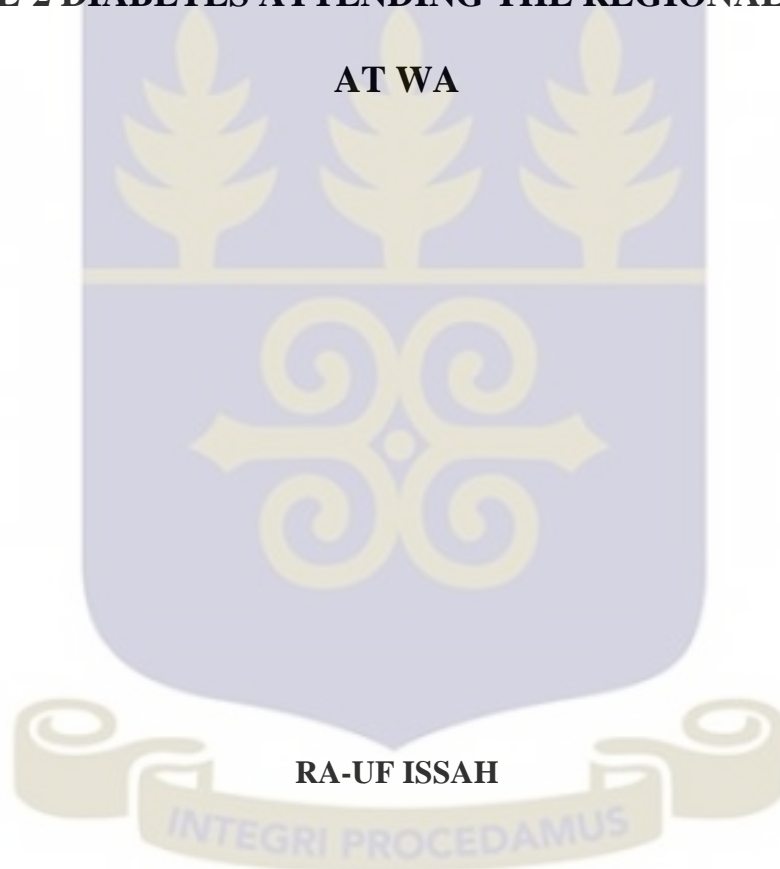


**NUTRITION KNOWLEDGE AND DIETARY HABITS OF PATIENTS  
WITH TYPE-2 DIABETES ATTENDING THE REGIONAL HOSPITAL**

**AT WA**



**RA-UF ISSAH**

**INTEGRI PROCEDAMUS**



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2 DIABETES ATTENDING THE REGIONAL HOSPITAL AT WA**

**BY**

**RA-UF ISSAH**

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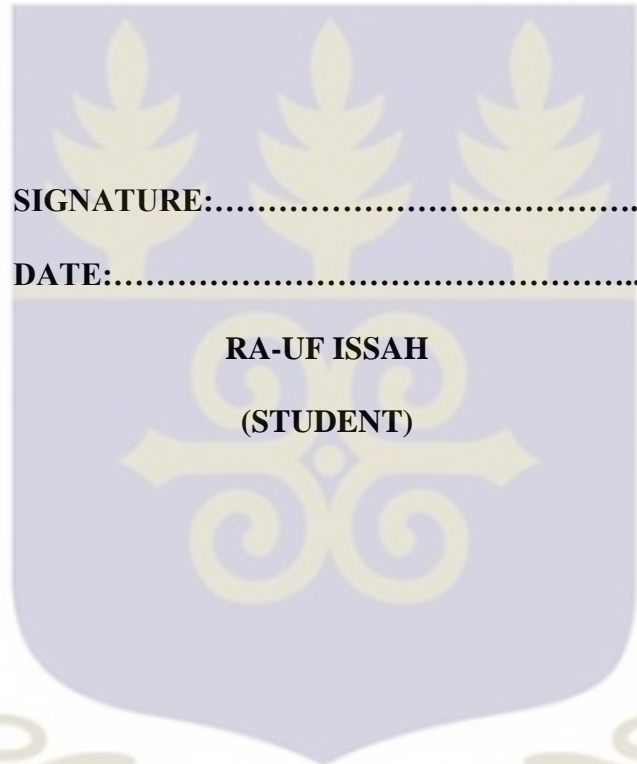
**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE  
AWARD OF A MASTER OF SCIENCE DEGREE IN DIETETICS**



**JULY, 2016**

**DECLARATION**

I, Ra-uf Issah, certifies that this dissertation is the results of an objective research supervised by Dr. Joana Ainuson-Quampah and Frank Ekow Atta Hayford of the School of Biomedical and Allied Health Sciences (SBAHS). All references mentioned in this dissertation have been fully acknowledged.



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## ABSTRACT

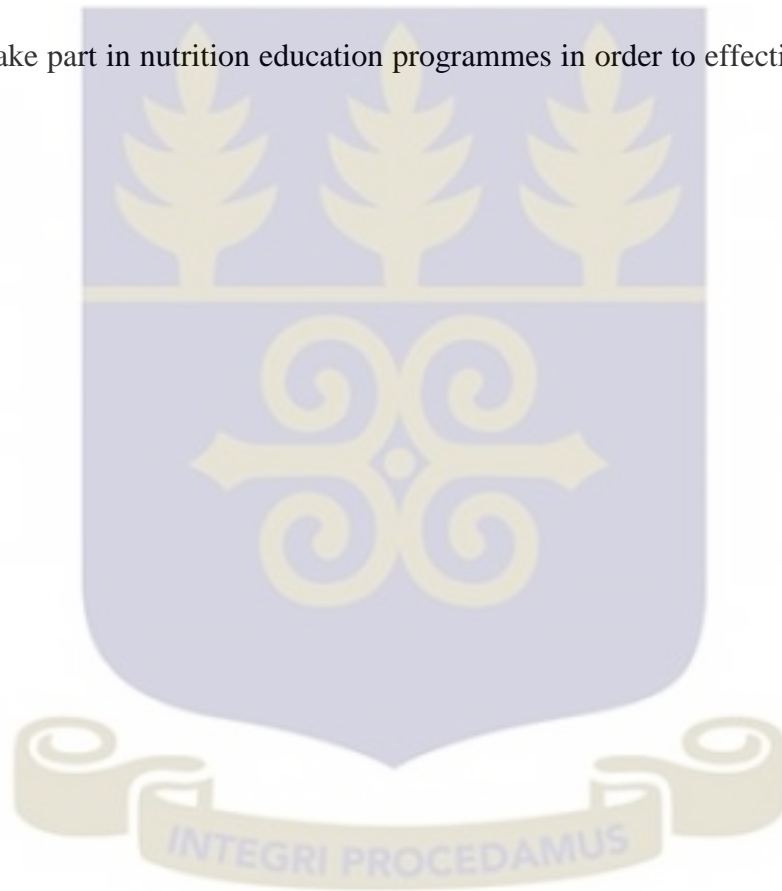
**Background:** Chronic diseases such as type-2 diabetes require continuous medical care and ongoing patient self-management education and support to prevent multiple complications and premature mortality. Adequate nutrition knowledge and appropriate dietary habits play key roles in the nutritional management of type-2 diabetes. Therefore, providing adequate nutrition information and skills on indicators such as good diet, physical activity, and health have been shown to improve the well-being of the individual and/or groups.

**Aim:** To assess the nutrition knowledge and dietary habits of patients with type-2 diabetes attending the Regional hospital at Wa in the Upper West Region of Ghana.

**Method:** A cross-sectional study was conducted to assess the nutrition knowledge and dietary habits of patients with type-2 diabetes using systematic random sampling technique. One hundred and seventeen (117) participants were involved in the study. Key indicators investigated in the study were nutrition knowledge, dietary habits, body fat composition, percentage visceral fat, body mass index and glycated haemoglobin levels. The relationship between dietary habits and body fat composition; percentage visceral fat; body mass index; glycated haemoglobin levels were also investigated. The raw data solicited from the study participants were entered into excel and transferred into statistical package for social sciences (SPSS) version 20 software for analyses. Using chi-square and correlation analysis, associations between the variables of interest were established with a level of significance ( $p < 0.05$ ). The results of the analyses were presented as standard deviations, numbers and percentages using tables and graphs. The nutrition knowledge of the study participants was scored using a standard scale of reference.

**Results:** Key findings of the study showed below average nutrition knowledge (45.3%) and dietary habits generally indicated a poor nutritional status among the study participants. The mean BMI for the female and male participants were  $28.59 \pm 4.699 \text{kgm}^{-2}$  and  $24.96 \pm 4.019 \text{kgm}^{-2}$  respectively. There was a significant association between dietary habits and body fat composition; percentage visceral fat; BMI level and glycated haemoglobin level ( $p < 0.05$ ).

**Conclusion:** It was concluded that below average nutrition knowledge was associated with poor dietary habits and nutritional status. Type-2 diabetic subjects should therefore be encouraged to take part in nutrition education programmes in order to effectively manage the disease.



## **DEDICATION**

This research is dedicated to my son (Zaidan Ra-uf) for his strength in these difficult times, to my sister (Asmau Issah) for her unrelenting effort and support, and to my wife (Umuhani Yunus) whose endurance, patience and encouragement has taken me this far.



## ACKNOWLEDGEMENT

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Secondly, I will like to thank Professor Matilda Steiner-Aseidu, who doubles as the President of Ghana Nutrition Association, and an associate Professor at the Department of Nutrition and Food Science, University of Ghana, Legon, for her motherly love and inspiration.

I am also indebted to Novo Nordisk Pharmaceuticals for their full support for this study, Alhaji Sully Yaka (Regional Health Administration, Wa), Lawyer Hamida Jimba, Mr. Ben Dere (GetFUND), Dr. Barnabas Naa Gandao Bamahu (Medical Director, Regional hospital, Wa), and Mr. Samuel Yaw Oduro (Laboratory Manager, Regional Hospital, Wa) and. I express my heartfelt gratitude for your support towards this successful study.

My sincere thanks to my family, my friends (especially Halidu Iddrisu) and loved ones for their encouragement and prayers for the success of this study.

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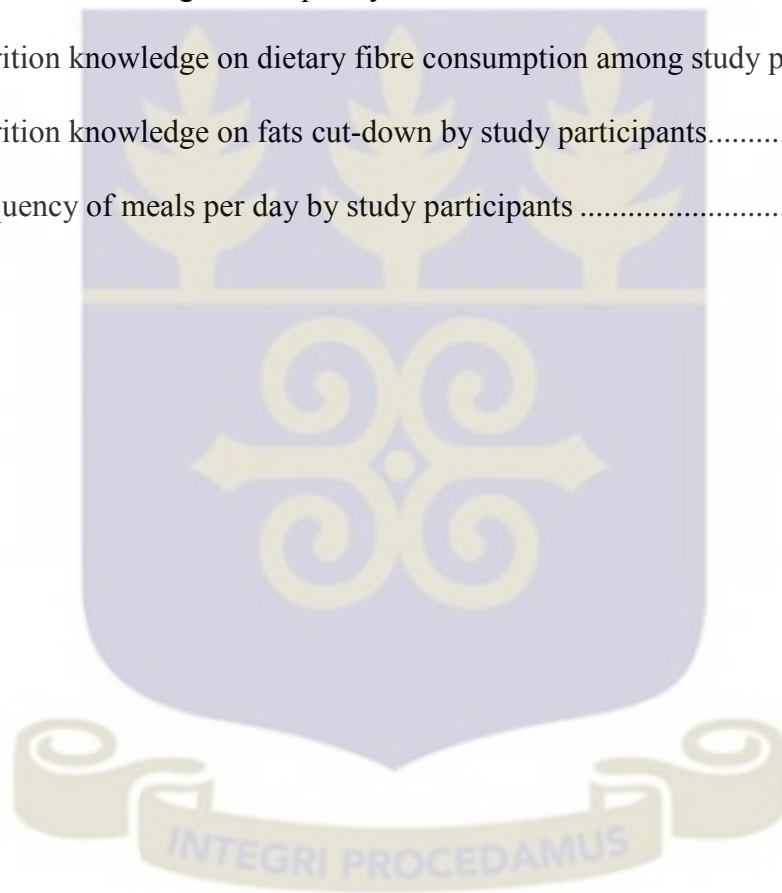
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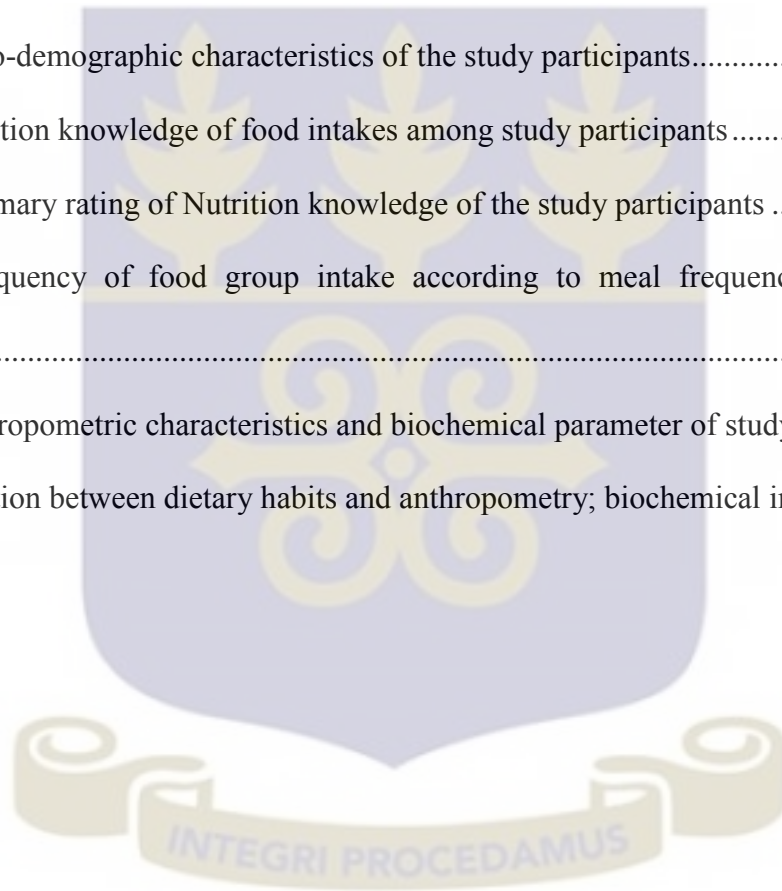
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## LIST OF ABBREVIATIONS

ADA American Dietetic Association

BIA Bio-electric Impedance Analysis

BMI Body Mass Index

CDA Canadian Diabetes Association

CD Chronic Disease

CDC Centre for Disease Control and Prevention

CVD Cardio-Vascular Disease

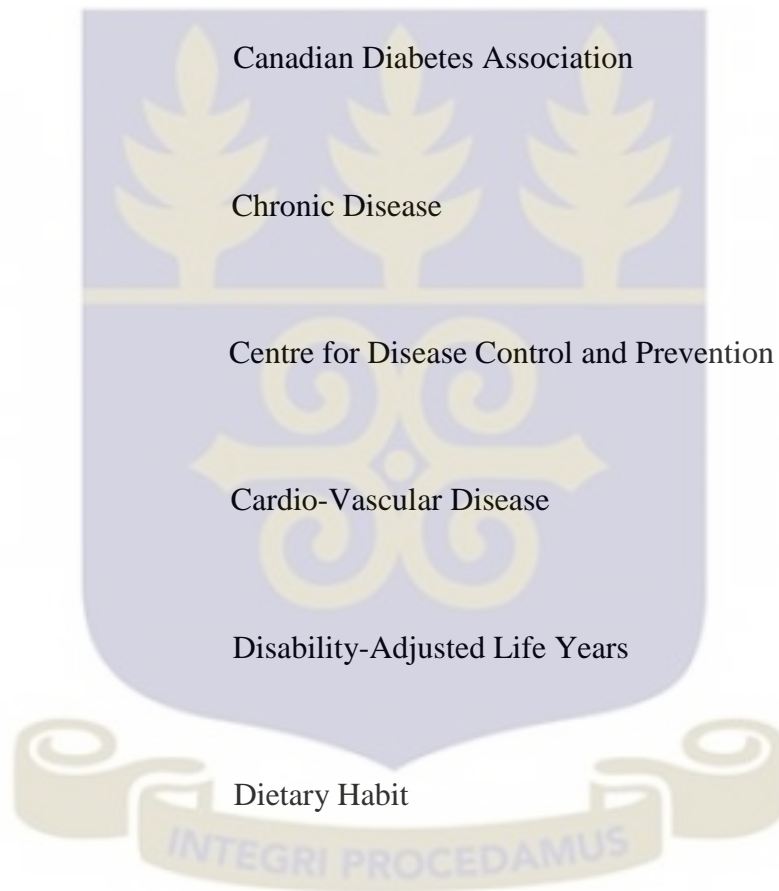
DALYs Disability-Adjusted Life Years

DH Dietary Habit

DUK Diabetes United Kingdom

FAO Food and Agriculture Organisation

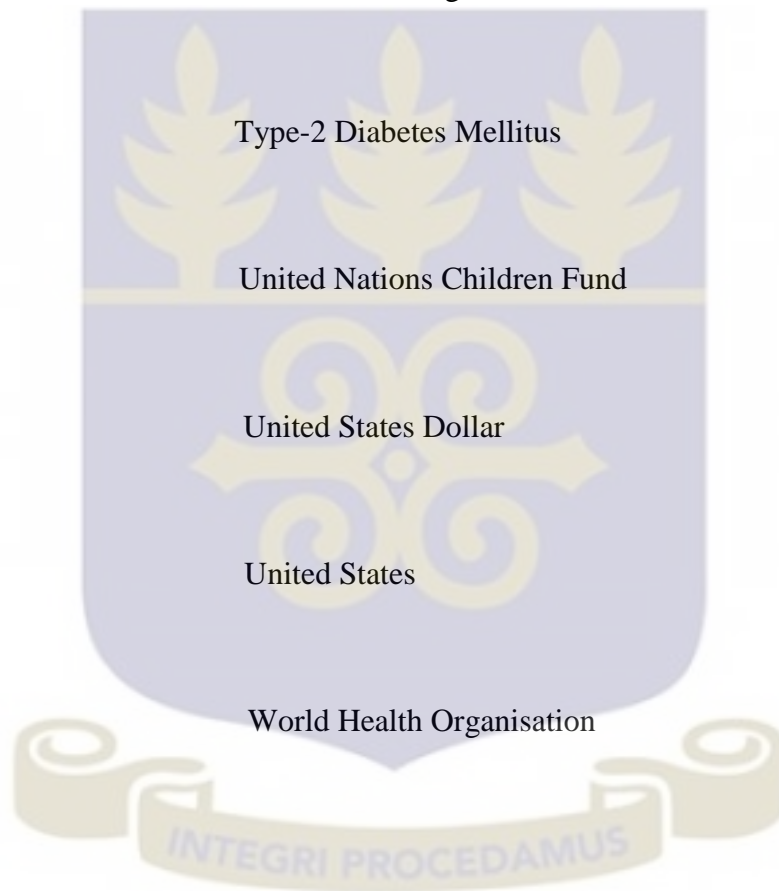
FFQ Food Frequency Questionnaire



FPG	Fasting Plasma Glucose
HbA1c/ A1c	Glycated Haemoglobin
NHIA	National Health Insurance Authority
NIH	National Institute of Health
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
NCD	Non-Communicable Disease
NHIA	National Health Insurance Authority
NHMRC	National Health and Medical Research Council
NK	Nutrition Knowledge
NOO	National Obesity Observatory
OMRON	Healthcare Company Limited



RPG	Random Plasma Glucose
RODAM	Research on Obesity and Diabetes among African Migrants
SPSS	Statistical Package for Social Sciences
T2DM	Type-2 Diabetes Mellitus
UNICEF	United Nations Children Fund
USD	United States Dollar
U.S	United States
WHO	World Health Organisation



## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background

Chronic diseases (CDs) are one of the major health and developmental challenges of the 21st century and have implications on the socioeconomic fabric of countries, particularly low- and middle-income countries (World Health Organisation, 2014). Chronic diseases such as diabetes require continuous medical care and ongoing patient self-management education and support to prevent multiple complications and premature mortality (American Dietetic Association, 2013). According to WHO report (2016), diabetes now accounts for at least 15% of total health care expenditure in many low- and middle income countries.

The global prevalence estimate of diabetes was 9% among adults aged 18 years and above, and accounted for more than 80% of diabetes deaths occurring in low- and middle-income countries (WHO, 2014). This growing problem of diabetes was largely related to overweight and obesity, due to reduction in physical activity and adoption of unhealthy diets, which are high in calories from fats and sugars, high in salt, and low in vegetables and fruits (ADA, 2015). Excess body fat which also gives an indication of poor dietary habits and physical inactivity served as another predisposing factor for type-2 diabetes (T2DM). Intrinsically, percentage body fat is the clearest evidence-based and the largest relative risk for many chronic diseases (WHO, 2016).

Preventing and controlling diabetes and its complications can therefore be achieved through healthy diets, regular physical activity, maintaining a normal body weight, avoiding tobacco use and blood glucose control (WHO, 2014). Dietary behaviour is also key to this strategy.

