ENABLING FACTORS OF GLYCEMIC CONTROL AMONG DIABETIC CLIENTS BEING MANAGED AT HEALTH FACILITIES IN NAIROBI COUNTY, KENYA

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This dissertation is my original work and has not been submitted for award of a degree in any other university

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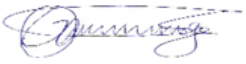
Sign:  Date: **19th January 2022**

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DEDICATION

I dedicate this dissertation to my most caring parents Julius Wambua and Rose Mbuki, my brothers Evans Matheka, Gabriel Makau and Sebastian Nzoka and my sisters Judith Mueke and Marita Robi. May God increase your portions.

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ABSTRACT

Diabetes mellitus refers to a long-term disorder that occurs when pancreas is incapable of producing sufficient insulin and/or the body cells do not commendably utilize insulin. Globally, the prevalence of Diabetes Mellitus has been rising in the past two decades but at a faster rate in Low and Medium Income Countries. Diabetes being a complex endocrine disease is associated with other complications which are accountable for heavy burden to households in terms of treatment cost and decreased manpower. Self-care practices, sociodemographic characteristics and nutritional status have been shown to contribute greatly in the prognosis of diabetes. The broad objective of this study was to establish the enabling factors of poor glycemic control hence development of diabetic complications among clients in selected hospitals in Nairobi County. The study was conducted as hospital-based analytical retrospective cohort design. Kenyatta National Hospital, Mbagathi and Kayole II Hospitals were sampled to represent different levels of healthcare in the County. The study participants included 165 individuals more than 15 years of age who were attending outpatient diabetic clinics between the months of January and March 2021. The data were collected using semi-structured questionnaire uploaded in Online Toolbox Kit and extraction of data from the patient files. Analysis was done using SPSS and program R. The study showed that age (p=0.00), period after diagnosis with diabetes (p=0.00), area of residence (p=0.006), education level (0.00), education on modification of diet during management of diabetes (p=0.01), knowledge (p=0.03) and attitude (p=0.01) towards diabetes recommendations were significantly associated with poor glycemic control among diabetics. In conclusion, these factors were the enabling factors to development of diabetic complications. The study recommends that education on diet modification needs to be handled independently possibly on different sessions or days from the general diabetic education to allow better understanding by the clients.

OPERATIONAL DEFINITIONS

Attitude: Was measured as a score between zero and 100 on a test comprising 8, 11, 4 and 6 questions to assess perceived benefit, confidence, difficulty and external effects on carrying out the diabetic recommendations respectively. The following cut- off points are applied to categorize participants according to their performance; less than <50% was categorized as poor, 50-79 was average while ≥80% was optimum attitude

Client: This term refers to a male or female above 15 years of age who was visiting the diabetic clinic at the selected health facilities due to either health discomforts related to already diagnosed diabetes mellitus or a scheduled regular follow-up on the same

Diabetes complications: This term was used to refer to diseases that arise from uncontrolled diabetes mellitus. They range from cardiovascular, neuropathy, kidney failure, foot ulcerations, visual impairment, impotence, nephropathy and any disease reported after diagnosis of diabetes mellitus

Diabetic management practices: Refers to the activities that through education, diabetics are encouraged to observe to control their blood sugar. They covered components of psychosocial support, nutrition, physical activity and blood glucose monitoring as defined in the Kenyan national clinical guidelines for management of diabetes mellitus, version 2010. Each of the 11 activities was rated according to the frequency it was done with scores of 0, 0.5 and 1 for never, sometimes and as recommended respectively. The number of correct answers was calculated as a percentage of the highest possible score; less than <50% was categorized as poor, 50-79 was average while ≥80% was optimum practice

Glycemic control: This refers to the levels of blood sugar among the diabetic individuals. It was measured by the percentage of glycated haemoglobin which has been used as a reliable indicator for the prognosis of the disease. Clients were classified to have poor glycemic control if their glycated haemoglobin was above 9% or had developed co-morbid conditions after diagnosis of diabetes mellitus such as renal insufficiency and macrovascular complications

Nutritional knowledge: Refers to the measure of the information and skills gained through nutrition education and counselling on management of diabetes based on Kenyan national guidelines of 2010. Nineteen questions were employed for this knowledge section and scores awarded based as a percentage of correct answers to total number of questions; less than <50% was categorized as poor, 50-79 was average while ≥80% was optimum knowledge

KAP Score: this was calculated as an average of knowledge, attitude and practice scores of the study participants. It was used as a predictor of the likelihood of the diabetics carrying out the recommended management practices constantly and in the right manner

Nutritional status: Refers to classification of the rate at which the respondent's physiological needs for nutrients are being met based on cut-off points of Body Mass Index as recommended by WHO, 2019; <18.5kg/M^2 was categorized as underweight, 18.5-24.9kg/M^2 as normal BMI, 25-29.9kg/M^2 as overweight and ≥30kg/M^2 as obese

Respondent: This term is used to refer to the study participants whose measurements of weight, height and glycated haemoglobin was included in the results and who were the sole respondents during the interview with the principal researcher

LIST OF ABBREVIATIONS

BMI – Body mass index

CGM - Continuous glucose monitoring

DDS – Dietary diversity score

DFNST – Department of food science nutrition and dietetics

DI – Diabetic insipidus

DM – Diabetes mellitus

DKA – Diabetic ketoacidosis

FBO – Faith based organization

FBS – Fasting blood sugar

FPG- Fasting Plasma Glucose

GDM - Gestational diabetes

HbA1c- Glycated haemoglobin

IDDM - Insulin-dependent diabetes mellitus

IDF - International diabetes federation

IDH - Infectious Disease Hospital

KAP-Knowledge, attitude and practices

KEMRI - Kenya Medical Research Institute

KMTC - Kenya Medical Training College

KNH – Kenyatta National Hospital

LMIC – Low and medium-income countries

MARD - Mild Age-Related Diabetes

MLKH – Mama Lucy Kibaki Hospital

MORD - Mild Obesity-related Diabetes

NASCOP - National AIDS and STIs Control Program

NCD – Non-communicable diseases

NEML –National essential medicine list

NGO – Non-governmental organization

NIDDM- Non-insulin-dependent diabetes mellitus

OGTT- Oral Glucose Tolerance Test

OHA – Oral hypoglycemic agents

ODK – Open data kit

PPS – Probability proportional to size

RA – Research assistants

RBS – Random blood sugar

SAID - Severe autoimmune diabetes

SDG –Sustainable development goals

SIDD – Severe insulin-deficient diabetes

SIRD - Severe insulin-resistant diabetes

SMBG - Self-monitoring of blood glucose

SPSS - Statistical package for social science

SSA – Sub-Saharan Africa

T2DM- Type 2 diabetes mellitus

TB - Tuberculosis

USD- United states dollar

CHAPTER ONE: INTRODUCTION

1.1 Background information

Diabetes mellitus (DM) refers to a long-term disorder that follows when pancreas is incapable of producing sufficient insulin and/or the body cells do not commendably utilize insulin. As a result there is a raised blood sugar levels over period and advanced damage of body organs. Its complications can be acute or chronic. The common acute ones are diabetic ketoacidosis and non-ketotic coma, while chronic ones are individual organ failures (WHO, 2014; Ross et al., 2014). The prevalence of diabetes in the world among individuals above 18 years rose from 4.2 to 8.5% in 1980 and 2014, respectively. Two million Mortalities were attributed to high blood sugar in 2012 while more than one and half million deaths in 2016 were directly triggered by diabetes. Most of these deaths occurred before the age of 60 years, which is the most productive population. Every six seconds a person in the world expires from diabetes and associated disorders in the world (International Diabetes Federation atlas, 2013) DM, cancers, cardiovascular and respiratory diseases contribute to 86% mortality and 76% disease burden in the European countries (WHO, 2018).

The prevalence of diabetes in the world among adults was estimated to be 6.4% in 2010 and projected to be 7.7% by 2030 while its prevalence was already at 7.1% in Sub-Saharan Africa (SSA) by 2018 (WHO, 2010; Sonak, et al., 2018). The prevalence of DM in Kenya stood at 3.3% in 2015 and was projected to raise to 4.5% by the year 2025. The survey also reported that more than two-thirds of the diabetic cases in the country were undiagnosed (STEPwise survey, 2017). This prevalence had also been estimated to be at 10.7% and 2.7% in urban and rural areas, respectively (IDF Atlas, 2014).

The prevalence of diabetes is increasing faster in low and medium-income countries (LMICs) than in the rest of the world, (WHO, 2018). It has also been anticipated that mortalities from Non-communicable diseases (NCDs) will overtake infectious disease mortality by 2030 in SSA yet most of the efforts are funding the later and Human Immunodeficiency Virus (HIV) projects (Gustafson et al., 2010; world bank, 2020). Similarly, it was shown that NCDs accounted for 40% hospital mortality, 27% of the aggregate mortality and more than 50% hospital admissions in the Nairobi County. DM was listed among the top ten causes of mortality in the county. (Nairobi City County, 2017).

It has been shown that HbA1c is related to people's lifestyle, such as physical activity, choice and quantity of meals as well as glucose monitoring (Wayne et al., 2015). Studies done on nutritional awareness and diseases such as HIV and cancer have shown a significant relationship with the disease prognosis (Muthike et al., 2015; Muthamia et al., 2015). Other studies have reported that poor knowledge in diabetic patients is associated with unsatisfactory glycemic control (Sakari & William, 2019). Knowledge, attitude and practice also plays a key role during prevention as well as early detection, wholesome management, close monitoring and evaluation of all NCDs (MoH-Kenya, 2011). Information on the number of persons screened for diabetes, level of knowledge on diabetes among those affected as well as the trained health professionals and community health workers on diabetes in is limited (Nairobi City County, 2017).

The concentration of HbA1c has been reported to give a reflection of the control of a patient's diabetes; a controlled level of HbA1c decreases the incidence of chronic complications due to disease (Ye et al., 2016).

1.2 Statement of the problem

DM being a complex endocrine disease is associated with complications which vary from non-vascular to micro vascular and macrovascular diseases hence affecting a wide range of organs and systems in the body especially with uncontrolled glycemia (Rivich et al., 2016). These complications arising from uncontrolled diabetes are accountable for amplified incidences of disability, morbidity and mortality as well as heavy burden to households in terms of treatment cost and decreased manpower (Ghabban et al., 2020). The widespread development of diabetic complications across the Country raise speculations on the enabling factors of uncontrolled glycemia among the diabetics.

The identification of the factors contributing to occurrence of these diabetes complications are important for the modification of practices and policies in the management of diabetes. It has been acknowledged that poor blood glycemic control, diabetes duration, negative attitude of DM, poor adherence to diabetic recommendations, poor knowledge about the disease and its management, age, hypertension, obesity, smoking, dyslipidemia, and genetics are significant risk factors for most diabetic complications (Abebe, 2017).

1.3 Justification

Expansion of urban centers has been named to be a significant contributor of the snowballing NCD epidemic (Marquez, P. V., Farrington, 2013; MoH-Kenya, 2015). Close to one quarter of the population in Kenya resides in urban centers, whereby the growth rate of this urban population is increasing two times faster than the entire population in the country (World Bank, 2020). As a result, it would be of ultimate significance to invest in a research that targets management of diabetes in the Kenyan County that houses the largest urban center in the country. This would contribute towards achievement of the third Sustainable Development Goal (SDG).

The behavioral and pharmaceutical interventions have been reported to avert upto 80% of the mortalities resulting from DM (Kenyan STEPwise survey, 2015). The behavioral interventions are achieved by impaction of knowledge and influence to change bad habits. This is attained through education and counselling sessions at the health centers as well as different media platforms and formal education. Nutrition education among the diabetics has been recounted to improve knowledge scores (Muchiri et al., 2016). Few studies have been done to establish the level of knowledge, attitude and dietary practices as well as the nutritional status among the diabetics in the Kenyan urban population.

The identification of the enabling factors of poor glycemic control among the diabetics would help in promoting for specific changes in management of DM to reduce the burden of the disease in the Country. The results of the study would also be used in formulating and strategies and programs at the hospital, community and Country at large targeting achievement of stable glycated haemoglobin among the diabetics.

1.4 Aim of the study

To contribute towards achievement of diabetes care system that is responsive and effective.

1.5 Purpose of the study

To generate data that can be used to reduce episodes of hyper and hypoglycemia hence reduce the rate of development of other complications among diabetic clients in the Country.

1.6 Objectives

1.6.1 Main objective

To determine the enabling factors of glycemic control among diabetic clients in selected hospitals in Nairobi County.

1.6.2 Specific objectives

1. To describe the socio demographic characteristics of diabetic clients attending selected health facilities in Nairobi County.
2. To establish the level of knowledge, attitude and management practices of diabetes among diabetic clients attending various health facilities in Nairobi County.
3. To determine the nutritional status of diabetic clients in selected hospitals in Nairobi County based on their Body Mass Index (BMI).
4. To determine the relationship between glycemic control and selected risk factors among diabetes among clients in selected hospitals in Nairobi County.

1.7 Hypotheses

1. There is no relationship between the socio-demographic characteristics and the glycemic control among clients attending their clinics in hospitals in Nairobi County.
2. There is no relationship between the level of knowledge, attitude and management practices and the glycemic control among diabetic clients in Nairobi County
3. There is no association between the nutritional status of diabetic clients in Nairobi County and their individual glycemic control among diabetic clients in Nairobi County.
4. There is no relationship between glycemic control and the selected risk factors among diabetic individuals attending selected hospitals in Nairobi County.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

The term "diabetes" was first coined by Aretaeus of Cappadocia as διαβαίνω in Latin which means "to run or go through" in the second century. Later Galen defined it as a disease specific to the kidneys. In 1675 Thomas Willis added the words mellitus and insipidus for distinct types of urine which was "sweet" and "tasteless" respectively in individuals with diabetes. In 1776, Thomas Willis discovered that the sweetness of the urine in DM resulted from increased levels of glucose in the blood. Mering and Minkowski identified the role of pancreas in DM in 1889. The word insulin as blood sugar lowering hormone was coined in 1909 and was isolated by Banting and Macleod in 1923 (Singh et al., 2010).

DM refers to a group of metabolic disorders characterized principally by high levels of blood glucose whereas diabetes insipidus is characterized by enormous volumes of dilute urine due to impaired production of pituitary hormone. There are three different types of DM; namely type 1, type 2, gestational diabetes (GDM). Type 1 diabetes manifests as absolute insulin insufficiency while the rest of the types are characterized by insulin resistance and/or delayed or inadequate insulin production. Despite the fact that in most cases GDM is resolved during the post-partum period, any reported GDM case has 7-13 times higher risk to develop DM later in life (WHO, 2019; Ziegler, 2014).

Glycemia is the concentration of glucose in the blood. It is an important parameter of all physiological activities since glucose is required to provide metabolic energy for all cell functions (d'Emden et al., 2015). This concentration is determined by a number of factors including intake of nutrients, physical activity, alcohol intake, exercise, intake of various medications as well as epinephrine, insulin, glucagon, glucocorticoids and steroid hormones (Fekadu et al., 2019).

2.2 Risk factors of diabetes

The main risk factors of DM are heredity, decreased physical activity, alcohol abuse, unhealthy diets, and tobacco use, advanced age, ethnicity, and prolonged inadequate intake of correct nutrients, infection and side effects of drugs (Id et al., 2019; Wahome et al., 2018). Existence of one risk can predispose an individual to diabetes irrespective of how well the other risks are controlled. For example, a study in Malaysia showed that only one-fifth of the study participants consumed more than individual nutrient requirement per their ages and gender. Despite such a recommendable diet observance, the study reported very high prevalence of overweight and obesity (86.7%) and poorly controlled HbA1c of 20.2% among the diabetic clients (Firouzi et al., 2015). Similarly, the individuals with family history of DM have been reported to be more informed as well as have better attitude towards the recommendations in its management but demonstrate unsatisfactory eating behaviors (Waidyatilaka et al, 2019).

The available studies show inadequate public mindfulness about DM, poor behaviors and reluctance to embrace better and healthy régimes which is a significant contributory element to the epidemic rise incidences of diabetes among other NCDs (Marquez et al., 2013). Among individuals with higher than normal fasting blood sugars or on diabetic treatment, an average of 43.7% were aware of their condition but only 20% of those diagnosed had received medication (MOH-Kenya, 2018). Other studies which reported a high level physical activity also showed high rates of over nutrition age-specific prevalence of diabetes of 10.5 % among 50-54 years (Ayah, et al., 2013; WHO, 2019). Urbanization has also been named as one of the steering risk factors of diabetes across age, gender and social groups possibly due to the lifestyle of the urban residents (Chege, 2010).

