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SCHOOL OF FOOD TECHNOLOGY, NUTRITION AND BIO-ENGINEERING (SFTNB)

ASSESSMENT OF KNOWLEDGE AND CONSUMPTION PATTERNS OF FIBRE RICH FOODS AMONG DIABETIC PATIENTS AGED 18 YEARS AND ABOVE AT KIRUDDU HOSPITAL

BY

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A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF FOOD TECHNOLOGY NUTRITION AND BIO ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF BACHELOR OF SCIENCE IN HUMAN NUTRITION

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DECLARATION

I NAKITENDE HAJARAH, hereby declare that all the information in this report is my original work and has never been presented or submitted to any university or institution for the award of a degree.

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APPROVAL

This is to certify that this research titled "ASSESSMENT OF KNOWLEDGE AND CONSUMPTION PATTERNS OF FIBRE RICH FOODS AMONG DIABETIC PATIENTS AGED 18 YEARS AND ABOVE AT KIRUDDU HOSPITAL" was carried out under my supervision.

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DEDICATION

This special project report is dedicated to God for all He has provided me throughout my academic journey.

I also dedicate this report to my mother Miss Bukenya Margaret for all her social, emotional and financial support.

I dedicate this to my siblings especially my sisters Brendah and Sharon for all their support.

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I thank God for the gift of life, knowledge and for all the strength he has provided me to conquer all my challenges throughout these years.

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May God reward and bless you abundantly.

ACRONYMS

DM	Diabetes Mellitus
ADA	American Diabetes Association
BMI	Body Mass Index
CVD	Cardiovascular Disease
HbAIC	Glycosylated Hemoglobin
HDL	High Density Lipoprotein
IDF	International Diabetes Federation
SPSS	Statistical Package for Social Sciences
MoH	Ministry of Health
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
WHO	World Health Organization
CHD	Coronary Heart Disease

ABSTRACT

Type 2 diabetes mellitus (T2DM), a disease previously known for "the rich", has become a health problem affecting both the rich and poor. The disease has increasingly become prevalent in adults and the elderly. Diabetes mellitus is a medical complication characterized by an elevation of blood glucose level. In 2015, it was estimated that there were 408 million people with type 2 diabetes in the world. This accounted for about 90% of diabetes cases. However, with the increasing prevalence of T2DM, there has not been enough sensitization about this killer disease.

Diet, exercise and behavioral approaches represent the key for management and prevention of diabetes. More important, consumption of dietary fibers was inversely related to T2DM and CVDs. Researchers stressed that, consumption of more than 26g a day had an 18% lower risk of developing type 2 diabetes than those with the lowest intake. Fibre is related with a variety of physiological effects and some health benefits include reduced risks of obesity, CHD and diabetes.

This study was aimed at assessing the knowledge and consumption patterns of fibre rich foods among diabetic patients at Kiruddu Hospital. Specific objectives included; i) assessing the knowledge on health benefits of consuming dietary fibre, ii) assessing the consumption patterns of fibre rich foods, iii) determining their nutritional status and iv) determining the lifestyle factors used in management of diabetes among diabetic patients at Kiruddu Hospital.

Majority of the respondents were female (62%), and most of the respondents were educated to at least primary level (48%). The majority (70%) of the respondents were overweight and obese. Results from the study showed that majority of the people were not engaged in smoking (85% non-smokers) and alcohol consumption (51% non-drinkers). Majority (60.2%) of the respondents had knowledge on fibre and had attained it from medical workers. There was a significant relationship between knowledge of fibre and consumption of fibre among the patients but food sources of fibre were mainly consumed occasionally by the respondents.

There was awareness on fibre among the diabetic patients at Kiruddu Hospital and patients had knowledge on some of its uses in the management of diabetes especially glycemic control. However, there is need for sensitization on frequency and amount of fibre the patients should consume.

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background

Diabetes is a chronic, progressive disease characterized by elevated levels of blood glucose. Hyperglycemia is the hallmark sign of type 2 diabetes mellitus, and this is a condition where glucose levels in blood are abnormally high (Kaku, et al., 2010). A random plasma sugar test of 200 mg/dL (11.1 mmol/l) or higher is the diagnosis of type 2 diabetes mellitus (WHO, 2006). This occurs when either the pancreas does not produce enough insulin, a hormone that regulates blood glucose, or when the body cannot effectively use the insulin it produces (WHO, 2018). This is referred to as type 1 and type 2 diabetes respectively. Type 2 diabetes is much more common and accounts for around 90% of all diabetes cases worldwide (King & Rewers, 2011)

Around 8.8 percent of the global adult population suffered from diabetes in 2017 and by the year 2045 this number is expected to rise to almost 10 percent (Elflein, 2019). Africa is expected to see a 153 percent increase in the number of diabetics in the region from 2017 to 2045 (Elflein, 2019). According to International Diabetes Federation (2019), an estimated 15.5 million adults aged 20-79 years in the IDRIED FRUIT region were living with diabetes in 2017, representing a regional prevalence of 3.3%. The highest prevalence of diabetes in the Region is found in adults aged 55 to 64 (IDRIED FRUIT 2019). More than half (55.3%) of adults living with diabetes in the Africa Region live in urban areas. Diabetes was also responsible for 312,000 deaths in the IDRIED FRUIT Africa Region in 2017. 3 in 4 of these deaths were in people under 60 (IDRIED FRUIT 2019). According to WHO (2016), the prevalence of diabetes and risk related factors in Uganda has been increasing steadily with the numbers now at 2.7% for males and females at 3.0%. Diabetes contributes 1% of all total deaths among all ages in the country (WHO, 2016).

T2DM has increasingly become prevalent in adults and the elderly. The increase in the disease is attributable to changes towards a western lifestyle (a high caloric diet with reduced physical activity) and the rise in cases of overweight and obesity (Chan et al., 2009). Decades of research have shown that much of the burden of chronic diseases is attributable to multiple lifestyle factors working collectively. Proximate risk factors for type 2 diabetes include obesity, family history,

insufficient physical activity, raised cholesterol, tobacco use, harmful use of alcohol and unhealthy diets (Eriksson, van den Donk, Hilding, & Ostenson, 2013).

Diabetes and hyperglycemia present a complex set of clinical problems. Uncontrolled diabetes reduces patients' life expectancy by a mean of 15 years and increases morbidity by 3-4 times that of a nondiabetic population because of vascular and neuropathic complications (Gardner, 2014). Complications of poorly controlled hyperglycemia include the acute manifestation of dehydration and metabolic dysfunction of ketoacidosis (DKA), hyperosmolar nonketotic coma and lactic acidosis (Gardner, 2014). These patients also suffer chronic problems of wound infection, delayed wound healing, as well as chronic target organ damage, such as cardiovascular disease, cerebrovascular disease, renal disease, autonomic neuropathy and retinopathy (Gardner, 2014). Other symptoms also include increased thirst, frequent urination, fatigue and unexplained weight loss, increased hunger, feeling tired, and sores that do not heal (Yach, Hawkes, Gould, Hofman, 2014).

The American Diabetes Association (ADA) and American Association of Clinical Endocrinologists (AACE) endorse no specific diets for diabetes. However, the emphasis should be on a low fat (avoid fried foods) and a more complex high-fibre carbohydrate diet, particularly foods with soluble fibre such as leafy vegetables, fruits, cereals, roots and pulses. Brown bread or whole wheat bread, pasta, basmati rice, chapattis or potatoes should be the main part of meals, avoiding the use of spreads (Joshi, 2014). Fibre provides several health benefits such as helping to maintain a healthy body weight, and lowering the risk of diabetes and heart disease (Nordqvist, 2017). In people with diabetes, fibre particularly soluble fibre can slow the absorption of sugar and help improve blood sugar levels (Nordqvist, 2017). Increased fibre intake also improves insulin sensitivity and glucose metabolism in the body (Mitra, 2017). High fibre diets and guar gum have been used in diabetics to decrease and delay carbohydrate digestion and absorption (Mitra, 2017). Dietary fibre is reported to improve the postprandial glycemic response and insulin concentrations, most likely by slowing the digestion and absorption of food and by regulating several metabolic hormones (Meyer, 2000). Increased fibre in the diet is associated with a reduction of glycated hemoglobin (HbA1c), improved lipid profile, and loss of body weight in type 2 diabetes patients (Lubia, 2016).

1.2 Problem statement

Type 2 diabetes mellitus is one of the Non-communicable diseases which have increasingly become a health threat globally (Rowley, et al., 2017). A survey carried out in Uganda, by the ministry of Health titled rapid assessment of morbidity due to Non-Communicable diseases showed that type 2 diabetes mellitus accounts for 25% of the NCD related deaths in Uganda (Maher, Waswa, & Baisley, 2011). However, this death can be prevented and the disease can be managed through adjustments in lifestyle, dietary patterns and medications.

Type 2 diabetes mellitus leads to a number of complications amongst the patients (Stolar, 2010). Over time diabetes can damage the heart, blood vessels, eyes, kidneys and nerves, and increase the risk of heart disease and stroke. Diabetes is among the leading causes of kidney failure (WHO & IDRIED FRUIT, 2012). With such complications, a number of the diabetic patients are hospitalized reducing on their productivity and at worst leading to death.

Limited knowledge about the risk factors, prevention and management of type 2 diabetes is a problem amongst most communities in Uganda (Mayega, 2014). Little information is known on the use of dietary fibre in management of diabetes among patients in Uganda. There is need to determine the consumption patterns of fibre rich foods among the diabetic patients and the knowledge they have with respect to dietary management of diabetes. The study therefore aimed at identifying the gap in knowledge on fibre rich foods and their consumption patterns among diabetic patients at Kiruddu Hospital.

1.3 OBJECTIVES

1.3.1. General objective

To assess the nutrition knowledge and food consumption patterns of diabetic patients at Kiruddu Hospital.

