MAKERERE UNIVERSITY

COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES (CAES)

SCHOOL OF FOOD TECHNOLOGY, NUTRITION, AND BIOENGINEERING (SFTNB)

Physical Activity and Associated Factors Among Type 2 Diabetes Mellitus Patients (Aged ≥20 Years) Attending Care at Kiruddu Hospital: A Hospital Based Cross-Sectional Study

MUYINDA MATHEW ROGERS
16/U/738
216000458

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF FOOD SCIENCE AND NUTRITION IN PARTIAL FULFILMENT OF A BACHELOR'S DEGREE IN HUMAN NUTRITION

August, 2019

DECLARATION

I **Muyinda Mathew Rogers,** do hereby declare that all the work presented in this dissertation is my own original work unless otherwise acknowledged and has not been submitted before any institution for any assessment purposes.

16/8/19
.....
Date

.....
Signature
Muyinda Mathew Rogers

This dissertation was developed and submitted for assessment with the supervision and approval of the following supervisor:

Signature: .....
Turyashemererwa Florence, PhD
School of Food Technology, Nutrition and Bioengineering
Date: 16/8/19

DEDICATION

To my intellectual icons who have actuated and given me perpetual impetus to become a better thinker whose thinking is governed by clear intellectual standards.

ACKNOWLEDGEMENT

I wish to extend my gratitude to Dr. Turyashemererwa Florence for consenting to be my supervisor and for her astute guidance throughout this project, as well as to Mr. Ssenyondo Muzafaru for scrupulously reviewing and duly rendering constructive feedback upon which this dissertation was revised and neatened out into its final form.

Sincere thanks to friends and colleagues who offered any kind of support to me in this educational endeavour. A special thanks to the government of Uganda for the sponsorship throughout my undergraduate study.

Finally, appreciation to the administration of Kiruddu hospital that, upon submission of my exigent request, contiguously allowed me to conduct the study at the facility.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADA	American Diabetes Association
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CVD	Cardiovascular disease
DM	Diabetes mellitus
GPAQ	Global Physical Activity Questionnaire
Hb1Ac	Glycated haemoglobin
HDL	High-density lipoprotein
IDF	International Diabetes Federation
LDL	Low-density lipoproteins
LMICs	Low-and-Middle Income Countries
LTPA	Leisure time physical activity
METs	Metabolic equivalents
MI	Myocardial infarction
MVPA	Moderate-to-vigorous physical activity
NCBI	National Centre for Biotechnology Information

NCD	Non-communicable disease(s)
PA	Physical activity
SES	Socioeconomic status
SPSS	Statistical Package for Social Scientists
SSA	Sub-Saharan Africa
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
TCF/L2 gene	Transcription factor 7-like 2 gene
WHO	World Health Organization

ABSTRACT

Introduction: Diabetes mellitus (DM) is an illness of epidemic proportions affecting about 425 million adults worldwide, and 1.5% adults in Uganda. Physical inactivity is a risk factor of type 2 diabetes mellitus (T2DM) which itself is a global pandemic and causing 7% of all T2DM cases. Although the benefits of physical activity (PA) have been unequivocally established, diabetics are one of the least active populations. Data regarding patients' PA and associated factors is essential in developing interventions to increase their activity levels. Such data is, however, scanty in Uganda and, thus, the current study was an attempt to address the data gap. The objective of the study was to establish the level of PA and the factors associated with PA among T2DM patients under care. **Methodology**: A cross-sectional descriptive study was conducted on a sample of 103 T2DM patients (aged ≥20 years) attending care at the diabetes outpatient clinic of Kiruddu hospital. Respondents' data were obtained using a structured questionnaire and PA was assessed using the GPAQ. Data analysis was done using IBM SPSS 25.0. A p-value of <0.05 was used as a criterion for statistical significance. **Results**: Majority (76.7%) of participants did not meet current PA recommendations, 94.1% were overweight and obese, and 68.9% had waist circumferences above normal. Eighty per cent (80.6%) of patients were educated on PA, mostly by medical personnel (67.8%). Most (64.1%) patients had fair while 29.1% had poor knowledge regarding PA. Majority (93.2%) of patients had positive attitudes towards PA. Most reported motivator to engage in PA was "to become healthier" (19.5%) while the most reported barrier was "lack of enough time" (13.9%). Identified risk factors of physical inactivity among T2DM patients included living in urban areas, secondary education, low socioeconomic status and being self-employed ($p<0.001$). **Conclusions**: Collectively, the findings of this study highlight high physical inactivity levels among T2DM patients and the need for healthcare approaches and interventions that aim to improve their activity levels, knowledge and attitudes which may assist in preventing and managing T2DM in Uganda.

Keywords: physical activity, exercise, knowledge, attitudes, motivators, barriers

1.0 CHAPTER ONE: INTRODUCTION

1.1 Background

Non-communicable diseases (NCDs), notably cardiovascular diseases (CVD), cancers, diabetes mellitus and chronic respiratory diseases, are the leading cause of mortality and morbidity worldwide accounting for 71.3% of all (56.9 million) global deaths, with more than three quarters (31.5 million) of the NCDs deaths occurring in low- and middle-income countries (LMICs). According to the same data, NCDs account for 32.9% (97,600 deaths) of all 296,600 national deaths *i*n Uganda, a low-income country (WHO, 2018a).

Diabetes mellitus (DM) is a chronic disease that occurs in two types, type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM), the latter type accounting for over 90% of all cases (Zheng, Ley, & Hu, 2017). Raised blood glucose levels in DM over time can cause serious damage to the body especially the heart, blood vessels, eyes, kidneys, and nerves, with possible complications including heart attack, stroke, kidney failure, lower limb amputations, blindness and nerve damage (WHO, 2018b).

Diabetes mellitus is an illness of epidemic proportions affecting about 425 million adults (20-79 years) worldwide, a number expected to ascend by a staggering 48% to 629 million adults by 2045. DM is responsible for about 4 million global deaths, and disproportionately affects people in LMICs where 79% of all cases are prevalent (International Diabetes Federation, 2017). The prevalence of DM in Uganda is 1.5% (259,100 adults) and is responsible for 6,154 national deaths. It is projected that this prevalence will increase by 26.7% to 1.9% (873,400 adults) by 2045 (International Diabetes Federation, 2017).

Physical activity (PA) has myriad health benefits and plays an important role in the prevention and management of NCDs. Regular and adequate levels of PA have been shown to reduce the risk of hypertension, coronary heart disease, stroke, T2DM, cancers (breast and colon) and depression; improve muscular and cardiorespiratory

fitness; improves bone and functional health; and helps in weight control (WHO, 2018c). Despite the health benefits of PA, physical inactivity is a global pandemic contributing to substantial disease and economic burden worldwide (Ding, 2018). Indeed, insufficient PA is the fourth leading risk factor for global mortality, accounting for 6% of deaths globally (WHO, 2009a), and is on the rise in many countries, adding to the burden of NCDs (WHO, 2018c). More than a quarter (27.5%) of adults globally are insufficiently active which puts more than 1.4 billion adults at risk of developing or aggravating diseases (Guthold, Stevens, Riley, & Bull, 2018). Physical inactivity causes an estimated 6%, 7%, 10% and 10% of coronary heart disease, T2DM, breast cancer, and colon cancer, respectively (Lee et al., 2012).

Besides the general health benefits of PA, there is evidence of several diabetes-specific benefits (Hayes & Kriska, 2008), thus, playing a significant role in the prevention and management of T2DM (Powers et al., 2017; Sigal et al., 2018). Regular moderate to vigorous physical activity (MVPA) helps to reduce the risk of progression from pre-diabetes to T2DM, and in patients with T2DM, it reduces the risk of cardiovascular disease, improves blood glucose, glycaemic control, and reduces all-cause mortality (Levesque, 2017). Although the benefits of PA in T2DM are well-known and accepted, the majority of people with T2DM are inadequately active (Duclos et al., 2013; Hayes & Kriska, 2008; Qiu, Sun, Cai, Liu, & Yang, 2012), and are significantly non-adherent to exercise recommendations compared to drug prescriptions and dietary changes (Jenkins & Jenks, 2017; Qiu et al., 2012).

In Sub-Saharan Africa (SSA) where diabetes has a greater impact on morbidity related to the disease than any other region in the world (Pastakia, Pekny, Manyara, & Fischer, 2017), there has been very slow progress to embrace PA in the management of T2DM, and the paucity of data on in this domain being testament to the phenomenon (Jasper, 2014). Uganda being a part of SSA is no exception to the aforementioned trend. There is very scanty or nearly no data on the "diabetes–physical activity" domain in terms of physical inactivity risk factors, PA levels, knowledge, attitudes regarding PA; barriers and facilitators of PA engagement by

diabetics. The paucity of informative data presents a challenge in the prevention and management of T2DM in Uganda because (1) physical inactivity is a risk factor for T2DM causing an estimated 7% of all cases (Lee et al., 2012), (2) studies have highlighted knowledge gaps regarding T2DM and supported the need for better awareness of how to control the risk factors of T2DM (Islam et al., 2014); (3) an evaluation of patients' current knowledge, attitudes, and practices – in this case regarding PA – is a prerequisite to initiating an educational programme or other interventions for DM patients; and (4) PA levels are, in part, mediated by patients knowledge and attitudes (Hoseinzadeh, Alipour Heidari, Karbord, Azimian, & Alizadeh, 2016).

1.2 Problem statement

Regular physical activity (PA) is the cornerstone of T2DM prevention and management (Lee, Ha, Blaum, Gretebeck, & Alexander, 2018), making it an indispensable component of lifestyle modifications in diabetics. In order to instigate necessary lifestyle changes – increasing PA in this case, therapeutic patient education should be a planned and structured programme that is comprehensive in scope, flexible in content, responsive to an individual's needs and adaptable to the patient's background (Hidvégi, 2011). This can be achieved by conducting studies to characterise patients in terms of their current PA levels, knowledge, attitudes among other considerations including facilitators and barriers to participation in PA, and the information obtained used to tailor efficient education programmes.

The prevailing situation is, however, a far cry from the ideal one described above. For example, Jasper (2014) contends that there are no recommendations for screening and exercise protocols in SSA. In Uganda, there are evidence-based national guidelines/protocols/standards developed for the treatment of DM, but these have only been partially implemented (WHO, 2018b). Another deviation from the ideal situation is the paucity of studies and hence data on PA among diabetics. This gap is bound to render exercise intervention programmes ineffective since little, if any, is

known about the patients to develop bespoke strategies and interventions to increase their PA to beneficial levels; and also imposes a barrier to evaluating the effectiveness of current exercise interventions. In light of scarce data, for example, anecdotal evidence suggests a lack of knowledge as the most significant barrier to PA among diabetes patients in SSA (Jasper, 2014).

Considering the problem (gap) expatiated upon above, it is necessary to conduct studies to obtain data on patients' PA characteristics, that is, current levels, knowledge, attitudes, facilitators, and barriers to participation, risk factors for physical inactivity, among others. Data gleaned from these studies can then be used to inform the development of well-founded PA intervention programmes, help evaluate existing ones, and as well as inform policy-level interventions.

1.3 Objectives

1.3.1 General objective

The general objective of this study was to establish physical activity levels and the factors associated with physical activity among type 2 diabetes mellitus patients attending outpatient care at Kiruddu hospital.

1.3.2 Specific Objectives

The specific objectives of the study were:

1. To determine background characteristics of type 2 diabetics
2. To determine physical activity levels and proportion of type 2 diabetics who meet WHO physical activity recommendations.
3. To assess the knowledge and attitudes of patients regarding PA
4. To examine the motivators and barriers to engage in PA by type 2 diabetics
5. To determine the anthropometric nutritional status of type 2 diabetics
6. To determine risk factors of physical inactivity among type 2 diabetics.

1.4 Research questions

1. What are some of the important background characteristics of patients with T2DM?
2. What are the levels of PA among T2DM patients, and what proportion meets the WHO and ADA recommendations?
3. What levels of knowledge regarding PA do T2DM patients possess? What attitudes do patients with T2DM have towards PA?
4. What are the facilitators for and barriers to participation in PA by patients with T2DM?
5. What is the anthropometric nutrition status of patients with T2DM?
6. What are some of the identifiable risk factors for physical inactivity among patients with T2DM?

1.5 Significance of the study

The study was an attempt to address the scarcity of data in the "physical activity-diabetes" domain in Uganda by evaluating quantitative (PA levels) and qualitative (knowledge, attitudes, facilitators and barriers) characteristics of T2DM patients. The baseline data from the study will be used by healthcare providers for future assessments, to plan, design, implement and evaluate T2DM education and management interventions, with emphasis on increasing activity to levels that confer a benefit to patients. Findings of the study may also be used by policymakers to develop policies and action plans to address the low levels of PA among diabetics, as well as in the general population as a preventive step to forestall the incidence of T2DM. Lastly, the results of this study will provide a benchmark against which future research in the same domain will be based on.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The focus of this literature review is on physical activity (PA) among patients with type 2 diabetes mellitus. In preparation of this review, related reports and peer-reviewed journal articles were searched through several bibliographic databases including (but not limited to) Google Scholar, Scopus, PubMed, NCBI, and Research Gate. Articles published in languages other than English were excluded. The review starts by defining the term physical activity (PA), its different types, exploring and its general health benefits. Physical inactivity is then discussed in terms of its prevalence and its association with chronic disease. The review then explores diabetes mellitus in terms of its definition, types and pathophysiology, epidemiology and risk factors. Then, physical activity is discussed in the context of type 2 diabetes mellitus with a focus on how PA plays a role in the prevention, control, and management of T2DM.

As per the objectives of the study, the literature review will then explore socio-demographic correlates of PA, levels of activity, knowledge regarding and attitudes towards PA, facilitators, and barriers to participation in PA, and anthropometric nutrition status of patients with T2DM.

2.2 Physical activity

2.2.1 Definition and types

Physical activity (PA) refers to any form of body movement produced by skeletal muscles that results in an increase in expenditure of energy and includes activities undertaken while working, playing, doing household chores, travelling and engaging in recreational pursuits (WHO, 2010). Exercise is a subcategory of PA that is planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness (WHO, 2018c). However, PA and exercise will be used interchangeably in this dissertation.

2.2.2 Types of physical activity

Physical activity is described and classified under several schemes by specifying the activity under discussion.

- **Activity by the predominant physiologic effect**

Activity by predominant physiologic effect is subdivided into *aerobic* and *anaerobic physical activity*. Aerobic PA involves continuous, rhythmic movements of large muscle groups, such as walking, soccer, fast dancing, bicycling, swimming or jogging, normally lasting for at least 10 minutes at a time (Sigal et al., 2018), long enough to maintain or improve an individual's cardiorespiratory (heart and lungs) fitness (Physical Activity Guidelines Advisory Committee, 2018). Aerobic PA is maintained using only oxygen-supported metabolic energy pathways.

Anaerobic PA refers to relatively short (2-3 minutes), high-intensity activity, such as sprinting and powerlifting, that exceeds the capacity of the cardiovascular system to provide oxygen to muscle cells for the usual oxygen-consuming metabolic pathways (Physical Activity Guidelines Advisory Committee, 2018).

Muscle-strengthening activities, such as push-ups and pull-ups, sit-ups, resistance exercises with exercise bands, weight machines, and free weights, maintain or improve muscular strength, endurance, or power (Physical Activity Guidelines Advisory Committee, 2018). Other examples include everyday behaviours, such as carrying heavy groceries, lifting children, or climbing stairs (Health Service Executive & Department of Health and Children, 2009).

Bone-strengthening activities, such as jumping, hopping, skipping, and dancing, are movements that create impact and muscle-loading forces on the bone. These forces stress the bone, which adapts by modifying its structure (shape) or mass (mineral content), thereby increasing its resistance to fracture (Physical Activity Guidelines Advisory Committee, 2018).

- **Domains of physical activity**

PA is categorised into four main domains ("International Physical Activity Questionnaire," 2002; Physical Activity Guidelines Advisory Committee, 2018):

Occupational or job-related physical activity is performed while one is working. Stocking shelves in a store, delivering packages in an office, preparing or serving food in a restaurant, or carrying tools in a garage are examples of occupational physical activity. *Transportation physical activity* is performed in order to get from one place to another. Walking or bicycling to and from work, school, transportation hubs, or a shopping centre are examples. *Household physical activity* is done in or around one's home. It includes household tasks such as cooking, cleaning, home repair, yard work, or gardening. *Recreation, sport and leisure-time physical activity* is performed at one's discretion when one is not working, transporting to a different location, and not doing household chores. Sports or exercise, going for a walk, and playing games (hopscotch, basketball) are examples of leisure-time physical activity.

- **Absolute intensity of physical activity**

Absolute intensity is the rate of energy expenditure required to perform any physical activity and is usually measured in metabolic equivalents (METs). One MET is the rate of energy expenditure while sitting at rest, which, for most people approximates an oxygen uptake of 3.5 millilitres per kilogram per minute (ml/kg/min). The energy expenditure of other activities is expressed in multiples of METs (Physical Activity Guidelines Advisory Committee, 2018).

PA, using absolute rates of energy expenditure, can be categorised based on the intensity involved in the specific activities (Physical Activity Guidelines Advisory Committee, 2018; WHO, 2010).

Vigorous-intensity physical activity requires 6.0 or greater METs, that is, raises body metabolism by more than 6 times the resting level. Vigorous intensity means activity

that causes you to work up a sweat and become out of breath (Health Service Executive & Department of Health and Children, 2009). Examples include walking very fast (4.5 to 5 mph), running, carrying heavy groceries or other loads upstairs, or participating in an aerobics class.

Moderate-intensity physical activity requires 3.0 to less than 6.0 METs, that is, it raises body metabolism to 3-6 times the resting level. Moderate intensity means activity that raises your heartbeat and leaves you feeling warm and slightly out of breath (Health Service Executive & Department of Health and Children, 2009). Examples include walking briskly or with a purpose (3 to 4 mph), mopping, or raking a yard.

Light-intensity physical activity requires 1.6 to less than 3.0 METs. Examples include walking at a slow or leisurely pace (2 mph or less), cooking activities, or standing while scanning groceries as a cashier.

Sedentary activity requires 1.0 to 1.5 METs. A typical example is sitting, reclining or lying quietly.