Individual risk factors of diabetes are likely to compromise glycemic control which is the goal for all in the management of DM. Consequently, clients and caregivers are always reminded to put the risk factors in control even after diagnosis of diabetes. Factors such as the duration of diabetes, drug utilization patterns, BMI >25KgM^2, poor adherence to diet recommendation and low physical activity contribute to poor glycemic control (Goyal et al., 2019). Other factors include knowledge level, culture, perception on diabetes and its treatment, fear of stigma, physical health conditions, depression among other social, time and occupational factors (Manyara & Fischer, 2017).

Some factors beyond the control of the client may include availability of health care resources, professionalism of healthcare providers as well as disease progression and treatment-related factors (El-busaidy et al., 2014). Figure 1 shows some of the contributors of poor glycemic control which in an indicator of progress in management of diabetes.

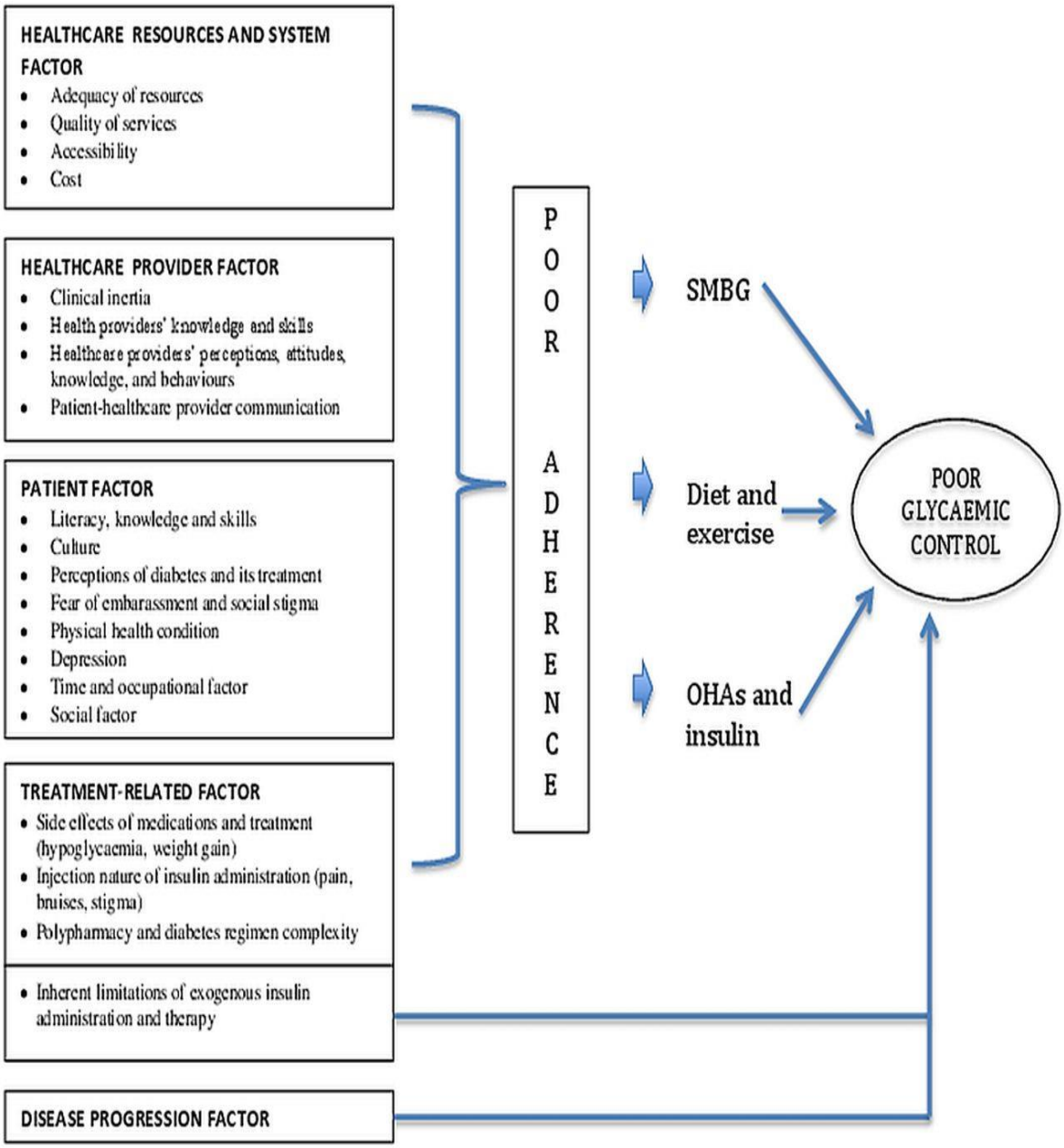


Figure1: Diabetes framework (Tong et al., 2015)

2.3 Epidemiology of diabetes

The world prevalence of DM varies as low as 0.6% in Benin to as high as 18.2% in Reunion of Madagascar Island. In the SSA, it ranges from 1% in rural Uganda to 12% in urban areas in Kenya (Victoria Hall et al., 2011). T2DM is more prevalent, as it comprises, 85-95% of all diabetes cases in the world. T2DM related to overweight is more prevalent in individuals in the urban areas and/or of Asian and mixed African and Western ancient while T2DM related to undernutrition is more prevalent in SSA. The prevalence of T1DM is significantly higher in the rest of the world than in the SSA though the rate of survival beyond one year after diagnosis is quite low in the later (Farrington, 2013; WHO, 2018).

The prevalence of diabetes has been projected to be rising in the entire world but at a higher rate in the SSA especially in the urban and peri-urban areas. A comparative study reported that black South Africans with glucose intolerance progressed faster to T2DM paralleled to their white South African colleagues. This was related to the difference in fat distribution, genetic variation, malnutrition and environmental factors such as infection and toxins (Chivese et al., 2019). There is also an elevated risk among richest wealth quintile than poorest wealth quintile that is 33.4% and 5.2% respectively (MoH-Kenya, 2015).

DM have been reported to escalate threefold the possibility of contracting infectious diseases, such as, tuberculosis (TB) and that the presence of TB can as well predispose an individual into developing diabetes. Other diseases that are directly linked to diabetes include pneumonia and HIV; potentially due to inflammation associated with them (Manos et al., 2019). A few macro vascular complications of diabetes such as concomitant occurrence with hypertension is also common in SSA (Alsous et al., 2019).

About one fifth of the diabetic clients in the rural areas in Kenya have shown symptoms of depressive disorder especially among clients with worsening glycemic control, according to the data obtained from the clinics in which they are followed. Other medical conditions occurring alongside DM include sepsis (Hall et al., 2011). A higher percentage (76.4%) of mortalities caused by DM was among individuals less than sixty years of age in SSA in 2014. This was attributed majorly to late diagnosis and inadequate care provided to the clients that resulted to various complications of DM (Marquez et al., 2013)

2.4 Burden of diabetes

According to the World Health Organization three quarters of the patients with diabetes reside in Low and Medium Income Countries (LMICs). Majority of the individuals affected by diabetes are sole breadwinners of their families who utilize an average 25% of their income on medical care (KNBS, 2018). The major challenges pointed out in the SSA are lack of available studies among specific to the population groups, inadequate funding for the NCDs, difference between patients at rural and urban areas, lack of equality among public and private health sector and unavailability of drugs. The funding agencies have concentrated more on the communicable diseases according to WHO, 2018. Similarly, in addition to the low Gross Domestic Product (GDP), SSA spend only 5.5% to fund their health sector compared to 12.4% in the European countries (WHO, 2018).

Diabetic individuals spend a range of $26 to $234 and $418 to $987 in public and private sectors respectively annually (Subramanian et al 2018). A large proportion of Kenyans lack health insurance and National Health Insurance Fund (NHIF) does not cover some laboratory tests and medications used in diabetic management (National Health Insurance Fund, 2015).

In addition, 36.1% of Kenyans who live below global poverty line (US$1.90 per day) are likely to be less equipped to afford the drugs and the laboratory tests required for optimal management of diabetes. (KNBS, 2018). Despite a significant decrease in the prices of oral hypoglycemic agents (OHA) due to introduction of their generic forms, the cost of insulin has remained high over time. There is a poor implementation of national essential medicine list (NEML) in the LMICs. NEML is tasked with ensuring availability and affordability of OHA, long and short-acting insulin formulations among other drugs (Marquez et al., 2013).

The life expectancy in the SSA could be crippled as a result of increased burden of diabetes whose incidence and prevalence increases as the population ages. More than two-thirds of the individuals who succumbed to diabetes in 2013 were below 60years of age. Diabetes also increases the risk of other diseases such as pneumonia, HIV/AIDS, mental disorders such as depression and TB which increase the medical bills on the individuals affected (MoH-Kenya, 2014)

2.5 Diagnosis of diabetes

The common laboratory tests done to diagnose diabetes include oral glucose tolerance test (OGTT), random and fasting blood sugars as well as glycated haemoglobin (HbA1c). Indicators of pre-diabetes include impaired glucose tolerance and impaired fasting glucose levels (Cristina et al., 2019). Although time-consuming, relatively costly, and uncomfortable OGTT is a definitive and standard test for the diagnosis of DM (Tuso, 2014). Adequate carbohydrate intake must be ensured for at least three days before the test and nutritional status of the patient is taken into consideration. The blood specimen is obtained two times; the first after a night's fast (≥10 hours) and the second one after the client ingests 75g of glucose in a solution. The blood sugar level is reported to be elevated if the readings are ≥6.1 mmol/L and 11.1 mmol/L for fasting and two hours after ingestion with glucose solution respectively (Appel & Wadas, 2018).

Fasting blood glucose (FBS) is used mostly for screening purposes (WHO, 2019). It is done after an overnight fast with an exception of water only. It is a poor a screening test for mild diabetes which is only detectable after sugar load. Any individual who screens with a FBS between 6.1-6.9mmol/L is described to have impaired glucose tolerance while FBS ≥7mmol/L to be glucose intolerant. These tests have to be repeated at specific return dates for those who screen positive for the confirmation of diabetes, with exception of children and pregnant women who should be admitted immediately for monitoring (Ye et al., 2016).

Random blood sugar (RBS) is considered high if ≥11mmol/L. Other tests such as HbA1c are necessary during the control of diabetes. HbA1C levels of <6.5% shows controlled, 7.5-9% moderately controlled whereas ≥9% show uncontrolled glycemic levels for those on diabetic treatment. Non-diabetic persons are expected to have <5% of glycated haemoglobin. Reliability of HbA1C results may be reduced by the presence of disorders that affect turnover of red blood cell such as hemolytic among other anemias, glucose-6-phosphate dehydrogenase deficiency as well as use of drugs that stimulate erythropoiesis, end-stage kidney disease, pregnancy and recent blood transfusion (d'Emden et al., 2015).

Individuals who retest negative for glucose intolerance or rather have impaired fasting glycemia are required to repeat the tests after one year. However, it has been revealed that most of the individuals in SSA show reluctance in follow up with medical tests despite the phone-based reminders. For example, less than 25% of study participants returned for confirmatory tests (Sonak et al 2017). In addition the more reliable tests such as HbA1C were afforded by less than 20% of the diabetic patients attending public health centers beside the subsidized prize of USD. 10 as compared to USD. 25 in private hospitals in Kenya (MoH-Kenya, 2015).

An initial test of HbA1c is recommended for all diabetic clients followed by routine measurements whose frequency depend on doctor's judgment, treatment on which the individual client is on and clinical situation. Urine sugar determination by use of Benedicts solution is stable, of low cost and easier to interpret quantitatively but its validity is quite low in diagnosis of diabetes. Other tests used include oral cortisone-glucose tolerance test, intravenous glucose tolerance test, blood insulin determination and tolbutamide response test (Alexander, 1968).

2.6 Management of diabetes

Type 2 diabetes is related to overweight thus its management includes a combination of physical exercise, modified diet and metformin and sulfonylureas therapy among other lifestyle changes such as smoking and alcohol intake. The oral pharmacological interventions are only initiated once the individual's glycemia goals are not achieved by the combining appropriate changes in lifestyle, diet adjustments and physical activity. Initially cases that present with exceedingly high blood sugar levels but with no ketones are managed with high doses of insulin followed by oral agents and lower doses of insulin. Some patients may not need any insulin for weeks to years depending on their subsequent FBS.

Ketosis-prone atypical diabetes characterized by weight loss, polydipsia, polyuria and severe hyperglycemia is controlled by periodic insulin which can be substituted with OHA until the next dose of insulin is required (MPHS-Kenya, 2010). The prevention and prognosis of diabetes relies heavily on the knowledge and skills rendered to the client on disease and its complications. Poor knowledge scores and malnutrition among the diabetic clients were directly associated with poor glycemic control among diabetic clients (Sakari & William, 2019; Tunrayo, 2013).

A comprehensive initial education, accompanied with frequent individual follow-up, group meetings and distribution of materials to diabetic clients have been shown to have a positive impact on the knowledge scores on self-care (Gupta & Nainiwal, 2019; Muchiri et al., 2016). Other studies however, demonstrated that willingness to learn and being receptive to the guidelines on diabetic management did not translate to appropriate practices in prevention and management of diabetes (Waidyatilaka et al., 2019).

One of the greatest challenge in achieving glycemic control among diabetics in Kenya is late diagnosis possibly due to inaccessibility of health facilities, ill-equipped clinics, lack of training, and unwillingness to take the tests (Brown et al., 2015). It was also reported that despite existence of comprehensive policies in management and prevention of diabetes, there exists a significant gap in its implementation since the strategies are based on inadequate resident evidences and frail monitoring systems (Fekadu et al., 2019).

2.7 Glycemic control

Glycemia refers to the concentration of blood glucose. This concentration is maintained within normal ranges by the insulin and glucagon produced in the pancreas (Ye et al., 2016). In cases where the production or utilization of these two hormones in the body is altered, the variability of blood glucose has to be maintained by administration of drugs alongside modified quantity, choice and frequency of meals, physical activity or any complication that might arise within one's body. Other body hormones which contribute to changes in blood glucose include growth, glucocorticoids, thyroid, stress and epinephrine (Ziegler., 2014). Both hypoglycemia and hyperglycemia have adverse effects in the body ranging from acute symptoms to coma and organ failure (Id et al., 2019; Kim et al., 2019). As a result, glycemic control has been named to be the major target in management of DM (Care & Suppl, 2021).

HbA1c being one of the most reliable indicators of glycemic control and risk maker for diabetic complications, gives the average percentage of glycated haemoglobin in the body for the past 8-12 weeks. In cases where the targets of glycemic control have not been met, during pregnancy of change of anti-diabetic drugs, it is recommended that the test is done more oftenly, that is, every 3months for closer monitoring in the changes being experienced. Otherwise, the test is recommended to be taken twice a year for the diabetics (MPHS-Kenya, 2010).

HbA1c test is dependent on the concentration of haemoglobin in one's blood. Consequently, the results can be increased in case of iron and/or vitamin B12 deficiencies, alcoholism, and ingestion of high doses of aspirin or if there is erythrocyte destruction in one's body. The results can also be falsely decreased in cases of chronic liver failure, ingestion of iron, aspirin, vitamins E, B12 and C, splenomegaly and use of antiretroviral drugs. Altered haemoglobin as experienced during pregnancy and chronic kidney failure is likely to give variable changes in HbA1c results (Rn et al., 2018).

HbA1c does not report short-range glycemic variability or hypoglycemic events. As a result, for T1DM or T2DM clients with severe insulin insufficiency, a combination of self-monitoring blood glucose (SMBG) or Continuous Monitoring of Glucose (CMG) and Hb1c is preferable for monitoring of glycemic control. (Chehregosha et al., 2019). The glycemic control is classified as uncontrolled if >9% and controlled if <6.5 %. HbA1C for children younger than 5 years old, 7-9% is acceptable and older children 7-8% (Kenya, 2010).

