1 liter / 4 cups
Salt	To taste

METHOD

Add water to cassava dough and drain to get rid of all starch. Pass through wooden sieve and discard residue. Add one stewing spoonful corn flour and salt to cassava dough. Portion mixture into 1 heaped soup spoon moulds and steam for 2 -3 minutes in a steamer lined with corn husk. *Recipe from vendors*

TUOZAAFI

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Corn flour (corn meal)	450g / 3 cups
Cassava flour	156g / 1½ cups
Water	240 mls / 1 cup

METHOD

Mix ½ cup corn flour to 1 cup boiling water, stir vigorously. Cook to porridge consistency and allow mixture to boil for 10 -15 minutes. Mix the cassava flour to the rest of the corn flour.

Add gradually to porridge and cook whilst stirring until colour becomes translucent. Mould into balls. *Recipe from participants*

KELEWELE

INGREDIENTS	**WEIGHT (g)/HANDY MEEASURE**
Ripe plantain (apantu)	189g / 1 medium finger

Onion (shallot)	33g / 4 thumb size
Pepper (fresh red)	18 g / 3 middle finger size)
Ginger (fresh)	5g / 1 thumb size
Mixed spice (traditional)	6 g / 1 teaspoonful

METHOD

Wash, peel plantain and cut length wise. Remove all seeds and cut into pieces (about 1 inch cubes). Wash and grind together onion, ginger and mixed spice Add spice to ripe plantain pieces and let stand for 10 minutes to marinade. Heat oil till very hot but not burning (bubbles should form on knife when dipped in hot oil). Add spiced cut up ripe plantain to hot oil and fry till golden brown, stirring occasionally to ensure cooking is thorough and to prevent burning. Remove and drain off oil in a colander. *Recipe from vendors*

MILLET PORRIDGE

INGREDIENTS	**WEIGHT (g)/HSNDY MEASURE**
Millet	813g / 2 ½ margarine tin
Mixed spices Whintia (Peppercorn), Suruwisa (black pepper), Wedieaba, Pepre (cloves), Ginger, Dried red pepper)	2g: 2g: 2g: 2g: 3g: 8g: 8g ratio
Water	4.5 liters / 18 cups

METHOD

Soak millet for 24 hours and drain off water. Add spices and mill smoothly. Take one part millet and spice mixture to 2–3 parts water. Cook on low heat until colour becomes translucent grey.

Recipe from vendors

BOILED YAM/CASSAVA/COCOYAM

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Yam or cocoyam or cassava	As desired
Water	Enough to cover food
Salt	To taste

METHOD

Remove peel off yam, cassava or cocoyam and Cut into desirable sizes. Wash and rinse off any dirt off the yam, cassava or cocoyam in clean water. Put yam, cassava or cocoyam in sauce pan and add water to cover up to 2 inches above food item. Add salt to taste Cook until soft and a skewer easily pierces through. Take food off heat and drain off all water. *Recipe from participant*

BOILED GREEN OR RIPE PLANTAIN

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Plantain (green or ripe)	As desired
Water	Enough to cover plantain
Salt	To taste

METHOD

Rinse off dirt from plantain. Remove peel off plantain. Slightly scrape the outer layer off the green plantain to smoothen it. Cut plantain into two pieces. Put plantain in sauce pan and add water to cover up to 2 inches above plantain. Add salt to taste. Cook plantain until soft and a skewer easily pierces through. Take plantain off heat and drain off hot water. Add cold water to green plantain and let stand for 2-3 minutes and drain off water. *Recipe from participant*

BOILED PEELED POTATO

INGREDIENTS	WEIGHT (g)/HANDY MEASURE
Potato	As desired
Water	Enough to cover potatoes
Salt	to taste

METHOD

Remove peel off Potato and cut into desirable sizes. Thoroughly rinse dirt off the potato. Put Potato in sauce pan and add water to cover up to 2 inches above Potato. Add salt to taste. Cook Potato until soft and a skewer easily pierces through. Drain off all water. *Recipe from participant*

FUFU (PLANTAIN AND CASSAVA)

INGRDIENTS	WEIGHT (g)/HANDY MEASURE
Plantain (apantu)	189g / 1 medium finger
Cassava	72g / 2 small tin tomato size
Water	Enough to cover plantain and cassava

METHOD

Peel cassava and plantain. Break plantain and cut cassava into small tin tomato sizes

Wash off all dirt and place in sauce pan and add water to cover up to 2 inches above plantain and cassava. Cook until cassava and plantain are soft. Drain off water. Cool plantain and cassava to warm. Pound till pliable. Mould and serve. *Recipe from participant*

FRIED RIPE PLANTAIN

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Ripe plantain (apantu)	192g / 1 medium finger
Vegetable oil	Enough for deep fat frying
Salt	To taste

METHOD

Wash and peel plantain. Slice into desirable shape. Add salt to taste. Heat oil in a sauce pan or frying pan and add sliced ripe plantain to hot oil. Fry turning over until each side is golden brown and cooked through. Remove from oil and drain off excess oil. *Recipe from participant*

KENKEY (GA AND FANTE)

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
White corn (corn meal)	2442g / 6 margarine tins full
Corn husks or plantain leaves	Enough to cover corn mixture
Salt (Ga Kenkey only)	To taste

METHOD

Put corn flour in a container and add enough water to dampen but not soak corn flour. Mix water and corn flour, cover and leave to ferment for 2 – 3 days. Work the fermented corn dough with the hands until it is well mixed and becomes a little hardened. Boil one margarine tin of water in a sauce pan. Slowly add half the fermented dough. Whilst stirring constantly and vigorously, cook for 10-15 minutes. Remove from heat and mix thoroughly with the remaining uncooked dough. Divide mixture into desired portions and wrap with corn husk for Ga kenkey or plantain leaves for Fante kenkey. Arrange wrapped dough in a sauce pan and add hot water to about 4 inches above wrapped dough. Bring to boil and cook slowly for about three hours or until cooked **Note:** Ga kenkey has salt added to dough. *Recipe from vendors*