1.3.2. Specific objectives

i. Assess the knowledge of diabetic patients at Kiruddu Hospital on dietary fibre in management of type 2 diabetes.
ii. To assess the consumption of fibre rich foods among diabetic patients at Kiruddu Hospital
iii. To determine nutritional status of diabetic patients at Kiruddu Hospital

iv. To determine the lifestyle factors used in management of diabetes among diabetic patients at Kiruddu Hospital

1.3.3. Hypothesis

i. There is no relationship between nutrition knowledge and consumption of fibre rich foods among diabetic patients at Kiruddu Hospital.

ii. There is no relationship between nutritional status and presence of diabetes among diabetic patients at Kiruddu Hospital

iii. There is no relationship between lifestyle and management of diabetes among diabetic patients at Kiruddu Hospital

1.4. Significance of the study

The findings of the study provided knowledge on whether the diabetic patients seeking medical care at kiruddu hospital have knowledge on fibre rich foods, it's importance in management of the disease. The study also generated information which can be used to formulate interventions or policies for better management of diabetes among the patients. This information can be used as a basis for providing education to the patients depending on the knowledge gaps found.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Trends and prevalence of diabetes

2.1.1. Globally

It was estimated in 2017 that there were 451 million (aged 18-99years) people with diabetes worldwide and these were expected to increase to 693 million by 2045 (N.H. Cho, 2018). In 2017, approximately 5 million deaths worldwide were attributable to diabetes in 20-69years age range and the global health care expenditure on people with diabetes was estimated to be USD 850 billion.

According to (Whiting, 2011) a total of 565 data sources were reviewed, of which 170 sources from 110 countries were selected. The top ten countries with the highest number of people with type two diabetes mellitus include, china with 90 million, India with 60.l million, USA with 23.7 million, Russia with 12.6 million, Brazil with 12.4 mi1lion, Japan withl0.7 million, Mexico with 10.3 million, Bangladesh with 8.4 million, Egypt with 7.3 million and lastly Indonesia with 7.3 million people.

The largest increases are expected in the older age groups in low and lower-middle income countries, with numbers more than doubling for the over 60-year age-group. The overall total predicted increase in numbers with diabetes from 2011 to 2030 is 50.7%, at an average annual growth of 2.7%, which is 1.7 times the annual growth of the total world adult population (Rowley, et al., 2017).

2.1.2. Africa

According to the WHO Global report on diabetes, the prevalence of diabetes in Africa was 3.1% in 1980 but increased to 7.1% (25 million) in 2016 (WHO 2016).

Sub-Saharan Africa, like the rest of the world, is experiencing an increasing prevalence of diabetes alongside other non-communicable diseases. A systematic review and meta-analysis of sub-Saharan Africa reported a regional estimate at 5.7% for DM (Hall et al, 2011). Diabetes prevalence varies between countries and rural-urban gradients from 0.6% in rural Uganda to 12% in urban Kenya. A low to medium prevalence (0-7%) was recorded in Cameroon, Ghana, Guinea, Kenya,

Nigeria, South Africa and Uganda and a very high prevalence (> 10%) was recorded in Zimbabwe (Hendrickson, 2011).

Prevalence estimates varied considerably between different studies for some countries, with estimates for rural South Africa ranging from 3.9% to 8.8%. Variation between urban and rural populations was frequently observed, with a higher prevalence recorded in urban populations. Prevalence recorded in Christensen's Kenyan survey ranged from 2% in rural areas to 12% in urban areas. The prevalence also ranged from 18% in urban Libya to 13.1% in rural Egypt (Maliik & Wegner, 2012)

2.1.3. Uganda

In Uganda, diabetes and other NCDs were rare in the early 1900 (Cook, 1901) but recent data suggest that they have become significant public health problems. A cross-sectional study in Kampala and Mukono districts in 2012 estimated the prevalence of type 2 diabetes mellitus to be 7.4 % amongst adults. Prevalence estimates for diabetes have varied from 0.4% in cross-sectional surveys around the shores of Lake Victoria to 8.1% in towns close to the city of Kampala and 9.0% in foothills of Rwenzori Mountains in Western Uganda. (Bahendeka & Wesonga, 2016).

2.2. Pathophysiology of type 2 diabetes mellitus

Type 2 diabetes, formerly known as non-insulin dependent diabetes mellitus (NIDDM), is caused by decreased sensitivity of target tissues to insulin (Ozounghu, et al., 2013) followed by beta cell exhaustion leading to insufficient insulin production from beta cells. Insulin resistance, which is the inability of cells to respond adequately to normal levels of insulin, occurs primarily within the muscles, liver, and fat tissue. In the liver, insulin normally suppresses glucose release. (Kaku, et al., 2010). Thus, insulin resistance leads to an overall rise in the level of glucose in the blood. Glycogen stores become markedly reduced and there is less glucose available for release when it may be needed. Obesity and lack of physical activity are thought to be major causes of insulin resistance (Booth, et al., 2013).

Diabetes is diagnosed by fasting plasma glucose of 7.0 mmol/l (126 mg/dl) or above, or random plasma glucose of 11.1mmol/l or above (ADA, 2016). Individuals with sustained blood pressure greater than 135/80 mmHg, BMI greater than 25kg/m^2, family history of type 2 diabetes (first degree relative), altered lipid profile (HDL below 35mg/dl, LDL above 250mg/dl) and age 45 years have been recommended for screening for type 2 diabetes (ADA, 2012).

2.3. Risk factors for type 2 diabetes

Type 2 diabetes, is a heterogeneous multifaceted disorder that results from both genetic factors related to abnormal insulin secretion and insulin resistance. Factors like obesity, unhealthy lifestyle like excessive eating, lack of exercise, stress as well as aging may also contribute to the development of the disease (Kaku, 2010).

There is a close association between BMI and risk of developing T2DM, the relative risk of T2DM increasing with BMI. For each kilogram of weight gained annually over a period of 10 years, there is an associated 49% increase in the risk of developing T2DM in the subsequent 10 years. Conversely, for each kilogram of weight lost annually over 10 years, there is an associated 33% reduction in the risk of developing T2DM in the subsequent 10 years (Daousi, et al., 2010).

Increased fat accumulation results into elevated non esterified fatty acid (NEFA) levels in the plasma that in turn results into insulin resistance hence increasing risks for type 2 diabetes mellitus (Karpe, Dickmann, & KN, 2011). An increase in body fat is generally associated with an increase in risk of metabolic diseases such as type 2 diabetes mellitus, hypertension and dyslipidemia (WHO, 2003).

Diet quality also plays an important role in the development of diabetes, independent of body mass index (BMI) and a series of other risk factors. Especially, higher dietary glycemic load and trans-fat intake are associated with increased diabetes risk, whereas higher consumption of cereal fibre and polyunsaturated fat are associated with decreased risk (Hu, Manson, & Stampfer, 2007).

In a number of studies, the results from the NHS indicated that the higher nut and peanut butter consumption will lower the risk of type 2 diabetes (Dietz,2009), and the higher consumption of sugar-sweetened beverages is associated with a greater magnitude of weight gain and an increased risk for development of type 2 diabetes (ADA, 2008), yet higher potato and French fry consumption are both positively associated with the incident type 2 diabetes and this association is more pronounced in those with obesity (Malik, et al., 20I0).

With rapid globalization and socioeconomic development, smoking and alcohol consumption are becoming more and more common and arouse increasing public concern. Meta-analysis found that active smoking is positively associated with an increased risk of type 2 diabetes (Wilii, Bodonmann, Ghali, Farah, & Cornuz, 2013).

Compared with non-smokers, current smokers had a 45% increased risk of developing diabetes. The association between the number of cigarettes smoked and diabetes risk was consistent with a dose-response phenomenon (Shimokata, Muller, & Andres, 2010). Even with a normal BMI, smokers tend to have a greater risk of having abdominal obesity than nonsmokers, because smoking has an anti-estrogenic effect and can disorder the hormonal balance and then lead to abdominal obesity. General obesity and abdominal obesity are both strongly associated with the development of type 2 diabetes (Jin, Huang, & Bi, 2011).

Physical inactivity has also been sighted out as one of the risk factors for type 2 diabetes mellitus. A sedentary lifestyle is directly linked to the risk of type 2 diabetes mellitus. A survey carried out by the NHS showed that individuals who watched TV for 4hours per day increased their risks of getting type 2 diabetes mellitus by 14%. The adoption and maintenance of physical activity are critical foci for blood glucose management and overall health in individuals with diabetes and pre-diabetes (Avery, et al., 2015). Rural dwellers' higher level of physical activity and related energy expenditure compared with urban subjects goes far to explain why obesity was found to be at least four times higher in urban areas than rural (Aspraly et al., 2000). Thus, lack of physical activity appears to be a significant risk factor for diabetes in Sub- Saharan Africa.

Evidence also suggests that depression is a significant risk factor for developing type 2 diabetes and it has been found that the relative risk was 1 in 17 women with depressed mood and 1.25 in women using antidepressants (Pan et al., 2010).

2.4. Complications of DM

Hyperglycemic damage is responsible for the micro and macro-vascular complications of diabetes, which are the major sources of mortality and morbidity in diabetic patients. Macrovascular complications of diabetes include coronary artery disease, stroke and peripheral artery disease while micro vascular complications include retinopathy and neuropathy (Fowler, 2008).

The prevalence of chronic complications of diabetes varies across studies. Some researchers have reported the most common chronic complications were erectile dysfunction at 64% (Peter et al., 2012), visual disturbance at 33.8% (Worku, et al., 2010), cardiovascular disorders at 30.1% (Liu et al., 2010), neuropathy at 29.5% (Worku, et al., 2010) and nephropathy at 15.7% (Worku, et al.,2010).

Diabetic retinopathy may be the most common micro-vascular complication of diabetes and it is responsible for approximately 10000 new cases of blindness every year in the US alone (Fong et al., 2004). Retinopathy may begin to develop as early as 7 years before diagnosis of diabetes in patients with type 2 diabetes (Fong et al., 2004). A number of mechanisms have been proposed to underlie development of retinopathy. Excessive glucose into the body is converted to a sugar alcohol (sorbitol) by aldose reductase enzyme via the polyol pathway. Sugar alcohol accumulation has been linked to micro-aneurysm formation, thickening of basement membranes, and a loss of pericytes (Fong et al., 2004). Also, advanced glycosylated end products formed by non-enzymatic reactions of excess glucose and proteins have also been associated with micro vascular damage (Fowler, 2008). Oxidative stress from hyperglycemia may also play an important role in cellular injury. High glucose levels can stimulate free radical production and reactive oxygen species formation which are detrimental to vascular function (Fowler, 2008).

Diabetic neuropathy is recognized by the American Diabetes Association (ADA) as the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes (ADA, 2007). Peripheral neuropathy in diabetes may manifest in several different forms, including sensory, focal/multifocal, and autonomic neuropathies. More than 80% of amputations occur after ulceration or injury, which can result from diabetic neuropathy (Chan JC et al., 2009).