Personalized SMBG has been encouraged by several studies to keep a track of the blood sugar concentrations and help to figure out the effect on specific health behaviors on ones control of glycemia. It is also the solitary way to diagnose and fast-treat hypoglycemia or hyperglycemia before significant damage is done to the body organs.

2.8 Review of Methodologies

2.8.1 Questionnaires

There are four ways of collecting data using questionnaires, that is, face-to-face, telephone, self-administered and online interviews. The questionnaires can be structured, semi-structured or unstructured. The questions in either of a questionnaire can be open or close-ended. Self-administered questionnaire is important especially when sensitive information is being sought ref. The information from the study participants was collected using structured questionnaire adapted from WHO STEPwise approach to chronic disease risk factor surveillance (WHO, 2003). It was composed of both open and close-ended questions and administered face-to-face. This method was considered because it provides a richly detailed exploration of individual's own accounts of their lived experiences.

2.7.2 Anthropometric methods

These are taken with an aim of estimating the body composition, that is, the proportion and distribution of muscle mass, fat, bone and water. Analysis of anthropometric measurements give indicators of nutritional status, explicitly, the measure of the balance between nutrient requirement and intake. The recommended anthropometric measurements for adults include weight and height. For the purpose of this study, weight, height, waist and hip circumference were measured. These were chosen due to their reliability and availability of the required standard equipment.

2.8.3 KAP survey methods

This method seeks to gauge the level of knowledge of a chosen sample of a population on a particular subject(s). This is done by including open questions in a questionnaire on the participant's understanding of specifics of the subject.

It also assesses the attitude on the known guidelines of a specific subject to the interviewee in terms of perceived benefit, difficulty and self-confidence in carrying them out. For the practice, the participant is questioned on how they practically carry certain task(s) in management or prevention of a certain condition. The KAP surveys seek to investigate the ability of individuals to carry out self-management of their medical conditions (Diabetes, MichigaDiabetes, M., & Center & Center, 1998).

2.8.4 Glycemic control

HbA1c is an indirect reflection of average presence of glucose in the blood (glycaemia) over a period of approximately 3 months. An initial test is required for all diabetic clients followed by routine measurements whose frequency depend on doctor's judgment, treatment on which the individual client is on and clinical situation. It is normally done every six months for patients who have had normal glycaemia while on treatment and every three months when changing treatment or when the patient is developing new complications.

The level of glycated haemoglobin has been shown to be an excellent indicator of glycemic control and hence probability of developing complications. In For type 1 diabetes or type 2 diabetes patients with severe insulin insufficiency, a combination of Self-Monitoring Blood Glucose or CMG and HbA1c is preferable. To provide sufficient information on hypoglycemic risk, the blood glucose is taken pre-prandial, 2-hour post-prandial and occasional overnight blood glucose measurements. Although application of SMBG has less impact in achievement of glycemic control especially among the T2DM patients on insulin therapy, it has been documented to be vital self-management (Karter et al., 2001).

The efficiency of SMBG is increased through combination with a series of education sessions on how and when to carry it out, how to read and systematically record the results and the interpretation of the results. SMBG alongside the HbA1c results act a reliable source of the need to change the therapy on any diabetic client. In circumstances where the results of SMBG do not match with HbA1c and/or at least annually, it is recommended that SMBG is compared with laboratory measurement of Fasting Plasma Glucose (FPG).

2.9 Gaps in Knowledge

Diabetes being a chronic disease requires patients to continue their treatment for the rest of their live. The emphasis therefore is on the emphasis of the control of the condition through a tight schedule blood glucose monitoring, medication as well as adjustment of dietary and physical exercise routine. Such a chronic disease needs proficient self-care which can be established by exhaustive understanding of the disease by the patient and presupposes the need for education and counselling for the diabetics. For people with diabetes, medical issues are not the only area that requires management; psychosocial, family, economic, cultural and lifestyle issues also need attention. In the past decade, the MOH has implemented public and specialized awareness of chronic diseases especially through primary health care systems (MoH-Kenya, 2015). This effort has however been met with a rapid raise in the prevalence of the DM especially at the urban areas in the country (Fischer, 2017; Mohamed et al., 2018). There is lack of data on actual diabetes knowledge perceived by the diabetics, their attitude towards the recommendations and the possibility of carrying them out in control of DM as well as the tools approved for collection of this kind of information at the health facilities.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

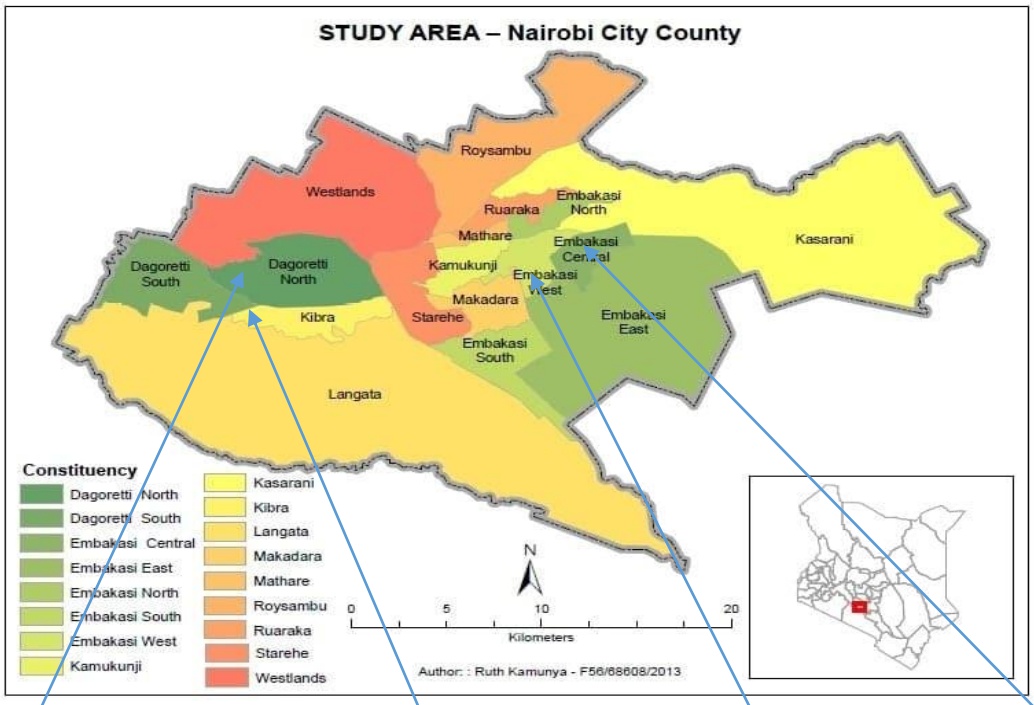
3.1 Study design

This research was conducted as hospital-based analytical retrospective cohort design. The study involved looking back to compare the exposure of the selected risk factors with the current outcome among the diabetic clients attending outpatient clinics at selected hospitals in Nairobi County. The study design allowed the researcher to identify whether the selected enabling factors were associated with higher than expected percentage of glycated haemoglobin hence risk of developing other complications after diagnosis with diabetes.

3.2 Study setting

3.2.1 Geographical location

Nairobi metropolitan is one of the city counties among the 47 counties in the Kenya. It stretches across 684 square kilometers of land and houses more than 4.3 million people (KNBS, 2019). Nairobi County is made up of seventeen Sub-counties and 85 wards as shown in figure 2. It borders Machakos, Kiambu and Kajiado Counties.



KNH Mbagathi hospital MLKH Kayole II Hospital

Figure 2: Map of Nairobi County, *Tuko.ke*

3.2.2 Health care facilities

The county has approximately 672 health facilities which offer services at various levels of care, also called tiers. Primary health facilities also known as tier 2 make up 84% of the aggregate number of these health facilities. More than 50% of the health facilities are privately owned, 22% are Government facilities while the residual 27% is owned by Faith-Based Organizations (FBO) and Non-Governmental Organizations (NGO). Several facilities which are not registered operate in underserved areas, mainly in the informal settlements. Out of a total of 175 community units, about 121 are fully functional and all provide diabetes care. On the other hand, only less than half (304) of the health facilities are equipped to provide diabetes care. As of close of 2013/2014 year, there were 12,677 diabetics on treatment in the County (Nairobi City , 2017).

3.3 Study site

The study was conducted in three hospitals within Nairobi County, which are, Kayole II, Mbagathi and Kenyatta National Hospitals. Mama Lucy Kibaki Hospital (MLKH) was used for testing of study materials and equipment. Kayole II hospital is a level III hospital that is located in Embakasi central sub county. It has a bed capacity of 40 patients and receives an average of about 1700 diabetic outpatients in a year. It has got an operative outpatient clinic for the NCDs, including diabetes.

MLKH is located in Embakasi West Sub-County at Kayole II estates. It was officially opened in 2013 and has about 456 health workers. It operates as a level IV hospital with a bed capacity of more than 300 patients. Since it opened its doors, the MLKH has served close to 200,000 outpatients, about 7,000 inpatients and more than 3,000 deliveries have taken place in the maternity wing. The data on the diabetic patients among other NCDs was missing.

Mbagathi Hospital is situated in Kibra Sub-County. It was built in the 1950s to offer health care services mainly for infectious disease which required isolation such as TB, measles, meningitis and leprosy. In 1995, Infectious Disease Hospital (IDH) was curved from KNH and transformed into an autonomous district hospital for Nairobi. It currently operates as a level 4 hospital under the ministry of health (MOH) and has the largest catchment area of about one million people, comprising mainly of the underprivileged. It has a bed capacity of about 320 patients and average annual diabetic outpatient attendance of 9500. It also has got an operational outpatient diabetic clinic.

Kenyatta National Hospital (KNH) is the oldest hospital in the country having been founded in 1901 as the Native Civil Hospital and currently operates as a state corporate and a level six hospital. It is located in upper hill, Dagoretti North Sub-County.

The institution works closely with College of Health Sciences (University of Nairobi), the Kenya Medical Training College-Nairobi, Kenya Medical Research Institute (KEMRI) and National AIDS and STIs Control Program (NASCOP). It covers an area of 45.7 hectares. It has a bed capacity of 1800, staff capacity of 6000, an average annual inpatient attendance of 100, 000 and average annual diabetic outpatient attendance of 50, 000. It also has got more than 22 outpatient clinics among which is a diabetic clinic (KNH, 2018).

3.4 Study population

The study population included both male and female clients who were already diagnosed with diabetes and attending outpatient clinic at KNH, Mbagathi Sub-County and Kayole II hospitals. The outpatient clinic was chosen over the inpatient because the clients were more stable and could give more conscious responses to the questions, there was more space to allow the social distancing during the interview and the patients were less predisposed to COVID-19 due to compromised immunity. The health centers were selected due to adequate number of diabetics visiting and to represent different tiers as per the national categorization of health centers.

3.4.1 Inclusion criteria

The respondents included in this study were diabetic patients who were above 15 years of age and visited the outpatient clinic between the months of January and March 2021.

3.4.2 Exclusion criteria

The diabetic clients who were pregnant, could not hold a clear conversation or did not give their consent to the study voluntarily were excluded from the study.

3.5 Sampling size determination

The sample size was calculated based on Fischer's et al. (1991) formula as shown:

$$n = \frac{Z^2 x P\ x Q}{d^2}$$

Where; n = minimum desired sample size

Z = value for the chosen confidence interval at 95% = 1.96

p = prevalence of adult diabetes as percentage, 10.7% (Diabetes Atlas, 2014)

q = 1-p the estimated proportion

d = degree of desired accuracy

$$n = \frac{1.96^2 \text{x } 0.107 \text{ x } 0.893}{0.05^2}$$

$$= 147$$

Attrition rate was assumed to be 10%

Hence the adjusted minimum desired sample size, $n = \frac{147}{0.9}$

$$= 164$$

3.6 Sampling procedure

A multi-stage sampling procedure was employed. Considering that Nairobi County houses the largest urban set-up in the country, it was purposively selected as the study site. Three health facilities, that is, Kenyatta National Hospital, Mbagathi Hospital and Kayole II Health Center were then selected purposively as clusters for the study and to be representative for different levels of the hospital.

The number of clients to be interviewed from each hospital was determined by probability proportional to size (PPS) in respect to the estimated number of total clients attending each health center in a month. KNH, Mbagathi and Kayole II reported an average of 50, 000, 9,500 and 1,700 outpatients respectively per month in the year 2017 (KNH, 2018). The calculation is shown below. The research was conducted only during the diabetic clinic days especially in Mbagathi and Kayole II hospitals so as to achieve the targeted numbers.

Simple random sampling was applied at the clinics to choose the specific respondents during the study. The list from which to draw the sample was constructed by separating the diabetic clients from those suffering from other NCDs since they would be in the same waiting bay and their files together from the record's office. The patient's files were used to identify the diabetic clients already at the waiting bay. The target sample for each day was achieved by assigning numbers alongside the names of clients who had arrived in the clinic by 8am. The daily target sample was set at 8 respondents. However, 10-12 clients were selected as an allowance in case of decline of consent or the client was due for a lengthy laboratory test that would go beyond 2pm. Half the number of the study participants targeted for that day were then randomly picked. The process was repeated at noon or on finishing interviews of the first lot to sample the other half so as to reduce the bias of those who arrive first in the clinics. The selected clients were then informed about the research on concluding consultation with the rest of the medical cadres.

Total number of outpatients in the three hospitals; = 50000+9500+1700

= 61,200

Minimum sample at KNH; $= \frac{50000}{61200} \times 147$

= 120

Minimum sample at Mbagathi; $= \frac{9500}{61200} \times 147$

= 23

Minimum sample at Kayole II health center; $= \frac{1200}{61200} \times 147$

= 3

The attrition numbers were added on to the Kayole II hospital sample; 17+3 = 20

3.7 Sampling schema

Figure 3 shows the sampling schema employed in this study.

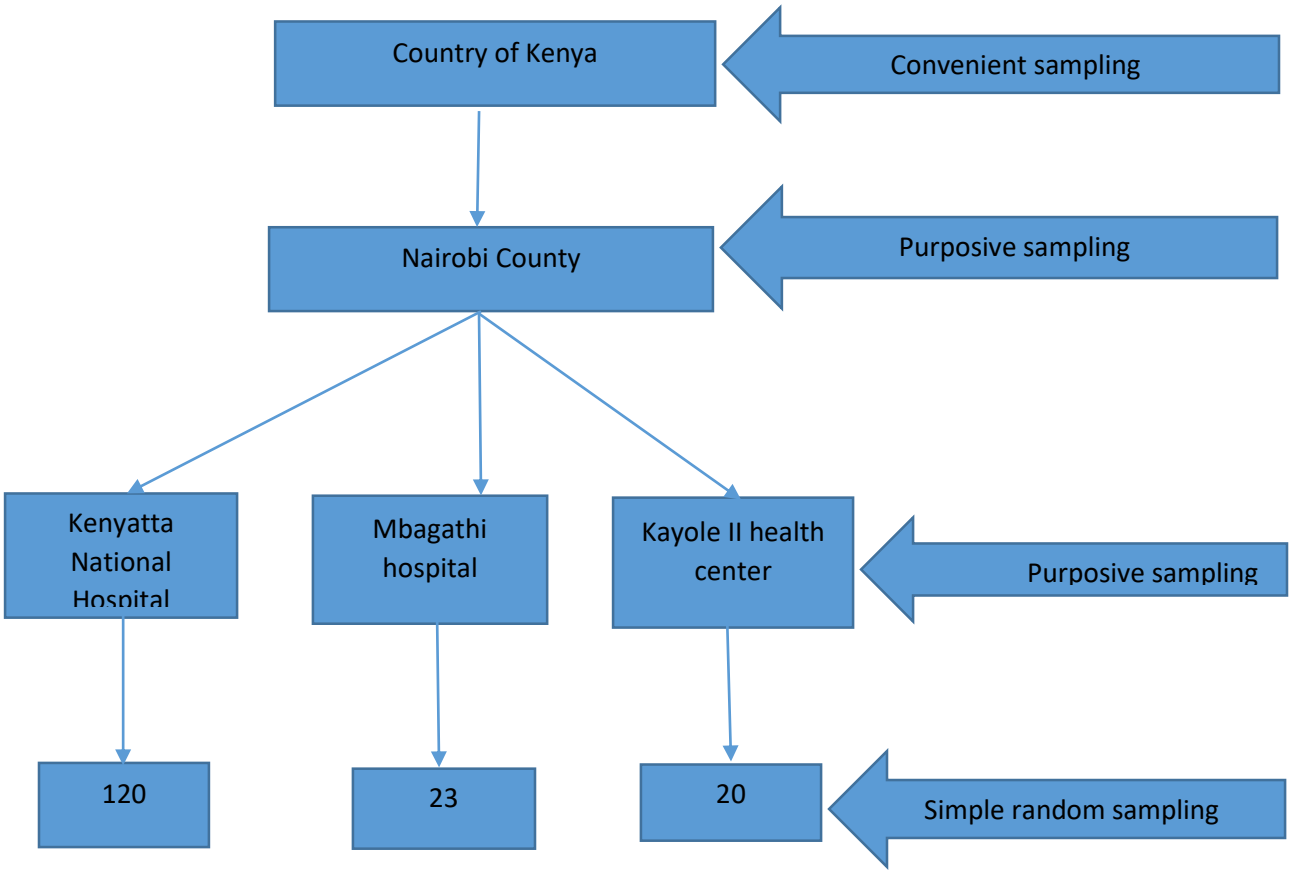


Figure 3: Sampling schema

3.8 Data collection procedures

The interview was conducted with strict observation of current guidelines to reduce the spread of COVID-19. Sampling of the study participants was done after the triage only among the unsuspected cases of COVID-19. Both the researcher and the client were tasked to wear the masks correctly and observe hand hygiene with alcohol-based sanitizer. The study setting was in open air or a well-ventilated room and social distance observed in positioning of the researcher and the study participant. The interview took a maximum of 20 minutes per individual respondent.