BANKU

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Corn flour (corn meal)	750g / 5 cups
Cassava dough	750g / 12 large egg size
Water	Enough to cover and cook through
Salt	To taste

METHOD

Combine the corn flour and cassava dough with just enough warm water to dampen and mix well. Cover the container with a clean cloth and allow mixture to stand in a warm place for 2 to 3 days. This is to allow fermentation to take place. When properly fermented the mix should have a slightly sour and malt-like aroma. Knead the fermented dough with your hands until it is

thoroughly mixed and slightly stiffened. Mix 250ml water with corn dough and cassava mixture in a large pot. Slowly cook on a low heat, simmer for 20 minutes or more, stirring constantly and vigorously with a wooden stick. The banku will become thick and stiff (like fufu) and will become slightly grey. Mould the banku into balls of desired sizes. *Recipe from participant*

GARI FORTOR

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Gari	109g / 1 milk tin
Onion	61g / 1 medium egg size
Tomato	152g / 2 large egg size
Tomato paste	30g / 2 tablespoonfuls
Pepper	To taste
Vegetable oil	45mls/ 3 tablespoonfuls
Stock (chicken ,or beef, or fish)	Enough to moisten mixture
Salt	To taste
Spices (garlic, ginger)	To taste

METHOD

Chop onions and fry in heated vegetable oil until onion becomes translucent. Blend pepper and add to onion; fry for a minute and add blended tomato and cook for 3 minutes. Add tomato paste and cook for about 1 minute. Add stock and spices; cover and simmer for 4 minutes. Take stew off heat and let cool to room temperature. Stir in gari gradually until mixture becomes soft and moist. You may add smoked fish, cooked chicken, cooked meat, dried shrimp powder or mushrooms to stew before adding gari if desired.

Recipe from reference book

TRADITIONAL DOUGH NUTS

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Wheat flour	220g / 2 cups
Water	480 mls 2 cups
Sugar	144g / ½ cup
Yeast	6g / 2 teaspoonfuls
Vegetable oil	Enough for deep fat frying

METHOD

Mix the flour, sugar, water, and yeast together until the batter is smooth. Cover dough with damp cloth and let stand for about 2½ hours until dough has risen to about twice the size. Put vegetable oil into a pot, enough for deep fat frying. Heat oil till hot and then reduce the heat. Use a spoon to dish up the batter, and another spoon or spatula to drop it in the hot oil. Batter should rise to the top of oil if oil is hot enough for frying. Fry for a few minutes until the bottom side is golden brown. Turn the ball over and fry for a few more minutes until the other side is golden brown. Remove cooked dough nuts from oil with a perforated spoon. Put doughnuts in a colander to drain away excess oil. *Recipe from reference book*

SAUSAGE ROLL

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Wheat flour	330g / 3 cups
Eggs	2 medium
Margarine	114g / ¼ margarine
Egg white	2 medium
Water	125 mls / ½ cup

Salt	9g / ½ tablespoonful
Sausage	Enough to fill rolls
Vegetable oil	250 mls / 1 cup
Spices of choice	To taste

METHOD

Combine flour, butter, eggs, water and salt together and knead into dough. Cover the dough and let it rest for about 2 hours. Slightly fry sausages; do not brown them. Spice to taste.

Preheat the oven to 400 degrees. Roll out dough (about ¼ inch thick) and cut dough into rectangular strips (about 2 inches wide and 3 inches long). At the end of each strip of rolled out dough put a piece of sausage. Roll the dough around the sausage until it is completely covered. Repeat this process until all rolled out dough has been used. Slightly brush some egg white on the upper side of the sausage roll. Place the sausage rolls on a baking sheet; ensure that sausage rolls do not touch each other. Bake until golden brown. *Recipe from vendors*

MEAT PIE

INGREDIENT	**WEIGHT(g)/HANDY MEASURE**
Wheat flour	660g / 6 cups
Eggs	4 medium
Egg white	from 4 medium eggs
Salt	18g / 1 tablespoonful
Margarine	114g / ¼ margarine tin
Minced meat	500g /10 medium egg size
Cooked spaghetti	140g / 2 cups
Onions	122g / 2 medium egg size

Cabbage	75g / 1 cup (shredded)
Water (chilled)	420 mls / 1 ¾ cup
Spices (of choice)	To taste

METHOD

Preheat oven to 400ºF. To make the dough, combine the flour and salt. Cut in the butter until mixture becomes like bread crumbs. Combine eggs and water and gradually add to flour mixture with a fork; don't knead dough, cover and let it rest for 2-3 hours in a refrigerator. To make the filling, slightly sauté chopped cabbage, chopped onions and add to the cooked spaghetti. Spice and brown the minced meat; drain off all stock from it. Combine meat and vegetable mixture. Cut dough into pieces and roll out each piece to ½ inch thick on a floured board. Cut dough into circles. Put meat mixture in the middle of each circle of dough. Lightly brush water around the edge of each circle of dough and fold over. Press edges with fork. Brush the top of each pie with egg white. Place each pie on a baking sheet and leave spaces in-between. Bake until golden brown. *Recipe from vendors*

CROISSANT

INGREDIENT	**WEIGHT(g)/HANDY MEASURE**
Wheat flour	138g / 1¾ cup
Sugar (white)	15g / 2½ teaspoonfuls
Milk (warm)	160 mls / 2/3 cup
Dry active yeast	4g / 1¼ teaspoonful
Water (warm)	45 mls / 3 tablespoonfuls
Salt	9g / 1½ teaspoonfuls
Vegetable oil	30 mls / 2 tablespoonfuls