This is because it evolves over time, being influenced by many factors and complex interactions. Additionally, income, food prices (which affects the availability and affordability of healthy foods), individual preferences and beliefs, cultural traditions, geographical, environmental as well as social and economic factors also interact in a complex manner to shape individual dietary patterns (WHO, 2014). Therefore, creating awareness and providing adequate nutrition information on healthy lifestyles and environmental factors, and their social and economic determinants should be the focus of intervention strategies that are aimed at preventing and controlling diabetes.

However, various studies have shown that having adequate nutritional information does not always guarantee patients' strict compliance. This therefore suggest that dietary recommendations may not always be strictly followed by subjects even when appropriate dietary information and resources are available (Marianne et al., 2006) and therefore will negatively affect the efforts of health promotion and information strategies. A study has shown that the link between nutrition knowledge and dietary habits of majority of athletes was positive but weak on the higher intakes of fruits and vegetables (Spronk et al., 2014). This was largely attributed to the heterogeneity of methods used to assess nutrition knowledge and dietary intake. Other studies have shown that majority of people usually have little difficulty in understanding the front-of-pack (FOP) nutrition information, and in putting it to use in making inferences about the healthiness of food products (Klaus, 2012)

Nevertheless, having adequate nutrition information has been shown to often help individuals to make appropriate selection of foods (Whitney, 2014). Providing nutrition knowledge and skills on indicators such as good diet, physical activity, and health has been shown to improve the well-being of the individual and/or groups (Hawkes, 2013).

Also, the conceptual framework has shown that the immediate causes of malnutrition including lack of knowledge, inadequate dietary intakes, water and sanitation and related diseases, directly affect the individual's nutrition and health status (United Nations Children Fund , 2015). Evidence from another study showed that among Iranian athletes, their nutrition knowledge was poor in the area of nutrient function as indicated by their poor food choices and dietary practices, which therefore reflected in lower nutrient intakes than recommended (Azizi et al., 2010).

Therefore, assessing the relationship between nutrition knowledge and dietary habits using diet quality scores or indices aims at evaluating compliance to dietary guidelines (Inge et al., 2014) may therefore be valuable for effective nutrition interventions. It also helps in planning and allocation of resources in diabetes programme implementation for effective results achievement.

## **1.2 Problem statement**

Currently, 422 million adults worldwide have diabetes (WHO, 2016). In developed countries, most people with diabetes are above the age of retirement, whereas in developing countries those most frequently affected are the working group (aged between 35 and 64 years) (WHO, 2014). Diabetes is a disease with high rates of morbidity and mortality (Zimmet et al., 2001). In 2012 diabetes was the direct cause of 1.5 million deaths with higher-than-optimal blood glucose accounting for an additional 2.2 million deaths worldwide. Forty-three percent (43%) of these 3.7 million deaths occur before the age of 70 years. Additionally, the percentage of deaths caused by high blood glucose or diabetes occurring by age 70 is higher in low- and middle-income countries than in high-income countries (WHO, 2016).

Apart from the effects of diabetes in terms of health and quality of life, it imposes a financial burden on many societies (Gandy, 2014). Although there is good evidence that a large proportion of cases of diabetes and its complications can be prevented by a healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco, this evidence is not widely implemented (WHO, 2014). Key sources of nutrition knowledge and attitudes that can be sought to ascertain healthy eating habits include attitude to healthy eating, knowledge about healthy eating attitudes on one's own weight, knowledge about healthy physical activity levels, and attitude to physical activity and self-efficacy in relation to physical activity (Noo, 2010). However, having adequate nutrition knowledge does not necessarily lead to a shift in appropriate dietary patterns; this requires a long-term process of cultural and behavioural modifications (Gandy, 2014).

Currently in Ghana, 266,200 persons with diabetes has been recorded, with the health care cost per person being 180.6 United States Dollars (USD) (International Diabetes Federeation, 2015). Deaths due to diabetes alone accounted for 4,790 lives. The burden of noncommunicable diseases including T2DM is 31% (WHO, 2010). Even though efforts have been made towards preventing and controlling T2DM, there are still gaps in changing lifestyles and increasing physical activity level. Having appropriate nutrition counselling aimed at improving dietary habits will therefore play a key role in improving nutrition knowledge, and changing attitudes and perceptions about healthy diet. However, there is limited data on understanding how nutrition knowledge and dietary habits of type-2 diabetic subjects can improve their nutrition and health conditions. Therefore, the study sought to add to the existing limited data on how nutrition knowledge and dietary habits affect the management of T2DM.

### **1.3 Research questions**

1. How is the nutrition knowledge of type-2 diabetic subjects?
2. What are the dietary habits of type-2 diabetic subjects?
3. How is the nutrition status of type-2 diabetic subjects?
4. What is the relationship between the dietary habits and body fat composition; percentage visceral fat; Body Mass Index (BMI); glycated haemoglobin (HbA1c) levels of type-2 diabetic subjects?

### **1.4 Hypothesis**

The following assumptions have been made on the outcome of the study:

1. Nutritional knowledge (NK) and dietary habits of T2DM subjects negatively affect management outcomes.
2. Dietary habits of T2DM subjects have a negative relationship with their body fat composition and HbA1c level.

### **1.5 Aim of the study**

To assess the nutrition knowledge and dietary habits of subjects with T2DM attending the Regional Hospital at Wa.

#### **1.5.1 Specific objectives of the study**

1. To assess the Nutritional Knowledge (NK) of T2DM subjects.
2. To assess the Dietary Habits (DH) of T2DM subjects.
3. To determine the nutritional status of T2DM subjects.
4. To determine the relationship between their dietary habits and body fat composition; percentage visceral fat; BMI levels; HbA1c levels of T2DM subjects.

### **1.6 Significance of the study**

The study is expected to bring to the attention of diabetes subjects, Dietitians, Nutritionists and other stakeholders the interplay between nutritional knowledge and dietary habits and how they affect diabetes management so as to ensure effective allocation of scarce resources. It will also help to put in place cost-effective intervention strategies in preventing and controlling T2DM in Ghana and the world over. Finally, as the first research of its kind to be conducted in the Upper West Region, it will add to the scarce literature on how nutritional knowledge and dietary habits affect the management of T2DM in the Region and the country as a whole.



## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

This chapter discusses relevant literature on diabetes globally but with emphasis on the Ghanaian socio-cultural environment. The chapter also examines the major literature in the area of nutrition knowledge and dietary habits of T2DM subjects and how they are linked with glycated haemoglobin (HbA1c), Body Mass Index, body fat composition and percentage of visceral fat. Finally, the purpose of this chapter is to provide the necessary background against which the findings of this study on nutrition knowledge and dietary habits of T2DM subjects attending the Regional hospital at Wa could be understood.

#### 2.2 Epidemiology of diabetes mellitus

Diabetes mellitus is a metabolic disorder characterized by the presence of hyperglycaemia due to defective insulin secretion, defective insulin action or both (Canadian Diabetes Association, 2013). Insulin is a hormone that regulates blood sugar. Hyperglycaemia is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels. There are three (3) types of diabetes namely type-1 diabetes, T2DM and gestational diabetes (WHO, 2014).

Type-1 diabetes is the less common type (about 5 to 10 percent of all diagnosed cases) where the pancreas loses its ability to synthesize the hormone insulin (Whitney & Rolfes, 2008). Type-1 diabetes occurs primarily due to pancreatic beta cell destruction and may result in ketoacidosis (CDA, 2013). It also includes cases due to autoimmune processes and those for which the aetiology of beta cell destruction is idiopathic.

T2DM is the most prevalent form of diabetes, accounting for 90 to 95 percent of cases, and is often asymptomatic (Whitney & Rolfes, 2008). The primary defect in T2DM is insulin resistance, a reduced sensitivity to insulin in muscle, adipose, and liver cells. To compensate, the pancreas secretes larger amounts of insulin, and plasma insulin concentrations can rise to abnormally high levels (hyperinsulinemia). Gestational diabetes is also hyperglycaemia with blood glucose values above normal but below those diagnostic of diabetes, occurring during pregnancy (WHO, 2014). Increasing blood glucose levels increase the risk for both mother and foetus and require treatment to reduce problems for the mother and infant. Treatment may include diet modification, regular physical activity, or insulin (Centre for Disease Control and Prevention, 2014). Women with gestational diabetes are at an increased risk of complications during pregnancy and at delivery. They are also at increased risk of T2DM in the future (WHO, 2014). The occurrence of gestational diabetes in itself is a risk factor for developing recurrent gestational diabetes with future pregnancies. However, the risk factors for gestational diabetes are similar to those for T2DM (ADA, 2014). These are older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity (CDC, 2014).

The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and is expected to be 4.4% in 2030. The total number of people with diabetes was initially projected to rise from 171 million in 2000 to 366 million in 2030 (Sarah et al., 2004). However, recent data suggest the global prevalence of diabetes in 2014 to be 9% higher than initially estimated (WHO, 2014). Except in high-income countries, the proportion of deaths due to high blood glucose for both men and women are highest in the age group 60–69 years (WHO, 2016). It is also observed that most diabetes cases occur in urban areas.

Urban population in developing countries is projected to double between 2000 and 2030 (Sarah et al., 2004). Urbanization and lifestyle changes maybe the most important factors contributing to the increase in incidence of obesity and diabetes mellitus in the world (WHO, 2014). Research evidence indicates that the prevalence of diabetes in some urban communities in Ghana rose from 0.2% in the late 1950s (among a community of men in Ho) to 6.0% in 2009 (among a community of men in Kumasi) (Ama, Ellis & Charles, 2012). Mixed communities in Accra recorded a prevalence of 6.4% in the 1990s as against 9.1% recorded among civil servants in 2006. This suggest an overall increasing trend in diabetes prevalence in Ghana. Prevalence rates of impaired glucose tolerance (IGT) and impaired fasting glucose (IFG), when measured were double or treble the diabetes prevalence suggesting higher numbers of individuals being at risk of developing diabetes in the future (Ama, Ellis & Charles, 2012). Intensifying effective health education and promotion on diabetes control and prevention most especially in the urban areas will therefore be imperative.

With diabetes hitting people in the prime productive years, the threat to Africa's economic development is clear. Currently around 20 million people have diabetes – a prevalence of 4.9% - but over the next two decades the number of people with diabetes was expected to more than double, threatening many of the development gains Africa has achieved. Africa is challenged with health time-bomb with diabetes having an increasing impact on people of working age with most deaths due to diabetes in 2013 being under the age of 60 years (IDF, 2013). Also, when public health systems are weak, payment for care can trap poor households in cycles of debt and illness. In India, for example, treatment for diabetes costs an affected person on average 15–25% of household earnings (Ala, Gauden & David, 2011).

People with Non-Communicable Diseases (NCDs) such as diabetes are also more likely to miss work, become unemployed or retire early. A World Bank study also showed that cardiovascular diseases lead to catastrophic expenditure for 25% of Indian families and drives 10% of families into poverty (Ala, Gauden & David, 2011).

Finally, the burden of diabetes is very high with an annual mortality linked to diabetes worldwide estimated at more than one million (WHO, 2007). Unknown diabetes in Africa is in the order of 60% to 80% in cases diagnosed in Cameroon, Ghana and Tanzania. The rate of limb amputations varied from 1.4% to 6.7% of diabetic foot cases. In these regions, people affected by chronic diseases, including diabetes, seek care from facilities at the peripheral levels. Though these facilities are oriented toward acute problems, they are generally not adapted to provide care to those affected by chronic diseases.

### **2.3 Prediabetes**

Prediabetes is a condition in which individuals have high blood glucose or HbA1c levels but not high enough to be classified as diabetes (CDC, 2014). The cut-off ranges for prediabetes are:

- For HbA1c, from 5.7% to 6.4%.
- For fasting blood glucose (FBG), from 100 to 125 mg/dL (5.6 to 6.9 mmol/L).
- For a sample of blood drawn 2 hours after a 75-gram glucose drink, from 140 to 199 mg/dL (7.8 to 11.1 mmol/L). However, this level is not acceptable during pregnancy due to slow metabolism (Khan & Weinstock, 2011).

People with prediabetes have an increased risk of developing T2DM, heart disease, and stroke (WHO, 2014b). An estimated 57 million American adults have prediabetes, placing them at increased risk for developing T2DM (CDC, 2009). However not everyone with prediabetes will progress to diabetes. Nevertheless, people with prediabetes or diabetes are at a higher risk of death from cardiovascular diseases than others (WHO, 2014). Moreover, studies have shown that lifestyle interventions that resulted in weight loss and increased physical activity in prediabetics can prevent or delay T2DM and in some cases return blood glucose levels to within the normal range (CDC, 2014).

#### **2.4 Type-2 Diabetes Mellitus (T2DM)**

Diabetes is a disease with high rates of morbidity and mortality (Zimmet et al., 2001). T2DM is characterized by insulin resistance in peripheral tissue and an insulin secretory defect of the beta cells (Mayfield, 1998). The role of insulin resistance as opposed to beta cell dysfunction differs among individuals, with some having primarily insulin resistance and only a minor defect in insulin secretion, and others with slight insulin resistance and primarily a lack of insulin secretion (CDC, 2014). As the most common form of diabetes mellitus, T2DM comprises 90% of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity (WHO, 2014). T2DM is also the fourth or fifth leading cause of deaths in most developed countries and there is growing evidence that it has reached epidemic proportions in many developing and newly industrialised countries (Steyn et al., 2004). Until recently, this type of diabetes was seen only in adults but it is now also occurring in children.

Symptoms of T2DM may be similar to those of Type-1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset once complications have already arisen (WHO, 2014). The global estimates of the number of people living with T2DM indicates in Africa was approximately 3 million in 1994 and was projected to go through a 2 to 3-fold increase by the year 2010 (Levitt, 2008). Another study suggests that 10.8 million people had diabetes in sub-Saharan Africa in 2006 and expected rise to 18.7 million by 2025, which is an increase of 80%, exceeding the globally predicted increase of 55% (Levitt, 2008). Highest prevalence of T2DM is seen in adult populations of Indian origin, followed by black populations and Caucasians globally (Motala, Omar & Pirie, 2003). People mostly affected by T2DM were found in urban communities, unlike rural communities where people retain traditional lifestyles (Steyn et al., 2004). These dramatic changes observed in the prevalence or incidence of T2DM in the urban communities is due mainly to major changes in dietary intake, from a traditional indigenous diet to a typical 'Western' diet, e.g. Pima Indians in Arizona, Micronesians in Nauru and Aborigines in Australia (Steyn et al., 2004).

Diabetes is a major cause of adult morbidity and death in Ghana ((WHO, 2012)). About four million people in Ghana may be affected with diabetes and T2DM is the most prevalent (WHO, 2012). T2DM is associated with macro vascular complications (cardiovascular disease, stroke, peripheral vascular disease) leading to heart attacks, hemiplegia and amputations, and micro vascular complications causing foot ulcers, blindness and kidney failure (EURODIAB, 1994). The average cost of health care per an individual with diabetes in Ghana is one hundred and twenty-three United States Dollars (USD 123). Because insurance does not cover their total healthcare cost, most diabetic subjects are unable to pay for their healthcare (National Health Insurance Authority, 2015).

The low level of diabetes-related health expenditures has prevented a very small proportion (0.6%) of diabetes-related deaths (International Diabetes Federation, 2014). Therefore, increased funding for cost-effective diabetes prevention and treatment is crucial. However, the challenge for government is how to strengthen existing health systems to improve health for people currently with diabetes and to prevent the projected almost two-fold increase in diabetes prevalence (IDF, 2013).

People living with T2DM experience complex psychosocial challenges including psychological and emotional insecurities, and limited social support. Management and self-care is poor, and healer-shopping between medical systems is common. Major limitations exist with diabetes care including poor diabetes education, a lack of guidelines for diabetes care, erratic supply of essential diabetes drugs at health facilities and poorly trained health care professionals to manage diabetes including doctors, nurses and dieticians ((WHO, 2012)).

#### **2.4.1 Modifiable risk factors for type-2 diabetes mellitus**

A health risk factor is a factor that raises the probability of adverse health outcomes (WHO, 2009). The risk for developing diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity (CDC, 2014). Risk factors of T2DM are grouped into modifiable and non-modifiable factors. The modifiable risk factors are obesity, physical inactivity and excessive alcohol consumption (WHO, 2005).

Poor diet (high consumption of sugar, salt, saturated fat, etc.) and unhealthy lifestyle (smoking, alcohol consumption and physical inactivity) have also been identified as other modifiable risk factors of cardiovascular disease and other non-communicable diseases (NCDs) (Awosan, Ibrahim & Essien, 2014). Lifestyle interventions show the greatest effect, with reductions of 28–59% in the risk of diabetes following implementation (Walker et al., 2010). These include achieving and maintaining a healthy body weight, being physically active, avoiding tobacco use and eating a healthy diet of between 3 and 5 servings of fruit and vegetables a day and reducing sugar and saturated fats intake (WHO, 2014). Many diseases including T2DM are caused by more than one risk factor, and thus may be prevented by reducing any of the risk factors responsible for them.

As a result, the sum of the mortality or burden of disease attributable to each of the risk factors separately is often more than the combined mortality and burden of the disease attributable to the groups of these risk factors. Eight risk factors (alcohol use, tobacco use, high blood pressure, high body mass index, high cholesterol, high blood glucose, low fruit and vegetable intake, and physical inactivity) account for 61% of cardiovascular deaths (WHO, 2009). Of these risk factors, alcohol use, high body mass index, high cholesterol intake, high blood glucose, low fruit and vegetable intake and physical inactivity contribute significantly to the cause of T2DM globally (WHO, 2014).

Health risks are in transition: populations are ageing owing to successes against infectious diseases; at the same time, patterns of physical activity and food, alcohol and tobacco consumption are changing. Low- and middle-income countries now face a double burden of increasing chronic, non-communicable conditions, as well as the communicable diseases that traditionally affect the poor (WHO, 2016).

Understanding the role of these risk factors is important for developing clear and effective strategies for improving global health (WHO, 2009). Estimates suggest that if the major risk factors for chronic disease were eliminated, at least 80% of all heart disease, stroke, and T2DM would be prevented, and more than 40% of cancer cases would also be prevented (CDC, 2009). Although these major risk factors are usually associated with high-income countries, over 84% of the total global burden of diseases they cause now occurs in low- and middle-income countries. Most of these preventable deaths occurred in the WHO African Region (39%) and the South-East Asia Region (43%). Reducing exposure to these risk factors would increase global life expectancy by nearly 5 years (WHO, 2009). However, the focus of this research was to investigate the modifiable risk factors of T2DM most especially, dietary habits, and how it relates to Body fat composition, visceral fat percentage and glycated haemoglobin levels.

#### **2.4.1.1 Physical activity**

It is any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits (WHO, 2015). Physical activity is positively associated with physical fitness (Blair, 1985). A relatively consistent trend has emerged relating increased physical activity being positively associated with a decreased risk of T2DM, coronary heart disease, hypertension (Siscovick, Laporte & Newman, 1985), and osteoporosis and increased longevity (Paffenbarger et al., 1986).

Physical activity also invariably decreases body fat levels (Wood et al., 1983), although caloric intakes are higher in more active persons (Blair et al., 1981). As an additional benefit, physical activity helps to reduce body weight (Blair, Kohl & Powell, 1990), and this is an indirect benefit for T2DM subjects.

Physical activity also improves musculoskeletal health and reduces the symptoms of depression (WHO, 2009). Many people with T2DM can control their blood glucose by following a healthy meal plan and a program of regular physical activity, losing excess weight, and taking their medications (ADA, 2014). A large prevention study of people at high risk for diabetes shows that lifestyle intervention that resulted in weight loss and increased physical activity in this population can prevent or delay T2DM and in some cases return blood glucose levels to within the normal range (CDC, 2014). Thus, physical activity reduces the risk of cardiovascular disease, some cancers and T2DM (WHO, 2009).

Globally, 1 in 4 adults is not active enough (WHO, 2015). Physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally). Physical inactivity is also estimated by WHO to be the main cause for approximately 21–25% of breast and colon cancers, 27% of diabetes and approximately 30% of ischaemic heart disease burden. And that around 23% of adults aged 18 and over were not active enough in 2010 (men 20% and women 27%) (WHO, 2015). More than 80% of the world's adolescent population were insufficiently physically active globally. In high-income countries, 26% of men and 35% of women were insufficiently physically active, as compared to 12% of men and 24% of women in low-income countries. Low or decreasing physical activity levels often correspond with a high or rising gross national product. The drop in physical activity also is partly due to inaction during leisure time and sedentary behaviour on the job and at home (WHO, 2015).

However, it is recommended that one should do at least 150 minutes of moderate-intensity physical activity throughout the week, or do at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity. For additional health benefits, adults should increase their moderate-intensity physical activity to 300 minutes per week, or equivalent (WHO, 2015).

#### **2.4.1.2 Obesity**

Obesity is defined as abnormal or excessive fat accumulation that may impair health (Ellulu et al., 2014). It becomes the most glaring outward sign of the changing face of malnutrition in developing countries; increase the chances of a person falling prey to the other non-communicable diseases. In 2014, 11% of men and 15% of women aged 18 years and older were obese (WHO, 2014). Obesity is measured through the Body Mass Index (BMI), a simple index of weight–height relationship that indicates amount of body fat used to classify overweight and obesity in adults (Ellulu et al., 2014). The risk transition has witnessed major risks to health shift from traditional risks (e.g. inadequate nutrition or unsafe water and sanitation) to modern risks (e.g. overweight and obesity). Modern risks may take different trajectories in different countries, depending on the risk and the context. Nevertheless, obesity is rated among the top five risk factors for the cause of chronic diseases and cancer (WHO, 2009).

