PREVALENCE AND RISK FACTORS FOR UNDIAGNOSED DIABETES MELLITUS AMONG PATIENTS SEEN IN THIKA LEVEL 5 HOSPITAL IN KIAMBU COUNTY, KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH, DEPARTMENT OF HEALTH SERVICES MANAGEMENT, MOI UNIVERSITY.

DECLARATION

Declaration by the candidate:

This thesis is my original work and has not been presented for an award of a degree or any other award in any university. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

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DEDICATION

This research is dedicated to my late mother Loise and my sisters Diana, Jane and Sarah.

ABSTRACT

Background: Globally, about 537 million people have Diabetes Mellitus (DM), the majority (70%) living in low- and middle-income countries while 1.5 million deaths are directly attributed to DM each year. The burden is forecasted to be at 643 million by the year 2030. In Africa, the proportion of undiagnosed DM stands at 53.7%. According to estimates, 43.7% of Kenyans with DM have not received a diagnosis. Opportunistic screening is important in lowering the proportion of undiagnosed DM as well as reducing the latent period of DM during which there are no symptoms. The late diagnosis and treatment of DM is linked with the increased occurrence of acute and chronic complications, highlighting the need for early diagnosis of DM.

Objectives: To determine the prevalence of undiagnosed DM, level of physical activity extent of alcohol and tobacco consumption, level of knowledge of DM in patients attending Thika Level 5 Hospital, Kiambu County.

Methods: A cross-sectional study utilizing both quantitative and qualitative approaches was conducted in Thika Level 5 Hospital. A sample size of 375 adult patients presenting at the outpatient department were purposively selected as they exited the consultation rooms. A modified WHO STEPS was used to collect quantitative data while an FGD guide was used to collect qualitative data. Random blood sugar was done as part of the survey and those with a random blood sugar ≥ 7.8 mmol/l were requested to return for a fasting blood sugar, a cut-off of ≥7.0 mmol/l established a DM diagnosis. Qualitative data was collected through four Focus Group Discussions (FGDs) using an FGD guide. The Statistical Package for Social Sciences (SPSS) was used to analyze data. Univariate analysis and comparative analysis were used to analyze quantitative data and show the association between DM and body mass indices respectively. Logistic regression was used to measure the relationship between undiagnosed DM and the various risk factors.

Results: About 3.2% of the participants had undiagnosed DM. There was a family history of DM in 33.3% (p=0.042) of the participants with DM. Participants aged 60 years and above had the highest percentage of those diagnosed with DM (33.3%, p=0.003), versus those without. Seven of the DM participants had elevated blood pressure (p= 0.007) indicating a strong correlation of an elevated blood pressure and DM. Findings from FGDs indicated that there was limited knowledge of DM.

Conclusion: Elevated diastolic blood pressure above 90 mmhg, family history of DM and age above 60 years showed significant association with undiagnosed DM.

Recommendation: There should be targeted DM screening for patients presenting in the outpatient department with elevated blood pressure, those aged 60 years and above, and those with a family history of DM.

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ABBREVIATIONS AND ACRONYMS

ADA: American Diabetes Association

APHRC: African population and health research Centre

BoD: Burden of Disease

CI: Confidence interval

COI: Cost of Illness

CPD: Cost of productive time lost due to permanent disability

CPM: Cost of productive time lost due to DM-related premature mortality

CPV: Cost of productivity lost due to the work time lost by relatives accompanying patients

CTD: Cost of productive time lost due to DM-related temporary disability

DALYs: Disability Adjusted Life Years

DC: Direct Costs

DM: Diabetes Mellitus

DW: Disability Weight

E.N.T.: Ear, nose and throat

ELSA: English longitudinal study for ageing

FGD: Focus group discussion

GBD: Global Burden Disease

GDP: Gross Domestic Product

GNI: Gross National Income

GNIPC: Gross National Income per Capita

ICD: International Classification of Disease

IDF: International Diabetes Federation

IREC: Institutional Research and Ethics Committee

KDHS: Kenya Demographic Health Survey

MoH: Ministry of Health

NCD: Non-communicable diseases

SD: Standard deviation

SPSS: Statistical package for social sciences

WHO: World Health Organization

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DEFINITION OF TERMS

1. **Burden of Disease**: It refers to the impact of a health issue as evaluated by financial cost, mortality, morbidity, or other indicators. Often, it is quantified in terms of quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs), both of which quantify the number of years lost due to disease.
2. **Comorbidity:** Any distinct clinical entity that has occurred or that may happen during the clinical course of a patient who has the index disease under research.
3. **Diabetes Mellitus (DM):** It is a chronic, metabolic ailment characterized by heightened levels of blood sugar, which gradually causes severe harm to blood vessels, the heart, kidneys, nerves and the eyes.
4. **Diagnosis:** This means confirmation of DM in individuals who have symptoms, or who have had a positive screening test.
5. **Disability:** This is a condition that might restrict an individual's sensory, mental, and mobility activities to undertake or perform a task in the same manner as an individual who does not have a disability.
6. **Incidence:** It is a measure of rate or frequency of occurrence of a disease or a specified medical situation in a population within a definite period.
7. **Morbidity:** It refers to the departure from a state of physical or psychological well-being resulting from illness, disease, injury, or sickness, especially where the affected person is aware of their condition.
8. **Mortality:** The condition or state of being subject to death; moral character, existence or nature.

9. **Opportunistic screening:** This is undertaken at a period when individuals are attended to, by health care experts, for intentions other than the condition in question.
10. **Prevalence:** It means the proportion of people in a population having an ailment or characteristic.
11. **Risk factor**: It is a characteristic, disorder, or behavior that increases the probability of getting an ailment. They often coexist and interact with one another.
12. **Screening:** Based on World Health Organization "Principles of Screening" document, “Screening refers to the procedure of recognizing those people who are at satisfactorily high risk of a certain disorder to necessitate direct action or further investigation. Screening is systematically offered to a population of individuals who have not sought medical attention on account of symptoms of the disease for which screening is being offered and is usually done by medical experts or authority and not by a patient's request for help on account of a specific complaint.
13. **Undiagnosed DM:** This refers to a person having the disease(DM) but the disease has not yet been identified in them through diagnosis.
14. **WHO STEPS Instrument:** The WHO STEPwise approach to Non Communicable Disease (NCD) risk factor surveillance (STEPS) is a simple, standardized method for collecting, analyzing and disseminating data on key NCD risk factors in countries. The survey instrument covers key behavioral risk factors: alcohol use, tobacco use, unhealthy diet, physical inactivity, as well as key biological risk factors: raised blood pressure, overweight and obesity, raised blood glucose, and abnormal blood lipids. Through the utilization of expanded modules, the survey instrument can be lengthened to cover a range of topics beyond these risk factors, such as sexual health, oral health, and road

safety. The STEPwise approach to noncommunicable disease risk factor surveillance (STEPS) dwells on gathering important data on the established risk factors that determine the major burden of NCDs.

ACKNOWLEDGEMENTS

I thank the Almighty God for providing me with the opportunity, resources, will and dedication to undertake this thesis.

I would specifically like to thank the following people:

Prof. Violet Naanyu and Dr. Caroline Sawe my supervisors, for the advice, corrections and guidance accorded throughout the process of developing the thesis. Jackline Sitienei for the guidance through the process of developing the thesis.

The manager Abbott Diabetes care Phillips Pharmaceuticals Ltd, Kenya for, donating a glucometer and glucosticks.

CHAPTER ONE

1.1 Introduction

This chapter entails the background to the study, problem statement, justification, research questions, main objective and specific objectives.

1.2 Background information

Diabetes Mellitus (DM) is a metabolic disorder of multiple etiologies that is characterized by chronic hyperglycemia induced from defects of insulin secretion and action or both. According to Bantie, et al. (2019), there are more than 537 million people who are presently living with DM and the burden is forecasted to be at 643 million by the year 2030. The Type 2 DM, that is mainly preventable through healthy balanced diet, consistent physical activity and improved living environments, is the most common. It is also important to note that the incidence and magnitude of DM has significantly increased, specifically in low and middle-income nations such as the sub-Saharan Africa (WHO, 2022).

