BARRIERS IN PREVENTING LONG-TERM COMPLICATIONS AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS AT THE KENYATTA NATIONAL HOSPITAL

A THESIS SUBMITTED IN PART FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN MEDICAL-SURGICAL NURSING OF THE UNIVERSITY OF NAIROBI.

BY

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SUBMITTED NOVEMBER 2011

DECLARATION

I, M'Kiunga Stephen Kainga declare that this thesis is my original work and has not been presented in any other institution for the purpose of obtaining a degree or for any other award.

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DEDICATION

I dedicate this work to my loving wife Doris and children Evans and Karen. Thank you so much for the support and understanding you accorded me throughout the entire process.

ACKNOWLEDGEMENTS

I would like to acknowledge everyone who assisted me in whatever way when preparing this thesis. I would gratefully give special thanks to the Director, Board of Postgraduate Studies of the University of Nairobi for financial support during the process of carrying out this research. My special thanks also go to the CEO of the Kenyatta National Hospital for authorization and support during the process of data collection.

For James, Daniel, Mutua and Mbogua, I greatly appreciate your support during the entire period of data collection. My special regards also goes to Philip Ayieko for the support he provided during data analysis. To all my classmates, thank you so much for your invaluable encouragement and companionship during the entire course of the research process.

Thank you so much for your support.

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LIST OF ABBREVIATIONS

ACEs	Angiotensin - Converting Enzyme Inhibitors
ADA	American Diabetes Association
AGE	Advanced Glycation End-product
ARBs	Angiotensin - Receptor Blockers
CAD	Coronary Artery Disease
CAM	Complementary and Alternative Medicine
CDC	Centres for Disease Control
CVD	Cardiovascular Disease
DAWN	Diabetes Attitudes, Wishes and Needs
DM	Diabetes Mellitus
DSME	Diabetes Self Management Education
ESRD	End-Stage Renal Disease
IDF	International Diabetes Federation
IEA	Institute of Economic Affairs
JNC VII	Seventh Report of Annual National Committee of Prevention, Detection, Evaluation and Treatment of High Blood Pressure
KNH	Kenyatta National Hospital
LLA	Lower Limb Amputation
NCDs	Non-Communicable Diseases
NCEP-ATP III	National Cholesterol Education Program Adult Treatment Panel III
NSAIDs	Non-steroidal Anti-inflammatory Drugs

OHA	Oral Hypoglycaemic Agent
PAD	Peripheral Arterial Disease
SSA	Sub-Saharan Africa
T2DM	Type 2 Diabetes Mellitus
US DHHS	United States Department of Health and Human Services
USD	United States Dollars
WDF	World Diabetes Federation
WHO	World Health Organization
WHR	Waist Hip Ratio

OPERATIONAL DEFINITIONS

Anthropometric Measurements – A set of non-invasive quantitative techniques for determining an individual's body fat composition by measuring, recording and analyzing specific dimensions of the body such as height and weight, skin-fold thickness and body circumference at the waist, hip and chest (National Health and Nutrition Examination Survey III, CDC 1988).

Barriers - Obstacles faced by diabetic patients when managing their disease condition.

Exercise - Physical activity done for at least 30 minutes per day for five or more days per week or vigorous physical activity for at least 20 minutes per day three or more days per week (CDC, 2010).

Health – Infrastructure: Set of interconnected structural elements that provide the framework for supporting the entire health service delivery structures.

Health Diet – A diet that provides adequate energy and nutrients for maintenance of body functions. It should contain carbohydrates, proteins, vitamins, fats, minerals, fiber and water.

Health-Seeking Behaviour - Personal actions to promote optimal wellness, recovery, and rehabilitation (Nursing Outcomes Classification 2009).

Lifestyle Modification - Individual's alteration or change of risky habits in order to prevent development or complication of a disease.

Metabolic Syndrome - Presence of three or more of the following essential components constitutes the metabolic syndrome; central obesity, Type 2 Diabetes, Hypertension and Dyslipidemia (Kenya National Clinical Guidelines for Management of Diabetes, 2010).

Obesity - An adult who has a BMI of 30 or higher is considered obese (CDC 2010).

Physiological Measurements – Physiologic measurement covers the quantitative assessment and visualization of physiologic function in research and clinical practice, e.g. blood pressure and the arterial pulse rate.

Socioeconomic Status - An economic and sociological combined total measure of a person's work experience and of an individual's or family's economic and social position relative to others, based on income, education, and occupation.

Stress - Imbalance between environmental demands and individual's ability to meet them.

ABSTRACT

Background: Diabetes mellitus and other non-communicable diseases have become a threat to global and national development. Scientific evidence shows that appropriate lifestyle modification decreases risks of getting diabetes in addition to decreasing and delaying diabetic long-term complications. Patients' self-care is central in comprehensive diabetes management but patients face multiple barriers which may be related to individual lifestyle behavior, health status or healthcare system. However, these barriers are preventable once identified. **Objective:** The objective of this study was to determine barriers in preventing long-term complications among patients with Type 2 Diabetes Mellitus (T2DM) at the Kenyatta National Hospital (KNH). **Methods:** A descriptive cross-sectional survey involving 147 participants who had T2DM diagnosed at least one year prior to the study was done. Self-administered questionnaires were completed by the participants and a focused group discussion was carried out among nurses caring for diabetic patients in the clinic and the wards. Data analysis was done using SPSS software (version 17). Univariate descriptive analysis of demographic and social characteristics of study participants was done. Means and measures of dispersion including standard deviation and ranges were calculated for age, duration of illness and anthropometric measurements. Categorical variables were summarized using frequency tables and presented using tables, and graphs. The association between long-term complications and different demographic, social and clinical characteristics was estimated by calculating odds ratios at 95 percent confidence intervals. A p-value was estimated using the chi square test or Fisher's exact test. Statistical significance was based on a cut off value of 0.05. **Results:** Findings from this study provide evidence of barriers to prevention of long-term complications. Long distance (43%) and inadequate finances (66%) were barriers limiting access to the KNH healthcare services. In addition, high prevalence of comorbidity (91.8%), inadequate education on health diet, lack of regular checkups, non-

adherence to treatment regimens and lack of standard physical activity were barriers compromising optimum diabetes care. Further, lack of regular income (83.7%), high prevalence of psychological stress (91.8%) and obesity (47.6%) increased vulnerability among our study participants. Hypertension was the most common comorbid condition (63.3%) while eye (43.5%) and foot (41.1%) diseases were the most prevalent long-term complications identified. **Conclusion and Recommendations:** The findings from this study provide evidence of multiple barriers to optimal diabetic care and prevention of long-term complications. Diabetes Self-care Management Education (DSME) should be improved through partnerships between the healthcare providers and the patients to enhance sustainability of long-term care. Comprehensive diabetes care including patients' psychosocial screening and counseling should be done preferably under one setting. Capacity building among the healthcare system, subsidizing costs of diabetes care commodities and improving insurance cover will greatly ease the burden of healthcare finance among patients with T2DM.

CHAPTER ONE

1.0 INTRODUCTION

Diabetes mellitus is a “metabolic disorder with heterogeneous etiologies that is characterized by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both” (World Health Organization, 2011). The long–term relatively specific effects of diabetes include development of retinopathy, nephropathy and neuropathy. People with diabetes are also at increased risk of cardiac, peripheral arterial and cerebrovascular disease. The metabolic dysregulation associated with diabetes mellitus causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system (Fauci et al, 2009)

According to the WHO (2006), there are three basic types of diabetes. Type 1 diabetes results from insulin deficiency due to destruction of pancreatic cells and mostly affects children and young adults. Type 2 diabetes mellitus (T2DM), accounting for 85% to 95% of all cases, is usually characterized by insulin resistance when the body no longer uses insulin properly. A third type is gestational diabetes which occurs only during pregnancy. T2DM can remain undetected for many years and diagnosis is often made from the associated complications or through incidentally an abnormal blood or urine glucose test. T2DM is often but not always associated with obesity (WHO, 2006).

Diabetes mellitus is a chronic disease. A chronic condition as defined by the WHO; is the one that requires “ongoing management over a period of years or decades”. Epidemiological studies confirm diabetes to be a disease of lifestyle which was once thought to be essentially a condition of western affluence (IDF, 2007). However, in the current situation, according to

WHO (2006), it is the poorest nations that bear the heaviest burden of diabetes. Further report from the World Health Organization indicates that the three main risk factors for chronic diseases, i.e., overnutrition, lack of physical activity, and tobacco use are generally increasing in the developing countries (WHO, 2007). The WHO (2006) diagnostic criteria for diabetes include a fasting plasma glucose (FPG) of ≥ 7.0 mmol/l (126mg/dl) or 2-hour plasma glucose (venous plasma glucose 2–hour after ingestion of 75g oral glucose load) of ≥ 11.1mmol/l (200mg/dl).

1.1 BACKGROUND INFORMATION

Diabetes is the most common non-communicable disease (NCD) in the 21st century affecting over 285 million people globally with the figures projected to rise to 438 million by 2030 if no interventions are put in place (IDF Atlas, 2009). An estimated 3.4 million die from diabetes globally each year with about 70% coming from developing countries, majority being in Africa (IDF Atlas, 2009). Furthermore, four out of five cases of diabetes are from low and middle income countries, majority being in sub-Saharan Africa (SSA). Diabetes is one of the leading health problems in Africa and the estimated number of cases in 2010 stood at 12.1 million (3.2% of the adult population had diabetes) with only 15% diagnosed (IDF 2010). Estimates from WHO (2006) predicts that Africa will have the highest relative increase (27%) in the number of people with diabetes over the coming decade. According to International Diabetes Federation, (2010), increased costs, insecure supply chains for essential drugs, lack of national diabetes programs and the existence of wide disparities in the distribution of healthcare resources are the factors responsible for diabetes crisis in Africa. In sub-Saharan Africa, study reports indicate that majority of diabetic patients lack basic knowledge on diabetes management, use herbal medicine for treating diabetes, and are

relatively unable to visit the doctor except when serious manifestations or complications occur (Chinyere et al, 2010).

According to the Kenya Ministry of Health report, in the year 2007, about 53% of hospital admissions in Nairobi were due to NCDs where diabetes contributed about 27.3% of the total bed occupancy. Statistics from the Kenya National Diabetes Strategy (KNDS) [2010-2015] indicate that more than 1.5 million in Kenya today people are living with diabetes and this is projected to rise to 2 million by 2030 if no preventive measures are put in place. Unfortunately, many Kenyans are unaware that they have this condition. From this report, the prevalence of diabetes ranges between 2.7% in rural areas to 10.7 % in urban areas with a national prevalence of 3.3%. Local studies show that majority of patients attending the outpatient clinics have poor glycemic control; Otieno and colleagues (2007), concluded that this was due to sub-optimal medication and deteriorating diabetes. Numerous studies have shown that diabetes self-management education (DSME) results in improved preventive care practices and clinical outcomes (Silink et al 2010, Ivan, 2009 and Song et al, 2009). However, when poorly managed, certain long-term complications unfortunately occur among patients with T2DM.

1.2 LONG-TERM COMPLICATIONS OF TYPE 2 DIABETES MELLITUS

Chronic hyperglycemia is associated with long-term damage and dysfunction of small and large blood vessels culminating in failure of various organs (Keecia et al, 2005). Strong epidemiological evidence supports a direct link between hyperglycemia and the incidence of long-term diabetic complications. According to the American Diabetes Association (ADA) (2004) expert committee report on the diagnosis and classification of diabetes, it is the chronic hyperglycemia that is “associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels”. Long-term

complications due to diabetes mellitus can be divided into vascular and nonvascular complications; the vascular complications are further subdivided into microvascular (retinopathy, nephropathy and neuropathy) and macrovascular complications (coronary artery disease (CAD), peripheral vascular disease (PAD), and cerebrovascular disease). Nonvascular complications include problems such as gastroparesis, infections, periodontal disease and skin changes (Fauci et al, 2009).

Macrovascular complications primarily affect large blood vessels and body organs. Microvascular complications affect the small blood vessels of the body and are caused by the same atherosclerotic changes that lead to macrovascular damage (Fauci et al, 2009). Studies have revealed that microvascular changes begin to develop at least seven years before the clinical diagnosis of T2DM and the specific risk factors include hyperglycemia, hypertension, smoking and poorly controlled diabetes (over 5 years) (Keecia et al, 2005).

1.3 PROBLEM STATEMENT

Chronic diseases are responsible for a large percentage of global burden of diseases and are the major cause of death in all the countries (WHO 2007). Diabetes is the most common non-communicable disease globally and premature deaths from it and other NCDs account for a large and increasing share of disease burden (Stephanie, 2010). Diabetes mellitus is the fourth to fifth leading cause of death in most developed countries and there is substantial evidence that it is epidemic in many developing and newly industrialized nations (IDF, 2009). According to International Diabetes Federation report (2009), in sub-Saharan Africa, the deaths attributed to diabetes stood at 332,584 in the year 2010 alone. Complications from diabetes are resulting to increased disability, reduced life expectancy and enormous health costs for virtually every society (IDF Atlas 2007). According to CDC (2008) report, cardiovascular disease is a major complication of diabetes and the leading cause of early death among people with this disease. About 65 percent of people with diabetes die from heart disease and stroke with diabetic adults being 2-4 times more likely to have heart disease or suffer stroke than people without diabetes and diabetes is the leading cause of end-stage renal disease (ESRD). In addition, diabetic retinopathy is the leading cause of new blindness in persons aged 25-74 years in the United States, approximately contributing about 12% cases of blindness (CDC, 2008). Research has shown that of all amputations done in the world, 70% are suffered by people with diabetes with foot ulceration being the key risk factor in the developing world (The Kenya National Diabetes Strategy 2010-2015)**.** In 2010, diabetes healthcare expenditures accounted for 11.6% (USD 376) of the total healthcare expenditure in the world and by 2030, this number will exceed some USD 490 billion (IDF 2009).

This study is being carried out at a time when statistics in Kenya show that the mortality rate due to diabetes is on the increase (Kenya National Guidelines for Managing Diabetes

Mellitus). There were a total of 13, 471 deaths attributable to diabetes alone in the year 2010 (Kenya National Diabetes Strategy 2010-2015). Among the age groups, the most productive one, 30-39 years, bears the highest diabetes mortality; 32% of the total (Diabetes Atlas, 2009). Statistics indicate that the current national prevalence of diabetes stands at 3.3% and with an urban prevalence of 10.7%. However, these estimates are highly conservative as the reports indicate that majority of people with diabetes are not aware. Unfortunately, only 15% of the affected population is aware and the diagnosis is mostly made secondary to a complication (Kenya National Diabetes Strategy 2010-2015). Among the patients who are diagnosed, majority have generalized long-term complications e.g. nephropathy, retinopathy, neuropathy and cardiovascular disease. Statistics from the Kenyatta National Hospital (referral hospital) show that mortality due to diabetic complications is also on the increase. In the year 2009, among the patients who were admitted with diabetes at the KNH, the mortality rate was 24.75% and in the year 2010, it rose to 31.46%. The morbidity due to diabetes at the referral hospital was also high with a total of 1119 patients admitted in 2009 and 1216 in 2010 due to diabetes-related conditions. Most of the mortality and morbidity were associated with preventable long-term diabetic complications which could be avoided if barriers to prevention were identified. In the current situation, data on the barriers to prevention of long-term complications are lacking locally hence the significance of this study. Diabetic nephropathy accounts for 9-15% of all cases of ESRD in Kenya (Saraladevi, 2009) and an estimated 32% of all amputations done at the KNH are related to diabetic gangrene (Obimbo et al, 2010).

1.4 JUSTIFICATION OF THE STUDY

Diabetes presents major challenges to patients, health systems and national economies. Effective prevention strategies for diabetes are not costly and may actually bring down costs related to other NCDs. Research has shown that diabetes reduces life expectancy approximately by 5-10 years (IDF, 2009). The costs of treatment and loss of productivity undermine and stunt economic growth and negatively impact on realization of Millennium Development Goals, Vision 2030 and other national development targets (Kenya National Diabetes Strategy 2010-2015).

According to the World Diabetes Federation, treatment of diabetes in Kenya, as in other parts of SSA, is faced with many problems. Besides challenges related to diagnosis, care, and treatment, there is a lack of understanding and knowledge about the disease among healthcare professionals and the general population, and a perception that diabetes is not as critical as other diseases affecting the continent. The healthcare team directs the treatment; but the patient must also manage the complex therapeutic regimen. For this reason, patient and family education is an essential component of diabetes treatment and is as important as all other components of the regimen (WDF 2004). Unfortunately, diabetic patients experience multiple barriers in their daily life as they manage their chronic disease and engage in the appropriate lifestyle modification. These barriers make the patients vulnerable to develop long-term diabetic complications. There are no studies done on barriers to preventing long-term complications among T2DM patients in this country. This study sought to bridge that gap.

Findings of this study will contribute to the current literature on long-term complications as a result of diabetes. They may also be used by healthcare professionals to develop an education

package to empower those suffering from diabetes on the best ways to prevent and/or delay complications. This will facilitate long-term risk factor reductive lifestyle among diabetic patients. The morbidity, disability and mortality resulting from these complications will be prevented, decreased and/or delayed leading to improved quality of life in patients with T2DM. Resources that are used to manage these complications could be channeled to address other development priorities. The recommendations of this study will assist in policy formulation and provide evidence of putting more emphasis on preventive healthcare and also serve as a model for managing other chronic diseases. The study report will also assist the training institutions to improve their curricula to capture the needful preclinical training on managing diabetes and other chronic diseases. Findings from this study will serve as a foundation base for future studies.

1.5 OBJECTIVES AND THE RESEARCH QUESTION

1.5.1 Broad Objective

The study sought to determine barriers experienced by patients with T2DM in the prevention of long-term complications.

1.5.2 Specific Objectives

a) To assess the awareness of long-term diabetic complications among the participants.
b) To assess biochemical, physiological and physical parameters among the participants.
c) To assess participants' practice in the prevention of long-term diabetic complications.
d) To assess the nurses' views on barriers in preventing long-term diabetic complications.
e) To establish the common long-term complications among participants attending KNH.
f) To identify the obstacles that participants face in preventing long-term diabetic complications.

1.5.3 Research Question

The study sought to answer the following question;

"What are the barriers that contribute to long-term diabetic complications in patients with T2DM at the KNH?"

1.6 HYPOTHESIS

Long-term diabetic complications are associated with the presence of the patients' and health system-related barriers which compromise appropriate care and lifestyle modification in patients with T2DM.

1.7 EXPECTED BENEFITS OF THE STUDY

The identified barriers in preventing long-term diabetic complications will greatly enhance diabetic patients' management. More education on health diet will enhance the benefit of diet on glycemic control. Diabetic patients will be educated on the available sources of different foods and adherence to maximum food portions per serving. Measures to prevent excessive use of salt will be given. Exercise interventions for sedentary patients will be customized to individual's level of physical functioning and lifestyle. Patients will be given more education on the importance of timely health seeking behaviour for preventive care services.

The recommendations of this study will contribute to improving diabetes care through; advocacy on capacity building in the healthcare system to enhance diabetes care, institution of comprehensive diabetes care units in health facilities, dissemination of diabetes clinics across the country, inclusion of psychosocial screening when planning care for diabetic patients and continuous monitoring and appraisal of individual diabetic patients self-care management practices. The government and the private sector will facilitate increased health insurance coverage for the population to improve health care access.

The findings of this study will also help to formulate effective treatment modalities for individual patients. Gaps which exist in provision of healthcare will be specifically addressed through capacity building and provision of material and human resources. Disparities that exist in the provision of healthcare across the country will be further highlighted and this will help hasten remedial measures.