Unsalted butter (chilled)	157g / 2/3 cup
Egg	1medium
Water	5 mls / 1 teaspoonful

METHOD

Combine yeast, warm water, and 1 teaspoon sugar. Allow to stand until creamy and frothy. Measure the flour into a mixing bowl. Dissolve 2 teaspoons sugar and salt in warm milk. Blend into flour along with yeast and oil. Mix well; knead until smooth. Cover, and let rise until over triple in volume. Deflate gently, and let rise again until doubled. Deflate and chill 20 minutes. Massage butter until pliable, but not soft and oily. Pat dough into a 14 x 8 inch rectangle. Smear butter over top two thirds, leaving 1/4 inch margin all around. Fold unbuttered third over middle third, and buttered top third down over that. Turn 90 degrees, so that folds are to left and right. Roll out to a 14 x 6 inch rectangle. Fold in three again. Sprinkle lightly with flour, and put dough in a plastic bag. Refrigerate 2 hours. Unwrap, sprinkle with flour, and deflate gently. Roll to a 14 x 6 inch rectangle, and fold again. Turn 90 degrees, and repeat. Wrap, and chill 2 hours.

To shape, roll dough out to a 20 x 5 inch rectangle. Cut in half crosswise, and chill half while shaping the other half. Roll out to a 15 x 5 inch rectangle. Cut into three 5 x 5 inch squares. Cut each square in half diagonally. Roll each triangle lightly to elongate the point, and make it 7 inches long. Grab the other 2 points, and stretch them out slightly as you roll it up. Place on a baking sheet, curving slightly. Let shaped croissants rise until puffy and light. In a small bowl, beat together egg and 1 tablespoon water. Glaze croissants with egg wash. Bake in a preheated 475 degrees F (245 degrees C) oven for 12 to 15 minutes. *Recipe from www.allreipes.com*

CUP CAKES

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Wheat flour (all purpose)	138g / 1¼ cups
Baking soda	3g / ¾ teaspoonful
Salt	A pinch
Butter	73g / 5 tablespoonfuls
Milk	160 mls / 2/3 cups
Sugar (white)	288g / 1 cup
Eggs	2 medium
Egg yolk	from 1 medium egg
Vanilla extract	5mls / 1 teaspoonful

METHOD

Preheat an oven to 350 degrees F (175 degrees C). Line a standard muffin tin with 12 paper cupcake liners. Combine flour, baking soda, and salt in a bowl; set aside. Heat the butter and milk in a small saucepan over low heat until the butter has melted. Beat the sugar, eggs, egg yolk, and vanilla with an electric mixer in a large bowl until it has thickened slightly and is lighter in color. Gradually beat in the flour mixture on low speed until just incorporated. Slowly pour in the hot milk, beating until just combined. Divide batter evenly between cupcake liners. Bake until toothpick inserted into center comes out clean, about 20 minutes. Cool cupcakes in pan for 10 minutes. Transfer cupcakes to a cooling rack to cool completely. *Recipe from www.allreipes.com*

DOUGH NUT (DONUT)

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Envelope dry yeast	14g / 2 packets
Water (warm)	60 mls (¼ cup)
Milk (lukewarm)	360 mls / (1 ½ cups)
Sugar (white)	144g / ½ cup
Salt	6g / 1 teaspoonful
Eggs	2 medium
Shortening	75g / ⅓ cup
Wheat flour (all purpose)	550g / 5 cups
Vegetable oil	½ liter / 4 cups
Butter	78g / 1/3 cup
Sugar (confectioners)	250g / 2 cups
Vanilla	7.5mls / 1 ½ teaspoonfuls
Water (hot)	60mls / 4 tablespoonfuls or as needed

METHOD

Sprinkle the yeast over the warm water, and let stand for 5 minutes, or until foamy. In a large bowl, mix together the yeast mixture, milk, sugar, salt, eggs, shortening, and 2 cups of the flour. Mix for a few minutes at low speed, or stirring with a wooden spoon. Beat in remaining flour 1/2 cup at a time, until the dough no longer sticks to the bowl. Knead for about 5 minutes, or until smooth and elastic. Place the dough into a greased bowl, and cover. Set in a warm place to rise until double. Dough is ready if you touch it, and the indention remains. Turn the dough out onto a floured surface, and gently roll out to 1/2 inch thickness. Cut with a floured doughnut cutter. Let doughnuts sit out to rise again until double. Cover loosely with a cloth. Melt butter in a saucepan over medium heat. Stir in confectioners' sugar and vanilla until smooth. Remove from heat, and stir in hot water one tablespoon at a time until the icing is somewhat thin, but not

watery. Set aside. Heat he toil in a deep-fryer or large heavy skillet to 350 ºF or 175 ºC. Slide the doughnuts into the hot oil using a wide spatula. Turn doughnuts over as they rise to the surface. Fry doughnuts on each side until golden brown. Remove from hot oil, to drain on a wire rack. Dip doughnuts into the glaze while still hot, and set onto wire racks to drain off excess. Keep a cookie sheet or tray under racks for easier clean up. *Recipe from www.allreipes.com*

BREAD ROLL

INGREDIENT	**WEIGHT(g)/HANDY MEASURE**
Water (warm)	360mls / 1 ½ cups
Dry active yeast	9g // 1 tablespoonful
Sugar (white)	36g / 2 tablespoonfuls
Vegetable oil	30mls / 2 tablespoonfuls
Salt	6g / 1 teaspoonful
What flour (bread type)	440g / 4 cups