Globally, about 537 million individuals have DM, with many living in low and middle income countries, and 1.5 million deaths are directly attributed to DM each year. The number of cases of DM have increased by 16% from the previous estimates in 2019 (IDF, 2021). Chronic ailments, such as stroke, respiratory diseases, cancer, and DM mellitus (DM), are undoubtedly the leading cause of mortality in the world, accounting for 63% of global deaths (World Health Organization, 2022). Non-communicable diseases like DM, cancers and cardiovascular diseases, and their associated risk factors such as high cholesterol, high blood pressure, and extreme bodyweight are increasing in Kenya (Onyango et al., 2018). Diabetes

Mellitus Type 2 – previously known as Non-Insulin Dependent or Maturity onset DM makes up 85- 90% of total DM burden in Kenya (Masaba et al., 2021).

Masaba et al., (2021) highlighted that notwithstanding the higher prevalence of DM in high-income nations, the majority of the disease burden from DM, more than 70%, is in the developing regions partly because of their larger populations. In Kenya, the prevalence of DM was estimated to be 3.3% (Ministry of health, 2023). This number is pegged on regional forecasts and is likely to be an underestimation as over 60% of individuals diagnosed to have DM in Kenya usually come to the health care facility with seemingly isolated complaints (Onyando et al., 2019).

Exposure to the four primary behavioral risk factors that contribute to non-communicable diseases – physical inactivity, tobacco use, harmful use of alcohol and unhealthy diets - remains high worldwide and is increasing in the majority of low- and middle-income countries (World Health Organization, 2022). The speedily increasing burden of NCDs in low- and middle-income countries is hastened by the negative effects of rapid unplanned urbanization, globalization, and increasingly sedentary lives. Individuals in developing nations are increasingly consuming diets with higher levels of total energy and are being targeted by marketing for alcohol, tobacco, and junk food, while availability of these products increases (World Health Organization, 2022). In African countries, NCDs are increasing fast and are likely to exceed communicable, maternal, perinatal, and nutritional ailments as the most common causes of death by 2030 (Bigna et al., 2019).

Early diagnosis and treatment are the primary interventions to mitigate the complications and deaths that arise from DM (Peer et al., 2020). Nonetheless, worldwide one in two

individuals living with DM are undiagnosed (IDF, 2023). The late diagnosis and treatment of DM is linked with the increased occurrence of acute and chronic complications. The complications from undiagnosed DM leads to a substantial decrease in patients' quality of life which are normally preventable through the early identification of risk factors (Peer, et al., 2020). In a study conducted globally to estimate the cases of undiagnosed DM globally and regionally revealed that The highest proportions of undiagnosed DM (53.6%) were found in the Africa, Western Pacific (52.8%) and South-East Asia regions (51.3%), respectively. These statistics point towards the need to improve on DM screening to reduce the prevalence of Undiagnosed DM, particularly in low- and middle-income countries (Ogurtsova et al., 2022).

Notwithstanding the burden of deaths, DM pose a significant economic and social burden to economies (Onyando et al., 2019). The sharp increase in DM is projected to obstruct poverty reduction activities in the low-income nations, especially by increasing household expenses linked to health care (WHO, n.d.). The existing competing demands of increased burden of infectious diseases and other ailments connected to poverty, makes it more unlikely for health systems in Africa to have requisite funding to address DM and its effects. Apart from the economic burden on the health-care system and national economy, often DM imposes catastrophic individual expenditures from out-of-pocket payments and loss of income necessitated by premature deaths and disability (Onyando et al., 2020). As such, the socially disadvantaged and vulnerable populations in the society are prone to mortality and morbidity compared to individuals of higher social positions.

According to the Kenya Vision 2030, the Kenyan government is focused on improving the health sector through provision of affordable, equitable and quality health care to all citizens.

In Kenya, DM is managed based on three units of care, i.e., at the district level through the district hospitals, county hospitals and national referral hospitals (Shannon et al., 2019). In the management and treatment of DM, the goal is to maintain healthy blood glucose levels through controlling high cholesterol and blood pressure levels to obstruct the progression of other DM-related complications such as stroke, heart disease and kidney problems. The undiagnosed cases of DM pose a significant challenge because individuals are unaware of their condition and might not receive requisite management and treatment. Undiagnosed DM carries significant health risks and complications. Persons with undiagnosed DM have uncontrolled blood glucose levels, which can lead to long-term complications such as kidney damage, cardiovascular disease, neuropathy and eye problems (Aikaeli et al., 2022). The common risk factors can be reversed or avoided through behaviour modification. In those people with DM it is important to have an early diagnosis which helps to prevent complications associated with uncontrolled DM.

In Kenya, NCDs make up for more than 50% of overall hospital admissions and more than 55% of hospital deaths (Ammoun et al., 2022). Diabetes Mellitus causes 5% of deaths in people below the age of 60 years (IDF, 2021). Treatment of DM in Kenyan hospitals includes dietary recommendations, administration of insulin and physical exercises. Since DM is a chronic disease whose control depends on patient self-care, there has been an increased emphasis on patient education in the recent years. The education focuses on monitoring of blood glucose levels, dietary information, proper self-administration of insulin shots, lifestyle improvement and home management of the disease. A larger part of this education is undertaken at the point of care with the individuals' healthcare provider. Kenya can reduce the burden of DM by channeling more funds to health promotion activities and streamlining

health care interventions. Consequently, this will trigger population behaviors to embrace healthy living lifestyles.

1.3 Problem statement

According to Bantie, et al. (2019), the African continent has the most population of individuals with undiagnosed DM compared to other regions. According to the same report, approximately 62.3% of the individuals with the disease are not aware.

The prevalence of microvascular and macrovascular complications of DM in newly diagnosed Type 2 DM in Low- and Middle-Income countries was the subject of a systematic review. For microvascular complications, the median prevalence (interquartile range) of retinopathy, nephropathy, and neuropathy were, respectively, 12% (6%-15%), 15% (7%-35%), and 16% (10%-25%). The study further revealed that the median prevalence (interquartile range) for macrovascular complications was 10% (7%-17%) for ischemic heart disease, 6% (1%-20%) for peripheral arterial disease, and 2% (1%-4%) for stroke (Aikaeli et al., 2022).

According to estimates, 43.7% of Kenyans with Diabetes Mellitus have not received a diagnosis (IDF, 2021). In another study carried out in Kenya, 52.8% of study participants had undiagnosed DM (50.7% of females and 55.9% of males) (Mohamed, 2021). In a study conducted in a Kenyan population, 34.6% of subjects reported having complications related to their DM. Microvascular complications were common in 35.3% (n=65) of subjects, with neuropathy (n=41, 21.5%) and microalbuminuria (n=27, 14.1%) occurring most frequently (Otieno, 2021). Complications from DM impose a substantial economic burden on individuals and the healthcare system (Yaya et al., 2021). There is a high proportion of

undiagnosed cases of DM that end up with irreversible complications imposing a huge burden to the individual, family, community and the health care system (Dessie et al., 2020).

Despite the high prevalence of DM in Kenya, the extent of undiagnosed DM in the Kiambu County region is still poorly understood as there are no studies on the prevalence of undiagnosed DM that are specific to the county. Research is needed to guide timely and effective identification of people living with DM in these settings. This study, therefore, seeks to establish the extent of undiagnosed DM in Kiambu County and hence guide in the development of county specific policies.

1.4 Justification

The long and latent asymptomatic period in which DM can be detected needs to be shortened by ensuring screening of patients (Symptoms & Causes of Diabetes - NIDDK, n.d.). Not all people can be screened due to limited resources hence the need to prioritize the people who need to be screened for DM by conducting research to classify the individuals at increased risk of having the disease. Opportunistic screening of people presenting to hospital for illnesses other than DM would be a convenient type of screening in all health facilities (Uittenbogaart et al., 2020). It is crucial to understand the proportion of people who come to hospital and leave without a diagnosis of DM being made when they already have the disease.