Globally, 65% of the world's population live in countries where overweight and obesity kill more people than underweight (this includes all high-income and most middle-income countries) (WHO, 2009). One (1) in every 3 adults and nearly 1 in every 5 young people aged 6–19 are obese in the American population (CDC, 2009).

Mean BMI, overweight and obesity are increasing worldwide due to changes in diet and increasing physical inactivity. Rates of overweight and obesity were projected to increase in almost all countries, with 1.5 billion people overweight in 2015 alone. Globally, 44% of diabetes burden, 23% of ischaemic heart disease burden and 7–41% of certain cancer burdens are attributable to overweight and obesity. In both South-East Asia and Africa, 41% of deaths caused by high body mass index occur under age 60, compared with 18% in high-income countries (WHO, 2009). Obesity rates in Western Africa are estimated to be 10%.

Rates of obesity among women are three times those found in men. In urban West Africa rates of obesity have more than doubled in the last 15 years (Ellulu et. al, 2014). Additionally, obesity has increasingly emerged as a priority in chronic disease prevention and has been linked to increased risk for heart disease, high blood pressure, T2DM, arthritis-related disability, and some cancers (CDC, 2009). As a result, obesity has also become a major health concern for people of all ages.

In Ghana, the prevalence of obesity among women alone 2003 was 8.1% (WHO, 2006). A Research on Obesity and Diabetes among African Migrants (RODAM) study reveals that 70% of the urban population in Ghana were obese compared to 90% of African migrants living in Berlin, London and Amsterdam (Agyemang, 2012). It also revealed that obesity was higher among African migrants, exposing them to T2DM in the long run. Findings further indicated that among men in urban Ghana, the prevalence of T2DM was five times higher as compared to Ghanaian men in Berlin who were 11 times prone to T2DM. Among women, T2DM prevalence was 2.5 times higher in urban Ghanaians as compared to the five times higher rate of Ghanaian women based in Berlin. For obesity, the prevalence was five times higher in urban Ghanaian men compared to the 10 times prevalence rate of Ghanaian men based in London.

The rate of obesity among Ghanaian women was mostly 2.6 times higher as compared to the 3.6 times prevalence rate of Ghanaian women based in London. The study results further indicated that the rate at which these people were becoming obese and diabetic was mainly linked to the inability of people to engage in physical activity, their eating habits, as well as their lifestyles, and genetics.

A Body Mass Index (BMI) level of  $30\text{kgm}^{-2}$  and above is now widely accepted as denoting Obesity (WHO, 2000). The likelihood of crippling the obesity epidemic within the expected future appear remote specially in societies that have struggled for decades to escape from the exhausting monotony and the economic diets and living conditions of a survival livelihood (Ellulu et al., 2014). Paradoxically further economic development probably would be one of the best ways out of the problem by carrying populations beyond the poverty-obesity links (Stunkard, 1996).

#### **2.4.1.3 Alcohol consumption**

Although alcohol consumption is deeply embedded in the cultures of many societies, an estimated 45% of the global adult population has never consumed alcoholic beverages in their lives (WHO, 2014). Alcohol intake forms the world's third largest risk factor for disease and disability in middle-income countries which have the greatest risk. It is also a causal factor in 60 types of diseases and injuries and a component cause in 200 others. Almost 4% of all deaths worldwide are attributed to alcohol (Awosan et al., 2014).

The leading global risks for the burden of a disease as measured in disability-adjusted life years (DALYs) are underweight (6% of global DALYs) and unsafe sex (5%), followed by alcohol use (5%) and unsafe water, sanitation and hygiene (4%) (WHO, 2009).

Three of these risks particularly affect populations in low-income countries, especially in the regions of South-East Asia and sub-Saharan Africa. The fourth risk – alcohol use – shows a unique geographic and sex pattern, with its burden highest for men in Africa, in middle-income countries in the Americas and in some high-income countries (WHO, 2009). These behaviours lead to four key metabolic/physiological changes: raised blood pressure, overweight/obesity, hyperglycaemia and hyperlipidaemia.

In terms of attributable deaths, alcohol is not among the leading Non-Communicable Disease (NCD) risk factors globally which include raised blood pressure (to which 13% of global deaths are attributed), followed by tobacco use (9%), raised blood glucose (6%), physical inactivity (6%), and overweight and obesity (5%) (WHO, 2014). However, a study indicates that eight risk factors including alcohol use, tobacco use, high blood pressure, high body mass index, high cholesterol, high blood glucose, low fruit and vegetable intake, and physical inactivity account for 61% of loss of healthy life years from cardiovascular diseases and 61% of cardiovascular deaths (WHO, 2009). Increasing rates of obesity, T2DM, hypertension, dyslipidaemia and Cardiovascular Diseases (CVDs), coupled with cigarette smoking and alcohol abuse, are frequent outcomes of the modernization/acclulturation process (WHO, 2007).

However, several studies have also suggested that moderate alcohol intake is associated with a reduced incidence of T2DM. For example, some study finding shows that alcohol contributes to more than 60 types of disease and injury, although it can also decrease the risk of coronary heart disease, stroke and diabetes (WHO, 2009). Another study conducted on women nurses suggests a reduction in the incidence of diabetes in women who consumed alcohol compared with those who did not (ADA, 2013).

The study also showed a strong inverse relation between alcohol consumption and body weight, which could explain much of the apparent protective effect of alcohol consumption. Therefore, the net effect of alcohol on cardiovascular disease in older people may be protective in regions where alcohol is consumed lightly to moderately in a regular fashion without binge drinking. Ischaemic stroke deaths, for example, would be 11% higher in high-income countries if no one drank alcohol (WHO, 2009).

Additionally, alcohol has no storage capacity within the body and so all ingested alcohol is oxidized immediately (WHO, 2000). This response dominates oxidative pathways and reduces the rates at which other fuels are oxidized. Although alcohol consumption meets some of the body's energy needs, it also allows a greater proportion of energy from other foods eaten to be stored/ and is thus associated with an increased risk of abdominal fat.

#### **2.4.1.4 Dietary habits**

Dietary habits refer to the manner in which an individual or a people usually select, cook/prepare, serve or eat foods, as well as the ways people obtain, store, use, and discard food (Lowenberg et al., 2001). Individual social, cultural, religious, economic, environmental, and political factors all influence people's eating habits. Although human diets have social and cultural determinants, the high energy cost of foods with low energy density is the most important reason why the diets of low-income households consist of very low quantities of nutritious food commodities (Sundaram et al., 2015). Optimal nutrition makes people stronger and more productive. Healthy eating habits lead to a stronger immune system, less illness, and a better health (WHO, 2007).

Proper and healthy nutrition are fundamental to a better quality of life (WHO, 2007). Good nutrition in middle ages gives people metabolisms that are better prepared to ward off the diseases associated with changes in diet and physical activity. Without good nutrition, people's lives and livelihoods are built on quicksand (WHO, 2014). A well-planned diet is adequate, balanced, moderate in energy, and moderate in unwanted constituents, and offers a variety of nutritious foods. However, a study shows that in the presence of intense visceral factors, such as hunger, thirst, or addiction, an individual will be compelled to make choices that undermine long-term health objectives (Loewenstein, 1996). Improving food systems will help at fostering more balanced, diversified, and healthier diets. Consumers also need help in making better informed dietary choices for improved nutrition with education, information, regulation, and other interventions (Sundaram et al., 2015).

Unhealthy dietary habits have also emerged over the years with negative nutrition and health implications for the individual. Four of the ten leading causes of death in the United States directly linked to nutrition were coronary heart disease, cancer, stroke, and diabetes mellitus (Abood, Black & Feral 2003). Although there is a positive relationship between economic status and quality of diet, inadequate consumption of nutritious foods like fruits and vegetables and dietary imbalances are found among high-income consumers as well. Many people eat energy-dense foods which are rich in fats and sugars making foods more palatable, and therefore results in lack of satiation and satiety as their consumption is increased (Adam Drewnowski & Darmon, 2005). This in turn results in a considerable degree of resistance to the substitution of energy-dense food despite consumer awareness, and even when more nutritious foods are available and affordable (Sundaram et al., 2015).

Evidenced-based researches also revealed that food advertisements primarily focus on energy-dense food high in fat, salt, and sugar, and that such food advertising has a strong influence on diets (Cairns, Angus & Hastings, 2009; Hastings et al., 2006) and therefore influences one's dietary habits greatly. Ending malnutrition in all its forms – caloric undernourishment, micronutrient deficiencies, and diet-related non-communicable diseases often associated with obesity – will therefore require a combination of appropriate interventions in food systems, public health, provision of safe water and sanitation, education, and social protection to guarantee the availability of and access to diverse diets; to reduce the susceptibility to disease; to improve the absorption of nutrients; and to increase consumer awareness of the importance of good nutrition (Sundaram et al., 2015). Additionally, healthy diets should be fostered in preschools, schools, public institutions, at the workplace and at home, as well as healthy eating by families. This will help in the long-run to reduce malnutrition in all its forms drastically in the world.

## **2.5 Nutritional knowledge**

Nutrition knowledge is defined as knowledge of nutrients (Shakkour, 2003). This knowledge is applicable when a consumer learns how to benefit from the knowledge of nutrients. Insight into determinants of nutrition knowledge is important, both for designing measures aimed at increasing levels of nutrition knowledge and for food industry attempting to position food products based on their nutritional properties (Klaus, 2012). Unhealthy eating behaviours and lifestyles, and the rising numbers of obese people in the world have led many health professionals to become more concerned about ways by which these trends may be altered. Many strategies and ideas have therefore been suggested to reverse such unhealthy eating habits. One of these strategies involves increasing nutrition knowledge of consumers (Frazao & Allshouse, 2003).

T2DM subjects who have misconceptions about their eating habits, probably nutrition interventions involving nutrition education, counselling and information may most effectively influence them positively especially those who do not have this specific knowledge.

However, research has shown that nutritional knowledge is not the only influential factor that influences dietary habits but also include the perceived consequences of a certain behaviour, beliefs about a certain behaviour, skills that are required, the social and physical environments of consumers, and most importantly, motivators (Frazao & Allshouse, 2003). For instance, a study conducted on T2DM in a rapidly urbanizing region of Ghana on their dietary preferences, knowledge and practices showed that nutritional knowledge, attitudes and practices among T2DM patients and their caregivers were remarkably comparable among both urban and rural dwellers, apart from the perception of the cost of vegetables (Doherty et al., 2014). Other studies suggest that education could improve eating behaviours, yet the behaviour is not necessarily guaranteed (Dyer et al., 2004).

A report from another study showed that nutrition education interventions tend to increase nutritional knowledge but have low, short-lived effects on actual healthy eating behaviour changes (French et al., 1997). Therefore, to ensure success in the fight against diabetes, intervention strategies should target programs that include comprehensive behavioural components such as family involvement, dietary modifications, nutrition information, physical activity, and behavioural strategies (Kirk, 2005).

Various study designs and methodologies have also been used to show how adequate nutrition knowledge and dietary habit information can be solicited from T2DM subjects, but challenges still persist as different standards are used.

For example, a study used reliable instruments on adult samples, but has concentrated on a particular aspect of nutrition, for example, fat (Steenhuis et al., 1996) or fat, fibre and cholesterol (Resnicow et al., 1997). Others used questionnaire and biochemical indices to relate nutrition knowledge and dietary habits to attitude and practice (Stafleu et al., 1996). These, although useful, would not therefore, be appropriate for use in measuring the overall nutrition knowledge of a population (Parmenter & Wardle, 1999).

### **2.5.1 Nutrition knowledge and dietary habits of T2DM subjects**

Eating well for most T2DM subjects may mean consuming a variety of foods from the 4 food groups (vegetables and fruits; grain products; milk and alternatives; meat and alternatives), with an emphasis on foods that have low postprandial blood glucose effect (CDA, 2013). This may help a person to attain and maintain a healthy body weight while ensuring an adequate intake of carbohydrate (CHO), fibre, fat and essential fatty acids, protein, vitamins and minerals. However, this dietary behaviour depends on one's knowledge on how to make appropriate and healthy food choices. Nutrition knowledge is a pre-requisite for using nutrition information to make food choices.

Research has shown that women tend to have higher levels of nutrition knowledge than men, and this was attributed to their more dominant role in food purchasing and preparation (Spronk, Catrina & Helen, 2014). Other studies also suggested that most people regardless of their gender get most of their nutrition information from the media (Rolfes, 2006) which help them to make appropriate food choices and dietary habits. Contrary to these findings, it's been shown in another study that there have not been any significant differences in dietary habits between people who have nutrition knowledge compared to those who do not have (Frazao & Allshouse, 2003).

And that those that have new nutrition information for the first time are most likely to implement what they have acquired. Despite the differences in research findings on the relation between nutrition knowledge and dietary habits, demographic characteristics and environmental factors have been strongly shown to also have an influence in eating patterns and dietary behaviour (Spronk, Catrina & Helen, 2014).

A study has also shown that demographic determinants are important, not least because the incidence of unhealthy eating habits is known to be unequally distributed across social classes (Shelton, 2005). In West Africa however, most studies focus on household food and nutrition security rather than improving nutrition knowledge and dietary habits (United Nations Development Programme, 2012). Few studies have evaluated the level of nutrition knowledge in the general community or other specific group samples, and that the impact of nutrition knowledge on dietary intake is still largely unexplored (Spronk, Catrina & Helen, 2014). Nutrition security is therefore seen as a multidimensional phenomenon, requiring secure physical, economic, social, and physiological access to adequate and nutritious food, a sanitary environment, adequate health services, sufficient safe water and fuel used for cooking, adequate food preparation capabilities and knowledgeable care (United Nations Development Programme, 2012). This is a broad and much more blanket area of intervention and therefore does not effectively address challenges associated with nutrition knowledge and dietary habits of T2DM subjects.

Another study conducted in Ghana on dietary preferences, knowledge and practices of urban dwellers with T2DM showed that there were several factors that affect these nutrition knowledge and dietary habits and that additional quantitative studies were required to ascertain the associations in actual consumption patterns (Doherty et al., 2014).

Whati *et al.* (2005) norm reference performance-rating standard scale for nutrition knowledge is used to assess the level of nutrition knowledge and dietary habits of T2DM subjects. The table below shows the performance-rating scale for grading nutrition knowledge and dietary habits:

**Table 2.1: Norm referenced performance-rating scale for nutrition knowledge questionnaire**

Stanine Performance	Score (%)	Interpretation
1	<34	Very poor
2-4	34-51	Fair/ Below average
5	52-57	Good
6-9	58-75	Very good/ Above average
9	76+	Excellent

Source: (Whati et al., 2005), <=less than, %= percentage,

## 2.6 Nutritional status

The condition of health of a person that is influenced by the intake and utilisation of nutrients is called nutritional status (Khurshed, 2000). The nutritional needs of human beings vary according to their physiological stage, age and health conditions (Adebisi, 2012). Normal nutritional status is determined by balanced food intake and normal utilisation of nutrients (Khurshed, 2000). However, when there is a lack or excess intake of one or more nutrients and/or faulty utilisation of nutrients in our body, it leads to the state of imbalance in the body (United Nations Children Fund , 2015). This condition is known as malnutrition.

The procedures used to determine the nutritional status of an individual or a group is known as nutritional status assessment. These procedures include measuring physical growth, determining dietary intake and recognising nutritional deficiency diseases (Khursheed, 2000). Assessment of nutritional status of T2DM subjects on the study was based on indices such as Body Mass Index, Body fat composition, visceral fat percentage and glycated haemoglobin levels as the key anthropometric and biochemical measurements. Gathering such data therefore provides the objective basis for recommendations and evaluation of care and compliance.

### **2.6.1 Visceral fat composition**

Visceral fat is body fat that is stored within the abdominal cavity and is therefore stored around a number of important internal organs such as the liver, pancreas and intestines (Samuel, 2004). A relatively good indicator of visceral fat is to take a waistline measurement. A higher waist circumference indicates high levels of visceral obesity (Singh et al., 2000). Too much fat is thought to be closely linked to increased levels of fat in the bloodstream, which can lead to common diseases like hyperlipidaemia and diabetes, which impairs the ability of insulin to transfer energy from the bloodstream and using it in cells (WHO, 2000). Thus, storing higher amounts of visceral fat is associated with increased risks of a number of health problems including T2DM. Excessive visceral fat is associated with insulin resistance and other metabolic risk factors can also cause coronary heart disease (Samuel, 2004). It is therefore important to reduce visceral fat level to an acceptable level.

Also, people with high visceral fat levels tend to have large stomachs. Metabolically obese (visceral obesity with normal weight) represents fats levels that are higher than average, even if a person's weight is at or below the standard for their height reference (OMRON BF511, 2011). Therefore one's visceral fat should not exceed 10% of the total body fat (Samuel, 2004).

Bio-electric impedance is used for calculating total body water, fat free mass and fat tissue mass (Goksun & Cimen, 2011). This method is based on the principle that the conductivity of body water varies in different compartments.

**Table 2.2: Reference standard for visceral fat classification**

Visceral Fat Level	Level Classification
1-9	0 (Normal)
10-14	+ (High)
15-30	++ (Very high)

Source: (OMRON BF511, 2011)

### 2.6.2 Body fat composition

Body fat composition (percentage) is the amount of body fat mass in regards to the total body weight expressed as a percentage (OMRON BF511, 2011). Depending on where the fat is distributed in the body, is classified as visceral or subcutaneous fat. Fat and lean components of the body including total body fat, fat-free mass and total body water and ectopic fat accumulation are important constituents that link obesity, aging, and chronic disease to subsequent morbidity and mortality (Goksun & Cimen, 2011). Body fat composition also indicates fitness level and serves as the only body measurement indicator that directly measures a person's relative body composition without taking height or weight into account (Leiper, Molla & Molla, 2003). Abnormal or excessive fat accumulation arising from excessive caloric intakes and physical inactivity causes obesity and may impair health (Elaine et al., 2004). Obesity is a modifiable risk factor for T2DM (WHO, 2005). Obesity is also directly related to body fat composition and BMI levels (Elaine et al., 2004).

Generally, the cut-offs for percentage body fat for men and women to be at risk of developing Chronic diseases are shown in table 2.3 below.

**Table 2.3: Reference standard for body fat composition**

<b>Gender</b>	<b>Cut-off</b>
Female	< 25%
Male	≤ 35%

Source: (Singh et al., 2000), <= less than, ≤= less than or equal to.

The percentage of essential body fat percentage is higher in women than in men and its attributable to the demands for child bearing and other hormonal functions (Ati, Beji & Danhvir, 1995). A body fat composition of more than 25% for men and above 30% for women are generally associated with an increased risk of developing a non-communicable disease including T2DM (Singh et al., 2000). BIA machine is used to measure body fat composition (OMRON BF511, 2011). However, when a measurement is made with this method, a slight change in the place of electrodes can produce differences in results. The measurements can also show 2% variability in different days (Goksun & Cimen, 2011).

### **2.6.3 Body Mass Index**

It is defined as an individual's body mass (in kilograms) divided by height (in metres squared): BMI units =  $\text{kg/m}^2$  (NIH, 2004). Acute malnutrition in adults is measured using Body Mass Index (BMI) (UNICEF, 2012). BMI is commonly used as a surrogate measure of obesity because of its generality and ease of measurement.

Also, differences in body build, particularly muscularity, vary among different ethnic groups and therefore show a degree of the relation between percentage body fat and BMI levels (Elaine et al., 2004). The cut-offs for the assessment of BMI are shown in the table 2.4.

**Table 2.4: Reference standard for classification of BMI levels**

<b>Classification</b>	<b>BMI range</b>	<b>Interpretation</b>
Low weight	< 18.5	Increased disease risk
Normal	18.5-24.9	Normal
Overweight	25.0-29.9	Increased disease risk
Obese I	30.0-34.9	High disease risk
Obese II	35-39.9	Very high disease risk
Morbid Obese III	≥40.0	Extremely high disease risk

Source (NIH, 2004), <= less than, ≥= greater than or equal to.

With BMI levels showing overweight and obesity; abdominal obesity and physical inactivity are associated with an increased risk of developing T2DM and its complications (Steyn et al., 2004). The cut-offs imply that, a BMI above or below the normal range is associated with an increased burden and/or risk of developing or worsening a non-communicable diseases such as T2DM (WHO, 1997). However, BMI does not distinguish between weight associated with muscle and weight associated with fat (WHO, 2000).

#### **2.6.4 Glycated haemoglobin level**

This develops when haemoglobin, a protein within red blood cells that carries oxygen throughout your body, joins with glucose in the blood, becoming 'glycated' (Diabetes United Kingdom, 2013). HbA1c is also referred to as haemoglobin A1c or simply A1c.

By measuring glycated haemoglobin (HbA1c), health experts can picture what our average blood sugar levels have been over a period of weeks/months. Diabetic subjects who have higher HbA1c levels are at a greater risk of developing diabetes-related complications (Diabetes United Kingdom, 2013). Haemoglobin, which is made of Iron, binds to oxygen in red blood cells that carry oxygen to the cells of the body. Glucose molecules in the blood normally become stuck to hemoglobin molecules making haemoglobin become glycosylated (Khan & Weinstock, 2011). As a person's blood sugar becomes higher, more of the person's hemoglobin becomes glycosylated. The glucose remains attached to the hemoglobin for the entire lifespan of the red blood cell, or about 2 to 3 months. An HbA1c reading can be taken from blood from a finger but is often taken from a blood sample that is taken from a vein in your arm. HbA1c unit of measure is either as percentage or as a value in mmol/mol (DUK, 2013).