METHOD

In a large bowl, stir together warm water, yeast, and sugar. Let stand until creamy, about 10 minutes. To the yeast mixture, add the oil, salt, and 2 cups flour. Stir in the remaining flour, 1/2 cup at a time, until the dough has pulled away from the sides of the bowl. Turn out onto a lightly floured surface, and knead until smooth and elastic, about 8 minutes. Lightly oil a large bowl, place the dough in the bowl, and turn to coat. Cover with a damp cloth, and let rise in a warm place until doubled in volume, about 1 hour. Deflate the dough, and turn it out onto a lightly floured surface. Divide the dough into 16 equal pieces, and form into round balls. Place on lightly greased baking sheets at least 2 inches apart. Cover the rolls with a damp cloth, and let

rise until doubled in volume, about 40 minutes. Meanwhile, preheat oven to 400 degrees F (200 degrees C). Bake for 18 to 20 minutes in the preheated oven, or until golden brown. *Recipe from* *www.allrecipes.com*

TRADITIONAL WHITE BREAD

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Dry active yeast	14g / 2 packages
Sugar (white)	54g / 3 tablespoonfuls
Water (warm)	600mls / 2 ½ cups
Lard / shortening (softened)	42g / 3 tablespoonfuls
Salt	6g / 1 teaspoonful
Flour (bread type)	715g / 6½ cups

METHOD

In a large bowl, dissolve yeast and sugar in warm water. Stir in lard, salt and two cups of the flour. Stir in the remaining flour, 1/2 cup at a time, beating well after each addition. When the dough has pulled together, turn it out onto a lightly floured surface and knead until smooth and elastic, about 8 minutes. Lightly oil a large bowl, place the dough in the bowl and turn to coat with oil. Cover with a damp cloth and let rise in a warm place until doubled in volume, about 1 hour. Deflate the dough and turn it out onto a lightly floured surface. Divide the dough into two equal pieces and form into loaves. Place the loaves into two lightly greased 9x5 inch loaf pans. Cover the loaves with a damp cloth and let rise until doubled in volume, about 40 minutes. Preheat oven to 425 degrees F (220 degrees C). Bake at 375 degrees F (190 degrees C) for about

30 minutes or until the top is golden brown and the bottom of the loaf sounds hollow when tapped. *Recipe from* www.allreipes.com

POUND CAKE (SPONGE CAKE)

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Egg whites	From 2 medium egg
Egg yolk	From 1 medium egg
Flour (all purpose)	138g / 1 ¾ cup
Baking powder	4g / 1 teaspoonful
Baking soda	4g / ½ teaspoonful
Milk	160mls / 2/3 cups
Vanilla extract	15mls /1 tablespoonful
Butter	176g / ¾ cup
Sugar (white)	100g / ½ cup
Sugar (confectioners)	31g / ¼ cup
Sugar (brown)	55g / ¼ cup

METHOD

Preheat oven to 325 degrees F (165 degrees C). Grease and flour two ‘8 by 4’ inch loaf pans. Sift together the flour, baking powder and baking soda and set aside. In a medium bowl, cream together the butter, white sugar, confectioners’ sugar and brown sugar until smooth. Add egg whites and egg yolks, beating after each addition. Stir in the vanilla. Stir in the dry ingredients alternating them with the milk. Divide the batter evenly between the two pans. Bake for 60 to 70 minutes in the preheated oven, until a toothpick inserted in the center of the cake comes out clean. Cool in the pan for 10 minutes before inverting onto a wire rack to cool completely.

Recipe from www.allreipes.com

SAABO

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
White corn (dried)	814g / 2 cups
Groundnuts	73g / ½ cup
Corn husk	Enough for mixture
Water	Enough to cook Saabo
Salt	To taste

METHOD

Soak dried corn overnight. Mix soaked corn with groundnuts and put in corn husk. Fold corn husk around and over the mixture and tie with a string to prevent mixture from leaking into boiling water. Put tied up corn and groundnut mixture in a deep pan and cover with water so that water is about 4 inches above corn and groundnut mixture. Boil until cooked, about 1½ to 2 hours. *Recipe from vendors*

OBLAYOO

INGREDIENT	WEIGHT(g)/HADY MEASURE
Corn grits (polished)	560g/ 1 margarine tin full
Water	2 liters / 8 cups
Salt	To taste

METHOD

Add water to corn grits and cook. Stir to prevent porridge from becoming lumpy. Cook until grains are soft and mixture obtains a porridge texture.

EKUEGBEMLI

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Corn grits (polished, larger pieces)	545g/ 1 margarine tin full
Water	2 liters / 8 cups
Salt	To taste

METHOD

Soak corn grits overnight. Add water to corn grits and cook. Stir to prevent porridge from becoming lumpy cook until grains are soft and mixture obtains a porridge texture. *Recipe from vendors*

MPORTROBA

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Corn dough	160g / 2 ½ large egg sized corn dough
Water	1 ¼ liters / 5 cups
Salt	To taste

METHOD

Heat 4 cups of water in a saucepan. Divide corn dough into two; mix one half in the remaining water and mould the other half of corn dough into tiny ball, each size of a thumb. Add balls of corn dough to boiling water and cook gently for 10 minutes. Add corn dough and water mixture to it and cook further for 4-5 minutes stirring gently. *Recipe from reference book*

TOM BROWN/WEANIMIX

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Roasted corn flour or weanimix powder	285g / 3 milk tins
Water	1 ½ liters / 6 cups
Salt	To taste

METHOD

Bring 4 cups of water to boil in a large saucepan. Mix roasted corn flour or weanimix powder with rest of the water. Slowly add to boiling water whilst stirring to prevent porridge from becoming lumpy. Cook for 10 -15 minutes. *Recipe from participant*

KONKONTE

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Cassava flour (dry)	500 g / 1 ½ margarine tin full
Water	480 mls (2 cups)

METHOD

Bring water to boil; divide water into 2 and put half aside. Lower the heat so water simmers. Gradually add cassava powder to simmering water and stir vigorously to prevent lumps. Continue to stir and knead with a wooden spoon. Add some of the boiled water if mixture becomes too hard. Continue to stir and knead whilst adding cassava flour and hot water until all the flour is used up and the desired texture is obtained. The texture of the finished product should be smooth, soft and pliable but not sticky. Mould konkonte into balls of desired sizes. *Recipe from participant*