Thika level 5 hospital is the referral hospital for Kiambu county residents and the surrounding counties. Conducting the study at Thika Level 5 hospital makes it locally relevant and impactful because the hospital serves a big population. Thika Level 5 hospital serves a significant population, and understanding the prevalence of undiagnosed DM in this

setting provides valuable information for healthcare planning and resource allocation. It is thus important to generate data specific to Kiambu County in order to generate information that can be used to guide the formulation of evidence-based policies within the devolved government in Kenya. The findings can guide healthcare providers and policymakers in implementing appropriate preventive measures, improving DM screening programs, and enhancing the overall quality of care for people with DM.

Outpatient departments within a hospital play an important function in the early detection of chronic diseases, including DM. Patients attended at the outpatient department are usually seeking healthcare for different reasons, providing an opportunity to screen them for DM. Screening for DM is an effective way to ensure early diagnosis and hence treatment.

While DM management and its risk factors is quite inexpensive and simple, managing and treating complications is costly and requires healthcare experts with high level of skill and specialized equipment. Therefore, the prevention of complications remains vital (Onyando et al., 2019). According to Overview Diabetes, (2024), effective primary healthcare lowers hospital admissions and reduces overall treatment costs. With transformation in lifestyles in both the upcoming urban settlements and rural areas, DM and obesity have become a new priority for health in the African region. Regional and global estimates are normally documented, but rarely county data.

A lot of progress has been made in the management of DM but despite this progress in DM management there is still a knowledge gap on the extent of undiagnosed DM at the county level. This study, therefore, seeks to establish the extent of undiagnosed DM in Kiambu County and hence guide in the development of county specific policies. The implications

behind this study include offering public health experts with knowledge to provide health promotion and DM prevention and also enabling the early identification of adults at risk of Diabetes Mellitus in future.

1.5 Research Question

What is the prevalence of undiagnosed DM and associated risk factors in patients attending the outpatient department at Thika Level 5 Hospital, Kiambu County?

1.6 Broad Objective

To determine the prevalence of undiagnosed DM and associated risk factors among adults attending Thika Level 5 Hospital outpatient department.

1.7 Specific Objectives

1. To determine the prevalence of undiagnosed DM in patients attending Thika Level 5 Hospital, Kiambu County.
2. To establish the level of physical activity among patients attending Thika Level 5 Hospital, Kiambu County.
3. To assess the extent of alcohol and tobacco consumption among patients attending Thika Level 5 Hospital, Kiambu County.
4. To assess the level of knowledge of DM among adults in Thika Level 5 Hospital , Kiambu County.

1.8 Significance of the Study

The information generated in the study will inform policy in Kiambu County on the importance of working towards sustainable and comprehensive solutions regarding DM.

This data avails a framework for further deliberations, like in relation to healthcare interventions aimed to treat or prevent the disease, and manage disease-associated expenses. Data regarding medical cost of DM is crucial in knowing the prolonged economic effects of prevention of DM. Thus, assuming prevention costs can be kept low, effective DM prevention initiatives will probably lead to a decrease in lasting medicinal expenses.

1.9 Limitations of the Study

The findings of this research will not be inferred to the general population since this is a hospital-based study. This is because the study's findings will be limited to the specific population attending the outpatient department at Thika Level 5 Hospital. Extrapolating the results to the broader population may not be appropriate, as it might not be characteristic of the whole adult population. There is also the limitation of cross-sectional nature. The study involves collecting data at a specific point in time, which limits the ability to establish causal relationships or determine temporal associations. Longitudinal design over time duration such as 8-10 years would be the most suitable for future studies to quantify the costs associated with management of complications arising from DM. Finally, despite efforts to control for confounding variables, there may still be unmeasured or unaccounted factors that could influence the prevalence of undiagnosed Diabetes Mellitus and its associated risk factors. These uncontrolled factors might affect the validity and generalizability of the research's findings. The limitation on confounding was addressed by restricting the patients sampled to include adults in the outpatient department and excluding persons who were pregnant.

1.10 Delimitations of the Study

The study is limited to Thika Level 5 Hospital and its outpatient department. The findings might not be applicable to other healthcare facilities, as healthcare settings and patient populations may vary. The setting is also another delimitation as the study targets the outpatient department of Thika Level 5 Hospital. Inpatient populations or individuals receiving care at other departments or healthcare settings are not included in the research.

1.11 Assumptions of the Study

The research assumed that the demographics, characteristics, and health profiles of the participants in the study reflect those of the target population. The study also assumed that the participants would comply with the study procedures, including attending the initial interview, undergoing screening tests and providing complete and accurate information. The assumption is that participants would provide informed consent and freely partake in the research activities as needed. The research postulates that requisite primary and secondary data would be drawn from diverse sources regarding the prevalence of undiagnosed DM and associated risk factors among adults.

It is also assumed that whatever information given, the respondents and other consulted sources will provide truthful information to guarantee sufficient, reliable and valid results. The study assumes that the data collected from the participants, including self-reported information and measurements, are accurate and reliable. The assumption is that the participants provide honest and truthful responses and that the measurements taken, such as blood glucose and blood pressure levels, are accurate and representations of their health status.

Further, there is the assumption of generalizability. The researcher assumes that the results obtained from Thika Level 5 hospital outpatient department can be applicable to other outpatient departments or healthcare facilities with similar characteristics.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

The International Diabetes Federation estimates that internationally, as many as 47% of people have undiagnosed DM (IDF, 2021). Majority of the undiagnosed cases of DM are type 2 DM. Diabetes Mellitus has universally developed as a major public health concern of the 21st era. The earlier an individual is diagnosed and management of DM starts, the higher the chances of preventing harmful and expensive complications. The urgent requirement for detecting and offering necessary care to individuals with DM is hence very high (Adu et al., 2019).

No country has diagnosed every person that has DM. Even in high-income countries, about one-third of people with DM are undiagnosed. Worldwide, 85% of all individuals who remain undiagnosed with DM are in low- and middle-income countries (Saeedi et al., 2019). Opportunistic identification through screening of people with risk factors for undiagnosed type 2 DM is feasible and cost effective. While undiagnosed DM is a substantial problem, population-wide screening for DM is neither appropriate nor feasible in most countries. Countries should develop health systems that can meet the needs of people living with DM with priority being given to providing good care and treatment to those already identified with DM, and targeted screening for those at high risk of undiagnosed DM (Briggs et al., 2021).

DKA can be present at the time of DM onset in 4 to 29% of young people with type 2 Diabetes Mellitus based on a systematic review (Elundu et al., 2023). An individual with

DM can live for some years without presenting any symptoms, during which time high blood glucose is silently damaging the body and DM complications may be developing. The complications linked to DM are so different that even when symptoms do present, DM may not be thought to be the cause and hence no appropriate and accurate testing is undertaken. In a study on undiagnosed DM, 35% (n=2456) DM patients had diabetic complications around diagnosis (Gedebjerg et al., 2019).

The African continent also has the largest proportion of undiagnosed DM as more than half (54%) of people living with DM in the African Region are undiagnosed (IDF, 2021). Diabetes Mellitus is estimated to contribute to one in nine deaths among adults aged 20-79 years (Saeedi, 2020). An estimated 416,000 deaths in the continent can be linked to DM. In 2021, 24 million adults in the Africa Region are estimated to have DM, with a regional prevalence of 4.5% (IDF, 2021). In urban Tanzania rates increased from 0.3% in the 1980s to 10.3% in 2021 according to the IDF 2021 fact sheet. The World Health Organization estimates that the prevalence of DM in Kenya is 3.3% (IDF, 2021).