Therefore, HbA1c test measures the amount of glycosylated hemoglobin in the blood. This usually shows how a person's average blood glucose level was for the 2 to 3 months before the test (Khan & Weinstock, 2011). This can help determine how well a person's diabetes is being controlled over time. Shown in the following table 2.5 are the results when HbA1c is being used to diagnose diabetes:

**Table 2.5: Reference standard for classifying HbA1c levels**

HbA1c Level	Interpretation
< 5.7%	Normal
5.7%-6.4%	Pre-diabetes
≥6.5%	Diabetes

Source: (ADA, 2014), <= less than, ≥= greater than or equal to, %= percentage.

Research findings also suggest that diabetics subjects who have maintained lower HbA1c readings of 53 mmol/mol (7%) or below had significantly lower risks of kidney damage, retinopathy and cardiovascular problems (Khan & Weinstock, 2011).

However, the HbA1c target for people with diabetes to aim for is 48 mmol/mol (6.5%) (ADA, 2014). Because HbA1c is thought to reflect average glycaemia over several months and has strong predictive value for diabetes complications, HbA1c testing should be performed routinely in all patients with diabetes, at initial assessment and then as part of continuing care. For patients prone to glycaemic variability (especially type 1 diabetic patients or type 2 diabetic patients with severe insulin deficiency), glycaemic control is best judged by the combination of results of self-monitoring and the HbA1c (ADA, 2013).

Additionally, patients with Impaired Glucose Tolerance (IGT), Impaired Fasting Glucose (IFG), or an HbA1c of 5.7–6.4% should be referred to an effective ongoing support program targeting weight loss of 7% of body weight and increasing physical activity to at least 150 min/week of moderate activity such as walking (ADA, 2013).

## **2.7 Dietary habits and its association with anthropometric and biochemical indices**

### **2.7.1 Dietary habits and body fat composition**

What we eat has a bearing on our nutritional status. Dietary habits of individuals or groups are usually shaped by both environmental and societal factors (WHO, 2000). As a habits that is adapted, modifiable lifestyle is key to determining optimal nutritional status which reflects in normal body fat composition, body weight and visceral fat percentage level. Lifestyle modifications include increased physical activity, moderation of alcohol intake and optimal dietary intake (WHO, 2014). However, when energy intake exceeds energy expenditure, the resultant implication is an increase in body weight and body fats levels (Walker et al., 2010).

A study has shown that poor dietary habits lead to either over-nutrition or undernutrition (United Nations Development Programme, 2012). For example, insufficient intake of fruit and vegetables increases the risk for cardiovascular diseases and many cancers; high salt consumption is an important cause of high blood pressure and cardiovascular risk and increases the risk of stomach cancer; high intake of saturated fats and trans-fatty acids is linked to heart disease; a range of dietary factors have been linked with diabetes; red and processed meat consumption is associated with some cancers (WCRF, 2007; Steyn et al., 2004). Another study has as shown that imbalance increment of energy intake more than energy expenditure is one of the basic causes of obesity and overweight (Ellulu et al., 2014). These findings were attributed to high fats, sweets and salt intake coupled with sedentary lifestyle.

Over-nutrition has implications on body fat levels among T2DM subjects. Excessive energy intake leads to overweight and obesity contributed by increased body fat levels, and is associated with a range of NCDs including T2DM (WHO, 2000). Diabetes has particularly strong association with obesity (Steyn et al., 2004), and evidence shows associations between body fatness and some leading cancers (WCRF, 2007). Thus, an unhealthy diet is also one of the major risk factors for NCDs. A study shows that there is a correlation between dietary intake, BMI (which is an obesity indicator) and body fat levels (Gallagher et al., 1996). Therefore, the quantification of obesity and its relation to dietary habits of T2DM subjects, and the determination of body fat distribution are important for assessing future health risks.

### **2.7.2 Dietary habits and percentage visceral fat**

Various prospective and cross-sectional studies have demonstrated that visceral obesity is closely related to impaired glucose tolerance, dyslipidaemia, hypertension, insulin resistance and metabolic syndrome (Goksun & Cimen, 2011).

Intra-abdominal fat is also implicated as an important independent risk factor for cardiovascular disease and T2DM (Walker et al., 2010; WHO, 2000). High energy intake with low energy expenditure is implicated in the incidence of overweight/ obesity and increased visceral fat levels (WHO, 2000). Environmental and societal differences may account for the type, frequency and variety of dietary intakes (WHO, 2016) and therefore have implication on nutritional status. A study conducted among Asian Indians and Europeans revealed that Asian Indians have more visceral fat than Europeans and were more at risk of T2DM and ischaemic heart disease (Rush et al., 2004). Findings from another study among Japanese Americans shows a direct link between diet high in animal fat and intra-abdominal fat deposition and insulin resistance (Erber et al., 2010). Visceral fats were also directly associated with intra-abdominal fat deposition among Japanese Americans. This might explain the differences in significant results for the fat and meat pattern among overweight Japanese Americans and Caucasians.

Findings from other studies associated high visceral fat levels with an increased risk of myocardial infarction, stroke and premature death, whereas these diseases were not associated with measures of generalized obesity such as BMI (Larsson, Svardsudd & Wellin, 1984). It has also been shown that BMI levels of women were associated with increased risk of these diseases and identified waist-hip ratio as a stronger independent risk factor than BMI (Lapidus et al., 1984). A further study showed that visceral adiposity precedes the development of T2DM in Japanese Americans and independently influences fasting insulin, insulin secretion, glycaemia, total and regional adiposity, and family history of diabetes (Boyko et al., 2000). Other studies have shown that sleeping duration was directly associated with long-term visceral fat accumulation, independent of BMI variations than overall adiposity (Chaput, Bouchard & Tremblay, 2014).

Therefore, achieving a healthy sleep pattern could facilitate appetite control and positively impact certain behaviours such as eating habits and physical activity participation which in the long-term would limit age-related gains in body weight and adiposity.

### **2.7.3 Dietary habits and Body Mass Index**

Excessive energy intake coupled with physical inactivity and stress have been implicated with increase in BMI levels (Zimmet, Alberti & Shaw, 2001) (WHO, 2000). A recent study on the dietary habits and BMI levels of female students in Saudi Arabia indicates that bad eating habits including skipping breakfast, the frequency of drinking aerated beverages 3 or more times per week and eating snacks such as chocolate and chips per week and watching TV during eating meals was common among obese and non-obese students (Bothaina et al., 2015). The findings also revealed that dietary habits of such students can lead to increase in body weight in the future and are likely to become regular habits for them and their families.

Other study also demonstrated a strong relationship between BMI and the socio-demographic variables such as age group, ethnic group, demographic area, educational background, occupation and family history (Ruhe & Mahomodally, 2015) rather than just diet. For example, a study has found that the risk of obesity increases with age (Misra et al., 2001). Another study showed a positive association between the level of education and BMI level (Shukla et al., 2002). BMI and overweight/ obesity are directly linked (WHO, 2000).

The risk of chronic diseases has increased as BMI levels have increased over the decade resulting in obesity among the populace (Ellulu et al., 2014). These diseases include cardiovascular diseases, diabetes, musculoskeletal disorders, cancer, and premature death (WHO, 2014). Changes in dietary and physical activity patterns are often the result of environmental and societal changes (Ellulu et al., 2014).

Ledikwe *et. al* (2006) in their study on US adults, showed that persons with a high intake of fruit and vegetable had the lowest prevalence of obesity. Fruit consumption was found to have a significantly negative link with body weight status in all the age groups in men and women. Some study has also shown that chronically reduced sleep time was associated with higher BMI levels (Anuradha, Ravivarman & Timsi, 2011).

Several studies have also examined dietary habit and how it affects BMI and body fat composition between male and females. For instance, a study that looked at analysis of BMI and percentage body fat in T2DM subjects of Punjab who were native Indians revealed that BMI levels of females were higher than that for males (Singh *et al.*, 2000). A similar study among Indian migrants in Punjab also presented similar findings. However, these differences could only be observed as a result of differences in dietary habits and societal factors (WHO, 2015; CDC, 2009). Forty-five percent of the T2DM subjects in the Punjab study consumed a diet with proper calorie content for their current weight, and proteins were the dietary macronutrient showing the highest degree of appropriate consumption, while 48% of the study population were found to have an appropriate fibre consumption (Singh *et al.*, 2000).

#### **2.7.4 Dietary habit and glycated haemoglobin**

T2DM describes a metabolic disorder with heterogeneous aetiologies associated with chronic hyperglycaemia and disturbances of carbohydrate, fat and protein breakdown resulting from defects in insulin secretion, insulin action, or both (WHO, 2011). HbA1c levels directly correlate with blood glucose level as a measure of glycaemic control. Studies have shown increased fibre intake in the diet is associated with a reduction of glycated haemoglobin (HbA1c), improved lipid profile, and loss of body weight in T2DM patients (Velázquez-López *et al.*, 2016).

Highest peaks of calories consumption were associated with a higher fasting glucose level and weight. It also revealed that among women, HbA1c decreased as legumes intake frequency increased, and increased as the frequency of intake of staple carbohydrates increased. Higher fibre intake was associated with a low HbA1c, high HDL-c levels, low weight, and waist circumference.

Evidence from other study showed that HbA1c decreased significantly as the frequency of the intake of fish increased in all populations (including T2DM) (Kyoung-Lack et al., 2012). The consumption of milk and dairy products may also have beneficial effects on body weight, insulin resistance syndrome and cardiovascular disease (Ness, Smith & Hart, 2001) (Mennen et al., 1999). Also, appropriate consumption of fruits may be an adequate strategy to reducing HbA1c level, given the fibre content, and may prevent complications from diabetes (Velázquez-López et al., 2016). HbA1c is now widely used to confirm T2DM and glycaemic control (WHO, 2011).



## CHAPTER THREE

### 3.0 METHODOLOGY

#### 3.1 Study design

A cross-sectional study design was adapted to assess the nutrition knowledge and dietary habits of patients with T2DM attending the regional hospital at Wa in the Upper West Region of Ghana for routine clinical services. Structured questionnaires were used to solicit nutrition information from T2DM subjects and also, data on anthropometric measurements and biochemical data were taken. The structured questionnaire used in the study was adapted and modified from Parmenter *et al.* (1999) nutrition knowledge, and food frequency questionnaire.

#### 3.2 Study site

The study on nutrition knowledge and dietary habits of patients with T2DM was carried out at the Regional Hospital at Wa in the Upper West Region of Ghana. The Regional hospital has a diabetics' clinic that takes care of patients living with all types of diabetes in the region. It is also a major referral hospital in the region that takes care of major conditions that cannot otherwise be managed at other hospitals in the Region (Regional Hospital Health Administration, 2014). The Hospital was established in 1919 as a health centre, rose to a district hospital status in 1955 and was designated as a Regional Hospital in 1985 two years after the creation of the Region. The hospital performs a dual function as a Regional hospital and a Municipal hospital and is the main referral centre within the healthcare delivery system in the Region. It has a number of operational departments including Public health, Clinical Care, Nursing Administration, Financial Management, Pharmaceutical Services and finally the Health Administration and Support Services division.

Upper West Region has a total population of 702,110 with male and female populations representing 48.6% and 51.4% respectively (GSS, 2012). The Region is composed of eleven (11) Districts with the Regional capital being at Wa. Additionally, Wa is also the Capital of Wa municipal Assembly, which has the largest population of 224,066 representing 38.9 per cent of the total Upper West population. The Region currently has a population growth rate of 1.9% and contributes to 2.8% of the national population. The Region also is bound by Upper East to the East, Burkina Faso to the North-West, and Northern Region to South-East direction. The Region is predominantly a Guinea Savannah zone with a land mass of 18,476 square Kilometres largely covered with grasses and interspersed with shrubs, mahogany, baobab trees, shear-trees and Kapok trees. The predominant activity in the Region is farming. Agricultural activities in the Region is seasonal as it is rainfall dependents. Major crops produced in Upper West are millet, maize, sorghum, groundnuts and yam. Animals reared also mainly include cattle, sheep and goats. Most farmers in Upper West Region are subsistence farmers (FAO, 2003). Most ethnic groups are from the Mole-Dagbani origin. The predominant religious affiliation is Catholic, followed by Islam and traditionalists respectively (GSS, 2012).

### **3.3 Study participants**

The study population from which the sample was drawn was the list of T2DM subjects (35-64 years) who attended the Regional hospital at Wa for routine services. This age group was selected on the bases that it was the working group mostly affected by the disease. Also, all the T2DM subjects attending the diabetics' clinic at the regional hospital at Wa were diagnosed and confirmed as having T2DM and hence the essence of the study.

### **3.4 Inclusion and exclusion criteria**

The inclusion and exclusion criteria were put in place to get the most suitable target group for the study.

#### **3.4.1 Inclusion criteria**

The study included all T2DM subjects (35-64 years) who attend the Regional Hospital Diabetic Clinic for routine services.

#### **3.4.2 Exclusion criteria**

Excluded in the study were:

1. Diabetic subjects with concomitant debilitating illness causing impaired nutritional status with the help of a qualified Doctor.
2. Diabetic subjects with impaired memory or cognitive functions, or presence of mental illness causing inability to give appropriate or logical response to questions with the help of a Psychiatrist.
3. Diabetic pregnant women, due to inability to assess the actual values of their anthropometric measurements.
4. Subjects suffering from type-1 diabetes.

### **3.5 Sample size determination**

The sample size of 140 T2DM subjects was calculated using confidence level of 95%, an allowable margin of error of 3% and a normal distribution value of 1.96 using a diabetes prevalence rate of 3.3% for Ghana (International Diabetes Federation, 2014).

$$N = Z^2 (p) (q) / (E)^2 \quad (\text{Bartlett et al., 2001})$$

Where N is the required sample size

Z is the normal distribution value at a chosen confidence interval,  $\alpha$ .

For this study, a 95% confidence level was chosen. At  $\alpha = 95\%$ ,  $Z = 1.96$ .

Also, the prevalence of diabetes was 3.3% (0.033) (IDF, 2014).

$p$  = probability that someone has diabetes (0.033).

$q$  = probability of not having diabetes is (1-0.033).

Therefore,  $q = 0.967$

E is the allowable margin of error (3%).

$$N = (1.96)^2 (0.033) (0.967) / (0.03)^2 \quad N = 136.3 \approx 137$$

To make room for any shortfalls in participants' answering of questionnaires, 140 participants were considered for the study. However, 117 T2DM subjects were interviewed due to time constraints.

### 3.6 Sampling technique

Systematic random sampling technique was employed to select consented T2DM subjects for the study. A sample frame of the names of all T2DM subjects (35-64 years) was drawn from the register of all diabetic subjects based on the inclusion and exclusion criteria. Numbers were then assigned to the list of all qualified T2DM subjects in the sample frame. The total number in the sample frame was then divided by the sample size (that is 140) and a sample location, which was also used to subsequently identify selected participants', determined. A number from a list of numbers from one (1) to the sample location number within the sample frame was then randomly selected using blind-folded method. This randomly selected number was then set aside as the first selected and qualified number and the subsequent numbers identified from each step by adding the sample location number till all the 140 selected T2DM subjects were drawn.

A structured questionnaire was then administered to each selected subject, and BMI, body fat composition, percentage visceral fat and glycated haemoglobin also taken.

### **3.7 Pre-testing of questionnaires**

Twenty percent (20%) of the questionnaire were pre-tested on other T2DM subjects in Upper West Regional not attending the Regional Hospital for routine services to ascertain its validity and reliability before use in the field. Incorrect wording and other shortfalls made during pre-testing were corrected and/or modified to suit the context of the research.

### **3.8 Data collection**

- A. Data on nutrition Knowledge were collected using the modified nutrition knowledge questionnaire (Parameter & Wardle, 1999). These included assessing participants' knowledge on appropriate dietary habits; various food groups and; disease conditions/ health problems related to dietary intakes.
- B. Data on dietary habits were collected using Food Frequency Questionnaire (FFQ). These will include the timing of meals; frequency of meals and choices of meal intakes.
- C. Data on socio-demographic variables such as age, gender, educational status and ethnicity were also collected using semi-structured questionnaire.
- D. Data on anthropometry were collected using a Microtoise and a Bioelectrical Impedance Analysis (BIA) machine (OMRON BF511, 2011) with each graduated to the nearest 1.0cm and 0.1Kg respectively. Measurements taken were heights, weights, Body Mass Index (BMI), body fats and visceral fat compositions of participants. BMI levels were automatically calculated after inputting the height (measured using the Microtoise) into the BIA machine. BMIs of participants were used to determine their weight status using WHO standards.

E. Data on biochemical indices: Blood samples of participants were collected through the vein and be used in the medical laboratory for biochemical analysis to determine their Glycated haemoglobin levels.

### **3.9 Anthropometric measurements**

Specific anthropometric data that were collected from each T2DM subjects were height, weight, BMI level, body fat composition and percentage visceral fat. The following were instruments and methods used for the anthropometric measurement:

#### **3.9.1 Measurement of body mass index, body fat composition and visceral fat percentage**

Bio-electric Impedance Analyses (BIA) machine was used to calculate the BMI, body fat composition and visceral fat levels of subjects (OMRON BF511, 2011). The heights of subjects were measured using a Microtoise, which was then fed into the BIA machine to find the BMIs of subjects. BMI levels of subjects were measured in Kilogram per metres square ( $\text{Kg m}^{-2}$ ) with the weights and heights recorded in kilogram and metres respectively. The body fat and visceral fat levels were also measured as percentages using the BIA machine. The least count of the height measurement on the Microtoise was 0.1cm while that of the weight on the BIA machine was 0.1kg. Measurements on the BIA machine were taken as subjects were standing straight on required position on the machine while holding the handles of the machine with arms stretched and straight, perpendicular to the body. However, the height, age and sex of each subject was taken and fed into the machine before BMI, body fat and visceral fat levels were measured and recorded. The BIA machine was always placed on a flat and smooth surface to ensure accuracy in measurements.

No alcohol or any liquid was used to whip on the stand of the BIA machine as a precautionary measure (OMRON BF511, 2011). Polarised batteries were removed and entirely new ones fixed on the machine. The Microtoise which was used to measure the height was also mounted on a firm hook on a straight wall that was perpendicular to the floor. The floor was also flat and smooth to ensure that heights of subjects were accurately measured. Heights of subjects were read with respect to the red mark on the gauge of the Microtoise. Readings were also taken at eye level to ensure correct measurements of heights of T2DM subjects.

### **3.10 Measurement of glycated haemoglobin level**

Measurements of HbA1c were recorded as percentages according to WHO standards. Venous blood samples were drawn from consented T2DM subjects and analysed in the laboratory for HbA1c levels. Blood samples were taken in the morning where T2DM subjects had not eaten at least 8 hours prior to the test. T2DM subjects on medication were required to bring their tablets with them and to take them after their blood measurement if possible (if they had not done so, informed the relevant laboratory staff). To ensure that laboratory analyses and results were valid and reliable, the procedures taken to collect blood samples were:

1. Explain to client the procedure of the test and seek consent.
2. Find out whether the client has fasted for at least 8 hours.
3. Arm was selected and a tourniquet was placed on the arm above the draw site.
4. Most commonly the median cubital vein was selected.
5. Site was cleansed with a sterile alcohol prep pad.
6. Blood sample (1-35mmol/L) was drawn using an unused needle and syringe.
7. Tourniquet was removed within one minute.
8. A small gauze pad and Band-Aid were placed on the venous blood drawn site.
9. The blood collection tube was labelled with the patient's information.

10. The blood collection tube was placed in a rack to clot for 15-30 minutes and then centrifuged.
  11. Tubes were sent to the specified laboratory for analyses.
  12. The laboratory processed the specimen within 24 hours of receiving the samples.
- (Richard, 1999)

### **3.11 Assessment of nutrition knowledge**

Data on nutrition knowledge of T2DM subjects were collected using modified nutrition knowledge questionnaire (Parmenter & Wardle, 1999) to ascertain whether they had the requisite nutrition knowledge or not. Relevant data collected using this tool were data on various food groups and; disease conditions/ health problems related to dietary intakes. This data was also collect to understand how knowledge on dietary intakes relate to T2DM management.

### **3.12 Assessment of dietary habits**

A modified food frequency questionnaire was used to suit the context of the research. Data collected on dietary habits of T2DM subjects were: the frequency of food intake per day, the number of snacks and times they are taken, meal time-spacing, the major meal times and the types of meals consumed, the types of fatty foods, dietary fibre and carbohydrates mostly eaten per day. These were collected to determine how they were applying their nutrition knowledge to diet preparation, intake and meal time-spacing. It also indicated how glycaemic control influences HbA1c levels among T2DM subjects.

### **3.13 Data analysis**

Data collected was entered into excel and transferred into IBM Statistical package for Social Sciences (SPSS) version 20 for analysis. Chi-square was used to explain variations in the magnitude of the various indicators of interest among the categorical variables (male and female T2DM subjects). It was also used to find the correlation between dietary habits and body fat composition, percentage visceral fat, BMI levels and HbA1c levels of the study participants. Standard deviations were also used to relate the means in body fat composition, BMI, percentage visceral fat and HbA1c levels between the categorical variables involved. Percentage scores were used in the study to determine the level of nutrition knowledge among T2DM subjects on various indicators of interest using Whati *et al.* (2005) norm reference performance-rating scale for the nutrition knowledge. The socio-demographic characteristics were also grouped according to FAO guidelines (2014). Finally, a level of significance was set at  $p < 0.05$  to determine the associations that the study sought to find out.