OMU TUO

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Rice	150g / 1 cup
Water	¾ liter – 1liter / 3 - 4 cups
Salt	To taste

METHOD

Cook rice until texture is very soft and slightly sticky. (Continue to add water until this consistency is obtained). Remove rice from fire and stir and knead with a wooden spoon to make it soft and pliable. Mould cooked rice into balls of desired sizes. *Recipe from participant*

TATALE

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Over-ripe plantain (Apantu, peeled)	756g / 4 medium fingers
Wheat flour	110g / 1 cup
Onions	122g / 2 med egg size
Pepper	To taste
Salt	To taste
Palm oil	240 mls / 1 cup
Ginger	To taste

METHOD

Wash, peel and pound over-ripe plantain to a smooth paste. Grind pepper, ginger and onions and mix with plantain paste using a wooden spoon. Mix in wheat flour and add salt to taste. Leave to stand for approximately 45 minutes. Heat a tablespoonful of palm oil in a frying pan and scoop a ladle full of ripe plantain mixture into oil and fry on low heat. Fry one at a time until tatale is

golden brown on one side: Turn tatale over and fry the other side. Remove with perforated spoon and drain on tissue. *Recipe from participant*

ABOLOO

INGREDIENT	WEIGHT(g)/HANDY MEASURE
Corn flour (polished)	500g / 10 stewing spoonful
Sugar	100g / 5 ½ tablespoonfuls
Baking powder	8g / 2 teaspoonfuls
Yeast	2.83g / 1 teaspoonful
Salt	To taste
Water	

METHOD

Divide corn flour into 3 portions and mix 1 portion with water and cook to form a thick porridge. Let porridge cool to room temperature and add remaining2 portions to it. Whisk mixture to form a consistency that allows the mixture to drop from a spoon. Add yeast and baking powder to mixture and allow mixture to rise. Scoop a ladle each onto clean broad leaves and steam or bake for 30 -45 minutes. *Recipe from participant*

ROASTED RIPE PLANTAIN OR YAM

INGREDIENTS	WEIGHT(g)/HANDY MEASURE
Ripe plantain	As much as desired
Yam	As much as desired

METHOD

Wash and peel ripe plantain or yam; cut into desired pieces. Light a charcoal pot, ensure that fire is not too hot; remove all brightly lit charcoal leaving more ash. Put on a wire mesh. Put peeled plantain or yam on wire mesh and turn plantain or yam occasionally until it is cooked through. Colour of cooked plantain or yam is slightly paler than original colour and is not sticky to touch but dry. Peeled ripe plantain can also be roasted in an oven on a baking sheet. *Recipe from vendors*

ROASTED CORN

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Fresh corn	As many whole pieces as desired

METHOD

Wash and remove husk from corn. Light a charcoal pot, ensure that fire is not too hot; remove all brightly lit charcoal leaving more ash. Put wire mesh or lit coal pot. Put corn on wire mesh and turn occasionally to prevent charring. Continue the occasional turning until it is cooked through.

Recipe from vendors

BOILED CORN

INGREDIENTS	**WEIGHT(g)/HANDY MEASURE**
Fresh corn	As many whole pieces as desired
Water	Enough to cook corn
Salt	To taste

METHOD

You may remove or leave husk from corn. Rinse corn thoroughly. Put the corn in a cooking pot and add enough water to cover corn, about 2 – 4 inches above corn. Add salt to taste and cook maize until it is soft. Drain the water of the maize. If husk was left on during cooking, then remove it before serving. *Recipe from participant*

SPRING ROLL

INGREDIENTS (spring roll wrapper)	**WEIGHT(g)/HANDY MEASURE**
All-purpose flour	110g / 1 cup
Water	180 mls / ¾ cup
Salt	1 ½ g / ¼ tsp
Cooking oil	Enough for deep fat frying

METHOD

In a large bowl, stir the salt into the flour. Mix the water into the flour to form a batter. Cover and let rest for 1 hour. The batter should be well mixed and fairly thick, but still thin enough to drop off the back of a wooden spoon. With a piece of clean cloth rob a little oil inside the pan and heat on medium low heat. Turn the heat down to low and add a heaping tablespoon of the batter to the middle of the pan. Quickly spread the batter out evenly to form a circle 5 - 6 inches in diameter. Continue smoothing out the batter as the skin cooks. Cook the skin briefly, until it is cooked on the bottom and the edges curl slightly. Take care not to overcook. Remove carefully and refrigerate or freeze until ready to use as called for in the recipe.

INGREDIENTS (spring roll filling)	WEIGHT (g)/HANDY MEASURE
garlic (minced)	18g / 3 cloves
Ginger	6g / 1 thumb piece
green onions	22g / 2 whole
cabbage (shredded)	38g / ½ cup
beef (minced)	500g / (10 egg size)
Oil	30 mls / 2 tablespoonfuls
Oil	enough for deep fat frying
soy sauce	30 mls / 2 tablespoonfuls

METHOD

Place 2 Tbsp. oil in a large frying pan over medium to high heat. Add garlic, ginger and green onion. Stir-fry (about 1 minute) until you can smell the fragrance. Add cabbage and stir-fry for 1- 2 minutes, until vegetables have softened. Add the soy sauce as you stir fry. Remove from heat. Place a spring roll wrapper on a clean working surface. With a slotted spoon, remove filling from pan into another dish. This process helps to reduce the amount of liquid in the filling. Place one heaping tablespoonfuls of the filling on the wrapper. Spread the filling lengthwise along the spring roll wrapper nearer the end closest to you. Fold the left and right sides of wrapper over filling, then lift up the wide end nearest you and tuck overtop. Roll to the other end. Secure the roll by dipping your fingers in some water and wetting the end, "pasting" it shut. Place some oil (about 1 inch deep) in deep-sided frying pan over medium-high heat. When bubbles rise, or when the oil begins to form snake-like lines across the bottom of the pan, the oil may be hot enough. To test it, dip one corner of a spring roll into the oil. If it begins to sizzle and cook, the oil is ready. Place the spring rolls in oil, fry for about 1 minute on each side until they turn light to medium golden-brown. Remove with slotted spoon onto on paper towels or a clean dish towel to drain off excess oil. *Recipe from vendor*

