

**ORAL HEALTH AND NUTRITIONAL STATUS OF ADULTS ATTENDING
DENTAL CLINICS IN KORLE-BU**

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10271142**

**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL
FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE MSc DIETETICS DEGREE**

INTEGRI PROCEDAMUS

JULY, 2015

**DEPARTMENT OF NUTRITION AND DIETETICS
UNIVERSITY OF GHANA SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES**

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DECLARATION

I, KERR-RABBLES SHARON LYDIA, hereby declare that with the exception of the cited references, all information in this project is the result of my own original research under the supervision of my supervisors; Rev. Tom Ndanu and Mr. Frank Hayford.

Sign

Kerr- Rabbles Sharon L.

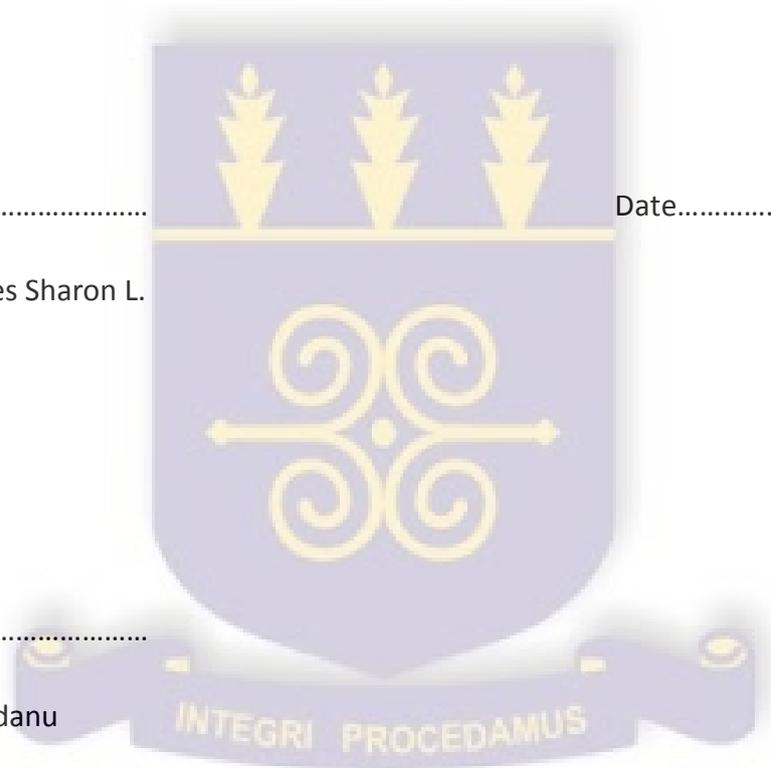
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Rev. Tom Ndanu

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Mr. Frank Hayford



ABSTRACT

Background: The ageing process involves physiological and nutritional changes and many health issues have been associated with these changes. Poor oral health, which affects chewing and swallowing is common in the ageing population (≥ 50 years) and has an influence on their overall nutrition and general health. A number of studies have linked missing teeth and other oral issues to poorer diets, however not many studies have related these results to effects on BMI, energy and micronutrient intakes in Ghana. Knowledge of changes in nutritional status due to poor oral health will not only help in better management of nutritional problems, but will also enable better clinical outcome.

Aim: - To determine the oral health and nutritional status of adults 50 years and above attending clinic at the Korle-Bu Dental School Clinic and Maxillofacial Unit (MFU) of the Korle-Bu Teaching Hospital (KBTH)

Methodology: This study was a cross-sectional study, involving older adults (50+ years) with or without oral health problems, visiting the dental clinics. Patients attending the clinics on the days of data collection that met the inclusion criteria and consented were included in the study. A total of 255 participants comprising 190 cases; who had visited the clinic with a particular oral problem and 65 participants as controls were recruited in the study. The patients were interviewed using structured questionnaires for socio-demographic information which included age, gender, educational level and employment status. Oral health and medical history were also obtained from log books for the cases. Food Frequency questionnaires and 24-Hour Recalls were used to collect information on frequency and pattern of food and nutrient intakes.

Results: Most (41.6%) of the participants surveyed were obese and none was underweight. There was no significant association of weight categories with age, marital status and employment status. However, there was a significant association of weight categories with employment status. There was a significant association between weight category and bad breath with overweight people having significant level of reported bad breath.

The mean energy intake was 1392kcal. Fruits juices and evaporated milk were taken just once or twice a week. Cereal products were major sources of energy. Fish was major source of animal protein and consumed daily. Watermelon was the most consumed fruit.

Most people took their vegetables in the form of stews or soups or as gravy and light soup in a week. Nuts, chocolate and toffees/candies were rarely consumed and more than 70% of participants never took any in a week.

Toothache, cavities, loose teeth, gum infection, tooth loss, mouth ulcers, halitosis and issues like broken or cracked tooth or dentures were some of the specific oral problems reported. About 80% of participants had lost one or more teeth and extraction was the highest cause of tooth loss. Most (24.3%) of the participants had lost their teeth over ten years and 23.1% were over 70 years of age. Periodontal disease (14.1%) and dental caries (9.4%) were the most occurring among those treated at the clinics.

About 39.6% of participants said oral problem had affected their food intake while 34.3% said they had changed their diets due to oral problems opting for liquid or soft foods as a way of coping with the oral problems. Majority had stopped eating hard foods like nuts and chips while others had stopped meat/ fish, fruits/vegetables.

Conclusion: Majority of the participants were either overweight or obese even though their estimated nutrient intakes did not meet recommended energy and macronutrients requirements for older adults. Frequency of intakes of fruits and vegetables, the major sources of micronutrients were also low indicating inadequate micronutrients intakes.

Most of the participants had had some form of oral problem in the past or were still experiencing some sort of oral problem. All the participants observed the basic good oral hygienic practice of brushing the teeth at least once a day and several had visited the dentist before.

The participants indicated that their oral health condition affected their food intake and hence inadequate nutrient intake in the elderly.

DEDICATION

I dedicate this work to my parents, whose love and support have seen me through all the changing scenes of life.



ACKNOWLEDGEMENT

My heartfelt thanks first and foremost to God Almighty for seeing me through two years of master's program in Dietetics and for His grace to see this work to completion.

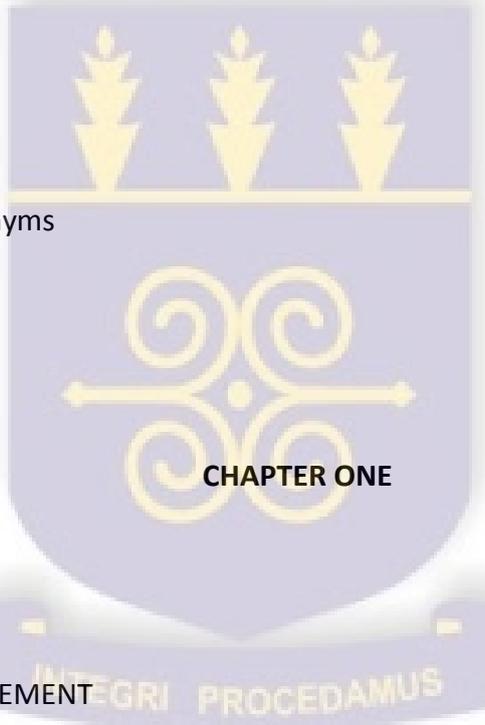
Thanks also to my loving parents and siblings and my entire family who assisted me in diverse ways.

An expression of sincere gratitude to my supervisors, Rev. Tom Ndanu and Mr. Frank Hayford, who supervised my work with all patience, to the head of department and all lecturers of the Department of Nutrition and Dietetics, who assisted me in diverse ways throughout my course.

Finally, special thanks to all participants who agreed to take part in my study and to those who helped me in my data collection.



TABLE OF CONTENTS

CONTENT	PAGE
Declaration	ii
Abstract	iii
Dedication	v
Acknowledgement	vi
Table of Contents	vii
List of Figures	x
List of Tables	xi
Interpretation of Acronyms	xiii
List of Appendices	xiv
 The watermark is a large, semi-transparent crest of the University of Ghana. It features a shield with a purple background and yellow symbols: three stylized trees at the top, a central decorative motif with two horizontal arrows, and a banner at the bottom with the Latin motto 'INTEGRI PROCEDAMUS'. The text 'CHAPTER ONE' is overlaid on the central part of the crest.	
1 INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PROBLEM STATEMENT	2
1.3 SIGNIFICANCE OF STUDY	3
1.4 THE AIM OF THE STUDY	4

CHAPTER TWO

2	LITERATURE REVIEW	5
2.1	INTRODUCTION	5
2.2	GLOBAL ORAL HEALTH BURDEN	5
2.3	ORAL HEALTH STATUS OF THE ELDERLY	6
2.4	FOOD CHOICES AND NUTRITIONAL ADEQUACY IN THE ELDERLY	8
2.5	EDENTULISM AND NUTRITION IN THE ELDERLY	13
2.6	PERIODONTAL DISEASE (PERIODONTITIS) AND NUTRITION IN THE ELDERLY	15
2.7	DENTAL CARIES AND NUTRITION IN THE ELDERLY	16
2.8	DENTURES AND NUTRITION IN THE ELDERLY	17
2.9	XEROSTOMIA AND NUTRITION IN THE ELDERLY	18
2.10	MEDICALLY COMPROMISING CONDITIONS ASSOCIATED WITH ORAL HEALTH	19
2.11	ASSESSING NUTRITIONAL STATUS IN THE ELDERLY	22
2.12	IMPROVING ORAL HEALTH AND NUTRITIONAL STATUS IN THE ELDERLY	24

CHAPTER THREE

3	MATERIALS AND METHODOLOGY	27
3.1	RESEARCH DESIGN	27
3.2	RESEARCH SETTING	27
3.3	PARTICIPANTS RECRUITMENT	27
3.4	ETHICAL APPROVAL	29
3.5	PROCEDURE FOR DATA COLLECTION	29
3.6	DATA PROCESSING AND ANALYSIS	32

CHAPTER FOUR

4	RESULTS	33
4.1	DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS	33
4.2	ANTHROPOMETRY AND WEIGHT CATEGORIES	35
4.3	DIETARY ASSESSMENT	41
4.4	ORAL HEALTH STATUS OF PARTICIPANTS	49
4.5	ASSOCIATION BETWEEN ORAL HEALTH AND FOOD INTAKE	53
4.6	OTHER ORAL HABITS AMONG THE RESPONDENTS	56

CHAPTER FIVE

5	DISCUSSION	57
5.1	DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS AND INFLUENCE ON DIET AND ORAL HEALTH	58
5.2	ANTHROPOMETRY AND WEIGHT CATEGORIES	59
5.3	NUTRIENT INTAKES AND ADEQUACY OF PARTICIPANTS	60
5.4	FREQUENCY OF CONSUMPTION OF VARIOUS FOODS IN FOOD GROUPS	62
5.5	ORAL HEALTH STATUS	64
5.6	ASSOCIATION BETWEEN ORAL HEALTH ON FOOD INTAKE	66
5.7	OTHER ORAL HABITS AMONG THE RESPONDENTS	67
5.8	CONCLUSION	68
5.9	RECOMMENDATIONS	69
5.10	LIMITATIONS TO THE STUDY	69
	REFERENCES	70
	APPENDICES	76

LIST OF FIGURES

FIGURE 1: WEIGHT CATEGORIES OF PARTICIPANTS	36
FIGURE 2: NUMBER OF TOOTH LOST BY WEIGHT CATEGORY	55

LIST OF TABLES

TABLE 4.1: DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS	34
TABLE 4.2: MEAN (\pm SD) ANTHROPOMETRY OF PARTICIPANTS	35
TABLE 4.3: WEIGHT CATEGORY BY CASE AND CONTROLS	36
TABLE 4.4: WEIGHT CATEGORY BY SEX	37
TABLE 4.5: WEIGHT CATEGORY BY AGE GROUP	37
TABLE 4.6: WEIGHT CATEGORY BY MARITAL STATUS	38
TABLE 4.7: WEIGHT CATEGORY BY EMPLOYMENT STATUS	38
TABLE 4.8: WEIGHT CATEGORY BY EDUCATIONAL LEVELS	39
TABLE 4.9: THE ASSOCIATION BETWEEN WEIGHT CATEGORIES AND GUM CONDITIONS	40
TABLE 4.10: MEAN INTAKES BY RESPONDENTS	42
TABLE 4.11: PERCENT OF RESPONDENTS WITH MACRONUTRIENT INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS	43
TABLE 4.12: PERCENT OF RESPONDENTS WITH MINERAL INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS	43
TABLE 4.13: PERCENT OF RESPONDENTS WITH VITAMIN INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS	44
TABLE 4.14: FREQUENCY OF CONSUMPTION OF SWEETENED DRINKS AND JUICES IN THE PREVIOUS WEEK	45
TABLE 4.15: FREQUENCY OF CONSUMPTION OF MILK AND MILK PRODUCTS IN THE PREVIOUS WEEK	46
TABLE 4.16: FREQUENCY OF CONSUMPTION OF CEREALS AND GRAINS IN THE PREVIOUS WEEK	46

TABLE 4.17: FREQUENCY OF CONSUMPTION OF ROOT TUBERS AND PLANTAIN IN THE PREVIOUS WEEK	46
TABLE 4.18: FREQUENCY OF CONSUMPTION OF ANIMAL PRODUCTS IN THE PREVIOUS WEEK	47
TABLE 4.19: FREQUENCY OF CONSUMPTION OF FRIED FOODS IN THE PREVIOUS WEEK	47
TABLE 4.20: FREQUENCY OF CONSUMPTION OF SPREADS IN THE PREVIOUS WEEK	47
TABLE 4.21: FREQUENCY OF CONSUMPTION OF FRUITS IN THE PREVIOUS WEEK	48
TABLE 4.22: FREQUENCY OF CONSUMPTION OF VEGETABLES, SOUPS AND STEWS IN THE PREVIOUS WEEK	48
TABLE 4.23: FREQUENCY OF CONSUMPTION OF OTHER FOODS IN THE PREVIOUS WEEK	48
TABLE 4.24: ORAL HYGIENE PRACTICES BY CASE AND CONTROL	50
TABLE 4.25: ORAL HEALTH PROBLEMS BY CASE AND CONTROL	51
TABLE 4.26: CAUSES OF ORAL PROBLEMS	52
TABLE 4.27: ASSOCIATION BETWEEN ORAL HEALTH AND FOOD INTAKE	54
TABLE 4.28: ASSOCIATION BETWEEN SMOKING AND TOOTH LOSS	56

INTERPRETATION OF ACRONYMS

BMI- Body Mass Index

DRI- Dietary Reference Intakes

FFQ- Food Frequency Questionnaire

MFU- Maxillofacial Unit

APPENDICES

APPENDIX I- QUESTIONNAIRE FOR PARTICIPANTS	76
APPENDIX II- FOOD FREQUENCY QUESTIONNAIRE	78
APPENDIX III- 24-HOUR RECALL	80
APPENDIX IV- PARTICIPANT INFORMATION SHEET	81
APPENDIX V- PARTICIPANT CONSENT FORM	82
APPENDIX VI- ETHICAL CLEARANCE	83

CHAPTER ONE

1 INTRODUCTION

1.1 BACKGROUND

Ageing is a normal process involving a range of biochemical and physiological changes in all parts of the body (Thomas and Bishop 2007). Deciding when someone is old is subjective and as people grow older it becomes more likely for factors such as nutrition, genetics, physical activity and stress to influence their ageing process. Each of these factors interacts differently with others to affect the ageing process positively or negatively. As ageing progresses, changes in the body's structure adds to the body's declining function (Rolfes et al. 1997).