2.2 Prevalence of DM

According to Mohamed et al. (2018), in case the prevailing trends maintain, both the number of individuals having DM and DM related deaths are projected to surge. Specifically, low income nations are projected to witness the highest increase in DM prevalence at 92%, trailed by lower-middle income nations at 57%, upper-middle income nations at 46% and higher income countries at 25%. Undiagnosed instances of DM have become a public health issue because of the costly health implications that are associated with DM complications as a result of late DM diagnosis and hence delayed initiation of treatment for DM (Aikaeli et al., 2022). Worldwide, cases of undiagnosed DM remains high. Global projections for

undiagnosed DM are 50% more common among those between 20-79 years; the percentage of undiagnosed DM in Africa is 53.6% compared to that of high-income countries that have a prevalence of 35.7% in Europe and 24.2% in North America (IDF, 2021). These occurences contribute to the high morbidity and mortality burden, which happens at a younger stage in Africa. This might have extra cost implications for households and the already overstretched health structures (Onyando et al., 2019). Therefore, it is crucial to increase screening initiatives worldwide to obstruct the development to DM.

As per the World Health Organization (WHO), the prevalence of DM in Kenya stands at 3.3% and by 2025, the prevalence will have risen to 4.5%. Due to lack of awareness among Kenyans, two-thirds of diabetic patients are undiagnosed and this poses a big challenge to the Kenyan health sector. With so many individuals undiagnosed, Kenya's progress towards adressing and possibly eradicating DM complications becomes a more difficult task. According to the International Diabetes Federation (IDF, 2021), Kenya was ranked the 31st African country in terms of DM prevalence of approximately 460 cases per 10,000 individuals. A systematic analysis by Assefa & Shifera (2022), of African countries reveals that the pooled prevalence of undiagnosed DM among adults was 3.85%, with 4.43% in Eastern Africa; 4.72% in Western Africa; 4.27% in Northern Africa, and 1.46% in Southern Africa respectively.

In a study done in Meru County, Kenya, the prevalence of DM was higher among women (16.35%, 95% CI: 12.3–21.4) compared to that among men (13.95%, 95% CI: 9.5–20) and significantly increased with advancing age, BMI, previous diagnosis of hypertension, and high cholesterol (Sarah et al., 2021). High prevalence of DM (20 per 10000) was recorded

in a study conducted at Thika Level 5 Hospital which serves as a referral hospital for Kiambu County residents (Githinji et al., 2018).

2.3 Physical Activity and Physical Measurements

Physical activity and physical measurements are key factors in the development and management of DM. The World Health Organization recommends at least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity physical activity for persons aged 18 years and above. Lack of physical activity serves as a risk factor for undiagnosed DM while regular physical activity is linked to reduced risk of developing DM (WHO, 2022). Engaging in moderate-intensity aerobic activities such as brisk walking, cycling, or swimming, produces the positive effects of improved insulin sensitivity, glucose regulation and weight management (Pavlović et al., 2022). Physical activity also contributes to general cardiovascular health, which is key for persons with DM who are at higher risk of cardiovascular complications. Conversely, an inactive lifestyle characterized by prolonged sitting and low levels of physical activity is connected to a higher risk of developing DM and mortality (WHO, 2022). Sedentary behavior contributes to weight gain, decreased insulin sensitivity, and impaired glucose metabolism, all of which can contribute to the development of DM. Evidence supports that people and communities exposed to green spaces, especially in their neighborhood, reduce the risk of DM and reduce the risk of being obese and increase the likelihood of physical activity. The onset of DM can be moderated by using green spaces, improving physical activity levels, and reducing the risk of being overweight and obese (De la Fuente et al., 2021).

Nearly 10.5% of the world's population suffers with DM, which is largely caused by the fast growth in obesity prevalence. The incidence of DM in young people is also sharply rising (Ruze et al., 2023). Obesity is a solid influential driving factor DM, which resulted in a nearly equivalent rise in DM epidemiology mainly through the adaptation of unhealthy diets, lack of physical activity, and maternal obesity. High blood pressure, contributes to cardiovascular complications in persons with DM (Yildiz et al., 2020). Individuals with DM experience abnormal lipid levels such as high triglycerides which is the bad cholesterol and low high-density lipoprotein cholesterol which is the good cholesterol. Typically, these abnormalities are associated with an increased risk of cardiovascular disease, which is a major complication of DM (Aikaeli et al., 2022).

Traditional diets, typically consisting of whole grains, fruits, vegetables and legumes are often replaced with diets high in processed foods, unhealthy fats, added sugars and low in dietary fiber. This shift to a Westernized or “urban” diet increases the risk of NCDs, such as DM, hypertension, obesity and cardiovascular diseases (Olatona et al., 2018).

Kenya has witnessed upsurges in poor dietary habits, abdominal obesity, excessive alcohol consumption and sedentary lifestyles (World Health Organization, 2022).

2.4 Alcohol and Tobacco Consumption

Alcohol and tobacco consumption are both recognized as risk factors for the development of DM (Mishra et al., 2022). Particularly, excessive consumption of alcohol is linked with a higher risk of having type 2 DM. The correlation between alcohol and DM is complex and influenced by various factors including the amount and frequency of alcohol consumed. In a study conducted in China, only the high-risk alcohol drinkers of WHO drinking risk levels increased the risk of type 2 diabetes (T2DM) when compared to never drinkers. The risk of

type 2 diabetes mellitus rose with decreasing age at which alcohol consumption began, as well as with increasing years of alcohol consumption and intake—but only in men (Wu et al., 2021).

Alcohol consumption disrupts glucose metabolism and impairs insulin sensitivity. It can also lead to increased resistance of insulin, thereby making it more challenging for the body to utilize glucose effectively. Alcohol consumption can contribute to DM risk through weight gain and obesity. Alcohol is high in calories and excessive consumption leads to weight gain and an elevated risk of DM (Neelakantan et al., 2021). Heavy alcohol consumption can cause liver damage, including alcoholic fatty liver disease and cirrhosis.

Tobacco use, especially smoking of cigarette, is related with increased risk of developing type 2 DM (Carlsson et al., 2019). One of the mechanisms that contributes to this association is insulin resistance. Smoking can impair insulin sensitivity and increase resistance of insulin. The chemicals contained in tobacco can disrupt glucose regulation, causing increased blood sugar levels. The heightened risk of developing type 2 DM is also fueled by inflammation and oxidative stress. Tobacco smoke has various harmful chemicals that induce oxidative stress and inflammation in the body. Chronic inflammation and increased oxidative stress can lead to the advancement of insulin resistance and DM. Smoking tobacco influences body weight regulation. There are some individuals who use smoking as a means to suppress appetite or control body weight. Smoking cessation can lead to weight gain, which is a risk factor for DM (Mukharjee et al., 2020).

To understand the association between tobacco utilization, alcohol intake and DM among women, Mishra et al., (2022), find that smoking and using smokeles tobacco and alcohol

intake were risk factors for DM among women. The socioeconomic determinants of NCDs among women are well-documented with an increased risk amongst women from poor resource backgrounds. Consequently, the low-income women are highly likely to smoke and have a higher prevalence of many chronic ailments and associated risks compared to higher-income women (Walli-Attaei et al., 2020). Also important to note is that the co-existence of higher levels of tobacco use and alcohol consumption needs different approaches to tackle the susceptibility of women to DM, including early detection and screening of DM particularly among those people who chew or smoke tobacco and drink alcohol.