Chronic sensorimotor distal symmetric polyneuropathy is the most common form of neuropathy in diabetes. Typically, patients experience burning, tingling and “electrical pain” but sometimes they may experience simple numbness. In patients who experience pain, it may be worse at night. Patients with simple numbness can present with painless foot ulceration, so it is important to realize that lack of symptoms does not rule out presence of neuropathy. Physical examination reveals sensory loss to touch, vibration, and temperature (Fowler, 2008).

Diabetes also increases the risk that an individual will develop cardiovascular disease (CVD), which is the primary cause of death in people with either type 1 or type 2 diabetes (Fowler, 2008). The vascular disorders include retinopathy and neuropathy, peripheral vascular disease (PVD), stroke, and coronary artery disease (CAD) (Dokken, 2008). Diabetes also affects the heart muscle, causing both systolic and diastolic heart failure (Dokken, 2008).

2.5. Management of diabetes

The major aspects of managing diabetes include dietary and lifestyle modifications, such as increasing exercise to avoid or treat obesity and smoking cessation. Regular exercise, independent of weight loss improves insulin sensitivity and cardiovascular outcomes (Bilous and Donnelly, 2010).

Lifestyle changes include maintenance of normal weight, weight loss, exercise programs (e.g. aerobic physical activity in form of cycling, brisk walking, jogging and any other sporting activities), avoiding/ cessation of smoking, limited or no consumption of alcohol and healthy diet (ADA, 2013). Regular physical activity is a key part of diabetes self-management. Studies show that the risk of mortality among people with diabetes is inversely related to fitness level (Morrato, et al., 2006).

Avoiding sedentary periods may not only help prevent T2DM for those at risk but also aid in glycemic control for those with diabetes (ADA, 2017). All adults and particularly those with type 2 diabetes, should decrease the amount of time spent on daily sedentary behavior like sitting on computer and watching TV by interruptions every 30minutes through walking, standing and light activities for blood glucose benefits (Dempsey et al,.2016).

Alcohol consumption among adults in moderation of less than 1 standard drink of alcohol per day for adult women and no more than 2 standard drinks of alcohol per day for adult men has no reported deteriorative effects on long term glucose control in diabetes. However, excessive consumption is associated with hypoglycemia, weight gain and hyperglycemia (Mozzafarian, 2016). Evidence also suggests that stopping smoking reduces the risk of microvascular and macrovascular complications in people with type 2 diabetes mellitus (Tuomilehto, 2005).

2.5.1. Dietary management of diabetes

Nutrition therapy is an integral part of the treatment and self-management of diabetes (CDA, 2013). Diet plays an important role in the development and control of type 2 diabetes mellitus and many patients with type 2 diabetes mellitus can be managed by diet alone without the use of hypoglycemic agents or insulin (Alam Khan, 2003). Determining and following an eating plan is the most challenging part for many diabetic patients and there is not a one-size fits all eating pattern for individuals with type 2 diabetes (ADA, 2017). Many healthful eating patterns have been made like the Mediterranean diet (Espositol, et al., 2009), the DASH diet (Cespedes et al., 2016) and

plant-based diets (Rinaldi et al, 2016) among others for management and prevention of diabetes. For proper management of diabetic individuals, the diet must be designed to supply adequate amount of nutrients namely carbohydrates, fat, proteins, vitamins and minerals. The diet should contain 60% carbohydrates, 20-25% fat and 15-20% protein (Alam Khan, 2003).

The amount of carbohydrate in a meal is the most important factor influencing blood glucose levels after a meal (Nutrition Australia, 2009). Monitoring carbohydrate intake and considering the blood glucose response to dietary carbohydrate is a key for improving postprandial glucose control (Delahanty et al., 2009). The glycemic index (GI) is a useful tool to choose foods to help control blood glucose levels in people with diabetes. Carbohydrates in food are digested and absorbed at different rates. The GI is a way of ranking carbohydrate containing foods (from 0-100) based on whether they raise blood sugar levels a lot, moderately or a little. Carbohydrate containing foods that are digested quickly result in a high blood glucose level and are classified as high GI foods with a GI of 70 and above. Carbohydrate foods that are digested more slowly raise blood glucose levels more slowly and so have a lower GI (low GI foods) and these are foods with a GI of 55 and below e.g. milk and dairy products of reduced or low fat varieties, whole grain bread, breakfast cereals, grains like barley, legumes like beans and peas, fruits and vegetables (Nutrition Australia, 2009). Eating foods with a low GI can help people with diabetes control their blood glucose levels (Nutrition Australia, 2009). Some studies have shown that consuming low glycemic load carbohydrates reduces HbA1c by 0.2% to 0.5% (Wheeler et al., 2010) which indicates better glycemic control.

According to Wheeler and colleagues, a diet high in proteins (as 30% of calories) may or may not improve HbA1C but appears to improve one or more cardiovascular risk factors among diabetic patients (Wheeler, et al., 2012). However, ingested protein may enhance the insulin response and cause hypoglycemia in individuals with type 2 diabetes and therefore carbohydrate sources high in protein should not be used to treat or prevent hypoglycemia (Layman et al., 2008).

Since diabetes makes heart disease more likely, it is particularly important to keep the risk as low as possible by eating foods lower in unhealthy fats especially saturated and trans fats (Ratini, 2017). However, an eating plan emphasizing an element of monosaturated fats and polyunsaturated fat may improve glucose metabolism and lower CVD risk (Estruch, et al., 2013). Such a diet can be an effective alternative to a diet low in total fat but relatively high in

carbohydrates. Generally, type 2 diabetics are advised to follow guidelines for the general population i.e. reducing dietary intake of saturated fat to less than 7% (FAO, 2010), reducing dietary cholesterol and trans fats of animal origin (USDHHS, 2016) and increasing plant and fish based mono and polyunsaturated fats (ADA, 2017).

Diabetes especially when poorly controlled is associated with increased accumulation of oxidative end products. The increased oxidative stress in diabetes is the result of excess glycaemia and depletion of the antioxidant defense system. However, measurements of individual antioxidant vitamins have not consistently been shown to be deficient in people with diabetes (Chehade, 2009). Vitamin, mineral and herbal/non-herbal supplementation for diabetic patients is not supported by evidence, unless underlying defficiencies have been reported (Evert et al., 2014). Routine supplementation with antioxidants such as vitamin E, C and carotene is not advised because of lack of evidence of efficacy and concern of long term safety (Chehade, 2009). People with poorly controlled diabetes are susceptible to multiple micronutrient deficiences and should therefore be educated about the importance of acquiring daily vitamin and mineral requirements from natural food sources (Chehade, 2009).

2.5.2. Fibre and diabetes

The diabetic nutrient study group recommends fibre intake of >20 g/1000kcal/day and a total calories from carbohydrates of 45-60% (Ley et al,. 2014). Fibre is commonly classified as soluble, which dissolves in water or insoluble, which doesn't dissolve (Ayman, Ihab, & Amin, 2016). The soluble fibre can dissolve in water to form a gel-like material. Soluble fibre is found in oats, peas, beans, apples, citrus fruits, carrots, barley and psyllium (Ayman, Ihab, & Amin, 2016). The solubility of fibre refers to its ability to dissolve in water, forming viscous gels that bypasses the digestion of the small intestine and slow down the absorption and digestion of carbohydrates (Wong & Jenkins, 2007). Evidence suggests that addition of soluble dietary fibre e.g. oat products, eggplants, beans slows gastric emptying and delays the absorption of glucose in the small intestine thereby improving postprandial blood glucose control (Anderson et al., 2004). Individuals with diabetes are therefore encouraged to replace refined carbohydrates and sugars with whole grains, legumes, vegetables and fruits.

Dietary fibre consumption has an effect in reducing postprandial glucose, increased satiety, better glycemic control, improvement of cardiovascular risk factors, and reduced risk of macrovascular

complications. It is therefore important to promote a varied diet, with a high consumption of high soluble and insoluble fibre foods, mainly derived from vegetables, whole grains, dried fruits, and fruits with a low glycemic index (Lubia, et al., 2016).

Soluble fibre may produce a slower and longer-lasting release and absorption of macronutrients due to increased intraluminal viscosity (Dikeman & Fahey, 2006). In the intestine, the gel-like material that is formed by soluble fibre traps nutrients inside its gel and slows down their absorption considerably while passing through the digestive tract. Inside the gel, nutrients are protected from the action of digestive enzymes and less likely to reach the wall of the intestines for absorption (Kritchevsky & Bonfield, 2012). This lowers the sharp rise of blood sugar after a meal, and improves the sensitivity of the cells to the action of insulin (Kritchevsky & Bonfield, 2012). In addition, Water soluble fibre thickens the unstirred water layer covering the surface of the intestines, which makes the nutrients more resistant to cross this layer and to diffuse into the body (Guillon & Champ, 2000).

Increased fibre in the diet is associated with a reduction of glycated hemoglobin (HbA1c), improved lipid profile, and loss of body weight in type 2 diabetes patients. It has been proposed that appropriate consumption of fruit in the diet may be an adequate strategy to reduce HbA1c, given the fibre content, and prevent complications from diabetes (Lubia, et al., 2016). Dietary fibre can also reduce the incidence of stroke in patients with type 2 diabetes (Lubia, et al., 2016).

Large hip and thigh circumferences are associated with a lower risk of type 2 diabetes, independently of BMI, age and waist circumference where as a larger waist circumference is associated with a higher risk (Snijder, 2003). A higher fibre intake is associated with lower levels of weight and waist circumference (Lubia, et al., 2016) thus reducing the risk of T2DM.

The 2015 Dietary Guidelines for Americans included the following three healthy dietary patterns: a Healthy US-style Pattern, a Healthy Vegetarian Pattern and a Healthy Mediterranean-style pattern. Fruits, nuts, and seeds play a prominent role in all three of these food-based dietary patterns, which recommend 350–440 g/day of fruit, and 16–28 g/day of nuts and seeds.

To extend their shelf life, fresh fruits can be processed by various techniques to become dried fruits (Chang, Alasalvar, & Shahidi, 2016). Dried fruits are a concentrated form of fresh fruits with a lower moisture content. Fruits can be dried whole (e.g., apricots, berries and grapes), in halves, or

in slices (kiwis, mangoes and papayas). In this form, they are easy to store and distribute, they can be available throughout the year, and they are a healthier alternative to salty or sugary snacks. Nuts such as almonds, Brazil nuts, cashews, hazelnuts, macadamias, peanuts, pecans, pine nuts, pistachios and walnuts are also good sources of fibre. Pistachios are particularly rich in β-carotenes which have been widely associated with a protective T2D role (Sluijs, et al., 2015).