Nutrition plays a great role in the prevention of many changes believed to be unavoidable consequences of growing old such as cataracts, arthritis, edentulism, osteoporosis and dementia. (Rolfes et al. 1997). Thus, good nutrition in old age is very crucial. Research has shown that sound nutrition can help reduce the deterioration of body tissues which comes with ageing (Thomas and Bishop 2007). However, some changes alter the structure and function of the gastrointestinal tract, decreasing the number of taste bud and causing tooth loss and gum disease. In older adults this affects food intake and overall nutrition. Most individuals do not reach old age with a full set of teeth and inadequate dentition and ill-fitting dentures have been shown to be significant contributors to under-nutrition in old age (Burton and Foster 1988).

Poor dentition and oral health results in the avoidance of food which requires chewing thoroughly, thus persons with tooth loss, gum disease and/or ill-fitting dentures are likely to limit their diets to softer foods (Burton and Foster 1988). These conditions make chewing difficult and painful and dentures, even when fitted appropriately are less effective than natural teeth and inefficient chewing can cause choking and indigestion (Burton and Foster 1988). As time goes by, vital food items are repeatedly left out of the diet. In addition the normal source of bulk:- fruits and vegetables which are typical sources of vitamins, minerals and fibre and when food groups are excluded and variety is limited hence nutrient deficiency follows (Burton and Foster 1988).

1.2 PROBLEM STATEMENT

The primary nutrition problem involving the oral cavity is the failure to maintain sufficient oral intake (Nelms et al. 2010). This may lead to changes in dietary selection with risk of an impaired nutritional status especially in people over the age of fifty. A study by Rathee and Hooda (2009) in the United States revealed that, one in five older adults reported that oral condition prevented them from eating the foods they would choose, 15% took longer to complete their meals and their enjoyment of food was limited by oral condition. Another 5% avoided eating certain foods because of chewing problems. In Ghana, past studies have focused greatly on the associations between oral health and nutritional status in younger generations, with very few considering the older generations. Appropriate medical, dental and nutritional interventions are needed to improve, dietary intake, of people over fifty years to prevent them from becoming malnourished.

1.3 SIGNIFICANCE OF STUDY

Adequate nutrition and good health are the right of all individuals and also form a basis for the development of a nation. Ageing is inevitable and the population of older adults the world over is increasing necessitating an increase in ways in which dieticians and health professional can help prevent malnutrition associated with poor oral health. In Ghana, very little research is carried out on the population above 50 years old. Understanding the true plight of this group of adults relating to oral health and nutritional status is key to planning effective nutritional intervention programs and also promoting lifestyle changes to ensure successful ageing. Findings from this study can also be used to support advocacy toward policies on nutrition for our older population and also serve as a cornerstone for future researches for a similar population elsewhere.

1.4 THE AIM OF THE STUDY

To determine the oral health and nutritional status of adults fifty years of age and above attending dental clinics at the Dental School Clinic and Maxillofacial Unit (MFU) of the KBTH

1.4.1 SPECIFIC OBJECTIVES

The specific objectives were to:

- Determine the nutritional status of adults over fifty years of age using;
 - a) Food Frequency Questionnaire
 - b) 24-Hour recall
 - c) Anthropometry (Body Mass Index)
- Assess the oral health of the sample using
 - a) Treated oral conditions
 - b) Questionnaires
- Assess the relationship between oral health and food intake.

CHAPTER TWO

2 LITERATURE REVIEW

INTRODUCTION

Oral health denotes more than just good teeth. It also means being free of chronic orofacial pain, oral and pharyngeal (throat) cancer, oral tissue lesions, birth defects such as cleft lip and palate and other diseases and disorders that affect the oral, dental and craniofacial tissues known as the craniofacial complex (Petersen, 2003). Oral diseases, as well as systemic diseases with oral expressions, affect an individual's ability to eat and their nutrition status. Likewise, nutrition and diet can affect the development and integrity of the oral cavity and progression of oral disease. Studies have shown a lifelong relationship between diet, nutrition and the integrity of the oral cavity in health and disease (Touger-Decker and Mobley 2013).

2.1 GLOBAL ORAL HEALTH BURDEN

Poor oral health can decrease appetite and the ability to eat, which in turn may lead to poor nutrition. Compromised nutritional status may result in an impaired immune response and resistance to infection, retarded wound healing, poor oral health, and, ultimately, general ill health. The National Dental Survey of Oral Health of United States Adults' indicates that 42% of those attending senior centers are edentulous (Papas et al. 2007). Even with the great achievements in the oral health of people globally, problems still remain in many communities around the world; particularly among underprivileged groups

in developed and developing countries. Prevalence of edentulism in Ghana was found to be 13.4%. (Peltzer, et al., 2014).

Dental caries and periodontal diseases have over all been identified as the most important global oral health burdens. At present, the distribution and severity of oral diseases vary in different parts of the world and within the same country (Petersen, 2003).

The relationship between oral health and general health is particularly evident among older people. Health authorities worldwide are now confronting an increasing public health problem, including a growing burden of oral disease among older people (Kandelman et al., 2008). Globally, poor oral health among older people has been shown mainly in high levels of tooth loss, dental caries experience, periodontal disease, xerostomia, and oral cancer (Kandelman et al., 2008). Among the negative impacts on daily life of poor oral health are reduced chewing performance, constrained food choice, weight loss, impaired communication and low self-esteem.

2.2 ORAL HEALTH STATUS OF THE ELDERLY

The number of older people is increasing more rapidly than of any other age group. There are almost 600 million people who are 60 years and over, and this quantity will double by 2025 with about 2 billion elderly living in developing countries (Petersen and Yamamoto, 2005). As a result of decreased fertility and increased life expectancy, the populations of most countries are ageing rapidly. By the year 2050 it is expected that more than half of the total growth of the world population would be people over 60 years (United Nations, 2007). The proportion of older persons in developed countries is currently much higher

than in developing countries; however, from a global perspective the majority of older persons live in developing countries (United Nations, 2007).

A notable aspect of population ageing is the progressive demographic ageing of the older population itself. Worldwide the most rapidly growing age group consists of persons aged 80 years or over. Although this age group now accounts for less than 2% of the total world population, the number of very old people is expected to increase four times from less than 90 million in 2005 to 400 million in 2050 (United Nations, 2007).

Although most individuals may now hope to live longer, the risk of developing at least one chronic disease increases with age. This shows the increasing consequences of life-long exposures to risk factors and not necessarily an increase in age. The common risk factors include unhealthy eating, smoking, alcoholism and stress which are shared by a lot of chronic diseases and injuries, including oral disease (Petersen, 2003). Increased life expectancy short of improved quality of life has a direct impact on public health and is becoming a key public health issue in the more developed countries (Petersen, 2003). A systematic review of the scientific literature by Kandelman et al., (2008) to assess the impact of oral disease on the general health of older people established strong associations between periodontal disease and diabetes, and tooth loss with poor nutrition.

Major challenges prevent older individuals from getting adequate dietary intake that relate not only to appetite but also to alterations in absorption and metabolism of key nutrients (Steele and Walls, 2004). Rathee and Hooda in 2009 also showed from their study that 25% of older people could not eat food they chose because of their oral problems while 15% took more time to finish their meals and did not enjoy their meals due to difficulty in

eating. Another study showed that masticatory efficiency in complete dentures wearers was approximately 80% lower than in people with natural dentition (Nelms et al., 2010).

2.3 FOOD CHOICES AND NUTRITIONAL ADEQUACY IN THE ELDERLY

Food provides the energy and building materials essential for the growth and survival of living things (Spiegel and Stellar, 1990). Different characteristics of foods, including color, form, texture, and flavor and a host of factors invite consumption. Humans consume more food when offered different foods than when variety is limited (Spiegel and Stellar, 1990). A number of factors influence peoples dietary choices and these include health, mood, cost, convenience and taste, familiarity, ethical concerns amongst other factors (Peltzer et al, 2014). Recent years have witnessed growing interests studying the attitudes and beliefs associated with healthy eating.

Studies by Krongl and Coleman, (1984) have shown some measures of psychological factors that influence fat and fibre consumption including items related to beliefs in the link between diet and disease, social norms among other factors. However health is not the only thing people consider when choosing food and focusing solely on it will limit the influence of other factors. Food availability and cultural factors also influence people's selection of food (Krongl and Coleman, 1984). Certain cultures exclude certain foods in their diet and might even have different preparation methods (Krongl and Coleman, 1984). Consumption of certain "prestige" foods may also become an index of social status while

the availability of certain foods in the market on demand greatly influences what people eat (Sanjur, 1982).

At the individual level, the likes and dislike of certain foods will influence the individuals food choice while the taste will also greatly influence its selection (Drenowski, 1992). High fatty foods are mostly consumed because of the role of fats in texture and aroma in many foods. Health and weight maintenance as well as stress and negative emotions also affect food choices (Drenowski, 1992). Food is absolutely essential for life and the pattern of consumption of food affects the human metabolism which is a complex process, constantly active and relies on a supply of nutrients. Most feeding occurs by repeatedly consuming those foods necessary for well-being (Spiegel and Stellar, 1990).

Ghanaians, as well as foreigners residing in Ghana have adopted eating patterns and habits dependent on the foods available in the country. Agble et al. (2009) stated that, members of a group adopt the eating pattern or food choices of the host country. A typical Ghanaian traditional diet is promoted for both its health benefits and its palatability (Agble et al., 2009). Being rich in plant foods and low in saturated fat, these diets have been associated with the health benefits of increased longevity and lower rates of chronic diseases in this region compared with other developing countries in the world (Agble et al., 2009). The main foods consumed in Ghana are cereals, starchy roots and plantain. The major staples are rice, yam, maize, cocoyam, cassava, plantain, millet and sorghum. They are accompanied by thick, well-seasoned sauces, the most popular being okro, fish, bean leaf, groundnuts and palava sauce (made from cocoyam leaves and melon seed). Popular cassava products are fufu (pounded cassava with plantain, cocoyam or yam), gari

(fermented cassava flour), agbelima (cassava dough), agbelikaklo (fried grated fermented cassava) and yakeyake (steamed grated cassava) (Agble et al., 2009).

Popular maize dishes are kenkey (fermented maize dough dumplings) and koko (porridge from sorghum/millet/fermented maize dough). These dishes are served mainly at lunch and dinner (Agble et al., 2009).

Generally, three meals are consumed daily, each one comprising one main course. Breakfast is usually quite substantial. The Ghanaian diet varies according to regions and between the urban and rural sector. Rice is a staple throughout the country, especially in urban areas. With rapid urbanization, the demand for imported foods has increased, especially for wheat and rice, causing a shift in consumption patterns of the urban population. The consumption of poultry meat, wheat and ready-made meals is much higher in urban areas than in rural areas. Christmas and Ramadan are the main religious celebrations in Ghana, during which meat is consumed, in particular chicken, goat and lamb (Agble et al., 2009). In terms of micro-nutrient intake, the rural diet is poorer than the urban one (Agble et al., 2009).

Despite the apparent good nutritional practices in Ghana, the dietary habits of the Ghanaian population have been deteriorating over the last two decades and have started to resemble a more 'Western' eating pattern, characterized by increased consumption of animal products and reduced intake of cereals, legumes, fruits and vegetables (Agble et al., 2009).

Eating a balanced diet is an essential part of healthy ageing. The link between oral status, masticatory function and nutrient intake is of great importance (Rathee and Hooda, 2009). Evidence from studies show that impaired oral health can affect individuals by causing dietary restrictions by means of chewing difficulty which can compromise nutritional status and well-being (Sheiham and Steele, 2001). Food choices are affected by our ability to chew. Chewing problems are relatively common in the elderly. Several studies show that people who cannot chew or bite comfortably choose not to eat foods that are difficult to chew are less likely to consume high-fibre foods such as bread, fruit and vegetables, in so doing risking decreasing their intake of very important nutrients (Sheiham et al., 2001, Sheiham and Steele, 2001, Steele and Walls, 2004). In a study involving 1755 people aged 65 years and over, 13% with impaired dentitions said that they 'often' or 'always' had problems biting or chewing in the previous three months and 10% experienced frequent limitations in the kinds or amounts of food eaten, while 9% always perceived discomfort while eating (Sheiham and Steele, 2001).

People who have lost some teeth can become quite handicapped by their dentition and, as a consequence, suffer impaired intakes of fruit and vegetables and some key nutrients (Steele and Walls, 2004). One area of particular worry is the markedly reduced level of dietary fibre intake in older people compared with the recommended dietary allowance (RDA). For example, a decreased intake to 11 g/day in edentulous older people in the UK compared with an RDA of 25 g/day has been reported (Steele and Walls, 2004). There were also substantial decreases in key micronutrients such as Vitamin C and retinol, folate and

Beta carotene in edentulous older people compared with those who have natural teeth (Steele and Walls, 2004).

The impact of tooth loss has resulted in low intakes of fruit and vegetables hence low biochemical levels of vital nutrients such as vitamin C (Steele and Walls, 2004). For example older people with some missing teeth consumed fewer vegetables, less fibre, and less carotene during meals. They however consumed more cholesterol and saturated fats predisposing these older people to chronic diseases such as diabetes, hypertension and stroke (Peltzer et al., 2014).