In a study done on DM correlates, correlates were: 13.1% smoking, 74.9% alcohol consumption, 75.7% high level of physical activity; 16.3% obese and 29% overweight with higher rates in women. In the KDHS 2022, nationally, 9% of people smoke daily in the home. A higher percentage of those in rural areas (11%) smoke daily in the home compared to the urban areas (5%). 12.9% of the men interviewed in Kiambu county smoke cigarettes. For males, Nairobi region has the highest proportion of users of legal alcohol (22.9%), followed by Central (22.2%), North Eastern (20.6%), Rift Valley (18.3%), Coast (17.6%), Eastern (16.8%), Nyanza (7.6%), and Western (6.8%). For females, Eastern region has the highest proportion (5.8%), followed by Nairobi (4.5%), Rift Valley (1.3%), Coast (1.9%), Nyanza (0.7%) and Central (0.5%)

2.5 Knowledge of DM

DM refers to a chronic metabolic disorder that happens when the pancreas fails to release enough insulin, or when the body cannot sufficiently utilize the insulin it releases. This leads to increased blood sugar which gradually leads to compounded organ damage. The most popular complications of DM entail – heart and blood vessels, eye complications, nervous

system, kidneys, and foot complications that necessitate amputations. Nonetheless, acute complications mostly happen like Diabetic ketoacidosis, and Diabetic non-Ketotic coma. The predisposing factors are: extreme body weight, too much alcohol consumption, progressing age, family history, sedentary lifestyle, stress, poor diet, gestational DM and chronic utilization of steroids.

Common symptoms of DM include: recurrent urination, excessive hunger, extreme thirst, mysterious weight loss, intensified fatigue, blurred vision, irritability, impotence and unresponsiveness or tingling feeling of the feet. In a study done in the general population in Saudi Arabia, of the participants, 86.8% were aware that pancreatic dysfunction can cause DM, 65.6% were aware that blood sugar rise occurs in DM, and around half (48.6%) recognized that DM is incurable (Alqahtani et al., 2020).

In a study conducted in Cameroon on the knowledge in DM in the general population, overall, 1524 persons (40.2% males) were included. Almost 99% of respondents had already heard of DM, but only 16.3% had ever received education on DM. The median score for the global knowledge was 79% (IQR 67–88). A person in the close circles of the participants (71.3%) or a health professional (58.8%) constituted the major sources of information; school (13.3%) and media (television (23.6%), newspaper/magazine (10.0%), radio (9.6%) and internet (6.8%) were less common. Younger ages (<45 years), lower levels of education, semi-urban residency, were independently associated with a lower level of knowledge on DM (Jobert et al., 2019).

2.6 Conceptual framework

Independent variable

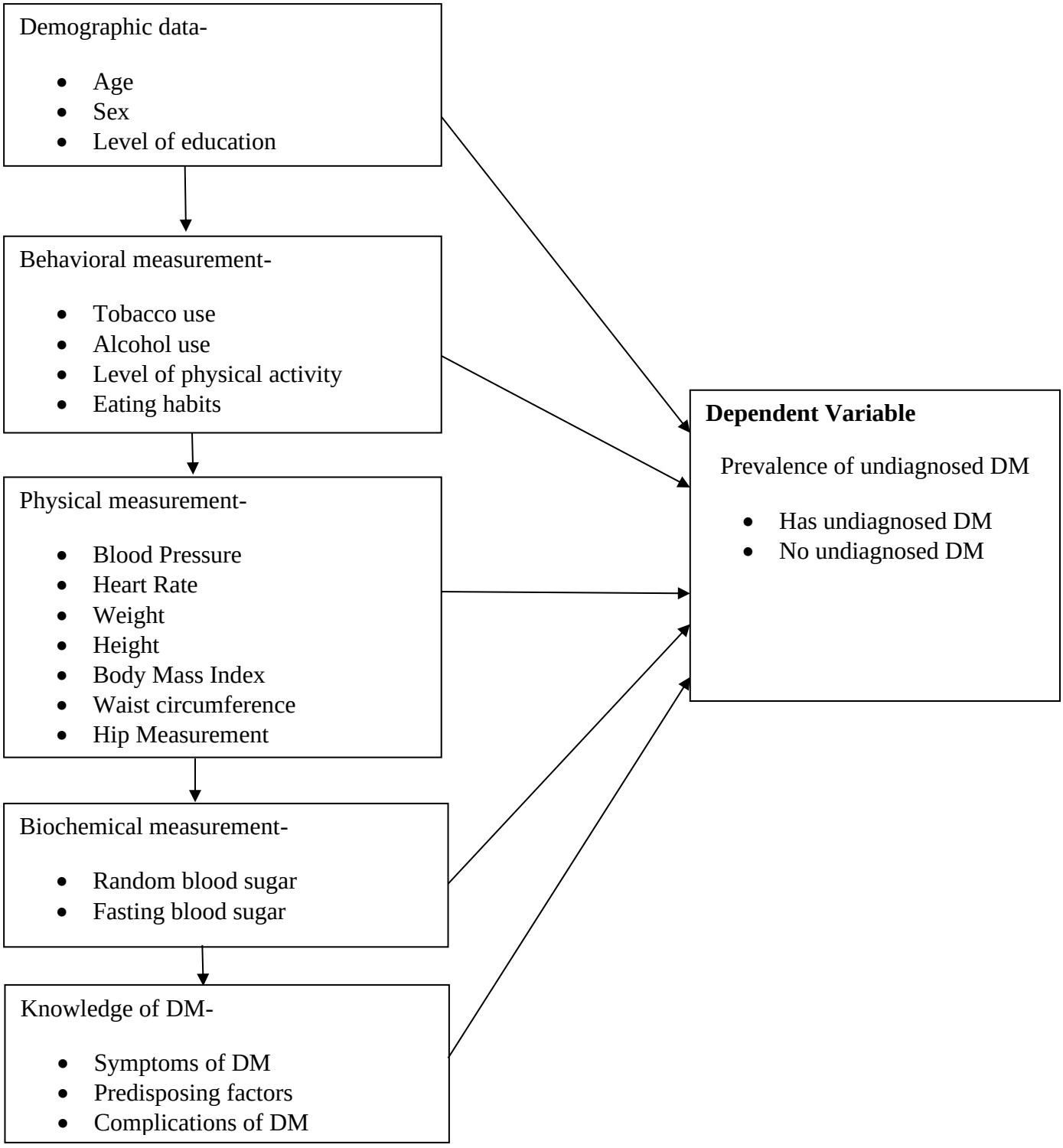

Figure 1: Conceptual framework. Source- researcher from literature review

Many risk factors are associated with DM mellitus in adults. The main ones are: poor diet, sedentary lifestyle, alcohol and tobacco use. Others include advancing age, family history of DM, other cardiovascular diseases such as hypertension, large waist circumference, overweight or have a high Body Mass Index .

2.7 Gaps to be filled

Many risk factors are associated with DM mellitus in adults. The main ones are: poor diet, sedentary lifestyle, alcohol and tobacco use. Others include advancing age, family history of DM, other cardiovascular diseases such as hypertension, large waist circumference, overweight or have a high Body Mass Index .

The prevalence of undiagnosed DM is unknown for most countries as it is given as an estimate globally. It is thus crucial to determine the exact prevalence of the disease and associated risk factors in specific counties to guide in the development of county specific evidence-based policies. Sources of knowledge of DM have also not been established in some studies conducted in Kenya (Kiberenge, Ndegwa, Njenga, & Muchemi, 2010). Information of these sources of knowledge would be essential in identifying the suitable media for distribution of health promotion strategies. DM knowledge leads to better management of the condition, and is acknowledged to be an essential segment of all-inclusive DM care.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This section provides the description and approaches that were used in undertaking the study. The sections covered are, study design, study area, study population, sampling procedure, inclusion criteria, exclusion criteria, data collection, data analysis, and ethical considerations.

3.2 Study Area

The study area was Thika Level 5 Hospital located in Thika west Sub County within Kiambu County. Kiambu County is located in the Central region of Kenya and has an area of 2,543 sq. km, the coordinates are 1.0418^0 S, 37.0787^0 E. The County has 15 Sub counties namely Kiambu, Limuru, Thika East, Thika West, Ndeiya, Githurai, Ruiru, Githuguri, Gatundu South, Gatundu North, Lari, Kabete, Kiambaa, Juja, and Kikuyu. It has a high population of 2,417,735.