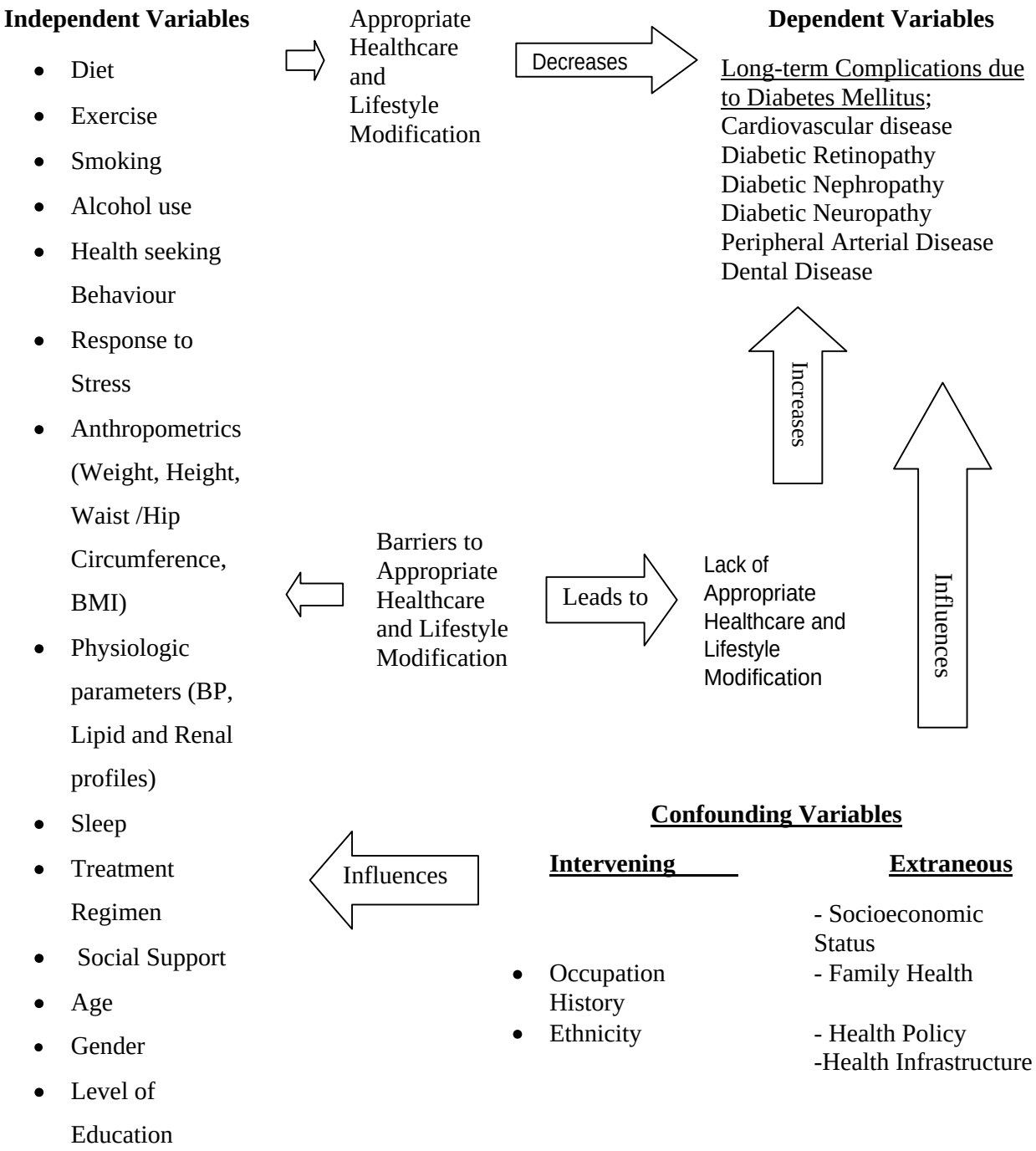
1.8 THEORETICAL FRAMEWORK

APPLICATION OF DOROTHEA E. OREM'S SELF-CARE DEFICIT NURSING THEORY

Introduction: According to Orem, nursing is defined as the provision of self-care which is therapeutic in sustaining life and health, in recovering from disease or injury or coping with their effects. The role of nursing in society is to enable individuals to develop and exercise their self-care abilities to the extent that they can provide for themselves the amount and quality of care required. The theory states that individuals whose requirements for self-care exceed their capabilities for engaging in self-care are said to be experiencing a self-care deficit. It is the presence of an existing or potential self-care deficit that identifies those persons in need of nursing. Orem's Self-care Deficit Theory forms the central focus of Orem's grand theory of nursing. People benefit from nursing because they have health-related limitations in providing self-care. These limitations may result from illness, injury or results of medication or treatments. Self-care deficit results when self-care agency (individual who provides self-care) is not adequate to meet the known self-care demands. Nursing actions focus on identification of limitations, inadequacies and helping people meet their own needs.

Theory Application: People with T2DM develop long-term complications due to inadequacy in the performance of self-care; i.e. they experience self-care deficit. Their self-care limitations may result from deficits in diabetes self-care knowledge, self medications and morbidity and effects related to the health system (e.g. attitude of healthcare workers and health infrastructure). This study focuses on identifying the sources of patients' self-care deficit. These represent the barriers that patients with T2DM experience in the prevention of the development of long-term complications.

1.9 CONCEPTUAL FRAMEWORK



CHAPTER TWO: LITERATURE REVIEW

2.1 DIABETES MELLITUS

Diabetes mellitus is the modern pandemic representing a considerable global economic and social burden for the person affected and the healthcare system (WHO 2008). Diabetes mellitus is associated with a number of macrovascular (coronary artery disease, cerebrovascular disease and peripheral arterial disease) and microvascular (retinopathy, neuropathy and nephropathy) complications (Rahman et al, 2007, and Lockhart et al, 2008). Persistent hyperglycemia is associated with increased oxidative stress; enhanced leucocyte-endothelial interaction; and glycation of protein, lipoproteins, apolipoproteins and clotting factors (Rahman et al, 2007). The cumulative effects of these factors enhance vasomotor tone, vascular permeability, growth and remodeling of the vascular tissues (Peppa at al 2003, and Singh et al 2011). Among the deleterious effects of hyperglycemia, most damage is attributable to the formation of sugar-derived substances called Advanced Glycation End products (AGEs) [Sohail et al, 2008]. AGEs usually form at constant but slow rate in human body (Rahman et al, 2007). However, in prolonged hyperglycemia, they are markedly accelerated due to the availability of glucose (Peppa et al, 2003). AGEs have a number of chemical and biological properties that are potentially pathogenic (Rahman et al, 2007, and Singh et al, 2008). AGEs build up slowly and accumulate with age. Formation of AGE results from chemical attachment of glucose to amino group of protein, lipids and nucleic acids without the help of an enzyme, to a reversible substance (Schiff base), which later is rearranged to form the Amadori product; a more stable form and the best known example is haemoglobin A1c (HbA1c) [Shaw, 2005 and Doreen and Victoria, 2010]. Permanent formation and presence of AGE interferes with normal protein and lipid function via disruption of molecular conformation, alteration of enzymatic activity, and reduction of

degradative capacity and receptor recognition of protein and lipids (Sohail et al, 2008, Rahman et al 2007 and Peppa et al, 2003). The rate of non-enzymatic glycation depends directly on the glycemic level and hence the importance of estimation of HbA1c as a useful index in the glycemic control among diabetic patients (Ekbar et al 2011).

2.2 PATHOGENESIS OF DIABETIC MACROVASCULAR DISEASE

Diabetic macrovascular disease is the major cause of morbidity and mortality and accounts for the higher prevalence of vascular diseases such as stroke, myocardial infarction and peripheral vascular diseases (Hussein et al, 2010; CDC, 2007; and Patersa et al, 2007). There is enough scientific evidence which links prolonged hyperglycemia with marked increase in atherosclerotic vascular damage. Prolonged hyperglycemia induces endothelial dysfunction, smooth muscle cell dysfunction, platelet hyper-reactivity, impaired fibrinolysis (coupled with a tendency for thrombosis and coagulation), and increased inflammation (Rahman et al 2007 and Singh et al, 2008). Endothelial dysfunction is the most critical etiology of diabetic macrovasculopathy. Physiologically, endothelial cells (ECs) release humoral factors that control relaxation and contraction, thrombogenesis and fibrinolysis, and platelet activation and inhibition (Heagerty, 2006). These cells also synthesize essential bioactive substances, e.g. nitric oxide (NO), prostaglandins, endothelin and angiotensin II, which regulate blood vessel structure and function (Heagerty, 2006). In endothelial dysfunction (ED), there is failure of the vascular endothelium in maintaining vascular homeostasis (Rahman et al 2007). Structural and vascular changes which include disappearance of capillary endothelium, weakening of intercellular junctions, altered protein synthesis and altered expression/production of adhesion glycoproteins on endothelial cells usually follow diabetes-related endothelial dysfunction (Lockhart et al, 2008). Endothelial cell damage, coupled with loss of vascular protective effects of nitric oxide is the early step in atherosclerosis (Rahman

et al, 2007). Moreover, prolonged hyperglycemia increases the oxidative stress and the formation of AGEs and protein kinase C (Akbar et al, 2011 and Rahman et al, 2007). These products in turn activate monocyte migration to the endothelial cells, formation of foam cells, and increase in cytokinase activity resulting in the formation of growth factors (epidermal growth factor, platelet-derived growth factor and transforming growth factor β) [Singh et al, 2011). These growth factors increase calcium uptake, cellular proliferation and extracellular matrix formation which eventually culminate in the formation of plaque (Rahman et al, 2007). Diabetes alters the vascular smooth muscle function increasing atheroma formation and instability of atheromatous plaques. Following loss of endothelial cell integrity, cell membranes become porous allowing macrophages and LDL to penetrate into the medial layer of arteries leading to the formation of foam cells (Singh et al, 2011). Following the formation of the foam cells, vascular smooth muscle cells in the medial layer of the arteries migrate into the primary intimal lesion where they replicate and lay down a complex extracellular matrix, an essential step in the progression to advanced atherosclerotic plaque (Rahman et al, 2007). Additionally, diabetes increases platelet aggregation and adhesion and decreases endogenous inhibitors of platelet activity (Sander et al, 2008). Glycation of platelet membrane proteins (due to increased AGEs) contributes to enhanced platelet aggregation. Abnormalities in platelet function may exacerbate the progression of atherosclerosis and the consequences of plaque rupture. The functional abnormalities in platelets appear to be related to elevation in platelet intracellular calcium mobilization that may significantly contribute to abnormal platelet activity since intraplatelet calcium regulates platelet shape change, secretion, aggregation and thromboxane formation (Rahman et al, 2007 and Singh et al, 2011). Moreover, chronic hyperglycemia increases formation of coagulation factors (plasminogen activator-1, von-Willebrand factor, fibrinogen, factor VII and thrombin-antithrombin

complexes), inhibits fibrinolysis, delays thrombolysis; with eventual progression of atheromatous plaques (Rahman et al, 2007).

2.3 DIABETIC MACROVASCULAR COMPLICATIONS

2.3.1 Cardiovascular Disease (CVD)

According to ADA (2003), diabetes is an independent risk factor for cardiovascular disease and the forms of cardiovascular disease associated with diabetes include coronary artery disease, congestive heart failure, hypertension, and peripheral arterial disease. In addition to increased morbidity, diabetic patients suffer high mortality rate, with CVD being the major cause of death accounting for some 50% of all diabetes fatalities (ADA, 2003). Atherosclerotic vascular disease has increased incidence in diabetic population and develops at an early age (ADA, 2003). The risk for cardiovascular events increase two to fourfold in a patient with T2DM compared to patients without diabetes (Hussein et al, 2010).

Studies show that early intensive insulin therapy and implementation of comprehensive treatment regimens that emphasize dietary modification, physical activity, and exercise, offer the most promise for reducing long-term complications in obese patients with T2DM (Enrique, 2009). Increasing physical activity in sedentary and overweight individuals has beneficial effects on reduction of metabolic risk factors for long-term diabetic complications (Ulf et al, 2007).

2.3.2 Cerebrovascular Disease (CVD, Stroke)

Diabetes is a strong independent predictor of risk for CVD and stroke and people with diabetes appear to develop CVD at an earlier age than those without and tend to have more

severe disease (CDC, 2007). The incidence of CVD is two times higher in patients with diabetes and the risk of stroke is two to four times higher compared to people without diabetes. Risk of stroke-related dementia and recurrence, as well as stroke-related mortality, is elevated in patients with diabetes (CDC, 2007). Management of hypertension and lifestyle modification of key risk factors, i.e., avoiding smoking, reducing alcohol intake, healthy diet, physical activity and proper stress management and use of poly-pharmacy (warfarin, NSAIDs, anti-hyperglycemics, lipid-lowering drugs, anti-hypertensives) can significantly reduce the risk of developing stroke (Dirk et al, 2008).

2.3.3 Peripheral Arterial Disease (PAD)

According to Edgar et al, (2007), in PAD, atherosclerotic plaques develop in both the large and small blood vessels of the lower extremities, particularly below the knee. The incidence of PAD is 20 times higher in individuals with diabetes and is a major risk factor for the development of foot ulcers (Petersa, 2007). Diabetic foot gangrene can develop from PAD with or without evidence of sepsis (Ekpebegh et al, 2009). Foot ulceration is a major cause of morbidity and mortality in patients with diabetes and between 45% - 75% of non-traumatic lower limb amputations (LLAs) are related to diabetes (Thomas et al, 2010). Good glycemic control, early detection and treatment of foot lesions and early management of systemic complications such as nephropathy and arteriosclerosis are considered important to avoid major amputations (Susumu et al, 2006).

Several studies done in Kenya indicate that foot ulcers are a significant complication at the tertiary facilities (e.g. Kenyatta National Hospital). Mario et al, (2008) ascertained that the risk factors responsible for the ulcers are modifiable and manageable and includes poor glycemic control, diastolic hypertension, infection, dyslipidemia, and poor self-care. A study

done at the KNH on the causes of amputations found that 17.5 % of all lower limb amputations (LLAs) were due to diabetes (Awori et al, 2007). A retrospective study done at the Tenwek Mission Hospital in rural Kenya showed that in the period 2001-2008, out of 150 patients who underwent limb amputation, diabetic gangrene constituted 32% of the total and 87% of the dysvascular cases. This study concluded that diabetic vasculopathy complicated by infection is the leading cause of amputations in elderly males in Kenya and recommended proper control of blood sugar, foot care education and vigilant infection prevention strategies (Obimbo et al, 2010). Addressing the patients' health behaviors (tobacco use, diet, physical activity, and supervised exercise) and adherence to pharmacological therapies is essential to successful prevention and management of PAD (Lyn et al, 2008).

2.4 PATHOGENESIS OF DIABETIC MICROVASCULAR DISEASE

Increased blood glucose is the long-term fuel for diabetic complications via formation of oxidative, pro-inflammatory AGEs (Peppa et al, 2003). Diabetic nephropathy is characterized by changes in both albuminuria and GFR in people predisposed to the development of diabetic renal disease. In diabetic nephropathy, there is usually an increase in GFR ('hyperfiltration'), followed by an increase in albumin excretion rate leading to microalbuminuria. In parallel with these changes, there is a rise in blood pressure which may begin before the development of microalbuminuria in T2DM (Shaw, 2005 and Patrella and Toth, 2004). In chronic hyperglycemia, development of albuminuria involves abnormalities of the glomerular endothelial barrier leading to excessive filtration as well as reduction of renal tubular cell albumin degradation and reabsorption (Dabla, 2010). Glomerular inflammation, hypertension, and oxidative stress worsen albuminuria, while angiotensin II and mechanical stress factors contribute to these processes (Dabla, 2010). According to Shaw (2005), diabetic nephropathy progresses in four stages; stage 1 is characterized by glomerular

hyperfiltration which may occur in normoalbuminuria and continue for several years into the microalbuminuric phase. The second stage is ‘silent’ and is associated with normal urinary albumin excretion or intermittent episodes of microalbuminuria. Despite lack of functional changes during this stage, there is evidence that structural changes (basement membrane thickening and mesangial expansion) have already occurred. This silent stage may last for several years and majority of diabetic patients will remain in this phase for their lifetime. The third stage is characterized by persistent microalbuminuria. Scientific evidence shows that GFR is preserved in patients who remain normotensive at this stage with their albumin excretion rates not rising progressively. Unfortunately, in T2DM, the onset of hypertension proceeds or accompanies this stage leading to a rise in albumin excretion rate and decline in GFR. Overt diabetic nephropathy occurs in the fourth stage characterized by clinically detectable proteinuria, hypertension and subsequent decline in GFR. The final stage occurs when subjects progress to end-stage renal failure. At this stage GFR has usually decreased to below 15 ml/min, necessitating the commencement of renal replacement therapy.

Microvascular retinal changes including increased proliferation of blood vessels, vascular occlusion, angiogenesis, microaneurysms and hemorrhages culminate in diabetic retinopathy (Doreen and Victoria 2010). Accumulation of AGEs due to persistent hyperglycemia, combined with the diabetic retinal changes are followed by thickening of the capillary basement membrane, capillary permeability, pericyte loss and increased endothelial cell turnover and death (Shaw, 2005). Developing retina is dependent on pericytes which specifically regulate angiogenesis, provide capillary stability, regulate blood flow and control endothelial proliferation (Sohail, et al, 2008). Thickening of the capillary basement membrane leads to loss of negative charge and increased leakiness. Capillary microaneurysms seen as red dots are the earliest clinical features of retinopathy (Shaw,

2005). In the setting of persistent hyperglycemia, increased capillary exudates causes edematous infarcts in the nerve fiber layer altering axoplasmic transport in ganglion cell neurons. Clinically, these exudates appear as cotton-wool sports (Shaw, 2005). Untreated, the retinal changes progress to proliferative stage (where new vessels form and grow along and outside the retina with a fibrous scaffold forming) leading to scar tissue formation, retinal traction and detachment, which eventually result in loss of vision (Shaw, 2005).

In peripheral neuropathy, hyperglycemia causes activation of the polyol pathway, where aldose reductase converts glucose into sorbitol. Subsequent accumulation of sorbitol lowers intracellular myoinositol which is associated with impaired Na+/K+ ATPase activity, alteration in protein kinase C subunits, vasoconstriction, reduced blood flow and slowed nerve conduction velocities. This leads to degradation of axonal structure leading to neuropathy (Boulton et al, 2005 and Martin et al, 2006).

2.5 DIABETIC MICROVASCULAR COMPLICATIONS

2.5.1 Diabetic Nephropathy

Diabetic nephropathy is a clinical syndrome characterized by excessive urinary albumin excretion, hypertension, and renal insufficiency (Vupputuri et al, 2010). It is the most common chronic kidney disease in the industrialized world and is the leading cause of ESRD (Vupputuri et al, 2010). Diabetic nephropathy and hypertension induce progressive and irreversible structural changes which eventually culminate in ESRD if unaltered (ADA 2004). In Kenya, diabetes accounts for 9-15% of patients with ESRD and few of these patients are offered adequate renal replacement therapy due to co-morbidity, cost and lack of insurance (Saraladevi, 2009). Unfortunately, patients with T2DM commonly present with albuminuria and overt nephropathy at the time of diagnosis or soon after (Keecia et al, 2005).

Epidemiological studies show that intensified intervention involving other CVD risk factors like hypertension and dyslipidemia and interception of the Renin-Angiotensin-Aldosterone system (RAAS) in patients with T2DM are associated with significant reduction in the risk for renal disease (Hussein et al, 2010). Blood pressure control using ACE inhibitors and Angiotensin Receptor Blockers (ARBs) have been shown to slow the progression of diabetic nephropathy, independent of their BP-lowering effect (Robert et al, 2004). Therefore, individuals with albuminuria, even if normotensive, should receive these renoprotective (ACE inhibitors and ARBs) agents. Screening for kidney disease in high-risk population i.e., (patients with diabetes and family history of kidney disease) and health education on prudent diet, control of hypertension, obesity, proteinuria, and exercise are extremely important in optimistic control of diabetes and hypertension ((Saraladevi, 2009).

2.5.2 Diabetic Retinopathy

Retinopathy occurs when the microvasculature that nourishes the retina is damaged leading to the leakage of blood components through the thin vessel walls (Kenneth, 2005). Diabetes is the leading cause of new cases of blindness among people aged 20-74, but most vision loss is preventable with early detection and intervention (CDC 2009). The World Health Organization has estimated that diabetic retinopathy is responsible for 4.8% of the 37 million cases of blindness throughout the world and patients with diabetes are 25 times more likely to become legally blind compared to those without. Clinical studies spanning more than 30 years have revealed that appropriate treatment can reduce the risks by more than 90% (WHO 2005). Since the duration of the disease and the degree of glycemic control provides the best indications for the development of retinopathy, early screening of retinopathy in diabetic population is essential for possible early management and prevention of sight threatening complications (Mahar et al 2010).

Educating patients on the benefits of regular screening and compliance to treatment is essential since the disease is usually asymptomatic until the late stages (Ockrim et al, 2010). Studies done in Kenya reveal that good glycemic control minimizes the ocular complications in patients with T2DM (Mwale et al, 2007).

2.5.3 Peripheral Neuropathy

Diabetic neuropathy occurs in approximately 50% of individuals with long-standing type 1 diabetes mellitus or T2DM with the most damage occurring in peripheral nervous system and prevalence increasing as the disease progresses (Sternberg, 2005). Early detection and treatment of foot lesions, proper glycemic control and early management of systemic complications such as nephropathy and arteriosclerosis are considered important factors to avoid major amputations (Susumu et al, 2005). Avoidance of smoking, foot care and appropriate treatment will prevent infections and decrease the risk of amputations (CDC, 2009).

2.6 PATHOGENESIS OF DIABETIC NON-VASCULAR DISEASE

In diabetic autonomic neuropathy (DAN), multiple etiological factors play a role in pathogenesis. Persistent hyperglycemic leads to activation of the polyol pathway resulting to accumulation of sorbitol that may cause direct neuronal damage and/or decreased nerve blood flow through reduction of intracellular myoinositol (Aaron et al, 2003). In addition, hyperglycemia activates protein kinase C which induces vasoconstriction and reduction in neuronal blood flow leading to degradation of axonal structure and subsequent neuropathy (Aaron et al, 2003).

Diabetes increases the risk of severe and progressive periodontitis; where infection or lesion leads to destruction of tissues and bone that form the attachment around the tooth (Southerland et al, 2005). Accumulation of AGEs secondary to persistent hyperglycemia exacerbates the severity of periodontal disease through associated chronic and intense inflammation (Shaw, 2005 and Southerland et al, 2005).