A means to reduce the effect of low nutrient intakes due to tooth loss will be to give dietary supplement to replace missing nutrients in people with impaired oral health. Intervention studies however, with micronutrient supplementation have failed to reduce the risk of either cancer or cardiovascular disease (Peltzer et al., 2014). It is more likely that the observed deficiencies are indicators of general poor diet. Instead of focusing on the individual nutrients that have shown to be deficient, the diet needs to be replaced with a more balanced diet including fruits and vegetables in order to obtain the benefit that comes with consuming foods with several nutritional components (Peltzer et al., 2014). A high intake of fruits and vegetables has been shown to be associated with lower risk of periodontal disease, a major cause of tooth loss which may mean that a low intake of fruits and vegetables may associated with edentulism (Peltzer et al., 2014).

2.4 EDENTULISM AND NUTRITION IN THE ELDERLY

Retention of teeth into older age is important in order to provide the functional means to eat varieties of foods, particularly fruit and vegetables. The ability to chew, swallow and enjoy food can influence food choice in the individual. Chewing and swallowing are the initial steps in the digestive process and can affect the enjoyment of the meal. In older individuals chewing is influenced by the number and distribution of natural teeth and the quantity and quality of saliva produced. These factors may change with ageing, resulting in older people having fewer natural teeth and possibly losing all with increasing age (Steele and Walls, 2004). Between individuals with teeth, comfort of eating was influenced by the number of teeth present, with chewing becoming easier with a greater number of natural teeth. Severe dental caries and periodontal disease are the major causes for loss of natural teeth. (Petersen and Yamamoto, 2005).

Review of literature by Peltzer, et al. (2014) and Wu et al., (2012) found a wide disparity in edentulism prevalence among adults aged 50 and above in five ethnic groups in the United States: Asians, African Americans, Hispanics, Native Americans, and non-Hispanic Caucasians. A high prevalence of edentulism was found also in Mexico, Russia and India and low prevalence of edentulism in Ghana, South Africa and China. Prevalence of edentulism in Ghana was found to be 13.4%. The difference in tooth loss patterns was attributed to the fact that Africans are less likely to have dental caries in general due to lower consumption of free sugars compared with industrialized nations such as the US (Peltzer et al., 2014).

Smoking and inadequate fruits and vegetable consumption were also associated with edentulism. According to Peltzer et al. (2014) smokers rather than non-smokers had an increased risk of tooth loss. Also a mixed diet population was found to be more edentulous compared with vegetarians. It was again observed that edentulous individuals were consuming inadequate amounts of fruits and vegetables necessary to maintain good health (Peltzer et al., 2014). These findings together with the observed levels of edentulism in developing countries suggest that edentulism has a great impact on nutrition, health and wellbeing in these countries.

Being edentulous has a significant relationship with the intake of several important nutrients in the older adults. They consumed less food, energy, protein, fibre, calcium, iron, niacin and vitamin C than dentate people which put them at a high risk of malnutrition. Conditions may worsen for older adults with disability or other co-morbidities and may be predominantly at risk to reduced intakes (Moynihan et al., 2009; Sheiham et al., 2001). Findings by Moynihan et al., (2009) showed that people with more than 20 natural teeth consumed more of the majority of nutrients than those with fewer proving that having more than 20 natural teeth is consistent with a good dietary capability and optimum nutritional intake. Another finding showed that intake of dietary fibre was much higher in people with more teeth showing that dental state is related to intake of dietary fibre.

Dietary fibre is a vital component of diet therefore must be taken into consideration when assessing nutritional needs of older people. Older people missing a number of teeth have been shown to consume about 181g/day of fruit and vegetables which is a major source of dietary fibre, compared with 267g/day by the dentate.

Also a variety of other nutrients including food energy, protein, calcium, iron, niacin and vitamin C showed a reduced intake with reduced dentition. Vegetables and fruit which have been cooked to softened may be tolerated by those with fewer teeth but may not provide enough Vitamin C (Walls et al., 1999). Interestingly, the intakes for people with very few teeth were higher than for those with none, signifying that having even a few natural teeth is important (Walls et al., 1999).

As more very old people retain their natural teeth, there may be the need for those who cater for the them to provide a more varied and nutrient-rich diet for those who are able to eat it (Sheiham and Steele, 2001; Sheiham et al., 2001).

2.5 PERIODONTAL DISEASE (PERIODONTITIS) AND NUTRITION IN THE ELDERLY

Periodontal disease is an infectious disease of the mouth which involves inflammation and loss of bone and the supporting tissue of the teeth. Even though the causes of periodontal disease involves bacteria and response to these bacteria, there are local, systemic and behavioral factors that impact the severity and advancement of the disease (Papas et al., 2007). These include types 1 and 2 diabetes mellitus, stress, cardiovascular disease, osteoporosis, immune status and presence of pathogens associated with periodontal disease in the mouth; poor oral hygiene, tobacco use and diet (The American Dietetic Association, 2007). Positive relationships between periodontal disease and other chronic disease states, including cardiovascular disease and obesity have been shown (Touger-Decker and Mobley, 2007).

A high intake of fruits and vegetables has been linked with lower risk of periodontal disease, a major cause of tooth loss which may mean that a reduced intake of fruits and vegetables may be an indirect cause of edentulism (Peltzer et al, 2014). Some evidence suggests that periodontal disease develops quicker in malnourished people therefore the important role of nutrition is in maintaining an adequate intake of nutrients especially vitamin C. Under-nutrition worsens the severity of oral infections and may eventually lead to their development into life-threatening diseases (Mei et al., 2014, Verneti-Callahan, 2013).

2.6 DENTAL CARIES AND NUTRITION IN THE ELDERLY

Dental caries is a major cause of tooth loss and about 90% of adults have experienced tooth decay (The American Dietetic Association, 2007). Diet and nutrition have a direct influence on the advancement of tooth decay. The major mechanism of preventing tooth decay is to maintain equilibrium in the dynamic demineralization-remineralization of the tooth surface. This can be done using diet counseling, fluoride therapy, use of sealants and control of cariogenic bacteria. In determining the cariogenic properties of the diet, the food form (liquid, solid or sticky, slowly dissolving) frequency of consumption of sugar and other fermentable carbohydrates, nutrient composition, potential to stimulate saliva, sequence of food intake, and combinations of foods are considered (The American Dietetic Association, 2007).

Tooth erosion associated with eating disorders such as anorexia nervosa and bulimia nervosa frequent consumption of acidic foods and beverages, and gastro-esophageal reflux can weaken tooth integrity and increase caries risk. (Touger-Decker and Mobley, 2007)

2.7 DENTURES AND NUTRITION IN THE ELDERLY

There are significant numbers of older people who rely on dentures (artificial teeth) for oral function. Even with those who have some teeth, many still need to use dentures in combination with their natural teeth to enhance appearance or function. Conditions are often a little better for those with some teeth than those who rely on complete dentures (Sheiham and Steele, 2001; Walls and Steele, 2004).

The numbers and distribution of teeth affect both the ease and comfort of chewing, as does the presence of dentures. In the absence of large numbers of teeth, some form of denture is usually used to improve the mechanical ability to chew. The skills required to use dentures are burdensome and many people find it difficult to handle. This worsens when combined with impaired salivary output affecting denture stability and tolerance. Eating can be uncomfortable where teeth have been lost and eating is not appealing and food may not taste as good. The ability to break down foods by chewing to allow easy swallowing is also affected. This can have a negative effect of nutrition and health (Walls and Steele, 2004).

Denture use is a significant indicator of perceived chewing capability in older adults without natural teeth. This suggests that poor dental status, the lack of denture use in a person with few natural teeth and impaired chewing ability may be significant factors associated with decreased nutritional status, quality of life and increased mortality (Moriya and Miura, 2014). The blend of personalized dietary interventions and replacement of dentures can positively change dietary behavior (Moriya and Miura, 2014).

2.8 XEROSTOMIA AND NUTRITION IN THE ELDERLY

Xerostomia (dry mouth) is also associated with difficulties in chewing and swallowing and can undesirably affect food selection and contribute to poor nutritional status (Rhodus and Brown 1990). Problems in lubricating, chewing, savoring and swallowing food contributes extraordinarily to the complex physiological and psychological manifestation of ageing. Rhodus and Brown (1990) in a study of older adults having xerostomia showed that adults with dry mouth had significant deficiencies in fibre, potassium, vitamin B-6, iron, calcium and zinc intakes. Salivary flow and composition vary little with age, in healthy unmedicated individuals, despite age related changes in the structure of salivary glands. However, there are great changes seen in salivary composition and flow rates with disease and conditions linked with age most commonly with drug use. There are a lot of drugs that may influence salivary secretion and the effects are synergistic resulting in dry mouth (xerostomia). Subjects with xerostomia not only have problems with chewing and swallowing but also with taste, speech, tolerance of dentures and both oral mucosal disease and dental caries (Petersen and Yamamoto, 2005).

Drug-induced xerostomia is most common in old age because high proportions of older adults take at least one medication that causes salivary dysfunction. The drugs mostly responsible for dry mouth are tricyclic antidepressants, antipsychotics, atropinics, beta blockers and antihistamines, thus the complaint of dry mouth is particularly frequent in patients treated for hypertension, psychiatric or urinary problems. Smoking is another important risk factor of dry mouth (Petersen and Yamamoto, 2005).

Xerostomia can have an impact on an individual's diet and could lead to altered foods choice. This could be due to poor chewing ability or because of mechanical difficulties with chewing or swallowing as a result of salivary change. Chewing in combination with salivary enzymes mixing foods in the mouth are important components of the initiation of digestion of foods. Also, our pleasure of foods depends on the release of tasteants into the mouth during chewing (Steele and Walls, 2004).

2.9 MEDICALLY COMPROMISING CONDITIONS ASSOCIATED WITH ORAL HEALTH

Maintaining an adequate nutritional status is important otherwise can lead to either underweight increasing the risk of infections and mortality or overweight, which increases the risk of chronic diseases such as hypertension and diabetes (Steele and Walls, 2004). The oral cavity is the entry portal to the gastrointestinal tract. Therefore, risks for oral problems increase with many systemic and chronic disease states, changes in health status, and/or adoption of practices that also may affect diet and nutritional status (Touger-Decker and Mobley, 2007)

2.9.1 OVERWEIGHT/OBESITY

Overweight and obesity in adults as well as at risk of overweight and overweight in children are risk factors for several chronic diseases, including type 2 diabetes mellitus, cardiovascular disease, hypertension, dyslipidemia, and metabolic syndrome. Relationships between weight status and oral health are a growing area of research. Studies have shown links between edentulism, periodontal disease, low calcium intake, and osteoporosis in older men and women (Touger-Decker and Mobley, 2007).

Yoshida, Suzuki, and Kikutani (2014) reported that consumption of carotene, vitamin A, vitamin C, dairy products, and green/yellow vegetables were reduced as people lost more teeth whereas ingestion of carbohydrates, rice and confectionaries increased as tooth loss increased. Also according to Moriya and Miura (2014), individuals with fewer than 28 teeth reported a significantly lower intake of carrots, salads and dietary fibre than did fully dentate people. Additionally, they had lower serum levels of beta carotene, folate, and vitamin C, indicating that dental status significantly affects diet and eventually weight. Tooth loss leads to decreased consumption of fruits and vegetables but increased consumption of carbohydrates, saturated fat and confectionery products in older adults which can lead to weight gain or obesity putting them at more risk of heart diseases, diabetes and other non-communicable diseases. Edentulism was associated with a weight gain of >5% in one year (Peltzer et al, 2014).

2.9.2 CHRONIC CONDITIONS AND ORAL HEALTH

Review of literature by Peltzer et al (2014) showed that chronic conditions such as asthma and arthritis, angina and hypertension were linked with edentulism. Evidence has also established that chronic periodontal disease is characterized by multiple potential bacteria activity which may allow periodontal pathogens to migrate to non-oral tissues. Also mediators such as C-reactive proteins are elevated in periodontal disease as a result providing a possible relationship with cardiovascular disease (McKenna et al, 2009).

Diabetes is a well branded risk factor believed to promote periodontal disease through an exaggerated inflammatory response to the periodontal microflora. This can affect tissues and organs at distant sites and may contribute to the periodontal tissue destruction seen in patients with diabetes (McKenna et al, 2009). Also a link between poor oral hygiene and lower respiratory tract infections has been observed and recent evidence suggests improved oral hygiene and regular professional oral care can decrease the incidence or advancement of respiratory tract diseases in high-risk elderly people. Bacterial species that normally do not colonize the oropharynx can cause health care associated pneumonia, and the oral cavity has been found to promote growth of these pathogens (McKenna et al, 2009).

Diet plays a key role in disease prevention in older age, as poor diets have been related to diseases such as osteoporosis, atherosclerosis and bowel disease. Although nutritional state is influenced by factors such as age, socio-economic status and general health, oral status is also extremely important. The American Dietetic Association (2007) recently stated that oral health and nutrition have a synergistic bidirectional relationship.

There is evidence that good oral health generally has very positive effects on dietary intake and nutritional status of older adults. Lower dietary intake of vitamins A, C, and B-6 may compromise visual, immunologic, and cardiovascular health. Other studies have also associated gastritis and peptic ulcers among those with oral health problems, which may be attributable to factors such as inadequate chewing or increased gastric acidity (Bailey et al., 2004)

2.10 ASSESSING NUTRITIONAL STATUS IN THE ELDERLY

Assessment of nutritional status involves measuring food and nutrient intake, body composition, body levels of nutrients and investigating functional markers of nutritional status. Determining the effect of oral health status on diet has focused on several different areas including the effect of oral health status on food choice and eating problems as well as intake of actual nutrients (Moynihan et al., 2009). To fully assess the impact of oral status on food and nutrient intake, information on usual dietary intake needs to be collected. The 24-hour recalls, food frequency questionnaires (FFQs) and dietary histories are retrospective methods used to bring together information on past diet and rely on memory. Prospective methods collect information on present intake and include the precise weighing method, weighed food diaries and estimated food diaries and do not rely on memory but on a person's ability to read and write. The method selected depends on the information that is required, the population to be studied (e.g. age and capabilities), size of the required sample and the resources, skills and time available to the researcher (Moynihan et al., 2009).

The 24-hour dietary recall method involves a researcher asking the subject to recall all the foods and drinks consumed using an estimated amount of food consumed in household measures over the previous 24 hours. The weight of food consumed is then estimated by the researcher based on the subjects' estimation of portion size and then food composition tables or softwares are used to translate food intake into nutrients. Food Frequency Questionnaires ask subjects to give the usual frequency with which they think they have consumed a list of foods from a list of food options. This method is useful in assessing patterns of usual intakes and can be designed to focus on particular relevant aspects of diet for example fats or sugar intake (Moynihan et al., 2009).