More than 30 years ago, the consumption of nuts and dried fruit was discouraged because of their high fat and sugar content, respectively. However, at the beginning of the 1990s, several randomized clinical trials (RCT) and animal experiments demonstrated their potential beneficial effect on cardiovascular diseases (CVD) (Ros, 2015). Nuts and dried fruit are essential foods in the Mediterranean diet (Widmer, Flammer, Lerman, & Lerman, 2015). Nuts and dried fruit contain various macro and micronutrients together with other important bioactive compounds that may synergically contribute to modulate specific metabolic diseases such as hypercholesterolemia, hypertension and type 2 diabetes (Chang, Alasalvar, & Shahidi, 2016). Nuts and Dried fruits contain compounds such as Vitamins (Vitamin E, niacin, choline and/or folic acid), minerals (magnesium, potassium, calcium and/or phosphorus), phenolic compounds, carotenoids and/or phytosterols (USDA, 2015). Importantly, both foods also contain a considerable amount of dietary fiber (Hernández-Alonso., Camacho-Barcia., & Salas-Salvadó, 2017). Overall, their unique and varied nutrient composition makes them key foods to counteract various metabolic diseases (Hernández-Alonso., Camacho-Barcia., & Salas-Salvadó, 2017).

Both nuts and Dried fruits are high in dietary fiber (USDA, 2015). Diets rich in complex carbohydrates (CHO) and fiber are associated with increased insulin sensitivity and reduced plasma insulin levels, promoting better glycaemic control in diabetic patients (Chandalia, et al., 2000). Soluble fiber increases gastric distension, viscosity in the gastrointestinal tract, and slower absorption of macronutrients (Dikeman & Fahey, Viscosity as Related to Dietary Fiber, 2006). As a consequence, the speed of CHO absorption and the concentration of postprandial glucose tend to be lower after the ingestion of fiber-rich foods than foods or meals poor in fiber (Hopping, et al., 2010). Fibre is resistant to enzymatic digestion in the small intestine and thus susceptible to fermentation by bacteria in the colon. It produces short chain fattyacids (SCFA e.g. acetate, propionate and butyrate) which reduce the production of hepatic glucose and stimulate the secretion of Glucagon-like peptide 1 (GLP-1) (Lovejoy, 2005). Incretins such as GLP-1 and gastric

inhibitory polypeptide (GIP) stimulate the secretion of insulin by β-cells and promote the proliferation of these cells, favoring the maintenance of normal blood glucose levels (Heppner & Perez-Tilve, 2015). The secretion of GLP-1 which is mainly performed by enteroendocrine L-cells of the gastrointestinal tract is partly mediated by monosaccharides, peptides and amino-acids, monounsaturated fatty acids and polyunsaturated fatty acids as well as by short chain fatty acids. Therefore, the positive influence of GLP-1 on blood glucose homeostasis, appetite sensations, and food intake provides a strong rationale for its therapeutic potential in the nutritional management of T2D and obesity (Bodnaruc, Prud'homme, Blanchet, & Giroux, 2016). Overall fiber contained in nuts and Dried fruits is also able to decrease postprandial glycaemic levels and this could be a strategy for increasing insulin sensitivity which improves T2D and several other CVD risk factors for chronic diseases (Brand-Miller, Hayne, Petocz, & Colagiuri, 2003). The inclusion of both nuts and dried fruits, vegetables and other sources of fibre in a balanced diet may reduce the overall glycaemic index of the diet, with benefits to glycaemic and insulinemic control in both healthy and T2D subjects (Mirrahimi, et al., 2014).

CHAPTER 3: METHODOLOGY

3.1. Area of study

The study was carried out at Kiruddu hospital which is a government hospital started in 2016. It is located in the neighborhood of Kiruddu, on Buziga Hill, in Makindye Division, one of the five administrative units of the Kampala Capital City Authority. This is approximately 13 kilometers, by road, south-east of the Mulago National Referral Hospital. The hospital attends to patients with diabetes, hypertension, kidney problems and many other health complications.

3.2. Study design

It was a cross section study where respondents were selected at random and data collected from diabetic patients attending clinics at Kiruddu Hospital using an interviewer administered questionnaire.

3.3. Study population

The study included diabetic patients between 18 years and above of age who obtain services from Kiruddu hospital and consented to participate in the study.

3.4. Selection criteria of the participants

3.4.1. Inclusion criteria

Only patients who attended the diabetic clinic at Kiruddu hospital aged 18 years and above and gave consent were included.

3.4.2. Exclusion criteria

- Patients below the age of 18 years.
- Those who do not consent to participate in the research.
- Patients without diabetes.

3.5. Sampling method

Respondents were chosen at random but selecting them to their convenience depending on the clinic schedule. Only patients that gave consent were interviewed.

3.5.1 Sample size calculation

The following formula (Daniel, 1999) was used to estimate the study sample size.

$n=(Z^2P(1-P))/d^2$

where

n = sample size,

Z = Z statistic for a level of confidence,

P = expected prevalence or proportion, in this which was the prevalence of diabetes.

and d = precision (in proportion of one; if 5%, d = 0.05).

Z statistic (Z): For the level of confidence of 95%, which is conventional, Z value is 1.96

Some books or guides suggest that if it is impossible to come up with a good estimate for P, one may set P equal to 0.5 to yield the maximum sample size (Daniel, 1999, Lwanga and Lemeshow, 1991).

In this case since the prevalence estimates for diabetes in Uganda gave a very small sample size of 42., the prevalence was set at 50%, this p was estimated at 0.5 which according to the formula give a sample size of 385. However due to financial constraints, only a sample of 100 patients were interviewed.

3.7. Data collection

A structured questionnaire comprising of open and closed ended questions was used to collect social demographic information, dietary intake, lifestyle, knowledge on Type 2 diabetes mellitus and consumption patterns of fibre rich tools among the patients.

A wooden height board and seca weighing scale were used to take anthropometric measurements. Both were calibrated to ensure that they were in the best conditions to provide accurate results. All clients were requested to have minimum clothing for weight measurements and extras like shoes and jewelry were removed. The BMI of the clients was calculated using the height and the weight of the clients. Height was measured to the nearest 0.1cm whereas weight was measured to the nearest 0.1kg. Glucose levels in blood were measured using a glucometer and categorized as random or fasting.

3.8. Data analysis and presentation

Data collected was analyzed using SPSS version 16.0. Descriptive statistics (frequencies) were used to describe data on social demographic characteristics, BMI, intake of fibre rich foods, information on diabetes mellitus and its risk factors.

3.9. Ethical considerations

Ethical clearance was obtained from Mulago Ethics. The Director of Kiruddu Hospital also provided permission to enable access to the patients.

Seeking information from the respondents was done with their own consent where a written consent form was given to a client and signed by them. The clients were not forced to answer questions they were not comfortable with.

3.10. Limitations of the study

- Inadequate funding for transport, photocopying and data collection assistants making me unable to reach the calculated sample size.
- Frequency of consumption of fibre rich foods was based on the patient's memory which could have been over or under estimated.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1. Socio-demographic characteristics.

The socio-demographic characteristics of the study respondents at Kiruddu hospital are presented in Table 1. From the study, most (62%) of the respondents in this study were females and 38% were males. The majority (62%) of the respondents were aged 46-69 years, 25% between 25-45 years, 7% between 18-25 years and 6% aged 70 years and above. Most (59%) of the respondents were married, while 41% were single. Majority (47.5%) were unemployed, 36.4% were employed, 9.1% were housewives and 7.1% were pensioners. Majority (48%) of them had attained primary education 35% attained secondary education. Only 8% attained tertiary education while 9% had no formal education.

Table 1:Socio-demographic characteristics of the diabetic patients at Kiruddu Hospital.

Characteristic	Frequency	Percentage
Sex		
Male	38	38
Female	62	62
Age		
18 to 25 years	7	7
25 to 45 years	25	25
46 to 69 years	62	62
70 years and above	6	6
Level of education		
Primary	48	48
Secondary	35	35
Tertiary	8	8
No formal education	9	9
Marital status		
Married	59	59
Single	41	41
Employment status		
Employed	36	36.4
Unemployed	47	47.5
Housewife	9	9.1
Pensioner	7	7.1

From the results in Table 1, majority of the respondents were females. This is because females turned up for follow up at the diabetic clinic more than the males. Females have better health seeking behavior compared to men therefore there was more women than men at the clinic. Women also often use free governmental institutions compared to males who often use private facilities (Katarina et al., 2011) and since Kiruddu Hospital is a government institution, this is probably why there were more female respondents than the males.

In relation to age category, majority of the respondents were aged 46-69 years while only 6% were aged above 70 years of age. Diabetes risk increases with age (ADA, 2017), with type 2 diabetes seen in middle aged and elderly adults (Mayega et al., 2014). In Uganda, individuals aged 30-49 years and 50-69 years were more likely to have diabetes (Bahendeka et al., 2014). This correlates with the results found among patients at Kiruddu Hospital where most of the respondents were between the ages 46-69 years.

With respect to marital status, majority of the patients were married. Ginerize & Frezle (2003) explain the relationship between age and marital status. Since this study was carried out amongst the adults, this could have been a reason for the high percentage of married people.

From the data above the biggest percentage (48%) of the patients only attained education to a primary level. This could be explained by the fact that most Ugandans stop at an upper primary level since very few join post-primary education since the government and other stakeholders find challenges managing the UPE output to secondary and tertiary institutions (MOES, 2016). Due to this, most of the population who are primary drop outs may find it difficult to read, listen and comprehend public health messages. This may affect their lifestyle behavior and increase the risk of developing type 2 diabetes thus having the biggest population of the diabetic patients as primary drop outs.

4.2. Clinical characteristics of the patients

Table 2 shows the clinical manifestations of the patients. From the Table, majority (95%) of the respondents had at least one complication which is consistent with the results of other researchers. Majority (30.3%) of the patients had had diabetes for more than 10 years. Liu and colleagues reported that the chronic complications of diabetes vary from 52% to 74% of the population (Abejew et al., 2015) however, from this study, the number was quite high (95%). The diabetic complications among the patients are due to high blood glucose levels (hyperglycemia).

Hyperglycemia is the primary cause of diabetic complications which are a leading cause of mortality and morbidity among diabetic patients (Fowler, 2008).