2.7 NON-VASCULAR DIABETIC COMPLICATIONS

2.7.1 Diabetic Periodontitis

Studies show evidence that diabetes is a risk factor for gingivitis and periodontitis and patients with poor glycemic control are at an increased risk of developing gingival inflammation and periodontal disease (IDF 2009, CDC 2007). Diabetes increases the risk of alveolar bone loss and attachment loss approximately three times to patients with diabetes compared to those without (Brian et al, 2007).

2.7.2 Autonomic Neuropathy

According to Fauci et al (2009), patients with long-standing diabetes may have problems with the motility and function of the gastrointestinal (GI) and genitourinary systems. The most prominent GI symptoms include delayed gastric emptying (gastroparesis) and altered small- and large-bowel motility. In addition, diabetic autonomic neuropathy may lead to genitourinary dysfunction including cystopathy, erectile dysfunction, and female sexual dysfunction.

2.7.3 Skin Changes in Diabetes

Diabetes commonly induces skin changes which eventually lead to skin infections (Fauci et al, 2009). The commonly observed diabetic skin changes include pruritus, infections,

delayed wound healing, diabetic foot gangrene and ulcers with women having more incidents than men (Khurshid et al, 2009).

2.8 BARRIERS IN PREVENTING LONG-TERM DIABETIC COMPLICATIONS

2.8.1 Socioeconomic Barriers

Cardiovascular disease accounts for the greatest component of health care expenditures in people with diabetes (Fowlerl et al, 2008). In SSA, heart failure accounts for over 30% of hospital admissions in specialized cardiovascular units and 3–7% in general medical wards with over 11% of adults with heart failure having diabetes (Anastase et al, 2008). However, heart failure as a cardiovascular complication remains largely unexplored in this area. Crosson et al, (2010) reported that physicians attributed patient barriers to CVD risk factor control primarily to socioeconomic issues (financial difficulties, patients caring for others neglected their own health), competing medical conditions (pain which could have been diabetes-related or due to arthritis competed with patients effort to engage in exercise) and lack of motivation to care for self. In Saudi Arabia, Aljoharah et al, (2009) studied patient barriers to healthy lifestyle and found that lack of resources was the most important barrier for physical activity, while lack of willpower and social support were both barriers for adherence to physical activity and a healthy diet. Pagan et al, (2007) found that when conventional health care becomes too expensive, people with diabetes turn to Complementary and Alternative Medicine (CAM) to meet their unmet health care needs.

According to Chlebowy et al, (2010), patient's support from family, peers and healthcare providers positively influence adherence behaviour by providing education, direct assistance and behaviour reinforcement. The report further indicates that internal factors e.g. lack of self-control on dietary habits, fears associated with glucose monitoring, memory failure and

perceived lack of personal control of diabetes could be a source of barrier to self-management behaviour. Barriers related to finances and cost may force patients to forgo care or be less compliant with treatment recommendations (Zgibor et al, 2001).

2.8.2 Demographic-related Barriers

According to Simmons et al (2005), individual patients' belief systems can present major barriers to effective management of diabetes and it comorbidities. In his study, he found that some patients dismiss hypertension as a significant medical problem (hypertension is often asymptomatic and lacks a tangible reinforcement factor to foster medication adherence), lack of consistent medical follow up and medication side effects could be barriers to effective control of hypertension. Ethnic and gender variations in terms of social support, acceptance of diabetes, perceived quality of life and long-term adherence behaviors occur in diabetic patients and if not addressed optimally can present barriers to long-term diabetes care (Ranjita et al, 2009). In WHO draft report (2010), social and cultural factors may play an important role in determining adherence to the diabetes treatment regimen even if issues of accessibility and affordability are addressed. Therefore, identifying barriers to the implementation and effective interventions, and research on the prudent mechanisms for making evidence-based clinical interventions available to all people diagnosed with diabetes in low-and-middle-income countries are of prime importance. Studies of patient barriers in managing diabetes in South Africa indicate that the common ones were mistaken beliefs about insulin, non-compliance, lack of understanding of diabetes, use of traditional herbs, fear of injections, and poor socioeconomic conditions (Haque et al, 2005). A study of diabetic Filipino Americans by Jordan et al, (2010) revealed that younger patients are less likely to perform and adhere to T2DM self-care behaviors pertaining to diet, medication taking and blood glucose testing compared to their older counterparts. A study carried out to assess the

exercise beliefs among women with gestational diabetes revealed that the women's partners positively influenced their exercise during pregnancy and postpartum. To enhance exercise behavior among diabetic patients, researchers are urged to use women's exercise beliefs, that is, its advantages and social influences (Downs et al, 2006). Cultural factors can significantly influence lifestyle measures to prevent long-term complications. In Kuwait, a study done to identify barriers to healthy diet adherence found that high number of social gatherings and living with extended families made adherence to health diet difficult (Maleka et al, 2007). Language and cultural barriers and patient population presents major impediment to diabetes care, especially for health workers in urban areas (Marshall et al, 2001).

2.8.3 Psychological Barriers

Numerous studies show that the most important barriers perceived by patients to long-term diabetes care are psychological and particularly relate to the strictness of the treatment regimen; including clinician review, dietary, exercise, self-glucose monitoring, and medication activities (David et al, 2007). A study carried out in Georgia, USA revealed that more attention needs to be directed to the emotional impact of diabetes diagnosis and the lifestyle adjustments that need to be made. In this study, many participants revealed their failure to recognize the risks and consequences of an asymptomatic condition. They needed more follow-up and refresher courses, support group discussions, nutrition education, education about medications, availability of different education modalities, and expanded clinic hours (Julie et al, 2009). Patients with multiple morbidities also have specific psychosocial factors that are independently associated with lower reported health status and physical functioning (Bayliss et al, 2007).

According to Shaban, (2010), psychological and diabetes related factors have a negative influence to practice of long-term preventive measures. People with diabetes are faced with specific visible consequences of living with this disease e.g., ulceration, excess body weight, impaired vision and body changes, that may lead to the development of negative body image. This negative body image may also interfere with their intimacy. Also, according to Teixeira et al (2010), patients with T2DM who are obese experience weight-related stigma in their daily life. Obesity stigma in the setting of diabetes can act as a barrier to ongoing management of both conditions. Obese patients with T2DM may feel responsible not only for their weight but also their diabetes. In the DAWN (Diabetes Attitudes, Wishes, and Needs) study; Funnell, (2006), found that diabetic patients faced major self-management burden and that psychological support given to them was inadequate in effective self management. A striking finding of the study was that 4 out of 10 patients with diabetes reported a feeling of poor well-being. “People without support networks, such as family, work colleagues, or friends - and, especially people living alone - were more likely to have poor well-being and to manage their diabetes less effectively”.

2.8.4 Individual Patient’s Behavioral Factors as Barriers

A systematic review done by Korkiakangas et al, (2010) identifying the reported barriers to regular exercise among adults either at high risk or diagnosed with T2DM reviewed the internal and external barriers. Internal barriers included factors that could be influenced by individual’s own decision making like lack of time and laziness. Due to internal factors, patients felt that the reasons, goals and the benefits of the exercise were insufficient compared to the cost of exercising. External barriers included factors that were beyond the control of the patient e.g. culture, weather conditions and presence of appropriate facilities.

Individual patient non-compliance with medication presents a significant barrier to complication reduction; Tan et al, (2008) demonstrated that the more non-compliant the patient, the worse the glycemic and blood pressure control, resulting in prescription of more medications which in turn makes it harder for the patient to be compliant with treatment. In Jordan, Maysaa et al, (2010) found that increased duration of diabetes and non-adherence to diabetes self-care behaviors resulted to poor glycemic control and the resultant increased risk of long-term complications.

2.8.5 Individual Health Status Barriers

Presence of multiple co-morbid conditions is associated with worse perceived health, fear and lack of understanding about both diabetes and exercises and can act as barriers to engaging in physical activity (Song et al, 2009, Visram et al, 2008). Potential barriers to self-management are significantly associated with lower levels of physical functioning, higher level of morbidity, greater financial constraints, greater number of compound effects of conditions, persistent depressive symptoms, higher level of patient-clinician communication, and lower income (Bayliss et al, 2007).

2.8.6 Health System Related Barriers

Successful management of diabetes requires a fruitful interaction between healthcare worker and the patient. Inaccessibility to the facility and poor relationship between the patient and the healthcare worker negatively influence diabetes care (McGinn et al, 2006). There is evidence that healthcare workers do not use evidence-based practices when caring for diabetic patients, Escobar et al, (2008) found that despite clinical trials showing the need for aggressive approach to diabetic risk reduction, the situation differs in daily clinical practice as

significant proportion of patients are undertreated. A study done in New Zealand reviewed that most primary care workers viewed lack of motivation as the major barrier to proper diabetes care (David et al, 2007).

Clinical inertia, i.e. failure to initiate or intensify treatment in a timely manner, is common in diabetes care. For example, fear of hypoglycemia resulting from intensive glycemic control, especially with insulin, is a major barrier to implementation of intensive treatment from the physicians' perspective (Davis et al, 2004). Studies done in South Africa identified doctors' barriers to initiating insulin therapy in patients with T2DM as lack of knowledge, lack of experience with and use of guidelines related to insulin therapy, language barriers between doctor and patients, and fear of hypoglycemia (Haque et al, 2005). More studies report healthcare provider gaps in diabetes management; for example, according to Milagros et al (2008), there is evidenced knowledge gaps among healthcare professionals regarding factors associated with increased diabetes risk leading to poor risk factor assessment, underutilized screening tests, and limited documentation of counseling and referral interventions for risk factors. Healthcare workers delay in effecting needful change in treatment regimens due to concern of patient nonadherence to nonpharmacologic and pharmacologic therapy (Marrero, 2009). Beliefs of some primary care physicians about the progression of diabetes and physiological effects of insulin are inconsistent with their diabetes treatment goals (Hayes et al, 2008).

Researchers in Germany revealed that low motivation, lack of familiarity or experience and time constraints are barriers experienced by healthcare professional managing T2DM patients (Kunt et al, 2009). In Canada, Carrie et al, (2010) found that diabetes educators lacked

confidence and had insufficient training in delivering physical activity and exercise counseling to diabetic patients. The study further revealed that those diabetic educators had no confidence on their patients' abilities to engage in physical activities. Shahady (2006), in his study on barriers to care in chronic diseases, found that lack of reimbursement for patient counseling was a barrier to compliance with principles of chronic disease care. Research shows evidence of suboptimal adherence by healthcare workers and patients on cardiovascular risk reducing interventions; Steenkiste et al, (2007), revealed that general practitioners find it difficult to assimilate multiple risk factors into an accurate assessment of cardiovascular risk. Barriers to the effective management of uncontrolled hypertension also include many physician-related problems, e.g., lack of ongoing attention to asymptomatic diseases such as hypertension in patients with symptomatic co-morbidities such as arthritis, diabetes, or pulmonary disease; lack of concern for higher than normal but ''not very high'' pressures; concern about drug adverse effects; complexity of prescribing or monitoring drug regimens; lack of physician-patient rapport and failure to communicate the importance of continuing therapy (Marvin, 2009).

Healthcare professionals do not always involve patients in decision-making processes resulting in lack of adherence to treatment regimens. For example Lavernia (2010), concluded that healthcare workers may fail to educate diabetic patients on the progressive nature of the disease. When patients encounter progressive increase in diabetic medications and eventually insulin therapy, they feel disheartened and this results in poor adherence leading to long-term complications.

The diagnosis of diabetic complications, e.g., PAD is difficult to determine because many patients are asymptomatic, many do not report their symptoms as they may not be fully

perceived due to concomitant diabetic complications, (e.g. neuropathy in this case) and despite them being a burden to the patient and the healthcare system, they are not routinely screened (Bianchi et al, 2007). The asymptomatic nature of the retinopathy, lack of routine physical examination, less education and inadequate healthcare finances could be barriers to timely eye care according to Paz et al (2006). Inna and Renee, (2001) on studying examination and referral practices of general practitioners found that the majority of general practitioners felt less able to perform thorough eye examinations and referred patients to specialists who did not provide immediate feedback.

Primary prevention and early detection are essential to reduce the personal and community burden associated with the metabolic syndrome and T2DM and its complications (Dunning, 2009). The patients' lifestyles are changing as well as their needs and involving them in their diabetes management is the key to success in managing the pandemic (Malinda 2006). Awareness of barriers and the identification of ways to overcome the obstacles and the working together between patients and caregivers will ultimately assist the patient in managing the chronic disease that requires dynamic daily decisions (Nagelkerk et al, 2006). In New York, Williams et al, (2009) concluded that health care providers' support for diabetic patients' autonomy and competence around medication use and diabetes self-management related positively to medication adherence, quality of life, and physiological outcomes.

CHAPTER THREE: MATERIALS AND METHODS

3.0 STUDY SETTING

This research was carried out at the Kenyatta National Hospital (KNH), the national referral hospital situated in Nairobi, the capital city of Kenya. KNH has a diabetes clinic within the general medical outpatient clinic. This hospital was founded in 1901 and is the oldest in Kenya. The hospital was started to fulfill the role of being a national referral and teaching hospital, as well as to provide medical research environment. It has 50 wards, 22 out-patient clinics, 24 theatres (16 specialized) and accident & emergency department. Out of the total bed capacity of 1800, 209 beds cater for the private wing patients. However, the hospital hosts more patients than its capacity with an average of 2500-3000 patients occupying beds each day. On average, it caters for over 80,000 in-patients and over 500,000 out-patients annually. This hospital covers an area of 45.7 hectares and within the KNH complex are College of Health Sciences (University of Nairobi); the Kenya Medical Training College; Kenya Medical Research Institute and National Laboratory Service (Ministry of Health). KNH serves as the primary teaching hospital of the University of Nairobi and the Kenya Medical Training College, Nairobi.

The diabetes clinic is located within clinic number 17 (medical outpatient clinic) which is situated on the left side adjacent to the entrance of the main hospital. A mini diabetes clinic is held daily on week days while a major clinic is held on Fridays. The mini diabetes clinic is mainly run by a clinical officer, three nurses and a nutritionist who have added training on diabetes management. A consultant endocrinologist offers support and advice to this group of health workers. Patients with comorbidities are referred to specific clinics within the hospital. Appointments are given by nurses and recorded in patients' appointment booklets which also have individual medical records. Major diabetes clinics are run by a team of doctors led by consultant physicians. The clinic has rooms for specific healthcare services e.g. physical

examination, health education, foot care and health diet counseling. According to the KNH Records Department, the clinic registered a total of 8,572 patients in 2009 with the numbers rising to 9,255 in 2010. In addition, a total of 1,216 patients were admitted in 2010 with diabetes-related illnesses. In the inpatient department, participants were taken from the medical and surgical wards in the 5^{th}, 6^{th}, 7^{th} and 8^{th} floors in the main hospital.

3.1 STUDY DESIGN AND POPULATION

A descriptive cross-sectional survey involving one hundred and forty-seven participants was conducted among the patients with T2DM attending KNH. One focus group discussion (FGD) was done involving nurses caring for patients with T2DM in the clinic and the wards (appendix II).

3.2 STUDY VARIABLES

Independent variables

Exercise	Obesity
Diet	Health Seeking Behaviour
Cigarette smoking	Stress
Alcohol use	Sleep
Treatment Regimen	Social Support
Age	Gender

Dependent Variables

Long-term Diabetic Complications: Diabetic retinopathy, diabetic nephropathy, diabetic neuropathy, cardiovascular disease, diabetic dental complications.

Confounding Variables

Ethnicity	Level of Education
Socioeconomic Status	Health System
Health Infrastructure	Occupation
Healthy Policy	

3.3 INCLUSION AND EXCLUSION CRITERIA

Patients with T2DM, both male and female and who were diagnosed at least one year prior to the study were included. Participants who consented were included in the study irrespective of the presence or absence of co-morbidities and long-term complications. Those who did not consent and/or were diagnosed with diabetes less than one year prior to the study were excluded. Patients with type 1 diabetes were also excluded.

3.4 SAMPLE SIZE DETERMINATION

The following formula by Fisher as quoted by Mugenda was used to calculate the sample size, (Mugenda and Mugenda, 2003):

$$n = \frac{Z^2pq}{d^2}$$

Where;

Z is the standard normal deviate at the required confidence level set at 1.96 which corresponds to 95% confidence interval.

P is the proportion in the target study population estimated to have the characteristics being measured (patients with diabetes). Data from the Kenya National Diabetes Strategy 2010-

1015 indicates that the urban prevalence of diabetes was 10.7% in the year 2010. The study area was within the urban area (Nairobi) and **10.7** was used as the **P** (prevalence) in the calculation.

q is the proportion in the target population estimated not to have the characteristics being measured (q = 1-p).

d is the level of precision set at ±0.05

Therefore;

$$n = \frac{Z^2P(1-P)}{d^2} = (1.96)^2 \times 0.107\ (1-0.107) = 146.8$$

$$n = 147$$

In the year 2010, a total of 10,471 patients with T2DM were attended at the KNH. Among these, 1,216 were admitted in the medical and surgical wards while 9,255 were attended at the outpatient clinic (Diabetes Clinic).

3.5 SAMPLING FRAME AND THE SAMPLING PROCEDURE

Participants with T2DM attending KNH outpatient and those admitted were interviewed.

Stratified random sampling was used because of dealing with a heterogeneous population; i.e. participants in the inpatient and outpatient settings had varying diabetes-related complaints, and thus stratification ensured proper representation at KNH. Further stratification was also done in the inpatient setting for proper representation of medical and surgical wards since participants admitted in these areas had varied complications. The sample was stratified based on the proportionate attendance for inpatient (in medical and surgical wards) and outpatient diabetic clinic for the year 2010.

Based on the KNH attendance statistics for diabetic care in the year 2010 as presented above, stratification was determined as per the table below (Table 1).

The correct sample size from each stratum was calculated using the following formula:

Sample size = $n_{1/}n_2 \times nf$:

Where;

n_1 = number of subjects in the stratum,

n_2 = total number of subjects in study population,

nf = minimum sample size required.

Table 1: Sample size allocation between the diabetes clinic and the wards

	Distribution of Patients in the Diabetes Clinic and the Wards	**Calculated Sample Size**
A	No. of patients from the diabetes clinic =	130
	9255/10471 X 100 = 88.4%	
	Therefore 88.4/100 X 147 = 129.9	
B	No. of patients from the wards =	17
	1216/10471 X 100 = 11.6%	
	Therefore 11.6/100 X 147 = 17.052	
	Total no. of patients	147

In the morning during the registration, participants were given health education as they were seated and informed about the research activity and requested to participate once they were through with their appointments. Among those who consented, random selection was done

and the selected participants were shown rooms where the interviews were done. In the wards, participants were randomly selected relative to their numbers in specific medical and surgical wards, informed about the research and requested to participate. Those who consented were interviewed and given relevant education.

3.6 RESEARCH INSTRUMENTS

A self-administered semi-structured participant's questionnaire was used (appendix II). A focus group discussion (appendix III) was also done with nurses caring for patients in the clinic and the inpatient settings (medical and surgical wards). The instrument for measuring blood pressure was the standard mercury sphygmomanometer (appendix VII) with appropriate cuff size for every subject. The waist and hip circumference measurements were done using a non-elastic tape measure (appendix VIII) while the height meter (appendix IX) was used for measuring height**.** Body weight was measured using a calibrated standard weighing scale (appendix IX).

3.7 PRE-TESTING THE QUESTIONNAIRE

The participants' questionnaire was pre-tested at the Mbagathi District Hospital situated in the vicinity of the KNH. Mbagathi District Hospital and the KNH are both public hospitals in the urban setting and patients attended in both hospitals have almost similar demographic characteristics.

3.8 DATA COLLECTION, MANAGEMENT AND ANALYSIS

3.8.1 Data Collection Method

Participants attending the Diabetes Clinic and those admitted in the wards were given questionnaires to fill. Training of three research assistants was done one week before

commencing data collection process. Participants' questionnaires were self-administered and those who could not read or write were assisted by research assistants. Blood pressure, pulse rate and the anthropometric measurements were taken by research assistants using appropriate instruments (section 3.7.1) from the clinic. These measurements were taken after participants were through with details of their appointments. A focus group discussion was done with nurses drawn from the diabetes clinic and the wards where diabetic patients were managed.

3.8.2 Data Management

Questionnaires were verified for completion immediately after each interview and any missing information or clarification was sought from the respective participants. Data was entered and stored into customized databases designed in MS Access and also in the source records accessible to the researcher. Confidentiality and anonymity of the participants' information was ensured. Coding was implemented at the data entry stage with all categorical variables stored as coded data with a label attached to each code. The databases contained a list of valid entries for closed ended (objective) questions and range checks for continuous variable entries to minimize errors during data entry. Data cleaning was done after completion of data entry.

3.8.3 Data Analysis

Data entered into SPSS databases contained in a PC was analyzed using SPSS software (version 17). Basic descriptive analysis of demographic and social characteristics of the sample was done. Results were presented using measures of central tendency with the appropriate measure of dispersion for continuous variables and measures of association.