Dietary history method is a detailed interview with a skilled dietician or nutritionist to obtain information on the usual/habitual diet using a 24-hour recall of food consumed and a food checklist. The foods recalled, along with an estimation of portion size, may be translated into the mean daily intake of nutrients using food composition tables or dietary analysis softwares. It relies entirely on memory and provides detailed and accurate information on habitual dietary intake. It is important that reports on studies of diet and oral health provide sufficient detail of the dietary methods employed to enable reproduction of methodologies (Moynihan et al., 2009).

Food composition tables are used with other dietary analysis methods due to the inconveniences involved in chemically analyzing individual diets. They give estimates of the nutrient contents food per 100 g and are usually incorporated parts of dietary analysis software. It is important that food tables or analysis software include up to date available food compositional data for a given country (Moynihan et al., 2009).

However, food composition tables are not available for all countries therefore sometimes; an exact match for a food consumed cannot be found in existing food tables. Allocating a 'best match' for a food introduces a level of subjectivity. Dietary data may be compared with standard goals such as national average intakes or with dietary recommendations for example the Dietary Reference Intakes (DRIs) or with WHO recommendation (Moynihan et al., 2009).

Anthropometric measures which include weight, height and other indices of body composition are an important part of assessing nutritional status and have been used to investigate the relationship with oral health (Moynihan et al., 2009). Values may be compared with standards example, body weight and height may be used to determine body mass index (BMI) which the World Health Organization (2006) has defined for underweight (<18.5), normal weight (18.5–25), overweight (>25) and obese (>30)

2.11 IMPROVING ORAL HEALTH AND NUTRITIONAL STATUS IN THE ELDERLY

One possible strategy to deal with oral health issues is to try to improve oral health and allow greater foods choice. Changes in oral health status tend to occur gradually, as teeth are lost one by one through disease and the effects of restoration. Regrettably, tooth loss is progressive and lost natural adult teeth do not grow back. However, dentures can be fixed and this may make a small impact (Walls and Steele, 2004).

The loss of teeth without replacement with dentures implies severe loss of oral functioning. This condition is common among the poor and disadvantaged population groups of both developed and developing countries. This reflects insufficient dental care and limited access to oral health services. Tooth brushing remains the most popular oral hygiene practice worldwide; however this practice is less frequent in developing countries. Meanwhile, traditional oral self-care such as use of chewing sticks or powder is common in developing countries (Petersen et al, 2010). In many of these countries policies for oral health have not been made and oral health services targeting this population group are rare. Services are primarily devoted to emergency care of pain and symptoms.

A number of studies have tried to achieve improvements in oral health with only dental intervention alone. Unfortunately, this approach shows to be ineffective (Walls and Steele, 2004). Changing habits acquired over a long period can be very difficult, as the poorest oral health status is also associated with additional issues that complicate dietary choices. The best solution to the problem of impaired nutrition affecting oral health or vice versa is much more long-term (Walls and Steele, 2004). The dental profession has a role in ensuring that functional dietary issues play a key part when planning treatment for the older adult. Those involved with health must recognize that as oral health improves and people increasingly retain their teeth, good health through nutrition is also promoted (Walls and Steele, 2004). The use of fluoride is effective in prevention of dental caries in elderly and must be promoted. Topical application and mouth rinsing with fluorides are shown to reduce the number of root surface caries lesions, old-age people. This can help patients improve their self-care skills such as brushing and flossing and reduced gingival bleeding (Petersen and Yamamoto, 2005).

The treatment and prevention of oral health problems should be an interdisciplinary approach (dentists, dietitians, and other health care professionals). Oral health problems can increase with age not only because of edentulism but other risks that comes with aging such as disease morbidities and medication use. Many of these changes cannot be prevented, but, some, like oral health, have the potential to be delayed or improved as we move into an era of “successful” aging (Bailey et al., 2004; Moynihan, et al., 2009). Much evidence has shown that poor oral health status is linked with a poor diet low in fruits and vegetables and fibre and high in fat. Older adults who have oral health issues are nutritionally vulnerable and there is the need for dietary intervention on for those with compromised dentition (Moynihan, et al., 2009). Researchers have recommended, as a result of their findings, the provision of dietary advice and education for older adult patients, particularly those who are partially dentate or edentulous. This would help in appropriate food selection and food preparation methods (Smith and Parnell, 2008; Moynihan et al., 2009)

CHAPTER THREE

3 MATERIALS AND METHODOLOGY

3.1 RESEARCH DESIGN

The study was a cross sectional study involving adults 50 years and above with or without oral condition.

3.2 RESEARCH SETTING

The study was conducted at the Korle-Bu Dental School Clinic and Maxillofacial Units (MFU) of Korle-Bu Teaching Hospital (KBTH). Korle-Bu Teaching Hospital is one of the oldest and biggest hospitals in Ghana, located at Korle-Bu, a suburb of Accra. It has various schools and units of which the Korle-Bu Dental School Clinic and Maxillofacial Units are part. These facilities provide dental and oral health care services to the population in Accra and it's environ.

3.3 PARTICIPANTS RECRUITMENT

Prior to recruitment, the researcher explained the purpose and the nature of the study to patients at the clinics. After informed consent was obtained, participants aged fifty (50) years old and above were recruited. Respondents for the study included both males and females, with or without any oral health problem. A total of 255 participants comprising 190 cases who had visited the clinic with a particular oral problem and 65 participants as controls were recruited in the study.

3.3.1 INCLUSION CRITERIA

Adults fifty years of age and above with or without any oral health problem capable and willing to take part in the study.

3.3.2 EXCLUSION CRITERIA

- Individuals below fifty years
- Individuals who cannot stand upright or without support and whose anthropometric measurements could not be taken accurately due to any disability.

3.3.3 SAMPLING TECHNIQUE

Consecutive patients attending the clinics on the days of data collection that met the inclusion criteria and consented were included in the study.

3.3.4 SAMPLE SIZE

According to Sheiham et al. (2001), the prevalence of oral health impact in free-living older people is 17%. With a confidence interval (CI) of 95%, a margin of error of 5% and an estimated proportion of success at 17% sample size was estimated as;

Z = z-score of the confidence interval (95%) = 1.96

P = proportion of success estimated = 0.17

d = margin of error = 0.05

n = minimum sample size

$$n = \frac{Z^2 * P(1-P)}{d^2}$$

$$n = \frac{1.96^2 * 0.17(1-0.17)}{0.05^2}$$

$$n = 217$$

To account for 15% non-response the overall sample size recruited was 250

In all 255 participants were recruited consisting of 190 cases and 65 controls

3.4 ETHICAL APPROVAL

Ethical approval for study was obtained from The Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences.

3.5 PROCEDURE FOR DATA COLLECTION

3.5.1 QUESTIONNAIRES

The patients were interviewed using structured questionnaires to source for socio-demographic information which included age, gender, educational level and employment status. Oral health and medical history were also obtained from log books for the cases. A validated Food Frequency and 24-Hour Recall questionnaires were used to collect information on frequency and pattern of food and nutrient intakes (Appendices II and III).

3.5.2 PRE-TESTING OF QUESTIONNAIRE

In order to make sure questionnaire were easily understood by participants during data collection, the questionnaire was pre-tested among a representative group at the MFU of KBTH. Questionnaires were pre-tested using 43 participants (20% of the sample size). The questionnaires were then reviewed before they were used for data collection. Foods which were missed (fish, alcoholic beverages) during design of questionnaires were added.

3.5.3 NUTRITIONAL ASSESSMENT

3.5.3.1 DIETARY ASSESSMENT

Dietary intake assessment involving a one day 24 hour food recall method was used to collect information on nutrients and energy intake. The participants were asked to recall the types and approximate amount of food consumed over the previous 24 hours starting with the most recent meal consumed. Food aids showing estimated portion of commonly consumed Ghanaian foods were used to help participants estimate amounts of food eaten.

A validated Food frequency questionnaire which included the most commonly eaten foods such rice, bread, fruits and vegetables etc. was used to investigate the most frequently consumed food items (daily and weekly) (Appendix III)

3.5.3.2 ANTHROPOMETRIC MEASUREMENT

Anthropometric measurements were taken and included three variables (body weight, height and Body Mass Index). Body Mass Index (BMI) was computed as a ratio of weight (kg) over height (m) squared (kg/m^2). Participants' underweight, normal weight, pre-obese

and obesity were defined as ≤ 18.5 , 18.5–24.9, ≥ 25.0 –29.9 kg/m² and ≥ 30 kg/m², respectively (World Health Organization, 2006; WHO/FAO, 2003). Strict adherence to accuracy and precision factors was ensured.

3.5.3.2.1 WEIGHT

Body weight was measured using a Seca scale (Hamburg, Germany) and was taken to the nearest 0.01 kg with subjects in light clothing. Measurements were taken three times and the mean weight determined. Participants stood erect and were asked to remove shoes, jackets, phones and other objects before standing on the scale.

3.5.3.2.2 HEIGHT

Height was measured using a Seca stadiometer (Hamburg, Germany) and readings were reported to the nearest 0.1 cm. Participants stood upright on base plate without shoes with their heads in Frankfurt's plane position and back straight, feet together and heels touching the back of the plate. The head plate was lowered to touch the top of the head and height noted.

3.5.4 ORAL DIAGNOSIS

The participants' oral diagnoses were retrieved from the log books at the dental clinics. The last three diagnoses were documented.

3.6 DATA PROCESSING AND ANALYSIS

3.6.1 DIETARY DATA ANALYSIS

Dietary data from the 24 hour recall questionnaire was converted to grams and nutrient intake was estimated using the Microdiet Nutritional Analysis Software (Downlee Systems Limited, United Kingdom)

3.6.2 STATISTICAL ANALYSIS

Data compilation and analysis was done using Microsoft Access and Statistical Package for Social Sciences (SPSS) Computer Software Program Version 20.0. Qualitative data was summarized as proportions, percentages and quantitative data as means, standard deviation and ranges (height, weight and ages). Chi-square test was used to compare categorical variables and regression analysis was performed to determine the strength of relationship between dependent and independent variables. Z-test for proportions was used to test for differences in proportion of categorical variables for the 2 groups. Microsoft excel was used to compute tables from the information obtained from SPSS. All tests were computed as 2-tail and p-values less than 0.05 were concluded as significant.

CHAPTER FOUR

4 RESULTS

The study aimed at investigating the oral health and nutritional status of adults fifty years and above attending Dental School Clinic and Maxillofacial Unit (MFU) of the KBTH.

The results as presented show the demographic characteristics of the respondents, their nutritional status as determined by BMI, food frequency questionnaire and 24 hour recall.

The oral health data was collected from questionnaire and log book at the dental clinics.

4.1 DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Table 4.1 shows the background information of adults fifty years and above who participated in the study. A total population of 255 comprising of 190 cases and 65 controls with majority within the ages of 50-59 years were involved in the study. The ages, marital status, educational levels, employment and marital status and who they were currently living with were also reported on. Most participants were found to be married and living with their spouses. There were significant differences in the gender, age groups, educational background and employment statuses of the two groups under study.

TABLE 4.1: DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Demographics	Cases	Controls	Total	p-value
	N (%)	N (%)	N (%)	
Gender				
Male	73 (38.4)	36 (55.4)	109 (42.7)	0.017
Female	117 (61.6)	29 (44.6)	146 (57.3)	
Age group				
50-59	71 (37.4)	36 (55.4)	107 (42.0)	<0.001
60+	119(62.6)	29 (44.6)	148 (58.1)	
Education				
Tertiary	82 (44.1)	24 (36.9)	106 (42.2)	0.005
Secondary	72 (38.7)	19 (29.2)	91 (36.3)	
Primary	24 (12.9)	21 (32.3)	45 (17.9)	
No education	8 (4.3)	1 (1.5)	9 (3.6)	
Employment status				
Currently employed	48 (25.3)	17 (26.2)	65 (25.5)	<0.001
Self employed	34 (17.9)	32 (49.2)	66 (25.9)	
Retired	88 (46.3)	15 (23.1)	103 (40.4)	
Unemployed	20 (10.5)	1 (1.5)	21 (8.2)	
Marital status				
Single	29 (15.3)	4 (6.2)	33 (12.9)	0.066
Married	113 (59.3)	47 (72.3)	160 (62.7)	
Widowed	38 (20.0)	8 (12.3)	46 (18.0)	
Divorced	10 (5.3)	6 (9.2)	16 (6.3)	
Currently living with				
Spouse	92 (48.4)	44 (67.7)	136 (53.3)	0.060
Children	55 (28.9)	12 (18.5)	67 (26.3)	
Relative	23 (12.1)	4 (6.2)	27 (10.6)	
Alone	20 (10.5)	5 (7.2)	25 (9.8)	
Total	190 (74.5)	65 (25.5)	255 (100)	

4.2 ANTHROPOMETRY AND WEIGHT CATEGORIES

Information on the weight categories of the participants is shown in Figure 1 and Tables 4.2 to 4.9. The mean weight, height and BMI of the participants were 78kg, 164cm and 29.1kg/m² respectively. Most (41.6%) of the participants surveyed were obese and none was underweight. Most of the controls were overweight (BMI= 25-30kg/m²) while a greater percentage of cases were obese (BMI>30kg/m²). More females were obese than males. There was no significant association in weight categories compared with age, marital status and employment status. However there was a significant association with weight categories and employment status.