Similarly, the consent of the client and their doctor was sought before the researcher could extract the data from the files. The information to be collected was uploaded in data tool kit and entered using laptop.

3.8.1 Socio-demographic Characteristics

Objective 1: To describe the socio demographic characteristics of diabetic clients attending selected health facilities in Nairobi County.

The data on socio-demographic characteristics of the study respondents were collected by administration of a semi-structured questionnaire (refer to appendix IX). The questions were uploaded on Kobo toolbox, which is an application (Office for the Coordination of Humanitarian Affairs (OCHA), 2019). The data collected through interview and entered using a laptop. The application was used to fill the information on age, gender, area of residence, level of education, marital status, type of insurance and occupation.

3.8.2 Diabetic Knowledge, Attitude and Management Practices

Objective 2: To establish the level of knowledge, attitude and management practices of diabetes among diabetic clients attending various health facilities in Nairobi County.

Data on understanding of the recommendations in management of diabetes, attitude towards the same and actual practices conducted by the study respondents were collected through interviews guided by closed questions in appendix IX. The questions were adopted from diabetes care profile developed by Michigan Diabetes Research and Training Center and modified to fit the context of this study (Diabetes, MichigaDiabetes, M., & Center & Center, 1998) . The modification was done based on Diabetes management protocol of 2010 (Kenya, 2010). The variables calculated from this data were the levels of knowledge, attitude and management practices.

The questionnaire consisted of closed-ended questions in matrix layout to allow quantitative rating. To identify and quantify the characteristics to depict knowledge, attitude and practice a likert scale of 3 was adopted in numeric system to minimize the subjectivity of the responses hence ease of analysis.

The participant's knowledge of glycemic control was established using specific questions included in the initial counselling sessions at the health facilities as per the Kenyan diabetic guideline for the newly diagnosed diabetic clients. The questions in the guide covered disease knowledge, disease management and control practices. Each question had options of which only one of them could be chosen for each participant. Among the options there was one answer which was correct and two or more expected answers from previous researches.

Similarly, a three scale attitude-related questions were asked based on perceived importance, difficulties as well as self-confidence in carrying out various recommendations in management of diabetes. The three-scale was achieved by using the options yes, not sure and no for the questions on attitude. Only one among the three was the correct attitude for each question.

Besides the participant's knowledge and attitude, the clients were asked to specify the actions they had actually been carrying out in an attempt to control their blood glucose. The questions had three options among which only one is appropriate (Asmelash et al, 2018).

3.8.3 Anthropometric data

Objective 3: To determine the nutritional status of diabetic clients in selected hospitals in Nairobi County based on their Body Mass Index (BMI).

The nutritional status of the study participants was established based on the weight and height of the study respondents. The measurements were taken by the nutritionist attached to the diabetic clinic under observation and guidance of the principal researcher. The data recorded in the patient's file would then be extracted at the end of the interview and recorded on the section V of the questionnaire (appendix IX).

The procedure followed at the clinics during measurements were confirmed to be in line with the recommendations by (WHO, 2007). The client was requested to have minimal clothing such as with no caps or heavy jackets during all the anthropometric measurements. Each measurement was taken twice and an average calculate to minimize errors.

Their height was measured to the nearest 0.1cm using a stadiometer as the client stood with their heads in a Frankfort horizontal plane as shown in (appendix III). The weight was taken to the nearest 0.1Kg using a bathroom seca scale. The weight scale was re-calibrated before each measurement is taken.

3.8.4 Glycemic Control

Objective 4: To determine the relationship between glycemic control and selected independent risk factors among diabetes among clients in selected hospitals in Nairobi County.

The data on glycemic control were obtained through interview using a semi-structured questionnaire (appendix IX) as well as through extraction of last recorded measurement of glycated haemoglobin from the patient file. Measurements included in the study were only reports from ISO 15189 accredited laboratories, that is, the KNH and MLKH laboratories.

The variables obtained for this objective were the level of glycated haemoglobin and presence or absence of other complications after diagnosis of diabetes as recorded on the patient's files. The episodes of high and low blood sugars levels were self-reported by the study respondents.

3.9 Research assistant

The research was conducted solely by the principal researcher. However, assistance was sought from the nutrition or clinical medicine interns attached to the diabetic clinics at the time of study. They would be informed the names of the study participants after sampling was done and the position of the research desk. Their role was to ensure smooth flow of clients from the consultation rooms, waiting bay and research desk to avoid confusion or crowding and ensuring that the sampled clients did not leave before they were contacted to request them to participate in the study.

3.10 Pretesting of data tools

The pretesting of data tools was done at MLKH. The hospital was selected for pretesting due to its similarity with the selected health facilities for the research. The objectives of the pre-testing was to determine the time required to administer each questionnaire and respondents' understanding of the questions and to validate the yield of tools. Pretesting was done two weeks before the study to allow appropriate time for the improvements from the feedback obtained.

3.11 Ethical consideration

3.11.1 Ethical review committee

The proposal was presented to the faculty at the Department of Food Science, Nutrition and Technology (DFNST) for quality check before submitting a copy to the KNH-UoN research ethics committee for approval. The proposal was approved as shown in the appendix IV. The principal researcher also sought permission from the individual institutions in which the research was conducted and from the Nairobi County Department of Non-Communicable Diseases (appendix VII).

3.11.2 Informed consent

The researcher ensured that each participant understood that participation in the study was voluntary and that none of the information given by individuals would be displayed to the public. The participants were informed of the purpose of the study, any potential risks, potential benefits and thereafter consent obtained before collection of the actual data.

They were allowed to ask any questions before, during or after the interview and measurement of the anthropometrics. They were also informed that they could leave the interview whenever they wish however, they were encouraged to complete the sessions. They were requested to voluntarily sign a consent form (appendix I) before starting the interview or the measurements.

3.12 Statistical data analysis plan

Data obtained from the study were analyzed using program R and SPSS version 20. Possible associations between the dependent and independent variables were established by using bivariate tests including chi-square, Fischer's exact, Analysis of Variance (ANOVA) and Pearson's

correlation tests. Their strength, direction and significance of effects was tested by application of simple, multiple linear and logistic regressions.

3.12.1 Data Transformation using SPSS

The data collected as strings, that is, from the options questions, were coded into dummy variables prior to analysis. The data were explored by working out the means, percentages, mode, and median and measures of dispersion (standard deviation, standard error of mean, skewness and kurtosis) applicable for each variable. For the scale questions, the correct responses for questions on knowledge and attitude were assigned a 1 and any other response awarded a 0. The questions on practice were coded based on the frequency which the study participant conducted a good/recommended practice. If any practice was conducted oftenly a 1 was assigned, if done sometimes 0.5 and if never done then a 0 was scored. The KAP score for each study participant was determined as a percentage calculated from the ratio of sum of all correct responses to the total number of questions. Any score below 50% was classified as poor, 51-79% as medium whereas ≥80% was categorized as optimum knowledge, attitude and practice.

The BMI was also calculated before various indicators were categorized for the purpose of descriptive analysis. The calculated BMI was exposed to cut-off points of $<18.5 kg/m^2$ for underweight, 18.5-24.9 for normal, 25-29.9 for overweight and $>30 kg/m^2$ for obese. The glycemic control was classified as uncontrolled if >9% and controlled if <6.5 %. (Kenya, 2010).

3.12.2 Bivariate Exploration in R Program

The data was imported into R from SPSS and converted to R data frame. To ensure recognition as missing values during analysis in the R, the missing values zeros for Hba1c which were entered as zeros were changed to missing values. Character variables were also converted into factors. Packages haven, polycor (polyserial), pspearman and car were installed to allow the tests required to be run on the R program.

Chi-square tests were applied to test for univariate associations between categorical variables. Polyserial correlation tests were applied to test for univariate associations between binary and continuous variables. In cases where the chi-square estimation was incorrect, that is, in the presence of very low cell counts, fisher's Exact Test was employed.

3.12.3 Correlations

Normality and homogeneity of variances was first checked through conducting Shapiro wilk and levene tests respectively. If normality was violated by the dependent variable (as was the by the last recorded HbA1c) spearman was used to test for the correlations, if not then pearson test was used.

3.12.4 Regressions

The dependent variables were transformed by computing the logarithms or the square roots where homogeneity and normality was violated were calculated before inferential models were run. Linear and generalized linear models/ logistic models (logit link function for binomial distribution) were used for continuous and binary/percentage dependent variables respectively. The statistical significance of the indirect effect was tested using bootstrapping (Hayes, 2014). Table 1, shows details of data analysis plan.

Table 1: Statistical data analysis plan

Objective aspect	Descriptive statistics	Inferential statistics	Inference test
Socio-demographic characteristics	Mean Median Mode Standard deviation Standard error of mean Skewness Kurtosis	Chi square test Polyserial	Associations
Nutritional status	Mean Median Mode Standard deviation Standard error of mean Skewness Kurtosis	Generalized Linear model Spearman test	Significant mean differences Associations
Knowledge, attitude and practice	Mean Median Mode Standard deviation Standard error of mean Skewness Kurtosis	Polyserial Chi square test Fischer's test Linear regression	Significant mean differences Associations
Glycemic control and development of complications	Mean Median Mode Standard deviation Standard error of mean Skewness Kurtosis	Polyserial Linear regression Pearson's regression	Significant mean differences Associations

3.14 Data quality control

To ensure the quality of data, all the study tools were pre-tested before use. The field assistants were also established and trained to eliminate any possible doubts in their quality of performance. The properties of the extracted data from clients' files were confirmed by cross-checking with the previous measurements in the files as well as directly enquiring from the client just in case the

health professional at the triage recorded a wrong reading. Similarly, the readings of the HbA1c were obtained from reports by recognized laboratories by KNH-UoN research ethical committee.

The data entry was done using Kobo toolbox to minimize errors during manual entry in the SPSS. The completeness and uploading of individual questionnaires was checked after the end of each day's data collection. The data were also explored for possible data entry mistakes before final analysis. In cases of outliers or abnormality in distribution of variables robust methods of analysis were applied.

CHAPTER FOUR: RESULTS

4.0 Introduction

These were the results collected from 165 diabetic patients who were attending diabetic outpatient clinic in KNH, Mbagathi and Kayole II health facilities; the distribution for each hospital was 120, 25 and 20 respectively. The data were collected between February and April 2021.

4.1 Response Rate

The response rate of the study was 97.6%. Those who declined were attending their clinic in Mbagathi and Kayole II hospitals.

4.2 Socio-Demographic Characteristics of the Study Participants

The socio-demographic characteristics established were; age, gender, ethnic origin, marital status, area of residence, education level, employment status, insurance plan(s), period after diagnosis with diabetes, number of persons living in the same house with the diabetic, persons helping in management of diabetes.

4.2.1 Gender and areas of residence of the study participants

Table 2 shows the distribution of the study participants by gender and areas of residence. Generally, more than two-thirds (67.9%) of the respondents were females. A higher percentage of females were reported in Kayole II hospital than the other two hospitals. There was no significant difference between the genders in the likelihood of developing diabetic complications (χ^2=2.017, df=1, p=0.118).

Majority (73.3%) of the respondents resided in the urban areas. None of the respondents attending their clinics in Kayole II hospital was a residence in rural area. The Chi square test showed a significant difference between the two residential areas in the likelihood of developing other complications after diagnosis with diabetes (χ^2=9.23, df=1, p= 0.002).

The residents of urban areas had 22% higher chance of developing diabetic complications than the residents of rural areas.

Table 2: Distribution of the study participants by gender and place of residence

Characteristic	Diagnosed with other diseases		P value
	Yes	No	
	N=143	N=22	
Gender			.118
Male	43(81.1%)	10(18.9%)	
Female	100(89.3%)	12(10.7%)	
Residence			**.002**
Urban	99(81.8%	0	
Rural	44(100%)	22(18.2%)	

4.2.2 Age of the study participants

Figure 4 shows the distribution of study participants by age. The age of the respondents ranged from 19-90 years with a median of 57 years and a standard deviation of 12.3 years. Majority of the study participants (71%) were older than 50 years. Similarly, there were more males than females among the youth unlike it was the case with the other age categories.

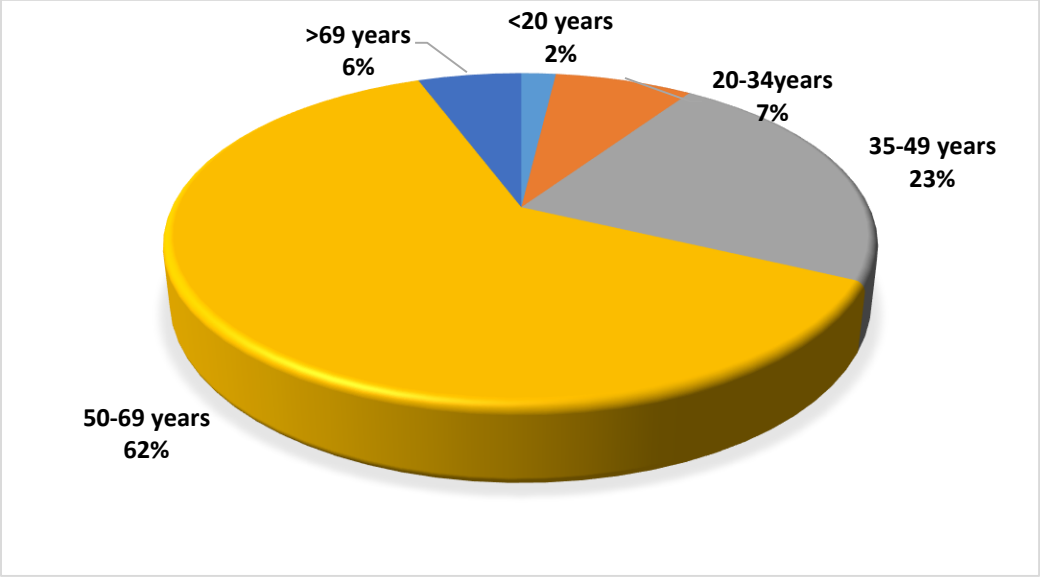


Figure 4: Distribution of study participants by age by years

4.2.3 Marital status of the study participants

Figure 5 shows the distribution study participants by marital status and gender. Almost two-thirds of the respondents (63%) were married. A higher percentage of females than males were reported among the divorced, separated or windowed as well as in Kayole II hospital, but the figures were not statistically significant (P>0.05).