### **3.14 Ethical considerations**

#### **3.14.1 Approval and clearance**

Before the study was conducted, permission was sought from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana at Korle-Bu prior to all research procedures.

#### **3.14.2 Voluntary written informed consent**

Consent of the participants were also sought before interviews were conducted. The research team continued to provide information during the study to participants as and when it was deemed necessary.

### **3.14.3 Confidentiality and data quality control**

Information sought from the participants were kept strictly confidential. T2DM subjects were given unique identifiable codes during the study to facilitate easy tracking. Information sought were kept in a safe cabinet and soft copy of data generated relating to the research were also saved electronically and password protected. After analysis of the data collected, the questionnaires were submitted to the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana at Korle-Bu to be stored.



## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1 Socio-demographic characteristics of the study participants

The results of the study were based on interviews on one hundred and seventeen (117) study participants. The gender distribution was 27.4% (32) males and 72.6% (85) females' participants respectively. Many of the participants were within the age range 45-49 years (35.9%) with females being the majority (Figure 4.1). Generally, the ages distribution was fairly distributed according to the normal distribution curve. Majority of the participants were married (89.7%) with very few of them being either single or widowed (5.1% each) (Table 4.1). Many participants had no education (43.6%) with female and male participants recording 50.6% and 25% respectively (Figure 4.2). Very few of the participants had some level of primary education (5.9%). Those who had secondary or tertiary education were 21.4% and 29.1% respectively. Most tribes were either Dagaabas or Waalas (46.2% each) with just 7.6% recording the other tribes respectively (Table 4.1). Dagaabas and Waalas were from Mole-Dagbani origin. Participants were mostly traders (41.9%) followed by Government workers and farmers who recorded 29.1% and 13.7% respectively (Table 4.1). Majority of those not engaged (11.9% or 14) in any kind of work were females. Majority (72.7%) of the households of the study participants had children under 18 years of age whom they catered for (Table 4.1). On who determines what should be cooked in the household, majority (81.3% and 84.7% respectively) of the male and female participants said they make the decision what should be cooked in the household (Figure 4.3). Over all, most female participants (66.7%) make decisions in their households on what should be prepared. Only very few female participants (5.9%) said it's their children under 18 years of age who tell them what they should prepare in the household. For all those participants (53.8%) who cooked at home, majority (62.4%) of them were female participants (Figure 4.4).

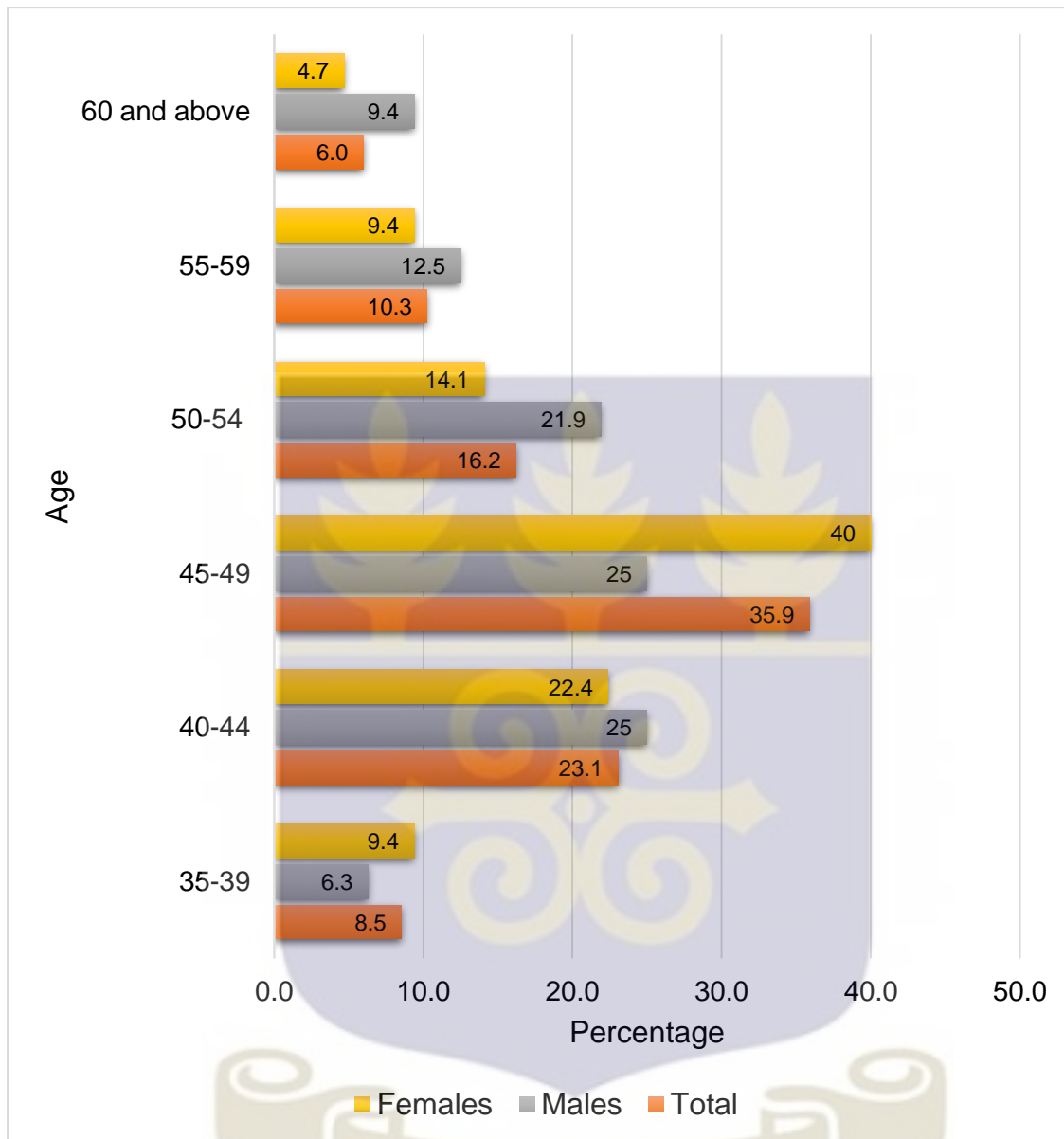
Households where participants do not cook by themselves were mostly adults (35%) who do the cooking. Only 6.8% of children under 18 years all from female participants' households do cooking for the family. Majority (86.3%) of the participants said those who cook in their households had the requisite nutrition knowledge on cooking (Figure 4.5). These distributions are shown in table 4.1 and the figures (4.1, 4.2, 4.3, 4.4 and 4.5) below:



**Table 4.1: Socio-demographic characteristics of the study participants**

VARIABLE	TOTAL (n=117)	MALES (n=32)	FEMALES (n=85)	P-VALUE
<b>Marital status</b>				
Single	6 (5.1%)	2 (6.3%)	4 (4.7%)	0.7357
Married	105 (89.7%)	30 (93.8%)	75 (88.2%)	0.3808
Widowed	6 (5.1%)	0 (0.0%)	6 (7.1%)	-
<b>Ethnicity</b>				
Dagaaba	54 (46.2%)	18 (56.3%)	36 (42.4%)	0.1789
Waala	54 (46.2%)	14 (43.8%)	40 (47.1%)	0.7489
Dagomba	1 (0.9%)	0 (0.0%)	1 (1.2%)	-
Mosi	1 (0.9%)	0 (0.0%)	1 (1.2%)	-
Sisala	4 (3.4%)	0 (0.0%)	4 (4.7%)	-
Others	3 (2.7%)	0 (0.0%)	3 (3.6%)	-
<b>Income source</b>				
Not working	14 (11.9%)	4 (12.5%)	10 (11.8%)	0.9130
Farming	16 (13.7%)	8 (25.0%)	8 (9.4%)	0.0287*
Trading	49 (41.9%)	6 (18.8%)	43 (50.6%)	0.0019*
Government work	34 (29.1%)	12 (37.5%)	22 (25.9%)	0.2173
Others (Mining and NGO)	4 (3.4%)	2 (6.3%)	2 (2.4%)	0.3011
<b>Any children under 18 years</b>				
Yes	85 (72.7%)	24 (75.0%)	61 (71.8%)	0.7264
No	32 (27.3%)	8 (25.0%)	24 (28.2%)	0.2736

Data presented in numbers and percentages. \*P <0.05 is significant, NGO= non-governmental organisation, %= percentage, n= number



**Figure 4.1: Age distribution of study participants**

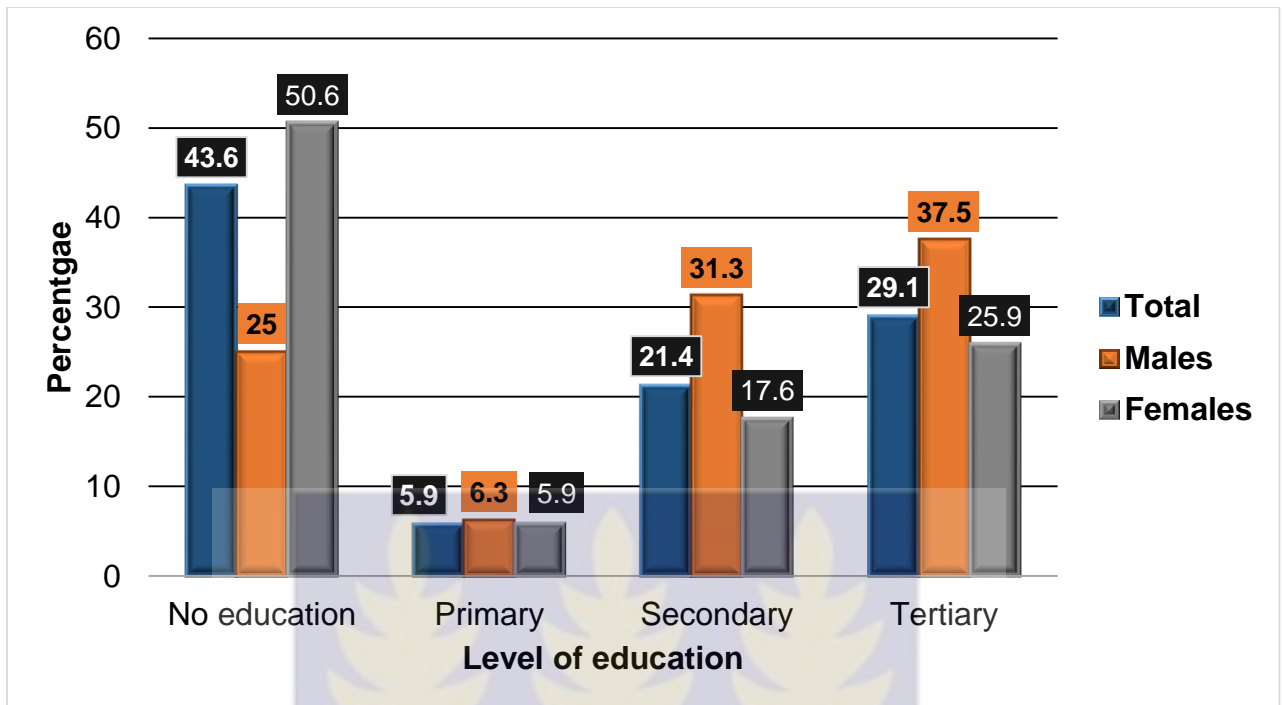


Figure 4.2: Educational status of study participants

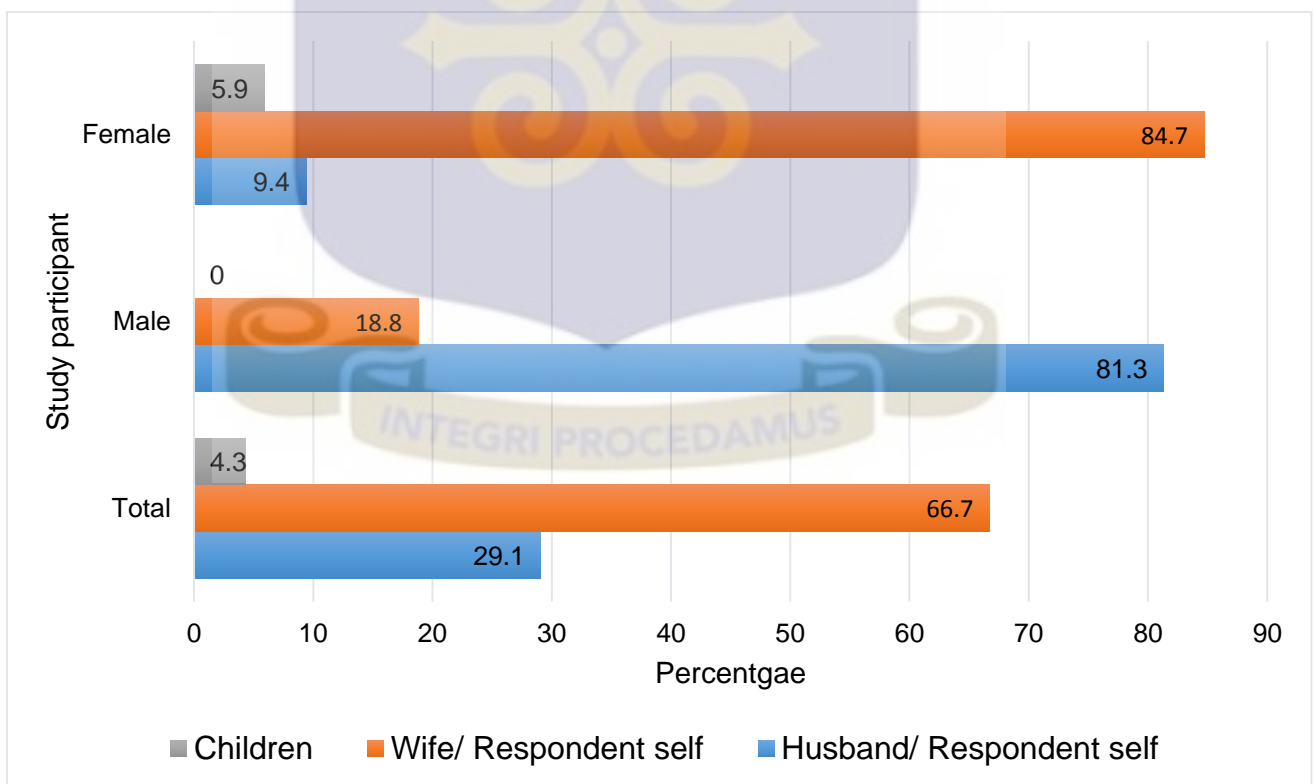
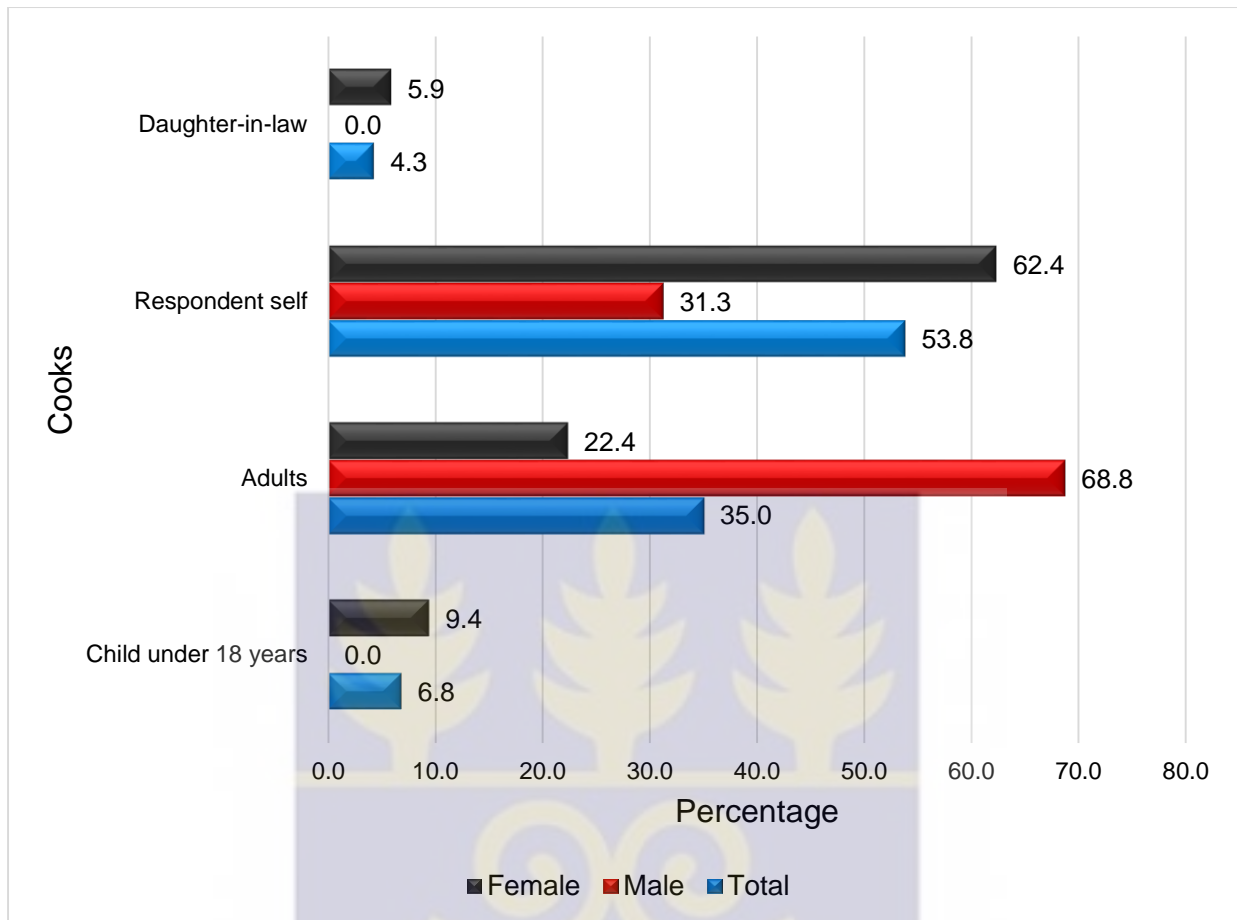
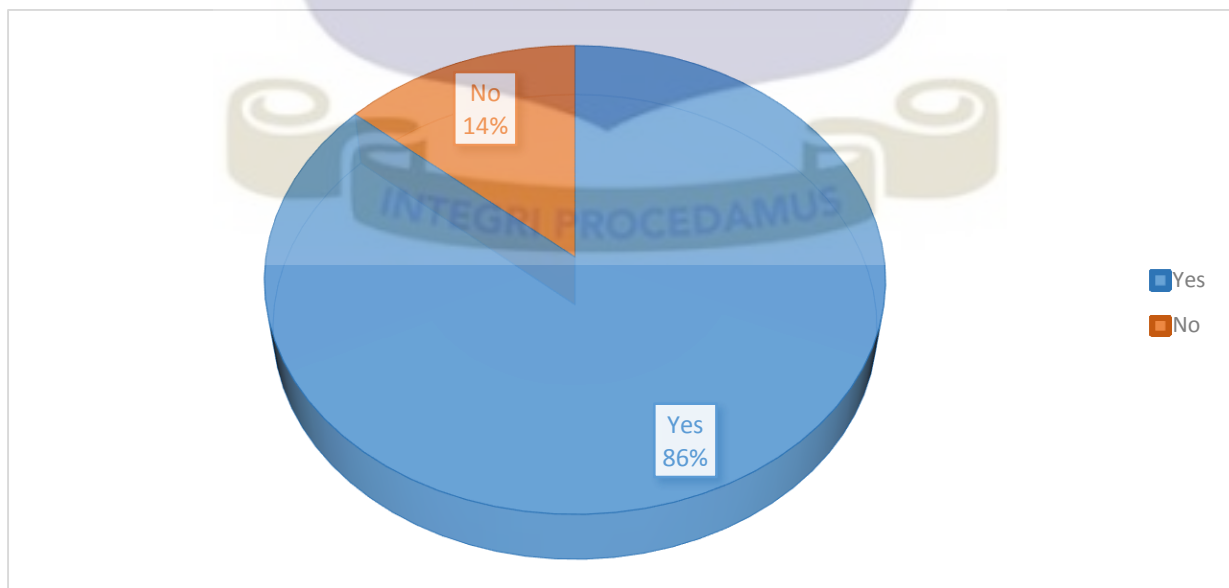


Figure 4.3: Persons who determine what food is to be cooked in participants' households