Thika level 5 Hospital is a government facility located in Thika West Sub County along General Kago Road. It was started in 1946 as a native hospital tending to the locals during the colonial era. It attends to a catchment population of 454,166 individuals and also functions as a referral hospital for Kiambu County and its surrounding counties. On the in-patient capacity, Thika Level 5 Hospital has a capacity of 265 beds with an average occupancy of 311 patients, and a day-to-day admission rate of 65 patients. The out-patient department serves an average of 21,000 patients monthly and an average of 700 patients per

day (Kiambu County, 2022). The clinics in the outpatient department are: Casualty, Eye, Ear Nose and Throat (E.N.T.), Dental, Orthopedic, Medical, Diabetic, Antenatal Care, Physiotherapy and Pediatric outpatient clinics. The hospital was selected due to the high volume of patients as well as due to the fact that it is a referral hospital serving Kiambu County and other surrounding counties. The hospital is located in the Mount Kenya region that is known to have a high prevalence (15.4%) of DM (Sarah et al., 2021). This prevalence is way above the national average of 3.3% (IDF, 2021).

3.3 Study population

In this study, the target population was patients who are 18 years and above, presenting themselves at Thika level 5 Hospital outpatient department, Kiambu County.

The study included male and female patients who were seeking outpatient care and had various health concerns or conditions.

3.4 Study Design

This research used a cross-sectional analytical study design that allowed for the gathering of information from participants due to its applicability in determining prevalence. A modified WHO STEPS tool was administered to adult patients presenting at different outpatient clinics at the Thika level 5 hospital, Kiambu County.

3.5 Sample size determination

The sample size was analyzed using population survey formulation. Sample size was calculated based on prevalence of undiagnosed DM in Kenya at 32.4%. (Nkatha, 2015) The desired precision for the study was 0.05.

The study applied the population survey formula below:

$n = z^2 p (1-p) / d^2$

$n = 1.96^2 \times 0.324 \times 0.676/0.05^2 = 349$

10% of 349 to cater for refusals =35 (As some of the recruited participants were asked to return on a subsequent day.)

Where: z= standard normal distribution curve value for 95% CI which is 1.96 (where α=0.05)

d= absolute precision (0.05)

n=384

By using the population survey formula to calculate the sample size, the researcher ensured that the sample is adequately representative and that the results are robust.

3.5.1 Sampling procedure

The study recruited patients presenting at Thika Level 5 Hospital outpatient department. This study adopted purposive sampling procedure. The participants were identified as they exited the different outpatient treatment rooms, the clinics that were included are Casualty, Dental, ENT, Orthopedic, Eye and Medical and thus it was conducted as an exit interview. The researcher approached the patients as they were exiting the consultation rooms as well as those in the outpatient waiting areas as they waited to collect medication at the pharmacy area. We would then engage the patients in a short discussion on what the study entails. Those who agreed to partake in the research were directed to the specific area for consenting

and data collection, while those that did not agreed to participate were not engaged further. All participants recruited into the study were screened for DM and DM risk factors.

3.5.2 FGD sampling

The participants were selected from the previous day sample including those who were returning for a fasting blood sugar. A total of four FGDs were conducted on four separate days. The participants who were assessed to be information rich on the issues of community activities were selected to come in for the FGD based on their age and gender.

Table 1 shows the segmentation of FGD participants who were grouped by age and sex. The age cut off point was based on the fact that DM type 2 which is the most common type of DM in adults, is more common after the age of 40 years. The male and female grouping was done so as to get an opinion from the different genders. The participants who were thought to be information rich were selected to come in for the FGD.

Table 1: Focus Group Discussion participants

Table 2 Focus Group Discussion participants

Group name	Number of Participants
Male group 1 (<40years)	9
Male group 2 (>40years)	8
Female group 1 (<40years)	10
Female group 2 (>40years)	12
Total	**39**

3.6 Inclusion criteria

- Patients seeking treatment at Thika Level 5 Hospital outpatient department.
- Age above or equal to 18 years.
- Willing and able to provide informed consent.

3.7 Exclusion criteria

- Pregnant participants.
- Patients with a previous diagnosis of Diabetes Mellitus.

3.8 Data collection

A total of 126 participants were consented in English while 249 participants were consented in Swahili. The literate participants were given time to read through the consent after which the research assistants would then go over the informed consent and assess for understanding of the informed consent and study procedures. For the illiterate participants, the informed consent was spelled and explained to them by the researcher and research assistants in the presence of a witness following which they were assessed for understanding of the informed consent and study procedures. Once the participants had signed/ put a thumbprint on the informed consent, the modified WHO STEPS instrument was administered by the research assistants and other study procedures carried out.

A questionnaire (Appendix ii), partially adapted from the WHO STEPS Instrument for Chronic Disease Risk Factor surveillance, was utilized to gather data on DM risk factors. The sections in the questionnaire include: demographic data, behavior measurement on use of alcohol, tobacco products and level of physical activity, history of raised blood pressure

and DM, physical measurement of height, weight, blood pressure, Body Mass Index, waist and hip circumference, random blood sugar.

All recruited participants had a random blood sugar test done. Those with a random blood sugar >7.8 mmol/l were requested to return on a subsequent day for a fasting blood sugar test. Participants who were requested to return for further tests were facilitated with transport to enable them return for the follow up visit. The participants were to return the following day for a fasting blood sugar. 28 participants returned within the five days when the data collection was ongoing while 5 participants returned at a later date after being called on the mobile numbers provided in the questionnaire. The fasting blood sugar was done by a research assistant working at Thika Level 5 Hospital who was involved in the follow up. two participants with a random blood sugar above 7.8mmol/l did not return for a fasting blood sugar. A total of 12 participants were diagnosed with DM and referred to the DM clinic within Thika level 5 hospital through the casualty department. The diagnostic criteria used was a fasting blood sugar equal to or above 7.0 mmol/l.

3.8.1 Data Collection tools

The WHO STEP-wise method to NCD risk factor surveillance is a validated tool used for gathering, analysing and distributing data regarding key NCD risk factors in countries. This survey instrument analyses major behavioural risk factors including alcohol use, tobacco use, physical inactivity, poor diet, and also biological factors such as high blood pressure, overweight and obesity, and increased blood glucose.

An FGD guide (appendix iii) was used to collect qualitative data during the FGDs. Four focus group discussions were held, 2 for male participants and 2 for female participants. The

age of the participants was put into consideration with one group from each gender comprising of people below 40 years of age and the other group comprising people above the age of 40 years. The number of participants in each group was an average of eight. Members were informed the day before and the FGD was held with those returning for a fasting blood sugar the following day and other participants who consented to return for the FGD. The FGD was held within the hospital premises. There was a facilitator and a recorder who carried out the FGD. The facilitator introduced participants, explained the purpose of the study and moderated the discussion while the recorder kept time and recorded the proceedings. The discussions lasted for 1 hour on average. The main topics covered were on the awareness of DM by the community, intervention in the community to curb the disease and the issue of excessive alcohol consumption among men. The data was recorded using an audio recorder and by taking notes.

3.8.2 Research Assistants

The study incorporated research assistants who assisted in the collection of data from study participants. They administered questionnaires, performed physical evaluations such as weight, blood pressure, height, and recorded relevant information accurately and efficiently. The research assistants ensured that data collection was standardized, and adhered to the study guidelines. The research assistants, three females and one male then engaged the participants following training by the researcher. The training was conducted one week prior to data collection commencement. The training and standardization helped to ensure consistency in data collection and reduced potential bias or errors introduced by variations in data collection techniques. The research assistants received training on conducting

interviews, using measurement instruments, and following ethical guidelines, thereby improving the validity and reliability of the study's data.

One researcher and four research assistants drawn from the Thika Kenya Medical Training College were involved in the sampling procedure, data entry and management. The nature of their training enabled them to carry out the study procedures. The filling of the modified WHO STEPS instrument took an average of 20-25 minutes per participant. The Random blood sugar was done by the researchers who were trained prior to the start of data collection. The research assistants had language and cultural competence that facilitated ease of communication and engagement with study participants. This helped in overcoming language barriers and in explaining the questions in a way that the participants could understand and cooperation.