TABLE 4.2: MEAN (\pm SD) ANTHROPOMETRY OF PARTICIPANTS

Anthropometry	Total (N=255)		Case and Control			
	Mean	\pm SD	Cases (190)		Controls (65)	
			Mean	\pm SD	Mean	\pm SD
Weight (kg)	78.18	12.97	79	13	77	12
Height (cm)	164.06	7.65	164	7	166	8
BMI (kg/m ²)	29.15	5.21	29.48	5.38	28.18	4.58

There was no significant difference between mean BMI of cases and controls (p=0.153)

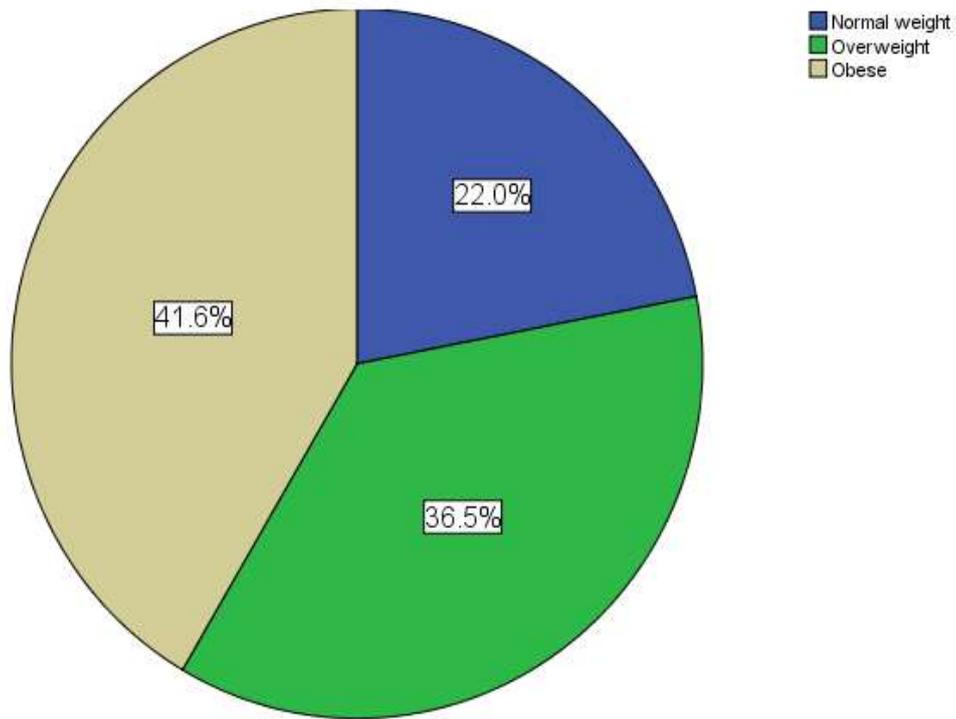


FIGURE 1: WEIGHT CATEGORIES OF PARTICIPANTS

TABLE 4.3: WEIGHT CATEGORY BY CASE AND CONTROLS

Case and Control	Weight category			Total
	Normal weight	Overweight	Obese	
Cases	44 (23.2)	62 (32.6)	84 (44.2)	190 (100)
Controls	12 (18.5)	31 (47.7)	22 (33.8)	65 (100)
Total	56 (22.0)	93 (36.5)	106 (41.6)	255 (100)

There is no significant difference in prevalence of overweight and obesity between cases and controls, $P=0.093$.

TABLE 4.4: WEIGHT CATEGORY BY SEX

Sex	Weight category			Total
	Normal weight	Overweight	Obese	
Male	32 (29.4)	48 (44.0)	29 (26.6)	109 (100)
Female	24 (16.4)	45 (30.8)	77 (52.7)	146 (100)
Total	56 (22.0)	93 (36.5)	106 (41.6)	255 (100)

There is a significant difference in prevalence of overweight and obesity between sexes, more females were obese while more males were found to be overweight and of normal weight, $P < 0.001$

TABLE 4.5: WEIGHT CATEGORY BY AGE GROUP

Age group	Weight category			Total
	Normal weight	Overweight	Obese	
50-59	28 (26.2)	36 (33.6)	43 (40.2)	107 (100)
60-69	19 (20.0)	36 (37.9)	40 (42.1)	95 (100)
70+	9 (17.0)	21 (39.6)	23 (43.4)	53 (100)
Total	56 (22.0)	93 (36.5)	106 (41.6)	255 (100)

There was no significant association between weight categories and age, $P = 0.707$

TABLE 4.6: WEIGHT CATEGORY BY MARITAL STATUS

Marital status	Weight category			Total
	Normal weight	Overweight	Obese	
Single	6 (18.2)	10 (30.3)	17 (51.5)	33 (100)
Married	36 (22.5)	64 (40.0)	60 (37.5)	160 (100)
Widowed	11 (23.9)	10 (21.7)	25 (54.3)	46 (100)
Divorced	3 (18.8)	9 (56.3)	4 (25.0)	16 (100)
Total	56 (22.0)	93 (36.5)	106 (41.6)	255 (100)

There was no significant association between weight categories and marital status, $P=0.124$

TABLE 4.7: WEIGHT CATEGORY BY EMPLOYMENT STATUS

Employment status	Weight category			Total
	Normal weight	Overweight	Obese	
Currently employed	14 (21.5)	22 (33.8)	29 (44.6)	65 (100)
Self employed	18 (27.3)	21 (31.8)	27 (40.9)	66 (100)
Retired	20 (19.4)	46 (44.7)	37 (35.9)	103 (100)
Unemployed	4 (19.0)	4 (19.0)	13 (61.9)	21 (100)
Total	56 (22.0)	93 (36.5)	106 (41.6)	255 (100)

There is no significant difference in prevalence of overweight and obesity between employment status, $P=0.209$

TABLE 4.8: WEIGHT CATEGORY BY EDUCATIONAL LEVELS

Education	Weight category			Total
	Normal weight	Overweight	Obese	
Tertiary	21 (19.8)	54 (50.9)	31 (29.2)	106 (100)
Secondary	24 (26.4)	13 (14.3)	54 (59.3)	91 (100)
Primary	6 (13.3)	24 (53.3)	15 (33.3)	45 (100)
No education	5 (55.6)	1 (11.1)	3 (33.3)	9 (100)
Total	56 (22.3)	92 (36.7)	103 (41.0)	251 (100)

There was significant relationship between weight category and educational levels with those with secondary level education having a higher obesity rate and those with tertiary level education having a higher overweight rate, $P < 0.001$.

4.2.1 ASSOCIATION BETWEEN WEIGHT CATEGORY AND GUM CONDITIONS

Table 4.9 shows the association between weight and gum conditions. The only significant association was between weight category and bad breath with overweight people having significant level of reported bad breath.

TABLE 4.9: THE ASSOCIATION BETWEEN WEIGHT CATEGORIES AND GUM CONDITIONS

Weight category	Bleeding gum	Swollen gum	Bad breath	Loose teeth	Sensitive tooth
Normal weight	14 (25.0)	19 (33.9)	6 (10.7)	18 (32.1)	28 (50.0)
Overweight	13 (14.0)	35 (37.6)	17 (19.3)	25 (26.9)	47 (50.5)
Obese	15 (14.2)	25 (23.6)	13 (12.3)	40 (37.7)	51 (48.1)
Total	42 (16.5)	79 (31.1)	36 (14.4)	83 (32.5)	126 (49.4)
p-values	0.150	0.074	0.018	0.112	0.939

4.3 DIETARY ASSESSMENT

4.3.1 NUTRIENT INTAKES AND ADEQUACY OF PARTICIPANTS

Information on the mean nutrient intakes of the participants and the adequacies are shown in Tables 4.10 to 4.13. The average amounts of energy and macronutrients, minerals and vitamins consumed using a 24 Hour Recall are shown. Percent adequacies of intakes by cases and controls are also shown

TABLE 4.10: MEAN INTAKES BY RESPONDENTS

NUTRIENTS	Total Sample		Case and Controls				Level of Adequacy By DRI ¹
	Mean	±SD	Cases		Controls		
			Mean	±SD	Mean	±SD	
ENERGY (kcal)	1392.41	840.91	1446	906	1239	604	<i>Inadequate</i>
*PROTEIN (g)	56.73	33.29	58	35	54	29	<i>Adequate</i>
+FAT (g)	36.55	26.33	38	27	34	24	<i>Adequate</i>
**CARBOHYDRATES (g)	220.49	162.35	230	179	194	102	<i>Adequate</i>
CHOLESTEROL (mg)	77.85	114.72	94	124	34	68	<i>Adequate</i>
SODIUM (mg)	492.27	792.29	488	812	505	741	<i>Inadequate</i>
POTASSIUM (mg)	772.91	1424.87	839	1610	588	666	<i>Inadequate</i>
CALCIUM (mg)	389.40	316.58	391	309	384	341	<i>Inadequate</i>
MAGNESIUM (mg)	70.21	137.65	84	157	33	31	<i>Inadequate</i>
PHOSPHORUS (mg)	832.01	608.75	876	663	700	385	<i>Adequate</i>
IRON (mg)	14.45	11.11	15	12	13	8	<i>Adequate</i>
COPPER(mg)	.90	.817	1	1	1	1	<i>Adequate</i>
ZINC (mg)	6.91	5.46	7	6	6	4	<i>Inadequate</i>
SELENIUM	12.90	17.66	15	19	8	13	<i>Inadequate</i>
MANGANESE (mg)	.44	1.06	1	1	0	1	<i>Inadequate</i>
IODINE (ug)	8.99	16.56	12	18	1	4	<i>Inadequate</i>
THIAMINE (mg)	.64	.65	1	1	1	1	<i>Inadequate</i>
RIBOFLAVIN (mg)	.69	.56	1	1	1	0	<i>Inadequate</i>
VIT B6 (mg)	.27	.53	0	1	0	0	<i>Inadequate</i>
VIT B12 (mg)	.89	1.91	1	2	1	1	<i>Inadequate</i>
VIT C (mg)	71.72	56.32	73	56	69	56	<i>Inadequate</i>
VIT D (mg)	1.55	6.74	2	7	1	4	<i>Inadequate</i>
VIT K (ug)	4.26	12.96	3	8	8	21	<i>Inadequate</i>
RETINOL (mg)	34.44	60.10	44	66	8	24	<i>Inadequate</i>
NIACIN (mg)	12.55	11.17	13	12	11	7	<i>Inadequate</i>
FOLATE (ug)	35.14	43.84	38	46	25	35	<i>Inadequate</i>

¹DRI= Dietary Reference Intakes.

PERCENT ENERGY CONTRIBUTIONS= *PROTEIN-16.3%

+FAT-20.4%

**CARBOHYDRATES-63.3%

TABLE 4.11: PERCENT OF RESPONDENTS WITH MACRONUTRIENT INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS

NUTRIENTS	Cases	Controls
	N (%)	N (%)
ENERGY	14 (5.5)	13 (5.1)
PROTEIN	76(29.8)	33(12.9)
CARBOHYDRATES	118 (46.3)	37(14.5)
FATS	32 (12.5)	13(5.1)
CHOLESTEROL	140 (54.9)	54(21.2)
N3FATTYACID	1 (0.4)	3(1.2)
N6FATTYACID	4 (1.6)	

TABLE 4.12: PERCENT OF RESPONDENTS WITH MINERAL INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS

NUTRIENTS	Cases	Control
	N (%)	N (%)
CALCIUM	5 (2.0)	2(0.8)
PHOSPHORUS	64(25.1)	22(8.6)
IRON	109(42.7)	36(14.1)
ZINC	50(19.6)	9(3.5)
SELENIUM	9(3.5)	
MANGANESE	16(6.3)	3(1.2)
IODINE	2(0.8)	1(0.4)
COPPER	99(38.8)	35(13.7)
SODIUM	11(4.3)	

TABLE 4.13: PERCENT OF RESPONDENTS WITH VITAMIN INTAKE ADEQUACY FOR BOTH CASES AND CONTROLS

NUTRIENTS	Cases	Control
	N (%)	N (%)
THIAMINE	9(3.5)	1(0.4)
RIBOFLAVIN	9(3.5)	1(0.4)
VITAMIN B6	7(2.7)	1(0.4)
VITAMIN C	58(22.7)	18(7.1)
VITAMIN D	5(2.0)	2(0.8)
VITAMIN B12	11(4.3)	-
VITAMIN K	-	1(0.4)
NIACIN	40(15.7)	13(5.1)

4.3.2 FREQUENCY OF CONSUMPTION OF FOODS

Frequencies on intakes of sweetened drinks and juices, milk and milk products, cereals and grains, root tubers and plantain, animal and animal products, fried foods, spreads, fruits, vegetables, soups and stews and others by the participants are shown in Tables 4.14 to 4.23.

Fruits juices and evaporated milk were the most consumed foods in their respective groups with most people taking them once or twice a week. Most people consumed bread, rice or kenkey in a week and 26.8% ate bread almost every day of the week. Very few people took cocoyam or potatoes with majority consuming yam, plantain or cassava (fufu) in the root tubers and plantain group. Fish was the most consumed animal product which 34.5% of participants ate almost every day. Intakes of fried foods and spreads were low and watermelon was the most consumed fruit. Most people took their vegetables in the form of stews or soups with most of the participants consuming gravy and light soup the most in a week. Nuts, chocolate and toffees/candies were rarely consumed among participants with more than 70% of participants never taking any in a week.

TABLE 4.14: FREQUENCY OF CONSUMPTION OF SWEETENED DRINKS AND JUICES IN THE PREVIOUS WEEK

SWEETENED DRINKS AND JUICES	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
SWEET DRINK	240	94.1	14	5.5	0	0.0	1	0.4	0	0.0
FRUIT JUICE	194	76.1	36	14.1	3	1.2	13	5.1	9	3.5
MALT DRINKS/MINERALS	143	56.3	90	35.4	8	3.1	3	1.2	10	3.9
ALCOHOLIC BEVERAGE	251	98.4	4	1.6	0	0.0	0	0.0	0	0.0

TABLE 4.15: FREQUENCY OF CONSUMPTION OF MILK AND MILK PRODUCTS IN THE PREVIOUS WEEK

MILK AND MILK PRODUCTS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
EVAPORATED/WHOLE/FRESH/SKIMMED MILK	102	40.2	61	24.0	8	3.1	29	11.4	54	21.3
POWDERED MILK	215	84.3	27	10.6	0	0.0	10	3.9	3	1.2
CONDENSED MILK	251	98.4	1	0.4	0	0.0	3	1.2	0	0.0
YOGHURT/ICE CREAM	207	81.2	43	16.9	3	1.2	2	0.8	0	0.0
CHEESE/WAGASHI	248	97.3	5	2.0	0	0.0	0	0.0	2	0.8

TABLE 4.16: FREQUENCY OF CONSUMPTION OF CEREALS AND GRAINS IN THE PREVIOUS WEEK

CEREALS, GRAINS AND PRODUCTS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
BREAD	53	20.9	62	24.4	22	8.7	49	19.3	68	26.8
BISCUIT/COOKIES	166	65.1	73	28.6	8	3.1	4	1.6	4	1.6
CAKES	235	92.2	18	7.1	0	0.0	0	0.0	2	0.8
PIES	196	76.9	58	22.7	0	0.0	1	0.4	0	0.0
PIZZAS	238	93.3	15	5.9	2	0.8	0	0.0	0	0.0
RICE	37	14.5	100	39.2	47	18.4	41	16.1	30	11.8
KENKEY/ BANKU/TZ	52	20.4	114	44.7	34	13.3	33	12.9	22	8.6
WHEAT	236	92.5	13	5.1	6	2.4	0	0.0	0	0.0
POPCORN	247	96.9	7	2.7	0	0.0	1	0.4	0	0.0