**Figure 4.4: Cooks in study participants' households**



**Figure 4.5: Nutrition knowledge of cooks as responded by participants**

## 4.2 Nutrition knowledge on foods among study participants

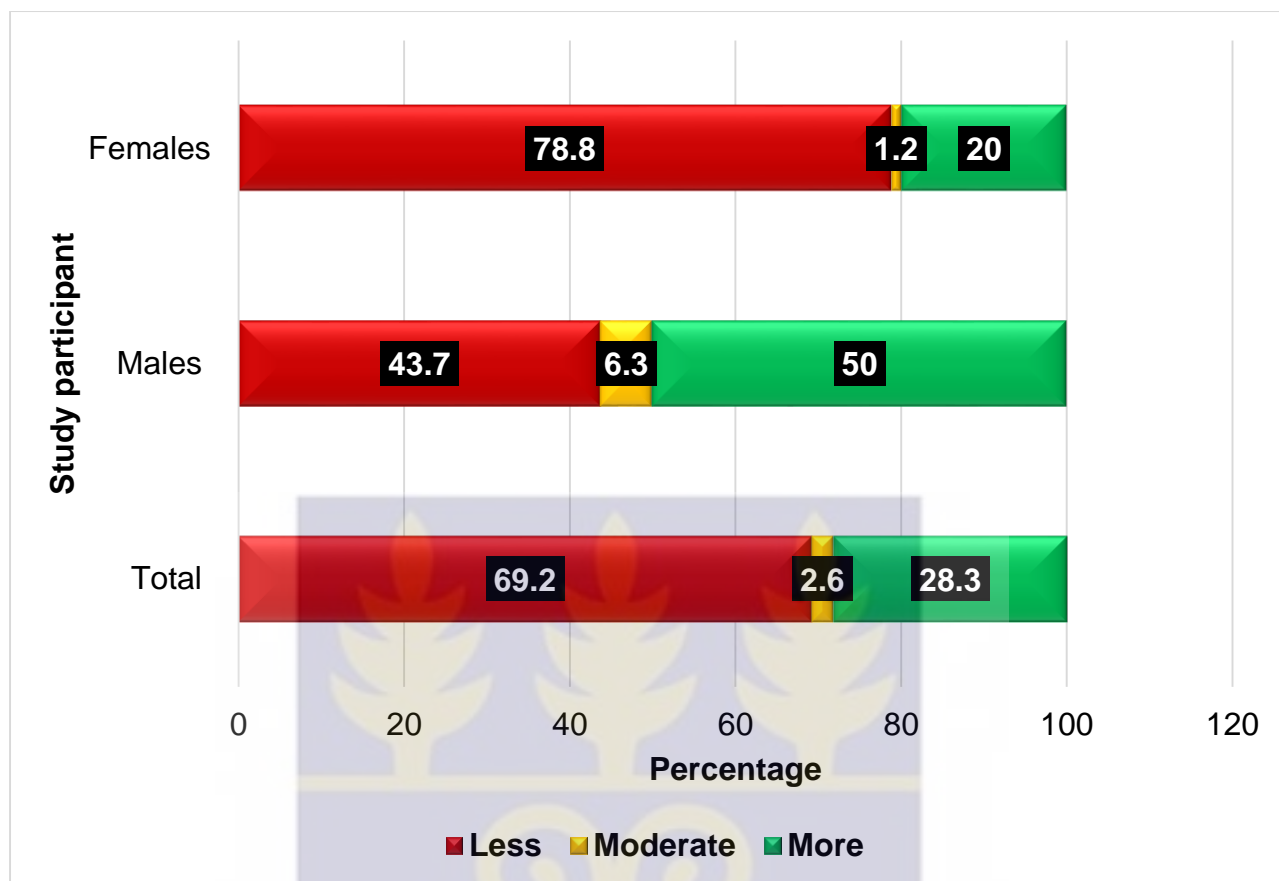
With nutrition knowledge on fats intake, 97.4% said less quantity of fats should be taken as against those who said ‘more’ or ‘not sure’ recording 0.9% each (Table 4.2). Majority (96.9% and 96.5% respectively) of both male and female participants said ‘less fats’ should be consumed. Nutrition knowledge on fruits intake recorded 69.2% for those in favour of less intakes (Figure 4.6). Only 28.2% and 2.6% of the study participants said ‘more’ and ‘moderation’ of fruits intake were appropriate. Most female participants (78.8%) said ‘less fruits’ intake compared to male participants (43.7%). Among those who favoured more intakes of fruits, male participants (50%) were the majority compared to female participants who recorded 20%. With nutrition knowledge on whether local cheese is a starchy food or not, 52.3% of the participants were ‘Not sure’, 14.5% said ‘Yes’ and 33.3% also said ‘No’ (Table 4.2). Most male and female participants were ‘Not sure’ whether local cheese is a starchy food or not.

With nutrition knowledge on the content of protein in red meat, many (52.7%) of the participants said that red meat had low protein content (Table 4.2). Those who said red meat had high content of protein or were ‘Not sure’ recorded 21.4% each. Mostly the male participants (50.0%) said red meat has a high content of protein. When it came to nutrition Knowledge on using brown sugar as a healthy alternative to white sugar, 57% of the participants agreed compared to 28.2% who disagreed (Table 4.2). Mostly male participants (68.8%) agreed and female participants who disagreed also recorded 34.1%. These distributions are shown in table and figure below:

**Table 4.2: Nutrition knowledge of food intakes among study participants**

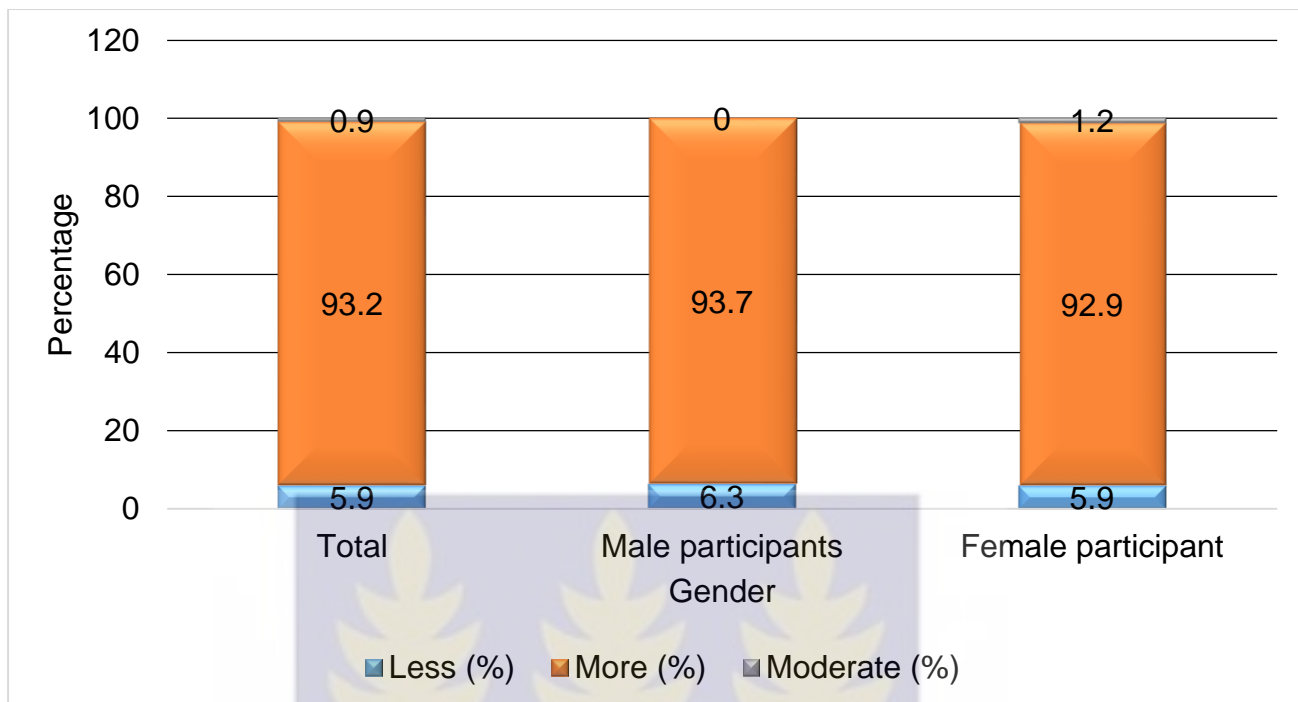
	TOTAL	MALE	FEMALE	P-VALUE
FOOD GROUP	(n=117)	(n=32)	(n=85)	
<b>Fatty food Intake</b>				
Less	113 (96.6%)	31 (96.9%)	82 (96.5%)	0.9145
More	1 (0.9%)	0 (0.0%)	1 (1.2%)	-
Not Sure	3 (2.6%)	1 (3.1%)	2 (2.4%)	0.8138
<b>Local Cheese as a starchy food</b>				
No	39 (33.3%)	8 (25.0%)	31 (36.5%)	0.2407
Yes	17 (14.5%)	4 (12.5%)	13 (15.3%)	0.7022
Not Sure	61 (52.3%)	20 (62.5%)	41 (48.2%)	0.7022
<b>Content of protein in red meat</b>				
Low	67 (57.3%)	14 (43.8%)	53 (62.4%)	0.0698
High	25 (21.4%)	16 (50.0%)	9 (10.6%)	< 0.0001*
Not Sure	25 (21.4%)	2 (6.3%)	23 (27.1%)	0.0144*
<b>Brown sugar as alternative to white sugar</b>				
Agree	57 (48.7%)	22 (68.8%)	35 (41.2%)	0.0078*
Disagree	33 (28.2%)	4 (12.5%)	29 (34.1%)	0.0205*
Not Sure	27 (23.1%)	6 (18.8%)	21 (24.7%)	0.4955

Data presented as numbers and percentages. \*P-value < 0.05 is significant, %= percentage, n= number



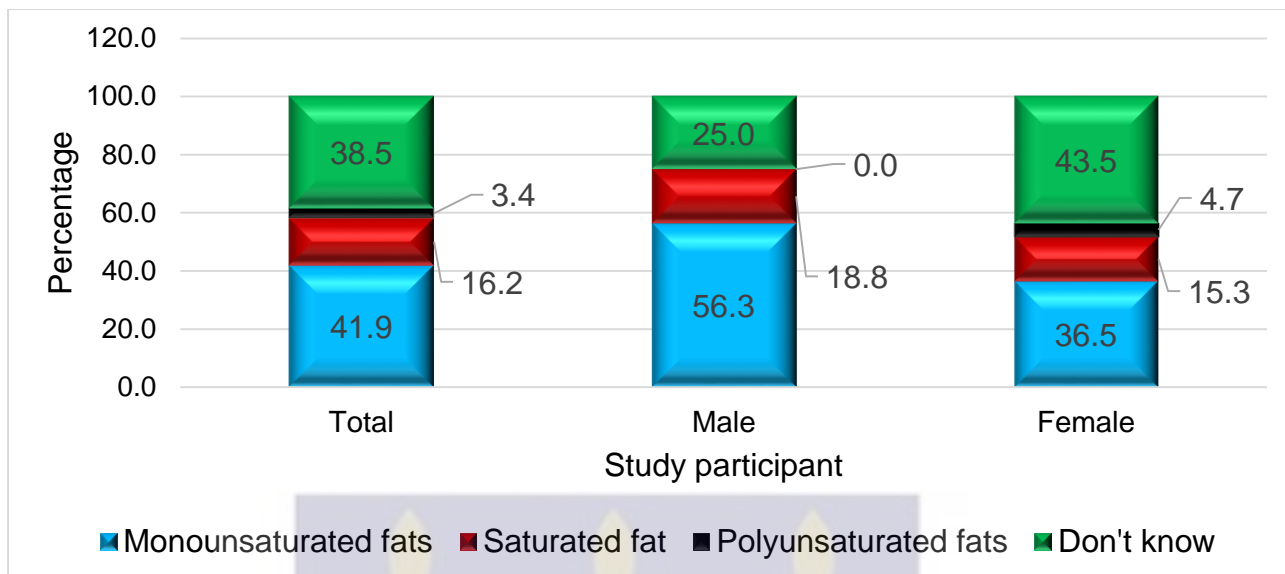
**Figure 4.6: Nutrition knowledge on frequency of fruit intake**

As shown in figure 4.7, 93.2% of the study participants said one should consume more of high fibre diets. Most male and female participants said it was appropriate to consume more of high dietary fibre. However, very few study participants were in favour of consuming moderate and low amounts of high dietary fibre (0.9% and 5.9%) respectively. No male study participant (0.0%) mentioned the consumption of moderate amount of a diet high in fibre.



**Figure 4.7: Nutrition knowledge on dietary fibre consumption among study participants**

With nutrition knowledge on the type of fats to cut-down on, 41.9% of the study participants said it was good to cut-down on monounsaturated fats (Figure 4.8). Male participants (56.3%) mostly said it is recommended to cut down on monosaturated fats. Of all those study participants who did not know (38.5%) which fats to cut-down on, 43% and 25% of them were female and male participants respectively. Only 3.4% recommended cut-down on polyunsaturated fats.



**Figure 4.8: Nutrition knowledge on fats cut-down by study participants.**

The table 4.3 below gives a summary rating of study participants' performance using Whati *et al.* (2005) reference standard for rating of Nutritional knowledge. Sub-indicators used to assess nutrition knowledge were graded into percentages and compared to the reference standard for rating Nutrition Knowledge as shown below.



**Table 4.3: Summary rating of Nutrition knowledge of the study participants**

<b>Sub-indicator</b>	<b>Whati <i>et al.</i></b>	<b>Present</b>		
	<b>(2005)</b>	<b>Whati <i>et al.</i></b>	<b>Study</b>	<b>Present</b>
	<b>Percentage</b>	<b>reference (%)</b>	<b>score (%)</b>	<b>Study</b>
		<b>(2005) rating</b>		<b>Rating</b>
NK on the quantity of fat intake	76+	Excellent	96.6	Excellent
NK on the type of fats cut-down on	<34	Very poor	16.2	Very poor
NK on the frequency of fruit intake	<34	Very poor	28.3	Very poor
NK on the protein content in red meat	<34	Very poor	21.4	Very poor
NK on brown sugar as a healthy alternative	<34	Very poor	28.2	Very poor
NK on whether local cheese is a starchy food	<34	Very poor	33.0	Very poor
NK on high fibre intake	76+	Excellent	93.2	Excellent
		Fair/ Below		Fair/ Below
Overall/ Average NK	34-51	average	45.3	average

NK= Nutrition Knowledge, <= less than, %= percentage, += or more than.

### 4.3 Dietary habits of the study participants

Table 4.4 shows the frequency of dietary intakes among study participants suggesting the meals frequencies from the various food groups are consumed. Milk and milk products were consumed by 34.2% (40) of the participants. Many of the consumers in terms of proportions came from those that had more than three (>3×) meals per day (55.6%). This was followed by those who had their meals only thrice (3×) a day with 36.6%. Very few (16.7%) twice (2×) meal consumers took milk. Consumption of meat, poultry, fish and alternatives were mostly taken by thrice meal (3×) consumers per day (55.6%) (Table 4.4). Very few (11.1%) study participants consume meat, poultry, fish and alternatives twice (2×) a day. Also, 47.9% of study participants consume meat, poultry, fish and alternatives at least twice (2×) a day (Table 4.4). On the average, almost all (99.1%) study participants consumed cereals/ tubers either twice (2×) or thrice (3×) or more than three times (>3×) per day. As many as 53.8% (63) of study participants consume legumes at least twice (2×) per day (Table 4.4). However, majority of them were from those with meal frequencies of either three times (3×) or more than thrice (>3×) per day (60% and 66.7% respectively). Furthermore, study participants who consume bread and wheats products twice (2×) or thrice (3×) or more than three times (>3×) per day were 16.7%, 34.4% and 66.7% respectively (Table 4.4).

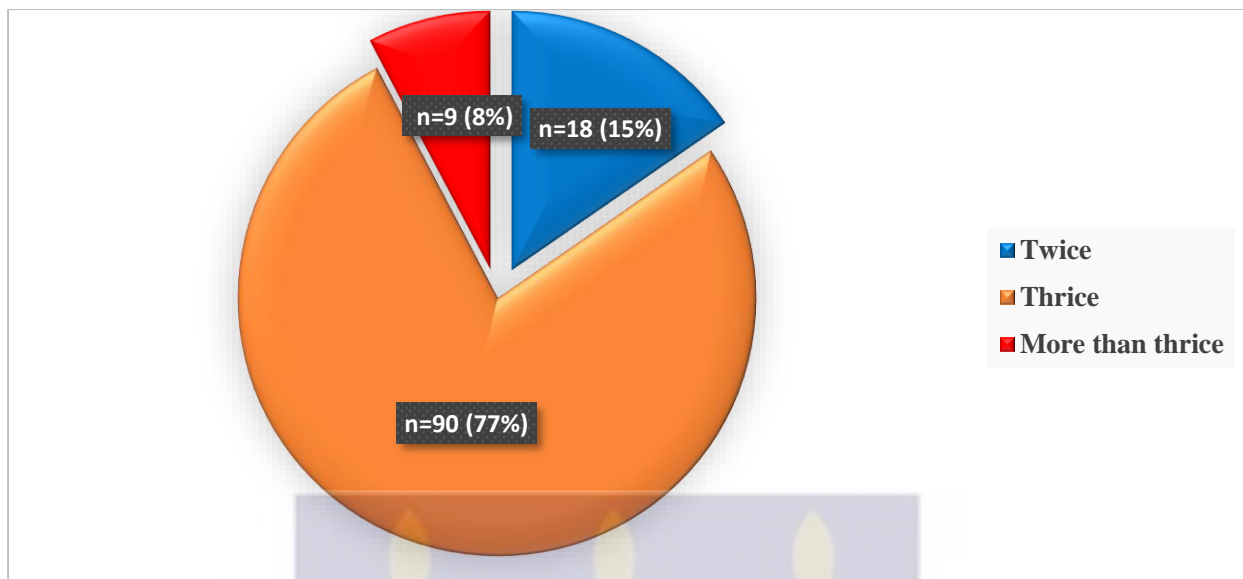
Few (34.2%) study participants consumed bread and wheat products at least twice (2×) a day. Additionally, 56.4% of the study participants consumed fruits and vegetables with meal frequencies of twice (2×) or thrice (3×) or more than three times (>3×) per day recording 44.4%, 56.7% and 77.8% respectively (Table 4.4). Furthermore, 88.9% of the study participants consumed sweets and fats at least twice a day. Out of this percentage, majority of the study participants (90%) consumed sweets and fats came from the thrice meal frequency (3×) per day group (Table 4.4).

Finally, 77% of the study participants ate their meals thrice (3×) per day, followed by twice (2×) per day and more than thrice (>3×) per day consumers (15% and 8%) respectively (Figure 4.9).

**Table 4.4: Frequency of food group intake according to meal frequency among study participants**

FOOD GROUP	MEAL FREQUENCY			TOTAL (n=117)
	TWICE (n=18)	THRICE (n=90)	MORE THAN THRICE (n=9)	
Milk and Milk products	3 (16.7%)	32 (35.6%)	5 (55.6%)	40 (34.2%)
Meat, Poultry, Fish and alternatives	2 (11.1%)	50 (55.6%)	4 (44.4%)	56 (47.9%)
Cereals/Tubers	17 (94.4%)	90 (100.0%)	9 (100.0%)	116 (99.1%)
Legumes	3 (16.7%)	54 (60.0%)	6 (66.7%)	63 (53.8%)
Bread and Wheat products	3 (16.7%)	31 (34.4%)	6 (66.7%)	40 (34.2%)
Fruits and vegetables	8 (44.4%)	51 (56.7%)	7 (77.8%)	66 (56.4%)
Sweets and Fats	16 (88.9%)	81 (90.0%)	7 (77.8%)	104 (88.9%)

Data presented as numbers and percentages, %= percentage, n= number



n= number, %= percentage

**Figure 4.9: Frequency of meals per day by study participants**

#### **4.4 Anthropometric characteristics and biochemical parameter of study participants**

Using a p-value < 0.05, the total mean age, height and weight of all study participants were  $52.9744 \pm 8.74097$ ,  $1.62485 \pm 0.217397$  and  $75.4308 \pm 13.17$  respectively (Table 4.5). The mean weight ( $76.36 \pm 13.62$ ) of male study participants was higher than that of female study participants ( $75.08 \pm 13.06$ ). However, the mean BMI of all the study participants was  $27.5845 \pm 4.79002$  (Table 4.5). There was a high level of significance in BMI between the female and male participants  $\{(28.59 \pm 4.699) \text{ and } (24.96 \pm 4.019) \text{ respectively}\}$ . Females had higher BMI levels than male participants. Recorded mean body fat composition was  $35.3835 \pm 10.2815$ , with a high level of significance between the mean BMI of female and male participants recording  $39.84 \pm 7.457$  and  $22.77 \pm 5.628$  respectively (Table 4.5). Mean visceral fat percentages between the male and female participants were  $8.867 \pm 3.730$  and  $8.953 \pm 2.659$ , which was insignificant.

Finally, the mean HbA1c level of all T2DM subjects was  $9.44783 \pm 4.28958$  (Table 4.5). The mean glycated haemoglobin (HbA1c) levels between female and male participants recorded a high level of significance ( $9.947 \pm 4.542$  and  $7.486 \pm 2.315$  respectively).