Appendix IX: A Table Containing Codes and Number of Portions of Carbohydrate Based Foods

Grains/Cereals Group	Codes	Portions	Tubers/Roots /Plantain Group	Codes	Portions	Beverage/Sugar Group	Codes	Portions
Abolo	AB00	8	Cassava (boiled)	CSB00	8	Chocolate drink	CH00	8
Agidi	AG00	8	Cocoyam (boiled)	CY00	8	Honey	HO00	8
Banku	BA00	8	French fries	FF00	8	Jam	JM00	8
Biscuit (chocolate chips)	BSCP00	1	Fufu	FU00	8	Soft drink	SD00	8
Biscuit (cream crackers)	BSCC00	1	Gari	GA00	8	Sugar	SU00	8
Biscuit (digestive)	BSD00	1	Gari ball	GB00	8	-	-	-
Biscuit (ginger snaps)	BSG00	1	Gari fortor	GF00	8	-	-	-
Biscuit (rich tea)	BSRT00	1	Kakro (medium)	KAM100	1	-	-	-
Bread (butter)	WB00	8	Kakro (small)	KAS100	1	-	-	-
Bread (roll)	WBR00	2	Kelewele	KW00	8	-	-	-
Bread (tea)	WBT00	8	Konkonte,	KK00	8	-	-	-
Cake (cup)	CC00	1	Mpotompoto	MPT00	8	-	-	-
Cake (sponge)	CS00	8	Plantain (green boiled)	PGB00	8	-	-	-
Corn (boiled)	CB00	8	Plantain (ripe boiled)	PRB00	8	-	-	-
Corn (roasted)	CR00	8	Plantain (ripe fried)	PRF00	8	-	-	-
Corn porridge	CP00	8	Plantain (ripe roasted)	PRR00	8	-	-	-
Cornflakes	CF00	8	Plantain chips	PC00	8	-	-	-
Crisp (Pringles)	CRP00	8	Potato (boiled)	PB00	8	-	-	-
Croissant	CRT00	2	Tatale (medium	TAM100	1	-	-	-
Doughnut (glazed)	DNG00	1	Tatale (small)	TAS100	1	-	-	-
Doughnut (holed)	DNH00	1	Yakeyake	YK00	8	-	-	-
Doughnut (jam filled)	DNF00	1	Yam (Mashed)	YM00	8	-	-	-
Doughnut (loaf type)	DNL00	1	Yam (boiled)	BY00	8	-	-	-
dough nut (party type)	DNP00	1	Yam (fried)	YF00	8	-	-	-
Doughnut (traditional)	DNT00	1	-	-	-	-	-	-
Doughnut (twisted)	DNW00	1	-	-	-	-	-	-

- means no carbohydrate type, no code or no portion

Appendix IX continued: A table containing codes and number of portions for carbohydrate based foods

Grains/Cereals Group	Codes	Portion	Tubers/Roots/Plantain Group	Codes	Portion	Beverage/Sugar Group	Codes	Portion
Fula	FL00	8	-	-	-	-	-	-
Kenkey (Fante)	KF00	8	-	-	-	-	-	-
Kenkey (Ga)	KE00	8	-	-	-	-	-	-
Macaroni	MA00	8	-	-	-	-	-	-
Meat pie (cocktail type)	MPc00	1	-	-	-	-	-	-
Meat pie (type 1)	MPt100	1	-	-	-	-	-	-
Meat pie (type 2)	MPt200	1	-	-	-	-	-	-
Meat pie (type 3)	MPt300	1	-	-	-	-	-	-
Millet porridge (bagged)	MTB00	8	-	-	-	-	-	-
Millet porridge (plated)	MTP00	8	-	-	-	-	-	-
Muesli	MU00	8	-	-	-	-	-	-
Oats	OP00	8	-	-	-	-	-	-
Oblayoo	OB00	8	-	-	-	-	-	-
Omotuo	OT00	8	-	-	-	-	-	-
Pastry chips (cubed)	PCC00	8	-	-	-	-	-	-
Pastry Chips (party type)	PCT00	8	-	-	-	-	-	-
Pastry Chips (strips)	PCS00	8	-	-	-	-	-	-
Pizza	PZ00	8	-	-	-	-	-	-
Popcorn	PPC00	8	-	-	-	-	-	-
Rice (boiled)	RB00	8	-	-	-	-	-	-
Rice (fried)	RF00	8	-	-	-	-	-	-
Rice (Jollof)	RJ00	8	-	-	-	-	-	-
Rice porridge	RP00	8	-	-	-	-	-	-
Rock Buns	RKB00	2	-	-	-	-	-	-
Saabo	SA00	1	-	-	-	-	-	-
Sausage roll (cocktail)	SSRC00	1	-	-	-	-	-	-

- means no carbohydrate type, no code or no portion

Appendix IX continued: A table containing codes and number of portions for carbohydrate based foods

Grains/Cereals Group	Codes	Portion	Tubers/Roots/Plantain Group	Codes	Portion	Beverage/Sugar Group	Codes	Portion
Sausage roll (large)	SSRL00	1	-	-	-	-	-	-
Sausage roll (medium)	SSRM00	1	-	-	-	-	-	-
Shredded wheat	SW00	8	-	-	-	-	-	-
Spaghetti	SG00	8	-	-	-	-	-	-
Spring Rolls (large)	SRL00	1	-	-	-	-	-	-
Spring Rolls (medium)	SRM00	1	-	-	-	-	-	-
Spring Rolls (small)	SRS00	1	-	-	-	-	-	-
Tom brown	TM00	8	-	-	-	-	-	-
Tuozarfi	TZ00	8	-	-	-	-	-	-
Waakye	WA00	8	-	-	-	-	-	-
Weetabix	WBX00	8	-	-		-	-	-