Categorical variables were presented using frequency tables, graphs and pie charts. The first two study outcomes were determined as: the number of participants showing awareness of the long term diabetes complications, and number of participants practicing self care activities, for the prevention of long term diabetes complications. Chi square tests were used to explore associations between awareness of diabetes complications and participants' demographic characteristics. A cut-off P value of 0.05 was used to determine the statistical significance. Similarly, the percentages of participants practicing recommended self care activities were compared with the levels of the main demographic variables which included age, gender, and education. Results were presented as bivariate tables of awareness versus each demographic factor and recommended self care practices versus each demographic factor. Multivariable analysis was conducted using logistic models to cater for independent variables i.e. social and demographic factors on the outcome of diabetic complications.

The barriers encountered in preventing long term complications were determined by analyzing open ended responses by participants and a focus group discussion (FGD) conducted during a session with nurses providing diabetic care. In the FGD, nurses discussed four questions; the sources of potential barriers, barriers that could be attributed to the healthcare system, barriers that were outside the healthcare system and suggestions for addressing those barriers. The most commonly reported barriers were identified and tabulated in terms of their importance based on clinical significance.

3.9 ETHICAL CONSIDERATIONS

Participants were informed about the nature of the study and included after they consented (appendix I). Clearances from the University of Nairobi and Kenyatta National Hospital Ethics Committee (Appendix X, Ref: KNH-ERC/A/99) as well as the Ministry of Education,

Science and Technology (Appendix XI, Ref: NCST/RRI/12/1/MED-011/79/5) were given. The research clearance permit was duly issued by the National Council for Science and Technology (Appendix XII, Research Permit No: NCST/RR1/12/1/MED-011/79). Study participation was voluntary and was based on the participants consenting to be included. There were no direct or indirect harms posed to participants. The benefits of inclusion in the study included diabetes health education and appropriate individualized advice to the participants including attention and/or referral of immediate health concerns. There was no conflict of interest in this study.

CHAPTER FOUR: RESULTS

4.1 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY PARTICIPANTS

4.1.1 Age Distribution

Majority of participants in this study (n = 110, 75%) were aged above 50 years with sixty-nine (47.6%) of them being elderly (>60 years). The mean age was 57.4 (SD 13.2) years with a range of 21 to 90 years. Only fifteen (10.2%) participants were below 40 years of age. The prevalence of T2DM gradually increased from 50 years, peaking at 60-69 age groups. However, it declined abruptly as the participants approach their 70th birthday (Figure 1 below).

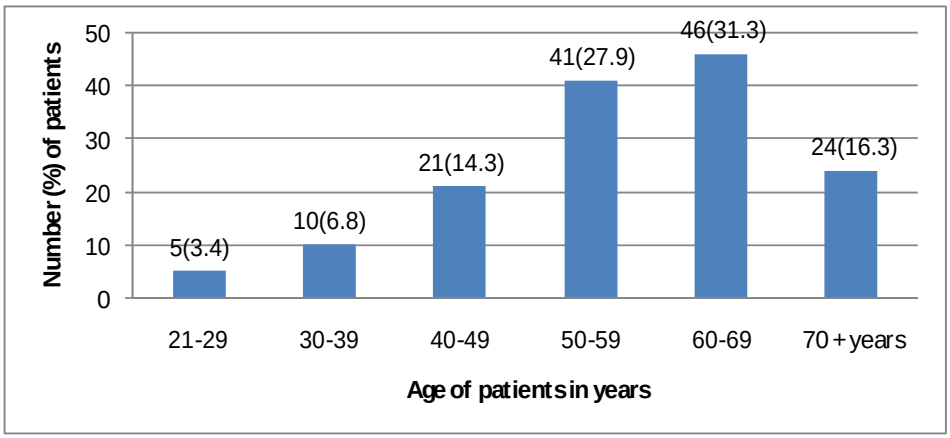


Figure 1: Age distribution of study participants attending the KNH clinic

4.1.2 Sex

In this study, there were eighty-six (58.5%) and sixty-one (41.5%) female and male participants respectively. Among the 60-69 age groups, the prevalence of T2DM was higher in female participants. However, overall, both genders were similarly distributed in the different age groups as shown in Table 2 (Fisher's exact p = 0.42).

Table 2: Distribution of participants in different age groups according to gender

Age Groups	Male n (%)	Female n (%)	Fisher's exact p value
21-29	1 (20)	4 (80)	0.42
30-39	5 (50)	5 (50)	
40-49	10 (47.6)	11 (52.4)	
50-59	19 (46.3)	22 (53.7)	
60-69	14 (30.4)	32 (69.4)	
70 + years	12 (50)	12 (50)	

4.1.3 Marital Status

Majority of participants (n = 106, 72.1%) in this study were married as shown in Figure 2 below.

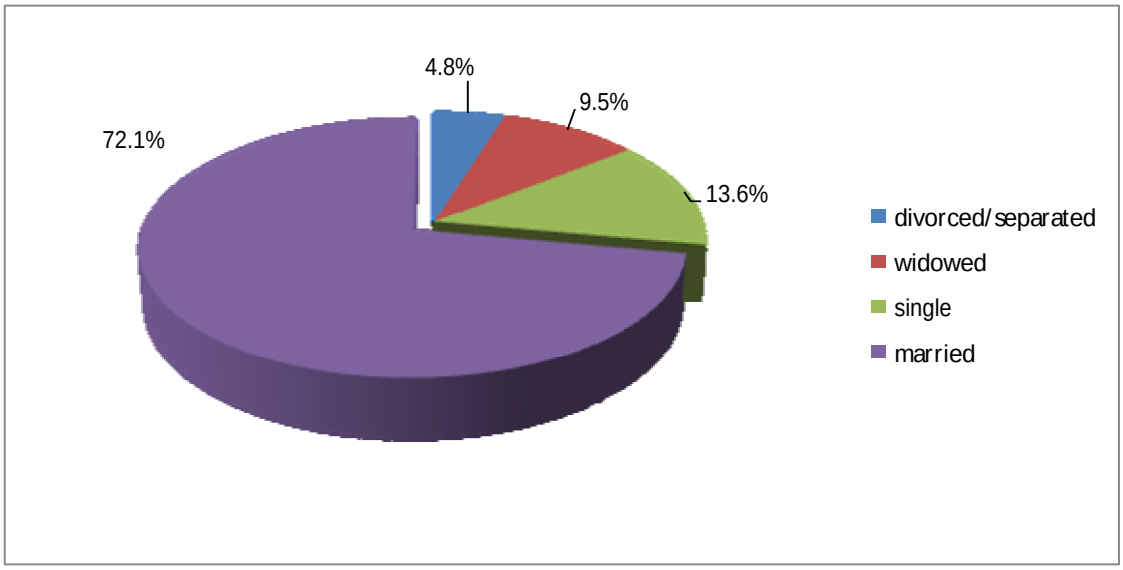


Figure 2: Marital statuses of the study participants

4.1.4 Education

Majority (n = 131, 89.4%) of the participants had attained formal education. However, only twenty-two (14.9 %) had attained college level education (Table 3 below).

Table 3: Level of formal education and occupations of the study participants

Education Level		Frequency (n)	Percent (%)
No formal education		17	11.6
Formal Education	Primary	57	38.8
	Secondary	51	34.7
	College/Univ □	22	14.9
	Total Formal Education	130	89.4
Occupation	Small-scale business	46	31.3
	Farming	34	23.1
	Informal employment	27	18.4
	Formal employment	24	16.3
	Housewife	7	4.8
	Retiree	9	6.1

□ University

4.1.5 Occupation

Majority of participants in this study (n = 43, 31.3%) engaged in small business and farming activities with only twenty-four (16.3%) of them being in formal employment (Table 3 above).

4.2 CURRENT HEALTH STATUS

The mean duration of diabetes among this group was 9.7 years (SD = 6.9, range 1-35 years). A significant number of participants (n = 65, 44.1%) had lived with diabetes for more than 10 years. The prevalence of co-morbidity was very high (n = 135, 91.8%), with hypertension being the most common illness (n = 93, 63.3%) accompanying diabetes mellitus. Prevalence of renal and other cardiovascular diseases (apart from hypertension) was relatively low among this group of participants, (Table 4 below).

Table 4: Health status of the study participants

Status		Frequency (n)	Percent (%)
Duration of diabetes	0 – 2 years	17	11.9
	3 – 5 years	27	18.9
	6 – 9 years	36	25.2
	≥ 10 years	63	44.1
Other diagnoses	Hypertension □	93	63.3
	Eye disease ±	64	43.5
	Foot disease	60	41.1
	Dental problem	46	31.3
	Arthritis	22	15.0
	Heart disease	8	5.4
	Kidney disease	8	5.4
	Asthma	2	1.4

□ Hypertension was the most common comorbidity while ± eye disease was the most common long-term complication.

4.3 PHYSICAL ASSESSMENT FINDINGS

4.3.1 Blood Pressure

Blood pressure was taken when the participants were seated. The range for systolic and diastolic blood pressure for the study participants was 90-190 mmHg and 60-110 mmHg, respectively (Figure 3 below). Based on the blood pressure measurements taken during the

interview, most (44.9%, n = 66) participants were classified as hypertensive. However, this figure (44.9%) differed from the percentage of participants who were on treatment for hypertension (63.3%) possibly due to the effects of antihypertensive drugs they were taking.

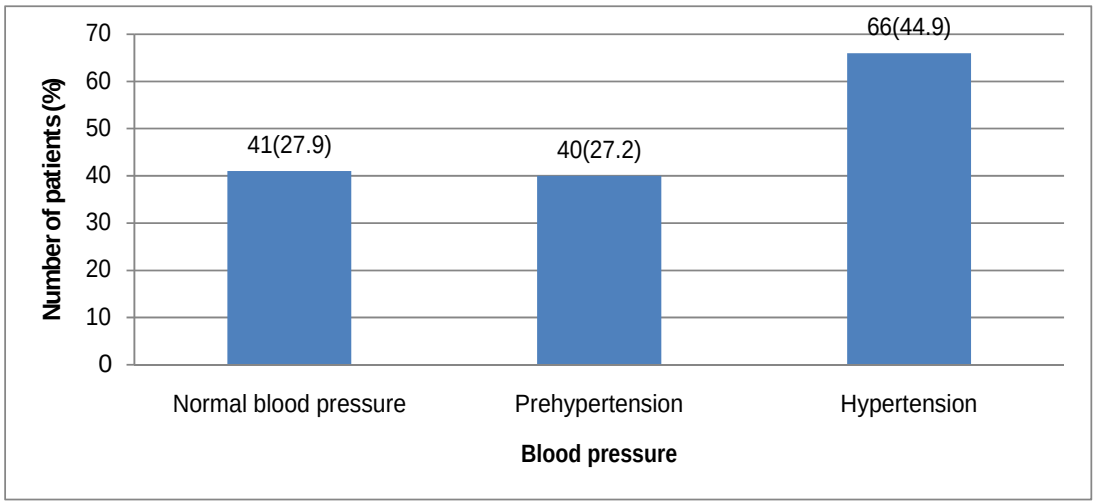


Figure 3: Hypertension Classification of Study Participants

Criteria: Recommendations of the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII)

Hypertension

The ages of participants and duration of diabetes mellitus were both significantly associated with a diagnosis of hypertension. On average, participants with hypertension were older than their normotensive counterparts (mean age = 60.3 versus 52.3 years, t = -3.74, p = 0.0003). Similarly, participants with hypertension had suffered from diabetes for an average period of 10.8 years compared to an average duration of 7.72 years among those without hypertension (t = -2.66, p = 0.0087).

Table 5: Relationship of hypertension to other independent variables

Independent Variables		Hypertension		Chi square	p value
		Yes (%)	No (%)		
Gender	Male	39 (63.9)	22 (36.1)	0.02	0.887
	Female	54 (62.8)	32 (37.2)		
Education Level*	None	10 (58.8)	7 (41.2)	7.544	0.056
	Primary	42 (73.7)	15 (26.3)		
	Secondary	32 (62.8)	19 (37.2)		
	College/Univ±	9 (40.9)	13 (59.1)		
Occupation	Farming	27 (79.4)	7 (20.6)	6.593	0.159
	Business	28 (60.9)	18 (39.1)		
	Informal	13 (48.2)	14 (51.8)		
	Formal	15 (62.5)	9 (37.5)		
	Other	10 (62.5)	6 (37.5)		
Regular Exercise	Yes	33 (58.9)	23 (41.1)	0.732	0.392
	No	60 (65.9)	31 (34.1)		
Adequate Sleep	Yes	40 (66.7)	20 (33.3)	0.505	0.477
	No	53 (60.9)	34 (39.1)		
Stressed	Yes	86 (63.7)	49 (36.3)	0.137	0.712
	No	7 (58.3)	5 (41.7)		
Insulin alone	Yes	7 (33.3)	14 (66.7)	0.122	0.727
	No	47 (37.3)	79 (62.7)		
Metformin alone	Yes	12 (40.0)	18 (60.0)	0.173	0.678
	No	42 (35.9)	75 (64.1)		
Insulin + Metformin	Yes	25 (36.8)	43 (63.2)	0	0.994
	No	29 (36.7)	50 (63.3)		
Use of an ACE inhibitor	Yes	26 (52.0)	24 (48.0)	7.598	0.006□
	No	28 (28.9)	69 (71.1)		

± University, * Confounding variable, □ Participants' treatment with an ACE inhibitor was significantly associated with hypertension

Among the participant factors presented in Table 5 above, treatment with ACE inhibitor was significantly associated with hypertension. Fifty two percent of participants who were on ACE inhibitors had hypertension compared to 28.9% of those not treated without ACE inhibitors ($p = 0.006$). There was no significant association of hypertension with other independent variables as presented in Table 5 above.

Table 6: Systolic Blood Pressure

	< 120 mmHg	120-139 mmHg	≥ 140 mmHg	Chi square	p value
Male	10 (16)	25 (41)	26 (43)	2.31	0.315
Female	10 (12)	46 (53)	30 (35)		
Eye problem					
Yes	11 (13)	45 (54)	28 (33)	2.34	0.310
No	9 (15)	25 (41)	27 (44)		
Foot problem					
Yes	5 (8)	29 (48)	26 (43)	3.01	0.222
No	15 (17)	42 (49)	29 (34)		

Table 7: Diastolic Blood Pressure

	< 80 mmHg	80-89 mmHg	≥ 90 mmHg	Chi square	p value
Male	23 (38)	23 (38)	15 (25)	0.97	0.615
Female	26 (30)	38 (44)	22 (26)		
Eye problem					
Yes	32 (38)	31 (37)	21 (25)	2.06	0.357
No	17 (28)	29 (48)	15 (25)		
Foot problem					
Yes	18 (30)	27 (45)	15 (25)	0.77	0.681
No	31 (36)	33 (38)	22 (26)		

The findings of the chi square tests presented above showed there was no significant association between elevated systolic or diastolic blood pressures with participants' gender or comorbidities (Tables 6 and 7 above).

Blood pressure and Diabetes Complications

Results of the linear regression presented in Table 8 below shows that the participants' BMI values were significantly associated with diastolic blood pressure ($p = 0.03$). On average, the diastolic blood pressure reading increased by 0.45 mmHg for each unit increase in BMI. After adjusting for this effect of BMI, participant's age and gender, there was no significant association between diabetes complications and diastolic blood pressure.

Table 8: Linear regression of the diabetes complications, BMI, age and gender on diastolic blood pressure

	Coefficient	p value	95% Confidence interval	
Gender	0.67	0.72	-2.99	4.33
Age	-0.08	0.29	-0.22	0.06
Eye problem	0.99	0.60	-2.71	4.69
Foot problem	-0.38	0.84	-4.14	3.37
BMI	0.45	0.03	0.06	0.84
Constant	70.01	0.00	53.10	86.92

Diastolic Blood Pressure and Lipid Profile

Our research showed no statistically significant association between lipid profiles and diastolic blood pressure after adjusting for the effect of age and gender (Table 9 below).

Table 9: Linear regression of lipid profiles on diastolic blood pressure of the study subjects (n = 54)

	Coefficient	p value	95% Confidence interval	
Gender	6.66	0.07	-0.57	13.90
Age	-0.13	0.39	-0.42	0.17
Cholesterol	-3.22	0.55	-13.88	7.44
HDL	1.44	0.78	-8.81	11.70
LDL	2.74	0.60	-7.80	13.29
Triglycerides	0.80	0.80	-5.65	7.25
Constant	83.44	0.00	64.76	102.11

4.3.2 Anthropometric Measurement Findings

The mean BMI for this group was 27.1 (SD = 4.5). Based on the calculated BMI, one-third (n = 49, 33.3%) of the participants had normal weight distribution while two-thirds were overweight and above. There was no participant with severe/morbid obesity (Table 10 below).

Table 10: BMI distribution among the study group: (Adapted from WHO, 1995, 2000 and 2004)

Classification	BMI (Kg/M^2)	Men	Women	Total
Underweight	**< 18.50**	**1**	**0**	**1**
Normal Weight	**18.50 - 24.99**	**22 (45%)**	**27 (55%)**	**49**
Overweight	**≥ 25.00**	**38 (39%)**	**59 (61%) ∓**	**97**
Pre-obese	**≥ 25 – 29.9**	**26 (42%)**	**36 (58)**	**62**
Obese	**≥ 30**	**12 (34%)**	**23 (66%) ±**	**35**
Obese Class I	**30.00 - 34.99**	**10 (37%)**	**17 (63%)**	**27**
Obese Class II	**35.00 - 39.99**	**2 (25%)**	**6 (75%) ϕ**	**8**
Obese Class III (Severe/Morbid Obesity)	**≥ 40.00**	**0**	**0**	**0**

Majority of the participants who were overweight (□), obese (±) and obese class I (ϕ) were women

Waist-Hip Ratio (WHR)

For both genders the WHR ratio showed a general increase with age from 0.93 to 0.97 in males and 0.87 to above 0.90 in females (Table 11 below).

Table 11: Mean WHR among age groups

	Mean WHR	
Age in Years	Male	Female
21-29	0.93	0.87
30-39	0.94	0.89
40-49	0.94	0.90
50-59	0.98	0.91
60-69	0.99	0.92
70 + years	0.97	0.93
Total	0.97	0.91

4.3.3 Lipid Profile

The results of lipid profiles for 54 of the 147 participants are presented in Table 12 below according to gender. Female participants had significantly higher cholesterol levels (mean =

5.4) compared to male (mean = 4.4) [p = 0.019]. There were no significant differences in HDL, LDL and triglyceride levels among male and female participants.

Table 12: Mean (SD) lipid profiles for the study participants according to gender

	Male (n =22)	Female (n = 32)	p value (*t*-test)
Cholesterol	4.4 (1.6)	5.4 (1.4)	0.019
HDL	1.7 (1.1)	1.8 (0.9)	0.577
LDL	2.2 (1.3)	2.9 (1.7)	0.128
Triglycerides	1.3 (0.6)	1.6 (0.8)	0.126

Age

As shown in Table 13 below, the lipid profiles of participants in the different age groups were not significantly different for HDL, LDL and triglycerides levels. However, there was a significant association between cholesterol levels and age. Participants above 50 years had higher cholesterol levels (mean > 5.0) than younger counterparts.

Table 13: Lipid Profiles among age groups

	Total Cholesterol	HDL	LDL	Triglycerides
Age in years				
21-29	2.6 (0.7)	1.5 (1.0)	0.8 (0.4)	0.9 (0.1)
30-39	4.3 (0.7)	2.2 (1.4)	1.9 (1.1)	1.1 (0.9)
40-49	4.3 (1.3)	1.2 (0.6)	2.4 (1.1)	1.5 (0.7)
50-59	5.5 (1.4)	1.9 (0.9)	2.8 (1.7)	1.6 (0.8)
60-69	5.5 (1.5)	2.0 (0.9)	2.9 (1.6)	1.4 (0.6)
70 + years	5.0 (2.2)	1.6 (1.0)	2.7 (2.0)	1.7 (1.1)
ANOVA p value	0.04	0.29	0.46	0.62

Waist Circumference and Lipid Profile

As shown in the table 14 below, age showed a statistically significant association with waist circumference (p = 0.03). After adjusting for the effect of age and gender, there was no significant association between waist circumference and participants' lipid profiles.

Table 14: Linear regression of lipid profiles on diastolic blood pressure of the study participants (n = 54)

	Coefficient	p value	95% Confidence interval	
Gender	0.09	0.98	-7.91	8.09
Age	0.36	0.03	0.03	0.69
Cholesterol	4.94	0.40	-6.85	16.73
HDL	-3.62	0.52	-14.95	7.72
LDL	-2.33	0.69	-13.99	9.33
Triglycerides	-1.52	0.67	-8.66	5.61
Constant	69.12	0.00	48.47	89.76

4.4 PARTICIPANTS' AWARENESS, PRACTICE AND BARRIERS IN PREVENTING LONG-TERM DIABETIC COMPLICATIONS

4.4.1 Health Seeking Behavior

Nearly all participants (n = 145, 98.6%) sought diabetic care in public hospitals or government institutions. However, only five participants (3.4%) were within 5 KM radius of the diabetes clinic. Most participants (n = 63, 43%) travelled a distance of at least 20 kilometers to reach the KNH diabetes clinic. One hundred and nine participants (75.2%) reported that they did not get all the services they wanted from the KNH. On further inquiry, certain aspects of care which were commonly identified as missing included essential drugs (56.5%), timely attention (34.6%), affordable drugs (30%), proper information (13.6%) and personal attention (10.9%), [Table 15 below].