3.8.3 Reference ranges for the physical measurements and the blood sugar measurements

Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape that provided a constant tension. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. For both measurements, the participants were standing with feet close together, arms at the side and body weight evenly distributed, while wearing little clothing. The participants were relaxed, and the measurements were taken at the end of a normal expiration.

Table 3 Body Mass Index reference range

	BMI
Underweight	<18.5
Normal	18.5-24.9
Overweight	25.0-29.9
Obesity	30.0-39.9
Extreme Obesity	>40

Body mass index or BMI is a statistical index using a person's weight and height to provide an estimate of body fat in males and females of any age. It is calculated by taking a person's weight, in kilograms, divided by their height, in meters squared, or BMI = weight (in kg)/ height^2 (in m^2). The number generated from this equation is then the individual's BMI number. These classifications for BMI are used the World Health Organization (WHO) for White, Hispanic, and Black individuals.

Waist Circumference

Men Normal-<=94cm**,** High->94cm

Women Normal-<=80cm**,** High->80cm

Waist Hip Ratio

Men Normal<0.90**,** High>=0.90

Women Normal<0.85**,** High>=0.85

The cut-off points for the Waist Circumference and Waist Hip Ratio are chosen based on disease risk for Cardio Vascular Disease, type 2 DM and on hard outcomes such as mortality.

Blood Pressure

Normal Diastolic<90mmhg, High-Diastolic >90mmhg

Random blood Sugar

Normal <7.8mmol/l, High >=7.8mmol/l

Fasting Blood sugar

Normal <7.0mmol/l, High >=7.0mmol/l

3.9 Data analysis

The data analysis consisted of scrutinizing the questionnaire for accuracy and completeness, coding and keying in data into a database in SPSS (Statistical Package for Social Sciences). On SPSS, data was analyzed to produce summary of statistics and graphical displays. Univariate analyses included frequency tables (obesity, overweight, levels of physical activity, alcohol consumption, and tobacco use, level of education and sex of respondents in percentages), mean values (age of participants, weight, Body Mass Index). Comparative analysis was done for those found to have undiagnosed DM versus those without DM to show the association of risk factors with undiagnosed DM. Odds ratios for the association between DM mellitus and body mass indices and hypertension were computed, with 95% Confidence Intervals. Logistic regression was computed to measure the relationship between undiagnosed DM and the different risk factors. The level of significance was set at $p<0.05$ and a confidence interval of 95%.

Model Specification

The goal of this study was to establish a relationship among variables using Logistic regression. Logistic Regression is the ideal regression analysis to conduct when the dependent variable is binary. It is used to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variable.

Dependent variable:

Presence/absence of undiagnosed Diabetes Mellitus (binary)

Independent variables:

Age (continuous)

Sex (binary: male, female)

Level of education (categorical: no formal education, primary school, secondary school, tertiary education)

Tobacco use (binary: yes, no)

Alcohol use (binary: yes, no)

Level of physical activity (categorical: sedentary, low, moderate, high)

Eating habits (categorical: poor, fair, good)

Blood pressure (continuous)

Heart rate (continuous)

Body mass index (continuous)

Waist circumference (continuous)

Hip measurement (continuous)

Blood sugar test (continuous)

Model:

Logistic regression model with presence/absence of undiagnosed DM as the dependent variable and all independent variables included simultaneously.

Odds ratios and 95% confidence intervals were calculated for each independent variable

A p-value of <0.05 will be considered statistically significant

The model equation for logistic regression is:

$\text{logit}(p) = \ln(p / (1 - p)) = \beta 0 + \beta 1x1 + \beta 2x2 + ... + \beta nxn$

Where:

p is the probability of the outcome (presence/absence of diagnosed Diabetes Mellitus)

ln is the natural logarithm

β0 is the intercept or constant term

β1, β2, ..., βn are the coefficients for each independent variable x1, x2, ..., xn

To obtain the odds ratio (OR) for each independent variable, the coefficient (β) for that variable can be exponentiated:

$OR = \exp(\beta)$

For example, if the coefficient for tobacco use (x1) is $\beta 1 = 0.5$, the odds of diagnosed Diabetes Mellitus in individuals who use tobacco are:

$OR = \exp(\beta 1) = \exp(0.5) = 1.65$

This means that individuals who use tobacco are 1.65 times more likely to have diagnosed Diabetes Mellitus compared to those who do not use tobacco, all other variables being equal.

Following the FGD, the facilitator and recorder met to review and complete the notes taken. The recordings were then transcribed using the participants' own words followed by listing key statements and attitudes expressed during the discussion. The findings were then

summarized according to the objectives and analyzed using a thematic approach in order to capture the opinions of the participants of the FGD.

3.10 Ethical considerations

The proposal was presented to IREC of Moi University/ Moi Teaching and Referral hospital for approval before commencement of data collection. Concurrently, the proposal was submitted to the Thika Level 5 Hospital Ethics and research committee for approval. The approval letters can be found in the appendix section of this document.

Informed consent was sought from the study participants before being recruited into the study. Obtaining informed consent was crucial to ensure that participants had a clear understanding of the study's purpose, procedures, risks, benefits and their rights. In order to ensure confidentiality and privacy of the study participants there was use of identification numbers rather than the names of the study participants in processing research data. The data gathered was stored securely and only accessed by the researcher. Personal identifiers such as the mobile phone numbers were recorded in a separate sheet that was stored separate from the records with the participant's study identifier. Study procedures were explained to the participants by a medical officer before blood samples were drawn. The results of the blood sugar level were interpreted by the medical officer and explained to the participants in simple terms. Referral to the Thika level 5 hospital DM clinic and casualty department were done to ensure proper treatment for those found to have an elevated random blood sugar as well as those with an elevated fasting blood sugar level. The participants were at liberty to pull out from the study at any instance with no penalties.

Another ethical consideration was the minimization of harm. The researcher undertook measures to minimize any discomfort or harm to participants. This included ensuring participants' physical and psychological well-being by providing a friendly environment, and providing appropriate support or referral for any identified health issues or concerns. Participation in the study was entirely based on voluntary basis. The participants did not face any forms of coercion, pressure, or negative consequences for choosing not to participate or withdrawing their participation at any stage of the study.

The researcher together with other research assistants handled and analyzed the data with integrity and ensured accurate reporting of the findings. Finally, the researcher was mindful of cultural practices, norms and sensitiveness when interacting with the participants. The questionnaire was explained in a language that the participants could understand and the researchers were dressed in professional attire.

The researcher liaised with the hospital's management for the requisite approval processes. The participants were given a background of the study and they were assured that the information provided would be handled with utmost confidentiality and privacy. The participants were also assured that their feedback was purely for research purposes and would help towards policy intervention and resource allocation.

With the assistance of hospital management, the researcher was able to identify the participants who were seeking outpatient services. The hospital management established a collaborative relationship with the researcher and understood the objectives and requirements of the study. By fostering a collaborative environment, the hospital management actively supported the research process and facilitated participant

identification. The management of Thika Level 5 hospital also ensured that the research study attained the necessary approval and permissions for it to be conducted within the hospital premises. The management of the hospital also designated a research liaison officer who served as a point of contact between researchers and the hospital management. The contact person helped the researcher and the assistants to navigate the administrative processes and facilitated participant identification.

Thika Level 5 hospital management supported the researcher and assistants in the referral of the participants with elevated random blood sugar as well as those with an elevated fasting blood sugar. More importantly, the hospital management emphasized the importance of patient privacy and confidentiality to the researcher and ensured that all data collection and participant identification processes adhered to ethical guidelines and legal requirements.

CHAPTER FOUR

4.0 Results

4.1 Introduction

The final number of study participants was 375 representing a 98% response rate. There were nine questionnaires that were incomplete hence they were not included in the analysis.