Glucose is converted to sugar alcohol sorbitol by aldose reductase via the polyol pathway. Sorbitol exerts a high osmotic pressure within blood vessels leading to microvascular damage. Excess glucose may also react with proteins via a non-enzymatic reaction to form advanced Glycosylated end-products which are detrimental to blood vessels, hence vascular complications (Fowler, 2008). These reactions take place within the patients with hyperglycemia causing the different complications like neuropathy, nephropathy and nerve damage.

Long duration of stay with diabetes among the patients could also be another reason for occurrence of diabetic complications. Previous studies reported that patients who had stayed with diabetes for a longer period of time had developed diabetic complications compared to their counterparts (Abejew et al., Roaeid et al., 2010).

Table 2: Clinical characteristics and duration patients had with diabetes.

Clinical characteristic	Percentage
Diabetic complications	
None	5
One complication	42
Multiple complications	53
Blood sugar levels	
Normal	45.5
Hyperglycaemia	55.5
Duration from time of diagnosis	
<1 year	19.2
1-5 years	28.3
6-10 years	22.2
>10 years	30.3

4.3. Nutrition status of the patients

Majority of the respondents were overweight and obese with a percentage of 70%, 30% of the respondents were normal, and none of the respondents was underweight.

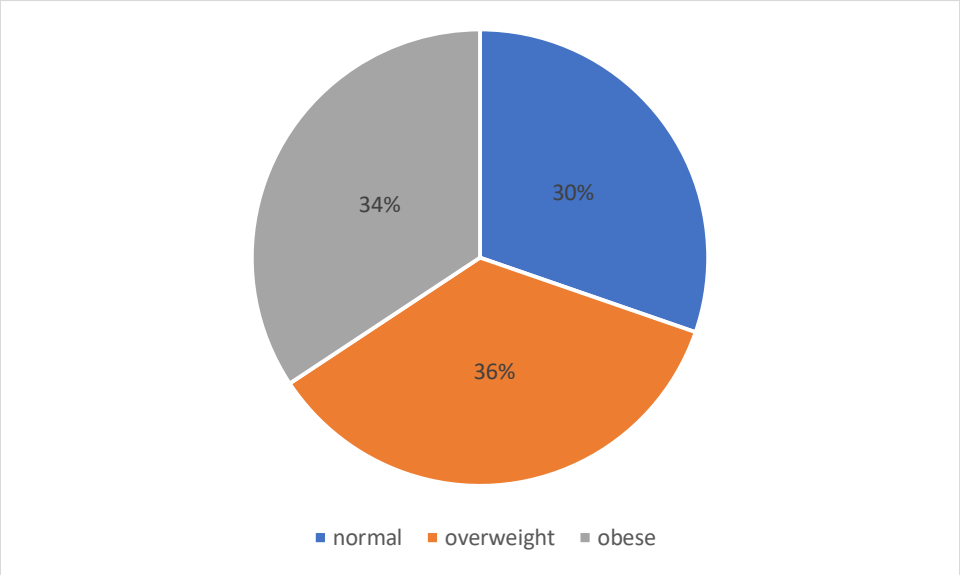

Figure 1: Nutrition status of the respondents.

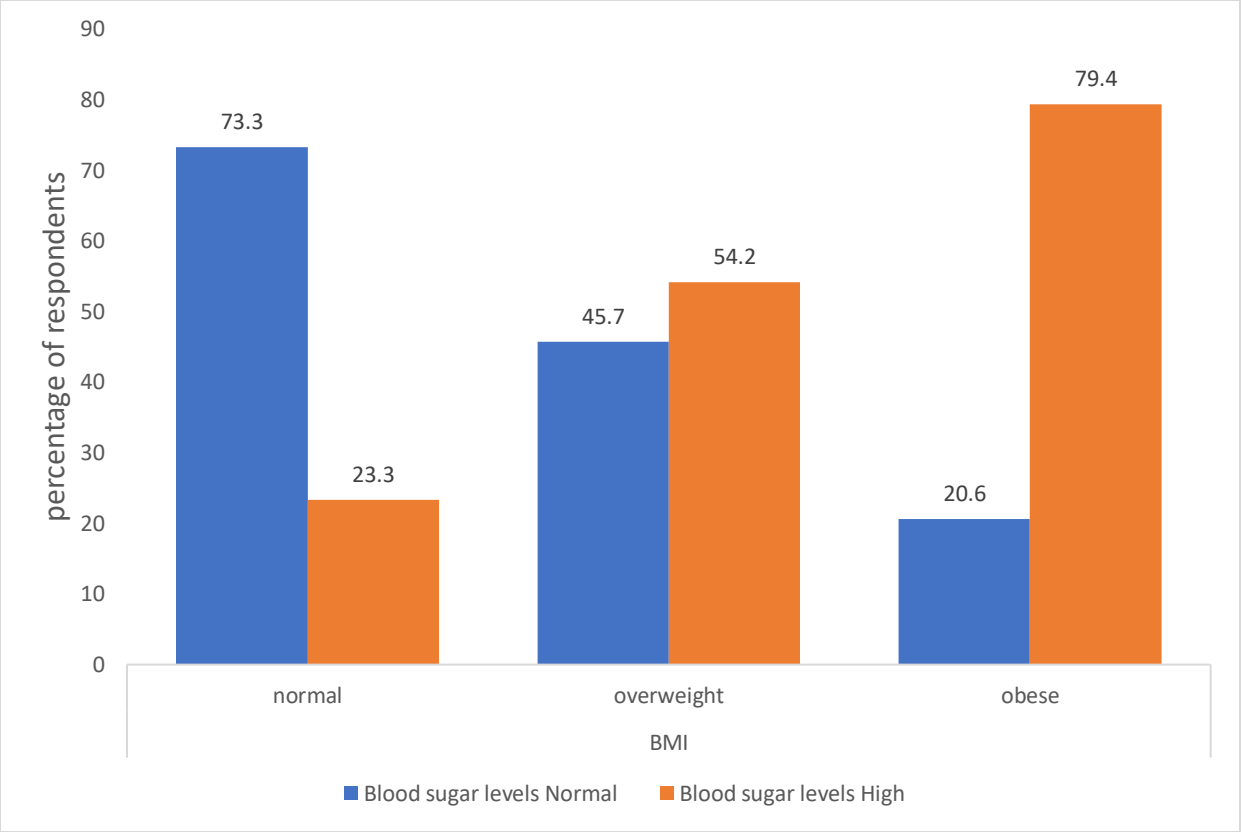

Figure 2: BMI and respondents' blood sugar levels

The results in Figure 2 show that majority (73.3%) of the respondents who had a normal BMI had normal blood sugar levels and 23.3% had high blood sugar levels. Majority (54.2%) of the respondents who were overweight had high blood sugar levels and 45.7% had normal blood sugar levels. Majority (79.4%) of the respondents who were obese had high blood sugar levels and 20.6% had normal blood sugar levels.

BMI was classified according to Deurenberg, Dietz, & Bellizi, 2006, BMI less than 18.5 were underweight, 18.5 to 24.9 were normal, 25 to 29.5 were overweight and those whose BMI was 30 and above were obese. Body Mass Index (BMI) is one of the major risk factors for T2DM (Swinburn,2002). For each kilogram of weight gained annually over a period of 10 years, there is an associated 49% increase in the risk of developing T2D in the subsequent 10 years. Conversely, for each kilogram of weight lost annually over 10 years, there is an associated 33% reduction in the risk of developing T2D in the subsequent 10 years (Daousi, et al., 2010).

A study carried out in China amongst the middle- aged and the elderly people, found out that BMI as an anthropometric index was a risk factor for T2DM ($p= 0.024$) at a significance level of 0.05.

Higher BMI was associated with increased insulin resistance and decreased insulin sensitivity in elderly with recently diagnosed type 2 DM. This study shows that higher BMI may be the most important pathogenic factor and associated with type 2 DM in elderly Asian population. (Wang, et al., 2017).

In another study carried out on the relationship between BMI and T2DM, it was noted that a higher BMI was a risk factor for T2DM. Respondents were followed up for a period of 3 years and results showed that there was a reduction in insulin sensitivity for the individuals who had gained over 15% body weight. For individuals who had less than 15% body weight gain, there insulin sensitivity didn't subsidize (Telford, 2007). Results in Figure 2 show that BMI was a risk factor for diabetes among the patients at Kiruddu Hospital and patients being overweight or obese put them at a higher risk of getting diabetes mellitus because majority of the patients who were overweight and obese had high blood sugar levels.

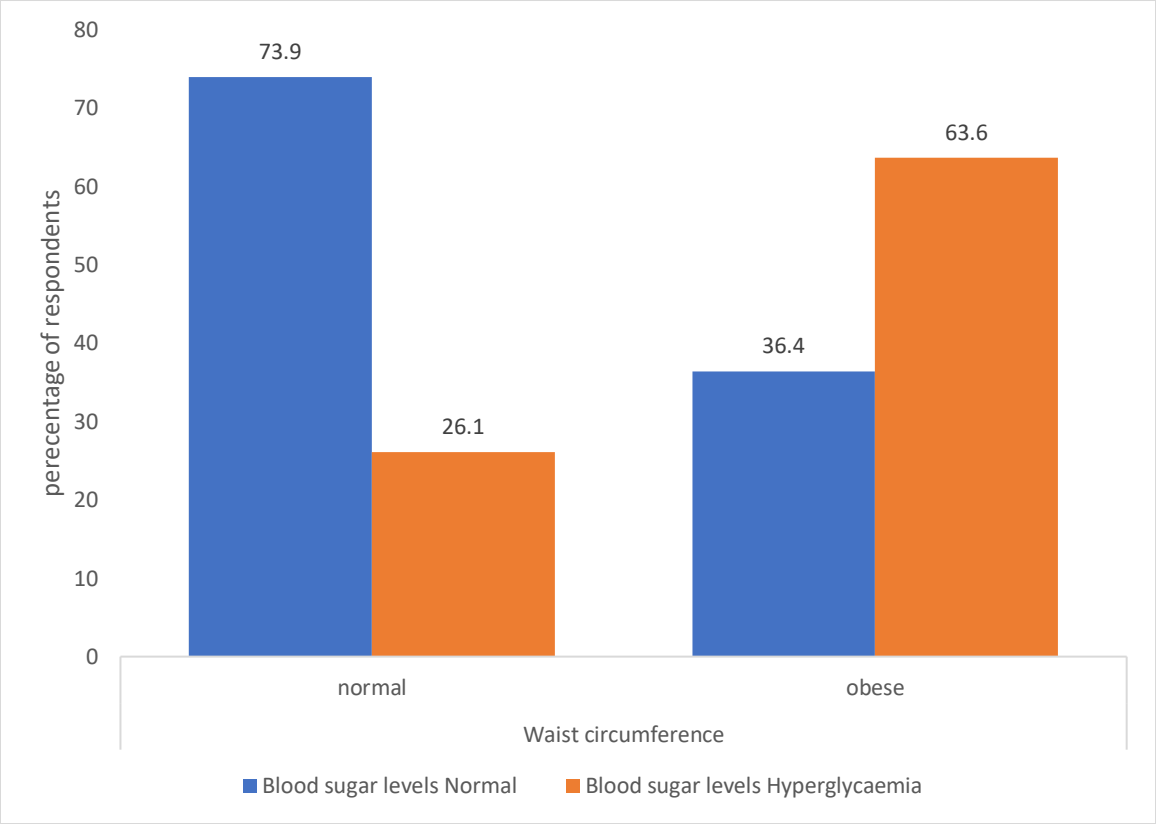

Figure 3: Waist circumference of the respondents and blood sugar levels

Results in Figure 3 show that majority (63.6%) of the respondents who had abdominal obesity (with a waist circumference of >94cm for men and >80cm for women) had hyperglycemia and 36.4% had normal blood sugar levels. Majority (73.9%) of the respondents who had a normal waist circumference had normal blood sugar levels and 26.1% had hyperglycemia.