Table 15: Health seeking behavior among the study participants

Health-Seeking Behavior	Frequency (n)	Percent (%)
Health facility visited		
Public	145	98.6% ±
Private	5	3.4%
Mission	1	0.7%
Distance to facility (Km)		
2 to 5	5	3.4%
5 to 10	30	20.6%
10 to 20	48	32.9%
>20	63	43.2% □
Diabetic care available		
Yes	36	24.8%
No	109	75.2%
Unavailable services		
Essential drugs	83	56.5%
Timely attention	51	34.6%
Affordable drugs	44	30%
Proper information	20	13.6%
Personal attention	16	10.9%

± Majority of participants sought diabetes care in public hospitals while □ majority of the participants travelled > 20 km to access KNH services, (km = kilometers).

On regular checkups, sixty-eight participants (46.3%) reported that they never had dental check since they did not know that they were at an increased risk of dental complications (gingivitis, dental caries). In addition, among those who had had dental checkup, twenty-five (31.6%) of them had their last check 2 years before the time of interview. Concerning eye checkup, twenty-five (17%) respondents had never had regular eye check with twenty-four (19.6%) of those who had eye check having done their last check 2 years before the time of interview. When the participants were asked to list the various routine tests that were supposed to be done by people suffering from T2DM, forty (27.2%) of them were unable to mention any test.

4.4.2 Preventive Eye Care

Education about the risk of development of eye disease due to diabetes was given to the majority of participants in this group (n = 117, 78.9%). One hundred and twenty two participants (83%) considered themselves at risk of getting eye disease due to diabetes. A total of 119 (80.9%) had had their eye checkup done by an eye specialist. Eight-four (57.9%) participants complained of eye problems. As shown in Table 16 below, a relatively higher proportion of participants with eye problems (89%) were seen by an eye specialist compared to the proportion also seen by a specialist (70%) but not having an eye problem (89% versus 70%, $\chi^2 = 8.24$, p = 0.005).

Table 16: Prevalence of eye problems among the participants and reported examination by eye specialist

Eye problem	Checked by eye specialist		Total	Chi square	p value
	Yes (%)	No (%)			
Yes	75 (89%)	9 (11%)	84	8.24	0.005 ±
No	43 (70%)	18 (30%)	61		
Total	118	27	145		

± Majority of the participants who were seen by an eye specialist had eye problems compared to those seen without eye problems.

Participants who attended regular eye checkups had significantly higher odds of eye disease compared to those who did not [OR= 3.57, 95% CI 1.50-8.50] (Table 17 below). Thus participants with eye disease were more likely to see a specialist compared to those without. Eye problems were significantly associated with obstacles in seeking eye treatment (p = 0.0001) and the attendance of regular eye checkups (p = 0.035). Participants who had problems accessing eye treatment had higher odds of getting eye disease compared to those without [5.36 times] (95% CI 2.11-13.52) (Table 17 below)

Table 17: Factors associated with prevalence of eye problems in study subjects

Independent Variable	Eye problem		Odds ratio (95% CI)	Exact p value
	Yes	No		
Problem in seeking eye care				
No	53 (49)	55 (51)	1.00	0.0001 ±
Yes	31 (84)	6 (16)	5.36 (2.11-13.52)	
Engage in regular exercise				
No	31 (57)	23 (43)	1.00	0.99
Yes	53 (58)	38 (42)	1.03 (0.52-2.03)	
Eye check ups				
No	9 (33)	18 (66)	1.00	0.035
Yes	75 (64)	43 (36)	3.57 (1.50-8.50)	
Regular medical check up				
No	31 (52)	29 (48)	1.00	0.233
Yes	53 (62)	32 (38)	1.55 (0.80-3.02)	
Alcohol consumption				
No	78 (59)	54 (41)	1.00	0.392
Yes	6 (46)	7 (54)	0.59 (0.20-1.78)	
Smoking				
No	80 (57)	60 (43)	1.00	0.398
Yes	4 (80)	1 (20)	3.00 (0.43-5.52)	

± Problems in seeking eye treatment were strongly associated with eye disease (p = 0.0001)

Prevalence of eye complications and other independent variables

On further analysis, the prevalence of eye complications was not significantly associated with the gender of participants (p = 0.104), education level (p = 0.87), occupation (p = 0.186), physical activity (p = 0.922) and adequate sleep (p = 0.934). Similarly, the prevalence of eye complications was not associated with stress (p = 0.976) and different modalities of diabetes management (Table 18 below).

Table 18: Eye complications versus other independent variables

Independent Variable		Eye complication		Chi square	p value
		Yes (%)	No (%)		
Gender	Male	54 (63.5)	31 (36.5)	2.642	0.104
	Female	30 (50.0)	30 (50.0)		
Education Level	None	11 (64.7)	6 (35.3)		
	Primary	34 (59.7)	23 (40.3)	0.712	0.87
	Secondary	27 (54.0)	23 (46.0)		
	College/University	12 (57.1)	9 (42.9)		
Occupation	Farming	25 (73.5)	9 (26.5)	6.183	0.186
	Business	22 (48.9)	23 (51.1)		
	Informal	13 (48.2)	14 (51.8)		
	Formal	14 (60.9)	9 (39.1)		
	Other	10 (62.5)	6 (37.5)		
Regular Exercise	Yes	53 (58.2)	38 (41.8)	0.01	0.922
	No	31 (57.4)	23 (42.6)		
Adequate Sleep	Yes	49 (57.7)	36 (42.3)	0.007	0.934
	No	35 (58.3)	25 (41.7)		
Stressed	Yes	77 (57.9)	56 (42.1)	0.001	0.976
	No	7 (58.3)	5 (41.7)		
Insulin alone	Yes	11 (52.4)	10 (47.6)	0.31	0.577
	No	73 (58.9)	51(41.1)		
Metformin alone	Yes	22 (73.3)	8 (26.7)	3.682	0.055
	No	62 (53.9)	53 (46.1)		
Insulin + Metformin	Yes	41 (52.6)	37 (47.4)	1.995	0.158
	No	43 (64.2)	24 (35.8)		
ACE Inhibitor	Yes	56 (59.0)	39 (41.0)	0.117	0.733
	No	28 (56.0)	22 (44.0)		

Eye problems as compared to age and the duration of diabetes mellitus

The occurrence of eye complications was not significantly associated with age of participants ($t = 1.51$, $p = 0.13$) or duration of diabetes mellitus ($t = 1.62$, $p = 0.12$). However, participants with eye problems were relatively older (mean age = 58.9 years) compared to those without (mean = 55.6 years). In addition, participants with eye problems had had diabetes for a longer duration (mean = 10.5 years) compared to those without mean = 8.6 years) [Table 19 below).

Table 19: Mean age (SD) and mean duration (SD) of diabetes among participants with and without eye problems

	Eye problem		p value (*t*-test)
	Yes (n = 84)	No (n = 61)	
Age	58.9 (12.5)	55.6 (13.6)	0.132
Duration of diabetes	10.5 (7.4)	8.6 (6.2)	0.109

Among those who had an eye problem, the most reported barrier in accessing eye treatment was the high cost of drugs [n = 26, 17.7%] (Figure 4 below).

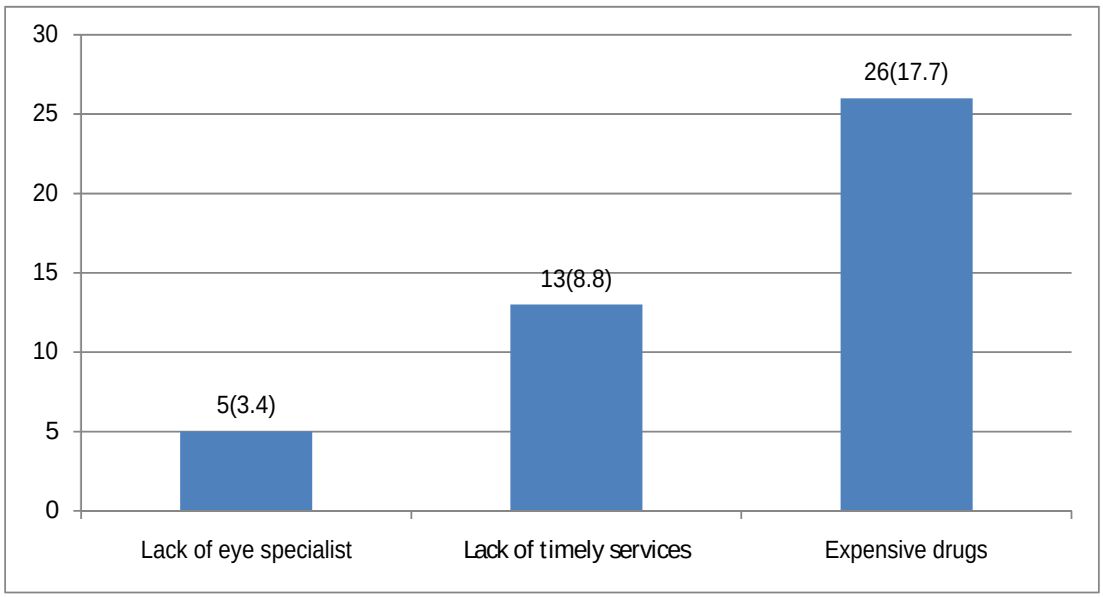


Figure 4: Problems experienced by study participants seeking eye treatment

4.4.3 Preventive Foot Care

Majority (n = 123, 83.7%) of participants reported that they had been educated on foot care. Sixty-six (44.9%) of them had had their feet examined by health care providers with fifty-two (35.4%) reporting that healthcare workers examined their feet during each hospital visit. Overall sixty (41.1%) participants had problems with their feet (Figure 5 below).

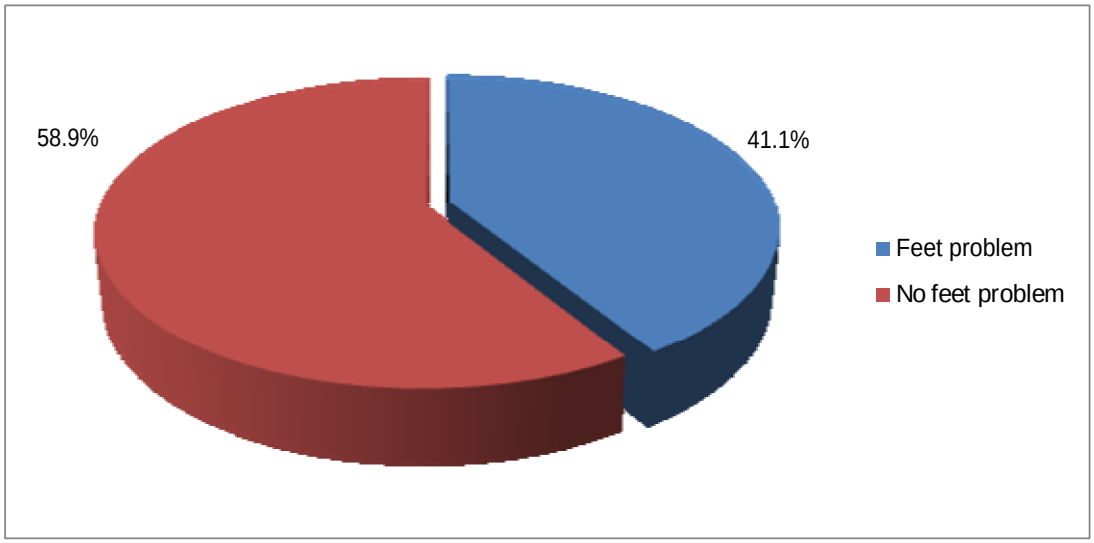


Figure 5: Prevalence of foot complications among the study participants

Foot complications showed significant association with a concurrent diagnosis of hypertension and reported problems in paying for health care. Participants who had hypertension were twice more likely to present with a foot complication compared to those who hadn't, OR [95% CI] = 2.18 [1.07 – 4.41]. Moreover, those who reported problems in financing their healthcare were also twice more likely to have a foot complication compared to those who had no problem, OR [95% CI] = 2.06 [1.002 – 4.22] (Table 20 below).

Although most smokers had foot complications, the association between smoking and foot complications was not statistically significant (p = 0.159). Similarly, alcohol consumption, regular checkups and exercise were not significantly associated with foot complications.

Table 20: Factors examined for association with prevalence of foot complications in the study group

Independent Variable	Foot complications		Odds ratio (95%CI)	Exact p value
	Yes	No		
Problem paying for care				
No	15 (30)	35 (70)	1.00	0.05
Yes	45 (47)	51 (53)	2.06 (1.002- 4.22)	
Hypertension diagnosis				
No	16 (30)	38 (70)	1.00	0.037
Yes	44 (48)	48 (52)	2.18 (1.07-4.41)	
Engage in regular exercise				
No	26 (46)	30 (54)	1.00	0.387
Yes	34 (38)	56 (62)	0.70 (0.36-1.37)	
Regular medical check up				
No	29 (48)	31 (52)	1.00	0.171
Yes	31 (36)	55 (64)	0.60 (0.31-1.17)	
Alcohol consumption				
No	56 (42)	77 (48)	1.00	0.559
Yes	4 (31)	9 (69)	0.61 (0.19-1.98)	
Smoking				
No	56 (40)	85 (60)	1.00	0.159
Yes	4 (80)	1 (20)	6.07(0.88-10.57)	

Foot Complaints versus other independent variables

Table 21 below shows the associations between prevalence of foot problems and participant factors along with diabetes treatment. Among the factors analyzed, only diabetes treatment modalities showed statistical associations with the prevalence of foot complications. Twenty eight percent of participants treated with ACE inhibitors had foot problems compared to 47.9% of patients not on ACE inhibitors who also had foot problems ($p = 0.02$). Participants managed using insulin and metformin co-administration had a significantly higher prevalence of foot problems (48.7%) compared to those not on these combination of treatments (32.3%, $p = 0.45$).

Foot problems were also significantly associated with duration of diabetes (t = 2.62, p = 0.0098) and the age of the participants (t = 3.43, p = 0.0008). Participants with foot problems were significantly older than those without (mean = 60.7 versus 55.0 years) and also had had diabetes for a significantly longer duration (mean = 12.1 versus 8.12 years) [Table 21 below].

Table 21: Foot complication versus other independent variables

Independent Variable		**Foot complication**		**Chi square**	**p value**
		Yes (%)	No (%)		
Gender	Male	23(37.7)	38(62.3)	0.498	0.481
	Female	37 (43.5)	48 (56.5)		
Level of Education	None	9 (52.9)	8 (47.1)	1.227	0.747
	Primary	23 (40.3)	34 (59.7)		
	Secondary	20 (40.0)	30(60.0)		
	College/Univ ±	8 (36.4)	14 (63.6)		
Occupation	Farming	16 (47.1)	18 (52.9)	2.317	0.678
	Business	19 (42.2)	26 (57.8)		
	Informal	9 (33.3)	16 (66.7)		
	Formal	8 (33.3)	16 (66.7)		
	Other	19 (42.2)	26 (57.8)		
Regular Exercise	Yes	34 (37.8)	56 (62.2)	1.067	0.302
	No	26 (46.4)	30 (53.6)		
Adequate Sleep	Yes	31(35.6)	56 (64.4)	2.655	0.103
	No	29 (49.2)	30 (50.8)		
Stresses	Yes	6 (50.0)	6 (50.0)	0.428	0.513
	No	54 (40.3)	80 (59.7)		
Insulin alone	Yes	53 (42.4)	72 (57.6)	0.611	0.435
	No	7 (33.3)	14 (66.7)		
Metformin alone	Yes	50 (43.1)	66 (56.9)	0.94	0.332
	No	10 (33.3)	20 (66.7)		
Insulin + Metformin	Yes	22 (32.3)	46 (67.7)	4.019	0.045
	No	38 (48.7)	40 (51.3)		
Use of ACE Inhibitors	Yes	14 (28.0)	36 (72.0)	5.387	0.02
	No	46 (47.9)	50 (52.1)		

± University

Comparison of Awareness of Eye and Foot Complications

Participant awareness of the two diabetes complications is compared in Table 22 below. The prevalence of eye problems (n = 85, 57.9%) was significantly higher than that of foot

problems (n = 60, 41.1%), z = 2.87, p = 0.004. Among this group, those with eye problems were more likely to seek the services of a specialist compared to those with foot problems (difference [95%CI] = 36% [25.8 to 46.3], p < 0.001). This may have been due to relatively more education on eye disease compared to foot disease (Table 22 below).

Table 22: Awareness, prevalence and specialist care for eye and foot problem among the study participants

	Eye problem	Foot problem	Difference(95% CI)	p value (z tests)
Educated on prevention of complication	83.7%	78.9%	4.8% (-4.1 to 13.7)	0.30
Checked by a specialist	80.9%	44.9%	36.0% (25.8 to 46.3)	<0.001 □
Problem diagnosed	57.9%	41.1%	16.8% (5.5 to 28.2)	0.004

□ Participants with eye problems were more likely to seek specialist care compared to those with foot problems (p < 0.001)

4.4.4 Preventive Renal Care

Among the study participants, majority (n = 83, 56.5%) had renal profile done. A total twenty-eight (33.7%) participants had results indicating some form of renal compromise (mostly HbA_IC levels greater than 6.5% and creatinine levels > 120 mmol/l). The prevalence of these renal complications was not significantly associated with age (t = 0.19, p = 0.85). Similarly, the duration of diabetes illness was not significantly associated with renal complications. The mean duration of illness was 11.3 and 9.0 years, respectively among patient with and without renal complications. As shown in Table 23 below the prevalence of renal complications was not significantly associated with most of the participant characteristics including gender, level of education, exercise, occupation or the specific diabetes treatment administered (Table 23 below).

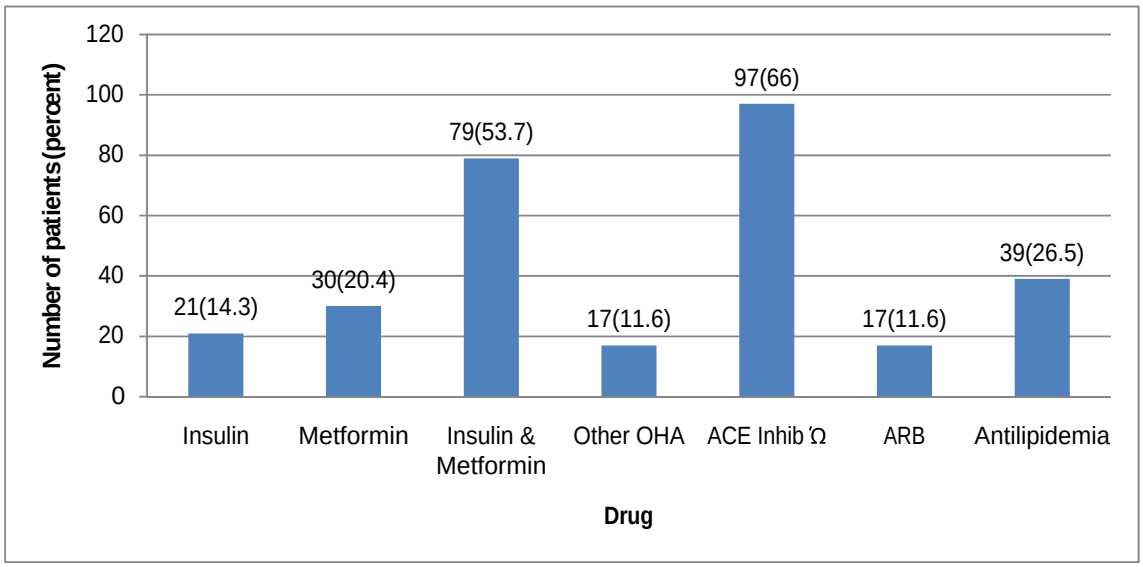
Table 23: Relationship of renal complications with participants' factors

Independent Variable		Renal complication		Chi square	p value
		Yes (%)	No (%)		
Gender	Male	36 (70.6)	15 (29.4)	1.106	0.293
	Female	19 (59.4)	13 (40.6)		
Level of Education	None	8 (80.0)	2 (20.0)	3.803	0.284
	Primary	22 (59.5)	15 (40.5)		
	Secondary	8 (88.9)	1 (11.1)		
	College/Univ	17 (63.0)	10 (37.0)		
Occupation	Farming	16 (72.7)	6 (27.3)	1.635	0.802
	Business	8 (57.1)	6 (42.9)		
	Informal	10 (62.5)	6 (37.5)		
	Formal	7 (77.8)	2 (22.2)		
	Other	7 (77.8)	2 (22.2)		
Regular Exercise	Yes	19 (55.9)	15 (44.1)	2.777	0.096
	No	36 (73.5)	13 (26.5)		
Adequate Sleep	Yes	33 (68.8)	15 (31.3)	0.314	0.575
	No	22 (62.9)	13 (37.1)		
Stressed	Yes	55 (69.6)	24 (30.4)	-	0.011
	No	0 (0.0)	4 (100.0)		
Insulin alone	Yes	9 (69.2)	4 (30.8)	-	0.539
	No	46 (65.7)	24 (34.3)		
Metformin alone	Yes	16 (80.0)	4 (20.0)	-	0.109
	No	39 (61.9)	24 (38.1)		
Insulin + Metformin	Yes	24 (66.7)	12 (33.3)	0.005	0.946
	No	31 (66.0)	16 (34.0)		
Use of ACE Inhibitor	Yes	23 (79.3)	6 (20.7)	3.393	0.065
	No	32 (59.3)	22 (40.7)		

4.4.5 Diabetes Management and Treatment

Majority of participants (n = 79, 53.7%) were on combined insulin and oral hypoglycemic treatment. Metformin was the most commonly used oral hypoglycemic agent (OHA). A total of ninety-seven (66%) participants were on ACE inhibitors and those on Antilipidemia therapy were thirty-nine (26.5%). All the participants in the study reported that they took their diabetes medication as prescribed. However, on further investigation of those on insulin therapy, (n = 37, 34.9% reported that they adjusted their insulin dose. The most frequent

reason given for this was stabilizing the blood sugars levels and thus preventing hypoglycemia and hypoglycemia. In addition, nineteen (12.9%) participants had problems injecting or taking prescribed therapy (Figure 6 below).