- means no carbohydrate type, no code or no portion

Appendix X: A Table of Plated Carbohydrates portions with Their Codes

Carbohydrate food	Portion size	Code
Banku	3	T11-B
	5	T11-C
	6	T11-D
	8	T11-A
White bread	2	T2-D
	3	T2-B
	5	T2-C
	8	T2-A
Chocolate drink	1	T1-A
	2	T1-D
	5	T1-B
	8	T1-C
Corn porridge	2	T6-B
	4	T6-A
	6	T6-D
	7	T6-C
Fufu	2	T12-B
	4	T12-A
	6	T12-C
	7	T12-D
Gari	1	T8-C
	4	T8-D
	7	T8-B
	8	T8A
Kenkey	1	T4-A
	3	T4-B
	5	T4-D
	8	T4-C
Green boiled plantain	1	T10-B
	2	T10-A
	5	T10-C
	6	T10-D

Appendix X continued: A table of plated carbohydrates with their codes

Carbohydrate food Rice	Portion size	Code
	1	T3-B
	5	T3-D
	6	T3-A
	8	T3-C
Sugar (granulated)	1	T5-C
	3	T5-D
	5	T5-A
	6	T5-B
Waakye	2	T7-D
	3	T7-A
	5	T7-B
	6	T7-C
Boiled yam	1	T9-C
	2	T9A
	3	T9-D
	4	T9-B

Appendix XI: Participant's Pilot Validation Form

PARTICIPANT ID: □□□ SEX: Male = 1 Female = 2

HEIGHT: _____ WEIGHT:_____kg BMI: _____

Meal type	Code of Selected carbohydrate	Code of Selected Carbohydrate from Photo Series	Actual Code for Selected Carbohydrate	Estimation
				Correct estimation 1 Under estimation 2 Over estimation 3
				Correct estimation 1 Under estimation 2 Over estimation 3
				Correct estimation 1 Under estimation 2 Over estimation 3

What do you think affected your ability to estimate portion sizes of the foods displayed?

Appendix XII: Participant's Major Validation Form

Department of Dietetics

School of Allied Health Sciences

College of Health Sciences

Participants ID:_____Gender:_____Height:_____Weight:_____BMI: _____

Carbohydrate Type	Coded Portion Displayed	Selected Coded Portion from Photo Atlas	Corresponding Coded Portion in Photo Atlas	Estimation
				1: (CE) 2: (UE) 3: (OE)
Banku	T11-B			(1), (2), (3)
	T11-D			(1), (2), (3)
Bread	T2-B			(1), (2), (3)
	T2-C			(1), (2), (3)
Chocolate Drink	T1-A			(1), (2), (3)
	T1-C			(1), (2), (3)
Corn Porridge	T6-A			(1), (2), (3)
	T6-C			(1), (2), (3)
Fufu	T12-A			(1), (2), (3)
	T12-C			(1), (2), (3)
Gari	T8-C			(1), (2), (3)
	T8-D			(1), (2), (3)
Kenkey	T4-A			(1), (2), (3)
	T4-D			(1), (2), (3)
Plantain(boiled)	T10-A			(1), (2), (3)
	T10-C			(1), (2), (3)
Rice (boiled)	T3-B			(1), (2), (3)
	T3-D			(1), (2), (3)
Sugar(granulated)	T5-A			(1), (2), (3)
	T5-B			(1), (2), (3)
Waakye	T7-B			(1), (2), (3)
	T7-C			(1), (2), (3)
Yam (boiled)	T9-A			(1), (2), (3)
	T9D			(1), (2), (3)

Appendix XIII: A table depicting frequency carbohydrate consumption at various meal times by participants in survey phase

Type of meals	Type of carbohydrate foods	Frequency of carbohydrate consumption/ meal time n (%)
Breakfast	Sugar	398 (18.20)
	Corn porridge	365 (12.13)
	White bread	228(10.41)
	Chocolate drink	234(10.22)
	Waakye	219 (10.01)
	Other carbohydrate foods	855(39.08)
Lunch	Boiled rice	289 (13.2)
	Kenkey	254 (11.61)
	Waakye	228 (10.42)
	Fufu	234 (10,23)
	Gari	221 (10.10)
	Other carbohydrate foods	961(43.94)
Supper	Banku	519 (13.82)
	Boiled rice	479(12.74)
	Green boiled plantain	402(10.71)
	boiled yam	395(10.51)
	Kenkey	381(10.13)
	Other carbohydrate foods	1582 (42.00)
Snack	White bread	38 (9.4)
	Sugar	39 (9.62)
	Chocolate drink	38 (9.31)
	Gari	35 (8.54)
	Pastry	32(7.80)
	Other carbohydrate foods	226 (55.39)