2.2.3 General health benefits of physical activity

PA has been documented to have myriad health benefits. Regular and adequate PA reduces rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, metabolic syndrome, T2DM, cancers (breast and colon), depression and falling. It increases cardiorespiratory and muscular fitness, promotes healthier body mass and composition, improves bone health, increased functional fitness and improves cognitive function (Physical Activity Guidelines Advisory Committee, 2018).

2.3 Physical inactivity

2.3.1 Definition

It is recommended that adults 18-64 years do at least 150 minutes of moderate 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 (WHO, 2010). Thus, physical inactivity can be defined as activity levels insufficient to meet the WHO recommendations (I. Lee et al., 2012).

2.3.2 Epidemiology and association with chronic disease

Physical inactivity is a global pandemic, contributing to substantial disease and economic burden worldwide (Ding, 2018). According to a comprehensive study which consisted of nearly 2 million people (representing 96% of the global population), the global age-standardized prevalence of insufficient physical activity is 27.5% and 80% of adolescents 11-17 years are insufficiently active. Women are less active than men with insufficient activity prevalence of 31.7% and 23.4%, respectively. In high-income countries, 32.0% of men and 41.6% of women are insufficiently physically inactive, as compared to 13.4% of men and 18.8% of women in low-income countries. Insufficient PA in more than a quarter (27.5%) of all adults (18+ years) puts more than 1.4 billion adults at risk of developing or aggravating diseases (Guthold et al., 2018). Insufficient PA is the fourth leading risk factor for global mortality, accounting for 6% of deaths globally (WHO, 2009a), and is on the rise in many countries, adding to the burden of NCDs (WHO, 2018c). Physical inactivity causes an estimated 6%, 7%, 10% and 10% of coronary heart disease, T2DM, breast cancer, and colon cancer, respectively (I. Lee et al., 2012).

Guthold *et. al* (2018) reported that the prevalence of physical inactivity in SSA is 21.4% with Uganda having the lowest prevalence in the region at 5.5% and in the world. The Uganda NCD Risk Factor Baseline survey reported that 3.7% of men and 4.9% of women physically inactive with higher inactivity levels among the urban population (8%) compared to the rural population (3.5%). Furthermore, 4.1% of individuals aged 18-29 years, 3.2% of individuals aged 30-49 years and 7.8% of older adults aged 50-69 years were physically inactive (Ministry of Health, 2014).

2.4 Type 2 diabetes mellitus (T2DM)

2.4.1 Epidemiology

Diabetes mellitus (DM) is a chronic illness of epidemic proportions responsible for about 4 million deaths worldwide (IDF, 2017), and with enormous medical, social and financial implications. Type 2 diabetes mellitus (T2DM) is the more prevalent form of diabetes mellitus accounting for over 90% of all cases, and T1DM accounting for the other 10% (Zheng et al., 2017).

In 2017, approximately 425 million adults (20-79 years) were living with DM, with a projected rise to 629 million by 2045. The proportion of people with T2DM is increasing in all countries, particularly in LMICs which accommodate 79% of all adults living with diabetes. In Uganda, it is estimated that 1.5% (259,100) of adults (20-79 years) have DM and is responsible for 6,154 deaths nationally. It is also estimated that by 2045, 1.9% (873,400) of adults in Uganda will have diabetes (IDF, 2017).

2.4.2 Pathophysiology

Blood glucose is controlled by the action of two pancreatic hormones insulin and glucagon. Insulin helps lower blood glucose level when it is too high (especially after a meal) while glucagon increases blood glucose level when it falls below normal (Tortora & Derrickson, 2014). In T2DM, the feedback loops between insulin secretion (beta cell dysfunction) and action (insulin insensitivity in target tissues including liver, muscle, and adipose tissue) do not function properly, resulting in abnormal blood glucose levels (Stumvoll, Goldstein, & Van-Haeften, 2005). In other words, T2DM is characterized by insensitivity to insulin by its target tissues which increases glucose production in the liver and decreased glucose uptake in muscle and adipose tissue; and beta cell dysfunction which results in reduced insulin release (Zheng et al., 2017), leading to high blood glucose levels.

Chronically raised blood glucose levels in T2DM over time can cause serious damage to the body especially the heart, blood vessels, eyes, kidneys, and nerves, with possible complications including heart attack, stroke, kidney failure, lower limb amputations, blindness and nerve damage (WHO, 2018b).

2.4.3 Risk factors

Major risk factors for T2DM include older age, non-white ancestry, family history of disease, low socioeconomic status, genetic factors (for example carrying risk alleles in the TCF7L2 gene), components of metabolic syndrome (increased waist circumference, increased blood pressure, increased levels of plasma triglycerides, low plasma levels of HDL cholesterol and small, dense LDL cholesterol particles), overweight or obesity (BMI $\geq$25 kg/m^2), abdominal or central obesity (independent of BMI), unhealthy dietary factors (such as regular consumption of sugary beverages and red meats and low consumption of whole grains and other fibre-rich foods), cigarette smoking, sedentary lifestyle, history of gestational diabetes, some medications such as statins, thiazides and beta blockers, and psychosocial stress and depression (Zheng et al., 2017).

2.5 Physical activity and type 2 diabetes mellitus (T2DM)

2.5.1 Benefits of physical activity in T2DM

Physical activity (PA) has profound physiologic and metabolic benefits in patients with T2DM (Jenkins & Jenks, 2017), and therefore a cornerstone in the prevention and management of the disease (Lee et al., 2018). The effectiveness of PA against the development of T2DM lies with its ability to alter several mechanistic factors involved in its pathogenesis (Koloverou et al., 2017). In people with T2DM, PA helps prevent or delay the debilitating and life-threatening complications associated with the disease (Haas et al., 2014).

Regular physical activity (PA) reduces the risk of pre-diabetes progression to DM (Jadhav, Hazari, Monterio, Kumar, & Maiya, 2017), inversely associated with

incident DM (Joseph et al., 2016), decreases insulin resistance by increasing insulin receptors and glucose transporters (Mann et al., 2014; Zanuso, Jimenez, Pugliese, Corigliano, & Balducci, 2010); reduces blood pressure and influences weight loss (Colberg et al., 2016), reduces mortality from CVD (Herbst et al., 2015); attenuates oxidative stress (Koloverou et al., 2017); and reduces risk of diabetes-related complications (Taylor, 2008), such as slowing the development of peripheral neuropathy (Balducci et al., 2006). PA may reduce disease progression through mitigating inflammation (Loprinzi & Ramulu, 2013).

Regular physical activity (PA) also improves glycaemic control (Chomistek, Chiuve, Jensen, Cook, & Rimm, 2011; Mann et al., 2014; Zanuso et al., 2010), increases cardiovascular fitness (Fiocco et al., 2013); improves blood lipid profile (Chudyk & Petrella, 2011). and increases muscular strength in adults with DM (Gordon, Benson, Bird, & Fraser, 2009). Regular PA also improves overall health-related quality of life (HRQL) among T2DM patients (Thiel, Al, Vallance, Johnson, & Johnson, 2016).

2.5.2 Physical activity recommendations for T2DM patients

For optimal physical activity (PA) health benefits in diabetics, it is recommended that adults with T2DM perform at least 150 minutes per week of moderate-to-vigorous aerobic PA spread over at least 3 days per week with no more than 2 consecutive days without exercise, plus at least 2 sessions per week of resistance exercise (American Diabetes Association (ADA), 2017).

2.6 Socio-demographic correlates of physical among T2DM patients

Physical activity (PA) among patients with T2DM is influenced by a number of factors. Among these are personal factors which can be both demographic and health-related (Bosch, Robbins, & Anderson, 2015). Socio-demographic characteristics found to associated with PA among diabetics include age, race, marital status, educational level, income, employment status (Morrato, Hill, Wyatt, Ghushchyan, &

Sullivan, 2007; Plotnikoff et al., 2006). Table 2-1 shows guidelines for aerobic exercise and Table 2-2 shows resistance exercise guidelines for people with T2DM.

Table 2-1 Aerobic physical activities for people with T2DM

Definition and recommended frequency	Intensity	Examples
Rhythmic, repeated and continuous movements of the same large muscle for at least 10 minutes at a time	Moderate: 64–76% of the person's maximum heart rate	Biking, brisk walking, continuous swimming, dancing, raking leaves, and water aerobics.
Moderate to vigorous intensity aerobic PA is recommended for a minimum of 150 minutes per week, no more than 2 consecutive days without exercise. Performance of smaller amounts of exercise is also beneficial, but to a lesser extent than the recommended amount. Higher-intensity interval training can increase aerobic fitness gains compared to continuous moderate-intensity exercise	Vigorous: >76% of the person's maximum heart rate	Brisk walking up an incline, jogging, aerobics, hockey

Source: Sigal, R. J et. al. Can J Diabetes (2018), 42, S54-S63

Men were reported to engage in more total leisure time PA (LTPA) and moderate-to-vigorous PA (MVPA) than women (Laaksonen et al., 2005). Morrato et. al (2007) found that regular PA decreased with increasing BMI and varied with age. PA was higher among patients who were male, white, had higher education and income levels, reported previous medical advice to exercise more, and had no limitations in physical functioning. However, no differences in PA levels were reported among females and males in older adults with T2DM and younger adults (<60 years) are more likely to engage in PA than older adults (60+ years) (Thomas, Alder, & Leese, 2004).

Table 2-2 Resistance physical activities for people with T2DM

Definition	Recommended frequency	Examples
Activities of brief duration involving the use of weights, weight machines or resistance bands to increase muscle strength and endurance	2–3 times per week Start with 1 ser using a weight with which you can perform 15 to 20 repetitions while maintaining proper form Progress to 2 sets and decrease the number of repetitions to 10-15 while increasing the weight slightly. If you cannot complete the required repetitions while maintaining proper form, reduce the weight Progress to 3 sets of 8 repetitions performed using an increased weight, ensuring proper form is maintained.	Exercise with weight machines Exercise with free weights

Source: Sigal, R. J et. al. Can J Diabetes (2018), 42, S54-S63

2.7 Physical activity levels among T2DM patients

Despite the clear evidence for its diabetes-specific health benefits, and that PA is a key element in controlling and managing T2DM, individuals with diabetes are among the least likely to engage in regular PA (Qiu et al., 2012).

An earlier study in the U.K reported that only 33% of diabetes (both type 1 and 2) patients engaged in physical activities, while 67% were inactive. The physical activities (walking and light gardening) mostly done were light intensity, however. Among the T2DM patients, 68% were inactive (Thomas et al., 2004). In the U.S, 40.8% of adults (18+ years) with diagnosed diabetes are physically inactive (Centers for Disease Control and Prevention (CDC), 2019). Studies done on older adults (≥ 60 years) with diabetes in the US report that they have 25.8% lower PA compared to normal participants (Steeves et al., 2015), and few participate in the types of aerobic and strength PA that can lead to benefits (Pearl G Lee et al., 2018). A French survey reported that 71% of diabetics found it hard to engage in regular PA (Mosnier-pudar et al., 2009). Another study conducted in Spain revealed low PA levels in 44% of individuals with known diabetes (Brugnara et al., 2016). A South African study reported that only 31.0% of adult diabetics engaged in physical work or exercise on a

daily basis, of which 64.6% indicated that it lasted more than 30 minutes per day (Roux, Walsh, Reid, & Raubenheimer, 2018).

However, not all studies report low PA levels among diabetes. In another South African study on patients with T2DM, 70% reported participating in exercise of which 59.3% and 40.7% were adherent and non-adherent to aerobic exercise, respectively (Umeh & Nkombua, 2018). An Indian study showed that 74% of patients with diabetes practised regular PA (Rathod, Rathod, & Parmar, 2014). In a study done in Sri Lanka, 77.9% of T2DM patients reported adequate levels – moderate intensity (79.0%) and high/vigorous intensity (30.9%) – of PA with their daily activities, while 22.1% had inadequate levels of PA (Kumara & Siriwardena, 2016). A Senegalese study of diabetic adults reported that PA is practised by 81.5%, with an average duration of 39.72 minutes at an average frequency of about 4 times a week. Of the active patients, 87% reported they practised PA at least 3 times a week. (Djiby et al., 2018). The discrepancies between findings of the studies could be due to different methodologies, definitions of terms, PA recommendations referred to, and different respondent characteristics, among other reasons.

2.8 Knowledge and attitudes towards physical activity among T2DM patients

High disease prevalence coupled with low knowledge about T2DM risk factors is common in LMICs (Gillani, Mohammad, Islam, & Hayat, 2018). The knowledge deficit is common among those diagnosed with T2DM (Islam et al., 2014), even among those patients who have been educated (Kumara & Siriwardena, 2016). These findings underscore the existence of gaps with respect to awareness of the risk factors for DM and how these factors can be avoided or mitigated (Carballo et al., 2018), or how these can be modified in the management of T2DM.

Knowledge levels regarding PA among T2DM patients vary widely across studies. An Indian study reported that 51% of patients believed exercise helped manage DM (Shah, Kamdar, & Shah, 2009). One South African study reported that almost 41.0% of diabetics believed that they can benefit from physical exercise, 15.0% did not

believe in physical exercise and 44.0% did not have any information if diabetes patients could benefit from physical exercise (Shilubane, Netshikweta, & Ralineba, 2016a). Kumara & Siriwardena (2016) reported that 58.3% of T2DM patients have poor knowledge regarding PA although the majority had been educated on the topic, and only 7.9% knew the PA recommendations for T2DM patients. Roux et. al (2018) reported that 96.1% of patients to be knowledgeable about the benefits of PA. Umeh & Nkombua (2018) reported that 67.3% of their respondents had a perception that exercise could help to control diabetes mellitus. Nagar et. al (2018) reported that 41% of people with T2DM were aware that the disease can be prevented by healthy diet and regular exercise.

2.9 Barriers to engaging in physical activity

There are a number of barriers and facilitators to physical activity in people with diabetes (Sigal et al., 2018) which may increase or reduce PA levels, respectively.

A plethora of barriers to participation in PA among diabetics have been cited and can generally be classified into internal (influenced by an individual's own decision-making) and external (independent of an individual's own decision-making) barriers (Duclos et al., 2013; Qiu et al., 2012). Internal barriers include (but not limited to) health concerns (other co-morbidities such as arthrosis, respiratory insufficiency), fatigue, fear of not obtaining concrete benefits, having no desire to show one's own body, general dislike for PA, fear of injury, lack of privacy, having never done sports or exercise, not feeling capable, lacking self-confidence, fear of hypoglycaemia, not feeling on the same level as others. External factors include lack of social support, structural or institutional factors (means of transportation, financial means, lack of free time).

Thomas et. al (2004) reported several barriers to PA participation among diabetics which included thinking that exercise was very difficult, lack of local facilities, no spare time, good programs on TV, other plans, poor weather, tiredness, feeling depressed, more-than-usual number of hypoglycaemic episodes. On controlling for

age and type of diabetes, the authors of the study reported the most significant barriers to engage in PA to include, perceived difficulty in taking part in exercise or lack of confidence, tiredness, good programs on TV, lack of local facilities, and lack of spare time. Thus, the conclusion from the study was that social factors may be more significant in discouraging PA than health-related concerns.

One study reported reduced access to gyms, equipment or similar exercise programs, and high costs of gyms as major barriers to participation in resistance exercise after one year following an intervention program (Wycherley, Mohr, Noakes, Clifton, & Brinkworth, 2012). The French MOBILE study reported negative self-image as the highest ranked barrier, followed by lack of support and encouragement, and by medical concerns and fear of injury (Duclos et al., 2015). A Canadian randomized controlled trial involving adults (39–70 years) with T2DM reported several barriers to exercise which included illness or injury, work commitments, poor weather, time, vacation, boredom and family commitments (Tulloch et al., 2013).

A high BMI is also another barrier to initiating and sustaining PA and is associated with other comorbidities, such as shortness of breath and arthritis, which can further prevent patients from exercising (Lidegaard, Schwennesen, Willaing, & Faerch, 2016). Also, a lack of knowledge about the importance and need for PA is another barrier to engaging in exercise by T2DM patients (Jenkins & Jenks, 2017).

Thomas et. al (2004) reported a lack of self-efficacy, feelings of tiredness and distraction by good TV programmes as main barriers to participation in PA among older adults. An Australian study among older adults (65+ years) reported ill health as the most significant barrier to participation in PA (Macniven et al., 2014). A cross-sectional study among older adults (average age 77 years) in Germany cited poor health (57.7%), lack of company (43.0%), and lack of interest (36.7%) as the most frequent barriers to PA, while lack of time (16.4%) was the least reported barrier (Moschny, Platen, Klaassen-Mielke, Trampisch, & Hinrichs, 2011).

2.10 Facilitators for engaging in PA by T2DM patients

Duclos et. al (2015) reported motivators to engage in PA to include lack of health concerns (no fear of any medical risk being trained on how to prevent hypoglycemia); medical support (direct request from the physician, regular monitoring of patients' Pa from the physician);support from a non-physician (someone to exercise with, someone encouraging); self-image (having sufficiently lost weight); environmental factors (sufficient infrastructures/parks available close by, pedometer to use, internet or smartphone devices, advice from a coach, having sufficient time).

A Canadian randomized controlled trial involving adults (39–70 years) with T2DM reported several prominent facilitators to exercise which included social support from family (main facilitator), health benefits, a sense of wellbeing and fitness improvements. Other facilitators included weight loss, enjoyment, personal trainer and diabetes improvement (Tulloch et al., 2013). Among T2DM patients on a supervised research-based intervention, motivation derived from the general improvements experienced during the program was a major facilitator to continue engaging in exercise after one year (Wycherley et al., 2012).

2.11 Anthropometric nutritional status of patients with T2DM

2.11.1 Body Mass Index (BMI)

It is generally accepted that overweight and obesity are important risk factors for the development of T2DM (Feller, Boeing, & Pischon, 2010). It is no surprise that several studies have found BMI among T2DM patients to be high (overweight and obesity). In the MOBILE study which compared active vs, inactive T2DM patients, it was found a lower mean BMI (28.6 ± 4.7 kg/m^2) in the active cohort compared to the inactive cohort (31.7 ± 4. kg/m^2). The percentage of obese (BMI ≥30 kg/m^2) patients was 33.5% and 58.0% in the active and inactive cohorts, respectively. Morbid obesity (BMI ≥35 kg/m^2) was found in 9.8% of obese active and 24.7% of obese inactive patients (Duclos et al., 2015).