TABLE 4.17: FREQUENCY OF CONSUMPTION OF ROOT TUBERS AND PLANTAIN IN THE PREVIOUS WEEK

ROOT TUBERS AND PLANTAIN	never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
CASSAVA/FUFU	94	36.9	119	46.7	22	8.6	15	5.9	5	2.0
COCOYAM/POTATOES	210	82.4	42	16.5	3	1.2	0	0.0	0	0.0
YAM	80	31.4	145	56.9	17	6.7	9	3.5	4	1.6
PLANTAIN	97	38.0	125	49.0	17	6.7	9	3.5	7	2.7

TABLE 4.18: FREQUENCY OF CONSUMPTION OF ANIMAL PRODUCTS IN THE PREVIOUS WEEK

ANIMAL PRODUCTS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
MEAT	145	57.3	53	20.9	37	14.6	10	4.0	8	3.2
POULTRY	126	49.4	78	30.6	30	11.8	8	3.1	13	5.1
FISH	50	19.6	35	13.7	31	12.2	51	20.0	88	34.5
KHEBEB	244	95.7	11	4.3	0	0.0	0	0.0	0	0.0
CORNED BEEF	239	93.7	16	6.3	0	0.0	0	0.0	0	0.0
SAUSAGE/BACON	234	91.8	12	4.7	5	2.0	2	0.8	2	0.8
EGGS	106	41.6	110	43.1	20	7.8	9	3.5	10	3.9

TABLE 4.19: FREQUENCY OF CONSUMPTION OF FRIED FOODS IN THE PREVIOUS WEEK

FRIED FOODS	never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
BOFROT/DONUT	207	81.2	40	15.7	4	1.6	0	0.0	4	1.6
AKARA	202	79.2	49	19.2	0	0.0	0	0.0	4	1.6
FRIED PLANTAIN/KELEWELE	195	76.5	52	20.4	4	1.6	3	1.2	1	0.4
FRIEDYAM/COCOYAM/POTATOES	210	82.4	43	16.9	2	0.8	0	0.0	0	0.0
PLANTAIN CHIPS/PASTRIES	224	87.8	31	12.2	0	0.0	0	0.0	0	0.0
FRIED EGGS	165	65.0	56	22.0	19	7.5	4	1.6	10	3.9
FRIED CHICKEN/MEAT	167	65.5	78	30.6	1	0.4	7	2.7	2	0.8

TABLE 4.20: FREQUENCY OF CONSUMPTION OF SPREADS IN THE PREVIOUS WEEK

SPREADS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
MARGARINE/BUTTER	193	76.0	30	11.8	9	3.5	11	4.3	11	4.3
CHOCOLATE SPREAD/JAM	236	92.5	15	5.9	2	0.8	2	0.8	0	0.0
GROUNDNUT PASTE	235	92.2	18	7.1	2	0.8	0	0.0	0	0.0
SALAD CREAM/ MAYONNAISE	228	89.4	25	9.8	0	0.0	2	0.8	0	0.0

TABLE 4.21: FREQUENCY OF CONSUMPTION OF FRUITS IN THE PREVIOUS WEEK

FRUITS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
CITRUS	157	61.6	76	29.8	14	5.5	5	2.0	3	1.2
PINEAPPLE	172	67.5	77	30.2	1	0.4	5	2.0	0	0.0
WATERMELON	145	56.9	86	33.7	5	2.0	11	4.3	8	3.1
MANGO	158	62.0	76	29.8	14	5.5	6	2.4	1	0.4
BANANA	170	66.7	71	27.8	6	2.4	5	2.0	3	1.2
AVOCADO PEAR	188	73.7	43	16.9	13	5.1	8	3.1	3	1.2
PAWPAW	168	65.9	73	28.6	8	3.1	2	0.8	4	1.6
GUAVA	250	98.0	5	2.0	0	0.0	0	0.0	0	0.0
APPLE	235	92.2	19	7.5	1	0.4	0	0.0	0	0.0
FRUIT SALAD	215	84.3	29	11.4	1	0.4	6	2.4	4	1.6

TABLE 4.22: FREQUENCY OF CONSUMPTION OF VEGETABLES, SOUPS AND STEWS IN THE PREVIOUS WEEK

VEGETABLES, SOUPS AND STEWS	never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
CARROT	193	75.7	49	19.2	5	2.0	3	1.2	5	2.0
CUCUMBER/CABBAGE/GREEN PEPPER	169	66.3	67	26.3	2	0.8	7	2.7	10	3.9
VEGETABLE SALAD	188	73.7	46	18.0	4	1.6	7	2.7	10	3.9
GRAVY	86	33.7	89	34.9	37	14.5	26	10.2	17	6.7
GARDEN EGGS STEW	141	55.3	103	40.4	8	3.1	2	0.8	1	0.4
OKRO STEW	152	59.6	87	34.1	8	3.1	4	1.6	4	1.6
KONTOMIRE STEW	118	46.3	106	41.6	20	7.8	9	3.5	2	0.8
LIGHT SOUP	79	31.0	136	53.3	22	8.6	18	7.1	0	0.0
GROUNDNUT SOUP	171	67.1	84	32.9	0	0.0	0	0.0	0	0.0
PALMNUT SOUP	146	57.3	104	40.8	1	0.4	2	0.8	2	0.8

TABLE 4.23: FREQUENCY OF CONSUMPTION OF OTHER FOODS IN THE PREVIOUS WEEK

MISCELLANEOUS	Never		1-2 times		2-3 times		4-5 times		>6 times	
	N	N %	N	N %	N	N %	N	N %	N	N %
CHOCOLATE	224	87.8	21	8.2	2	0.8	8	3.1	0	0.0
TOFFEES/CANDIES	204	80.0	42	16.5	2	0.8	0	0.0	7	2.7
NUTS	193	75.7	49	19.2	5	2.0	8	3.1	0	0.0

4.4 ORAL HEALTH STATUS OF PARTICIPANTS

Tables 4.24 to 4.26 show results for oral practices and oral problems experienced by participants. Toothache was the greatest oral problem with which people visited the dentist. Cavities, loose teeth, gum infection, lost tooth, mouth ulcers, halitosis among others (broken or cracked tooth or dentures) were some of the specific oral problems. Report by both cases and controls showed no significant difference with painful chewing ($p < 0.001$), bad breath ($p < 0.001$) and sensitive teeth ($p = 0.009$).

About 80% of participants had lost one or more tooth and extraction was the highest cause of tooth loss. Majority (24.3%) of the participants had lost their teeth over ten years and 23.1% were over 70 years of age. Periodontal disease (14.1%) and dental caries (9.4%) were the most occurring among those treated at the clinics.

TABLE 4.24: ORAL HYGIENE PRACTICES BY CASE AND CONTROL

	Case and Control		Total N (%)	P- Value
	Cases N (%)	Controls N (%)		
Brush teeth in the morning				
Yes	190 (74.5)	65 (25.5)	255 (100)	0.273
No				
Brush teeth before bed				
Yes	131 (51.4)	40 (15.7)	171 (67.1)	0.033
No	59 (23.1)	25 (9.8)	84 (32.9)	
Used for brushing teeth				
Toothpaste and brush	170 (66.7)	53 (20.8)	223(87.5)	
Chewing stick/sponge alone	2 (0.8)		2 (0.8)	0.685
Chewing stick/sponge and fluoride containing paste	9 (3.5)	2 (0.8)	11 (4.3)	
Combination of all the above	9 (3.5)	10 (3.9)	19 (7.5)	
Other				
Number of times in day for brushing				
1	64 (25.1)	21 (8.2)	85 (33.3)	
2	122 (47.8)	44 (17.3)	166 (65.1)	0.155
3	3 (1.2)		3 (1.2)	
4	1 (0.4)		1 (0.4)	
Tooth pick after meals				
Yes	122 (47.8)	48 (18.8)	170 (66.7)	0.028
No	68 (26.7)	17 (6.7)	85 (33.3)	
Tooth floss				
Yes	56 (22.0)	9 (3.5)	65 (25.5)	<0.001
No	134 (52.6)	56 (22.0)	190 (74.5)	
Ever visited dental clinic				
Yes	182 (71.4)	39 (15.3)	221 (86.7)	
No	8 (3.1)	25 (9.8)	33 (12.9)	<0.001
Not Sure		1 (0.4)	1 (0.4)	

TABLE 4.25: ORAL HEALTH PROBLEMS BY CASE AND CONTROL

	Case and Control		Total N (%)	P-Values
	Cases N (%)	Controls N (%)		
How long ago dental visit				
Less than 3 months	83 (35.3)	6 (2.6)	89 (37.9)	<0.001
6 months	25 (10.6)	10 (4.3)	35 (14.9)	
1 year	32 (13.6)	5 (2.1)	37 (15.7)	
2-4 years	40 (17.0)	17 (7.2)	57 (24.3)	
Don't remember	8 (3.4)	9 (3.8)	17 (7.2)	
Problem for dental visit				
Toothache	128 (54.2)	36 (15.3)	164 (69.5)	0.447
Bleeding gum	6 (2.5)		6 (2.5)	
Serious bad breath	2 (0.8)		2 (0.8)	
Loose teeth	19 (8.1)	3 (1.3)	22 (9.3)	
Mouth sores	7 (3.0)		7 (3.0)	
Other	28 (11.9)	7 (3.0)	35 (14.8)	
Specific oral problem?				
Yes	114 (44.7)	4 (1.6)	118 (46.3)	<0.001
No	76 (29.8)	61 (23.9)	137 (53.7)	
Types of specific oral problems				
Cavity/cavities	58 (51.3)		58 (51.3)	0.686
Loose tooth/teeth	12 (10.6)		12 (10.6)	
Gum infection/disease	19 (16.8)		19 (16.8)	
Lost tooth/ edentulism	14 (12.4)		14 (12.4)	
Mouth ulcers	2 (1.8)		2 (1.8)	
Halitosis	2 (1.8)		2 (1.8)	
Others (broken/cracked tooth, dentures etc.)	6 (5.3)		6 (5.3)	
Bad breath				
Yes	31 (12.4)	5 (2.0)	36 (14.4)	<0.001
No	152 (60.8)	51 (20.4)	203 (81.2)	
Don't know	2 (0.8)	9 (3.6)	11 (4.4)	
Red or swollen gum				
Yes	65 (25.5)	14 (5.5)	79 (31.0)	0.083
No	122 (47.8)	51 (20.0)	173 (67.8)	
Don't know	3 (1.2)		3 (1.2)	
Tender or bleeding gum				
Yes	27 (10.6)	15 (5.9)	42 (16.5)	0.096
No	163	50 (19.6)	213 (83.5)	
Don't know				
Painful chewing				
	93 (36.5)	8 (3.1)	101 (39.6)	<0.001
Loose teeth				
	64 (25.1)	19 (7.5)	83 (32.5)	0.452
Sensitive teeth				
	103 (40.4)	23 (9.0)	126 (49.4)	0.009

TABLE 4.26: CAUSES OF ORAL PROBLEMS

	Case and Control		Total	P-Values
	Cases	Controls		
	N (%)	N (%)	N (%)	
Lost tooth				
Yes	157 (61.6)	47 (18.4)	204 (80.0)	0.072
No	33 (12.9)	18 (7.1)	51 (20.0)	
Cause of last loss				
Accident	16 (6.3)	6 (2.4)	22 (8.6)	0.213
Extraction	87 (34.1)	21 (8.2)	108 (42.4)	
Loose tooth	15 (5.9)	9 (3.5)	24 (9.4)	
Cause of first loss				
Accident	4 (1.6)	13 (5.1)	17 (6.7)	<0.001
Extraction	48 (18.8)	15 (5.9)	63 (24.7)	
Loose tooth	4 (1.6)		4 (1.6)	
Length of tooth loss				
<6months	22 (8.6)	4 (1.6)	26 (10.2)	0.110
6months- 1 year	22 (8.6)	10 (3.9)	32 (12.5)	
2-4 years	27 (10.6)	8 (3.1)	35 (13.7)	
5-10years	16 (6.3)	2 (0.8)	18 (7.1)	
>10 years	39 (15.3)	23 (9.0)	62 (24.3)	
Age at last tooth loss				
<30 years	26 (10.2)	5 (2.0)	31 (12.2)	<0.001
31-50 years	24 (9.4)	19 (7.5)	43 (16.9)	
51- 70years	31 (12.2)	20 (7.8)	51 (20.0)	
70+	41 (16.1)	18 (7.1)	59 (23.1)	
Number of tooth lost				
1-2	63 (24.7)	31 (12.2)	94 (36.9)	0.016
3-4	39 (15.3)	12 (4.7)	51 (20.0)	
5-9	44 (17.3)	4 (1.6)	48 (18.8)	
≥10	3 (1.2)		3 (1.2)	
Treated conditions				
Fractured tooth/tooth loss	13 (5.1)		13 (5.1)	<0.001
Gum infections	13 (5.1)		13 (5.1)	
Mouth ulcers	1 (0.4)		1 (0.4)	
Periodontal disease	30 (11.8)		30 (11.8)	
Plague	2 (0.8)		2 (0.8)	

4.5 ASSOCIATION BETWEEN ORAL HEALTH AND FOOD INTAKE

With reference to table 4.27, 39.6% of participants said oral problem had affected their food intake while 34.3% said they had changed their diets due to oral problems. Most people opted for liquid/ soft foods as a way of coping with oral problem and majority had stopped eating hard foods like nuts and chips while others had stopped meat/ fish, fruits/vegetables. Eighteen percent of participants had smoked before and 78.4% said smoking could affect oral health.

Figure 2 also shows the link between the number of tooth lost on weight categories.