Appendix XIV: Macro Nutrient Content of Some Carbohydrate Foods

Carbohydrate food	Portion 1	Kcal	Protein (g)	Total fat (g)	Carbohydrates(g)
Aboloo	126	158.76	3.91	1.51	37.77
Banku	51	60.18	1.06	0.56	13.04
Biscuit (chocolate chip)	9	49.00	0.55	2.49	6.41
Biscuit (cream crackers)	10	44.40	0.88	1.72	6.86
Biscuit (digestive)	16	71.00	1.10	3.10	9.30
Biscuit (ginger snap)	10	47.00	0.60	1.70	7.20
Biscuit (Oreo)	11	53.00	0.60	2.10	6.50
Biscuit (rich tea)	8	35.00	0.60	1.20	5.60
Bread (butter)	34	90.44	3.71	1.24	16.15
Bread roll	33	94	3	1.3	17.5
Cake (sponge)	52	185.64	2.81	6.45	29.74
Chocolate drink	6	6.30	1.11	0.17	0.00
Cocoyam(boiled)	54	320.76	0.28	0.06	18.68
Corn (Boiled)	54	58.32	1.79	0.69	13.56
Corn (Roasted)	61	230.58	2.26	0.46	54.90
Corn flakes	30	108.00	2.01	0.03	26.01
Corn porridge	116	81.20	1.55	0.86	17.20
Crisp (potato chips)	30	154	1.86	7.41	14.40
Doughnut (glazed)	154	613.43	9.57	29.41	79.05
Doughnut (holed)	116	484.88	6.81	27.32	52.93
Doughnut (loaf type)	40	116.80	2.35	9.42	18.25
Doughnut (party type)	16	66.88	0.94	3.77	7.30
Doughnut (traditional)	49	176.40	3.09	9.46	20.87
Doughnut (twisted)	72	300.96	4.23	16.96	32.85
Doughnuts (jam filled)	118	265.00	3.70	6.90	31.90
Fante kenkey	93	123.69	2.38	1.33	26.43
Fufu	92	137.08	1.12	0.23	33.47
Fula	78	127.92	3.73	1.43	24.71
Ga kenkey	102	128.52	2.46	1.37	27.26
Gari	61	213.35	1.82	0.37	50.83
Jam	15	36.30	0.11	0.03	9.66
Kakro	40	81.60	1.78	1.86	15.95
Kelewele	64	130.56	2.84	2.98	25.52
Konkonte	266	661.03	5.63	1.15	157.50

Source: Armah SM., Mohammed H., Ghosh S and Vuvor F (2008). 'Ghana Foods Nutrients Database'. Department of Nutrition and Food Science, University of Ghana, Accra, Ghana. (Not Published)

Appendix XIV: Macro Nutrient Content of Some Carbohydrate Foods Continued

Carbohydrate food	Portion 1	Kcal	Protein (g)	Total fat (g)	Carbohydrates (g)
Macaroni	42	52.08	2.24	0.23	11.15
Meat pie (cock tail)	38	187.72	1.60	9.46	24.78
Meat pie (type 1)	98	484.12	4.12	24.4	63.90
Meat pie (type 2)	64	316.16	2.69	15.94	41.73
Meat pie (type 3)	82	405.08	2.44	20.42	53.46
Millet porridge	113	27.12	0.80	0.31	5.31
Mpotompoto	48	46.45	0.36	2.59	5.51
Muesli	82	151	3.87	2.36	30.59
Oats	130	92.30	3.30	1.98	15.60
Oblayoo	165	89.10	2.33	1.17	18.30
Pastry chips (cubed)	22	74.80	2.74	1.17	14.51
Pastry chips (flaked)	18	61.20	2.24	0.96	11.87
Pastry chips (strips)	26	88.40	3.24	1.39	17.15
Pizza (a wedge)	79	218	8.91	11.40	19.89
Plantain (green boiled)	93	107.88	0.73	0.17	28.97
Plantain (ripe)fried	56	114.24	2.49	2.61	22.33
Plantain (roasted)	73	89.06	0.95	0.27	23.28
Popcorn	6	22.68	0.22	0.05	5.40
Potatoes, boiled	62	53.94	1.16	0.06	12.48
Rice (boiled)	58	75.40	1.56	0.16	16.34
Rice ball	79	102.70	1.86	0.15	22.70
Rice Jollof	62	143.07	1.16	10.58	10.94
Rice porridge	135	54.00	0.99	0.08	11.93
Sausage roll (cocktail type)	38	135.44	3.56	10.18	7.38
Sausage roll (large)	94	335.00	8.79	25.18	18.26
Sausage roll (medium)	69	221.29	6.46	18.48	25.18
Soft drink	162	59.94	0.11	0.03	15.49
Sugar Granulated	5	19.35	0.00	0.00	5.00
Tea bread	37.5	99.75	4.09	1.37	17.82
Tom brown	222	555.1	13.65	23.29	78.47
Tuozaafi	75	76.81	1.39	0.76	16.54
Waakye	66	111.54	2.84	0.22	23.92
Weetabix	18	67.14	2.07	0.50	13.93
Yam (boiled)	136	155.04	2.03	0.19	36.71
Yam (fried)	82	261.58	3.08	13.98	30.76

Source: Armah, S.M., Mohammed, H., Ghosh, S. and Vuvor, F. (2008). 'Ghana Foods Nutrients Database'. Department of Nutrition and Food Science, University of Ghana, Accra, Ghana. (Not Published)

ACRONYMS

WHO: World Health Organization

PSEA: Portion size estimation aids

PSMA: Portion size measurement aids

BMI: Body mass index

CHO: carbohydrate

CE: Correct estimations

UE: Under estimations

OE: over estimations

NCD: Non communicable disease

CVD: Cardiovascular disease

FAO: Food and agriculture organization

DALYS: Disability adjusted life years

NASCO; National agricultural supply commission

3D: Three dimensional

2D: Two dimensional

NHANES: National health and nutrition examination survey

USDA: United States department of agriculture

NCND: National center for nutrition and dietetics

MAFF: Ministry of agriculture, forestry and fisheries

USA: United States of America

DES: Dietary energy supply

SAHS: School of allied health sciences

SPSS: Statistical Package for Social Sciences

PSMA: Portion size measuring aid

EPIC-SOFT: European Prospective Investigation into Cancer and Nutrition Software

ANOVA: Analysis of variance

FAOSTAT: Food and Agriculture of Organization of United Nations Statistical Databases

CDC: Centers for Disease Control and Prevention

WFP: World Food Programme

UNHCR: United Nations Commissioner for Refugees

UNICEF: United Nations Children's Fund

WFP: World Food Program

IDF: International Diabetes Federation

ORC: Opinion Research Corporation