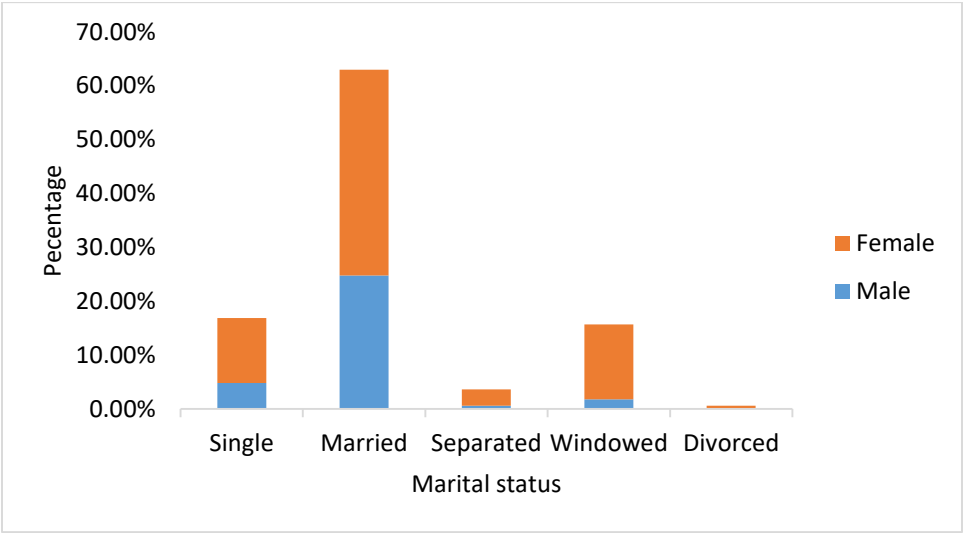


Figure 5: Distribution of study participants by marital status and gender

4.2.4 Number of years after diagnosis with DM among the study participants

Figure 6 indicates the distribution of respondents by period after diagnosis with DM. The period after diagnosis among the study participants varied between 0 to 30 years, with a median of 7 years and standard deviation of 7 years. About a quarter (24.8%) of the respondents had lived with diabetes for more than 12 years. The presence or absence of diabetic complications significantly depended on the number of years after diagnosis (F value = 15.036, df=1, p=0.00, CI =95%).

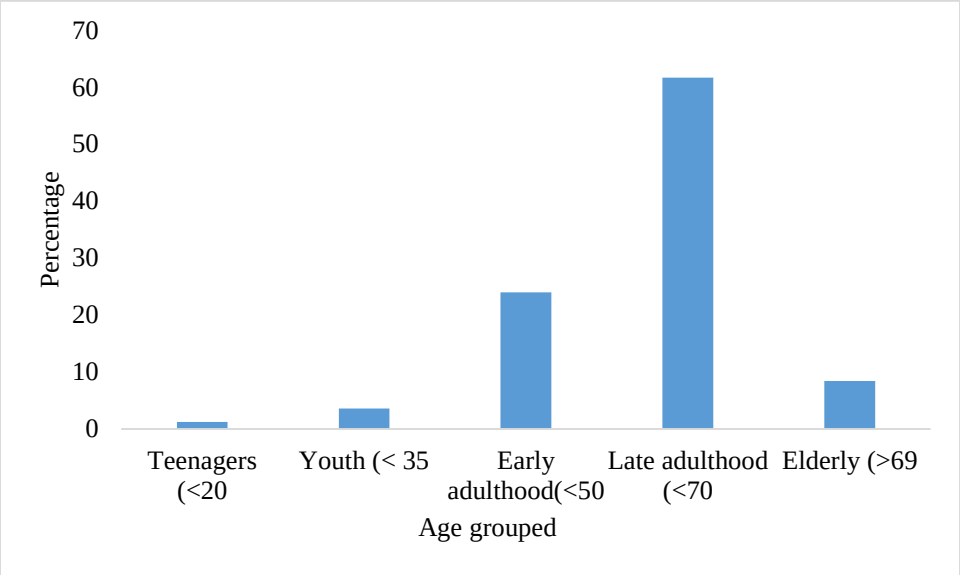


Figure 6: Distribution of respondents by period after diagnosis with DM

4.2.5 Distribution of the Respondents by their education levels and Employment Status

Table 3 shows the distribution of respondents by their education levels and employment status. The results showed that about half (47.3%) of the study participants had completed at least secondary level of education with only 12.7% having attended colleges/universities. Among the 14.5% who had never attended any formal education, 83.3% were in their late adulthood that is, more than 50 years of age.

There was a significant difference in the likelihood of developing diabetic complications among diabetics with different education levels ($\chi^2 = 16.347$, df = 3 and p = 0.0).

Majority (61.2%) of the study participants were self-employed. The employment status was depended on the education level of the study participants ($\chi^2 = 54.771$, df = 15 and p = 0.0). A few respondents (7.3%) had been disabled following various complications after diagnosis of diabetes hence rendered incapable of performing any physical task, some of them were below 50 years of age.

The results also showed that there was no significant difference in the likelihood of developing other complications among diabetics with different employment status ($\chi^2 = 8.567$, df = 5 and p = 0.13).

Table 3 Distribution of respondents by education level and employment status

Characteristic	Diagnosed with other diseases		Chi Square value	P value
	Yes N=143	No N=22		
Education level			16.345	**.001**
None	24(100%)	0		
Primary	60(95.2%)	3(4.8%)		
Secondary	44(77.2%)	13(22.8%)		
Tertiary	15(71.4%)	6(28.6%)		
Employment status			8.567	.128
Employed	27(75%)	9(25%)		
Self employed	88(87.1%)	13(12.9%)		
Others	28(100%)	0		

4.2.6 Socioeconomic characteristics of the study respondents

Table 4 summarizes the socioeconomic characteristics of the study participants. Majority of the study participants had active National Health Insurance Fund (NHIF) cards but only 4% could access outpatient services for diabetes care using their national health insurance funds. About two-thirds (62.4%) paid for the diabetic consultation, laboratory tests and the drugs individually by cash. The consultation, laboratory tests and most of the drugs were for all outpatient clinics were not charged at Kayole II health center. Only a few (13.9%) of the study respondents were living alone, majority (53.3%) more than persons within the same household.

Similarly 87.8% of the participants would get help from the people living with them in their management of diabetes. The likelihood of getting support from family in management of diabetic among the study participants was significantly dependent on the number of the persons living in the same household with the diabetic ($\chi^2 = 66.29$, df = 20 and p = 0.0).

Table 4: Socioeconomic characteristics of study respondents

Variables	**Percentage** **N=165**
Insurance plans	
NHIF	2.4
Institution-based	11.5
Individual	62.4
Community-based	18.8
Other	4.8
No. of people who live with the diabetic	
More than one person	53.3
One person	32.7
Alone	13.9
Persons helping in management	
Other relative	49.2
Spouse	29.6
Friends	4.8
Paid helper	4.8
None	12.2

4.3 Self-Rating for Health Status by the Respondents

Figure 7 shows results of self-rating for health status by the respondents. Majority of the participants (53.3%) rated their own health status to be fairly with only one of them (.6%) rating their health as very good.

The health status reported by the study respondents was directly related to their last recorded levels of HbA1c (χ^2 = 316.311, df = 204 and p = 0.000). However, the likelihood of being diagnosed with other complications after diagnosis with diabetes was not significantly related to the self-rating of health status by the study participants (χ^2 = 2.823, df = 4 and p = 0.59).

Figure 7: Self-rating for health status by the respondents

4.4 Exposure Diabetic Education among the Study Participants

Table 5 shows the distribution of study participants based on their exposure to diabetic education and education on diet modification. Majority (95.2%) of the study respondents had received at least one session of diabetes education as well as on modification of diet in diabetic management after they diagnosed with the disease.

Education on diabetes management to the study respondents did not show significant relationship with the likelihood of developing other complications (χ^2 = .99, df = 1 and p = .29). However, education on diet contributed significantly to decrease of the likelihood of developing other complications (χ^2 = 8.113, df = 2 and p = .017).

Table 5: Diabetic Education among the Study Participants

Variables	**Diagnosed with other diseases**		**Chi-Square**	**P value**
	Yes	**No**		
	N=143	**N=22**		
Received diabetes education			.99	.289
Yes	137(83%)	20(12.2%)		
No	6(3.6%)	2(1.2%)		
Received education on diet				
Yes	138(83.6%)	19(11.5%)	8.113	**.017**
No	5(3%)	2(1.2%)		
Not sure		1(.6%)		

4.5 Knowledge, Attitude and Practices Scores of the Study Respondents

Figure 8 shows the trend for the median of the knowledge, attitude, practices and KAP scores of the study respondents. More than three-quarters (78.8%) of the study respondents displayed optimal knowledge (gave correct responses for more than 79% of the questions in the knowledge section) of the management recommendations for the diabetics as per the Kenyan diabetic manual, only 9.1% scored below average (Ministry off public health, 2010).

The scores for attitude among the respondents ranged from 20-61% with a median of 45%, those who scored more than 79% were about a quarter (25.5%). Majority (52.7%) of the study participants attained a score below 50% on the practice scores, only 0.6% scored above 79% on practice.

The average scores for the knowledge, attitude and practice (KAP score) showed that majority (57.6%) of the study respondents scored optimally in the likelihood of implementation of the diabetic recommendations in the correct approach whereas only 0.6% actually implemented the recommendations.

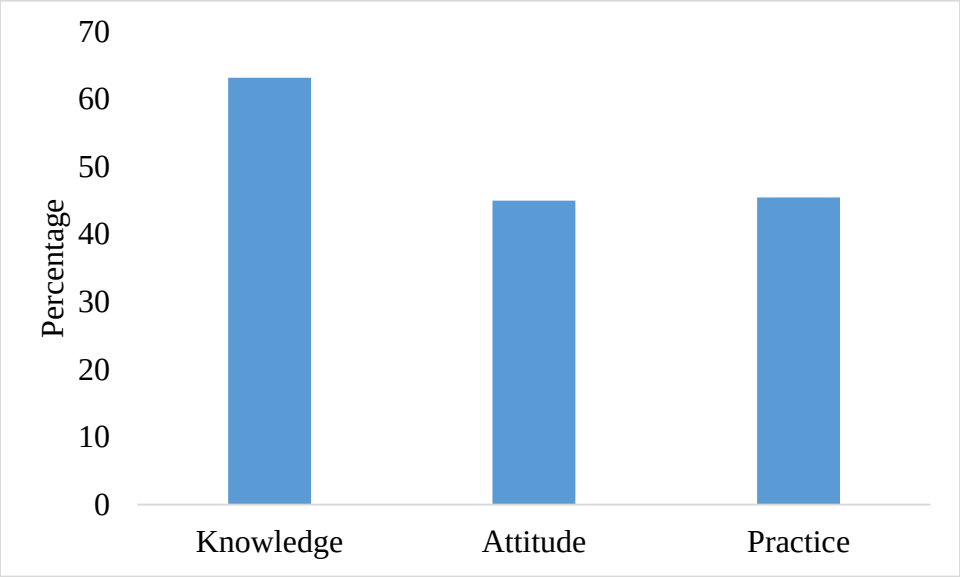


Figure 8: Average score of knowledge, attitude and practices scores of the study respondents

4.6 Nutritional Status of the Study Participants

Figure 9 shows distribution of the study participants based on their nutritional status. The results showed that the mean BMI for the study respondents was 27.6 kg/m^2 with a minimum of 19.1 kg/m^2 and maximum of 42.1kg/m^2. While only a quarter (24%) of respondents had normal BMI as per cut off points (MoH-Kenya, 2015), majority (48%) of the participants were reported to be overweight, that is, BMI between 25-29.9 kg/m^2.

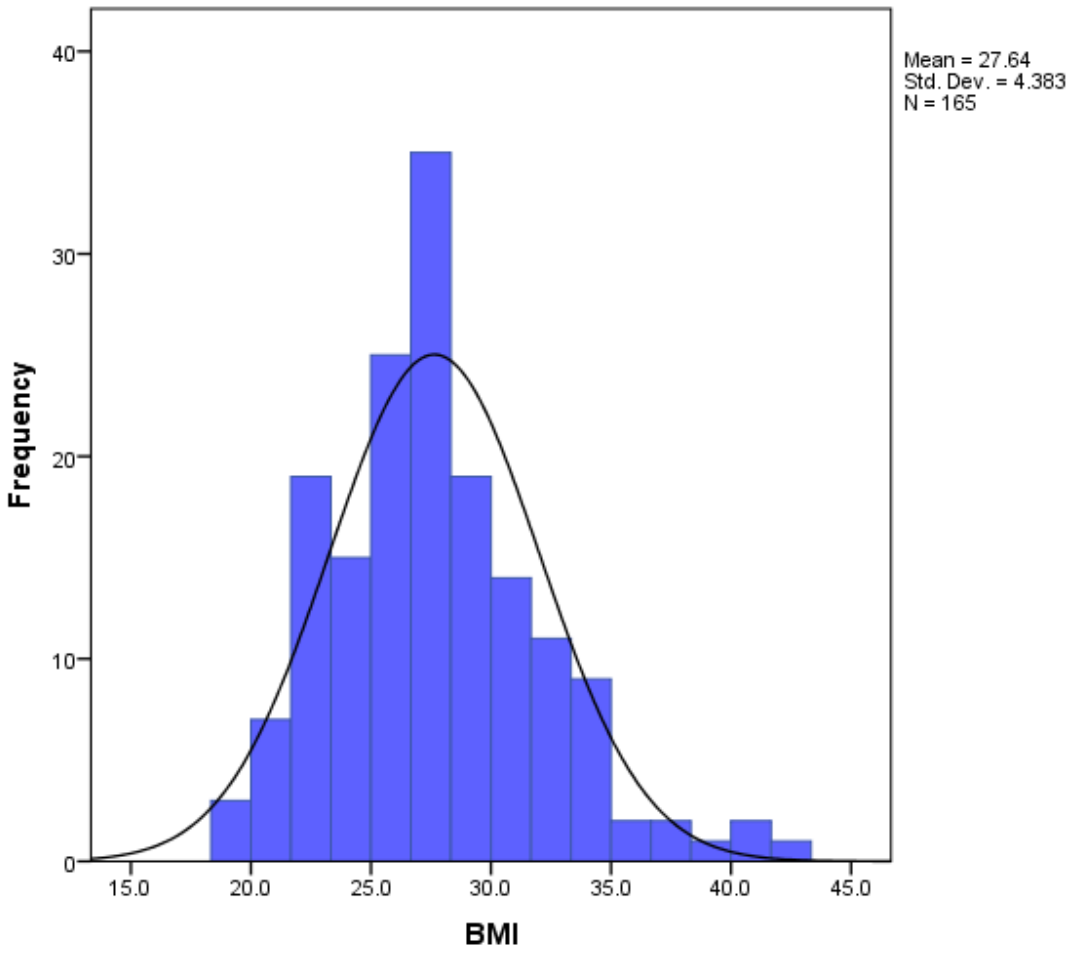


Figure 9: Distribution of study participants based on their nutritional status

4.7 Levels of Glycated Haemoglobin among the Respondents

This was established by categorization of the last recorded values of the HbA1c from the patient files, presence or absence of diabetic complications as well as momentary signs and symptoms of irregular blood sugar (WHO, 2019).

4.7.1 Levels of Glycated Haemoglobin among the Study Respondents

Figure 10 shows the categorized levels of HbA1c among the study respondents. Nearly half of the study participants (44.2%) had never taken the HbA1c test. The minimum and maximum levels of HbA1c was 4.3% and 20.2% respectively with a median of 6.7%. Majority (86.7%) had already developed other complications by the time of study following diagnosis of diabetes and only few (4.8%) had controlled glycosylated haemoglobin (HbA1c <7%) as from the last documented HbA1c.