**Table 4.5: Anthropometric characteristics and biochemical parameter of study participants**

VARIABLE	TOTAL (n=117)	MALE (n=31)	FEMALE (n=85)	P-VALUE
Age (year)	$52.9744 \pm 8.74097$	$54.81 \pm 7.714$	$52.28 \pm 9.043$	0.1638
Height (m)	$1.62485 \pm 0.217397$	$1.652 \pm 0.3905$	$1.614 \pm 0.09269$	0.4030
Weight (Kg)	$75.4308 \pm 13.17$	$76.36 \pm 13.62$	$75.08 \pm 13.06$	0.6407
BMI (Kg/m <sup>2</sup> )	$27.5845 \pm 4.79002$	$24.96 \pm 4.019$	$28.59 \pm 4.699$	0.0002*
% body fat	$35.3835 \pm 10.2815$	$22.77 \pm 5.628$	$39.84 \pm 7.457$	< 0.0001*
Visceral fat	$8.93044 \pm 2.95796$	$8.867 \pm 3.730$	$8.953 \pm 2.659$	0.8915
HbA1c	$9.44783 \pm 4.28958$	$7.486 \pm 2.315$	$9.947 \pm 4.542$	0.0346*

Data presented as mean  $\pm$  standard deviation. \*P < 0.05 is statistically significant. BMI=body mass index, % body fat= percentage body fat, HbA1c= glycated haemoglobin, n= number

#### **4.5 Relation between dietary habits and body fat composition; percentage visceral fat; BMI; HbA1c levels**

With a p-value <0.05, the type of carbohydrate intake was very highly significant with the mean BMI of  $27.5845 \pm 4.79002$ , marginally significant with the mean body fat composition and HbA1c levels (Table 4.6). It however had no level of significance with the mean percentage visceral fat.

However, the type of fatty acid intake was very significant with the means of BMI ( $27.5845 \pm 4.79002$ ), body fat composition ( $35.3835 \pm 10.2815$ ), percentage visceral fat ( $8.93044 \pm 2.95796$ ) and HbA1c ( $9.44783 \pm 4.28958$ ) (Table 4.6).

Finally, the type of fibre intake had a very high level of significance with BMI, body fat composition and percentage visceral fat. There was no level of significance in the type of fibre intake with HbA1c level as shown in table 4.6.

**Table 4.6: Relation between dietary habits and anthropometry; biochemical index**

Nutritional Status	Mean	P-value		
		Types of Carbohydrate	Types of Fatty acid	Types of Fibre
BMI	$27.5845 \pm 4.79002$	0.004	0.001	0.007
% Body fat	$35.3835 \pm 10.2815$	0.049	0.003	0.001
% Visceral fat	$8.93044 \pm 2.95796$	0.050	0.004	0.030
HbA1c	$9.44783 \pm 4.28958$	0.041	0.001	0.080*

Data presented as mean  $\pm$  standard deviation.  $P < 0.05$  is statistically significant. BMI= body mass index, HbA1c= glycated haemoglobin, \*= insignificant, %= percentage.

## CHAPTER FIVE

### 5.0 DISCUSSION AND CONCLUSION

#### 5.1 Discussion

##### 5.1.1 Socio-demographic characteristics of the study participants

Understanding the nutrition knowledge of patients with T2DM and its influence on their dietary intake is important for developing nutrition intervention strategies aimed at improving their dietary habits and overall nutritional and health status. The aim of this study was to assess the nutrition knowledge and dietary habits of patients with T2DM attending the regional hospital in the Upper West Region of Ghana. Previous studies aiming to assess the link between nutrition knowledge and dietary habits have often been criticised on the bases of uncertain validity and reliability of the instruments used (Shepherd and Towler, 1992; Anderson et al., 1988). This study therefore looked at all aspects of practical nutrition knowledge which could be used in future researches to link nutrition knowledge, demographic characteristics and dietary habits (Parmenter & Wardle, 1999) as well as body mass index levels, body fat composition, percentage visceral fat and glycated haemoglobin levels of the study participants. The research data revealed that the mean age of the study participants was 53 years. Female participants were the majority in the study confirming findings of the Ghana statistical survey (GSS, 2012). Majority of the study participants were also Waalas and Dagaabas mostly from the Mole-Dagbani origin. Many of the study participants had no formal education and many of these were females. This could have a bearing on how they process nutrition-related information when making food choices. Of all the study participants who were mostly traders, female participants were the majority with a bulk of them having children less than 18 years in their households. Decision-making on food preparation in participants' households was mostly done by participants themselves.

Also, most of the female participants involved in the study mostly prepared the meals in their households. These had implications on the manner in which they usually selected, cooked/prepared, served or ate foods, as well as the ways people obtained, stored, used, and discarded food (Lowenberg et al., 2001).

### **5.1.2 Study participants' nutrition knowledge**

The lack of knowledge regarding appropriate nutrition has various implications on nutrition and health. Assessing nutrition-related knowledge offers an opportunity to better understand a given situation by providing insights into the social, psychological and behavioural determinants of nutritional status (FAO, 2014). Information gathered from the study suggested that most of the study participants had very poor nutrition knowledge on the type of fatty foods to cut-down on, frequency of fruits intake, protein levels in red meat, brown sugar as a health alternative to white sugar and local cheese as a starchy food. A similar research on nutrition knowledge of Iranian athletes also had similar findings (Azizi et al., 2010). A poor level of nutrition knowledge could potentially indicate poor dietary habits (Sarah, 2005). The findings could also be due to the low level of education in the study area (French et al., 1997). Higher education is associated with lower risk of obesity and higher knowledge about food that can be passed on to children according to a study that examines eating patterns and physical activity characteristics among urban and rural students in Saudi Arabia (Abuzaid, 2012). Thus, education plays a key role in acquiring knowledge about food and making appropriate food choices. Very poor nutrition knowledge and misconceptions about the type of food consumed could potentially have serious implications on nutritional status of T2DM. The sources of nutrition information also play a significant role in determining the level of nutrition knowledge and dietary habits of T2DM.

The most prominent source of nutrition information is television (Gibbs & Karen, 2012). Media has been recognized as one of the forces that influence body image (Rolfes, 2006). However, this study solicited information from clients based on information their health experts give them. As the findings indicated, it may not be adequate enough to acquire the requisite nutrition knowledge and application of appropriate dietary practices. Additionally, the very poor nutrition knowledge of the study participants on these indicators could have implications on their clinical attendances rates and the type of nutrition education given during every session.

Findings from the study suggest that study participants had excellent nutrition knowledge on the quantity of fats and dietary fibre intake according to Whati *et al.* (2005) reference performance-rating on nutrition knowledge. Several studies have shown that reducing fats intake and increasing the consumption of high fibre foods are associated with improved nutrition and health outcomes. Adequate nutrition knowledge of food choices helps one to make appropriate food choices (Whitney, 2014). Nutrition knowledge is also a central element of health literacy and low health literacy is associated with poor health outcomes (Spronk, Catrina & Helen, 2014). People with adequate nutrition knowledge are able to follow healthy diet to avoid excessive weight gain (Grafova, 2006). Avoiding excess weight gain could lead to a reduction in the risk of microvascular and macrovascular complications among the study participants (CDC & ADA, 2014).

However, adequate knowledge does not always commensurate with dietary intakes. A study conducted to ascertain the nutritional knowledge, food habits and health attitude of Chinese university students revealed that majority of the students had nutrition knowledge on balanced diet but very few of them were able to apply this concept when selecting foods from a menu (Sakamaki et al., 2005).

Another study on assessing the relationship between nutrition knowledge and dietary intake reported that there was a significant, positive, but weak association between higher nutrition knowledge and dietary intake, most often a higher intake of fruit and vegetables (Spronk, Catrina & Helen, 2014). Nutrition knowledge does not necessarily translate into attitude and practice. A similar study by Shakkour (2003) on nutrition knowledge and its applications had similar findings. Other studies have also suggested that interventions involving nutrition knowledge would most effectively influence consumers positively who don't have this specific knowledge (Frazao & Allshouse, 2003).

Also, when a question was asked as to the adequacy of the nutrition knowledge of persons in participants' households who cook, majority of them said yes. This claim could not positively correlate with the nutritional status of the study participants according to the study findings. Thus, most participants had poor nutritional status. Limited nutrition knowledge may also signify unhealthier dietary habits that may lead to an abnormal increase in body weight (Kruger et al., 2002). Overweight and obese individuals who tend to have high BMI levels are usually linked to high intakes of fats and refined sugars as it's been observed among the study participants (WHO, 2015; CDC, 2009; Drewnowski & Darmon, 2005). Dietary intakes data on this study also confirmed similar findings.

Thus, inadequate nutrition knowledge could lead to poor dietary habits as implied in generally high anthropometric indicators and HbA1c levels of the study participants. Overall, the nutrition knowledge of the study participants was below average and therefore requires effective nutrition education intervention.

### 5.1.3 Dietary habits of the study participants

The results of the study showed that majority of the study participants eat three times (3×) per day, followed by twice (2×) eaters and more than thrice (>3×) eaters per day respectively. Findings also indicate 15.4% of the study participants skipped meals. While several trials reported that appetite was reduced when meals were spaced out over the course of a day. Others failed to detect such differences regardless of feeding frequency (Schoenfeld, Aragon & Krieger, 2015). However, many studies have established that eating 3 times or more daily meals actually have implications on BMI levels (Yunsheng et al., 2003). And that the number of meal frequencies was inversely associated with the risk of obesity. According to another study by Yunsheng *et al.* (2003), people who ate more than three times (>3×) per day had a 45% lower risk of obesity than those who ate three times or had lesser meal frequencies ( $\geq 3\times$ ). Participants who regularly skipped breakfast also had 4.5 times the risk of obesity as compared to those who regularly consumed breakfast. Energy intakes tended to be greater on days' breakfast was skipped.

LeBlanc *et al.* (1993 & 1986) also demonstrated that eating four (4) small meals doubled the thermogenic response attributed to the repeated stimulation of the sympathetic nervous system compared with eating the same number of total calories as large in a single meal. However, this study did to establish the relationship between meal frequency and energy expenditure.

An epidemiologic studies relating meal frequency to body weight also concluded that many studies failed to find any statistically significant relation between meal frequency and energy expenditure, those observed are consistently inverse (Bellisle et al., 1998). However, some studies demonstrated that low meal frequency was associated with higher 24-hour insulin concentrations compared with high meal frequency (Schoenfeld, Aragon & Krieger, 2015).

Eating multiple, small meals may suppress hunger and overall serum insulin concentrations (Bellisle et al., 1998). Insulin inhibits lipase enzyme activity and increases fat deposition. Since insulin is related to fatty acid storage, meal frequency may be one of the factors affecting body weight of T2DM patients (Bellisle et al., 1998). Another study demonstrated that when humans switch from eating three full meals per day to one moderate size meal every other day or only 500–600 calories 2 d/wk, they exhibit great changes in energy breakdown characterized by increased insulin sensitivity, reduced levels of insulin and leptin, mobilization of fatty acids, and elevation of ketone levels (Mark et al., 2014). Ketones, such as  $\beta$ -hydroxybutyrate, are known to have beneficial effects on high demand energy cells such as neurons in the brain. These findings could have similar implications on the differences in frequencies of meals among the study participants in this study.

With respect to meal patterns among the various meal frequency groups, the study showed that majority of them consumed cereals and tubers, and sweets and fats. High consumption of sweets and fats is associated with high risk of diabetes complications, obesity and other chronic diseases (WHO & FAO, 2002). A similar study by Ellulu *et al.* (2014) on obesity in low and middle income countries had similar findings. Consumption of legumes, and fruits and vegetables was also generally high among the various meal frequency groups. Increased consumption of legumes, fruits and vegetables is associated with good glycaemic control (Bijlani, 2007) and improve HbA1c levels (Kyoung-Lack et al., 2012).

Only few of the study participants in this study consumed milk and milk products, meat, poultry, fish and alternatives, and bread and wheat products. Purchasing power of study participants could play a role in these trends as indicated in the income status of the study clients.

A study has shown that as income levels increase, the consumption of animal sources increases considerably (FAO, 2003). Moderate consumption of animals and animal products, fish, bread and wheat bread have been associated with improved health outcome. For example, a study has shown that HbA1c decreases significantly as the frequency of the intake of fish increases in all populations (Kyoung-Lack et al., 2012). Wheat bread intake is also associated with improved postprandial glucose levels (Bijlani, 2007). Environmental factors and societal influence may also account for the food consumption frequencies of meals among various populations (WHO, 2016).

#### **5.1.4 Nutritional status assessment of study participants**

Anthropometric measurements conducted under this objective were weights, heights, BMI levels, body fat composition and percentage visceral fat. The only biochemical data collected from the study participants was glycated haemoglobin (HbA1c). The mean age, weight and height of the study participants were 53 years, 75.4Kg and 1.62m respectively. There were no significant differences in age, weight and height between the male and female study participants. However, the mean BMI of the study participants was  $27.6\text{Kg m}^{-2}$  with a very high level of significance ( $P\text{-value} < 0.05$ ) between the male and female participants. Most female participants had higher BMI levels than their male counterparts (WHO, 2015). Increased BMI level above the normal range (18.5-24.9)  $\text{Kg m}^{-2}$  is associated with overweight/ obesity (NIH, 2004). Study participants who were overweight/ obese were at an increased risk of developing cardiovascular diseases (WHO, 2009) and an increasing risk of developing diabetic macrovascular and microvascular complications (ADA, 2014) (CDC, 2014). It therefore implies that more female participants were at risk of developing diabetic complications than their male counterparts.

The high meal frequencies of sweets and fats, and the low consumption of wheat bread, fish and alternatives, and generally low fruits and vegetables intake could play a significant role in the observation made. Also body fat and visceral fat percentages correlate positively with overweight and/ or obesity (Vera et al., 2011; Rush et al., 2004). The findings of this study suggest that the mean visceral and body fat percentages were 8.9% and 35.4%, with a very high level of significance ( $P < 0.05$ ) among male and female participants for body fat composition. Body fat composition of female participants were mostly higher. However, the difference in percentage visceral fat among the male and female participants was insignificant. Body fat composition and visceral fat percentage positively correlated with BMI level (Goksun & Cimen, 2011). Higher body fat composition and/ or visceral fat saw higher BMI levels with females being the majority (Boyko et al., 2000) and therefore more predisposed to diabetic complications (Skyler, 2004; EURODIAB, 1994).

A study conducted to ascertain the association between nutritional status, food habits and physical activity level in school children revealed that overweight was directly associated with body fat composition attributable to environmental and behavioural factors including diet (Coelho et al., 2012). Another study found that the greater visceral adiposity precedes the development of T2DM among Japanese Americans and showed an effect independent of fasting insulin, insulin secretion, glycaemia, total and regional adiposity, and family history of diabetes (Boyko et al., 2000).

Furthermore, glycated haemoglobin levels helped to determine how effective the study participants postprandial glucose and glycaemic control in the past two to three months were (Gandy, 2014). Findings from the study indicate the mean HbA1c level as 9.5% ( $9.44783 \pm 4.28958$ ) with a very high level of significance ( $P < 0.05$ ).

Higher HbA1c levels were seen among female participants compared to their male participants. This implies a very poor glycaemic response most especially among the female participants. Factors that are fingered to have poor glycaemic response are the consumption of solely refined foods, the type of food processing, the physical form of the food and, amylose and/or amylopectin response (Bijlani, 2007). The high consumption of sweets, fats coupled with a low intake of legumes, wheat bread, fish and fruits and vegetables as observed in the study could account for the high HbA1c levels. Most of the participants were also engaged in various forms of trade which were either sedentary or stressful. Physical inactivity and stress could also play a role in the generally high HbA1c levels (Blair et al., 1985). A population-based case-control study conducted on HbA1c values and mortality risk in T2DM showed that high or low HbA1c levels were associated with mortality risk and age played a role in glycaemic control (Nicholas et al., 2013). It also observed that high HbA1c levels were associated with increased risk of diabetic macrovascular and microvascular complications.

Overall, it can be deduced from the nutritional status assessment findings of the study that HbA1c levels, BMI and body fat composition levels of the study participants were generally high with a very high level of significance between the male and female study participants. Additionally, most of the study participants had relatively normal visceral fat levels with insignificant differences in terms of sex distribution. These indices may infer poor dietary habits and the influence of some societal factors (WHO, 2016).

### **5.1.5 Relation between dietary habits and body fats composition; percentage visceral fat; body mass index; glycated haemoglobin level**

The types of carbohydrates, types of fats and types of fibre intakes were used as the food indices to relate the study participants' dietary habits to their body fats composition, percentage visceral fats, BMI levels, and HbA1c levels. This was because some studies have shown that these food types mostly affect postprandial glucose levels (Bijlani, 2007). Excessive energy intake is also associated with overweight and obesity (Steyn et al., 2004). Findings from the study showed that the types of carbohydrates, fats and fibre intake directly correlated with body fat composition. However, there were very high levels of significance in correlation with the type of fats and fibre intake. With the types of carbohydrate intake, though significant was a weak correlation. A similar study has shown that higher consumption of total carbohydrates and dietary fibre produced a reverse association with percentage body fat (Velázquez-López et al., 2016). These findings are contrary to the results of this study which showed a direct association with body fat composition. This study also observed a high frequency of refined carbohydrates (sweets) and fats intake among the participants and could therefore account for the observations made. For the types of fats intake, there was a very weak association (Velázquez-López et al., 2016) compared to a strong correlation observed in this current study.

However, the findings from the Velázquez-López *et al.* (2016) study noted that increased consumption of saturated fat alone was linked to lower levels of HDL-c and higher body weight. High consumption of saturated fat was also mostly linked to higher risk of cardiovascular diseases, obesity, and dyslipidaemia when compared to a higher consumption of polyunsaturated fats. Another study has shown that high saturated fat intake is directly linked with obesity and body fat composition (Misra, 2001).

Therefore, most of the fats from the diet should come from polyunsaturated and monounsaturated fats with a reduced intake of at least 10% of saturated fat as recommended (Velázquez-López et al., 2016). Finally, findings of this study concluded that lower calorie and saturated fat consumption may still be an appropriate strategy to reduce body fat, promote blood glucose control, and improve HDL-c levels. For the type fibre intake, the physical form of the food and the type of food processing could affect the fibre content of the food (Bijlani, 2007).

The findings of this study also showed a very significant positive correlation between BMI and the types of carbohydrates, fats and fibre intake among the study participants. However, findings from the Velázquez-López *et al.* (2016) study showed no association in BMI with carbohydrates and fats intake but however presented a positive but weak association with the type of fibre. Another study showed that there was no significant association between poor dietary habits usually comprising of high carbohydrate and fats intake, and low consumption of fruits and vegetables with BMI levels. However, other studies have shown that all dietary patterns were significantly correlated with BMI levels (Erber et al., 2010). Another study concluded that the disproportionate increase in energy intake more than energy expenditure is considered the fundamental cause of increased BMI levels (Ellulu et al., 2014).

High intake of energy dense foods which involve fats, sugars and salt have been particularly fingered as the cause of the increase in BMI levels and overweight/obesity. Dietary fibre consumption has also been shown to improve HDL-c and BMI levels which was consistent with reducing postprandial glucose, increased satiety, better glycaemic control, improvement of cardiovascular risk factors, and reduced risk of macrovascular problems (Velázquez-López et al., 2016)

Furthermore, the results of the study showed that visceral fat percentage had no association with the type of carbohydrate intake but however showed a strong link with the types of fats and fibre intake contrary to the results of Velázquez-López *et al.* (2016). However, in Velázquez-López *et al.* (2016) study the type of carbohydrate association with waist circumference though positive, was very weak to conclude on. According to Erber *et al.* (2010) a diet high in animal fat has been associated with intra-abdominal fat deposition and insulin resistance.

Another confounder of visceral obesity identified in their study was genetic predisposition (Rush *et al.*, 2004; Boyko *et al.*, 2000). Other study on the epidemiology of obesity in developing countries observed that sedentary lifestyle and high fat intake were important confounders of increased visceral fats percentage (Ellulu *et al.*, 2014). A further study also concluded that sleep duration (from 6 h/day to 7-8 h/day) is independently associated with 6cm<sup>2</sup> fewer visceral adipose tissue gain over a 6-year follow-up period in adults rather than just only dietary intake (Chaput, Bouchard & Tremblay, 2014).

Lastly, information obtained from the analysed data showed that HbA1c level was positively associated with the type of carbohydrate and fats intake and inversely related to the type of dietary intake contrary to the findings of the Velázquez-López *et al.* (2016) study. However, it has been shown that the consumption of refined carbohydrates alone increases postprandial glucose greatly compared to high carbohydrates which improve glucose tolerance (Bijlani, 2007). Poor glycaemic control could be associated with high HbA1c levels (WHO, 2011). High fibre diet also improves postprandial glucose levels and glucose tolerance (Bijlani, 2007). It has also been proven that fibre intakes positively correlated with triglyceride levels (Velázquez-López *et al.*, 2016).

The reverse association of dietary fibre with HbA1c levels could be attributed to type of food processing and the physical form of the food (Bijlani, 2007). HbA1c relation with the type of dietary intake may be also affected by a variety of genetic, haematologic and illness-related factors (WHO, 2011). Therefore, it is inferred from the association between dietary habits and body fat composition percentage visceral fat, BMI and HbA1c that not only diet has a role to play in the variations observed but also, socio-demographic characteristics and environmental factors.

## **5.2 Conclusion**

The present study participants had a below average nutrition knowledge on dietary intake. Additionally, the dietary habits of the study participants were generally directly associated with body fat composition, percentage visceral fat, BMI and glycated haemoglobin levels. The study participants generally had poor nutritional status with females mostly being the majority affected. Finally, apart from diet, environmental and socio-demographic characteristics are important in assessing the nutrition status of individuals and/or groups.

### **5.2.1 Limitations of the study**

The following were possible limitations of the study:

1. The participants may not have answered the questions honestly.
2. There was time constraint which made it difficult to get all the participants.
3. The study was also constrained with limited funding.