Bakr (2015) reported prevalence of overweight (BMI 25-29.9 kg/m^2) and obesity (BMI ≥30 kg/m^2) among type 2 diabetics to be 25.5% and 62.7%, respectively. The same study found T2DM patients to have a higher percentage of body fat than healthy people. A Malaysian study found that the mean BMI of respondent T2DM patients was 26.9 ± 4.7 kg/m^2 with 86.5% either were overweight or obese (Firouzi, Barakatun-Nisak, & Azmi, 2015).

Bosch et. al (2015) found that women with T2D differed from those without the condition by having higher BMI, 37.4 ± 8.2 kg/m^2 versus 29.6 ± 6.6 kg/m^2. Djiby et. al (2018) found that of their respondent T2DM patients, 43.20% of patients had a normal weight, 33.30% were overweight, and obesity was found in only 17.20% (men, 8.5%: women 20%) of cases. Lee et. al (2018) found the mean BMI of sedentary older individuals with T2DM in the obesity range (32.7 ± 5.9 kg/m^2).

Table 2-3 Current classifications of overweight and obesity

Classification of obesity				**Diabetes risk DAG, DD**	
DAG, DDG, DGEM, WHO	American Diabetes Association	BMI (kg/m^2)	Obesity class	Waist: Men: ≤102 cm Women: ≤88 cm	Waist: Men: >102 cm Women: >88 cm
Underweight	Underweight	<18.5			
Normal weight	Normal weight	18.5-24.9			
Overweight		≥25			
Pre-obesity	Overweight	25.0-29.9		Increased	High
Obesity	Obesity	30.0-34.9	I	Very high	Very high
		35.0-39.9	III		Very high
		≥40	III	Extremely high	Extremely high

Source: (Feller et al., 2010). DAG, German Obesity Society: DDG, German Diabetes Society; DGEM, German Society for Nutritional Medicine; WHO, World Health Organization; ADA, American Diabetes Association

2.11.2 Waist circumference

Although BMI is a general indicator of overt overweight and obesity, it does not give information about the distribution of body fat (Langenberg et al., 2012). Measuring waist circumference (WC) is a simple means of assessing the levels of visceral fat (central or abdominal obesity) and increased WC is also closely associated with an increased risk of T2DM (Ruan et al., 2013).

Waist circumference (WC) has been found to be considerably higher than normal in the T2DM patient population. Firouzi et. al (2015) found mean waist circumference of patients to be 90.0 ± 10.1 cm (men 93.4 ± 8.9; 88.8 ± 10.4 women). Duclos et. al (2015) found abdominal obesity in 46.6% and 69.8% for males (WC ≥ 102 cm) in the active and inactive cohorts, respectively; and in 74.3% and 86.5% for female (≥88 cm) in the active and inactive cohorts, respectively.

3.0 CHAPTER THREE: METHODOLOGY

3.1 Research design

Cross-sectional descriptive research design was adopted in this study to gather information on physical activity level, knowledge about and attitudes towards physical activity (PA), and motivators and barriers to engaging in PA among type 2 diabetes mellitus (T2DM) patients. A cross-sectional design involves the collection of data at one point in time.

3.2 Study variables

3.2.1 Dependent variable

The dependent variable was physical activity level (active vs. inactive). This variable was defined as **active** – total weekly activity greater than 600 METs or at least 150 minutes of moderate to vigorous activity, and **inactive** – total weekly activity less than 600 METs or less than 150 minutes of moderate to vigorous activity (Lee et al., 2012).

3.2.2 Independent variables

Socio-demographic characteristics (including age, gender/sex, religion, residence, education, marital status, socioeconomic status, and employment), health-related characteristics (including weight, height, BMI, waist circumference, blood glucose, blood pressure, duration with diabetes, family history of T2DM, medication – oral and insulin injection, smoking history, and alcohol use), knowledge, attitudes, motivators and barriers to engaging in physical activity were the independent variables.

3.3 Site of study

The study was done at the outpatient diabetes clinic of Kiruddu General Referral Hospital, an extension of Mulago National Referral Hospital which is abode in Makindye division, Kampala district. The hospital was selected for the study because

it receives a high number of patients diagnosed with diabetes mellitus from different health care facilities all over the country. The diabetes outpatient clinic receives over 100 patients with diabetes and operates once a week on Wednesdays.

3.4 Target population

The study targeted patients diagnosed with T2DM aged ≥20 years attending the diabetes outpatient clinic at Kiruddu General Referral Hospital.

3.4.1 Inclusion criteria

The study included patients who met the following criteria:

- Consenting to participate in the study
- Aged 20 years and above
- Attending diabetes outpatient clinic at the time of the study
- Diagnosed with T2DM within at least the last 6 months

3.4.2 Exclusion criteria

The study excluded patients with the following characteristics:

- Non-consenting patients
- Diagnosed with T1DM or diabetes secondary to other illnesses
- Newly diagnosed T2DM (< 6 months)
- Pregnant women
- Health complications such as kidney and cardiopulmonary diseases
- Attending the clinic for the first time

3.5 Sample size

The sample size for the study was determined using the Leslie Kish (1965) formula:

where, z – standard error away from the mean or value that corresponds to the 95% confidence interval (1.96); d – precision or acceptable error to be committed, p – physical activity level among study participants in the population.

After thorough online research, I found no similar Ugandan studies from which the proportion (p) could be obtained. A value of 0.5 was used in the formula of sample size as this would provide enough observations irrespective of the actual p-value of the population (Lemeshow, Hosmer Jr., Klar, & Lwanga, 1990). A precision of 0.05 was preferred, however, this would give too large a manageable sample size for this study. Therefore, a larger precision of 0.1 was used to give a smaller sample size (Khanal, 2016).

Using a precision of 0.1 at a 95% confidence interval, the calculated sample size for the study was 96 patients. A 10% of the sample was added to the sample to cater for non-response to make 106; however, data collection was successfully carried out on 103 diabetic patients.

3.6 Sampling techniques

A convenience sampling method was used to collect data from whichever patient who gave consent to participate in the study. Enrolment of the study participants was carried out at the beginning of each clinic day. To ensure that patients were interviewed once, a record of the patient number was recorded into questionnaire and the information shared with all research assistants. The data collection process took four weeks to make the 103 patients.

3.7 Data collection

3.7.1 Research instruments

A structured questionnaire divided into 3 different sections was used to collect data. Section 1 collected data on socio-demographic and health-related characteristics, Section 2 collected data on knowledge, attitudes, motivators and barriers to engaging

in physical activity, and Section 3 collected data on physical activity using the GPAQ (WHO, 2009b).

3.7.2 Pretesting of instruments

To ensure that research instruments were accurate, a pre-testing was done and the necessary adjustments were made. The pre-testing was done at the study site by taking 10.7% (11 diabetic patients) of the sample size of the population and administering the questionnaire to them.

3.7.3 Recruitment and training of research assistants

Prior to the data collection, five (4 finalists and 1 second-year) BSc. HMN course mates were asked to help with the process. The assistants were briefed on the study objectives, data collection tools and the GPAQ in order for them to familiarize themselves with the study.

3.7.4 Data collecting procedure

Before the data collection, study objectives were explained to the participants by the researcher and the assistants. Only those patients who gave informed consent were recruited to the study. The researcher and the assistants administered the questionnaires and also took anthropometric measurements.

3.7.5 Anthropometry procedures

Anthropometry data was collected by use of anthropometric parameters of height, weight followed by computation of BMI, and waist circumference.

Measurement of height: In order to measure height with a height board (SECA 214 portable stadiometer), the patient had to be barefooted and with minimal clothing to facilitate correct positioning of the body. The patient was made to stand with heels together, arms to the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane (“look straight ahead”). It was made sure that heels, buttocks,

scapulae (shoulder blades), and back of the head were against the vertical surface of the height board. Just before the measurement was taken, the patient was asked to inhale deeply, hold the breath, and maintain an erect posture ("stand up tall") while the headboard was lowered on the highest point of the head with enough pressure to compress the hair. The measurement was then read to the nearest 0.1 cm and with the eye level with the headboard to avoid errors caused by parallax.

Measurement of weight: The patient was asked to remove shoes and stand in the middle of the SECA weigh scale's platform without touching anything and with the body weight equally distributed on both feet. The weight was then read to the nearest 100g (0.1kg). An average of three successive measurements agreeing to within 0.1kg was recorded into the participants' questionnaire.

Body mass index (BMI): Body mass index was calculated by dividing the patient's weight (kg) by the square of his/her height in meters. BMI was then categorised according to the WHO cut offs.

Measurement of waist circumference: Waist circumference was measured using a SECA 201 cm measuring tape. The participant was asked to remove any outer clothing restricting easy access to the abdomen and waist or interfering with placement of the measuring tape against the bare skin or interfering with measurement accuracy (by compressing the abdomen or distorting the natural shape of the subject's abdomen and waist). The researcher and assistants then located the right iliac crest by using the fingertips to gently feel for the highest point of the hip bone on the participant's right side. Using a soft-tipped, washable pen, a short horizontal mark was drawn just above the uppermost lateral border of the right iliac crest, and then crossed with a vertical mark along the mid-axillary line.

The SECA tape was placed in a horizontal plane (parallel to the floor) around the abdomen at the level of the marked point on the right side of the subject. This was done while the participant stood erectly, abdominal muscles relaxed, arms at the side,

and feet together. It was ensured that the tape was snug against the skin but not so tight as to compress the skin. The reading was taken at the end of a normal expiration. The measurement was repeated twice to ensure that an accurate measurement was obtained and recorded the measurement to the nearest 0.1 cm in the participants' questionnaire.

3.7.6 Blood pressure and glucose measurement

Blood pressure measurement was done using an electronic Visomat® comfort 20/40 sphygmomanometer. The participant was seated quietly in a chair for at least 5 minutes with both feet on the floor and the arms supported at heart level. To ensure accuracy, the bladder cuff was made to circle at least 80% of the arm. At least two measurements were made and the average was recorded into the participants' questionnaire. Blood glucose measurements were done at the facility using a glucometer and readings were recorded from the patients' file into the study questionnaires.

3.7.7 Assessment of knowledge

Knowledge assessment was based on 11 questions with 3 answers for each question ("yes", "no" and "not sure"). Knowledge scores were calculated simply as the sum of correct answers to the knowledge items. Thus knowledge scores could range between 0 and 11, with 0 indicating wrong answers to all items, and 11 correct answers to all items, respectively. Knowledge scores were then used to categorise participants into good, fair, and poor according to the knowledge score given for each of its component. Good knowledge was defined if the patient correctly answered more than 75% of questions, "fair" knowledge was defined if the patient correctly answered between 50-75% of questions, and "poor" knowledge was less than 50%.

3.7.8 Assessment of attitudes

Attitudes towards physical activity was assessed using a scale which included 6 items on a continuum from harmful-beneficial, useless-useful, unimportant-important,

unenjoyable-enjoyable, boring-fun, and painful-pleasurable) (Courneya, Conner, & Rhodes, 2006). The scoring was adjusted so that choice of a positive, negative or neutral component would have a corresponding score added, deducted or unchanged, respectively. Scores for the choices were as follows: extremely disagree (-3), quite disagree (-2), slightly disagree (-1), neutral (0), slightly agree (+1), quite agree (+2), extremely agree (+3). Thus, attitude scores could range from –18 to +18.

Participants' attitudes were then categorised as very negative (score between -18 and -10), fairly negative (score between -9 and -1), fairly positive (score between 1 and 9), and very positive (score between 10 and 18).

3.7.9 Assessment of motivators and barriers

Facilitators of physical activity among respondents were captured using a set of 13 yes/no questions. A "yes" response would mean that the respondent considered that particular item as a reason or motivator to engage in physical exercise. A "no" response would mean that the respondent did not consider that particular item as a reason or motivator for engaging in physical exercise. A motivation score was calculated as the sum of all items to which the respondent answered "yes", and could range from 0 (answering "no" to all items) to 13 ("yes" to all items).

Barriers to participation in exercise were assessed using a series of 20 yes/no questions which were grouped under four categories: fitness and self-image, lack of support from non-physician, health concerns and environmental factors. A "yes" response would mean that the respondent considered that particular item as a reason/barrier/hindrance to engaging in physical exercise. A "no" response would mean that the respondent did not consider that particular item as a reason/barrier/hindrance to engaging in physical exercise. A barrier score was calculated as the sum of all items to which the respondent answered "yes", and could range from 0 (answering "no" to all items) to 20 ("yes" to all items).

3.7.10 Assessment of physical activity

The WHO (2009b) GPAQ version 2 was used to determine the physical activity level. The questionnaire is a validated standard and was found to be appropriate since it captures physical activity engagement in different domains of work, leisure, and transportation. The GPAQ has the advantage of being able to capture the intensity, frequency, and duration of overall physical activity (Guthold, 2009). The questionnaire also captures the aspects of sedentary behaviour. The average physical activity level was described by use of metabolic equivalents (METs). Participants were categorised into two groups of active (greater than 600 METs/week) and inactive (less than 600 METs/week).

3.8 Data analysis and presentation

The data obtained from the questionnaires was captured into Microsoft Excel® 2019, coded, checked and cleaned for consistency. Data was then transferred into Statistical Package for Social Scientists (SPSS) software Version 25.0 (IBM Corp, 2017) for analysis. Physical activity data was cleaned and analysed following the instructions in the GPAQ Analysis Guide (WHO, 2009).

Data was summarized using descriptive statistics of frequency, mean, standard deviation, range, tables, bar-charts, frequency, and percentage. Comparison of categorical variables was done using Chi-square tests, *t*-tests, correlation coefficient tests. A *p* value of less than 0.05 was used to determine statistical significance.

3.9 Ethical Considerations

In order to conduct the study, ethical clearance was sought the Mulago Hospital Research & Ethics Committee (MHREC) then administrative clearance was sought from Kiruddu Hospital. Respondents participated in the research based upon their informed consent and assurance of confidentiality by the researcher.

Before collecting data from a patient, details about the aim and objectives of the study were explained to the participants. Participants were free to withdraw from the

research at any stage without incurring any consequences. Confidentiality and anonymity of the information collected were ensured by not having any identification on the questionnaire so that information would not be traced back to individuals. Confidentiality was guaranteed by storing data safely and only the research team had access to raw data.

3.10 Limitations of the study

The study was carried out at only one hospital with a patient population that is not representative of all T2DM patients attending care in other hospitals around the country. This limits the generalisability of findings to the entire diabetic population in Uganda. The convenience sampling technique is a non-probability method, in which, the chance that an individual patient will be included in the sample is unknown. Hence, the sample was not representative of the larger patient population, and therefore the results of this study maybe be limited in terms of generalisability to the larger T2DM patient population attending the outpatient diabetes clinic at the hospital.

The study was of a cross-sectional design hence data obtained does not reflect the contribution on long-term effects of identified parameters on physical activity level. Also, the study relied on retrospective self-reported information from participants, a method which is prone to recall bias. Hence, data were very likely to be overestimated or underestimated. Participants might have also reported more favourable information and estimates due to the social desirability bias.

The small sample size of the study may also limit generalisability and mask important statistical information which would better be realised and analysed using a larger sample size.

4.0 CHAPTER FOUR: RESULTS

4.1 Background characteristics of type 2 diabetes mellitus patients

4.1.1 Socio-demographic and socio-economic characteristics

Overall, 103 patients with a mean age of the respondents was 45.9±11 years participated in the study. Table 4-1 summarises the socio-demographic characteristics of respondents.

Table 4-1 Socio-demographic characteristics of respondents

Variable		Frequency (n)	Percent (%)
Age	20-29 yrs	5	4.9%
	30-39 yrs	28	27.2%
	40-49 yrs	26	25.2%
	50-59 yrs	35	34.0%
	60-69 yrs	6	5.8%
	70-79 yrs	3	2.9%
Gender	Male	52	50.5%
	Female	51	49.5%
Religion	Catholic	30	29.1%
	Anglican	21	20.4%
	Muslim	33	32.0%
	Pentecostal	14	13.6%
	Seventh day Adventist	5	4.9%
Residence	Urban	81	78.6%
	Rural	22	21.4%
Marital status	Never married	19	18.4%
	Married	52	50.5%
	Living together	14	13.6%
	Divorced/separated	12	11.7%
	Widowed	6	5.8%
Level of education	None	10	9.7%
	Primary	33	32.0%
	Secondary	41	39.8%
	Tertiary	19	18.4%
Employment	Unemployed	11	10.7%
	Employed	28	27.2%
	Self-employed	46	44.7%
	Pensioner	1	1.0%
	Farmer	11	10.7%

	Manual labourer	2	1.9%
	Housewife	4	3.9%
Socioeconomic status (SES)	Insufficient funds all or most of the time	47	45.6%
	Sufficient funds most of the time	6	5.8%
	Insufficient funds some of the time	24	23.3%
	Balance	26	25.2%

4.1.2 Health-related and lifestyle characteristics

Health-related characteristics of respondents are summarised in Table 4-2. The mean fasting blood glucose (FBG) of the respondents was 11.6±4.4 mmol/L with majority (92.2%) above the normal range (>7.0 mmol/L). Majority (91.3%) were hypertensive, 61.2% had a family history of diabetes and 35.9% had been diagnosed with T2DM for a period of 1 to 5 years.

Table 4-2 Health-related characteristics of respondents (n=103)

Variable		**Frequency (n)**	**Percent (%)**
Blood glucose (mmol/L)	>7.0	95	92.2%
Blood pressure(mmHg)	Normal	9	8.7%
	Pre-hypertension	44	42.7%
	Hypertension I	32	31.1%
	Hypertension II	18	17.5%
Duration of T2DM	<1 yr	14	13.6%
	1-5 yr	37	35.9%
	5-10 yr	32	31.1%
	>10 yr	20	19.4%
Family history of T2DM	Yes	63	61.2%
	No	40	38.8%
Oral medication		86	83.5%
Insulin		20	19.4%
Smoking	Never	84	81.6%
	Currently smoke	9	8.7%
	Quit	10	9.7%
Alcohol consumption	Never	45	43.7%
	Currently drink	45	43.7%
	Quit	13	12.6%
Frequency of alcohol consumption	Rarely (less than 3 times a month)	19	18.4%

	Daily	6	5.8%
	Always (at least 3times a week)	21	20.4%
	Not at all	57	55.3%

4.2 Anthropometric nutritional status of patients with type 2 diabetes mellitus

Majority (64.1%) of respondents were obese (BMI ≥30kg/m^2) with more women 40 (38.8%) than men 26 (25.2%) in this weight category. Only 4.9% of respondents were normal weight and 30.1% were overweight (Table 4-3).