Measuring waist circumference is a simple means of assessing levels of visceral fat (Silke, Heiner, & Tobias, 2010). Although waist circumference and BMI are interrelated, waist circumference provides an independent prediction of risk over and above that of BMI. Waist circumference can be used to identify increased risk associated with abdominal fat in adults. Although the BMI captures the degree of overweight and obesity, it ignores body fat distribution for example, visceral fat tissues id metabolically more active than non-visceral fat and secretes more hormones and cytokines which may be important for the development of diabetes (Hanslam, 2005). Increased waist circumference is closely associated with an increased risk of diabetes (Schulze et al.; 2006). A high waist circumference is associated with an increased risk for type 2 diabetes, dyslipidemia, hypertension and CVD in patients with a BMI in a range between 25 and 34.9kg/m^2 (Chan, Rimm, Colditz, Strampfer, & Willet, 1994). Changes in waist circumference are useful predictors of changes in CVD risk factors (Lemieux, Prud'homme, Bouchard, Tremblay, & Despes, 1996). A study on the association between BMI and waist circumference with respect to the risk of developing type 2 DM among men and women who participated in the European Prospective Investigation into Cancer and Nutrition found a statistically significant interaction between BMI and waist circumference with respect to the risk of DM with a p value of 0.0001 (Silke, Heiner, & Tobias, 2010).

4.4. Lifestyle of the respondents.

The study shows that majority (51%) of the respondents did not take alcohol, 25 % consumed alcohol and 24% had quit. Majority (85%) of the respondents did not smoke, 5% of the respondents did smoke, and 10% quit smoking.

The largest proportion (80%) of the respondents were engaged in light physical exercise and 20% of the respondents were not engaged in physical exercise. The majority of the people that were engaged in physical activity exercised 2-5 days a week.

Table 3: Lifestyle of the respondents

Question	Choices	Frequency	Percentages
Alcohol intake	Yes	25	25
	No	75	75
Smoking	Yes	5	5
	No	95	95
Engagement in physical exercise	Yes	80	80
	No	20	20

Results in Table 3 above show that majority (75%) of the respondents do not consume alcohol and 25% of the respondents consume alcohol. Majority (95%) of the respondents do not smoke and 5% do smoke. Majority (80%) of the respondents engage in physical exercise and 20% do not engage in physical exercise.

Alcohol increases the risk of a person getting diabetes however, several biological mechanisms have been proposed to explain the apparent reduction in risk of type 2 diabetes amongst moderate drinkers. These include the anti-inflammatory hypothesis, which posits that alcohol may beneficially alter the expression of inflammatory proteins implicated in metabolic processes (Akash, Rehman, Chen, 2013) including adiponectin (Brien, Ronksley, Turner, Mukamal, Ghali, 2011) and interleukin- 1β (Szabo, Mandrekar, Catalano, 2006), and a possible stimulatory effect of alcohol upon the synthesis of high-density lipoprotein (Brien, Ronksley, Turner, Mukamal, Ghali, 2011). However, studies investigating such mechanisms are subject to notable limitations, including short follow-up periods and small sample sizes, limiting the generalizability of findings both at the population level and over the long term (Schrieks, Heil, Hendriks, Mukamal, Beulens, 2015)

In a follow up study carried out on alcohol intake and the incidence of type 2 diabetes mellitus in Japan, it was identified that there was a significant relationship between alcohol intake and type 2 diabetes mellitus incidences after a follow up period of 16 years (Wannametne, Shaper, Alberti, & Peny, 2012). However, in this study it was noted that few of the respondents are alcohol consumers.

The differences between this study and other studies is also likely to have been as a result of the small sample size of only 100 respondents (Schrieks, Heil, Hendriks, Mukamal, Beulens, 2015). However, for some of the patients who were alcohol consumers and it could have been one of their risk factors for diabetes.

Cigarette smoking is a well-known risk factor in many diseases, including various kinds of cancer and CVDs. Many studies have also reported the unfavourable effects of smoking for diabetes (Sang, 2012). Smoking increases the risk of developing diabetes and aggravates the micro and macrovascular complications of DM. smoking is associated with insulin resistance, inflammation and dyslipidemia but the exact mechanisms through which smoking influences diabetes mellitus are not clear (Sang, 2012). Smoking also increases inflammation and oxidative stress (Morrwo, et al., 1995), to directly damage β-cell function (T.D. & Blake, 1988) and to impair endothelial function (Noma, et al., 2005). Some of the respondents could have been at risk of diabetes due smoking however the effects of smoking on aggravating the diabetic complications is usually taught to the patients on clinic visits which can explain the low incidence of smoking among the respondents.

Physical exercise has been considered as one of the cornerstones in the treatment of diabetes mellitus along with nutrition and medication since from the past 100 years ago (Sigal, Kenny, Wasserman, Castaneda-Sceppa, 2004). Physical exercise plays a key role in the prevention and management of type 2 diabetes mellitus by increasing energy expenditure and improving action of insulin (Nakhanakhup, Monigmee, Appel, & Duarte, 2006). However, it was noted by (Yuzo, 2003), that for effective maintenance of blood glucose levels, physical exercise had to be combined with dietary management therefore, exercise might not help in managing diabetes due to dietary factors.

In a randomized control study carried out in Italy, 25 patients were monitored over a period of 4 months while doing aerobic exercise 3 times a week. Results of this study showed that Aerobic exercise reduces blood glucose concentrations to a greater extent than resistance exercise (Sukal, et al., 2012).

Similar to this study, it was identified that exercise did not have a significant role on the blood glucose levels of patients as in a case control study in Australia (Kriketos, Cooney, Hawley,2004). Several factors influence exercise fuel use, but the most important are the intensity and duration

of physical activity (Bajpeyi, et al.,2009). There are a variety of conditions that need to be considered in understanding hypoglycaemia during exercise including the type and duration of exercise, glucose concentrations prior to starting exercise, and the relation of exercise to meals and insulin doses (Yavari, Hajiyev, Naghizadeh, 2010). Brisk walking was the most preferred form of physical exercise because it is an easy and low-cost activity for most people (Cynthia 2014). Parajuli also reported similar results in Nepal that the most commonly practiced form of physical exercise by type 2 diabetic patients was brisk waking (Parajuli et.; 2014). This correlates with my study because the exercise most of the respondents participated in was walking for about 30 minutes but it did not show a significant role in lowering the blood sugar levels and this could have probably been due to the exercise not being intense enough as discussed above and poor diet like consumption of a lot of refined foods like white rice, white bread, posho from refined flour, etc.

4.5. Knowledge and consumption patterns of fibre rich foods among the diabetic patients at Kiruddu Hospital.

The results indicate that majority (60.2%) of the respondents attending the diabetic clinic at Kiruddu Hospital have knowledge of fibre as seen in Figure 4.

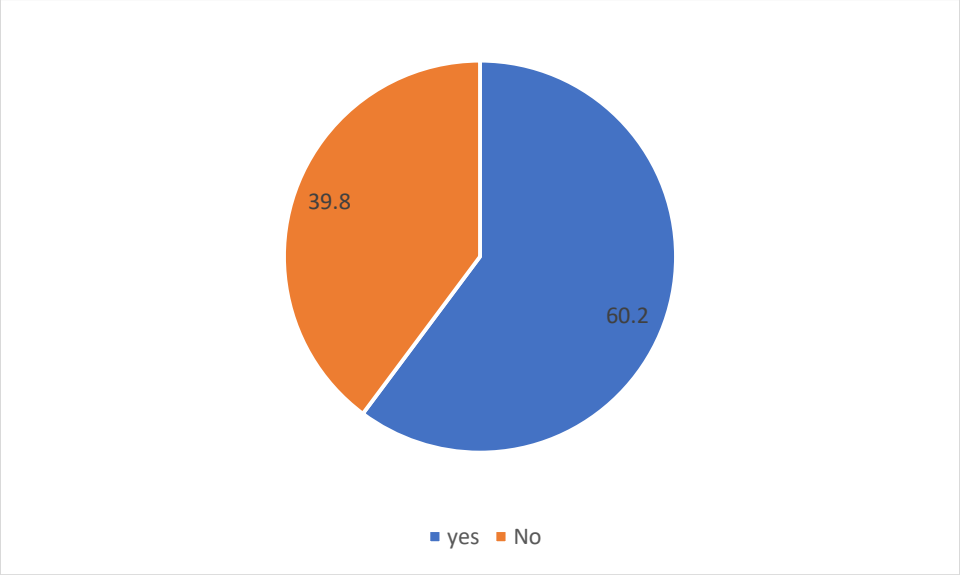

Figure 4: Respondent's knowledge of fibre.

Of the respondents who had knowledge of fibre, majority (84.7%) of them got it from the medical workers as seen in Table 4.the knowledge is usually acquired during checkup or when they are given nutrition education on their clinic visits. Some of the other sources of knowledge were from school, on the internet and friends as seen in Table 4. Majority (50.8%) knew vegetables as a food source of fibre and the other food sources included fruits, vegetables, brown bread, brown rice and legumes as seen on Table 4. According to WHO (2004), public interest in healthy eating has increased due to the high incidence of several human health disorders. Accordingly, initiatives emerging in the public health system and communication industry have been reflected in an increasing demand for healthy foods (Tudoran et al, 2009). This explains why most of the respondents had knowledge on fibre, its food sources and that most of them acquired it from health workers.