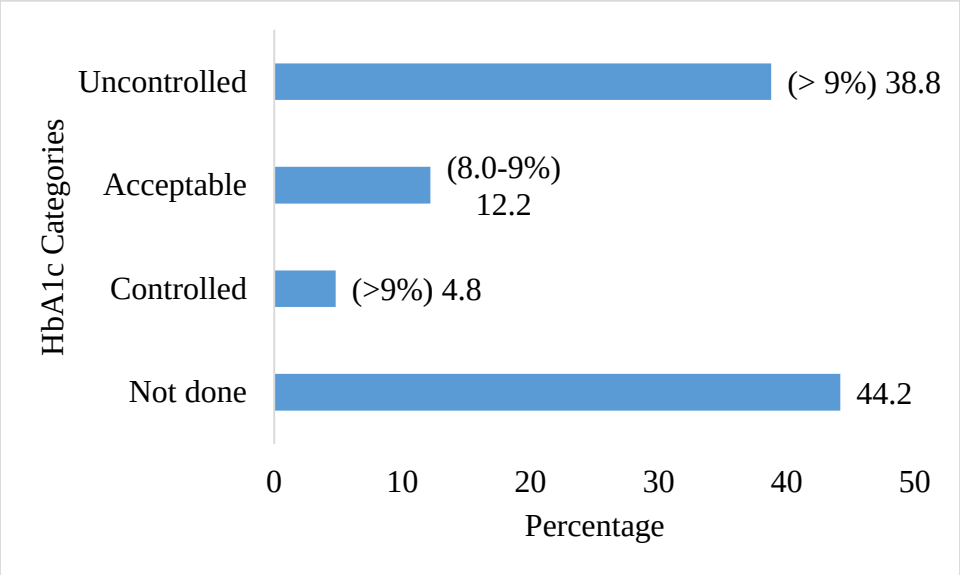


Figure 10: Categories of the level of HbA1c among the study respondents

4.7.2 Distribution of Respondents based on Episodes of High and Low Blood Sugar among the Respondents

Figure 11 displays the distribution of respondent by episodes of high and low blood sugar. Incidences of higher than normal fasting blood sugar (>6.9 mmol/l) were experienced by more than three-quarters (78.2%) of study participants in the previous month before the study whereas 81.2% had reported episodes of low blood sugar.

Episodes of severe low blood sugar were dependent on the level of knowledge of the individual study participant (χ^2 = 13.213, df = 6 and p = .040).

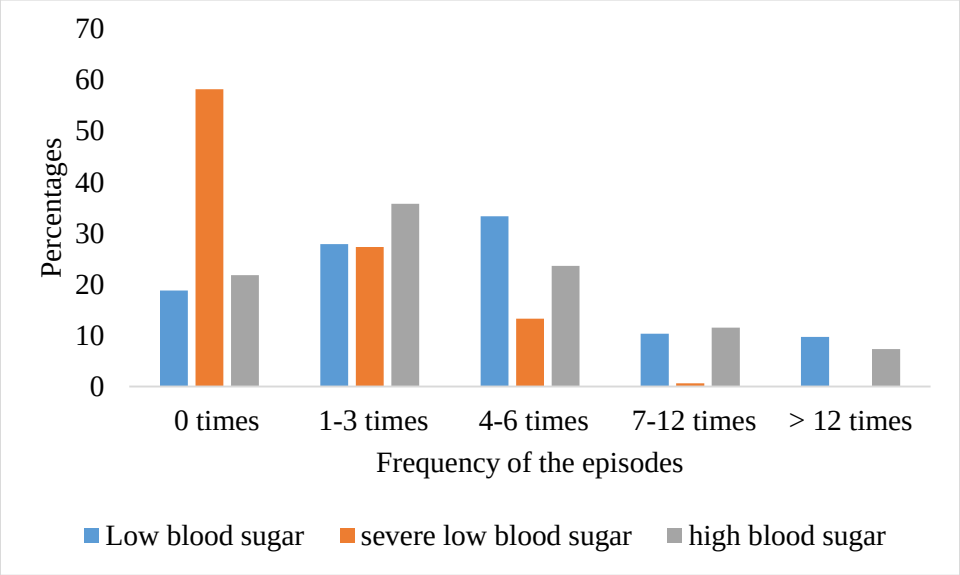


Figure 11: Distribution of study respondents by episodes of high and low Blood sugar

4.7.3 Presence or Absence of Diabetic Complications among the Respondents

Figure 122 shows diabetic complications among the study respondents. Most (86.7%) of the study participants had been diagnosed with other diseases following DM. The common diseases following diagnosis of diabetes were high blood pressure, visual impairment, kidney diseases, foot ulcerations and impotence. Some of the study respondents had already been diagnosed with more than one complications after diagnosis with DM during the time of study. Other complications reported included cervical cancer, deep vein thrombosis, anaemia and arthritis.

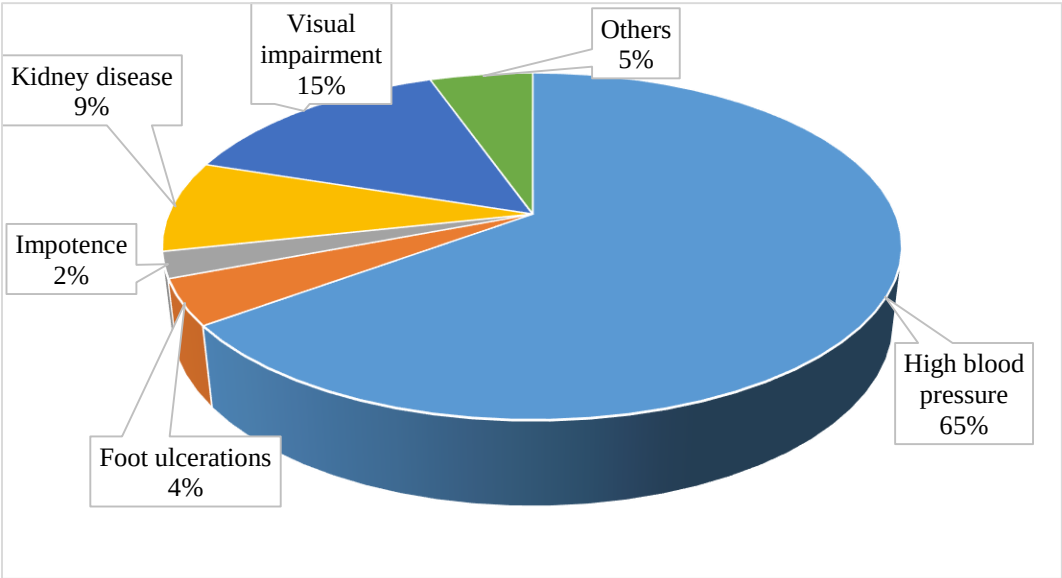


Figure 12: Diabetic complications among the study respondents

4.8 Enabling Factors of Glycemic Control among Study Respondents

The likelihood of the outcome variables (elevated glycated haemoglobin and development of diabetic complications after diagnosis of DM) among the study respondents was predicted by program R. The risk factors measured were; sociodemographic characteristics, nutritional status, knowledge on diabetic management recommendations, attitude towards the same and the actual practices conducted by the diabetics.

4.8.1 Socio-demographic factors associated with development of diabetic complications

4.8.1.1 Demographic factors associated with development of diabetic complications

Table 6 shows the demographic factors associated with development of diabetic complications. Polyserial test showed that age was significantly associated with the possibility of developing other diseases after diagnosis with diabetes (Chi-square = 23.62, df = 5, p = 0.0). Older individuals were at a higher risk of developing diabetic complications than the young diabetics.

The place of residence was also associated with the outcome (Chi-square = 7.72, df = 1, p-value = 0.005). The individuals who resided in urban areas and attended clinics in the city were more likely to have developed diabetic complications than the residents of rural areas.

Similarly, the more the years after diagnosis the higher the risk of developing other complications (Chi-square = 106.1, df = 5, p = 0.0).

The difference in number of persons living the diabetic (p = 0.43) and the gender (p = .23) did not significantly predict the likelihood of developing diabetic complications.

Table 6: Demographic factors associated with development of diabetic complications

Demographic characteristics	**Likelihood of developing diabetic complications**		
N=165	**Chi-square**	**df**	**P value**
Age	23.62	5	**0.000**
Years after diagnosis	106.1	5	**0.000**
Gender	1.4243	1	0.2327
Residence	7.7244	1	**0.006**
No. of persons living with the diabetic	1.7082	2	0.4257

4.8.1.2 Socio-economic factors associated with development of diabetic complications

Table 7 shows the association between socioeconomic factors with the likelihood of development of diabetic complications. Education level was also associated with the development of complications (Chi-square = 41.35, df = 5, p = 0.0). The higher the level of education the lower the likelihood of developing other diseases among the study respondents.

There was a significant association between education on meal plan and development of complications (Chi-square = 8.11, df = 2, p = 0.02). Lower ratio of individuals among those educated on meal plan had developed other complications compared to those who had never had sessions specifically on diet.

Similarly, the individuals who had no results for the level of glycated haemoglobin were more likely to develop diabetic complications than their counterparts (χ^2 = 16.93, df =1 and p = 0.02).

However, employment status (p = 0.13), type of insurance plan (p = 0.65), general diabetes education (p = 0.29), ethnic group (p = 0.58) and hospital attended (p = 0.87) were not significantly associated with development of diabetic complications.

Table 7: Socio-economic factors associated with development of diabetic complications

Independent variable	**Likelihood of developing diabetic complications**		
N=165	**Chi-square**	**df**	**P value**
Education level	41.35	5	**0.000**
Education on meal plan	8.1126	2	**0.01731**
Insurance plan	6.8393	9	0.6538
Employment status	8.5667	5	0.1276
Not measuring HbA1c	16.993	1	**0.016**
General diabetes education	0.21348	1	0.6441
Hospital attended	0.27404	2	0.872

4.8.2 Association between KAP Levels and Nutritional Status and Development of Diabetic Complications

Table 8 shows the association between KAP levels and nutritional status and development of diabetic complications. The level of knowledge (Chi-squared 11.78, df = 5, p = 0.03) and attitude (Chi-squared = 14.61, df = 5, p = 0.01) of the respondents were significantly associated with having other diseases reported after diagnosis of diabetes. The higher the knowledge and attitude scores the lower the probability of developing diabetic complications among the study respondents.

Table 8: Association between KAP levels and nutritional status and development of diabetic complications

Independent variable	**Likelihood of developing diabetic complications**		
N=165	**Chi-square**	**df**	**P value**
Nutritional status	4.536	5	0.4751
Knowledge scores	11.78	5	**0.03798**
Attitude scores	14.61	5	**0.01219**
Practice scores	5.128	5	0.4005

4.8.3 Factors Contributing to High Levels of Glycosylated Haemoglobin

Table 9 shows the spearman test results for the correlation between level of glycosylated haemoglobin and sociodemographic characteristics. The sociodemographic characteristics and presence or absence of diabetic complications showed no significant direct relationship with the level of HbA1c. There was a negative correlation between level of glycated haemoglobin and the number of years after diagnosis, number of people living with the study participant and their age in years. The factors that showed a small (not significant, p>0.05) included; gender, education level, age and whether the respondent had received diabetes education in general and on meal plan.

Table 9: Correlation between level of glycosylated haemoglobin and sociodemographic characteristics

Independent variables **N=165**	**Spearman Statistic**	**P-value**	**Correlation**
Number of years after diagnosis	131582.3	0.89	-0.01
Gender	116043.5	0.32	0.11
Education level	106840.6	0.09	0.18
Age in years	150864.4	0.12	-0.16
Number of people living together	134920.7	0.71	-0.04
NE on meal plan	116178.9	0.32	0.10

4.9 Inferential Models

Here the relationships between the independent variables and dependent variables were established an aim to control for effect contributed by other variables.

4.9.1 Regressions between Socio-demographic Characteristics Presence other Diseases

Table 10 shows results the logistic regression models assessing the strength and direction of the association between sociodemographic characteristics presence of other diseases while controlling for the other independent variables.

Only the number of years with diabetes were significantly associated with development of other complications ($p<0.001$). For every single increase in number of years of diabetes, there was 1.224 times increase in the odds of developing other complications.

Table 1: Regression between sociodemographic characteristics presence of other diseases

Risk Factors **N=165**	**Presence of other diseases**
Gender	1.008 (0.591)
Age	1.023 (0.028)
Residence	22594226.49 (1457.081)
Education level	1.725 (0.384)
Employment status	0.582 (0.344)
Years after diagnosis	**1.224 (0.074)****
NE meal plan	3139229.897 (5344.912)

- P value < 0.05* * - P value < 0.01* **** - P value < 0.001*

4.9.2 Association between Knowledge, Attitude and Practice Scores and Levels of HbA1c and Nutritional Status

Table 11 shows the association between knowledge, attitude and practice and level of glycosylated haemoglobin and nutritional status. Generalized linear model showed a significant relationship between of glycosylated haemoglobin and knowledge levels ($p<0.05$) controlling for percentage attitude and practice scores. For every unit increase in percentage knowledge, there was a 44.8% decrease in the level of glycosylated haemoglobin.

Practice scores significantly predicted the nutritional status of the respondents while controlling for percentage attitude and knowledge scores ($p<0.001$). For every unit increase in percentage practice, there was a 0.3% decrease in BMI.

Despite the fact that neither practice, attitude nor knowledge levels were significant when either of the two were held constant, the development of other complications entirely depended on the model with the levels of knowledge, attitude and practice (Intercept P value >0.05). This scenario was not observed in the level of glycosylated haemoglobin (Intercept P value <0.001) and nutritional status (Intercept P value <0.001).

Table 2: Association between knowledge, attitude and practice and level of glycosylated haemoglobin and nutritional status

KAP indicators N=165	**Diagnosed with other diseases**	**Level of glycosylated haemoglobin**	**Nutritional status**
Intercept	0.385 (1.472)	**2.673 (0.237)*** **	**3.357 (0.078)*** **
Percentage practice	0.371 (2.074)	-0.001 (0.003)	**-0.003(0.001)*** **
Percentage attitude	1.325 (3.984)	-0.002 (0.006)	0.003 (0.002)
Percentage knowledge	0.376 (1.825)	**-0.448 (0.242)***	0.000 (0.001)
R2		0.072	0.032
R2 Adj.		0.041	-144.9

*p < 0.05, **p < 0.01, *** < 0.001, standard error indicated in the brackets

4.10 Effect of Intermediate Variables on Independent Variables

Mediations were conducted to assess and quantify the effect some of the intermediate variables on other independent variables in predicting the likelihood the outcome variables, that is, how one independent variable contributed to effect of another independent variable in predicting the outcome.

4.10.1 Direct, mediated and total effect of years after diagnosis and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases

Table 12 shows direct, mediated and total effect of years after diagnosis and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases. Years after diagnosis were significantly predictive of 7.8% higher likelihood of being diagnosed with other diseases (standardized coefficient = 0.078, p = 0.0).

There was a significant positive total relationship between years after diagnosis and likelihood of diagnosis with other diseases accounting for both the direct predictive effect of years after diagnosis and the mediation role of level of glycosylated haemoglobin (standardized total coefficient = 0.073, p = 0.0).

The level of glycosylated haemoglobin however, was not significantly mediative of the effect of years after diagnosis on the likelihood of being diagnosed with other diseases ($p>0.05$).

Table3: Direct, mediated and total effect of years after diagnosis and last documented HbA1c on likelihood of being diagnosed with other diseases

Effect	Model	Standard Error	Z-Statistic	p-value	Beta (Standardized)
Direct	Diagnosed with other diseases<-years after diagnosis	0.022	3.561	**0.000**	0.078
Direct	Glycosylated haemoglobin<-years after diagnosis	0.280	-0.025	0.979	-0.007
Direct	Diagnosed with other diseases<-glycosylated haemoglobin	0.008	-0.237	0.812	-0.001
Mediation	Diagnosed with other diseases<-years after diagnosis* glycosylated haemoglobin	0.001	0.025	0.979	0.000
Total	Diagnosed with other diseases<years after diagnosis years after diagnosis + years after diagnosis years after diagnosis * glycosylated haemoglobin	0.022	3.561	**0.000**	0.078

4.10.2 Direct, mediated and total effect of knowledge and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases

Table 13 shows the direct, mediated and total effect of levels of knowledge and glycosylated haemoglobin on likelihood of being diagnosed with other diseases. There was significant negative relationship between the level of glycosylated haemoglobin and percentage knowledge (standardized indirect coefficient = -4.4, p = 0.04). For every unit increase in knowledge, there was a 4.4 times decrease in the level of glycosylated haemoglobin.

The level of glycosylated haemoglobin was not significantly mediative and there was no significant total effect of level of glycosylated haemoglobin was accounted for ($p>0.05$) on predictability of the likelihood of developing other complications by the individual level of knowledge.