Table 4-3 Body mass index and weight categorisation of participants (n=103)

Category	BMI (kg/m^2)	Frequency (n)	Percent (%)
Underweight	<18.5	1	1.0%
Normal	18.5-24.9	5	4.9%
Overweight	25.0-29.9	31	30.1%
Obese	≥30	66	64.0%
Class I (moderately obese)	30.0-34.9	41	39.8%
Class II (severely obese)	35.0-39.9	20	19.4%
Class III (morbidly obese)	≥40	5	4.9%
Total overweight and obese	≥25	97	94.1%

The mean waist circumference of the respondents was 98.5±11.2 cm. The mean waist circumference of men was 104.3±10.3 cm while that of women was 92.45±8.6 cm. The majority of respondents had waist circumferences above the normal risk cut-offs (Table 4-4).

Table 4-4 Waist circumference of respondents

Waist circumference		Cut-off	Frequency (n)	Percent (%)
Gender	Male (n=52)	>102 cm	32	61.5%
	Female (n=51)	>88 cm	39	76.5%

4.3 Association between socio-demographic, health-related characteristics and anthropometric nutritional status

Chi-square test revealed a significant association (x^2=12.864, p=0.005) between gender and BMI, with more women (n=40) than men (n=26) being obese, and more

men (n=21) than women (n=10) being overweight. There were no significant associations realised with other characteristics (Table 4-5).

Table 4-5 Relationship between BMI and selected variables using Chi-square test

	Chi-square (x^2)	p-value	df
BMI			
Gender	12.864	0.005*	3
Residence	7.394	0.060	3
Religion	10.931	0.535	12
Marital status	23.448	0.024*	12
Education	14.429	0.108	9
Employment	24.852	0.129	18
Socioeconomic status	10.304	0.326	9
Blood pressure class	13.016	0.162	9
Duration with T2DM	10.459	0.314	9
Family history	1.873	0.599	3
Smoking history	3.698	0.717	6
Alcohol consumption	4.778	0.573	6
Frequency of alcohol use	6.141	0.726	9

4.4 Education and information sources regarding physical activity

The majority (80.6%) of respondents reported having received some form of education and/or information regarding the role of physical activity or exercise in the management of type 2 diabetes mellitus. The most common (67.8%) reported source of information was medical personnel (Figure 4-1). The internet was more frequently reported as an information source among respondents with tertiary education (84.2%; n=16).

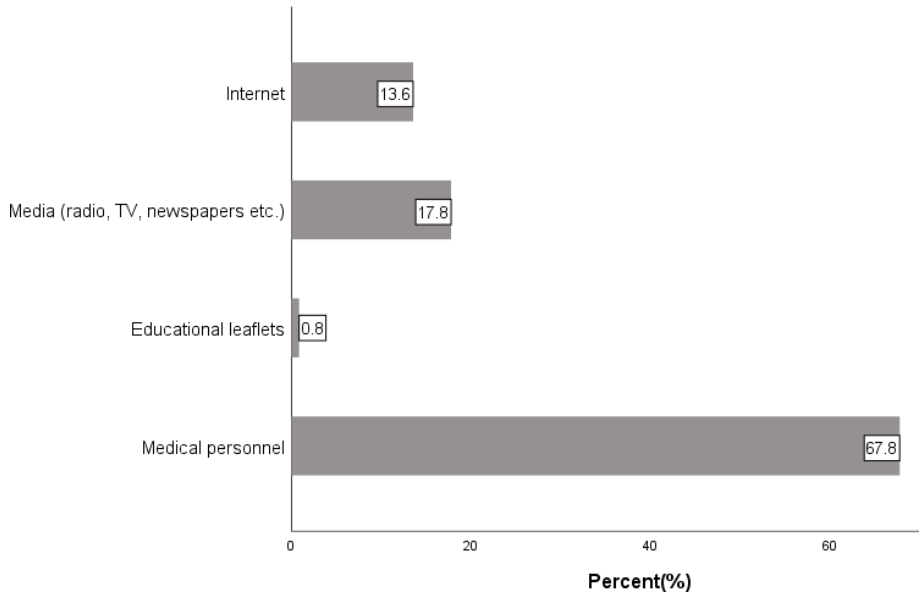

Figure 4-1 Information sources regarding physical activity among participants

4.5 Knowledge regarding physical activity

Respondents' knowledge regarding physical activity was assessed using an 11-item questions with scores that could range from 0 (all incorrect responses) to 11 (all correct responses). The respondents had "fair" knowledge regarding physical activity and T2DM with a mean knowledge score of 6.3±1.8. Majority (64.1%) had "fair" knowledge, while only 6.8% had "good" knowledge regarding physical activity and type 2 diabetes mellitus (Figure 4-2). Table 4-6 summarises respondents' correct versus incorrect responses on all knowledge questions.

Table 4-6 Correct vs. incorrect responses on knowledge items by participants

Statement	Response	
	Correct n (%)	**Incorrect** n (%)
Do you think that T2DM can be controlled by regular exercise?	89 (86.4)	14 (13.6)
Do you think that exercise is as important as drugs and dietary control in the management of T2DM?	89 (86.4)	14 (13.6)
Do you think that physical activity or exercise is an optional strategy in the management of T2DM?	68 (66.0)	35 (34.0)
Do you think that all diabetics or only obese/overweight should do exercise?	86 (83.5)	17 (16.5)

Do you think believe that diabetics should continue with exercise after achieving their target weight?	82 (79.6)	21 (20.4)
Do you think that diabetics with hypertension should exercise?	83 (80.6)	20 (19.4)
Do you know the minimum recommended duration and frequency of exercise for people with T2DM?	2 (1.9)	101 (98.1)
People with T2DM need at least 2 ½ hours of exercise that causes small increases in breathing or heart rate and/or exercises that cause large increases in breathing or heart rate	20 (19.4)	83 (80.6)
People with T2DM need at least 2 sessions of resistance exercise per week	39 (37.9)	64 (62.1)
Is doing household activities adequate as a form of exercise for diabetics?	43 (41.7)	60 (58.3)
Do you think that diabetics on insulin should exercise?	53 (51.5)	50 (48.5)

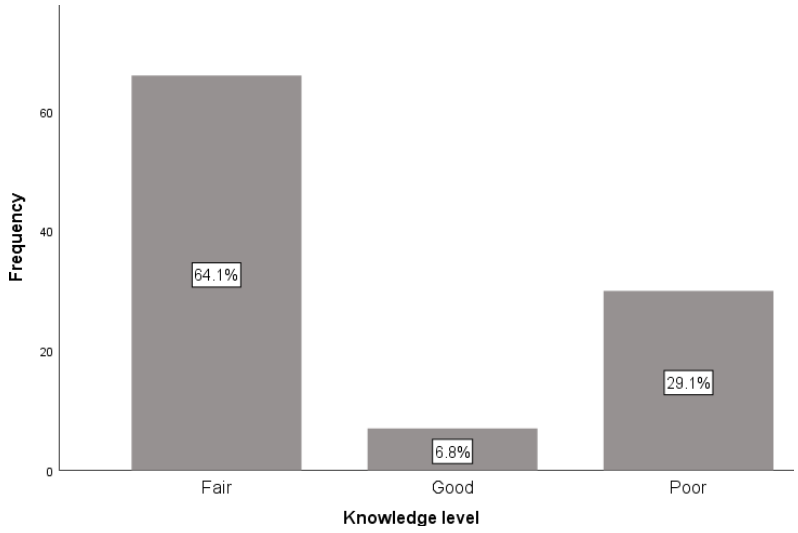

Figure 4-2 Knowledge levels of participants

There were no significant differences in the mean knowledge score of respondents different age groups (*p*=0.095), levels of education (p=0.371), employment status (p=0.209), socioeconomic status (p=0.450), BMI categories (p=0.552), and family history of T2DM (p=0.359). Respondents who had been diagnosed with T2DM more than one year ago had significantly higher mean knowledge scores than those diagnosed less than a year ago (p<0.05) (Figure 4-3).

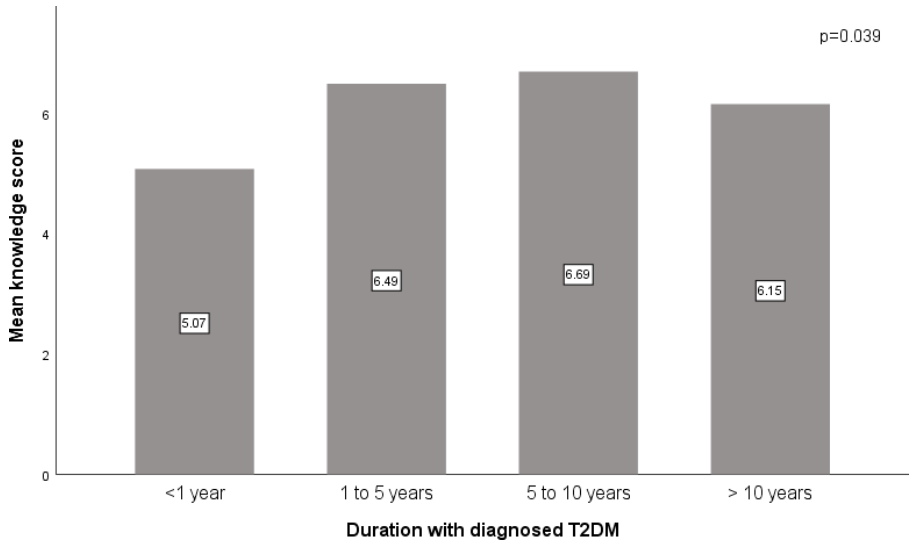

Figure 4-3 Mean knowledge score of participants by age group

4.6 Attitude towards physical activity

Respondents' had "fairly positive" attitude towards physical activity with a mean attitude score of 7.63±4.7, which ranged from -4 to 18. Attitude levels of the respondents are summarised in Table 4-7. There were no significant differences in attitude score between age groups (*p*=0.911), levels of education (p=0.221), employment status (p=0.772), socioeconomic status (p=0.764), BMI (p=0.660), duration with T2DM (p=0.959), and family history of T2DM (p=0.221).

Table 4-7 Participants' attitudes towards physical activity

Attitude category	Frequency (n)	Percent (%)
Very positive	36	34.9%
Fairly positive	60	58.3%
Neutral	3	2.9%
Fairly negative	4	3.9%
Very negative	0	0.0%

4.7 Association between knowledge and attitude towards physical activity

A bivariate Pearson correlation test showed that there was a strong positive relationship (*r*=+0.710, p=0.01) between knowledge score and attitude score. There

was also a significant relationship between knowledge and attitude levels (p<0.005) (Table 4-8).

Table 4-8 Association between participants' attitude and knowledge level using Chi-square test

		Knowledge level			
		Fair (n)	Good (n)	Poor (n)	
Attitude	Fairly negative	2	0	2	x^2 =
	Fairly positive	37	0	23	30.184;
	Neutral	0	0	3	df=6;
	Very positive	27	7	2	p=0.01

4.8 Motivators to engage in physical activity

Respondents had a mean motivation score of 4.97±1.9. Most reported motivators to engage in physical exercise were "to become healthier" (19.5%), "to be fit" (18.6%), "doctor motivation" (14.8%), while the least reported motivators were "to impress others" (0.6%) and "can afford gym" (1.8%) (Table 4-9 and Figure 4-4). There were no significant differences in motivation score between age groups (*p*=0.568), level of education (p=0.446), employment status (p=0.254), socioeconomic status (p=0.685), BMI categories (p=0.213), duration with T2DM (p=0.325), and family history of T2DM (p=0.355). There were no significant between-gender differences in motivators reported to engage in physical exercise.

Table 4-9 Participants' motivators for engaging in physical exercise

	Responses	
Motivator/facilitator	n	Percent
I want to become healthier	100	19.5%
I want to be fit	95	18.6%
I was asked and motivated by my doctor	76	14.8%
I want to lose weight or maintain "healthy" weight	71	13.9%
I want to look better	54	10.5%
I want to relieve stress, relax and feel better	40	7.8%
I am motivated by my family and friends	21	4.1%
I want to socialise with other people	18	3.5%
I want to have fun while doing exercise	13	2.5%
I want to please my family and friends	12	2.3%

I can afford and access gym and other facilities to do exercise	9	1.8%
I want to impress others	3	0.6%

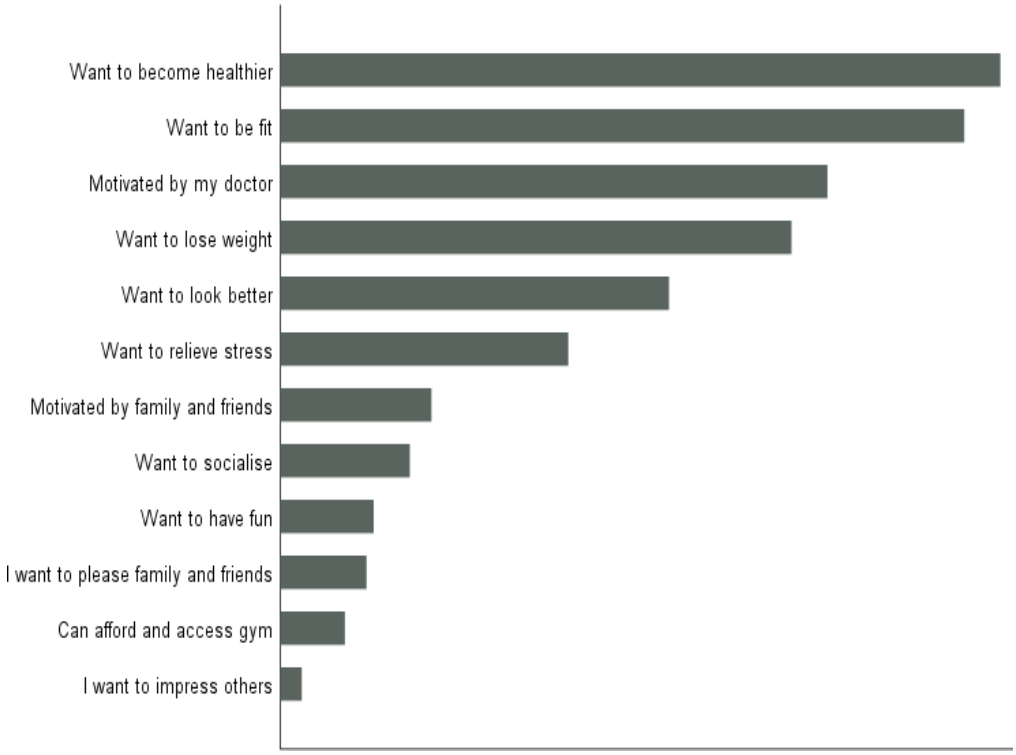

Figure 4-4 Motivators to engage in physical activity by participants

4.9 Barriers to engaging in physical exercise

Respondents had a mean barrier score of 5.72±2.9. Most reported barriers were no time (13.9%), tiredness (11.9%), and not feeling like doing exercise (9.3%), and least reported barriers were physical disability (0.7%), fear of diabetes getting worse (0.7%), and fear of hypoglycaemia (1.7%) (Figure 4-5).

Table 4-10 Barriers to engaging in physical activity

	Responses	
Barrier	n	Percent
I don't have enough time to do exercise	82	13.9%
I feel too tired	70	11.9%
I don't feel like doing exercise	55	9.3%

I am too fat for exercise	46	7.8%
I feel unfit for exercise	45	7.6%
I fear getting an injury	43	7.3%
I fear my blood pressure to rise	28	4.7%
I don't have access to information on what types of exercise I should do and for how long	27	4.6%
I fear getting a heart attack	27	4.6%
I don't have access to facilities to do exercise	23	3.9%
I don't have enough privacy to do exercise	21	3.6%
I cannot afford to go to gym	21	3.6%
I am contented with my current levels of physical activity	21	3.6%
I have no body to encourage me	19	3.2%
I have no body to exercise with	16	2.7%
I feel so conscious about my body looks	15	2.5%
It is not safe for me to do exercise outside	13	2.2%
I fear my blood sugar levels dropping too low	10	1.7%
I have a disability	4	0.7%
I fear my diabetes from getting worse	4	0.7%

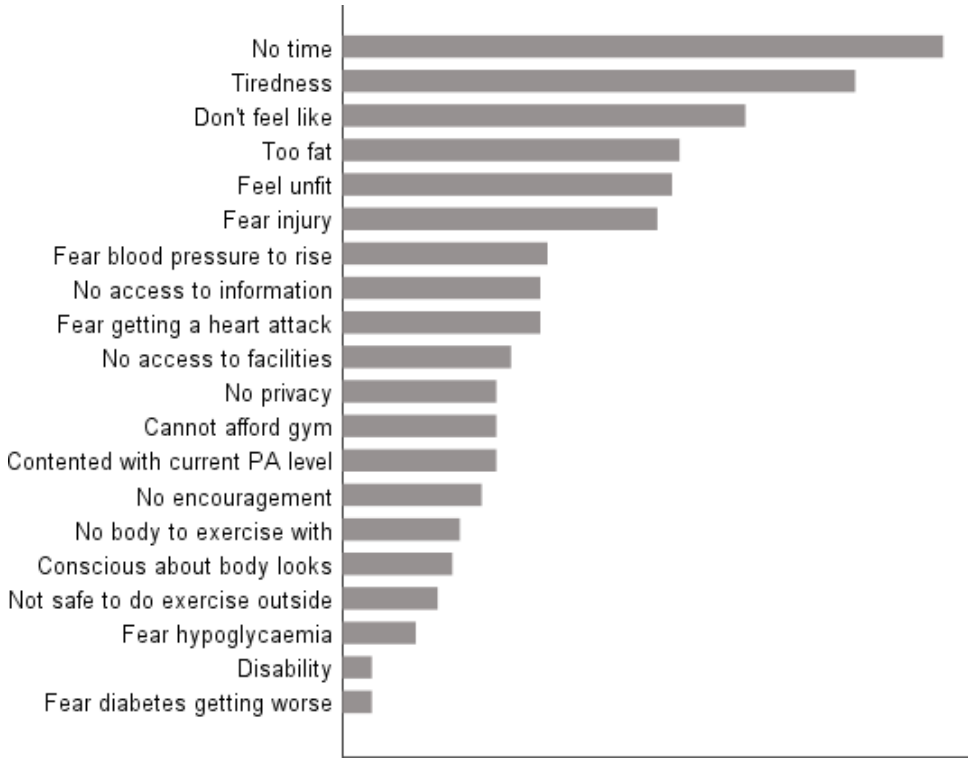

Figure 4-5 Barriers to engaging in physical exercise by participants

There were no significant differences in barrier score between age groups (p=0.891), level of education (p=0.689), employment status (p=0.144), socioeconomic status (p=0.350), BMI (p=0.063), and duration with T2DM (p=0.670). Respondents with family history of T2DM had significantly higher mean barrier score (6.29) than those without (4.90) family history of the disease (p=0.024). There were some statistically significant differences in barriers reported by men and women. Women were more likely to report tiredness (p<0.01) (Figure 4-6) and being "too fat" (p<0.01) (Figure 4-7) as barriers to engaging in physical exercise. Women also reported no encouragement (p=0.057), nobody to exercise with (p=0.08) as barriers compared to men.