TABLE 4.27: ASSOCIATION BETWEEN ORAL HEALTH AND FOOD INTAKE

	Case and Control		Total N (%)	P- Value
	Cases N (%)	Controls N (%)		
Has dental problem affected meals				
Yes	95 (37.3)	6 (2.4)	101 (39.6)	<0.001
No	95 (37.3)	59 (23.1)	154 (60.4)	
Changed diet due to oral problem				
Yes	55 (21.6)	7 (2.7)	62 (24.3)	0.003
No	135 (52.9)	58 (22.7)	193 (75.7)	
Coping method				
Chew on one side only	21 (8.2)		21 (8.2)	0.001
Chew slowly and carefully	15 (5.9)	5 (2.0)	20 (7.8)	
Opts for liquid/soft food	30 (11.8)	2 (0.8)	32 (12.5)	
Foods stopped				
Cold foods	5 (2.0)		5 (2.0)	0.003
Fruits/vegetables	4 (1.6)		4 (1.6)	
Meat/fish	13 (5.1)	2 (0.8)	15 (5.9)	
Other hard foods (chips, nuts)	28 (11.0)		28 (11.0)	
Starchy roots/ tubers/ plantain	9 (3.5)	1 (0.4)	10 (3.9)	
Sugar, sugary foods/drinks	1 (0.4)		1 (0.4)	
Smoking				
Yes	32 (12.5)	14 (5.5)	46 (18.0)	0.265
No	152 (59.6)	51 (20.0)	203 (79.6)	
Don't remember	6 (2.4)		6 (2.4)	
Can smoking affect oral health				
Yes	143 (56.1)	57 (22.4)	200 (78.4)	0.043
No	20 (7.8)	6 (2.4)	26 (10.2)	
Don't know	27 (10.6)	2 (0.8)	29 (11.4)	

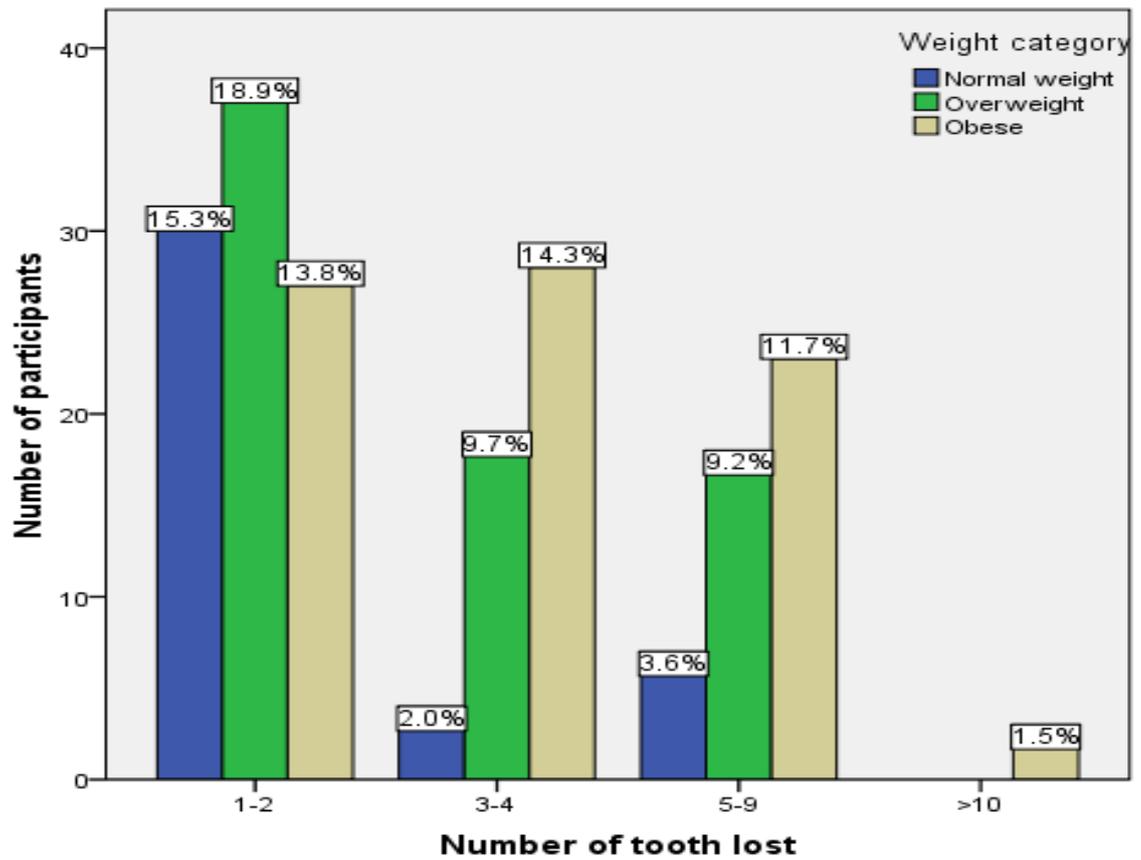


FIGURE 2: NUMBER OF TOOTH LOST BY WEIGHT CATEGORY

There was significant difference between the number(s) of tooth lost with weight category. Obesity increased with an increasing number of tooth loss ($P < 0.001$)

4.6 OTHER ORAL HABITS AMONG THE RESPONDENTS

In table 4.28 there was no significant association between smoking and tooth loss in this study ($p=0.451$).

TABLE 4.28: ASSOCIATION BETWEEN SMOKING AND TOOTH LOSS

Smoking	Lost tooth		Total
	Yes	No	
Yes	36 (78.3)	10 (21.7)	46 (100.0)
No	162 (79.8)	41 (20.2)	203 (100.0)
Don't remember	6 (100.0)	0 (0)	6 (100.0)
Total	204 (100.0)	51 (100.0)	255 (100.0)

CHAPTER FIVE

5 DISCUSSION

The primary nutrition problem involving the oral cavity is the failure to maintain sufficient oral intake (Nelms et al. 2010). This may lead to changes in dietary selection with risk of poor nutritional status especially in people over the age of fifty. Reports have indicated that, one in five older adults reported that oral condition prevented them from eating the foods they would choose, 15% took longer to complete their meals and their enjoyment of food was limited by oral condition. Another 5% avoided eating certain foods because of chewing problems (Rathee and Hooda 2009).

Adequate nutrition and good health are the right of all individuals and also form a basis for the development of a nation. Past studies have focused greatly on the associations between oral health and nutritional status in younger generations in Ghana, with very few considering the older generations. Ageing is however inevitable and the population of older adults the world over is increasing necessitating an increase in ways in which dieticians and health professional can help prevent malnutrition associated with poor oral health. In Ghana, very little research is carried out on the population above 50 years old. Understanding the true plight of this group of adults relating to oral health and nutritional status is key to planning effective nutritional intervention programs and also promoting lifestyle changes to ensure healthy ageing.

This study was carried out to assess the relationship between oral health and nutritional status in adults, fifty years and above visiting Korle-Bu Dental clinics using cases and controls.

5.1 DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS AND INFLUENCE ON DIET AND ORAL HEALTH

Life-style characteristics have been found to affect food intake and dietary quality adversely and these include low educational attainment, marital status and socioeconomic status (Papas et al., 2007). Also according to Papadaki and Scott (2002), the most common reasons suggested to affect food choices in older adults include changes in living arrangements, cost and financial resources. These reports show that it is necessary to determine the background characteristics of participants to know the socio-demographic components that effect food behaviors among the elderly. In this study the demographic characteristics used to assess dietary behaviors include sex, age, marital status, educational level and employment status.

Studies have shown that age positively predicts the importance of nutrition therefore nutrition is more important as people age (Glanz et al., 1998). For many elderly people, the desire for long-term benefits of good health may deter them from choosing food which would grant them immediate gratification as they feel they are growing old and must make healthier food choices.

The participants who have acquired some form of higher education (secondary or tertiary) and are believed to also have some knowledge on the importance of healthy eating might make healthier food choices however Contento et al., (1992) states that knowledge alone does not enable people to adopt healthier eating behaviors.

Financial status which is usually determined by employment status can also influence food choices in the elderly. Nearly half (48.6%) of the participants were either retired or unemployed meaning that their financial status might be affecting their food choices and hence can affect their intakes. In addition 62.7% of the participants were married while only 9.8% were living alone. According to Story et al., (2002) eating behaviors are also strongly influenced by social environments, which include family, friends, and peer networks. Interpersonal processes and relationships within the family and with friends, neighbors, and acquaintances all have a substantial impact on food choices and eating behaviors. Social influences can affect eating behaviors through ways such as social support, and perceived norms.

5.2 ANTHROPOMETRY AND WEIGHT CATEGORIES

In the anthropometric evaluation, the mean weight, height and BMI of the participants were 78kg, 164cm and 29.1kg/m² respectively. Only 22% were found to be of normal weight, but 36.5% were overweight, and the greater proportion (41.6%) were obese. There were no significant differences in prevalence of overweight and obesity ($p=0.093$), age

($p=0.707$), marital status ($p=0.124$), and employment status ($p=0.209$) between cases and controls.

There was however a significant difference in prevalence of overweight and obesity between sexes with more females being obese and more males being overweight and normal weight ($p<0.001$). Also there was significant association between weight category and educational levels. Participants having secondary level education had a higher obesity rate compared to those with tertiary level education who had a higher overweight rate ($p<0.001$). Overweight and obesity in adults are risk factors for several chronic diseases, including type 2 diabetes mellitus, cardiovascular disease, hypertension, dyslipidemia and metabolic syndrome (Peltzer et al, 2014).

Relationships between weight status and oral health are a growing area of research. Studies have shown links between edentulism, periodontal disease, low calcium intake, and osteoporosis in older men and women (Touger-Decker and Mobley, 2007). In this study the overweight people reported higher prevalence of bad breath than the other weight categories.

5.3 NUTRIENT INTAKES AND ADEQUACY

5.3.1 ENERGY AND MACRONUTRIENTS INTAKE

The mean daily intakes for the participants were energy, 1392kcal, protein 57g, fats 37g and carbohydrates 220g. WHO/FAO (2003) has recommended a range of intakes for protein, carbohydrate and fat (expressed as a percentage contribution to total energy intake) that would allow for an adequate intake of all the other nutrients while improving

general health outcomes and ranges are applicable to all adults, including older people. The recommended range for protein is 15% to 25%, carbohydrate is 45% to 65% and for fat is 20% to 35% of total energy.

The participants met the percent energy contributions requirement for protein (16.3%), fat (20.4%) and carbohydrates (63.3%). However the proportion of individuals who actually met their DRI was less than 50% for both the cases and controls. Cholesterol intake showed that 55% had adequate intake among the cases.

Energy is required in the body for metabolic processes, physiological functions, muscular activity, heat production, growth, and the synthesis of new tissues and protein. Carbohydrate and fat (the macronutrients) and alcohol from foods and drinks are the only sources of energy for humans. Mean energy intake for the participants was 1392kcal which was below recommended level. This may be due to under-estimation of food and nutrients during data collection and might reflect in nutrient analysis since participants may not be able to recall exact amounts of foods eaten. Energy requirements decreases with age and can vary according to gender, body size and physical activity yet still research has found that older people consume smaller meal sizes and slower rates of eating leading to lesser energy intakes. Reduced energy intake usually leads to weight loss, depending on energy expenditure which is also often decreased in older adults which is not the case in this study.

5.3.2 MINERALS INTAKE

Participants' mean nutrient intakes were found to be inadequate for several of the minerals and all of the vitamins when compared to their DRIs. Essential nutrients like selenium and zinc, vitamins A, D and K required for maintaining the integrity of the oral cavity were inadequate.

Although energy requirements decrease with age, macronutrient and micronutrient requirements generally do not decrease with age and some of them (e.g., calcium) actually increase with age. By consuming a variety of foods from the different food groups, a person is more likely to meet his/her macronutrient and micronutrient requirements, and is more likely to achieve energy balance (Lobo, 2006).

5.4 FREQUENCY OF CONSUMPTION OF VARIOUS FOODS IN FOOD GROUPS

Fruits juices and evaporated milk were the most consumed foods in their respective groups with most people taking them once or twice a week. Most people consumed bread, rice or kenkey in a week and 26.8% ate bread almost every day of the week. Only less than 25% never consumed any bread, rice or kenkey/banku in a week indicating that majority of the respondents showed high dependence on these foods for energy. According to Agble et al., (2009), rice is a staple throughout the country and is therefore consumed largely by most people in Ghana hence its high consumption frequency by most Ghanaian older adults.

With rapid urbanization, the demand for imported foods has increased, especially for wheat and rice (Agble et al., 2009) and this statement was also verified as the consumption

of wheat and its related product, bread was also found to be relatively high among participants. Maize which is normally consumed in the form of kenkey by most Ghanaians was also frequently consumed by most of the participants in the week. Very few people took cocoyam or potatoes with more consuming yam, plantain or cassava (fufu) among the root tubers and plantain group.

Fish was the most consumed animal product which 34.5% of participants ate almost every day. Intakes of fried foods and spreads were rather low. Intake of fruits was also low, with most opting for watermelon probably due to its seasonality, which only 33.7% ate 1-2 times in the previous week. Intakes of vegetables as gravy or light soup showed the highest frequency. The low intakes of fruits and vegetables, the main sources of micronutrients, could lead to micronutrient deficiencies and also affect vital metabolic processes like wound healing and cell replication. A high intake of fruits and vegetables has been linked with lower risk of periodontal disease, a major cause of tooth loss which may mean that a reduced intake of fruits and vegetables may be associated with edentulism (Peltzer et al., 2014).

Most people took their vegetables in the form of stews or soups with most of the participants consuming gravy and light soup the most in a week. Most meals consumed in Ghana are accompanied by thick, well-seasoned sauces or soups, the most popular being okro, groundnuts, palm nut and palava/kontomire sauce or soup (Agble et al., 2009). The frequency of the consumption of soups and stews or sauces showed gravy or tomato stew was largely consumed by most of the participants several times in the week, followed by light soup. This stew and soup is believed to have been consumed frequently by older

adults due to their preferences above other soups or stews and also due to the availability of ingredients and the ease at which they can be cooked. Also stews and soups serve as a method of preserving perishable foods such as vegetables and also provides variety in the diet.

Nuts, chocolate and toffees/candies were rarely consumed among participants with more than 70% of participants never taking any in a week. According to Agble et al. (2009), the main foods consumed in Ghana are cereals, starchy roots and plantain and results obtained confirmed this.

5.5 ORAL HEALTH STATUS

5.5.1 ORAL PRACTICES

All the participants in this study performed the basic good oral hygiene practice of brushing their teeth in the morning with a majority (87.5%) using a fluoride containing toothpaste and tooth brush. Two-thirds (66.7%) of participants used toothpicks and 86.7% reported that they have earlier ever visited a dentist and this was significant among cases and controls ($p < 0.001$).

Good oral health is maintained by observing good oral hygiene such as brushing the teeth and avoidance of use of toothpicks and sharp objects. Tooth brushing remains the most popular oral hygiene practice worldwide. Meanwhile, traditional oral self-care such as use of chewing sticks or powder is common in developing countries (Petersen et al., 2010). Also a link between poor oral hygiene and lower respiratory tract infections has been observed

and recent evidence suggests improved oral hygiene and regular professional oral care can decrease the incidence or advancement of respiratory tract diseases in high-risk elderly people.

Bacterial species that normally do not colonize the oropharynx can cause health care associated pneumonia, and the oral cavity has been found to promote growth of these pathogens (McKenna et al, 2009). Regular visit to the dentist is therefore recommended for early diagnosis and treatment.