Table4: Direct, mediated and total effect of knowledge and last documented HbA1c on likelihood of being diagnosed with other diseases

Effect	**Model**	**Standard Error**	**Z-Statistic**	**p-value**	**Beta (Standardized)**
Direct	Diagnosed with other diseases<-level of knowledge	0.193	-1.600	0.109	-0.308
Direct	Glycosylated haemoglobin <- level of knowledge	2.233	-1.963	0.049	-4.383
Direct	Diagnosed with other diseases<-level of glycosylated haemoglobin	0.009	-0.551	0.582	-0.005
Mediation	Diagnosed with other diseases<- level of knowledge d* glycosylated haemoglobin	0.040	0.531	0.596	0.021
Total	Diagnosed with other diseases<- level of knowledge + level of knowledge * glycosylated haemoglobin	0.189	-1.519	0.129	-0.287

4.10.3 Direct, mediated and total effect of nutritional status and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases

Table 14 shows the direct, mediated and total effect of nutritional status and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases. There was a significant total effect of nutritional status on probability of developing other diseases mediated by the level of glycosylated haemoglobin (P = 0.008).

For every unit increase in BMI, there was a 44.7% increase in the likelihood of being diagnosed with other diseases (Standardized coefficient = 0.45, p = 0.007).

There were significant positive total relationships between nutritional status and the likelihood of diagnosis with other diseases accounting for both the direct predictive effect of BMI and the mediation role of the nutritional status (standardized total coefficient = 0.44, p = 0.0085). The total effect accounted for an increase of 43.9% increase on the likelihood of developing other complications.

The level of glycosylated haemoglobin was not significantly mediative of the effect of nutritional status on the likelihood of being diagnosed with other diseases ($p>0.05$).

Table5: Direct, mediated and total effect of nutritional status and level of glycosylated haemoglobin on likelihood of being diagnosed with other diseases

Effect	**Model**	**Standard Error**	**Z-Statistic**	**p-value**	**Beta (standardized)**
Direct	Diagnosed with other diseases<-nutritional status	0.167	2.665	0.007	0.446
Direct	level of glycosylated haemoglobin <- nutritional status	2.057	0.821	0.411	1.690
Direct	Diagnosed with other diseases<- glycosylated haemoglobin	0.008	-0.466	0.640	-0.004
Mediation	Diagnosed with other diseases<- nutritional status * glycosylated haemoglobin	0.016	-0.405	0.685	-0.006
Total	Diagnosed with other diseases<- nutritional status + nutritional status * glycosylated haemoglobin	0.167	2.632	0.085	0.439

CHAPTER FIVE: DISCUSSION

5.1 The predisposition towards new information

The purpose of the study was to generate data that can be used to reduce episodes of hyper and hypoglycemia among diabetic clients hence reduce the rate of developing other complications among diabetics in the Country. The variables measured were the socio-demographic, nutritional status, knowledge, attitude and management practices by the clients.

The reported response rate in this study was a higher than what has been reported in similar studies in other countries (Houle et al., 2016). That would be suggestive that the diabetic clients in the county are open to information that aims at improving their prognosis. This readiness is a major strength in creating the awareness in this particular population set especially at the clinic setting where majority of the clients place their trust and are more alert than in the inpatient setting.

The few participants who did not give consent seemed impatient. Having waited to see the several health workers within the health facility, they were not willing to spend more time responding to the ‘same’ questions. This was suggestive that education sessions conducted at the end clinic visit by the clients were likely to have less impact on targeted change of behavior to achieve better glycemic control. Few of them were not fully convinced on the use of the data obtained hence halted the interview few minutes after it had started.

5.2 Demographic and Socio-economic characteristics

The fact that more than half of the study participants were reported to be of ethnic communities who mostly occupy the central counties added to the existing information that burden of the NCD being felt more at the central region of the country (Achoki et al., 2019).

This could have been aggravated by the lifestyle adopted by this population and faster rate of urbanization in this part of the country. In addition, this population group could also have better health-seeking behavior. Similarly, just like in majority of other studies done among diabetic clients this study had more female participants than males. It was consistent with the studies that showed that majority of individuals suffering from diabetes are aged above 50 years (Collier et al., 2015; Kim et al., 2019). The study also showed that diabetics were more likely to fit comfortably in their independent occupations rather than a fixed working environments and that majority got support from at least from one or more family members. Similar results had been reported in 2018 (KNBS, 2018). Unlike similar studies in other countries, this study reported far much less percentage of participants who had attained higher education levels (Zhang et al., 2021)

It was also noticed that by the time of the return date to the clinic, majority of the diabetic clients were already experiencing some health discomforts. Others would need medical attention even before the scheduled date for the check-up. The fact that almost half of the sampled population had not conducted the HbA1c test despite recommendation by their doctors, suggested that some of the basic laboratory tests are not affordable by majority of the population. These challenges had also been reported in a systematic review of adherence to diabetes self-care behavior from low and medium income countries (Mogre et al., 2019).

5.3 Nutritional Status

The study added to the findings reported in the previous studies that majority of the diabetic patients are overweight (Sami et al., 2017). This could be as a result of low physical activity, intake of higher than required nutrients as well as metabolic disorders among the diabetics. The management practices were shown to have significant impact on the respondents' nutritional status. This was consistent with the report among the Ugandan population (Matovu et al., 2017).

Unlike the findings in Bangladesh, the nutritional status of the study participants did not show significant direct effect on the likelihood of developing diabetic complications after diagnosis (Akter et al., 2014). However, the effect of uncontrolled glycemia on likelihood of developing diabetic complications was 43.9% independently mediated by the nutritional status of the individuals.

5.4 Knowledge, attitude and management practices by the diabetics

The results showed that the levels of knowledge was higher than the corresponding management practices among the study respondents. Similar, findings were reported in northern coast of South America (Kurup et al., 2019; Yarımadası et al., 2019). As a result, the intended behavior change through the current programs of diabetic education and counselling sessions has not been actualized. The average understanding of the national recommendation for management of diabetes as well as willingness to carry them out was notably higher in this study than in the previous studies (Waidyatilaka et al., 2019). This could have contributed by the diabetic awareness promoted at the hospitals, social media and at the community levels in the County.

5.5 Risk factors of poor glycemic control

The study reported that the socioeconomic status of individuals was an important predictor of the progression of DM (Azar et al., 2103; Hill-Briggs et al., 2021). Young age, residing in rural areas, shorter duration diagnosis with diabetes, higher education levels, education on meal plan were significantly associated with decreased risk of developing other complications after diagnosis with diabetes.

While controlling for the rest of the measured risk factors, only number of years after diagnosis diabetes was significantly associated with development of other complications. This signified inter-dependence on the effect of other factors to cause a significant influence on the individual's level of glycated haemoglobin.

Education on modification of diet was shown to have significant effect on development of diabetic complications. This was dependent of both the choice of foods, frequency and the quantities taken the diabetics. Similar findings had been reported in Switzerland (Fulton et al., 2021).

The individuals who had no results for the level of glycated haemoglobin were reported to have poorer health status compared to their counterparts. This finding matched that of a study conducted in Brazil which established that not measuring the HbA1c was independently related to poor prognosis among the diabetics (Cristina et al., 2019).

Practice of diabetes recommendations by the study participants was not associated with the glycemic control as well presence of other diseases such as hypertension and kidney dysfunctions prior to development of diabetes. These findings were contrary to what was reported by a study in Mexico which found out that diabetic knowledge and self-care practices were independently associated with control of glycated haemoglobin (Silva-Tinoco et al., 2020).

5.6 Inter-dependence of risk factors

Despite the fact that the number of years after diagnosis has been reported to negatively affect the prognosis of NCD (Ministry off public health, 2010; Rivich et al., 2016; Zibran & Mohammadnezhad, 2019), it did not significantly affect the individual's level of glycosylated haemoglobin which is a stable indicator of progression of diabetes.

On the other hand, the prediction of likelihood of developing diabetic conditions by period after diagnosis was fully mediated by the control of glycosylated haemoglobin.

The employment status was depended on the education level of the study participants while the likelihood of getting support in management of diabetic among the study participants was significantly dependent on the number of the persons living in the same household with the diabetic. These factors have also been captured to be independent of each other in the Kenya population situation analysis of 2013 (GOK, 2013).

The prediction of the levels of glycosylated haemoglobin by level of knowledge was significantly associated with the likelihood of developing diabetic complications when measured with the other risk factors. High levels of knowledge were also reported to positively contribute to the control of glycated haemoglobin by almost 50%. Similarly, episodes of severe low blood sugar were dependent on the level of knowledge of the individual study participant. A similar scenario had been observed in Saudi Arabia (Sami et al., 2017).

Although the practice scores and nutrition status did not show direct effect on glycemic control, nutritional status was significantly predicted by what was practiced by the individual study participants in managing DM. On the other hand, nutritional status was predictive of likelihood of developing other complications when mediated by the levels of glycated haemoglobin.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The study revealed that age, period after diagnosis with diabetes, area of residence, education level, and education on modification of diet during management of diabetes, knowledge and attitude towards diabetes recommendations were enabling factors of glycemic control among diabetics. Therefore, the study rejected the null hypothesis that there is no significant association between the investigated factors and the levels of glycated haemoglobin. The study revealed the crucial role of knowledge in controlling the levels of glycated haemoglobin hence delay diabetic complications which reduce the quality of living as well as increase the cost of treatment.

6.2 RECOMMENDATIONS

The researcher recommends that;

1. The impact of risk factors of glycemic control among the diabetics need to be established together due to the inter-dependence among them.
2. Education on diet modification needs to be designed and handled independently possibly on different sessions or days from the general diabetic education to allow better understanding by the clients.
3. The diabetic education sessions should be re-grouped across different levels of education and the age to ensure the speed and the language used is well understood by the clients.
4. Basics of prevention and management of DM should be incorporated in the various platforms to increase access by social media users.

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APPENDIX I: CONSENT FORM

Hello, my name is Rachael Mueni, a master's student of applied human nutrition at the University of Nairobi. I am the principal researcher in this study. You have been chosen at random to participate in a study about enabling factors of glycemic control among diabetic clients being managed at health facilities in Nairobi County, Kenya**.** The study aims at contributing towards achievement of diabetes care system that is responsive and effective. The purpose of the study is to generate data on the nutritional status, level of knowledge and attitude as well as the health practices among diabetic clients in selected hospitals in Nairobi County.

In this study, you will be expected to provide truthful information regarding your individual management of diabetes and any other accompanying complication. Once you consent to participate in the study, the researcher will ask you questions and the responses you give will be captured in an ODK mobile app. The principal researcher will also access your medical file to check your last results for weight, height and glycated haemoglobin (HbA1C). With your cooperation, the interview will last for approximately 20 minutes after which the researcher will leave you to continue getting services at the facility or go home.

The data collected shall only be seen by members affiliated with the study, and will not be linked to any identifying information such as name, address or other personal details that you will supply. The data collected shall be averaged over many participants and therefore your individual data shall not be identifiable.

This study poses no known risk(s) or benefits to you or your family. There is also no cost or payment to you. You may decide to stop participating in the study at any time however we encourage you to remain in the study and respond to all questions. You have the right to demand that any data provided until that point be withdrawn/destroyed. If you have any questions with regards to this information sheet, you can ask the researcher before the study begins, during the interview or contact me via Tel. No. 0729270559. If you feel as if you were not treated well during this study, or have questions concerning your rights as a research participant call the Secretary/Chairperson KNH-UoN ERC on Tel. No. 2726300 Ext 44102.

Kindly tick where appropriate:

I confirm that I have read (or been read to) and understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had the questions answered satisfactorily ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐

I understand that relevant sections of information and data collected during the study may be looked at by other members of this research team. I give permission for these individuals to have access to these records. ☐

I agree to take part in the study without any demands and of my own free will. ☐

Name of respondent: _____

Date: _____

Signature: _____

APPENDIX II: DEPARTMENT OF MEDICINE (KNH) APPROVAL

KENYATTA NATIONAL HOSPITAL
P.O. BOX 20723, 00202 Nairobi

Tel.: 2726300/2726450/2726550
Fax: 2725272
Email: knhadmin@knh.or.ke

Ref: KNH/HOD-MED/37/VOL.II

Date: 6th January, 2021

Rachael Mueni Wambua
Department of Food Science,
Nutrition & Technology
Faculty of Agriculture
College of Agriculture & Veterinary Sciences
University of Nairobi

Dear Ms. Wambua

RE: APPROVAL TO COLLECT DATA IN MEDICINE DEPARTMENT

Following approval by the KNH/UON-Ethics & Research Committee for your research proposal and subsequent filing of the study registration certificate, this is to inform you that authority has been granted to collect data in Medicine Department, Diabetic Clinic on your study titled ***"Enabling factors of glycemic control among diabetic clients being managed at health facilities in Nairobi County"*** at Kenyatta National Hospital

Kindly liaise with the Assistant Chief Nurse Diabetic Clinic for facilitation.

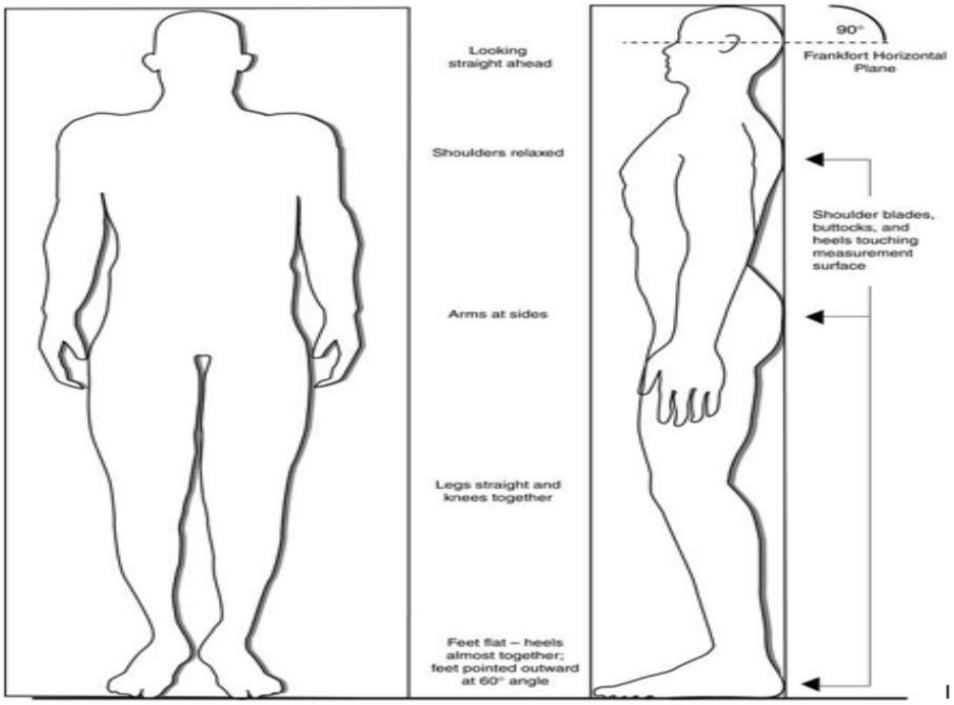
You will also be required to submit a report of your study findings to the office of the undersigned after completion of your study.

Dr. K. Ndege

Dr. Kinoti Ndege
HOD, MEDICINE

Cc. Assistant Chief Nurse, Diabetic Clinic

APPENDIX III: HEIGHT MEASUREMENT



Picture 1.1. Position for standing height

Hair ornaments, buns, braids, etc. must be removed to obtain an accurate measurement. Record the measurement to the nearest 0.1 cm.

APPENDIX IV: KNH-UON ERC APPROVAL LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/357

15th October 2020

Rachael Mueni Wambua
Reg. No.A56/36119/2019
Dept.of Food Science, Nutrition and Technology
Faculty of Agriculture
College of Agriculture and Veterinary Sciences
University of Nairobi

Dear Rachael

RESEARCH PROPOSAL – ENABLING FACTORS OF GLYCEMIC CONTROL AMONG DIABETIC CLIENTS BEING MANAGED AT HEALTH FACILITIES IN NAIROBI COUNTY, KENYA (P323/06/2020)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 15th October 2020 – 14th October 2021.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover

For more details consult the KNH- UoN ERC website**http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
The Dean, School of Medicine, UoN
The Chair, Dept. of Food Science, Nutrition and Technology, UoN
Supervisors: Prof. Wambui Kogi-Makua, Dept.of Food Science, Nutrition and Technology, UoN
Dr. George Ooko Abong', Dept.of Food Science, Nutrition and Technology, UoN

APPENDIX V: MAMA LUCY KIBAKI HOSPITAL APPROVAL

THE PRESIDENCY
EXECUTIVE OFFICE OF THE PRESIDENT
NAIROBI METROPOLITAN SERVICES

Telephone:
020 - 2297000
E-mail: medsupnedh@yahoo.com
When replying please quote

MAMA LUCY KIBAKI HOSPITAL-EMBAKASI
P.O. Box 1278-00515
NAIROBI

Ref: No.- MLKH/ADM/RES/1

Date: 19th January 2021

MAMA LUCY KIBAKI HOSPITAL
RECEIVED
21 JAN 2021
SIGN:.....
P. O. Box 1278-00515 BURU BURU-NAIROBI

WAMBUA RACHEL MUENI
University of Nairobi
NAIROBI

RE: PERMISSION TO COLLECT DATA

TITLE: ENABLING FACTORS OF GLYCEMIC CONTROL AMONG DIABETIC CLIENTS BEING MANAGED AT HEALTH FACILITIES IN NAIROBI COUNTY, KENYA.