Ω ACE Inhibitor

Figure 6: Drugs prescribed for diabetes and complications management

4.4.6 Regular Exercise

One-hundred and forty-four (98%) of the participants had been educated on the practice and benefits of physical exercise. Among those who engaged in physical activity, one hundred and seventeen (77.6%) walked regularly and only eleven (7.5%) did brisk/ aerobic exercises including jogging, cycling and running. The commonly stated reasons for lack of exercise were lower limb pains, sickness, individual commitments and advanced age.

4.4.7 Health Diet

Almost all the participants (n = 142, 97.3%) reported that they knew what a healthy diet was. Despite this reported knowledge of health diet, when asked to classify foods they commonly ate into main foods groups, inadequacy of knowledge was evident. Eight-four (57.1%) of them did not mention a carbohydrate or protein food in the main groups while one hundred and nineteen (81%) were unable to mentions fats contained in their diet. Taking snacks between meals and adding salt to food were common dietary habits among this group with 62.3% and 69.2% of them respectively reporting that they practiced these habits regularly (Table 24 below).

Table 24: Dietary habits among the study participants

Dietary Habit	Frequency (%)
Snacks between meals	91 (62.3)
Adds salt to food	101 (69.2)
Frequency of eating fruits	
Daily	109 (75.2)
Weekly	24 (16.6)
Occasionally	12 (8.3)
Frequency of eating vegetables	
Daily	134 (91.2)
Weekly	8 (5.4)
Occasionally	5 (3.8)

4.4.8 Sleep Disturbance

Most participants (n = 59, 40.1%) reported waking up at least twice each night with thirty-eight (25.8%) of them waking up at least three times (Table 22 below). Sixty (40.8%) of them reported that they had sleep disturbances and usually felt the effects of inadequate sleep when they woke up in the morning.

Table 25: Frequency of waking up at night

Frequency of waking up at night	Number	Percent (%)
No waking up	18	12.2
Once	32	21.8
Twice	59	40.1
Thrice	25	17.0
Four times	13	8.8

The average duration of sleep per night among this group was 7.97 hours (SD = 1.45) with a range of 4 to 12 hours. There were no statistically significant differences in the duration of sleep between male and female participants (p = 0.43) or between participants in different age groups (p = 0.13) [Table 26 below].

Table 26: Average (SD) duration of sleep among the study group

	Mean duration (SD)	p value (ANOVA)
Male	7.9 (1.5)	0.43
Female	8 (1.4)	
Age in years		
21-29	8.2 (2.0)	0.13
30-39	6.9 (1.3)	
40-49	7.6 (1.4)	
50-59	7.6 (1.4)	
60-69	8.2 (1.1)	
70 + years	8.8 (1.7)	

Effects of inadequate sleep

Inadequate sleep was significantly associated with individual participant's report of significant stress levels (p = 0.028). Only 56% of those reporting significant stress had adequate sleep compared to 92% of those who did not report significant stress. However, the

frequency of waking up at night was not significantly associated with inadequate sleep (Table 27 below).

Table 27: Sleep and Stress in Diabetes Mellitus

	Reported adequacy of sleep		p value (ANOVA)
Reported significant stress levels	Yes	No	
Yes	76 (56%)	59 (44%)	0.028
No	11 (92%)	1 (8%)	
Frequency of waking up			
Once	19 (59%)	13 (41%)	0.605
Twice	33 (54%)	26 (44%)	
Thrice	15 (60%)	10 (40%)	
Four times	10 (77%)	3 (23%)	

Age and BMI for participants with and without significant sleep were not significantly different. The mean BMI for participants reporting adequate sleep was 26.9 compared to a mean BMI of 27.2 for those reporting adequate sleep (p = 0.649).

4.4.9 Stress and its Management

Majority (n = 135, 91.8%) of participants reported that they experienced moments of stress in their daily life. The sources of stress as presented in Figure 7 below were commonly disease and domestic-related issues with each affecting more than half of the group. Participant's self-reported stress did not show a significant association with existing diagnosis of hypertension (Fisher's exact p = 0.760). Eighty-six (63.7%) participants reporting experience

of significant stress had hypertension compared to seven (58.3%) of those reporting they did not experience significant stress.

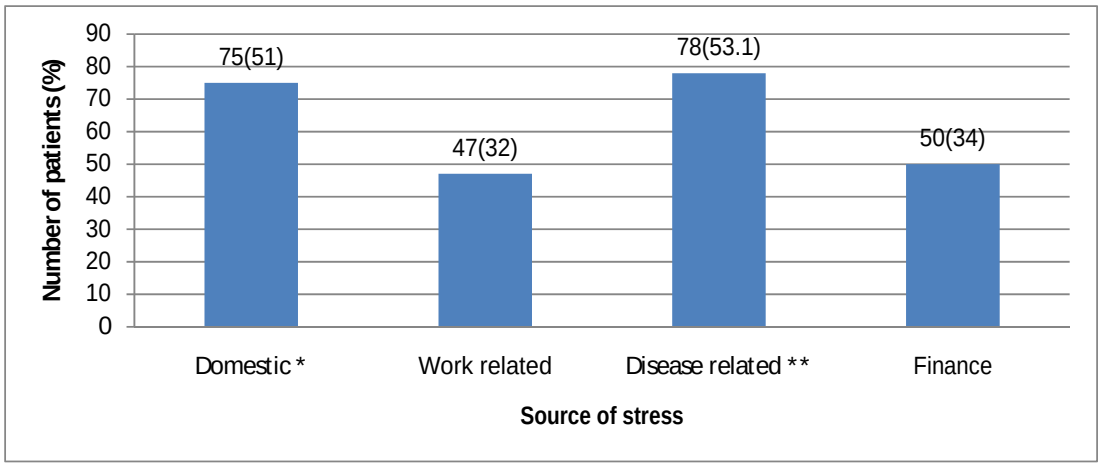


Figure 7: Reported causes of stress among the study participants

* Domestic and **disease related issues were the major sources of stress among the study participants.

4.5 HEALTHCARE FINANCING

Most (n = 97, 66%) participants reported problems in financing their treatment. Almost all of them (n = 142, 96.6%) reported that they contributed part or the whole amount of healthcare finance from their pocket and only twenty (13.6%) of them had NHIF cover (Table 28 below).

Table 28: Healthcare financing and its influence on access to diabetic care

Experience problems paying for healthcare	Frequency (n)	Percent (%)
Yes	97	66%
No	50	34%
Mode of payment		
Self	142	96.6%
Employer/ Company	5	3.4%
NHIF*	20	13.6% **
Other	11	7.5%
Problems encountered in paying for healthcare		
Paying more medical bills	50	34%
Lack of personal income	46	31.3%
Many dependants	27	18.4%
Lack of social support	9	6.1%
Out of job due to sickness	5	3.4%
Other problems	17	11.6%

* National Hospital Insurance Fund, **Few patients were covered (13.6%)

Owing to the high numbers of participants reporting problems in paying their medical bills, further exploration of the nature of this problem was done. The most common reason cited was that of paying other medical bills (34%), followed by lack of personal income (31.3%). Presence of foot problems had a significant association with reported problems in paying for healthcare. Thirty percent of the participants who had no problems paying for healthcare had foot problems compared to 46.9% of those who had problems financing their healthcare (chi = 3.87, p = 0.049)

CHAPTER FIVE: DISCUSSION

5.1 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY PARTICIPANTS

Report from this study shows that majority of participants suffering from T2DM were above 50 years of age (mean age 57.4 years) with only 10.2% of those affected below 40 years. This agrees with epidemiological data that advancing age is a non-modifiable risk factor for T2DM (WHO 2010). There was slightly higher proportion of women with T2DM compared to men with majority of participants being married. According to the World Health Organization, the prevalence of diabetes is higher in men compared to women. Our report contradicted these statistics probably due to gender variations in health seeking behaviour. Among this group, majority (89.4%) had attained some formal education, ranging from primary school to the university. The findings of this study support those of KDHS (2008) report which showed that literacy levels among women and men in the urban area stood at 96.2% and 96.7% respectively. The participants' main income generating activities were small scale business and farming. There was high level of comorbidity (91.8%) with hypertension being the most common illness (63.3%) accompanying T2DM. However, prevalence of renal and other cardiovascular diseases (apart from hypertension) was relatively low among this group, probably due to increased mortality after seventy years of age. There is enough scientific evidence that the frequency of T2DM increases with age and as populations live longer, the prevalence of diabetes rises (WHO, 2010). Majority of the participants were elderly (47.6%), and this group of population has higher prevalence of comorbities (WHO 2004). Despite the prevalence of T2DM increasing with age, findings from our study show a significant decrease after the age of 70 years. The highest prevalence was recorded at 60-69 age-group (31.3%) with the prevalence dramatically declining to 16.3% after 70 years of age. This implies that most participants with T2DM may not be reaching their 70^{th} birthday probably due to higher comorbidity and subsequent mortality as

the affected individuals approach their seventh decade of life. According to Caughey et al (2010), comorbidity in the elderly increases risks of adverse outcomes due to challenges in maintaining adequate exercise, increased cost burden due to multiple prescription medications and relatively less self financial independence. Our study population was relatively old and this made them vulnerable to long-term complications.

5.2 PHYSICAL ASSESSMENT FINDINGS

5.2.1 Blood Pressure

The range for systolic and diastolic blood pressure for the participants was 90-190 mmHg and 60-110 mmHg, respectively. Based on the guidelines of the Recommendations of the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII), sixty-six (44.9%) participants were classified as hypertensive from the results of blood pressures taken during the interview. However, this percentage (44.9%) may have differed from the percentage of participants who were on treatment for hypertension (63.3%) partly owing to the effects of antihypertensive drugs they took before the measurement. Results from linear regression showed that participants' BMI levels were significantly associated with diastolic blood pressure ($p < 0.05$). On average the diastolic blood pressure reading increased by 0.45 mmHg for each unit increase in BMI. After adjusting for this effect of BMI, participants' age and gender, there was no significant association between diabetes complications and diastolic blood pressure.

5.2.2 Lipid Profile

Our study analyzed lipid profiles for 54 of the 147 participants and found that female participants had significantly higher total cholesterol levels (mean = 5.4) compared to male (mean = 4.4) participants ($p < 0.05$). Our findings support those of Elnasri and Ahmed (2008)

that gender differences in cardiovascular risk profiles exist within the population with female diabetic patients having less favorable risk profile (higher total cholesterol levels and obesity). According to the guidelines from the World Health Organization (2006), the optimal lipid levels are; total cholesterol < 5.17mmo/l, LDL-cholesterol < 2.58 mmol/l, HDL-cholesterol > 1.55 mmol/l and triglycerides < 1.69 mmol/l. Our female participants (n = 32) had minimally high total cholesterol and LDL-cholesterol values. However, there were no significant differences in HDL, LDL and triglyceride levels among male and female patients. There was significant association between total cholesterol level and age. Participants above 50 years had higher total cholesterol levels (mean > 5.0) than younger counterparts.

5.2.3 Anthropometric Measurement Results

The mean BMI for the participants was 27.1 (SD = 4.5). Our report showed that two-thirds of the participants were overweight and beyond. This was probably related to inadequate physical activity among the study group. Both genders showed a general increase in WHR with age; 0.93 to 0.97 and 0.87 to 0.90 in males and females respectively. The average Waist Circumference (WC) for men was 98.1 cm and that of women was 97 cm. Cutoff values for WC vary among expert guidelines. The National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) guidelines and Health Canada identify WC values above 102 cm (40 inches) in men and 88 cm (35 inches) in women as being associated with substantially increased abdominal fat accumulation and health risks. Our average female participants' WC was above the cutoff values and this was a marker that they had increased risk to long-term diabetic complications (NCEP-ATP III Guidelines).

5.3 LIFESTYLE BEHAVIOR AMONG THE STUDY PARTICIPANTS

5.3.1 Physical Activity

Report from this study shows that almost all participants interviewed were educated on the benefits of physical activity (98%) and the major form of the physical activity accomplished was walking (77.6%). According to the guidelines from the American College of Sports Medicine (2004), people with T2DM who do not have significant complications or limitations should engage in endurance and resistance exercise so as to develop and maintain cardiorespiratory fitness, body composition, and muscular strength and endurance. These benefits help prevent cardiovascular disease, obesity and improve glycemic control; all of which work in preventing long-term diabetic complications. In our study, majority of the participants who performed exercise (92.5%) did not consider the above factors as they engaged in their usual routines as modes of exercise. The reasons behind this were probably related to inadequate instruction on appropriate exercise and follow up by the healthcare providers. In addition, a significant percentage of the participants was aged (≥ 60 years, 47.3%) while 41.1% of them complained of lower limb problems, meaning that their performance of physical activity was affected. Thus advanced age and the prevalence of comorbidity (98.1%) posed a significant barrier to physical activity among the study participants due to limitations e.g. in movement (foot problems) and sight (eye disease). Among the participants who were not able to engage in physical activity, the commonly stated reasons were lower limb pains, sickness, individual commitments and advanced age. Consistent with our report, Song et al (2009) and Visram et al (2008) concluded that presence of multiple co-morbid conditions is associated with worse perceived health, fear and lack of understanding about both diabetes and exercises and act as barriers to engaging in physical activity. This report also supports the findings of Dutton et al, (2005) and Korkiankangas et al, (2010) who found that the common barriers in achieving the required physical activity

among T2DM patients were physical limitations that hindered movement and lack of time and laziness respectively. According to Willeke et al (2010), education alone on physical activity without regular monitoring and appraisal is not sufficient to change the sedentary lifestyle behavior among patients with T2DM. In our study, healthcare providers seldom appraised the participants on the level of physical activity they were engaged in and this was a hindrance to the practice of appropriate exercise. Despite the majority of the participants being overweight and/or obese, their performance of physical activity was not varied or tailored to individual needs. This was probably related to shortage of staff in the clinic which compromised individualized patient care.

5.3.2 Health Diet

Majority of participants (97.3%) were educated on the importance of healthy diet in managing T2DM. However, on further interview, most participants were unable to classify their routine diets into the main food groups meaning that they had less benefit of dietary control of their blood sugar levels. Despite the amount of carbohydrate intake being an important factor in glycemic control, majority of participants (57.1%) were unable to mention carbohydrates or protein sources contained in their regular meals. This shows that education on health diet was inadequate among this group. Inadequate knowledge on dietary sources of carbohydrate greatly decreases the benefit of appropriate dietary management of T2DM. There was a significant percentage (69.2%) of participants who routinely added salt to their food on the table while eating. This habit increased individual risk of developing hypertension or worsening the already existing condition. According to Clyde et al, (2002), diabetes health literacy and improved adherence to self-management guidelines (including health diet) enhances self-care practices among patients leading to good clinical outcomes. Report from our study implies lack of understanding of appropriate dietary management of

T2DM and hence increased risk of long-term complications. A study done by Broadbent et al (2011) concluded that patients with T2DM had higher adherence to medications relative to diet and exercise because they perceived medications to be more important in managing their disease. A similar finding came from our study as more than two-thirds of our participants were unable to classify their foods into the main food groups, implying that they probably perceived the role of dietary management as less essential. Our participants did not implement adequate dietary control measures in managing their disease and this greatly increased their risks to long-term complications.

5.3.3 Stress Management

Disease and domestic-related problems were reported as the major sources of stress affecting 91.8% of the participants in our study. This finding agrees with Michael Vallis (2009), that emotional distress, especially depression and anxiety greatly interfere with self-management practice among patients with T2DM. Epidemiological studies indicate that the most important barriers to long-term diabetes care perceived by patients are psychological and particularly relate to the strictness of the treatment regimen; including clinician review, dietary, exercise, self-glucose monitoring, and medication activities (David et al, 2007). Similarly, our findings showed that a significant number of participants (53.1%) reported the presence of disease(s) as the source of their stress. These findings also support those of Peyrot et al (2004) who did a cross-sectional study across 13 different countries and found that psychological problems were common phenomenon among patients with T2DM. According to Shaban (2010) and Teixeira et al (2010), people living with diabetes may develop negative body image as a consequence of specific visible consequences related to the disease e.g., ulceration, excess body weight, impaired vision and body changes. Our group of participants had high prevalence of comorbidities (foot ulceration, obesity and impaired vision) which increased

their risk of developing negative body image, increased stress levels and vulnerability of developing long-term complications. Healthcare providers must therefore be able to identify and help patients with emotional distress as a way of providing comprehensive diabetes care.

5.3.4 Sleep

Although the average duration of sleep reported by our participants was approximately 8 hours (7.97 hours, SD = 1.45), 40.8% of them complained of sleep disturbances. Participants reported feeling these effects when they woke up in the morning. Our research showed that the report of inadequate sleep was significantly associated with participants' reports of significant stress levels. This report coincides with the findings of Escola de artes et al (2010), that inadequate sleep and T2DM are part of the vicious cycle where one influences the other. Loss of sleep and sleep disorders (e.g. sleep apnea) can act as stressors that trigger the sympathetic nervous system activation. This could lead to secretion of physiological defense mechanisms i.e. stress hormones and inflammatory responses, which eventually alter glucose tolerance and sensitivity to insulin and leptin, impairing appetite regulation. Hence, when chronically stimulated, these stress responses may favor the development of obesity and T2DM. Consequently, with the reported proportion of sleep disturbances, this group had more risk of developing long-term complications. As found in our study, there was no statistical significance between adequacy of sleep and BMI (estimation of obesity). Our study therefore agrees with the findings of Sridhar and Putcha (2005), who did a retrospective study on sleep and body weight in diabetes mellitus in Indian population and found no relationship between body weights and sleep disorders among T2DM patients.

5.4 HEALTH-SEEKING BEHAVIOR

5.4.1 Access to Health Facilities

Our report shows that nearly all participants (98.6%) sought diabetes care from public hospitals. A significant number of the participants (43%) attending the KNH diabetes clinic travelled a distance of more than 20 km to access the clinic. In addition, 75.2% of the participants did not get all the services they needed. Lack of essential drugs and timely attention were among the items identified as missing by majority of participants. These findings agree with the GTZ (2010) report that only about 40% of Kenyans live within 4 km of a functioning health facility, mostly in rural areas compared to 70% in urban areas. In addition, about 40% of sick Kenyans do not seek care when sick due to cost and approximately 1 million people go into poverty due to some illness in the family. These statistics are alarming. Our study report agrees with Keriga and Burja (2009) that there is evidence of disparities in healthcare service availability across Kenya. These findings also support the IDF (2010) report that among the factors responsible for diabetes crisis in Africa are increased costs of diabetes care and existence of wide disparities in the distribution of healthcare resources which leave huge number of people vulnerable and underserved. Travelling for more than 20 km costs a substantial amount of money in this country. Despite this, a significant number of participants (43%) came from the rural areas meaning that they had no better option for diabetic care in those areas. Lack of access to appropriate diabetic care services presents a major barrier to patients with T2DM (McGinn et al, 2006). From our study, frequent and substantial transport costs incurred while accessing care weighed heavily on individual participants' budget, owing to the fact that majority of them lacked regular income. According to the KDHS 2008-09 reports, wealth is concentrated in urban areas with 79% of the urban population falling in the highest wealth quintile. In contrast, people in rural areas are poorer with 25% in the lowest wealth quintile and only 6% in the highest quintile.

Poverty affects the ability to pay for health services, health diet and results in heavy out of pocket payments for those who do not have health insurance and this ultimately compromises diabetes care (Zgibor et al, 2001 and Chinyere et al, 2010). Majority of Kenyans who live in rural areas are poor and relatively less educated. The financial challenges faced by rural patients are complicated by relatively inadequate healthcare services, limited access to health insurance, limited access to specialty medical care and minimal exposure to diabetes education (KDHS 2008-09). Our group of participants who lived in rural areas (43%) was more likely to have foregone diabetes complication risk factor assessments such as eye examinations and kidney tests which are crucial to the detection of the diabetes-related complications. This posed a significant barrier in preventing long-term diabetic complications.