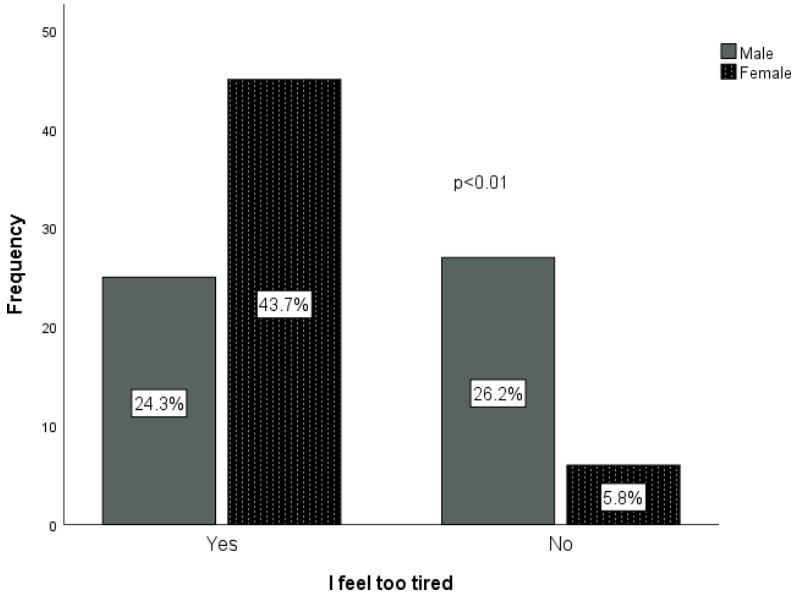

Figure 4-6 Gender differences in tiredness as a barrier to engaging in physical activity

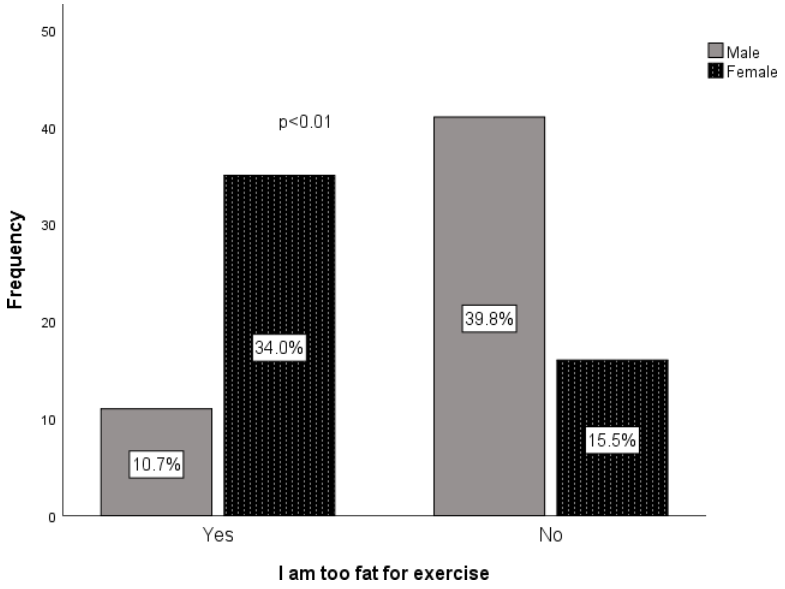

Figure 4-7 Gender differences in being "too fat" to engage in physical exercise

4.10 Physical activity levels

The GPAQ was used to assess physical activity levels of the study population. Data was collected on the type, frequency, duration and intensity of activity in the 3

domains of work, leisure and transportation. Sedentary behaviour was also assessed. Over three quarters (76.7%) of respondents had low levels of physical activity (inactive) and only 23.3% met (active) the recommended 600 MET-minutes/week (Figure 4-8).

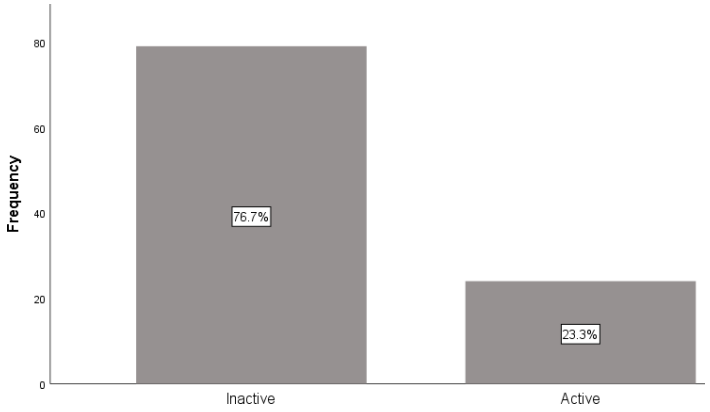

Figure 4-8 Proportion of active versus inactive participants

The inactive group of respondents spent on average 39±4 minutes in moderate to vigorous activity compared to 204±8 minutes spent by the active group (P<0.001). Majority (88 minutes) of activity time was derived from the work domain in the active group, while none of the inactive respondents engaged in work-related vigorous physical activity (Table 4-11). The inactive group spent significantly more time sitting than active respondents (p=0.001).

Table 4-11 Total minutes spent doing domain specific activity in active vs. inactive participants

Domain and Intensity	Inactive		Active		Total	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Work	10.9	24.8	88.0	54.0	28.8	46.9
Vigorous	0.0	0.0	55.4	54.9	12.9	35.1
Moderate	10.9	24.8	32.6	40.4	15.9	30.4
Leisure	12.5	24.3	39.3	63.3	18.7	38.6
Vigorous	0.4	3.9	5.2	25.5	1.6	12.8
Moderate	12.0	23.7	34.1	52.4	17.2	33.7
Transportation	15.4	25.6	76.3	75.5	29.6	49.6
Sedentary	450.7	96.9	364.5	123.8	430.6	109.4
Minutes/wk	38.7	42.1	203.7	79.8	77.1	87.8

No significant differences in total time spent engaging in physical activity were found between active and inactive respondents in the different age groups, as shown in Table 4-12 below.

Table 4-12 Total minutes spent in physical activity in active vs. inactive participants by age group

	Inactive		Active		Total		
Age category	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	p-value
20-29	32.5	37.8	175.0	.	61.0	71.6	
30-39	41.4	43.0	175.3	26.9	74.9	70.8	
40-49	25.9	35.0	235.0	77.7	58.0	87.6	0.479
50-59	45.7	42.6	190.3	69.9	91.1	85.5	
60-69	65.0	58.4			65.0	58.4	
70-79	0.0	0.0	454.0	.	151.3	262.1	
Total	38.7	42.1	203.7	79.8	77.1	87.8	

The study showed significant differences in total physical activity per day between active and inactive respondents. The inactive group spent significantly more time sitting on average per day (p=0.001), as shown in Table 4-13.

Table 4-13 Mean minutes of total activity on average per day in active vs. inactive participants

	Inactive		Active		Total				
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	F	df	p-value
All activity	5.5	6.0	29.1	11.4	11.0	12.5	178	1	<.001
Work	1.6	3.5	12.6	7.7	4.1	6.7	96.4	1	<.001
Transportation	2.2	3.7	10.9	10.78	4.2	7.08	38.0	1	<.001
Leisure	1.8	3.5	5.62	9.04	2.7	5.5	9.7	1	.002
Sedentary	64.4	13.8	52.1	17.7	61.5	15.6	12.7	1	.001

Overall, respondents spent majority of their active time walking to and from places. There were significant differences in the percentage of physical activity derived from work ($p<0.005$) and leisure ($p<0.05$) activities between active and inactive respondents (Table 4-14).

Table 4-14 Percentage total of physical activity that comes from each of the 3 domains of activity

	Inactive		Active		Total				
Domain	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	F	df	p-value
%work	23.55	36.81	51.29	35.09	33.49	38.35	9.042	1	0.004*
%walking	39.65	43.28	32.79	28.60	37.19	38.57	0.484	1	0.489
%leisure	36.80	45.70	15.92	22.77	29.32	40.15	4.381	1	0.040*

The study showed a very strong positive correlation (r=+0.8) between total time spent in physical activity and time spent walking to and from places. Weaker correlations were shown for other physical activity domains and intensity (Table 4-15).

Table 4-15 Correlation between total time spent in physical activity and time spent in each domain and intensity

	Pearson Correlation	p-value
Total time spent in moderate to vigorous physical activity		
Time spent in work vigorous-intensity activity	0.409**	<0.001
Time spent in work moderate-intensity activity	0.466**	<0.001
Time spent walking to and from places	0.778**	<0.001
Time spent in leisure vigorous-intensity activity	0.278**	0.004
Time spent in leisure moderate-intensity activity	0.509**	<0.001

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

One-way analysis of variance (ANOVA) test revealed significant differences in the total time spent in all domains and intensities of physical activity (Table 4-16).

Table 4-16 ANOVA table comparing total time means spent in different activity domains and intensities in active vs. inactive respondents

Domain/Intensity	F	df	p-value
Work/vigorous	82.294	1	<0.001
Work/moderate	10.324	1	0.002
Transportation	37.981	1	<0.001
Leisure vigorous	2.609	1	0.109
Leisure/moderate	8.484	1	0.004
Sedentary	12.734	1	0.001

4.11 Associations between physical activity with other study variables

Pearson correlation tests revealed no significant relationships between total physical activity (measured in MET-minutes/week) and selected demographic characteristics, knowledge, attitude, barrier and motivation scores (Table 4-17).

Table 4-17 Association between total weekly MET-minutes with other selected study variables

	r	p-value
Total MET-minutes/week		
Age	0.21	0.222
BMI	-0.10	0.317
Waist circumference	-0.065	0.517
Knowledge score	0.020	0.844
Attitude score	-0.082	0.410
Barrier score	-0.103	0.302
Motivation score	0.121	0.223

4.12 Background characteristics of active versus inactive respondents

4.12.1 Socio-demographics

The study revealed significant differences between active and inactive respondents and their residence ($p<0.01$) (Figure 4-9), level of education (Figure 4-10), employment (Figure 4-11)) and socioeconomic status (Figure 4-12).

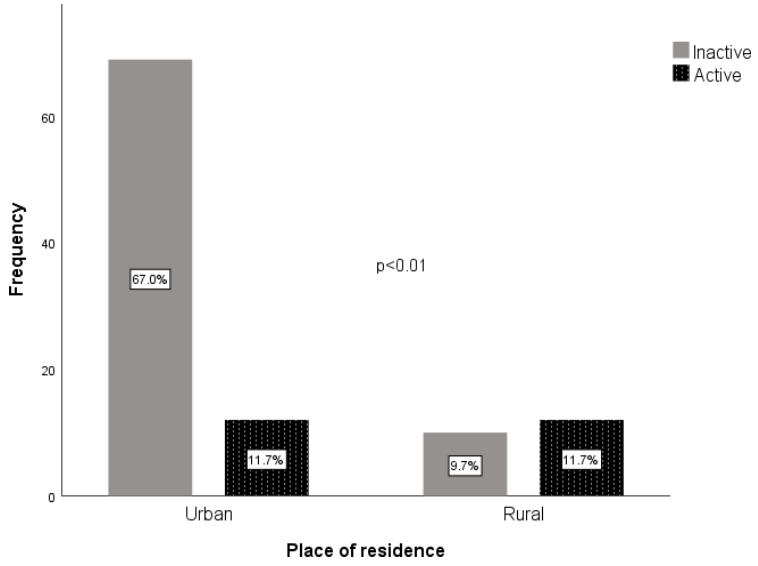

Figure 4-9 Residence of active vs. inactive participants

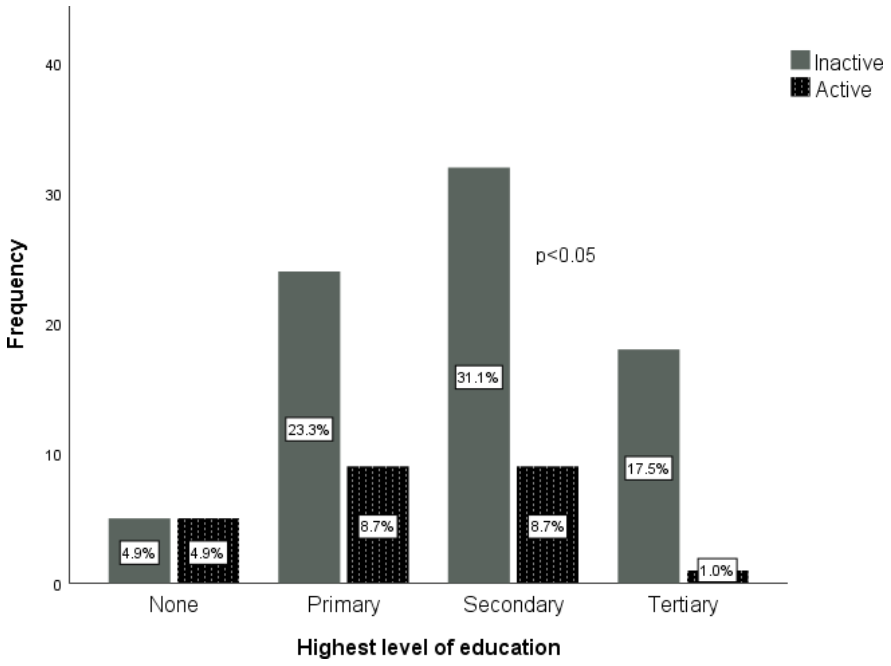

Figure 4-10 Education level of active vs. inactive participants

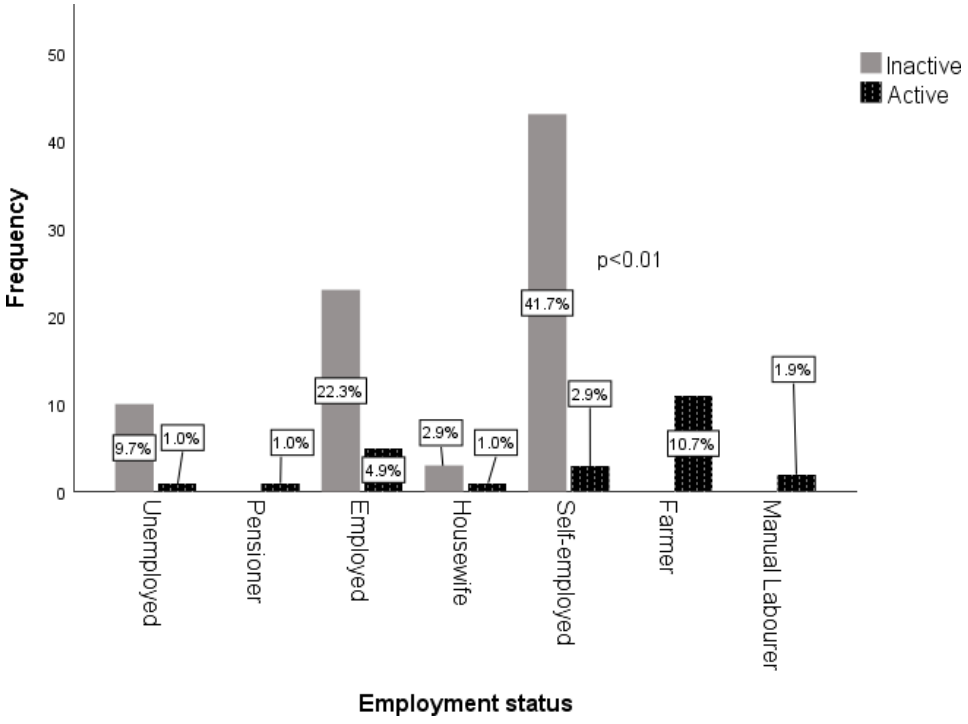

Figure 4-11 Employment status of active vs. inactive participants

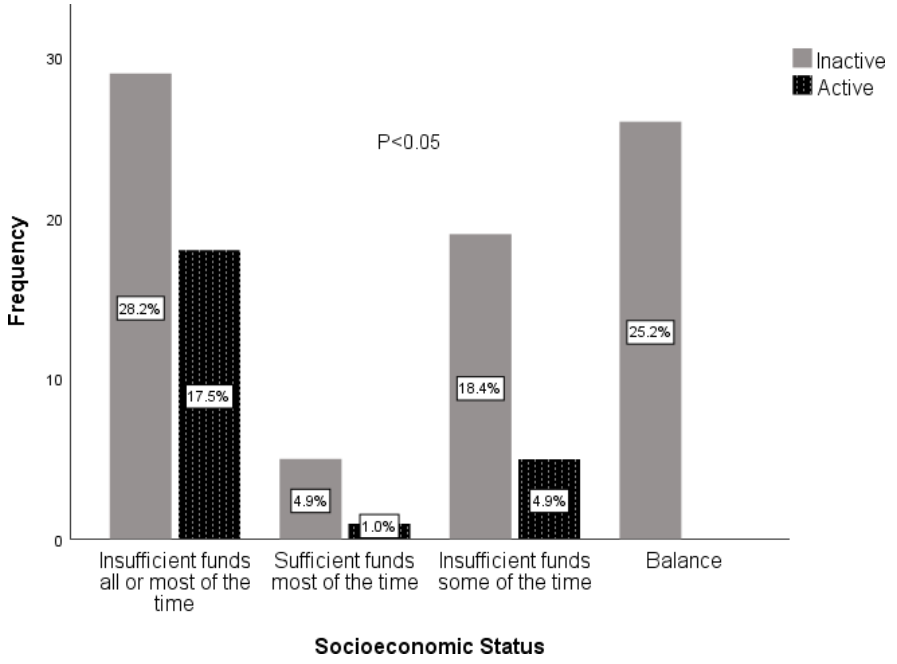

Figure 4-12 Socioeconomic status of active vs. inactive participants

4.12.2 Health-related characteristics

There were no significant differences between active and inactive respondents in terms of selected health and lifestyle characteristics as shown in Table 4-18 below.