### 5.2.2 Recommendations

Based on the findings of the study, the followings recommendations are made for further studies:

1. Ghana health service should organise community-based nutrition education durbars and meetings for community members periodically to improve their nutritional knowledge, attitudes and dietary practices.
2. Ministry of health should engage more Nutrition experts and dietitians at all levels with special focus at the community levels to ensure that nutrition information on appropriate dietary habits are well-disseminated.
3. Ghana health should organise capacity-building workshops for selected diabetics to serve as “bettering agents” at the community level on diabetes control and prevention, and refer suspected cases to the nearest health facility for further investigation.
4. A further study should be conducted by the Department of nutrition and dietetics (University of Ghana) on the feeding frequency, quantity of feeds and energy expenditure of diabetic subjects to identify the gap in energy imbalance.
5. Ministry of information and communication in collaboration with Ghana health service, training institutions should prepare and disseminated education materials on diabetes to all levels with special focus on the community levels in written Ghanaian local languages.

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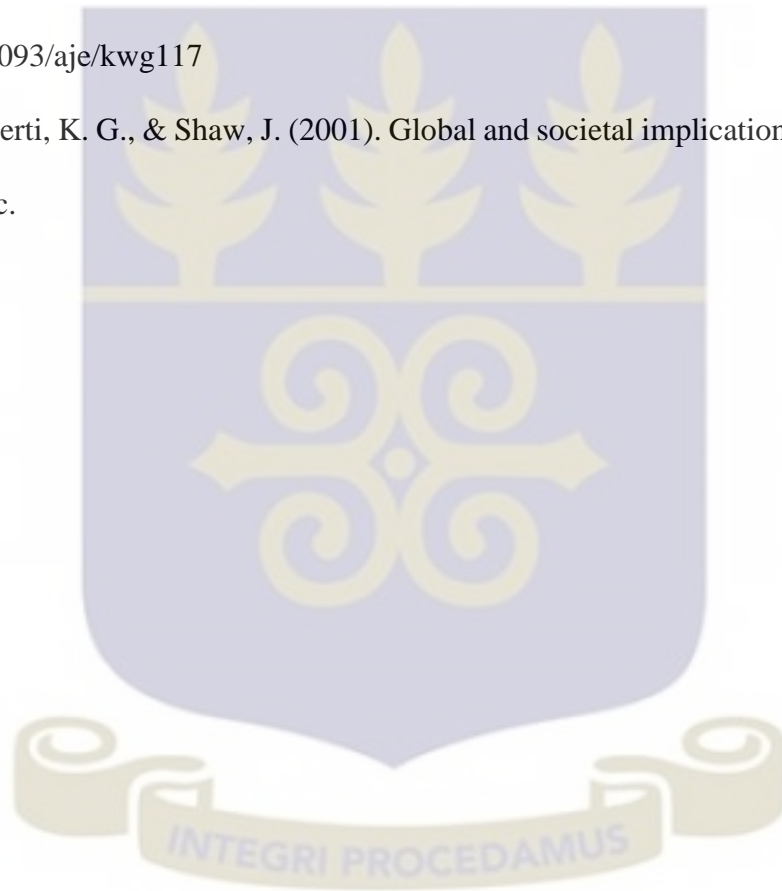
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## APPENDICES

### APPENDIX I: RESEARCH PARTICIPANT INFORMATION SHEET

Dear Madam/ Sir

My name is Ra-uf Issah, a Master of Science in Dietetics student at the School of Biomedical and Allied Health sciences, University of Ghana. I am conducting a study in conjunction with the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, College of Health Sciences, Korle-Bu. The principal objective of this study is to ‘study the nutrition knowledge and dietary habits of patients with type-2 diabetes attending the Regional Hospital at Wa’.

Your involvement, cooperation and commitment as a participant in this study are of great importance to the researcher. Questions asked and procedures that will be used are purely for academic purposes. We believe that you will give us your best support in this study.

#### EXPLANATION OF THE PROCEDURE

The study shall employ a structure questionnaire to collect personal information about you. You will be interviewed on your socio-demographic characteristics, nutrition knowledge and dietary habits. Your weight, height, body fat composition, percentage visceral fat, body mass index will also be taken. Lastly, your blood sample will also be taken to test for glycated haemoglobin level.

## RISKS AND DISCOMFORT

By agreeing to participate in this study, you are likely to experience some minor discomfort when blood samples are taken. The blood samples will be taken by a trained phlebotomist and will require the use of a syringe.

## BENEFITS

Results of your blood test will be given to you and you will also be given some dietary advice on healthy eating after the study. The findings of this study will also be used in planning dietary intervention programmes for people living with diabetes.

## CONFIDENTIALITY

Your real name or any data that will be used to trace you will not be used at any point in time during the data collection or in any written report. Your identity as a participant will not be disclosed to unauthorised persons. All participants involved in the study will be given codes as identification.

## WITHDRAWAL FROM STUDY

Your participation in this study is voluntary. You have the right to withdraw from the study at any point in time, for any reason and without prejudice.

## COST OF PARTICIPATION

You will not incur any cost for participating in this study. You will not also be paid for your participation in the study. In the light of the above, I will be grateful if you would complete the informed consent form as a testimony to your voluntary participation in the study.

## RIGHTS AND COMPLAINTS

To clarify any questions concerning the study, participants can call Ra-uf Issah, mobile 0208601100. Questions regarding any right issues as a participant in the study and in the case of injury due to the study should be directed to the chairman of the Ethical and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, College of Health Sciences, University of Ghana.





**APPENDIX III: QUESTIONNAIRE**

**Nutrition knowledge and dietary habits questionnaire for type-2 diabetic subjects**

IDENTIFICATION	CODES (OFFICIAL USE ONLY)				
QUESTIONNAIRE IDENTIFICATION	<table border="1" style="width: 100%; height: 100%;"> <tr> <td style="width: 33%;"></td> <td style="width: 33%;"></td> <td style="width: 33%;"></td> </tr> </table>				
NUMBER OUT OF 140 .....	<table border="1" style="width: 100%; height: 100%;"> <tr> <td style="width: 25%;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> </tr> </table>				
REGION:..... DISTRICT:..... HOSPITAL:..... TYPE-2 DIABETIC: YES <input type="checkbox"/> NO <input type="checkbox"/> (TICK RESPONSE) SIGNATURE (THUMB PRINT) OF RESPONDENT.....					
NAME OF INTERVIEWER:..... DATE OF INTERVIEW:...../...../..... <p style="text-align: center;">Day/ Month /Year</p> CHECKED BY SUPERVISOR (SIGNATURE):.....					

**SECTION A: NUTRITION KNOWLEDGE**

**The first few items are about what advice you think experts are giving us**

1. Do you think health experts recommend that people should be eating more, the same amount, or less of these foods? (Tick one box per food)

No.	Food	More	Same	Less	Not sure
1	Vegetables				
2	Sugary foods				
3	Meat				
4	Starchy foods				
5	Fatty foods				
6	High fibre foods				
7	Fruit				
8	Salty foods				

2. Which fat do experts say is most important for people to cut down on? (Circle one response).

(1) Monounsaturated fat (2) Polyunsaturated fat (3) Saturated fat (4) Not sure

**Experts classify foods into groups. We are interested to see whether you are aware of what foods are in these groups**

3. What do you think is the **level of sugar** in the following foods? (Tick one box per food)

No.	Food	High	Low	No sugar	Not sure
1	Bananas				
2	Minerals				
3	Water melon				
4	Orange juice				
5	Sugar cane				

4. Do you think these are **high or low in fat**? (Tick one box per food)

No.	Food	High	Low	No fat	Not sure
1.	Fried Doughnuts				
2.	Baked beans				
3.	Honey				
4.	Fried egg				
5.	Groundnuts				

5. Do you think experts put these in the **starchy foods group**? (Tick one box per food)

No.	Food	Yes	No	Not sure
1.	Local Cheese			
2.	Banku			
3.	TZ			
4.	Rice			
5.	Porridge			

6. Do you think these are **high or low in salt**? (Tick one box per food)

No.	Food	High	Low	Not sure
1.	Tin tomato			
2.	Red meat			
3.	Maggi			
4.	Koobi (salted fish)			
5.	Sardine			







**B. DIETARY HABIT**

**This session is to assess for appropriate dietary practices**

23. How many times do you take your main meals in a day?

- 1) Once    2) Twice    3) Thrice    4) Other (specify).....

24. How many hours' intervals do you often eat your meals?

- 1) Every one hour    2) Every two hours    3) Every three hours  
4) Ever four to five hours    5) Any time am hungry    6) Other (specify).....

25. What time of the day is your first meal?

- 1) I eat before 6 O'clock am    2) Between 6am and 7 am.  
3) From 7 to 8 O'clock am    4) After 8 O'clock am    5) Other (specify).....

26. What food you take as you first meal?

.....

27. Do you usually take snacks before your lunch meal?

- 1) Yes    2) No

(If "No", skip to Q30)

28. If yes, what time do you take your first snack?

- 1) 10 O'clock am to 11 O'clock am    2) 11 O'clock am to 12 O'clock pm  
3) After 12 O'clock pm

29. What food do you normally take as your mid-morning snack?

.....

30. Do you usually take lunch?

- 1) Yes    2) No

(If 'No', skip to Q33)



39. What type of carbohydrate foods do you mostly eat?

- 1) Monosaccharide    2) Disaccharides    3) Polysaccharides    4) (1) and (2) only  
5) (1) and (3) only    6) All carbohydrates

40. What types of fatty foods do you mostly eat?

- 1) Low fat diets    2) Medium fat diets    3) High fat diets

41. What types of fibre foods do you mostly eat?

- 1) Low fibre diets    2) High fibre diets    3) Both low and high fibre diets  
4) Don't know

**C. SOCIO-DEMOGRAPHIC CHARACTERISTICS AND NUTRITIONAL  
STATISTICS**

**I. I would like to ask you a few questions about yourself (Socio-demographic characteristics)**

42. Gender of respondent?

- 1) Male    2) Female

43. How old are you? (Write the age in the box in years)

--	--

44. Your marital status:

- 1) Single    2) Married    3) Separated    4) Divorced    5) Widowed

45. What is your ethnic origin?

- 1) Dagaaba    2) Waala    3) Sisaala    4) Others (Please specify): .....

46. What is your highest level of education?

- 1) No education    2) Primary education    3) Secondary education  
4) Tertiary education

47. What is your main source of income?

- 1) Not working    2) Farming    3) Government work    4) Trading  
5) Other (Specify).....



**APPENDIX IV: BODY FAT COMPOSITION CLASSIFICATION TABLE**

<b>Gender</b>	<b>Age</b>	<b>Low</b>	<b>Normal</b>	<b>High</b>	<b>Very high</b>
<b>Female</b>	20 – 39	< 21.0%	21.0 – 32.9%	33.0 – 38.9%	> 39.0%
	40 – 59	< 23.0%	23.0 – 33.9%	34.0 – 39.9%	40.0%
	60 – 80	< 24.0%	24.0 – 35.9%	36.0 – 41.9%	42.0%
<b>Male</b>	20 – 39	< 8.0%	8.0 – 19.9%	20.0 – 24.9%	25.0%
	40 – 59	< 11.0%	11.0 – 21.9%	22.0 – 27.9%	28.0%
	60 – 80	< 13.0%	13.0 – 24.9%	25.0 – 29.9%	30.0%

Source : (OMRON BF511, 2011), <= less than, %= percentage



**APPENDIX V: SOCIO-DEMOGRAPHIC CHARACTERISTICS DATA**

VARIABLE	TOTAL (n=117)	MALES (n=32)	FEMALES (n=85)	P-VALUE
<b>Age</b>				
35-39	10 (8.5%)	2 (6.3%)	8 (9.4%)	0.5856
40-44	27 (23.1%)	8 (25.0%)	19 (22.4%)	0.7619
45-49	42 (35.9%)	8 (25.0%)	34 (40.0%)	0.1316
50-54	19 (16.2%)	7 (21.9%)	12 (14.1%)	0.0179*
55-59	12 ( 12.3%)	4 ( 12.5%)	8 (9.4%)	0.0113*
60 and above	7 ( 6.0%)	3 ( 9.4%)	4 (4.7%)	0.0066*
<b>Marital status</b>				
Single	6 (5.1%)	2 (6.3%)	4 (4.7%)	0.7357
Married	105 (89.7%)	30 (93.8%)	75 (88.2%)	0.3808
Widowed	6 (5.1%)	0 (0.0%)	6 (7.1%)	
<b>Education status</b>				
No education	51 (43.6%)	8 (25.0%)	43 (50.6%)	0.0128*
Primary	7 (5.9%)	2 (6.3%)	5 (5.9%)	0.9404
Secondary	25 (21.4%)	10 (31.3%)	15 (17.6%)	0.1096
Tertiary	34 (29.1%)	12 (37.5%)	22 (25.9%)	0.2173
<b>Ethnicity</b>				
Dagaaba	54 (46.2%)	18 (56.3%)	36 (42.4%)	0.1789
Waala	54 (46.2%)	14 (43.8%)	40 (47.1%)	0.7489
Dagomba	1 (0.9%)	0 (0.0%)	1 (1.2%)	
Mosi	1 (0.9%)	0 (0.0%)	1 (1.2%)	
Sisala	4 (3.4%)	0 (0.0%)	4 (4.7%)	

Others	3 (2.7%)	0 (0.0%)	3 (3.6%)	
<b>Income source</b>				
Not working	14 (11.9%)	4 (12.5%)	10 (11.8%)	0.9130
Farming	16 (13.7%)	8 (25.0%)	8 (9.4%)	0.0287*
Trading	49 (41.9%)	6 (18.8%)	43 (50.6%)	0.0019*
Government work	34 (29.1%)	12 (37.5%)	22 (25.9%)	0.2173
Others (Mining and NGO)	4 (3.4%)	2 (6.3%)	2 (2.4%)	0.3011
<b>Any children under 18 years</b>				
Yes	85 (72.7%)	24 (75.0%)	61 (71.8%)	0.7264
<b>Who cook at home</b>				
Child under 18 years	8 (6.8%)	0 (0.0%)	8 (9.4%)	
Adults	41 (35.0%)	22 (68.8%)	19 (22.4%)	< 0.0001*
Respondent self	63 (53.8%)	10 (31.3%)	53 (62.4%)	0.0026*
Daughter-in-law	5 (4.2%)	0 (0.0%)	5 (5.9%)	
<b>Who determine what to cook</b>				
Husband	34 (29.1%)	26 (81.3%)	8 (9.4%)	< 0.0001*
Wife	78 (66.7%)	6 (18.8%)	72 (84.7%)	< 0.0001*
Children	5 (4.3%)	0 (0.0%)	5 (5.9%)	
<b>Nutritional Knowledge</b>				
Yes	101 (86.3%)	30 (93.8%)	71 (83.5%)	0.1515

Data presented as numbers and percentages, \*P< 0.05 is significant, %= percentage, n= number, <=less

than

APPENDIX VI: ETHICAL CLEARANCE LETTER



**UNIVERSITY OF GHANA**  
**SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES**

9<sup>th</sup> May, 2016.

Mr. Issah Ra-uf,  
Dept. of Nutrition and Dietetics,  
SBAHS,  
Korle Bu.

Dear Mr. Issah Ra-uf,

**ETHICS CLEARANCE**

Ethics Identification Number: SBAHS/10506863/AA/R10/2015-2016.

Following a meeting of the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences held on Wednesday, 13<sup>th</sup> January 2016, I write on behalf of the Committee to approve your research proposal as follows:

**TITLE OF RESEARCH PROPOSAL: "NUTRITION KNOWLEDGE AND DIETARY HABITS OF PATIENTS WITH TYPE-2 DIABETES ATTENDING THE REGIONAL HOSPITAL AT WA"**

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

• Telephone: +233 (0) 302 687 975

P. O. Box KB 143, Korle Bu, Accra, Ghana.

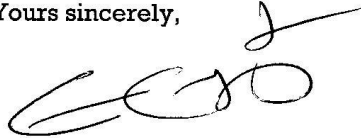
• Email: [sbahs@chs.ug.edu.gh](mailto:sbahs@chs.ug.edu.gh)

• Website: [www.chs.ug.edu.gh](http://www.chs.ug.edu.gh)

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

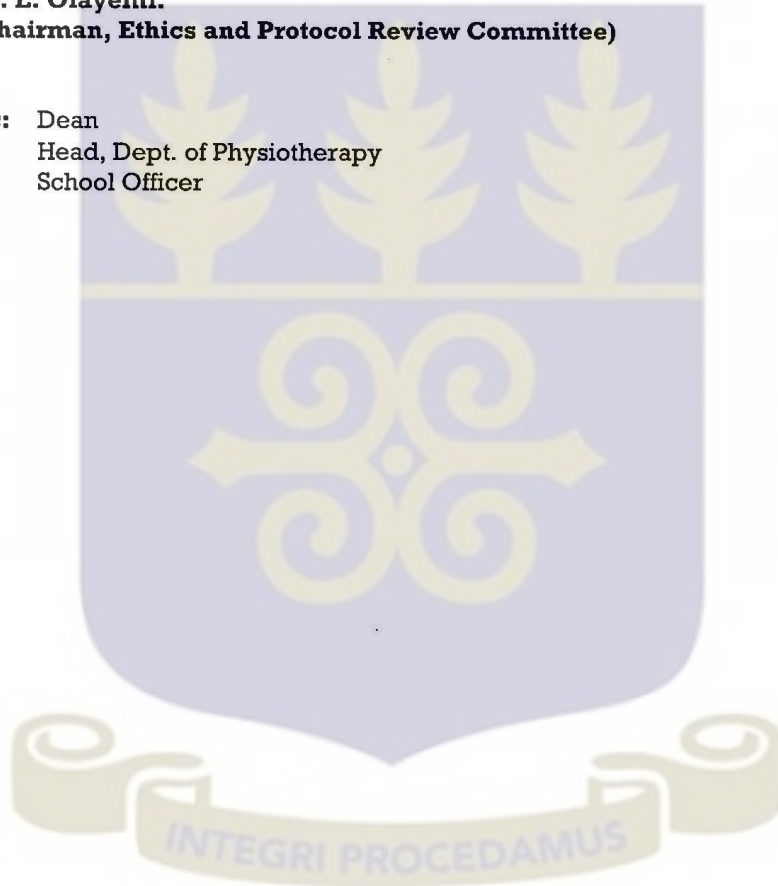
Thank you.

Yours sincerely,



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

**Cc:** Dean  
Head, Dept. of Physiotherapy  
School Officer



**APPENDIX VII: DEPARTMENT OF NUTRITION AND DIETETICS**

**INTRODUCTORY LETTER**



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

April 27, 2016

**THE OFFICER IN-CHARGE  
WA REGIONAL HOSPITAL  
UPPER WEST REGION  
WA**

Dear Sir/Madam,

**LETTER OF INTRODUCTION – RA-UF ISSAH**

Mr. Ra-uf Issah is a final year Master of Science (MSc. Dietetics) student of University of Ghana with the Department of Nutrition and Dietetics at the School of Biomedical and Allied Health Sciences.

He is to conduct a study on” **Nutrition Knowledge and dietary habits of patients with type-2 diabetes attending the Regional Hospital at Wa**” in the Upper West Region of Ghana.

We hereby write to request permission and assistance for the researcher to work with **your facility (Wa Regional Hospital)** between May 3, to May 20, 2016.

Please do not hesitate to contact the department for any further information.

Thank you.

Yours faithfully,

**Dr. Matilda Asante**  
**Head of Department**

COLLEGE OF HEALTH SCIENCES

• P. O. Box KB 143, Korle Bu, Accra, Ghana. • Telephone: +233 (0) 302 687974/5 / +233 (0) 505 870938  
• Email: [nd.sbahs@chs.ug.edu.gh](mailto:nd.sbahs@chs.ug.edu.gh) • Website: [www.chs.ug.edu.gh](http://www.chs.ug.edu.gh)

APPENDIX VIII: GHANA HEALTH SERVICE INTRODUCTORY LETTER

*In case of the reply the number  
and date of this letter  
should be quoted.*

My Ref. No GHS/UWR/HRP-51  
Your Ref. No.....



GHANA HEALTH SERVICE  
REGIONAL HEALTH ADMIN  
P. O. BOX 298  
WA UWR  
GHANA

May 11, 2016

Tel: +233 07 56 22 204 or 22 016  
Fax: +233 07 56 22 471  
Email: [ghs-uwr@africaonline.com.gh](mailto:ghs-uwr@africaonline.com.gh)

THE MEDICAL DIRECTOR  
UPPER WEST REGIONAL HOSPITAL  
WA

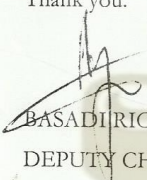
**INTRODUCTORY LETTER: MR RA-UF ISSAH**

The above named candidate is a final year Master of Science (MSc. Dietetics) student of the University of Ghana, Department of Nutrition and Dietetics.

As part of the requirement of his Programme of study, he has chosen to conduct a study in your Hospital on "Nutrition Knowledge and dietary habits of patients with type-2 diabetes attending the Regional Hospital at Wa".

Kindly accord him the necessary support and cooperation and take the necessary steps to ensure that the privacy and confidentiality of staff/clients who will be participating in the study are guaranteed.

Thank you.

  
BASADI RICHARD

DEPUTY CHIEF HEALTH RESEARCH OFFICER  
FOR AG. REGIONAL DIRECTOR OF HEALTH SERVICES

Cc:

Research file

Mr. Ra-uf Issah ✓