5.4.2 Cardiovascular Disease Risk-Reduction

The average age of our study participants was 57.4 years with 46.6% being elderly while hypertension was the most prevalent comorbidity (63.3%). Our participants had increased risk of cardiovascular disease due to advanced age and hypertension (ADA 2004). Our findings further showed that only 5.4% of the participants had a diagnosis of cardiac disease. Among the group, participants who reported history of alcohol use and smoking were 11.6% and 3.4% respectively. However, on further inquiry about the duration and the current practice, majority reported that they stopped those habits after diagnosis of diabetes mellitus. On the issue of health diet, a significant proportion of patients (57.1% and 81%) were unable to identify the sources of carbohydrates and fats respectively in their daily diet further decreasing the benefits of dietary control of hypertension and hyperlipidemia with consequent increased risks of cardiovascular disease. Further, 69.2% of the participants reported that regularly added salt to their food on the dining table to improve taste; sixty-six

percent of the participants were overweight with 42%, 23.8% and 18.4% being pre-obese, obese and obese class 1 respectively. In addition, a total of one hundred and thirty-five (91.8%) participants reported having stress in their daily life. This group represented a population who had multiple risk factors for cardiovascular disease (ADA 2004). Despite the high prevalence of hypertension (63.3%), only thirty-nine (26.5%) participants were on Antilipidemia therapy. According to the American Diabetes Association Guidelines (2011) on the prevention of cardiovascular disease, statin (Antilipidemia) therapy should be added to lifestyle therapy regardless of the lipid levels for diabetic patients without CVD who are ≥ 40 years of age and have other cardiovascular risk factors. Our study showed that a significant number of the participants were hypertensive and obese, and these are known CVD risk factors. Therefore, more participants were candidates for statin therapy which was lacking probably due to lack of prescription, unavailability in public hospitals or high cost in private pharmacies. This report agrees with the findings of Escobar et al (2008) that when caring for diabetic patients, healthcare workers do not adhere to evidence-based practices despite them being available. During the focus group discussion (FGD), nurses reported that; ignorance, noncompliance to medical therapy and delays in seeking care influenced by cultural beliefs result into major barriers to comprehensive care in diabetes mellitus. These findings further support the WHO (2010) report and those of Simmons et al (2005) that individual patients' belief systems can present major barriers to effective management of diabetes and its comorbidities. Consistent with our FGD report, Simmons et al (2005) found that some patients lacked consistent medical follow up and dismissed hypertension as a significant medical problem due to its asymptomatic nature. In conclusion, our group of participants had known and multiple risk factors for cardiovascular disease and there were evidence of gaps in following evidence-based practice in comprehensive care of patients with type 2 diabetes

mellitus. These barriers increased participants' vulnerability of developing long-term complications.

5.4.3 Preventive Eye Care

Majority of participants (78.9%) interviewed were educated on prevention of diabetic eye complications and majority (80.9%) had subsequently undergone eye checkup. However, the decision to go for an eye test was more influenced by the presence of an eye problem than the need for regular check up. This attests to the idea that participants were not engaging in preventive but in curative eye care services. Participants waited for an eye problem to set in and thence sought medical assistance. Ignorance presented a major barrier in health-seeking behavior among this group. From our analysis eye problems were significantly associated with problems encountered in seeking eye care services e.g. lack of an eye specialist or high cost of drugs. Thus, financial constraints presented major barriers in accessing preventive eye care among this group. On average, participants with eye complications were older and had stayed longer with diabetes compared to those without complications. Our report agrees with that of Paz et al (2006) that the asymptomatic nature of the retinopathy, lack of routine physical examination, less education and inadequate healthcare finances could be barriers to timely eye care services.

5.4.4 Preventive Foot Care

A total of sixty participants (41.1%) reported some form of foot problem. In this study, only 44.9% of the participants reported that their feet were once examined in the hospital and 35.4% of them had theirs examined during each hospital visit. Lack of routine foot care in the hospital is a major barrier in preventing foot problems since the benefits of continuous monitoring and evaluation of patients practice in foot care is not adhered to. Our study found

a significant association between the presence of a foot problem and concurrent diagnosis of hypertension and reported problems in paying for health care. Participants with hypertension and those who had problems paying for their healthcare were twice likely to develop foot problems compared to those without hypertension and those able to finance their healthcare. The findings of this research coincides with that of Claudia and Sallesa (2008) that inadequate hypertension and metabolic control in T2DM is a barrier associated with the development of foot complications. This report also supports the findings of Giorgia De Berardisa et al (2005) that a significant proportion of patients with T2DM are not offered adequate foot care, even in the presence of risk factors for lower limb complications. This provides evidence of a barrier related to the healthcare providers. Consistent with our findings, Habiba et al (2009) concluded that the financial costs resulting from diabetic foot complications greatly increase the economic burden of diabetic patients leading to challenges in priority setting in the context of managing comorbidities. These present barriers in self-management in the context of priority setting.

5.4.5 Regular Checkups

On regular checkups, (48.6%) of the participants reported that they never had dental check because they did not know that they were at an increased risk of dental complications (gingivitis, dental caries). In addition, among those who had had dental checkup, 17.8% of them had their last checkup 2 years prior to the time of interview. This report shows that majority of participants lacked adequate health education on diabetic long-term complications. Without adequate education, people cannot maintain appropriate lifestyle and health-seeking behavior and these acts as barriers exposing them to long-term complications. Concerning eye checkup, 17% of the respondents had never had regular eye check with 19.6% of those who had eye check having done their last check 2 years before the time of

interview. Among the reasons given for not undergoing regular checkups, were financial constraints and lack of knowledge of the need for the tests. When the participants were asked to list the tests routinely done by patients suffering from T2DM, ignorance was evidence as 27.2% of them did not know mention any test. Lack of adequate education on diabetes management was a major barrier frequently identified among this group. During the focus group discussion done with nurses, ignorance and inadequate compliance with treatment guidelines were some of the patient-related barriers to adequate glycemic control.

5.4.6 Healthcare Financing

Financing the cost of diabetes treatment was a problem for majority of participants in this study (66%). Among this group, only 13.6% had the National Hospital Insurance Fund (NHIF) cover and only 3.4% were covered by their employers. Results from the KDHS 2008-09 indicate that only 7 percent of women and 11 percent of men aged 15-49 are covered by medical insurance with the largest category of insurance being employer-based policies. However, according to statistics from the Institute of Economic Affairs (IEA), there were only 19.5% of Kenyans in formal employment as at 2008. Majority of Kenyans are in informal sector and engage their meager out-of-pocket expenses to finance health care. In Kenya, public health insurance via the NHIF caters mainly for the formally employed, with only a small proportion of the informal sector employees registered for the health insurance. NHIF only covers inpatient expenses, and does not address outpatient expenses. It does not also provide coverage for preventive health care services, which are critical to improving health outcomes in Kenya. Majority of patients with chronic diseases e.g. T2DM incur huge costs associated with outpatient treatment. As a result, they are left with an option of financing their health care directly from their pockets. Participants in this study had high prevalence of comorbidities (91.8%) implying that they had large number of prescriptions

and multiple clinic visits. This imposed high out-of-pocket expenses for their monthly and annual prescription and checkup expenses. On the other hand, in line with the findings of Rodbard et al, (2010), multiple prescription and high cost of medications can lead to poor adherence presenting a barrier to glycemic control. In this era of economic recession, priority setting in the context of limited financial budgets imposes difficult challenges. Personal medical costs compete with other expenses e.g. food, clothing, housing, that diabetic patients must balance on a daily basis. As a result, health care needs that are not 'urgent' e.g. routine medical checkups are not given their due attention. This consequently predisposes patients to long-term complications. Shahady (2006), in his study on barriers to care in chronic diseases, found that lack of reimbursement for patient counseling was a barrier to compliance with principles of chronic disease care. In Kenya, diabetes mellitus accounts for 9-15% of patients with ESRD and few of these patients are offered adequate renal replacement therapy due to co-morbidity, cost and lack of insurance (Saraladevi, 2009).

5.5 DIABETES AND COMORBIDITY MANAGEMENT

5.5.1 Diabetes Medical Management

Participants who were on insulin as part of treatment comprised 72.1% of the group. Eighty-six percent had an oral hypoglycemic agent (mostly metformin) as part of the treatment regimen. This report indicates that the healthcare providers initiated insulin treatment appropriately for effective glycemic control. Although all the participants reported taking their diabetes medication as prescribed; on further inquiry, 34.9% of those on insulin therapy reported that they routinely adjusted their dose. The most frequent reason given for this was stabilizing the blood sugars levels. Although adjusting insulin doses is crucial in maintaining effective glycemic control, patients need to have glucose meters at home and guidance from healthcare providers for effective blood glucose control. Glucose-meters and test strips are

relatively expensive and come with a cost that majority of our participants could not afford. From this report, adjustment of the insulin dose was probably not guided by the levels of blood sugar and these increased participants' susceptibility to complications. This posed a barrier to effective diabetes management. In addition, nineteen (12.9%) participants had barriers related to problems injecting or taking prescribed therapy.

5.5.2 Prevalence and Treatment of Diabetes Comorbidities

The prevalence of comorbidities was high among this group of participants as reported earlier. However, prevalence of renal and other cardiovascular diseases (apart from hypertension) was relatively low among this group. Sixty-six percent of participants were on ACE inhibitors while thirty-nine (26.5%) were on Antilipidemia therapy. These drugs are essential in preventing long-term complications. However, they impose huge financial burden among individual participants compromising other aspects of life that need to be addressed financially (Rodbard et al, 2010). Consistent with our findings, Bayliss et al (2003) concluded that people with comorbid conditions experience multiple barriers to self-care, including those specifically related to having multiple medical conditions. Presence of comorbidities, apart from interfering with priority setting imposes huge financial costs greatly providing a barrier to comprehensive diabetes management.

5.6 LIMITATIONS OF THE STUDY

This study considered participants attended at a referral hospital in an urban setting and would not be accurately generalizable to rural health facilities. Huge disparities exist in regard to human and material resources when comparing the national referral and the rural health facilities. Similar study designs will need to be undertaken in rural set ups to get

representative results. The accurate duration of T2DM among the participants could not be known since the disease develops long before the diagnosis and majority of patients seek treatment when signs and symptoms appear. Most participants had no lipid and renal profiles done probably due to associated costs.

5.7 CONCLUSION

Lack of Access to the KNH Healthcare Services: Significant percentage of the participants travelled long distances to come to the diabetes clinic. In addition, majority of the participants at the clinic were not satisfied with the services as they complained of being delayed and the essential drugs frequently missing. Further, lack of regular income and health insurance brought difficulties in financing healthcare among this group. These financial constraints were worsened by high prevalence of comorbidity.

Evidence of Inadequate Knowledge on Diabetes Care: Majority of the participants were unable to differentiate between protein, carbohydrate and fat sources from their daily diet. In addition, the issue of the specific food portions taken at one meal serving was not considered as an essential component of adherence to health eating while a significant proportion of participants routinely added salt to food at the table. Walking and farm activities were the mode of physical activity among this group. However, the issue of frequency, intensity and regularity which are essential aspects of standard exercise designed for therapeutic benefits were not considered as essential. Most participants did not adhere to regular checkups as majority were ignorant of the specific tests required (apart from facing financial constraints). In addition, most participants did not engage in primary prevention practices as the decisions to seek healthcare services were mostly secondary to a complication.

Evidence of Multiple Risk Factors for Complications: There was high prevalence of comorbidities with hypertension being the commonest. Multiple prescription medicines and multiple appointments in different specialty clinics increased financial burden and brought problems in prioritizing individual care among our group of participants. There was significant percentage of the participants who were overweight and obese in addition to the majority of them being elderly, complaining of living a stressful life and experiencing sleep disturbances.

Evidence of Gaps in Implementing Evidence-based Practices: Despite scientific evidence on benefits of Antilipidemia therapy in reducing cardiovascular risks among certain groups of T2DM patients, majority of the participants who met the standard criteria for Antilipidemia therapy were left out. Moreover, despite a significant proportion of participants being on ACE inhibitors, there was no evidence of records or follow up of microalbuminuria/macroalbuminuria results.

5.8 RECOMMENDATIONS

The report of this study shows that our group of participants experienced multiple barriers in their efforts to manage their disease and prevent long-term complications. The following recommendations, once implemented, would greatly improve diabetes care and prevent long-term complications:

5.8.1 Development and Implementation of Comprehensive Diabetes Self-Management Education (DSME) Package: The ministries of health should develop and implement comprehensive DSME package for people living with diabetes mellitus. There is need to increase health education among diabetic patients and their significant relatives through

continuous and customized health education on self-management of T2DM. A workable method of follow up and appraisal of the skills learnt should be devised by healthcare providers in partnership with patients to ensure sustainability of individual self care. Once the education package has been developed, the tools for effective dissemination in the whole country should be developed. This information should be translated into different languages to suit various population needs. Dissemination can be done through use of mass media (radio, TV, newspapers, magazines, and billboards), community health campaigns and schools. **Healthy diet**: Education on the sources of carbohydrates, fats and proteins should also to be done in accordance to what is readily available and affordable to individual patients. Dietary habits e.g. adding salt at the dining table should be discouraged by healthcare workers. Further, diabetic patients need more education on the aspects of adhering to maximum food portions per serving as the key to maintaining proper glycemic control. **Physical Activity:** Exercise interventions for sedentary patients should be customized to individual's level of physical functioning and lifestyle. However, individual patients should be counseled in regard to frequency, intensity, duration, and mode(s) of physical activity. Healthcare workers should provide information that explains the purpose and format of the physical activity. For patients who can afford, a home-based video kit with standard physical activity guidelines can greatly promote implementation of appropriate physical activity to improve glycemic control. **Health-Seeking Behavior:** Education on the importance of timely health seeking behaviour for preventive care services (e.g. regular eye and renal checkups) to appropriate health facilities should be implemented. **Lifestyle Modification:** People need more education on the dangers of excessive body weight and the benefits of maintaining appropriate weight. Education on maintaining healthy lifestyle should be a gold standard of diabetes health education in our country. Schools should be equipped to be able to offer this education from the elementary levels. The ministries of health should embark on national

diabetes health campaigns to encourage health lifestyle behaviour among the population, identify people with pre-diabetes and diagnose cases early for better management.

5.8.2 Capacity Building in the Healthcare System: As the prevalence of diabetes mellitus increases in Kenya, capacity should be built among the healthcare providers to equip them with the current knowledge of managing the disease and its complications. Training of the different cadres of healthcare providers on aspects of diabetes management should be implemented. In health institutions, comprehensive care for diabetes and its comorbidities should be done preferably under one roof to ensure coordinated care, improve continuity and enhanced follow up. Public healthcare facilities across the country should be equipped with human and material resources to increase healthcare access for the population. On the other hand, health facilities should maintain a system of monitoring and follow up to offer support and evaluate patients' compliance. The government should prioritize decentralizing special diabetes clinics across the country to improve coverage for diabetes management and education. The government should also enact policies which provide incentives for the private sector to participate in decentralizing diabetes management programs.

As part of comprehensive diabetes care, psychosocial screening should be done where individual patients' socioeconomic support and coping level, attitudes about the disease and outcome expectations are assessed and psychosocial counseling implemented on time. This will provide a baseline for continuing psychosocial support as candidates who are vulnerable to these problems will be identified early and appropriate preventive measures implemented on time.

5.8.3 Decreasing Population Disease Burden: The government and stakeholders should enact and implement policies to increase health insurance coverage in the country and include outpatient cover for NHIF customers. This will reduce the proportion of sick Kenyans (40% of the sick Kenyans do not seek healthcare due to costs, (Peter Nyarango, Healthcare Financing in Kenya, 2010) who fail to seek health care due to unaffordable costs. The government should increase cost effectiveness and ensure equitable allocation of national resources to reduce disparities in healthcare services. The prices of commodities used in the management of diabetes mellitus should be subsidized to increase access to diabetes care services. The government should also increase budgetary allocation to the health sector and manage population growth.

TIME SCHEDULE AND WORK PLAN FOR THE ENTIRE PERIOD OF STUDY: 2010 2011 ACADEMIC YEAR

Month →	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Activity ↓											
Concept Paper Development	XX										
Proposal writing		XX	XX								
Forward Proposal for Discussion and Approval (Supervisors)				XX	XX						
Refining of final Proposal and forwarding to KNH-ERC					XX	XX					
Pre-Testing of Study Tools							XX				
Data Collection							XX	XX	XX		
Data Processing and Analysis									XX	XX	
Report Writing										XX	
Draft Report presentation and Correction										XX	
Final Report presentation and Submission											XX
Thesis Defense											XX

STUDY BUDGET

Component	Activity Description	Item	Unit of Measurement	Unit Cost (KSH)	Total Cost
Literature Review	Browse, search for literature in the library	Transport and person effects	20 days	@ 300	6,000
	Cyber Café Services	Surfing for 2hours daily	30 days	@ 200	6,000
	Stationeries	Foolscaps	2 reams	@ 500	1,000
		A4 notebooks	2	@ 100	200
		Proposal Typing	3 drafts	@ 500	1500
		Photocopy charges	200 pages	@ 2	400
		Proposal printing	3 drafts	@ 500	1500
Subtotal	-	-	-	-	**16, 600**
Research	Pre-testing	Transport and sustenance for 3 people	1 day	@ 500	1,500
		Typing and printing questionnaires	20 copies	@20	400
	Questionnaires	Photocopying	200 copies	@20	4000
	Data collection	Sustenance	30 days	@ 500	15,000
		2 Research assistants sustenance	30 days	Each @ 500	30,000
		Data Processing and analysis	-	-	7,500
Subtotal	-	-	-	-	**58, 400**
Reports	Draft reports	Typing, printing	200 pages	@ 10	2,000
		Photocopying	5 draft copies	@400	2,000
	Final reports	Correction and printing	200 pages	@ 10	2,000
		Photocopying	6 draft copies	@400	2,400
		Binding	6 copies	@500	3,000
		Sustenance	30 days	@200	6,000
Subtotal	-	-	-	-	**17,400**
		Contingencies			13,860
Grand Total	-	-	-	-	**106,260**

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APPENDIX I: PARTICIPANT'S CONSENT FORM

A: INTRODUCTION

My name is Stephen Kainga, a postgraduate student at the **University of Nairobi**. I am conducting research on "Barriers in preventing long-term complications among patients with Type 2 Diabetes at the Kenyatta National Hospital". You are being requested to participate in this study because you are one of the patients attending Kenyatta National Hospital.

B: PROCEDURE

If you agree to be in this study the following will occur;

1. You will respond to a questionnaire and your participation will take about 30 minutes
2. Your Anthropometric Measurements and Blood Pressure will be taken.

C: RISKS/DISCOMFORTS

1. The physical measurements to be taken are non-invasive but may bring some slight discomfort.
2. Participation in this research may involve personal information but your records will be handled as confidentially as possible. No names will be used in any report from this study.

D: BENEFITS

There will be no direct benefit to you from participating in this study. However, you will get health education on diabetes management and advice or referral for any immediate problem. The study report will assist to improve the overall care of patients with diabetes mellitus.

E: CONSENT

Participation in this research is voluntary. You are free to decline to be in this study, or to withdraw from it at any point. Your decision as to whether or not to participate in this study will have no influence in your medical care in this hospital.

Volunteer Agreement:

I have read the consent form and/or explained to, describing the nature of the study and the benefits. I have had a chance to ask all questions regarding this study. I voluntarily agree to participate.

Date …….. Signature of the Participant
……

Date ……. Signature of the Person obtaining Consent
……

Contact: In case of any questions or clarifications, the research assistant will help you. If you have further questions, feel free to contact myself, Stephen Kainga (School of Nursing Sciences, University of Nairobi, Mobile 0722 577 582) or the Chairman for ERC, UoN/KNH at the following address: University of Nairobi, College of Health Sciences, P.O. Box 30197, GPO 00100, Nairobi; Telephone Contact: 726300-9

APPENDIX II: PARTICIPANTS' QUESTIONNAIRE
UNIVERSITY OF NAIROBI

RESEARCH TOPIC: BARRIERS IN PREVENTING LONG-TERM COMPLICATIONS AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS AT THE KENYATTA NATIONAL HOSPITAL

ENUMERATOR: ……...

DATE : ……...

QUESTIONNAIRE CODE NUMBER: ……....

INSTRUCTIONS

a) Please answer the following questions and fill in the blank spaces. My research assistant will guide or assist you in case of any need.
b) Feel free to ask for clarifications whenever in need.

101 DEMOGRAPHIC DATA

1. Gender: Male Female

2. Age in Years:

3. Marital Status: Single: Married: Divorced/Separated: Widowed:

4. Ethnicity: ……

5. Home District: ……

6. Current Residence: ……

7. Religion: ……

102 EDUCATION STATUS

1. Level of Education: Not gone to School Primary Secondary College/University

103 OCCUPATION: ……

104 HEALTH STATUS

1. Present Complaints: ……

2. Do suffer from any of the following conditions?

a) Heart Disease:	Yes	No	b) Kidney Disease:	Yes	No
c) Hypertension:	Yes	No	d) Eye Disease:	Yes	No
e) Foot Disease:	Yes	No	f) Dental Problem:	Yes	No

g) Arthritis: Yes No h) Asthma: Yes No

i) Others (Please Specify)……...