Table 4-18 Health-related characteristics of active vs. inactive participants

Variable		Inactive n(%)	Active n(%)	x^2	df	p-value
Glucose (mmol/L)	>7.0	75	20	3.460	1	0.083
	<7.0	4	4			
Blood pressure (mmHg)	Normal	8	1	2.188	3	0.534
	Pre-HTN	31	13			
	HTN I	25	7			
	HTN II	15	3			
Duration of T2DM	<1 yr	12	2	0.742	3	0.865
	1-5 yr	28	9			
	5-10 yr	24	8			
	>10 yr	15	5			
Family history of T2DM	Yes	48	17	1.231	1	0.342
	No	33	7			

Oral medication	Yes	67	19	0.425	1	0.537
	No	12	5			
Insulin	Yes	15	5	0.040	1	1.000
	No	64	19			
Smoking	Never	67	17	2.943	2	0.265
	Currently smoke	5	4			
	Quit	7	3			
Alcohol consumption	Never	33	12	0.560	2	0.810
	Currently drink	36	9			
	Quit	10	3			
Frequency of alcohol use	Rarely	16	3	0.991	3	0.820
	Daily	4	2			
	Always	16	5			
	Not at all	43	24			

4.12.3 Anthropometric nutritional status

There were no significant differences between active and inactive respondents in terms of their BMI (Table 4-19) and waist circumference (Table 4-20).

Table 4-19 BMI of active vs. inactive participants

	Inactive	**Active**			
Category	**n**	**n**	**Chi-square *(x^2)***	**df**	***p*-value**
Underweight	1	0			
Normal	3	2	5.101	5	0.433
Overweight	21	10			
Obese	54	12	3.443	3	0.380

Table 4-20 Waist circumference of active vs. inactive participants

			Inactive	**Active**			
Waist circumference			**n**	***n***	**x^2**	***df***	**p-*value***
Gender	Male	>102cm	26	6			
		<102cm	12	8	2.681	1	0.136
	Female	>88 cm	34	5			
		<88cm	7	5			

4.13 Knowledge and attitudes in active versus inactive respondents

4.13.1 Knowledge regarding physical activity

The mean knowledge score of active respondents was 6.4±1.8 and inactive respondents was 6.3±1.8. There were, however, no significant differences between the two groups (p=0.799). Similarly, there were no significant differences in knowledge level (poor, fair, good) between active vs. inactive respondents (p=0.059).

4.13.2 Attitude toward physical activity

The mean attitude score of active respondents was 6.9±5.5 and inactive respondents was 7.9±4.5. There were, however, no significant difference between the two groups (p=0.401). Similarly, there were no significant differences in attitude (very negative, fairly negative, neutral, fairly positive, very positive) in active vs. inactive respondents (p=0.162).

4.14 Motivators and barriers in active versus inactive participants

4.14.1 Motivators to engaging in physical activity

The mean motivation score of active participants was 5.3±2.2 and inactive participants was 4.9±1.8. There were no significant differences between active vs. inactive groups (p=0.353). There were neither significant differences in the frequency of motivators reported by the active vs. inactive respondents.

4.14.2 Barriers to engaging in physical activity

The mean barrier score of active participants was 5.1±2.2 and inactive participants was 5.9±3.1, with, generally, no significant differences between the groups (p=0.261). There were significant differences in the frequency of ”I have nobody to encourage me” response between active and inactive groups. About ninety five (94.7) percent of respondents who reported the barrier were inactive compared to only 5.3% active respondents (p=0.03).

4.15 Risk factors of physical inactivity

Categorical variables that were found to be significantly associated with the outcome (total physical activity) at bivariate analysis using Chi-square test, were subjected to multivariate analysis using logistic regression to reveal potential associations with physical inactivity (Table 4-21).

Table 4-21 Socio-demographic risk factors of physical inactivity among type 2 diabetics

	R^2	p-value
Total physical activity (MET-minutes/week)		
Residence	0.150	<0.001
Education	0.152	<0.001
Employment	0.193	<0.001
Socioeconomic status	0.217	<0.001

5.0 CHAPTER FIVE: DISCUSSION

5.1 Introduction

The aim of this study was to establish the levels of physical activity and the factors associated with physical activity among type 2 diabetes mellitus patients attending care at Kiruddu General Referral Hospital. This chapter explores the research findings and answers the research questions of the study.

5.2 Physical activity

Physical activity has been shown to have several profound physiologic and metabolic benefits in patients with T2DM (Jenkins & Jenks, 2017), thus, forming a cornerstone in the management of the disease (Lee et al., 2018). Despite the undisputable evidence for physical activity's benefits, patients with type 2 diabetes mellitus have been reported to be one of the populations least likely to participate in regular physical activity (Qiu et al., 2012).

The current study showed that 76.7% of respondents had low levels of physical activity (<600 MET-minutes/week) and only 23.3% met the recommended activity levels. These results conform to findings of several other studies that found high lower-than-recommended activity levels among diabetics. Monsier-pudar et. al (2009) reported that 71% of diabetics were inactive and found it hard to engage in regular physical activity. Thomas (2004) reported 68% of type 2 diabetics were inactive, and Roux et. al (2018) found that 69% of diabetics were inactive.

Other studies have, however, reported relatively lower inactivity levels among the diabetic population. The CDC (2019) reported that 40.8% of diabetics were physically inactive, and Brugnara et. al (2016) reported that 44% of individuals with diagnosed diabetes had low physical activity. On the other hand, other studies have reported significantly lower inactivity levels among diabetics. Kumara & Siriwadena (2016) reported 77.9%, Umeh & Nkombua (2018) reported 70%, Rathod et. al (2014)

reported 74%, and Djiby et. al (2018) reported 87% of diabetics were physically active and met the WHO recommendations.

The discrepancies between findings of the studies could be due to different methodologies, definitions of terms, physical activity recommendations referred to, and widely varying respondents' characteristics.

5.3 Socio-demographic characteristics and physical activity

The study found a significant relationship between type of residence and physical activity levels. Respondents living in rural areas were considerably more active than those in urban areas. This could be because patients from rural areas engage in more physically demanding work such as digging compared to those in urban areas who generally do less physically demanding work. This explanation is supported by the finding in the current study that nearly all patients from rural areas reported doing farm work (most especially digging) and had significantly higher levels of vigorous intensity activity.

Time spent in work-related activity strongly predicted total amount of time spent in physical activity. This is because many adults spend most of their time working (Quintiliani, Sattelmair, & Sorensen, 2008). This implies that interventions aimed at increasing activity levels at workplaces may help increase physical activity among T2DM patients to levels that confer health benefit. Other studies have found that leisure time activity predicted higher activity levels among T2DM patients (Arshad, Younis, Masood, Tahira, & Khurhsid, 2016).

The study found significant association between physical activity among and level of education, socioeconomic status and employment. Patients with a low socioeconomic status were more inactive than those with a higher status. Majority of inactive were self-employed. This could be because many of these patients live in urban areas and the nature of their work is not physically demanding. Some of the findings coincide with those of other studies that have found associations with educational level,

income, employment status (Morrato et al., 2007; Plotnikoff et al., 2006). The study, however, found no significant associations between physical activity and age, marital status, and religion.

5.4 Knowledge regarding physical activity

The current study shows that majority (80.6%) of the patients received some form of education and/or information regarding physical activity. This finding coincides with the findings of Kumara & Siriwardena (2016) who reported that 79.5% of patients had been educated on physical activity. However, not all studies report such high levels of education regarding physical activity among T2DM patients. Shilubane et. al (2016) reported that 44.0% did not have any information if diabetes patients could benefit from physical exercise.

In spite reporting having been educated on the topic, most (64%) of the T2DM patients had only fair knowledge and the minority (6.8%) had good knowledge, regarding physical activity in the management of T2DM. Most (86.4%) of the patients correctly identified that physical exercise could help control blood glucose and that exercise was as important as drugs and diet control in the management of T2DM. This finding coincides with that made by Roux et. al (2018) which reported 96.1% of diabetic patients to be knowledgeable about the benefits of PA. Other studies have reported lower cognizance of exercise's benefit among diabetics. Shah et. al (2009) reported that 51% of T2DM patients believed exercise helped manage the disease, Shilubane et. al (2016) reported that 41.0% of diabetics believed that they can benefit from physical exercise, 15.0% did not believe in physical exercise and 44.0% did not have any information if diabetes patients could benefit from physical exercise. Only 1.9% of the patients in this study knew the minimum recommended duration and frequency of physical activity for patients with T2DM, a much lower percentage compared to the 7.9% reported by Kumara & Siriwardena (2016). The findings of this study are similar to those of a number of other studies. Islam et. al (2014) noted that

knowledge deficit is common among patients with T2DM (Islam et al., 2014), even among those patients who have been educated (Kumara & Siriwardena, 2016).

Most of the patients appear not to translate their knowledge into physical activity (PA). This finding coincides with that made by Jasper et. al (2014) that knowledge gained through counselling and education may not necessarily lead to increased participation in physical activity. Therefore, factors hindering patients' participation in regular activity should be identified while educating patients and methods of tackling these barriers punctually addressed. Kumara & Siriwardena (2016) also found that patients met recommended physical activity levels despite having inadequate knowledge regarding PA.

Despite having received education regarding physical activity (most especially from medical personnel), patients had inadequate knowledge regarding physical activity. This discrepancy reveals potential gaps in the effectiveness of current patient education programmes. This could be due to, among other reasons, health literacy of patients, ineffectiveness of messages disseminated and knowledge deficiencies among the health professionals themselves (Jasper, 2014; Kumara & Siriwardena, 2016). These gaps underscore the need for having training and education programmes for healthcare professionals regarding lifestyle interventions related to diabetes (Kumara & Siriwardena, 2016), which include increasing physical activity levels.

5.5 Attitudes towards physical activity

The study found that patients had, on average, a "fairly positive" attitude towards physical activity. This finding coincides with those of Kumara & Siriwardena (2016) who found that T2DM patients had a positive attitude towards physical activity.

The positive attitude possessed by patients provides an opportunity for healthcare professionals working with diabetics to capitalize on and disseminate a sufficient amount of well-structured information effectively. Despite this opportunity, healthcare professionals have not taken advantage of it (Kumara & Siriwardena,

2016), which may partly explain the knowledge gap between education and knowledge levels, as well as possible knowledge deficiencies among healthcare professionals themselves (Jasper, 2014).

The study also found a significant positive correlation between knowledge and attitudes of patients towards physical activity. This implies that effectively educating T2DM patients can improve their attitudes towards physical activity, and a positive attitude may increase acceptability of education messages which in turn could improve patients' knowledge.

5.6 Motivators to engage in physical exercise

The study found that respondents had were fairly motivated. There were no significant differences in motivation between active and inactive participants. This finding contrasts the findings of Duclos et. al (2015) which showed that active patients had a significantly higher motivation score compared to the inactive T2DM patients. This difference in findings could be due the smaller sample size used in this study.

The most frequently reported motivators to engage in physical activity were to become healthier, to become fit, and motivation from the doctor. Other studies have reported leading motivations to be lack of health concerns, medical support (such as direct request from the physician and regular monitoring of patients' activity from the physician) and support from a non-physician for example, someone to exercise with, someone encouraging (Duclos et. al., 2015), social support from family, health benefits, a sense of wellbeing and fitness improvements (Tulloch et al., 2013), and general improvements experienced during an exercise program (Wycherley et al., 2012). The differences in the findings could be explained in terms of varying respondents' characteristics, sociocultural differences and items used in data collection tools. This underscores the need to develop individualized strategies to promote physical activity among the T2DM patients since different populations and

individuals may significantly differ in what motivates them to do exercise or become more active.

Motivation from doctor (medical personnel) was found to be one of the most common motivators for patients to engage in physical activity. This highlights a central role that these professionals who provide primary care to patients have to play in promoting physical activity among T2DM patients. Patients with physically active physicians/doctors have been shown to be significantly more active than those with inactive physicians (Duclos et. al., 2015). This is because healthcare professionals who engage in regular physical activity themselves are more likely to influence their patients to engage in regular PA (Duclos, Coudeyre, & Ouchchane, 2011), and more effectively and convincingly counsel patients to exercise (Abramson, Stein, Schaufele, Frates, & Rogan, 2000). These findings suggest a need to promote higher physical activity levels among healthcare professionals as a way of increasing the same among the patients who receive care from them.

5.7 Barriers to physical exercise

The study found that respondents had a mean barrier score of 5.72±2.9 with no significant differences between the groups (p=0.261). This contradicts with Duclos et. al (2015) who found that inactive patients had a significantly higher barrier score than active patients. This discrepancy could be possibly be explained in terms of sample size as this study had a much smaller sample size (n=103) compared to 1,766 patients in the MOBILE study.

Most reported barriers were no time, tiredness, and not feeling like doing exercise. Other studies have reported different most commonly cited barriers among T2DM patients. Duclos et. al (2015) reported negative self-image as the highest ranked barrier, followed by lack of support and encouragement, and by medical concerns and fear of injury. Wycherley et. al (2012) reported reduced access to gyms, equipment or similar exercise programs, and high costs of gyms as major barriers to participation in resistance exercise after one year following an intervention program. Tulloch et. al

(2013) reported illness or injury, work commitments, poor weather, time, vacation, boredom and family commitments as leading barriers to engaging in physical activity by T2DM patients.

The study found that inactive patients were significantly more likely to give lack of encouragement as a barrier to engage in physical activity compared to active patients. This implies that if patients are regularly encouraged to participate in exercise, it may significantly increase their activity levels which can help them control their diabetes. In order to do this, it requires that patients' families be involved in the management of T2DM as an ever-present source of encouragement to the patient to increase their participation in physical activity.

Another finding of the current study is that women were significantly more likely to report tiredness, being too fat, no encouragement and nobody to exercise with as barriers to engaging in physical exercise compared to men. This finding highlights the need to consider any gender-specific issues that may be affecting a particular gender's participation in physical activity.

5.8 Anthropometric nutritional status of T2DM patients

The current study found that 64.1% of T2DM patients were obese and 30.1% were overweight. Several studies have reported relatively similar prevalence of overweight and obesity among type 2 diabetics. Bakr (2015) reported that 25.5% and 62.7% of T2DM patients were overweight and obese, respectively. Firouzi et. al (2015) reported that 86.5% of patients were either overweight or obese. Djiby et. al (2018) found that of their respondent T2DM patients, 33.30% were overweight and 17.2% were obese.

The study found no significant differences between active and inactive respondents in terms of their BMI. Other studies have, however, found significant differences. Duclos et. al (2015) found that active patients had lower mean BMI than inactive

patients. The failure to notice this difference could probably be due to a small sample size used in this study.

The study found that T2DM patients had an average (98.5±11.2cm) waist circumference above the normal range for both men (104.3±10.3cm) and women (92.45±8.6 cm). These findings coincide with those of other studies. Firouzi et. al (2015) found mean waist circumference of patients to be 90.0 ± 10.1 cm (men 93.4 ± 8.9; 88.8 ± 10.4 women).

The study found no significant differences in waist circumference between active and inactive patients, as opposed to Duclos et. al (2015) who found that inactive patients had considerably above-normal waist circumferences compared to the active patients. The small sample size of the current study could be an explanation as to why this difference was not noticed.

5.9 Risk factors of physical inactivity

The study found that risk factors were living in urban areas, having only a secondary education, being self-employed and being in a low socioeconomic status. These findings coincide with those of other studies (Morrato et al., 2007; Plotnikoff et al., 2006). The study, however, could not establish old age, being female and marital status as risk factors of physical inactivity as reported by the studies. The small sample size in the current study could explain the failure to observe similar associations.

6.0 CHAPTER SIX: CONCLUSIONS AND RECOMMEDATIONS

6.1 Conclusions

Findings from the current study have availed seminal insight into understanding the physical activity levels, knowledge regarding, attitudes towards, motivators and barriers to engaging in physical activity among the T2DM patient population in Uganda. The major finding of this study was that majority of the T2DM patients did not meet physical activity for health recommendations and did not have adequate knowledge regarding physical activity. The positive attitudes found among the patients did not translate into increased physical activity, but present an opportunity to healthcare professionals that they optimally capitalize on to develop effective education messages (Kumara & Siriwardena, 2016), that aim to increase patients' physical activity levels.

Collectively, findings of this study highlight the need for healthcare approaches and interventions that aim to improve T2DM patients' activity levels, knowledge and attitudes which may assist in preventing and managing T2DM in Uganda. However, future better designed descriptive and intervention studies are needed to enquire into the domain of physical activity among T2DM patients.

6.2 Recommendations

Based on the findings of the current study, the author recommends the following for policy, practice and future research:

- Policymakers along with other stakeholders in health service provision should develop effective strategies that aim to increase physical activity among T2DM patients and the general population, through a multi-professional collaboration with emphasis on diabetes educators, nutritionists, medical doctors and nurses, exercise physiologists, counsellors and physiotherapists.

- A more preventative approach is needed to forestall incidence of T2DM in which government and non-government stakeholders increase public awareness of the importance of physical exercise in diabetes, while addressing fears and dispelling wrongly held beliefs (Jasper, 2014). This approach will target those already diagnosed with the disease as well as those who have not in order to reduce risk factors for T2DM.