Refer to your application to collect data on the above research in this institution.

This is to inform you that hospital has given you permission to allow you collect data subject to the following.

1. You are expected to adhere to the rules and regulations pertaining to the data collection.

2. You are expected to submit a copy of the final findings collected after completion to the research committee.

MAMA LUCY KIBAKI HOSPITAL 21 JAN 2021 P.O. Box 1278-00515 BURU BURU-NAIROBI

DR EMMA MUTIO
MEDICAL SUPERINTENDENT.

APPENDIX VI: MBAGATHI HOSPITAL APPROVAL

REPUBLIC OF KENYA

NAIROBI METROPOLITAN SERVICES

Mbagathi Hospital, P.O Box 20725 – 00202
Email: mbagathihosp@gmail.com
Tel: 0721311808, 2724712, 2725791

DATE: 04TH FEBRUARY, 2021

Racheal Mueni Wambua

University of Nairobi

RE: RESEARCH AUTHORIZATION.

This is in reference to your application for authority to carry out a research on ***'Enabling Factors of Glycemic Control Among Diabetic Clients being Managed at Health facccilities in Nairobi County, Kenya."***

I am pleased to inform you that your request to undertake research in the hospital has been granted.

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

MBAGATHI HOSPITAL 05 FEB 2021 TEL: 0721 311 808 NAIROBI METROPOLITAN SERVICES P.O. BOX 20725 - 00202, NAIROBI

Dr. David Kimutai
For: Medical Superintendent
Mbagathi Hospital.

APPENDIX VII: NAIROBI METROPOLITAN SERVICES APPROVAL

REPUBLIC OF KENYA

NAIROBI METROPOLITAN SERVICES

Directorate of Health Services

REF: EOP/NMS/HS/RS/67 DATE: 20TH NOVEMBER, 2020

Rachael Mueni Wambua
University of Nairobi
NAIROBI

Dear Wambua,

RE: RESEARCH AUTHORIZATION

This is to inform you that the Nairobi Metropolitan Services - Health Directorate's Research Technical Working Group (RTWG) reviewed the documents on the study titled "**Enabling Factors of Glycemic Control Among Diabetic Clients being Managed at Health Facilities in Nairobi County, Kenya**".

I am pleased to inform you that you have been authorized to undertake the study in Nairobi specifically at Mama Lucy Kibaki Hospital, Mbagathi Hospital and Kayole II Hospital. The researcher will be required to adhere to the ethical code of conduct for health research in accordance to the Science Technology and Innovation Act, 2013 and the approval procedure and protocol for research for Nairobi.

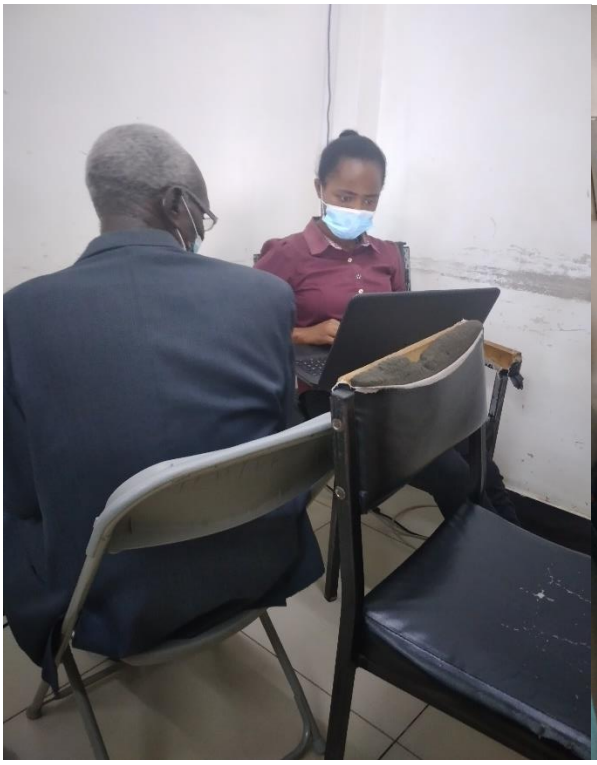
On completion of the study, you will submit one hard copy and one copy in PDF of the research findings to the RTWG. By copy of this letter, the Medical Superintendents – Mama Lucy Kibaki and Mbagathi Hospitals, Sub County MOH – Embakasi West are to accord you the necessary assistance to carry out this research study.

Yours sincerely,

DR. OUMA OLUGA
FOR: DIRECTOR HEALTH SERVICES

Cc: Medical Superintendent - Mama Lucy Kibaki Hospital
Medical Superintendent – Mbagathi Hospital
Sub County MOH – Embakasi West

APPENDIX VIII: PICTORIAL



APPENDIX IX: QUESTIONNAIRE

Section I - Demographics

Please answer each of the following questions by filling in the blanks with the correct answers or by choosing (use a tick) the single best answer.

Q1. Code: __ __ __ __ __

Q2. Have you ever participated in a KAP study before?

☒ Yes
☒ No
☒ Don't remember

Q3. Gender?

☒ Male
☒ Female

Q4. Age: __ __ years old

Q5. What is your marital status?

☒ Never married
☒ Married
☒ Separated
☒ Divorced
☒ Widowed

Q6. What is your ethnic origin? _____

Q7. Where do you live most of the year?

☒ Rural
☒ Urban
☒ Other _____

Q7a. Which estate/village do you stay in Nairobi? _____

Q8. How many people live with you in the same house?

- ☒ I live alone
- ☒ 1 person
- ☒ More

Q9. What is your education level?

- ☒ None
- ☒ Primary
- ☒ Secondary
- ☒ Tertiary

Q10. Which of the following best describes your current employment status?

- ☒ Employed
- ☒ Self-employed
- ☒ Homemaker
- ☒ In school
- ☒ Retired
- ☒ Disabled, not able to work
- ☒ Unemployed
- ☒ Something else? (Please specify): _____

Q11. Do you have a medical insurance plan? (Check all that apply)

- ☒ An individual plan
- ☒ A group/community-based
- ☒ Company/institution-based
- ☒ I have not had an insurance plan in the past 12 months
- ☒ Other (Please specify): _____

Section II – Knowledge

Q1. What year were you first told you had diabetes? (Please enter the year) __ __ __ __

Q2. In general, would you say your health is?

☒	☒	☒	☒	☒
Excellent	Very Good	Good	Fair	Poor

Q3. Compared to one year ago, how would you rate your health in general now?

- ☒ Much better now than 1 year ago
- ☒ Somewhat better now than 1 year ago
- ☒ About the same
- ☒ Somewhat worse now than 1 year ago
- ☒ Much worse now than 1 year ago

Q4. Have you ever received diabetes education?

☒ Yes ☒ No ☒ Not sure

Q5. Have you ever received diabetes education in form of a series of classes or series of meetings with a diabetes educator?

☒ No ☒ Yes ☒ Not Sure

Q6. Has your health care provider ever told you to take special care of your feet?

☒ No ☒ Yes ☒ Not Sure

Q7. Has your health care provider ever told you to follow an exercise program?

☒ No ☒ Yes ☒ Not Sure

Q8. Has your health care provider or nurse ever advised you to follow a meal plan or diet?

☒ No ☒ Yes ☒ Not Sure

Q9. Who helps you the most in caring for your diabetes?

☒ Spouse

☒ Other family members

☒ Friends

☒ Paid helper

☒ Health care professional

☒ No one

Q.10 Have you been taking any medication for management of diabetes?

☒ No ☒ Yes

Q.10a. What medication have you been taking?

☒ Oral hypoglycemic agents

☒ Insulin

☒Combination of above

Q.11The following are some of the items covered during diabetic education sessions as per the Kenyan guidelines. Respond true if you agree with them, false if you do not or not sure.

Q11	How do you agree with the following statements?	True	False	Not sure
a.	Diabetes is serious chronic disease, has no cure, but can be controlled			
b.	Glycosylated haemoglobin (HbA1c) is a test that measures your average blood glucose level in the past week.			
c.	A kilo of chicken has more carbohydrate in it than a kilo of potatoes.			
d.	Orange juice has more fat in it than low fat milk.			
e.	Unsweetened fruit juice raises blood glucose levels.			
f.	A can of diet soft drink can be used for treating low blood glucose levels.			
g.	Using olive oil in cooking can help lower the cholesterol in your blood.			
h.	Exercising regularly can help control blood sugar.			
i.	For a person in good control, exercising has no effect on blood sugar levels.			
j.	Infection is likely to cause an increase in blood sugar levels.			
k.	Wearing shoes a size bigger than usual helps prevent foot ulcers.			
l.	Eating foods lower in fat decreases your risk for heart disease.			
m.	Numbness and tingling may be symptoms of nerve disease.			
n.	Lung problems are usually associated with having diabetes.			
o.	When you are sick with the flu you should test for glucose more often			
p.	High blood glucose levels may be caused by too much insulin.			
q.	If you take your morning insulin but skip breakfast your blood glucose level will usually decrease.			
r.	Having regular check-ups with your doctor can help spot the early signs of diabetes complications.			
s.	Attending your diabetes appointments will stop you getting diabetes complications.			

Section III– Practice

Q1. Do you test your blood sugar?

☒ No ☒ Yes

Q1a. How many days a week do you test your blood sugar?

_____ (days / week)

Q1b. On days that you test, how many times do you test your blood sugar?

_____ (times / day)

Q1c. Do you keep a record of your blood sugar test results?

☒ No ☒ Yes ☒ Only Unusual values

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

		Yes, Limited a Lot	Yes, Limited a Little	No, Not limited at all
Q2.	**Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	☒	☒	☒
Q3.	Climbing **several** flights of stairs	☒	☒	☒

Q4.	**How often do you**	Never	Sometimes	Always
a.	Follow a meal plan or diet?			
b.	Weigh or measure your food?			
c.	Or the person who cooks your food use the exchange lists or food group lists to plan your meals?			
d.	Take your weight			
e.	Take Hb1c test			
f.	Do exercise			
g.	Skip your drugs			

Section IV – ATTITUDE

Benefits

Q1.	How do you agree with the following statements?	Strongly disagree	Neutral	Strongly agree
a.	the person with diabetes is the most important member of the diabetes care team			
b.	there is not much use in trying to have good blood sugar control because the complications of diabetes will happen anyway			
c.	keeping the blood sugar close to normal can help to prevent the complications of diabetes			
d.	people whose diabetes is treated by just a diet do not have to worry about getting many long-term complications			
e.	blood sugar testing is not needed for people with Type 2 diabetes			
f.	people who take diabetes pills should be as concerned about their blood sugar as people who take insulin			
g.	It is important to keep my weight under control			
h.	It is important to handle my feelings (fear, worry, anger) about my diabetes			
i.	support from family and friends is important in dealing with diabetes			

Confidence

Q2.	How do you rate your understanding of:	Poor	Good	Excellent
a.	overall diabetes care			

b.	coping with stress
c.	diet for blood sugar control
d.	the role of exercise in diabetes care
e.	medications you are taking
f.	how to use the results of blood sugar monitoring
g.	how diet, exercise, and medicines affect blood sugar levels
h.	prevention and treatment of high blood sugar
i.	prevention and treatment of low blood sugar
j.	prevention of long-term complications of diabetes
k.	foot care
l.	benefits of improving blood sugar control
m.	pregnancy and diabetes

Barriers

Q1.	**I want a lot of help and support from my family or friends in:**	**Strongly Disagree**	**Neutral**	**Strongly Agree**

a)	following my meal plan.
b)	taking my medicine.
c)	taking care of my feet.
d)	getting enough physical activity.
e)	testing my sugar.
f)	handling my feelings about diabetes.

Q2	**My diabetes and its treatment keep me from:**	**Strongly Disagree**		**Neutral**	**Strongly Agree**
a)	Having enough money.				
b)	Meeting school, work, household, and other responsibilities.				
c)	Going out or traveling as much as I want.				
d)	Being as active as I want.				
e)	Eating foods that I like.				
f)	Eating as much as I want.				
g)	Having good relationships with people.				
h)	Keeping a schedule I like (e.g., eating or sleeping late).				
i)	Spending time with my friends.				
j)	Having enough time alone.				

Q3.	**How often do you have trouble getting enough exercise because:**	**Rarely**	**Sometimes**	**Often**
a.	It takes too much effort?			
b.	You don't believe it is useful?			
c.	You don't like to do it?			

d.	You have a health problem?
e.	It makes your diabetes more difficult to control?

Q4.	When you don't test for sugar as often as you have been told, how often is it because:	Rarely	Often	Sometimes
a.	You forgot?			
b.	You don't believe it is useful?			
c.	The time or place wasn't right?			
d.	You don't like to do it?			
e.	You ran out of test materials?			
f.	It costs too much?			
g.	It’s too much trouble?			
h.	It’s hard to read the test results?			
i.	You can't do it by yourself?			
j.	your levels don’t change very often?			
k.	It hurts to prick your finger?			

EXTERNAL EFFECT

Q1.My family or friends:	Strongly Disagree	Neutral	Strongly Agree

a) Accept me and my diabetes
b) Feel uncomfortable about me because of my diabetes
c) Encourage or reassure me about my diabetes
d) Discourage or upset me about my diabetes
e) Listen to me when I want to talk about my diabetes
f) Nag me about diabetes

Section IV– Glycemic control

Q1 Do you test your glycated haemoglobin?

☒ No ☒ Yes

Q2a How many times do you test glycated haemoglobin?

_____ (times / year)

Q3 How many **times** in the last **month** have you had a **low blood sugar** (glucose) reaction with symptoms such as sweating, weakness, anxiety, trembling, hunger or headache?

☒ 0 times
☒ 1-3 times
☒ 4-6 times
☒ 7-12 times
☒ More than 12 times
☒ Don't know

Q4 How many **times** in the last **month** have you had **severe low blood sugar** reactions such as

passing out or needing help to treat the reaction?

☒ 0 times

☒ 1-3 times

☒ 4-6 times

☒ 7-12 times

☒ More than 12 times

☒ Don't know

Q5 How many **days** in the last **month** have you had **high blood sugar** with symptoms such as thirst, dry mouth and skin, increased sugar in the urine, less appetite, nausea, or fatigue?

☒ 0 days

☒ 1-3 days

☒ 4-6 days

☒ 7-12 days

☒ More than 12 days

☒ Don't know

Q6 How many **days** in the last **month** have you had **ketones** in your urine?

☒ 0 days

☒ 1-3 days

☒ 4-6 days

☒ 7-12 days

☒ More than 12 days

☒ Don't test

Q7. During the past year**,** how often did your blood sugar become **too high or too low** because:	**Never**	**Sometimes**	**Often**	**Don't Know**
a. You were sick or had an infection?				
b. You were upset or angry?				
c. You took the wrong amount of medicine?				
d. You ate the wrong types of food?				
e. You ate too much food?				
f. You had less physical activity than usual?				
g. You were feeling stressed?				

Q8. Have you been diagnosed with any other disease since you developed diabetes mellitus?

☒ No ☒ Yes

Q8a. Which complication?

☒ High blood pressure

☒ Visual difficulties

☒ Pain and/or tingling in the feet

☒ Foot ulcerations

☒ Kidney disease

☒ Impotence

☒ Stroke

☒ Other

Q8b. Name if other

SECTION V

From the file, what's the last documented?

Weight _____ Height _____ HbA1C_____