3. How long have you had Diabetes Mellitus (Years)?.....

105 DIABETES MANAGEMENT/TREATMENT

1. Are you on treatment for Diabetes Mellitus? Yes No

a) Insulin: Yes No If yes, indicate type: ……..

Dosage: ……..... Frequency: …….

b) Oral Drugs: Yes No If yes, indicate type: …….

Dosage: ……. Frequency: …….

c) Herbal Medicine: Yes No If yes, indicate type: ……..

d) Exercise and diet only: Yes No

2. a) Do you take your drugs as prescribed? Yes: No:

b) If no please explain: ……

…….

3. a) Do you ever adjust the dosage of your drugs or insulin? Yes: No:

b) If yes in 3 (a) above, please explain the reason for adjusting: …….

……...

4. Are you on treatment for any other condition? Yes No

5. If yes in 4 (a) above which drugs are you on?

a) ACE inhibitors: Yes No If yes, indicate type: ……

b) ARBs: Yes No If yes, indicate type: ……

c) Antilipidemia Drugs: Yes No If yes, indicate type: ……..

d) Steroids: Yes No If yes, indicate type: ……...

e) Others: Indicate type: …….

106 FAMILY HEALTH HISTORY

1. Does any member of your immediate family suffer from any of the following chronic diseases?

   Diabetes Mellitus: Yes No Heart Disease: Yes No

   Hypertension: Yes No Renal Disease: Yes No

   Other chronic disease(s): Yes No Type(s): ……

107 INDIVIDUAL LIFESTYLE

SMOKING

1. a) Do you smoke Cigarettes? Yes No

b) If yes in 1 above, how many cigarettes do you smoke in a day? Please tick below.

   [1-5] [6-10] [11-15] [1Packet] [>1 Packet]

2. Does your partner smoke cigarettes? Yes No

3. a) Do you combine smoking with other substances? Yes No

   b) If yes in 2 above; please specify; …….....

4. What lead you to stop smoking?.....

……....

5. How long has it been since you stopped smoking (Years)?.....

6. If you were unable to stop smoking, what happened?.....

……

ALCHOL USE

1. Do you consume alcohol? Yes No

2. If yes in 1 above, what type of alcohol?

   [Beer] [Wine] [Spirit] [Beer + Wine] [Beer + Spirit] [Chang'aa]

   Others, please specify: ……. [All]

3. How often do you take alcohol in a week?

   [Never] [Once] [Twice] [Thrice] [Four times] [Daily]

4. How many years have you consumed alcohol?.....

5. Does your partner consume alcohol? Yes No

108 SLEEP

1. What time do you go to sleep? …….....

2. How many times do you wake up to go to the washrooms at night?

   [Once] [Twice] [Thrice] [Four times] [> Four times]

3. What time do you usually wake up? …….

4. Do you feel that you rested enough after sleep? Yes No

5. If no in 4 above, please explain ……

109 STRESS MANAGEMENT

1. Do you experience moments of stress in your daily life? Yes No

2. If yes in 1 above, what are the most frequent sources of stress?

   a) Domestic issues b) Work-related issues c) Disease-related issues

   d) Financial issues e) Others explain: …….

3. How do you relieve your stressful moments in life?.....

……

110 SOCIAL SUPPORT

1. Apart from the hospital, who else assists you when you are sick? ……

2. What type of assistance do you get from these people?

   a) Family b) Financial c) Spiritual d) Social/Friends

   e) Other, please explain: ……

3. What do you feel that these people should do more to assist you?.....

…….

111 HEALTH SEEKING BEHAVIOUR

1. Where do you get your medical care? Public Hosp: Mission Hosp:

   Private Hosp: Herbal Doctor: Others, specify: ……..

2. How many KM is that institution from your home? [0-1] [2-5] [5-10] [10-20] [>20]

3. Do you usually get the services that you look for in that institution? Yes No

4. If no, what services are missing in that institution? Please tick appropriately.

a) Courtesy of the staff b) Essential drugs c) Affordable drugs

d) Timely attention e) Proper information f) Specialized services

g) Personal attention i) Others specify: …….

5. a) How often do you get tested for your eyes (Months)? [Never] [6] [12] [24] [>24]

b) If never in 5 above, please explain: ……..

…….....

6. a) How often do you get your teeth checked (Months)? [Never] [6] [12] [24][>24]

b) If never in 6 above, please explain: ……...

……

112 HEALTHCARE FINANCING

1. How do you pay for your medical care? Self: Employer/company:

NHIF: Other explain: ……

2. Do you experience problems when paying for your medical care? Yes No

3. If yes in 2 above, what is the nature of that problem? Tick appropriately.

a) Lack of personal income b) Paying more medical bills

c) Many dependants d) Out of job due to sickness e) Living alone

f) Lack of social support

g) Others explain: ……..

4. Please explain how you solve that problem (3 above): …….

113 HEALTH EDUCATION IN TYPE 2 DIABETES

<u>HEALTHY DIET</u>

1. Do you know what a healthy diet is? Yes: No:
2. What do you commonly eat to represent the following food groups?
   a) Carbohydrates: ……..
   b) Proteins: ……
   c) Fats: ……..
   d) Minerals/Vitamins: ……..

3. Have do you classify yourself in regard to diet? Vegetarian Non-vegetarian
4. How often do you take vegetables? Never Daily Weekly Occasionally
5. How often do you eat fruits? Never Daily Weekly Occasionally
6. What type of meat do you consume? Red White Both
7. What quality do you prefer? Lean Fat Both
8. What method of cooked/prepared meat do you prefer? Fried: Boiled:
   Nyama Choma: All:
9. Please briefly describe your regular meal in an average day;
   Breakfast: …….
   Lunch: ……..
   Supper: …….
10. What beverages do you take beverages after meals?
    a) Tea with milk b) Tea without milk c) Coffee d) Chocolate e) Soya
    f) Juice g) Soda h) Porridge i) Others specify: …….
11. Do you put sugar in your beverages? Yes No
12. If yes in 11 above, how many tea spoons of sugar do you put in a cup of your beverage? [1-2] [3-4] [4-5] [>5]
13. Do you take snacks between meals? Yes No
14. If yes in 13 above, what type of snack do you take? ……
15. Do you add salt to your food? Yes: No:
16. If yes in 15 above, explain why…….
17. Do you take different diet from your family? Yes No
18. Why do you feel that you need a special diet?.....
    ……
19. How often do you eat away from home? Many times Occasionally Rarely
20. Do you adhere to the diet advice you get from the DM clinic? Yes No
21. If yes in 20 above, please explain; …….
……...

REGULAR EXERCISE

1. Have you been educated on the practice of regular exercise? Yes No
2. Do you engage in regular exercise? Always: Sometimes: Never:
3. Please indicate the type of exercise: …….
4. If sometimes or never (2 above), please explain why; …….....
   ……...
5. How do you arrive at your work place? Walking By Bus/Vehicle
6. Does your work involve any form of physical activity? Yes No
7. If yes in 6 above, please explain the nature of the physical activity; ……..
   ……..

DIABETES MEDICAL MANAGEMENT

1. Have you been educated on appropriate use of medications for diabetes? Yes No
2. Are you comfortable with taking medications for diabetes? Yes No
3. If no in 2 above, please explain; ……..

…….

5. Are you aware of the common side effects of the diabetes drugs? Yes No
6. Please indicate the side effect(s) that you are aware of; ……
7. If yes in 5 above, how do you deal with them? Please explain; ……...

…….

EYE CARE

1. Have you been educated on the prevention of diabetic eye disease? Yes No
2. Do you consider yourself at risk of developing eye disease? Yes No
3. Have your eyes ever been checked by an eye specialist? Yes No
4. Have you had problems with your eyes or sight? Yes No
5. If yes in 4 above, please explain the nature of the problem; ……

……..

6. What problems do you experience when seeking treatment for your eyes?
   a) Lack of eye specialist b) Expensive drugs c) Lack of timely service
   d) Fear of operation e) Others specify: ……
   ……

REGULAR MEDICAL CHECK UPS

1. What regular are the regular routine tests for patients with Type 2 DM?
   Please list them: ……..

2. Do you regularly undergo the following investigations?

Blood Glucose:	Yes	No	Kidney Function:	Yes	No
Blood Lipids:	Yes	No	Blood Pressure:	Yes	No
BMI:	Yes	No	Waist/Hip Ratio:	Yes	No

FOOT CARE

1. Have you been taught about foot care in the hospital? Yes No

2. Is there a person who has been taught to assist you in foot care? Yes No

3. Have your feet ever been examined by the healthcare provider? Yes No

4. Does the doctor/nurse examine your feet when you visit the hospital? Yes No

5. Do you currently have any problems with your feet? Yes No

6. If ye in 6 above, please explain the nature of your problem; ……
   ……

114 BASIC INVESTIGATIONS AND PHYSICAL ASSESSMENT FINDINGS

BASIC INVESTIGATION RESULTS

- Lipid Profile: Total Cholesterol: …….
  Triglycerides: ……..
  HDL: ……..
  LDL: ……...

- Renal Profile: Microproteinuria: ……

  Urea: …… Creatinine: ……

  Na^+: ……K^+: …… HbA_1C: ……

PHYSICAL ASSESSMENT FINDINGS

Blood Pressure:

Reading 1: Systolic (mmHg): ……. Diastolic (mmHg): ……

Reading 2: Systolic (mmHg): ……. Diastolic (mmHg): ……

Average BP Systolic (mmHg): ……. Diastolic (mmHg): ……

Pulse pressure: …….

Heart Rate

Reading 1 Beats per minute: …….

Reading 2 Beats per minute: …….

Average Heart Rate: ……

Weight

Weight in kilograms (kg): …….

Height in centimeters (cm): ……..

Calculated BMI (Kg/m^2): …….

Waist Circumference in centimeters (cm): ……..

Hip Circumference in centimeters (cm): …….

Calculated Waist/Hip Ratio (WHR): ……..

END: THANK YOU FOR YOUR PARTICIPATION

APPENDIX III: FOCUS GROUP DISCUSSION

UNIVERSITY OF NAIROBI

INTRODUCTION

My name is Stephen Kainga, a postgraduate student at the **University of Nairobi**. I am conducting research on "Barriers in preventing long-term complications among patients with Type 2 Diabetes at the Kenyatta National Hospital". You are being requested to participate in this focus group discussion because you are one of the nurses attending to patients with Type 2 Diabetes Mellitus at the Kenyatta National Hospital.

Your contribution will be highly appreciated.

Questions

1. What do you perceive as the barriers that patients experience when preventing long-term diabetic complications?
2. What are the specific barriers that could be attributed to the healthcare system, i.e. the government policies, healthcare facility and the healthcare team members?
3. What are the specific barriers that patients experience that you think are outside the healthcare system (as in number 2 above)?
4. What are your suggestions for addressing these barriers?

APPENDIX IV: LETTER TO THE UNIVERSITY OF NAIROBI-KENYATTA NATIONAL HOSPITAL ETHICS COMMITTEE

M'Kiunga Stephen Kainga,

School of Nursing Sciences,

College of Health Sciences,

University of Nairobi.

10th February, 2011

The Chairperson,

UON-KNH Ethics Committee,

P.O. Box 20723, 00202,

Nairobi.

Dear Sir/Madam,

Re: Request to be allowed to conduct research

I hereby apply for the above. I am a postgraduate student at the University of Nairobi pursuing Master of Science degree in Medical-Surgical Nursing. I am preparing to conduct research as part of the requirements for the award of the degree. The study will be conducted at the Diabetes Clinic and the Inpatient departments of the Kenyatta National Hospital. My research title is ***"Barriers in Preventing Long-term Complications among Patients with Type Diabetes at the Kenyatta National Hospital".***

I would be very grateful for your consideration.

Thank you,

Signature: ……..

M'Kiunga Stephen Kainga: Contact: Mobile; 0722 577 582; E-mail: kaingasteve@yahoo.com

APPENDIX V: LETTER TO THE MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

M'Kiunga Stephen Kainga,

School of Nursing Sciences,

College of Health Sciences,

University of Nairobi.

10th February, 2011

The Permanent Secretary,

Ministry of Education, Science and Technology,

P.O. Box 30623, 00100,

Nairobi.

Dear Sir/Madam,

Re: Request to be allowed to conduct research

I hereby apply for the above. I am a postgraduate student at the University of Nairobi pursuing Master of Science degree in Medical-Surgical Nursing. I am preparing to conduct research as part of the requirements for the award of the degree. The study will be conducted at the Diabetes Clinic and the Inpatient departments of the Kenyatta National Hospital. My research title is ***"Barriers in Preventing Long-term Complications among Patients with Type 2 Diabetes at the Kenyatta National Hospital".***

I would be very grateful for your consideration.

Thank you,

Signature: ……..

M'Kiunga Stephen Kainga: Contact: Mobile; 0722 577 582; E-mail: kaingasteve@yahoo.com

APPENDIX VI: LETTER TO THE CEO, KENYATTA NATIONAL HOSPITAL

M'Kiunga Stephen Kainga,
School of Nursing Sciences,
College of Health Sciences,
University of Nairobi.

10th February, 2011

The Chief Executive Officer,
Kenyatta National Hospital
P.O. Box 20723, 00202,
Nairobi.

Attn: Deputy Director and Head of Clinical Services

Dear Sir/Madam,

Re: Request to be allowed to conduct research

I hereby apply for the above. I am a postgraduate student at the University of Nairobi pursuing Master of Science degree in Medical-Surgical Nursing. I am preparing to conduct research as part of the requirements for the award of the degree. The study will be conducted at the Diabetes Clinic and the Inpatient departments of the Kenyatta National Hospital. My research title is ***"Barriers in Preventing Long-term Complications among Patients with Type 2 Diabetes at the Kenyatta National Hospital".***

I would be very grateful for your consideration.

Thank you,

Signature: ……..

Cc:

Deputy Chief Nurses; Medicine and Surgery
Assistant Chief Nurses; Medicine and Surgery

M'Kiunga Stephen Kainga: Contact: Mobile; 0722 577 582; E-mail: kaingasteve@yahoo.com

APPENDIX VII: PROCEDURE FOR MEASURING BLOOD PRESSURE

Blood pressure (BP) was measured using plastic mercury sphygmomanometer pictured above. The procedure used for BP measurement was based on the American Heart Association guidelines. Blood pressure was measured in the sitting position using a mercury sphygmomanometer. Two separate blood pressure measurements were done in an interval of 20 minutes and an average blood pressure recorded.

APPENDIX VIII: MEASUREMENT OF WAIST AND HIP CIRCUMFERENCES

MEASURING TAPE

WAIST CIRCUMFERENCE

Waist circumference was measured using a measuring tape at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest in a horizontal plane. The patients were advised to stand upright with arms at the sides and the feet positioned close together. Measurements were taken at the end of a normal expiration. Two measurements were made and recorded to the nearest 0.5 cm. The mean of the two measurements was then entered into the data collection form. (WHO Guidelines, 2008)

HIP CIRCUMFERENCE

Hip circumference measurement was taken around the widest portion of the buttocks. The patients were advised to stand upright with arms at the sides and the feet positioned close together. Measurements were taken at the end of a normal expiration. Two measurements were made and recorded to the nearest 0.5 cm. The mean of the two measurements was then entered into the data collection form. (WHO Guidelines, 2008).

APPENDIX IX: PROCEDURE FOR HEIGHT AND WEIGHT MEASUREMENT

WEIGHT METER **HEIGHT METER**

WEIGHT

Weight was recorded to the nearest 0.1kg using a mechanical beam balance with the patient barefoot and wearing light clothing.

HEIGHT

Height was measured using a standard height meter. The patients were advised to stand upright with their arms on their sides and the meter parallel to their posterior. Height was recorded to the nearest 0.5 cm.

APPENDIX X: AUTHORIZATION LETTER FROM THE UON/KNH ERC

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP", Nairobi.
Email: KNHplan@Ken.Healthnet.org

Ref: KNH-ERC/ A/99

26th April 2011

M'Kiunga Stephen Kainga
School of Nursing Sciences
College of Health Sciences
University of Nairobi

Dear Stephen

RESEARCH PROPOSAL: **"BARRIERS IN PREVENTING LONG-TERM COMPLICATIONS AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS AT THE KNH" (P58/2/2011)**

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal for the period 26th April 2011 – 25th April 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The HOD, Records, KNH
The Director, School of Nursing Sciences, UON
Supervisors: Mr. Samuel Kimani, School of Nursing Sciences, UON
Dr. Margaret Chege, School of Nursing Sciences, UON
Mrs. Miriam Wagoro, School of Nursing Sciences, UON

APPENDIX XI: AUTHORIZATION LETTER FROM THE MINISTRY OF SCIENCE AND TECHNOLOGY

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123.
Fax: 254-020-2213215, 318245, 318249
When replying please quote

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: NCST/RRI/12/1/MED-011/79/5

Date: 28th June, 2011

Stephen Kainga M'kiunga
University of Nairobi
P. O. Box 30197
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on **"Barriers in preventing long term complications among patients with type 2 diabetes mellitus at the Kenyatta National Hospital"** I am pleased to inform you that you have been authorized to undertake research **in Dagoretti District, Nairobi** for a period ending ***30th April, 2012.***

You are advised to report to **the Director, Kenyatta National Hospital, Nairobi** before embarking on the research project.

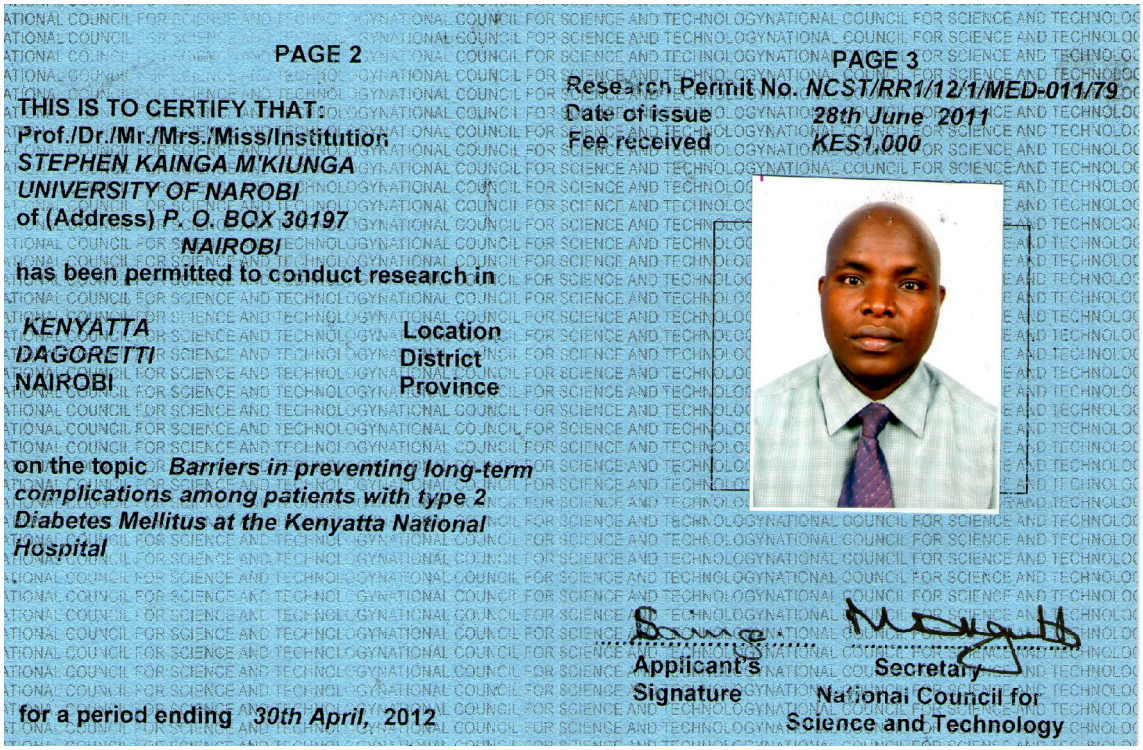
On completion of the research, you are expected to submit **one hard copy and one soft copy** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC
DEPUTY COUNCIL SECRETARY

Copy to:

The Director
Kenyatta National Hospital
P. O. Box 20723 - 00202
NAIROBI

APPENDIX XII: COPY OF THE RESEARCH CLEARANCE PERMIT



PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
STEPHEN KAINGA M'KIUNGA
UNIVERSITY OF NAROBI
of (Address) *P. O. BOX 30197*
NAIROBI
has been permitted to conduct research in

KENYATTA Location
DAGORETTI District
NAIROBI Province

on the topic *Barriers in preventing long-term complications among patients with type 2 Diabetes Mellitus at the Kenyatta National Hospital*

Applicant's Signature

for a period ending *30th April,* 2012

PAGE 3

Research Permit No. *NCST/RR1/12/1/MED-011/79*
Date of issue *28th June 2011*
Fee received *KES1,000*

Secretary
National Council for Science and Technology