- Diabetes patient educators regarding physical activity should explore empirical barriers to engaging in physical activity and seek ways of surmounting the challenges reported by the patients through individual consultation, education and motivation. Health care providers should also take into account patients' knowledge of physical exercise, attitudes as well as social, environmental and physical limitations to engaging in adequate physical activity.

- Since healthcare professionals are the leading source of information regarding physical activity and T2DM, promoting physical activity among them is one way of ensuring that messages and motivation to engage in activity are effectively and convincingly passed on to patients. This is supported by findings by Duclos et. al (2011) that physicians who were active themselves more consistently counselled and motivated patients to engage in physical exercise and thus had more active patients than those physicians who were inactive themselves.

- Physical activity education and counselling should be incorporated into routine patient visits to healthcare facilities as a first step towards raising the PA level of patients, since a combination of these two have been shown to be effective in promoting behavioural change toward physical activity among diabetics (Plotnikoff et al., 2011).

- Since merely educating patients on the benefits of physical activity may not translate into more activity (Jasper et al., 2014), it is important that healthcare professionals enquire into the barriers to engaging in exercise and develop methods to surmount these barriers among patients.

- Furthermore, a critical assessment of knowledge possessed by healthcare professionals is warranted since their knowledge deficiencies could partly explain the inadequate knowledge levels that their patients have regarding physical activity (Kumara & Siriwardena, 2016).

- Future studies should use more objective methods to assess physical activity levels in order to avoid over- and under-reporting that could have occurred during the current study since subjective reporting tools were employed. Also better designed studies need to be done to investigate any associations between physical activity and socio-demographic characteristics that this study could not find but have been reported in other studies conducted in other countries (Morrato et al., 2007; Plotnikoff et al., 2006)..

REFERENCES

Abramson, S., Stein, J., Schaufele, M., Frates, E., & Rogan, S. (2000). Personal exercise habits and counseling practices of primary care physicians: A national survey. *Clin J Sport Med*, *10*(1), 40–48.

American Diabetes Association (ADA). (2017). Standards of Medical Care in Diabetesâ□”2017. *Diabetes Care*, *40*(Suppl1), S6–S10. https://doi.org/10.2337/dc17-S001

Arshad, R., Younis, B. B., Masood, J., Tahira, M., & Khurhsid, S. (2016). Pattern of physical activity among persons with type 2 diabetes with special consideration to daily routine. *Pakistan Journal of Medical Sciences*, *32*(1), 234–238. https://doi.org/10.12669/pjms.321.8379

Bakr, E.-S. H. (2015). Nutritional Assessment of Type II Diabetic Patients. *Pakistan Journal of Nutrition*, *14*(6), 308–315. https://doi.org/10.3923/pjn.2015.308.315

Balducci, S., Iacobellis, G., Parisi, L., Biase, N. Di, Calandriello, E., Leonetti, F., & Fallluca, F. (2006). Exercise training can modify the natural history of diabetic neuropathy. *Journal of Diabetes and Its Complications*, *20*(4), 216–223. https://doi.org/10.1016/j.jdiacomp.2005.07.005

Bosch, M. L. Vanden, Robbins, L. B., & Anderson, K. (2015). Correlates of Physical Activity in Middle-Aged Women With and Without Diabetes. *Western Journal of Nursing Research*, *37*(12), 1581–1603. https://doi.org/10.1177/0193945914541333

Brugnara, L., Murillo, S., Novials, A., Rojo-Martínez, G., Soriguer, F., Goday, A., … Ortega, E. (2016). Low physical activity and its association with diabetes and other cardiovascular risk factors: A nationwide, population-based study. *PLoS ONE*, *11*(8), 1–12. https://doi.org/10.1371/journal.pone.0160959

Carballo, M., Mohammad, A., Maclean, E. C., Khatoon, N., Waheedi, M., & Abraham, S. (2018). Knowledge, attitudes, behaviours and practices towards

diabetes mellitus in kuwait. *Eastern Mediterranean Health Journal*, *24*(11), 1098–1102. https://doi.org/10.26719/2018.24.11.1098

Centers for Disease Control and Prevention (CDC). (2019, February 20). National Diabetes Statistics Report, 2017: Estimates of Diabetes and Its Burden in the United States [Government site]. Retrieved July 26, 2019, from Centers for Disease Control and Prevention website: https://www.cdc.gov/diabetes/data/statistics-report/index.html

Chomistek, A. K., Chiuve, S. E., Jensen, M. K., Cook, N. R., & Rimm, E. B. (2011). Vigorous Physical Activity, Mediating Biomarkers, and Risk of Myocardial Infarction. *Med Sci Sports Exerc*, *43*, 1884–1891.

Chudyk, A., & Petrella, R. J. (2011). Effects of Exercise on Cardiovascular Risk Factors in Type 2 Diabetes. *Diabetes Care*, *34*, 1228–1237. https://doi.org/10.2337/dc10-1881

Colberg, S. R., Sigal, R. J., Yardley, J. E., Riddell, M. C., Dunstan, D. W., Dempsey, P. C., … Tate, D. F. (2016). Physical Activity / Exercise and Diabetes: A Position Statement of the American Diabetes Association. *Diabetes Care*, *39*(November), 2065–2079. https://doi.org/10.2337/dc16-1728

Courneya, K. S., Conner, M., & Rhodes, R. E. (2006). Effects of different measurement scales on the variability and predictive validity of the "two-component" model of the theory of planned behavior in the exercise domain. *Psychology and Health*, *21*(5), 557–570. https://doi.org/10.1080/14768320500422857

Ding, D. (2018). Surveillance of global physical activity: Progress, evidence, and future directions. *The Lancet Global Health*, *6*(10), e1046–e1047. https://doi.org/10.1016/S2214-109X(18)30381-4

Djiby, S., Demba, D., Assane, N. M., Mané, D. I., Mahecor, D., Marie, K., … Maimouna, N. M. (2018). The Knowledge, Attitudes and Practices of Diabetics on Physical Activity at the Marc Sankale Center of Dakar. *Open Journal of Internal Medicine*, *8*, 33–41. https://doi.org/10.4236/ojim.2018.81005

Duclos, M., Coudeyre, E., & Ouchchane, L. (2011). General practitioners' barriers to physical activity negatively influence type 2 diabetic patients' involvement in regular physical activity. *Diabetes Care, 34*(7), e122.

Duclos, M., Dejager, S., Postel-Vinay, N., Nicola, S. di, Quéré, S., & Fiquet, B. (2015). Physical activity in patients with type 2 diabetes and hypertension – insights into motivations and barriers from the MOBILE study. *Vascular Health and Risk Management, 11*, 361–371.

Duclos, M., Oppert, J. M., Verges, B., Coliche, V., Gautier, J. F., Guezennec, Y., … Strauch, G. (2013). Physical activity and type 2 diabetes. Recommandations of the SFD (Francophone Diabetes Society) diabetes and physical activity working group. *Diabetes & Metabolism, 39*, 205–216. http://dx.doi.org/10.1016/j.diabet.2013.03.005

Feller, S., Boeing, H., & Pischon, T. (2010). Body Mass Index, Waist Circumference, and the Risk of Type 2 Diabetes Mellitus. *Deutsches Aerzteblatt Online*, *107*(26), 470–477. https://doi.org/10.3238/arztebl.2010.0470

Fiocco, A. J., Scarcello, S., Marzolini, S., Chan, A., Oh, P., Proulx, G., & Greenwood, C. (2013). The Effects of an Exercise and Lifestyle Intervention Program on Cardiovascular, Metabolic Factors and Cognitive Performance in Middle-Aged Adults with Type II Diabetes: A Pilot Study. *Canadian Journal of Diabetes*, *37*(4), 214–219. https://doi.org/10.1016/j.jcjd.2013.03.369

Firouzi, S., Barakatun-Nisak, M. Y., & Azmi, K. N. (2015). Nutritional status, glycemic control and its associated risk factors among a sample of type 2 diabetic individuals, a pilot study. *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences*, *20*(1), 40–46.

Gillani, A. H., Mohammad, F., Islam, A., & Hayat, K. (2018). Knowledge, Attitudes and Practices Regarding Diabetes in the General Population: A Cross-Sectional Study from Pakistan. *International Journal of Environmental Research and Public Health*, (Dm), 1–13. https://doi.org/10.3390/ijerph15091906

Gordon, B., Benson, A., Bird, S., & Fraser, S. (2009). Resistance training improves metabolic health in type 2 diabetes: A systematic review. *Diabetes Res Clin Pract, 83,* 157e75.

Guthold, R. (2009). *Physical Activity Surveillance: Report from the WHO Physical Activity Global Surveillance Meeting*. Retrieved from http://www.ccm-network.it/documenti_Ccm/convegni/Zurigo_OmsEuropa_2009/Guthold.pdf

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1·9 million participants. *The Lancet Global Health, 6*(10), e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Haas, L., Maryniuk, M., Beck, J., Cox, C. E., Duker, P., Edwards, L., … Youssef, G. (2014). National Standards for Diabetes Self-Management Education and Support. *Diabetes Care, 37*(Suppl1), S144-S. https://doi.org/10.2337/dc14-S144

Hayes, C., & Kriska, A. (2008). Role of Physical Activity in Diabetes Management and Prevention. *J Am Diet Assoc, 108,* 19–23. https://doi.org/10.1016/j.jada.2008.01.016

Health Service Executive, & Department of Health and Children. (2009). *The National Guidelines on Physical Activity for Ireland*.

Herbst, A., Kapellen, T., Schober, E., Graf, C., Meissner, T., & Holl, R. (2015). Impact of regular physical activity on blood glucose control and cardiovascular risk factors in adolescents with type 2 diabetes mellitus – a multicenter study of 578 patients from 225 centres. *Pediatric Diabetes, 16*, 204–210. https://doi.org/10.1111/pedi.12144

Hidvégi, T. (2011). [Patient education: An indispensable element of care of patients with diabetes mellitus]. *Orvosi Hetilap, 152*(48), 1941–1948. https://doi.org/10.1556/OH.2011.29262

Hoseinzadeh, K., Alipour Heidari, M., Karbord, A., Azimian, J., & Alizadeh, A. (2016). Knowledge, Attitude and Practice Regarding Physical Activity in

Nursing and Midwifery Students. *Biotechnology and Health Sciences*, *4*(1), e35842. https://doi.org/10.17795/bhs-35842

IBM Corp. (2017). IBM SPSS Statistics for Windows (Version 25) [English, X64 bit]. Armonk, New York: IBM Corporation Inc.

International Diabetes Federation. (2017). *IDF Diabetes Atlas* (8th ed.). https://doi.org/ISSN 1981-9900

International Physical Activity Questionnaire. (2002). Retrieved February 10, 2019, from http://www.sdp.univ.fvg.it/sites/default/files/IPAQ_English_self-admin_long.pdf

Islam, F. M. A., Chakrabarti, R., Dirani, M., Islam, M. T., Ormsby, G., Wahab, M., … Finger, R. P. (2014). Knowledge, attitudes and practice of diabetes in rural Bangladesh: The Bangladesh Population based Diabetes and Eye Study (BPDES). *PLoS ONE*, *9*(10), e110368. https://doi.org/10.1371/journal.pone.0110368

Jadhav, R. A., Hazari, A., Monterio, A., Kumar, S., & Maiya, A. G. (2017). Effect of Physical Activity Intervention in Prediabetes: A Systematic Review with Meta-analysis. *Journal of Physical Activity & Health*. https://doi.org/10.1123/jpah.2016-0632

Jasper, U. S. (2014). Diabetes and Exercise in Sub-Saharan Africa: Challenges and way forward. *Journal of Diabetes & Metabolism*, *5*, 360. https://doi.org/10.4172/2155-6156.1000360

Jasper, U. S., Ogundunmade, B., Opara, C., Akinrolie, O., Pyiki, E., & Umar, A. (2014). Determinants of diabetes knowledge in a cohort of Nigerian Diabetics. *J Diabetes Metab. Disord*, *13*(39), 39.

Jenkins, D. W., & Jenks, A. (2017). Exercise and Diabetes: A Narrative Review. *The Journal of Foot & Ankle Surgery*, *56*(5), 968–974. https://doi.org/10.1053/j.jfas.2017.06.019

Joseph, J. J., Echouffo-Tcheugui, J. B., Golden, S. H., Chen, H., Jenny, N. S., Carnethon, M. R., … Bertoni, A. G. (2016). Physical activity, sedentary behaviors and the incidence of type 2 diabetes mellitus: The multi-ethnic study

of atherosclerosis (MESA). *BMJ Open Diabetes Research and Care*, *4*(1). https://doi.org/10.1136/bmjdrc-2015-000185

Khanal, A. B. (Ed.). (2016). *Mahajan's Methods in Biostatistics for Medical Students and Research Workers* (8th Ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Kish, L. (1965). *Survey sampling*. New York: John Wiley & Sons.

Koloverou, E., Tambalis, K., Panagiotakos, D. B., Georgousopoulou, E., Chrysohoou, C., Skoumas, I., … Pitsavos, C. (2017). Moderate physical activity reduces 10-year diabetes incidence: The mediating role of oxidative stress biomarkers. *International Journal of Public Health*. https://doi.org/10.1007/s00038-017-1052-8

Kumara, M. D. R., & Siriwardena, P. R. (2016). Knowledge, attitudes and practices regarding physical activities among patients with type 2 diabetes. *Sri Lanka Journal of Diabetes Endocrinology and Metabolism*, *6*(1), 13–17. https://doi.org/10.4038/sjdem.v6i1.7299

Kumara, M., & Siriwardena, P. (2016). Knowledge, attitudes and practices regarding physical activities among patients with type 2 diabetes. *Sri Lanka Journal of Diabetes, Endocrinology and Metabolism*, *6*(1), 13–17. https://doi.org/10.4038/sjdem.v6i1.7299

Laaksonen, D. E., Lindstrom, J., Lakka, T. A., Johan G. Eriksson, Niskanen, L., Wikstrom, K., … Uusitupa, M. (2005). Physical activity in the prevention of type 2 diabetes: The Finnish diabetes prevention study. *Diabetes*, *54*, 158–165.

Langenberg, C., Sharp, S. J., Schulze, M. B., Rolandsson, O., Overvad, K., Forouhi, N. G., … Wareham, N. J. (2012). Long-term risk of incident type 2 diabetes and measures of overall and regional obesity: The epic-interact case-cohort study. *PLoS Medicine*, *9*(6), 17. https://doi.org/10.1371/journal.pmed.1001230

Lee, I., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and. *The Lancet*, *380*, 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

Lee, I.-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet (London, England)*, *380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

Lee, P. G., Ha, J., Blaum, C. S., Gretebeck, K., & Alexander, N. B. (2018). Patterns of physical activity in sedentary older individuals with type 2 diabetes. *Clinical Diabetes and Endocrinology*, *4*, 7–7. https://doi.org/10.1186/s40842-018-0057-4

Lee, Pearl G, Ha, J., Blaum, C. S., Gretebeck, K., & Alexander, N. B. (2018). Patterns of physical activity in sedentary older individuals with type 2 diabetes. *Clinical Diabetes and Endocrinology*, *4*(7).

Lemeshow, S., Hosmer Jr., D. W., Klar, J., & Lwanga, S. K. (1990). *Adequacy of Sample Size in Health Studies*. Baffins Lane, Chichester: John Wiley & Sons Ltd.

Levesque, C. (2017). Therapeutic Lifestyle Changes for Diabetes Mellitus. *Nurs Clin N Am*. https://doi.org/10.1016/j.cnur.2017.07.012

Lidegaard, L. P., Schwennesen, N., Willaing, I., & Faerch, K. (2016). Barriers to and motivators for physical activity among people with type 2 diabetes: Patients' perspectives. *Diabet. Med.*, *33*, 1677–1685.

Loprinzi, P. D., & Ramulu, P. Y. (2013). Objectively Measured Physical Activity and Inflammatory Markers Among US Adults With Diabetes: Implications for Attenuating Disease Progression. *Mayo Clinic Proceedings*, *88*(9), 942–951. https://doi.org/10.1016/j.mayocp.2013.05.015

Macniven, R., Pye, V., Merom, D., Milat, A., Monger, C., Bauman, A., & van der Ploeg, H. (2014). Barriers and enablers to physical activity among older Australians who want to increase their physical activity levels. *J Phys Act Health*, *11*(7), 1420–1429. https://doi.org/10.1123/jpah.2012-0096. Epub 2013 Dec 20

Mann, S., Beedie, C., Balducci, S., Zanuso, S., Allgrove, J., Bertiato, F., & Jimenez, A. (2014). Changes in insulin sensitivity in response to different modalities of exercise: A review of the evidence. *Diabetes Metab Res Rev 2014;*, *30*, 257–268. https://doi.org/10.1002/dmrr

Ministry of Health. (2014). *Non-Communicable Disease Risk Factor Baseline Survey: Uganda 2014 Report*.

Morrato, E. H., Hill, J. O., Wyatt, H. R., Ghushchyan, V., & Sullivan, P. W. (2007). Physical Activity in U.S. Adults With Diabetes and At Risk for Developing, 2003. *Diabetes Care*, *30*(2), 203–209. https://doi.org/10.2337/dc06-1128

Moschny, A., Platen, P., Klaassen-Mielke, R., Trampisch, U., & Hinrichs, T. (2011). Barriers to physical activity in older adults in Germany: A cross-sectional study. *Int J Behav Nutr Phys Act*, *8*, 121.

Mosnier-pudar, H., Hochberg, G., Eschwege, E., Virally, M., Halimi, S., Guillausseau, P. J., … Dejager, S. (2009). How do patients with type 2 diabetes perceive their disease? Insights from the French DIABASIS survey. *Diabetes & Metabolism*, *35*, 220–227. https://doi.org/10.1016/j.diabet.2009.02.001

Mosnier-Pudar, H., Hochberg, G., Eschwege, E., Virally, M.-L., Halimi, S., Guillausseau, P. J., … Dejager, S. (2009). How do patients with type 2 diabetes perceive their disease? Insights from the French DIABASIS survey. *Diabetes & Metabolism*, *35*(3), 220–227. https://doi.org/10.1016/j.diabet.2009.02.001

Pastakia, S. D., Pekny, C. R., Manyara, S. M., & Fischer, L. (2017). Diabetes in sub-Saharan Africa – from policy to practice to progress: Targeting the existing gaps for future care for diabetes. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *10*, 247–263.