5.5.2 ORAL HEALTH PROBLEMS AND CAUSES OF ORAL HEALTH PROBLEMS

Toothache was the greatest oral problem for which people visited the dentist. Caries, loose teeth, gum infection, tooth loss or edentulism, mouth ulcers halitosis among others (broken or cracked tooth, dentures etc.) were the specific oral problems the participants reported they were experiencing. There were significant difference of reported painful chewing, ($p < 0.001$), bad breath ($p < 0.001$) and sensitive teeth ($p = 0.009$) between cases and controls. People who may experience pain when chewing may choose not to eat foods that are difficult to chew therefore poor oral health can decrease appetite and the ability to eat, which in turn may lead to poor nutrition.

About 80% of participants had lost one or more teeth and extraction was the highest cause of tooth loss. Just 24.3% of the participants had lost their teeth over ten years and out of this 23.1% were over 70 years old. From this study periodontal disease (14.1%) and dental caries (9.4%) were the most occurring among those treated at the clinics. People who have

lost some teeth can be affected by their dentition and this can lead to reduced intakes of fruit and vegetables and some key nutrients (Steele and Walls, 2004). Dental caries and periodontal diseases have both been identified as important global oral health burdens.

At present, the distribution and severity of oral diseases vary in different parts of the world and within the same country (Peterson, 2003). Also evidence suggests that periodontal disease develops quicker in malnourished people therefore the important role of nutrition is in maintaining an adequate intake of nutrients especially vitamin C. Under-nutrition worsens the severity of oral infections and may eventually lead to their development into life-threatening diseases (Mei et al., 2014, Verneti-Callahan, 2013).

5.6 ASSOCIATION BETWEEN ORAL HEALTH ON FOOD INTAKE

Oral problems affected food intake of 39.6% of participants in this study while 34.3% said they had changed their diets due to oral problems. Most people opted for liquid/ soft foods; while some chewed on one side only or chewed very slowly and carefully. Such coping strategies will definitely affect one's enjoyment of his/her favorite food and also limit food choices. Majority had stopped eating hard foods like nuts and chips while others had stopped meat/ fish, fruits/vegetables due to their oral problems. The omission of these foods from the diets of older adults may lead to the omission of vital nutrients leading to nutrient deficiencies.

Poor dentition and oral health results in the avoidance of food which calls for thorough chewing and people with tooth loss and gum disease are likely to limit their diets to softer foods (Burton and Foster 1988). These conditions make chewing difficult and painful and inefficient chewing can cause choking and indigestion.

In addition the normal source of bulk; fruits and vegetables which are typical sources of vitamins, minerals and fibre and when food groups are excluded and variety is limited hence nutrient deficiency follows (Burton and Foster 1988).

5.7 OTHER ORAL HABITS AMONG THE RESPONDENTS

Common risk factors for oral diseases include unhealthy eating, smoking, alcoholism and stress which are shared by a lot of chronic diseases and injuries, including oral disease (Petersen, 2003). Eighteen percent of participants had smoked before and 78.4% said smoking could affect oral health. There was no significant association between smoking and tooth loss in this study ($p=0.451$).

5.8 CONCLUSION

Majority of the participants were either overweight or obese (78%) even though their estimated nutrient intakes did not meet recommended energy and macronutrients requirements for older adults. Frequency of intakes of fruits and vegetables, the major sources of micronutrients were also low indicating inadequate micronutrients in their diets.

Most of the participants (86.7%) had had some form of oral problem in the past and (71.4%) were still experiencing some sort of oral problem. From this study periodontal disease (14.1%) and dental caries (9.4%) were the most occurring among those treated at the clinics. All the participants observed the basic good oral hygienic practice of brushing the teeth at least once a day and several had visited the dentist before.

Oral health status was associated with poor food intake and hence inadequate nutrient intake in the elderly. Oral problem affected food intake of 39.6% of participants, $p < 0.001$ in this study while 34.3% said they had changed their diets due to oral problems. Most people opted for liquid/soft foods; while some chewed on one side only or chewed very slowly and carefully. Association between types of food avoided and ways of coping between cases with specific oral conditions and controls were significant, $p = 0.001$.

5.9 RECOMMENDATIONS

It is recommended that some form of dietary supplement is given to replace deficient nutrients in people with impaired oral health to prevent deficiencies.

Also the treatment and prevention of oral health problems should be an interdisciplinary approach (dentists, dietitians, nutritionist and other health care professionals) so that deficiencies and conditions associated with oral health can be recognized in the elderly.

Dietary advice and education for older adult on their risk of nutrient deficiencies and its effect on their oral health must be provided, particularly to those who have recurring oral problems or diseases. Raising awareness and improving perceptions of benefits and enhancing self-worth regarding fruit consumption should be given more attention.

Finally, similar studies can be conducted on different population groups.

5.10 LIMITATIONS TO THE STUDY

The time frame for the study was relatively short hence more controls could not be recruited. Dietary assessment methods used may be associated with both over-estimation and underestimation of meals. Microdiet, the food analysis software used, did not have the nutrient composition of some local foods hence similar foods were chosen to compensate for it and all these factors can have an effect on the final results

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7 APPENDICES

APPENDIX I- QUESTIONNAIRE FOR PARTICIPANTS

ORAL HEALTH AND NUTRITIONAL STATUS OF ADULTS 50 YEARS AND ABOVE VISITING KORLE-BU DENTAL CLINICS

Demographic Data

Respondents code:

1. Gender: [1] Male [2] Female
2. Age:
3. Educational background: [1] Tertiary [2] Secondary [3] Primary [4] No education
4. Employment status: [1] Currently employed [2] Self-employed [3] Retired [4] unemployed
5. Marital status: [1] Single [2] Married [3] Widowed [4] Divorced
6. Who are you currently living with? [1] Spouse [2] Children [3] Relatives [4] Alone

ORAL HABITS

7. Do you always brush your teeth in the morning? 1=Yes 2=No
8. Do you often brush before going to bed at night? 1=Yes 2=No
9. What do you use in brushing your teeth?

1=Toothpaste and brush

2=Chewing stick/sponge alone

3=Chewing stick/sponge and fluoride containing paste

4=Combination of all the above

5=Other, _____

10. How many times in a day do you often brush your teeth? _____
11. Do you use tooth pick after meals 1=Yes, 2=No
12. Do you use tooth floss 1=Yes, 2=No
13. Have you ever visited a dental clinic or seen a dentist? 1=Yes, 2=No, 3=Not sure
14. If you have visited a dental clinic how long ago?
 - 1) Less than 3 months
 - 2) Six month ago
 - 3) 1 year ago
 - 4) 2-4 years ago
 - 5) don't remember
15. What problem did you report at the dental clinic? [1] Toothache, [2] Bleeding gum [3] Serious bad breath, [4] Loose teeth, [5] Mouth sore [6] Other.....
16. Do you think you have any specific oral health problem? [1] Yes [2] No
17. If yes, state what you think your dental or oral problem(s) is/are?
.....

Do you currently experience the following conditions?

18. Bad Breath [1] Yes, [2] No [3] Don't know
19. Red or swollen gum [1] Yes, [2] No [3] Don't know
20. Tender or bleeding gum [1] Yes, [2] No [3] Don't know
21. Painful chewing, [1] Yes, [2] No [3] Don't know
22. Loose teeth [1] Yes, [2] No [3] Don't know
23. Sensitive teeth. [1] Yes, [2] No [3] Don't know
24. Have you lost any tooth [1] Yes, [2] No

- 25. How long ago did you lose your last tooth?
- 26. What caused the last tooth loss?
- 27. At what age did you lose your first tooth
- 28. What caused your first tooth loss?
- 29. How many teeth have you lost so far?

ORAL HEALTH RELATED DIETARY CHALLENGES

- 30. Has your dental problem affected your meals? [1] Yes, [2] No
- 31. Have you in anyway changed your diet as a result of the oral problem you have: [1] Yes [2] No
- 32. How have you been coping with the oral problems as regards your food intake?
- 33. What specific food have you stopped eating as a result of your dental problem?
- 34. Do you have any other health problems apart from oral health challenges? [1] Yes, [2] No, [3] Don't know
- 35. If you have any other health problems what are they?
- 36. Have ever smoked in your life? [1] Yes, [2] No, [3] Don't remember
- 37. Do you think smoking can affect your oral health? [1] Yes, [2] No, [3] Don't know

ANTHROPOMETRY

Weight:

Height:

BMI:

ORAL PROBLEM(S) FROM FOLDER

- 1.
- 2.
- 3.

APPENDIX II- FOOD FREQUENCY QUESTIONNAIRE

Please indicate how often you have eaten these foods

CODE		24hrs ✓ = Yes	No. of times in the past week
	DRINKS AND JUICES		
	Sweetened drinks (Tampico, Kalyppo, Refresh)		
	Fruit juices (Pure Heaven, Ceres, Nourisher)		
	Malt drinks/Minerals (Malta Guinness, Fanta, Sprite, Coke)		
	MILK AND DAIRY PRODUCTS		
	Evaporated milk/ whole/fresh milk/ Milk drinks (eg Milko)		
	Powdered milk		
	Condensed milk		
	Yoghurt / Ice cream		
	Cheese / Wagashi		
	CEREALS AND CEREAL FOODS		
	White bread (sugar or tea bread)		
	Biscuits / cookies		
	Cakes		
	Pie (meat and fish)		
	Pizzas		
	Rice/ Fried rice/ jollof		
	Kenkey/ banku/ TZ		
	Wheat		
	Popcorn		
	ROOTS AND TUBERS (BOILED)		
	Cassava (Fufu)		
	Cocoyam/Potato/Sweet potato		
	Yam		
	Plantain		
	PROTEIN FOODS		
	Meat (pork, beef, mutton, bush meat)		
	Poultry (chicken, duck, turkey, birds)		
	Fish		
	Kebab		
	Corned beef / luncheon meat		
	Sausage / Bacon		
	Eggs		
	FRIED FOODS		
	Bofrot / Donuts		
	Akara / Koose		

	Fried plantain / Kelewele		
	Fried yam / cocoyams/ sweet potatoes		
	Plantain Chips / Pastries		
	Fried eggs		
	Fried chicken/meat		
	SPREADS AND TOPPINGS		
	Margarine/ Butter		
	Chocolate spread/ Jam		
	Groundnut (peanut) paste		
	Salad cream/ Mayonnaise		
	FRUITS		
	Citrus (Orange, Tangerine, Grape fruit)		
	Pineapple		
	Water melon		
	Mango		
	Banana		
	Avocado pear		
	Pawpaw		
	Guava		
	Apple		
	Fruit salad		
	VEGETABLES, SAUCES AND SOUPS		
	Carrot		
	Cucumber/ cabbage/green pepper/		
	Vegetable salad		
	Tomatoes Stew/gravy		
	Garden eggs stew		
	Okro stew		
	Kontomire stew		
	Light soup		
	Groundnut soup		
	Palmnut soup		
	OTHERS		
	Chocolate		
	Toffees/candies/lollipops		
	Nuts (groundnuts/peanuts, cashew, tiger nuts)		

APPENDIX III- 24-HOUR RECALL

Meal type/time	Actual food eaten	Estimated amount of food eaten

APPENDIX IV- PARTICIPANT INFORMATION SHEET

Consent form for participation in a study conducted by students of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana, Korle-bu.

TITLE: ORAL HEALTH AND NUTRITIONAL STATUS OF ADULTS VISITING KORLE-BU DENTAL CLINICS

Dear Sir/Madam,

You are kindly invited to take part in this study voluntarily and you are at liberty to opt out at any point in time without any consequences.

Purpose of study: determining the association between oral health and nutritional status in adults 50 years and above

How it will be done: You will provide us with information about your oral and eating habits. Your height and weight will be measured.

Risks: There would be no risk involved. Competent and experienced health personnel will ensure that potential discomfort is minimized.

Benefits: Information obtained would be useful in planning effective nutritional and oral health intervention programmes and also promoting lifestyle changes to ensure healthy ageing and this information will be used for planning health programmes for in Ghana. Results of the survey will be given to your doctor or dietician so that you can be counseled or treated if necessary.

Privacy and confidentiality: Your personal information including your name and all other details provided will be kept confidential for reference purposes by investigators and not disclosed to anyone.

Contacts: If you have any questions or complaints about the study or about your rights as a participant, you may contact the following people:

Rev. Tom Ndanu (Tel. 0244872410). University of Ghana School of Biomedical and Allied Health Sciences, Korle Bu, Accra

Mr. Frank Hayford (Tel 0244680020), Department of Nutrition and Dietetics, University of Ghana School of Biomedical and Allied Health Sciences, Korle Bu, Accra

APPENDIX V- PARTICIPANT CONSENT FORM

I have fully understood the information on the consent form. I know what is required of me and what I stand to benefit should I partake in this study.

Name:

Signature/ Thumbprint.....

For Official Use

I have fully explained to the above named subject the nature and purpose of the above described procedure and risks that are involved in its performance. I have answered and will answer to the best of my ability, all questions relating to the study.

Signature.....

Date.....

APPENDIX VI- ETHICAL CLEARANCE



UNIVERSITY OF GHANA
SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES

14th April, 2015

Ms. Kerr-Rabbles Sharon L,
Dept. of Dietetics,
SBAHS,
Korle Bu.

Dear Ms. Kerr-Rabbles,

ETHICS CLEARANCE

Ethics Identification Number: SBAHS – ET./10 27 11 42/AA/2A/2012-2013.

Following a meeting of the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences held on Wednesday, 8th April, 2015, I write on behalf of the Committee to approve your research proposal as follows:

TITLE OF RESEARCH PROPOSAL: "Oral Health and Nutritional Status of Adults attending Dental Clinics in Korle-Bu"

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Committee on completion of the research. The Committee may observe the procedures and records of the research during and after implementation.

Please note that any significant modification of the research 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 research to the Committee within seven (7) days verbally and fourteen (14) days in writing.

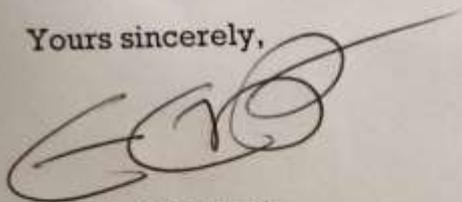
As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this research. You will therefore, be required to furnish the Committee with any manuscript for publication.

COLLEGE OF HEALTH SCIENCES

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

Thank you.

Yours sincerely,



Dr. E. Olayemi
(Chairman, Ethics and Protocol Review Committee)

cc Dean
Co-ordinator, Dept. of Nutrition & Dietetics
School Officer