Table 4: Respondents' knowledge on the food sources of fibre and respondent's source of the knowledge

characteristic		Frequency	Percentage
Source of knowledge about fibre	medical worker	50	84.7
	school	3	5.1
	internet	2	3.4
	don't remember	3	5.1
	medical worker, friends and the internet	1	1.7
Food sources of fibre	fruits	3	5.1
	vegetables	30	50.8
	brown bread	1	1.7
	Both fruits and vegetables	22	37.3
	vegetables, brown rice and legumes	1	1.7
	none of the above	2	3.4

Results showed that respondents having knowledge on fibre was effective and that majority (91.5%) of the respondents who had knowledge on fibre used it in their management for diabetes and all the respondents who had no knowledge on fibre did not use it in their management for diabetes.

From Table 5 below, it shows that fruits, vegetables, and whole grains are majorly consumed occasionally except for legumes which are mainly consumed daily by the respondents. This is because legumes are cheaper to purchase compared to the other food sources of fibre and also because they are used as sauce and makes it easy to be part of the respondents' meals.

Table 5: Food sources rich in fibre and their consumption patterns among diabetic patients.

Food group	Consumption patterns	Frequency	Percentage
Fruits	Occasionally	47	47.0
	once a month	4	4.0
	once a week	6	6.0
	2-3 times a week	15	15.0
	more than 3 times a week	8	8.0
	daily	17	17.0
	never	3	3.0
Vegetables	occasionally	22	22.0
	once a month	6	6.0
	once a week	14	14.0
	2-3 times a week	14	14.0
	more than thrice a week	11	11.0
	daily	32	32.0
	never	1	1.0
Whole grains	occasionally	51	51.5
	once a month	3	3.0
	once a week	11	11.1
	2-3 times a week	6	6.1
	more than thrice a week	2	2.0
	daily	7	7.1
	never	19	19.2
legumes	occasionally	9	9.1
	once a month	5	5.1
	once a week	11	11.1
	2-3 times a week	11	11.1
	more than thrice a week	19	19.2
	daily	43	43.4
	never	1	1.0

The diet-diabetes relationship has received a great deal of scientific attention over the past decades, accompanied by methodological efforts to assess dietary intake accurately (Willett, 1998). High consumption of refined foods leads to a high caloric intake which increases the risk of type 2

diabetes mellitus (T2DM) by increasing body weight, thus decreasing insulin sensitivity (Parillo, Riccardi, 2004). International evidence has identified some dietary items, such as whole-grain rich foods, cereal fibre, legumes, and green leafy vegetables that play a protective role against chronic conditions including T2DM (Gross, Li, Ford, Liu, 2004). A usual Ugandan diet comprises of starches as staple foods on the plate, accompanied by a small amount or infrequent sauce which is usually a plant protein, animal protein or vegetable (FAO, 2010). The starches are usually refined carbohydrates like white posho, white rice. Excessive consumption of refined carbohydrates may increase the risks of overweight and obesity, poor glucose control and development of diabetic complications (ADA, 2017).

Dietary fibre slows gastric emptying and delays the absorption of glucose in the small intestines, thereby improving postprandial blood glucose control (Anderson et al.,2004) therefore increase in consumption of fibre rich foods by the respondents could improve their blood sugar control. From Table 8 above, most (32%) of the diabetic patients at Kiruddu hospital consume vegetables daily but only a few servings a day and do not reach the recommended amounts. Most of them (47%) only consume fruits occasionally and this is because of the myth that fruits contain a sugar and should be avoided by diabetics. Majority 51.5% consume whole grains occasionally and they mainly consume popcorn and maize due to availability and lack of knowledge on other whole grain foods like brown bread, oats and brown rice and also because some whole grain products like brown rice are too expensive to include in their diet as compared to white rice which is a third the price. Majority (43.4%) consumed legumes daily and this was due to availability, low prices of the legumes and a culture where legumes are included as sauce in every meal.

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.1. Conclusion

- Majority of the diabetic patients at Kiruddu Hospital were overweight and obese.
- Majority of the diabetic patients at Kiruddu Hospital had knowledge of an ingredient known as fibre and its food sources especially vegetables.
- Most of the fibre rich foods were consumed occasionally by the patients at Kiruddu hospital.
- Knowledge on fibre rich foods especially vegetables and their use in the management of diabetes had influence the dietary management of diabetes among the patients.

6.2. Recommendations

- There should be increased sensitization to the people about diabetes mellitus. Sensitization should be focused on the risk factors, signs and symptoms, complications, prevention and dietary management of DM.
- Many respondents having complications in this study implied that there was poor glycemic control secondary to poor diet and poor exercise performance. There was therefore need to educate the patients in the community and during their clinic visits about the importance of a good diet and regular exercise. Adherence to diet and physical exercise improves glycemic control and prevents development of diabetic complications.

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APPENDIX I: QUESTIONNARE

A RESEARCH QUESTIONAIRE OF THE STUDY ON THE ASSESSMENT OF KNOWLEDGE AND CONSUMPTION PATTERNS OF FIBRE RICH FOODS AMONG DIABETIC PATIENTS AGED 18-69YEARSAT KIRUDDU HOSPITAL

Greetings,

I am Nakitende Hajarah, a student of Makerere University, School of Food Technology, Nutrition and Bio-engineering. I am carrying out a research on the topic **"Assessment of knowledge and consumption patterns of fibre rich foods among diabetic patients aged 18-69yearsat Kiruddu Hospital"**. The major objective of the study is to find out the knowledge and consumption patterns of fibre rich foods among the diabetic patients.

I am kindly requesting you to answer the questions below about this study. Your participation would be of great importance and would enable me acquire better knowledge on the subject which could be used for better management of diabetic patients through their diet.

I greatly appreciate your willingness to participate and would like to inform you that this is voluntary and your information will be confidential.

Consent: I freely agree to participate in this study.

a). yes ☐ b). No ☐

Signature

……..

Thank you.

SECTION A: SOCIO-DEMOGRAPHIC DATA

Please answer the following questions.

1. Age
   a.18-25years
   b.26-45years
   c.46-69years
   d. 70+ years
2. Gender
   a. Male
   b. female
3. District of residence ……....

5. Marital status

   a. Married

   b. Single

6. Highest level of education
   a. Primary
   b. Secondary
   c. Tertiary
   d. No formal education
7. Employment status
   a. Employed
   b. Unemployed
   c. Housewife
   d. Pensioner

SECTION B: ASSESSMENT OF NUTRITION STATUS AND HISTORY OF DIABETES

1a). Weight …… (kg) b). Height……. (m) c). BMI……... (kg/m^2)

d). Waist circumference……. (cm) e). Blood glucose……. (mmol/l)

2. Does or did anyone in your family have diabetes.

a). Yes ☐ b). No ☐

3. How long have you been diagnosed with diabetes?

a. <1year b. 1-5years c. 5-10years

d. >10years

4. Are you on any medication for diabetes?

a). Yes ☐ b). No

5. Do you have any of the following medical complications? Circle all that apply;

a. Cardiovascular disease (e.g. coronary artery disease, heart attack, stroke, etc.)

b. Kidney failure

c. Nerve damage (especially in the legs)

d. Eye damage

e. Hearing impairment

6. Do you smoke?

a. Yes b. No

7. How often do you smoke?

a. Daily

b. 1-3 days a week

c. Once a week

d. Once a month

e. Occasionally

8. Do you take alcohol?

a. Yes b. No

9. How often do you take alcohol?

a. Daily

b. 1-3 days a week

c. Once a week

d. Once a month

e. Occasionally

SECTION C: KNOWLEDGE ON FIBRE RICH FOODS (WHOLE GRAINS, FRUITS & VEGETABLES)

1. Do know of a food component known as dietary fibre?
    a. Yes
    b. No
2. Where did you get to know dietary fibre from?
    a. A medical worker
    b. School
    c. Friends
    d. Internet
    e. Don't remember
3. Which of the following foods are rich sources of fibre? (circle all that apply)
    a. Fruits
    b. Vegetables
    c. Brown rice
    d. Unpolished posho
    e. Brown bread
    f. Legumes

g. Other grains and cereals
h. None of the above
i. All the above

4. Do you think a diabetic patient should consume fibre rich foods?
   a. Yes
   b. No
   c. Don't know

5. Have you used fibre rich foods to manage diabetes before?
   a. Yes
   b. No
6. Do you think a diabetic patient should have fibre in all their meals?
   a. Yes
   b. No
   c. Don't know

SECTION D: ASSESSMENT OF CONSUMPTION PATTERNS OF FIBRE RICH FOODS AND LIFE STYLE FACTORS USED FOR MANAGEMENT OF DIABETES.

8. Do you do physical exercise?
   a. Yes
   b. No

If not, go to question number4.

9. If yes, how often do you exercise?
   a. Daily
   b. 2-5 times a week
   c. Once a week
   d. Once a month
   e. Occasionally
10. What kind of exercise do you do?
    a. Aerobic exercises (e.g. brisk walking, jogging, climbing stairs, dancing, biking, swimming, etc.)

b. Strength exercise (e.g. lifting weights, using resistance machines, etc.)
c. Flexibility exercise (e.g. stretching, yoga, etc.)
d. Balance exercise e.g. standing on one foot.
e. Light exercise like walking

11. How many meals do you have in a day?
    a. 1 meal
    b. 2 meals
    c. 3 meals
    d. More than 3 meals
12. How many meals do you have at home?
    a. 1
    b. 2
    c. 3
    d. None
    e. All the meals

13. How often do you consume any of the following foods?

FOOD TYPE	Rarely	Once a month	Once a week	1-3 times a week	3-5 times a week	Daily	Never
Fruits (mangoes, oranges, pineapples, jackfruit, water melons, tangerines, apples, guavas, strawberries, grapes, etc.							
Vegetables (nakatti, Sukuma, ddodo, bbuga, cabbages, avocado, pumpkin, eggplants, etc.							
Whole grains & cereals (brown rice, brown bread, unpolished posho, maize, popcorn, oats, etc.							
Legumes (beans, lentils, peas, soya beans, groundnuts, etc.							

14. How often do you consume refined foods?

FOOD	rarely	Once a month	Once a week	1-3 times a week	3-5 times a week	Daily	Never
White bread							
White flour							
Pastries (e.g. pies)							
White rice							
Fries							
cookies							
Ice-cream							
Cakes							
Pizza							

Thank you for your participation in this study.