Physical Activity Guidelines Advisory Committee. (2018). *2018 Physical Activity Guidelines Advisory Committee Scientific Report*. Washington DC.

Plotnikoff, R. C., Pickering, M., Glenn, N., Doze, S., Reinbold-Matthews, M., McLeod, L., … Flaman, L. (2011). The effects of a supplemental, theory-

based physical activity counseling intervention for adults with type 2 diabetes. *J Phys Act Health, 8*(7), 944–954.

Plotnikoff, R. C., Taylor, L. M., Wilson, P. M., Courneya, K. S., Sigal, R. J., Birkett, N., … Svenson, L. W. (2006). Factors associated with physical activity in Canadian adults with diabetes. *Med Sci Sports Exerc*, *38*, 1526–1534.

Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Fischl, A. H., … Vivian, E. (2017). Diabetes Self-management Education and Support in Type 2 Diabetes: A Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *Diabetes Educator*, *43*(1), 40–53. https://doi.org/10.1177/0145721716689694

Qiu, S., Sun, Z., Cai, X., Liu, L., & Yang, B. (2012). Improving Patients' Adherence to Physical Activity in Diabetes Mellitus: A Review. *Diabetes Metab J*, *36*, 1–5. https://doi.org/10.4093/dmj.2012.36.1.1

Quintiliani, L., Sattelmair, J., & Sorensen, G. (2008). *The workplace as a setting for interventions to improve diet and promote physical activity.*

Rathod, G. B., Rathod, S., & Parmar, P. (2014). Study of Knowledge, Attitude and Practice of General Population of Waghodia towards Diabetes Mellitus. *International Journal of Current Research and Review*, *6*, 63–68.

Roux, M. le, Walsh, C., Reid, M., & Raubenheimer, J. (2018). Diabetes-related knowledge, attitude and practices (KAP) of adult patients with type 2 diabetes mellitus in the Free State province, South Africa. *South African Journal of Clinical Nutrition*, *0*(0), 1–8. https://doi.org/10.1080/16070658.2018.1468536

Ruan, Y., Mo, M., Joss-Moore, L., Li, Y. Y., Yang, Q. Di, Shi, L., … Xu, W. H. (2013). Increased waist circumference and prevalence of type 2 diabetes and hypertension in Chinese adults: Two population-based cross-sectional surveys in Shanghai, China. *BMJ Open*, *3*(10). https://doi.org/10.1136/bmjopen-2013-003408

Shah, V. N., Kamdar, P. K., & Shah, N. (2009). Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region, Gujarat.

International Journal of Diabetes in Developing Countries, *29*(3), 118–122. https://doi.org/10.4103/0973-3930.54288

Shilubane, H., Netshikweta, L., & Ralineba, T. (2016a). Beliefs and practices of diabetic patients in Vhembe district of Limpopo Province. *African Journal of Primary Health Care & Family Medicine*, *8*(2), a949. https://doi.org/10.4102/phcfm.v8i2.949

Shilubane, H., Netshikweta, L., & Ralineba, T. (2016b). Beliefs and practices of diabetic patients in Vhembe district of Limpopo Province. *African Journal of Primary Health Care & Family Medicine*, *8*(2), a949.

Sigal, R. J., Armstrong, M. J., Bacon, S. L., Boulé, N. G., Dasgupta, K., Kenny, G. P., & Riddell, M. C. (2018). Physical Activity and Diabetes: Diabetes Canada Clinical Practice Guidelines Expert Committee. *Can J Diabetes*, *42*, 54–63.

Steeves, J. A., Murphy, R. A., Crainiceanu, C. M., Zipunnikov, V., Domelen, D. R. Van, & Harris, T. B. (2015). Daily patterns of physical activity by type 2 diabetes definition: Comparing diabetes, prediabetes, and participants with normal glucose levels in NHANES 2003 – 2006. *PMEDR*, *2*, 152–157. https://doi.org/10.1016/j.pmedr.2015.02.007

Stumvoll, M., Goldstein, B. J., & Van-Haeften, T. W. (2005). Type 2 diabetes: Principles of pathogenesis and therapy. *Lancet*, 1333–1346.

Taylor, R. (2008). Pathogenesis of type 2 diabetes: Tracing the reverse route from cure to cause. *Diabetologia*, *51*, 1781–1789. https://doi.org/10.1007/s00125-008-1116-7

Thiel, D. M., Al, F., Vallance, J. K., Johnson, S. T., & Johnson, J. A. (2016). Association between Physical Activity and Health-Related Quality of Life in Adults with Type 2 Diabetes. *Canadian Journal of Diabetes*, *xxx*, 1–6. https://doi.org/10.1016/j.jcjd.2016.07.004

Thomas, N., Alder, E., & Leese, G. (2004). Barriers to physical activity in patients with diabetes. *Postgraduate Medical Journal*, *80*(943), 287–291. https://doi.org/10.1136/pgmj.2003.010553

Tortora, G. J., & Derrickson, B. (2014). *Principles of Anatomy & Physiology* (14th ed.). John Wiley & Sons Inc.

Tulloch, H., Sweet, S. N., Fortier, M., Capstick, G., Kenny, G. P., & Sigal, R. J. (2013). Exercise Facilitators and Barriers from Adoption to Maintenance in the Diabetes Aerobic and Resistance Exercise Trial. *Canadian Journal of Diabetes*, *37*(6), 367–374. https://doi.org/10.1016/j.jcjd.2013.09.002

Umeh, A. E., & Nkombua, L. (2018). A study of the knowledge and practice of lifestyle modification in patients with type 2 diabetes mellitus in Middelburg sub-district of Mpumalanga. *South African Family Practice*, *60*(1), 26–30. https://doi.org/10.1080/20786190.2017.1364012

WHO. (2009a). *Global health risks: Mortality and burden of disease attributable to selected major risks*. Geneva.

WHO. (2009b). Global Physical Activity Questionnaire (GPAQ) Analysis Guide [World Health Organization]. Retrieved July 27, 2019, from https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf

WHO. (2010). Global recommendations on physical activity for health. Retrieved April 12, 2018, from https://www.who.int/dietphysicalactivity/global-PA-recs-2010.pdf

WHO. (2018a). *Global Health Estimates 2016: Disease burden by Cause, Age, Sex, by Country and by Region, 2000-2016*. Geneva.

WHO. (2018b). *Noncommunicable diseases country profiles 2018*.

WHO. (2018c). Physical activity. Retrieved November 24, 2018, from http://www.who.int/news-room/fact-sheets/detail/physical-activity

Wycherley, T. P., Mohr, P., Noakes, M., Clifton, P. M., & Brinkworth, G. D. (2012). Self-reported facilitators of, and impediments to maintenance of healthy lifestyle behaviours following a supervised research-based lifestyle intervention programme in patients with type 2 diabetes. *Diabetic Medicine: A Journal of the British Diabetic Association*, *29*(5), 632–639. https://doi.org/10.1111/j.1464-5491.2011.03451.x

Zanuso, S., Jimenez, A., Pugliese, G., Corigliano, G., & Balducci, S. (2010). Exercise for the management of type 2 diabetes: A review of the evidence. *Acta Diabetol*, *47*, 15–22. https://doi.org/10.1007/s00592-009-0126-3

Zheng, Y., Ley, S. H., & Hu, F. B. (2017). Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nature Publishing Group*, *14*(2), 88–98. https://doi.org/10.1038/nrendo.2017.151

APPENDICES

A. QUESTIONNAIRE

INFORMED CONSENT AND CONFIDENTIALITY STATEMENT

Good morning/afternoon, Mr/Mrs_____. I am a human nutrition student at Makerere University. I am working on a project concerned with physical activity or exercise and type 2 diabetes in which you could participate. The study aims at evaluating the levels of physical activity, knowledge regarding, attitudes towards, and facilitators and barriers to participation in exercise, among people with type2 diabetes.

I am completing a survey among participants in line with the above objectives. The interview will take about 10 minutes. All the information we obtain will remain strictly confidential and your answers and name will never be revealed. Also, you are not obliged to answer any question you do not want to, and you may stop the interview at any time.

This study is not intended to evaluate or criticize you, so please do not feel pressured to give a specific response and do not feel shy if you do not know the answer to a question. I am not expecting you to give a specific answer; I would like you to answer questions honestly, telling me about what you know regarding physical activity and the physical activities you do. Feel free to answer questions at your own pace.

Do you agree to participate in this interview? Yes_No_. *If yes, continue to the next question; if no, stop the interview*.

Do you have any question before we start? May I start now?

SECTION 1: PERSONAL DATA

A. SOCIO-DEMOGRAPHICS
Please answer the following:

1) Gender

Male	❑	Female	❑

2) What is your age?

20 – 29 years	❑	50 – 59 years	❑
30 – 39 years	❑	60 – 69 years	❑
40 – 49 years	❑	70 – 79 years	❑

3) What is your religion?

Catholic	❑	Pentecostal	❑
Anglican	❑	Seventh Day Adventist	❑
Muslim	❑	Other (Please specify)	❑

_____

4) Where is your residence?

Urban	❑	Rural	❑

5) What is your highest level of education?

None	❑	Secondary	❑
Primary	❑	Tertiary	❑

6) What is your marital status?

Never married	❑	Divorced/separated	❑
Married	❑	Widowed	❑
Living together	❑		

7) What is your employment status?

Unemployed	❑	Employed	❑
Pensioner	❑	Housewife	❑

8) What is your socioeconomic status (SES)? Please tick what statement best describes you.

Insufficient funds all or most of the time	❑	Insufficient funds some of the time	❑

Sufficient funds most of the time ❑ Balance ❑

B. HEALTH-RELATED DATA

First, I am going to take a few measurements, and then I will ask you some questions.

Weight: ___kg Height: ___cm BMI: ___kg/m^2

Blood glucose ___mmol/L Blood pressure: ___mmHg

Waist circumference (BMI) ___cm

1) For how long have you been living with diagnosed with diabetes?

< 1 years ❑ 5 – 10 years ❑

1 – 5 years ❑ More than 10 years ❑

2) Do you have a family history of type 2 diabetes?

Yes ❑ No ❑

3) Are you on oral medication for diabetes?

Yes ❑ No ❑

4) Are you on insulin injection?

Yes ❑ No ❑

5) Have you been diagnosed with any other disease?

Yes ❑ No ❑

If respondent checks or answers yes, ask for diagnosis or better to check their medical files and indicate below.

_____

Do you smoke?

Never ❑ Quit ❑

Currently smoke ❑

6) Do you take alcohol?

Never ❑ Quit ❑

Currently drink ❑

If you currently drink alcohol, how would you best describe your frequency of consumption?

Rarely (less than 3 times a month) ❑ Always (at least 3 times a week) ❑

Daily ❑

SECTION 2: KNOWLEDGE, ATTITUDES, BARRIERS AND FACILITATORS

A. KNOWLEDGE

1) Have you been educated on the role of physical activity or exercise in the management of diabetes on your visit(s) to this diabetic unit?

Yes ❑ No ❑

2) What are your sources of information regarding physical activity or exercise in the management of T2DM? (*Please tick all that apply*)

Doctors ❑ Nurses ❑

Educational leaflets ❑ Media (radio, TV, newspapers) ❑

Internet ❑ Other (Please specify) ❑

3) Please answer the following questions.

	Yes	**No**	**Not sure**
o Do you think that T2DM can be controlled by regular exercise?	❑	❑	❑
o Do you think that exercise is as important as drugs and dietary control in the management of T2DM?	❑	❑	❑
o Do you think that physical activity or exercise is an optional strategy in the management of T2DM?	❑	❑	❑
o Do you think that all diabetics or only obese/overweight should do exercise?	❑	❑	❑
o Do you think believe that diabetics should continue with exercise after achieving their target weight?	❑	❑	❑
o Do you think that diabetics with hypertension should exercise?	❑	❑	❑
o Do you know the minimum recommended duration and frequency of exercise for people with T2DM? *(if yes, probe to find out if what they know is true)*	❑	❑	❑
o People with T2DM need at least 2 ½ hours of exercise that causes small increases in breathing or heart rate (such as brisk walking) and/or exercises that cause large increases in breathing or heart rate (such as *carrying or lifting heavy loads, digging or construction work)*	❑	❑	❑
o People with T2DM need at least 2 sessions of resistance exercise per week	❑	❑	❑
o Is doing household activities adequate as a form of exercise for diabetics?	❑	❑	❑
o Do you think that diabetics on insulin should exercise?	❑	❑	❑

B. ATTITUDES TOWARDS PHYSICAL ACTIVITY

I perceive physical activity or exercise as (*Please tick one best option*):

	Extremely disagree	Quite disagree	Slightly disagree	Neutral	Slightly agree	Quite agree	Extremely agree
1. Beneficial	☐	☐	☐	☐	☐	☐	☐
2. Useful	☐	☐	☐	☐	☐	☐	☐
3. Important	☐	☐	☐	☐	☐	☐	☐
4. Enjoyable	☐	☐	☐	☐	☐	☐	☐
5. Fun	☐	☐	☐	☐	☐	☐	☐
6. Pleasurable	☐	☐	☐	☐	☐	☐	☐

C. BARRIERS TO PHYSICAL ACTIVITY

What prevents you from engaging in your desired levels of exercise? Please choose all that apply.

	Yes	**No**
Fitness and self-image		
o I feel too tired	❑	❑
o I am too fat to do exercise	❑	❑
o I don't feel like doing exercise	❑	❑
o I feel unfit for exercise	❑	❑
o I feel so conscious about my body looks	❑	❑
o I have a disability	❑	❑
o I am contented with my current levels of physical activity	❑	❑
	Yes	**No**
Lack of support from non-physician		
o I have no body to exercise with	❑	❑
o I have no body to encourage me	❑	❑
	Yes	**No**
Health concerns		
o I fear my blood pressure to rise	❑	❑
o I fear my blood sugar levels dropping too low	❑	❑
o I fear my diabetes from getting worse	❑	❑
o I fear getting a heart attack	❑	❑
o I fear getting an injury	❑	❑
	Yes	**No**
Environmental factors		
o I don't have enough privacy to do exercise	❑	❑
o I don't have enough time to do exercise	❑	❑
o I cannot afford to go to the gym	❑	❑
o I don't have access to facilities to do exercise	❑	❑
o I don't have access to information on what types of exercises I should do and for how long	❑	❑
o It is not safe for me to do exercise outside		
Others (Please specify)		

D. FACILITATORS OF PHYSICAL ACTIVITY

What motivates you to engage in physical activity? Please choose all that apply.

	Yes	No
o I want to become healthier	❑	❑
o I want to lose weight or maintain "healthy" weight	❑	❑
o I want to be fit	❑	❑
o I want to look better	❑	❑
o I want to have fun doing exercise	❑	❑
o I want to socialise with other people	❑	❑
o I want to relieve stress, relax and feel better	❑	❑
o I want to compete with others	❑	❑
o I was asked and motivated by my doctor	❑	❑
o I am motivated by my family and friends to do exercise	❑	❑
o I want to please my family and friends	❑	❑
o I want to impress others	❑	❑
o I can afford and access gym and other facilities to do exercise	❑	❑
Others (Please specify)		

SECTION 3: PHYSICAL ACTIVITY

Next, I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

QUESTIONS	RESPONSE	CODE
Activity at work		
Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.		
1. Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work*] for at least 10 minutes continuously?	Yes 1 No 2 *If no, go to P4*	P1
2. In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	No. of days ⌊__⌋	P2
3. How much time do you spend doing vigorous-intensity activities at work on a typical day?	hrs ⌊__⌋⌊__⌋ :mins ⌊__⌋⌊__⌋	P3 (a–b)
4. Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads*] for at least 10 minutes continuously?	Yes 1 No 2 *If no, go to P7*	P4
5. In a typical week, on how many days do you do	No. of	P5

moderate-intensity activities as part of your work?	days ⌊__⌋	
6. How much time do you spend doing moderate-intensity activities at work on a typical day?	hrs ⌊__⌋⌊__⌋ :mins ⌊__⌋⌊__⌋	P6 (a–b)

Walking to and from places		
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example, to work, for shopping, to market, to place of worship, take or bring children from school, to see friends, relative or others.		
7. Do you walk or use a bicycle (*pedal cycle*) for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If no, go to P10*	P7
8. In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	No. of days ⌊__⌋	P8
9. How much time do you spend walking or bicycling for travel on a typical day?	hrs ⌊__⌋⌊__⌋ :mins ⌊__⌋⌊__⌋	P9 (a–b)
Recreation activities		
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure), [insert relevant terms].		
10. Do you do any vigorous-intensity sports, fitness or recreational (*leisure*) activities that cause large increases in breathing or heart rate like [*running or football,]* for at least 10 minutes continuously?	Yes 1 No 2 *If no, go to P13*	P10
11. In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (*leisure*) activities?	No. of days ⌊__⌋	P11
12. How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	hrs ⌊__⌋⌊__⌋ :mins ⌊__⌋⌊__⌋	P12 (a–b)
13. Do you do any moderate-intensity sports, fitness or recreational *(leisure*) activities that causes a small increase in breathing or heart rate such as brisk walking,(*cycling, swimming, volleyball*)for at least 10 minutes continuously?	Yes 1 No 2 *If no, go to P16*	P13
14. Do you do any moderate-intensity sports, fitness or recreational *(leisure*) activities that causes a small increase in breathing or heart rate such as brisk walking,(*cycling, swimming, volleyball*)for at least 10 minutes continuously?	No. of days ⌊__⌋	P14
15. How much time do you spend doing moderate-intensity		P15

sports, fitness or recreational (*leisure*) activities on a typical day?	hrs ⌊_⌊_⌋ :mins ⌊_⌊_⌋	(a – b)
Sedentary behaviour		
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.		
16. How much time do you usually spend sitting or reclining on a typical day?	hrs ⌊_⌊_⌋ :mins ⌊_⌊_⌋	P16 (a– b)

B. ETHICS APPROVAL

C. PERMISSION LETTER TO CONDUCT STUDY AT KIRUDDU HOSPITAL