APPENDIX II: CONSENT FORM

Introduction

My name is Nakitende Hajarah a final year student at Makerere University pursuing a Bachelor's degree in Human Nutrition. My study is titled; assessment of knowledge and consumption patterns of fibre rich foods among diabetic patients aged 18-69 years at Kiruddu Hospital.

Objectives of the study

- Assess the knowledge diabetic patients at Kiruddu Hospital have on dietary fibre.
- To assess the fibre consumption patterns of diabetic patients at Kiruddu Hospital
- To determine nutritional status of diabetic patients at Kiruddu Hospital
- To determine the lifestyle factors used in management of diabetes among diabetic patients at Kiruddu Hospital

Purpose of the study

The findings of the study will provide knowledge on whether the diabetic patients seeking medical care at kiruddu hospital have knowledge on fibre rich foods and their importance in management of diabetes. The study will also generate information which can be used to formulate interventions or policies for better management of diabetes among the patients. The study is also for partial fulfillment of the degree of Bachelor of science in Human Nutrition of Makerere University.

Data collection procedures

A structured questionnaire comprising of open and closed ended questions will be used to collect personal information, dietary intake, lifestyle, knowledge on Type 2 diabetes mellitus and consumption patterns of fibre rich foods among the patients.

A wooden height board and seca weighing scale will be used in the process of physical body measurements. Both will be adjusted to ensure that they are in the best conditions to provide accurate results. The body mass index (BMI) of the clients will be calculated using the height and the weight of the clients. Height will be measured to the nearest 0.1cm whereas Weight will be measured to the nearest 0.1kg. Glucose levels in blood will be measured using a glucometer and categorized as random or fasting depending on when the patient last ate.

Discomforts and risks

The data collection procedure will pose no health risks to the respondent. The respondent is free to withdraw from the interview at any point they wish to.

Benefits

The study will be beneficial to the respondents since they will get to know their dietary habits and how fibre included in the diet can improve control of their blood glucose levels. From this, they will be advised accordingly on lifestyle modifications that will enable them manage the hypertension.

Compensation

For participation in this study, the respondent will receive a bar of soap to compensate for their time and inconvenience.

Contact information

If you have any questions, you may contact:

REC: The chairman of Mulago Hospital Research & Ethics Committee;

Dr. Nakwagala Frederick Nelson on 0772325869

Study investigator;

Nakitende Hajarah on 0704734087

Statement that the respondent has read and understood the form and has freely decided to participate in the study.

Hello,

My name is Nakitende Hajarah. I am a student at Makerere University. For my thesis, I am conducting a research study on knowledge and consumption patterns of fibre rich foods among diabetic patients aged 18-69 years at kiruddu hospital. . I need your help to complete this research and data gathered will be used for research purposes only. You must be 18 years or older, have been diagnosed with diabetes and are currently under management.

Your participation in this study is completely voluntary. Your response will remain confidential and anonymous. If you do choose to participate, you will be guided on how to answer the questions appropriately.

Kindly indicate your willingness to participate in the study

☐ Yes ☐

Signature.....

Date.....

Thank you for your participation.

APPENDIX III: TRANSLATED CONSENT FORM

FOOMU EWA OLUKUSA

Okweyanjula

Amanya agange nze Nakitende Hajarah nga ndi muyiizi ku univasiite ye Makerere nsoma diguri mu misomo gyebyendiisa ya bantu (Bachelor's degree in Human Nutrition). Omusomo gwange guyitibwa "okunonyeleza ku kumanya ne ndya ye mmere eyina ekilisa ekiyitibwa fayiba mu balwadde basukaali abalina emyaka 18-69 ku dwaliro lye kiruddu"

Ebigendererwa byomusoomo.

- Kunonyeleza ku kumanya abalwadde kwebayina ku kiliisa ekiyitibwa fayiba.
- Kunonyeleza ku mirundi abalwadde gye balyamu emmere elimu ekirisa kya fayiba.
- Okumanya embeera yobulamu ne biriisa ebili mu mibiiri gya balwadde.
- Okumanya embeera zobulaamu abalwadde zebakozesa okulabirira obulwadde bwa sukaali.

Omugaaso gwomusomo.

Ebinasangibwa mumusoomo gunno bigya tuwa okumanya oba abalwadde baffe abajja ku dwaliro lye Kiruddu baliina okumanya kummere ezilimu ekiliisa kya fayiba nomugaso gwayo mukulabirira obulwadde bwasukaali. Kino kiyinza nokutuyamba okuyisa enfuga kungeri abalwadde gyebasobola okulongoosa mungeri gyebalelabiriramu ngabalina sukaali. Omusomo natte gujja kunyamba okumaliza emisomo gyange emakerere nfune diguri.

Engeeri omusomo gyegugenda okolebwamu.

Wajakubawo okubuuliriza mubantu kukipapula ekitegekedwa obulungi okuli ebibuuzo kugwe ngomuntu, endyayo, eneyisayo mubulaamu, nokumanya kwolina ku kiliisa ekitibwa fayiba nenkozesa yakyo mukulabilira obulwadde bwa sukaali. Obuwanvu nobuzito bwabalwadde bujja kupimibwa kuminzani zabyo ezinaba zetegekedwa obulungi. Ebipimo byomubili ebiyitibwa BMI bija kufunibwa ela sukaali ejakupimibwa ngatukozesa ka masiini akapima sukaali mumusaayi akayitibwa gulukometa.

Ebiyinza okukutusako obulabe oba okukumalako emirembe

Mumusomo guno tewaali kija kututusaako bulabbe ela twegendereza okulaba nga tukola ekisoboka kyona okuba nga tetukumalako sanyu lwo.

Okuliwilira obudde namanyi go.

Olwokwegatta mumusomo gunno buli mulwadde ajja kuweebwa omutti gwa sabuuni nga akasiimo kukutuyayambisa kumagezige nobudde bwe.

Amasiimu.

Bwobanekibuuza kyona osobola okuba ku siimu ya;

Musawo Nakwagala Frederick eri 0772325869

Mukubirizi wa kakiiko akakola kumisomo gino mu malwaliro ga Mulago.

Oba Nakitende Hajarah 0704734987

Omukebeezi womusomo guno.

Kino kyekilaga nti omulwadde eyetabye mumusomo guno akiliza ela yeyagalidde.

Nkulamusiza sebbo oba Nyabo,

Amanya agange nze Nakitende Hajarah ngansaba obuyambi byo okwegatta mumusomo gwange guno. Okiliza nti olina emyaka 18 okwambuka wagulu ngela olina obulwadde bwasukaali nga bujanjabilwa ku dwaliro lwa Kiruddu Hospital.

Okudamu ebibuuzo bino weyagalidde ngela osigala tomanyikidwa manya oba gwani mungeri yona. Bwonoba okiliza okwegatta mumusomo guno ojakudamu ebibuuzo bulungi ela butuffu nga webikubuzidwa. Mubulungi saako omukono okulaga nti okiliza kwetaba mumusomo guno;

…….

Omukono gwo

…….

Ennaku zomwezi.

Webalenyo olwobuyambi bwo.

APPENDIX IV: INTRODUCTORY LETTER

MAKERERE UNIVERSITY

P.O. Box 7062,
Kampala-UGANDA

E-mail: foodtech@agric.mak.ac.ug

Phone: 256-414-533865
Fax: 256-414-533676

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES
SCHOOL FOOD TECHNOLOGY, NUTRITION & BIO-ENGINEERING
DEPARTMENT OF FOOD TECHNOLOGY AND NUTRTION

June 19, 2019

The Director/In-charge
Kiruddu Hospital
Kampala

Re: Introduction of Ms. Nakitende Hajarah

This is to introduce to you Ms. Nakitende Hajarah who is our Year III student pursuing BSC Human Nutrition. She will be conducting research titled "Assessment of Knowledge and Consumption Patterns of Fibre-rich Foods among Diabetic Patients aged 18-69 Years at Kiruddu General Referral Hospital" as part of her Special Project. She would like to conduct this research during the period June – July, 2019.

The purpose of this letter is to request for permission to enable her collect the relevant data on this project. She will abide by the regulations set by your institution.

Thank you.

Yours faithfully,

Prof. Archileo N. Kaaya
Head of Department

MAKERERE UNIVERSITY
DEPT. OF FOOD TECHNOLOGY & NUTRITION
★ 19 JUN 2019 ★
P.O.BOX 7062, KAMPALA

APPENDIX IV: APPROVAL FOR THE STUDY

TELEPHONE: +256-41554008/1
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E-mail: admin@mulago.or.ug
Website: www.mulago.or.ug

MULAGO NATIONAL REFERRAL HOSPITAL
P.O. Box 7051
KAMPALA, UGANDA

IN ANY CORRESPONDENCE ON THIS SUBJECT PLEASE Q

22nd July, 2019

Ms. Nakitende Hajarah
Principal Investigator
School of Food Technology, Nutrition and Engineering
Makerere University.

Dear Nakitende,

Re: Approval of Protocol MHREC 1693: "Assessment of Knowledge Consumption Patterns of Fibre Rich Foods Among Diabetic Patients Aged 18-69 Years at Kiruddu Hospital

The Mulago Hospital Research and Ethics Committee reviewed your proposal referenced above and granted approval of this study on 22nd July, 2019. The conduct of this study will therefore run for a period of one (1) year from 22nd July, 2019 to 22nd July, 2020.

This approval covers the protocol and the accompanying documents listed below;

- Consent Form (English & Luganda Versions)
- Questionnaire

This approval is subjected to the following conditions:

1. That the study site may be monitored by the Mulago Hospital Research and Ethics Committee at any time.
2. That you will be abide by the regulations governing research in the country as set by the Ugandan National Council for Science and Technology including abiding to all reporting requirements for serious adverse events, unanticipated events and protocol violations.
3. That no changes to the protocol and study documents will be implemented until they are reviewed and approved by the Mulago Hospital Research and Ethics Committee.
4. That you provide quarterly progressive reports and request for renewal of approval at least 60 days before expiry of the current approval.
5. That you provide an end of study report upon completion of the study including a summary of the results and any publications.
6. That you will include Mulago Hospital in your acknowledgements in all your publications.

I wish you the best in this Endeavour.

DR. NAKWAGALA FREDERICK NELSON
CHAIRMAN- MULAGO HOSPITAL RESEARCH & ETHICS COMMITTE
Vision: "To be the leading centre of Health Care Services"