4.2 Demographic characteristics

The mean age of the respondents was 36.4 (SD 13.5), with a range of 18 to 87 years.

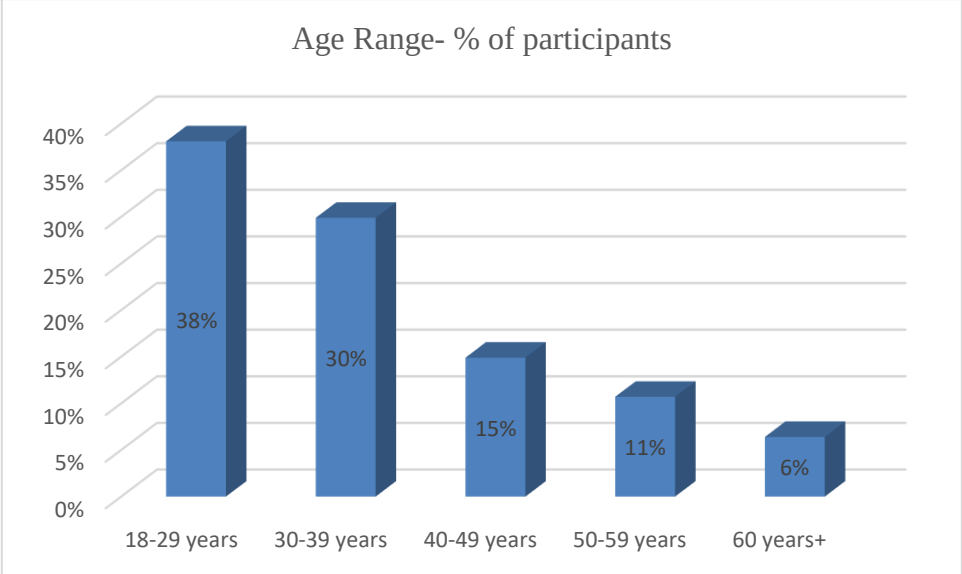

Figure 2: Age of participants

Majority of the participants had secondary school education (41.6%), while 2.9% had no schooling at all as shown in Table 3.

Table 4 Demographic characteristics

	Frequency	Percent (%)
Education level		
No schooling	11	2.9
Primary	104	27.7
Secondary	156	41.6
Tertiary	104	27.7

The results showed that 59.2% of the participants were females with 40.8% being males. Figure 3 below shows the absolute numbers.

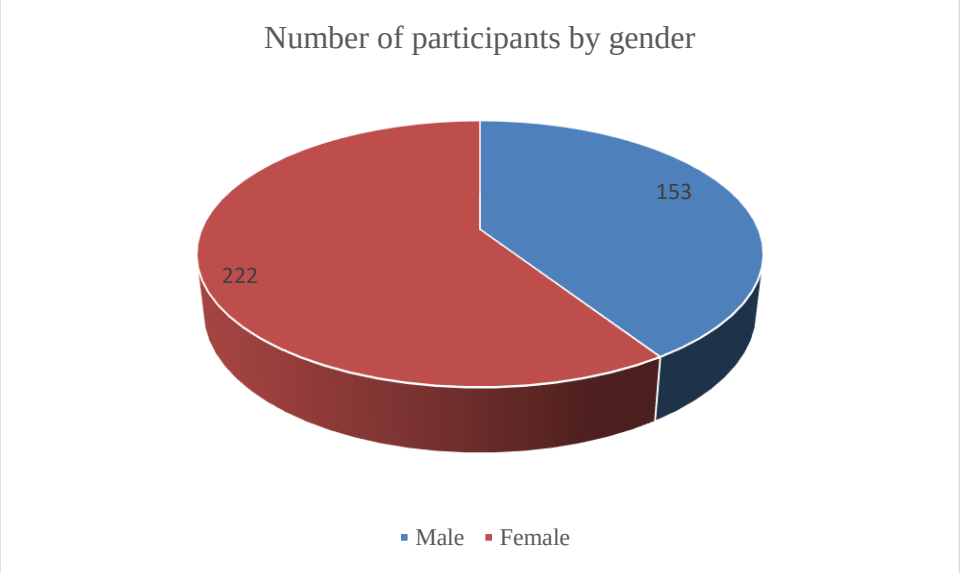

Figure 3: Number of participants by sex

4.3 Blood sugar level

The number of participants who had a random blood sugar above 7.8 mmol/l were 35(9.3 %), while 12(3.2%) out of the 375 participants had an elevated fasting blood sugar as shown in table 4.

Table 5 Number of participants with elevated random and fasting blood sugar level

	Frequency
Elevated random blood glucose (>7.8 mmol/l)	
Yes	35
No	340
Elevated fasting blood glucose (>7.0 mmol/l)	
Yes	12
No	363

4.4 Undiagnosed DM and demographic characteristics

Table 5 shows the relationship between the various demographic characteristics to having undiagnosed DM. Participants aged 60 years and above had the highest percentage of those diagnosed with DM (33.3%) versus those without. There was no increased risk of undiagnosed DM with the different levels of education.

Table 6 DM and demographic characteristics

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Sex				
Male	5 (41.7)	148 (40.8)	1.00	
Female	7 (58.3)	215 (59.2)	0.96 (0.30-3.09)	0.95
Age				
18-29 years	1 (8.3)	142 (39.1)	1.00	
30-39 years	2 (16.7)	110 (30.3)	2.58 (0.23-28.84)	0.441
40-49 years	4 (33.3)	52 (14.3)	10.92 (1.19-99.99)	0.034

50-59 years	1 (8.3)	39 (10.7)	3.64 (0.22-59.54)	0.365
60 years+	4 (33.3)	20 (5.5)	28.40 (3.02-266.97)	0.003
Education level				
No schooling	0 (0.0)	11 (3.0)	1.00	
Primary	5 (41.7)	99 (27.3)	1.08 (0.33-3.48)	0.904
Secondary	7 (58.3)	149 (41.0)	1.00 (1.00-1.00)	
Tertiary	0 (0.0)	104 (28.7)	1.00	

4.5 Behavioral measurement and undiagnosed DM

Tobacco use

Table 6 shows that the number of participants who were using tobacco (38) while the majority (337) were not using tobacco at the time of the interview. Only one participant with undiagnosed DM used hand rolled tobacco.

Table 7 Tobacco use and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Current tobacco use				
Yes	2 (16.7)	36 (9.9)	1.00	
No	10 (83.3)	327 (90.1)	0.55 (0.12-2.61)	0.452
Daily tobacco use				
Yes	1 (8.3)	34 (9.4)	1.00	
No	11(91.7)	329(90.6)	1.14(0.14-9.08)	0.904

Type of tobacco used				
Hand rolled cigarette	1 (8.3)	1 (0.3)		
Manufactured cigarettes	1 (8.3)	21 (5.8)		

According to results from Male FGD 1, smoking of cigarettes is as a result of parental influence and early exposure to the habit of smoking at home as well as by peers. "Parents send their children to the shops to buy cigarettes hence exposing them to cigarettes at a young age." (male FGD 1). Smoking cigarettes is considered a grown up activity and hence young men start smoking as a sign of maturity.

Alcohol consumption

Table 7 presents the level of alcohol consumption by the participants. Out of the 375 participants, 143 have ever used alcohol, while 232 had never used alcohol. None of the participants with DM took alcohol daily. 8.3% of those diagnosed with DM take alcohol.

Table 8 Alcohol use and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Ever used alcohol				
Yes	4 (33.3)	139 (38.3)	1.00	
No	8 (66.7)	224 (61.7)	1.24 (0.37-4.20)	0.728
Used alcohol in the past 12 months				
Yes	1 (8.3)	85 (23.4)	1.00	
No	11 (91.7)	278 (76.6)	3.36 (0.43-26.43)	0.249

Frequency of alcohol consumption in the past month				
<1 per month	1 (8.3)	26 (7.2)		
1-3 per month	0 (0.0)	11 (3.0)		
1-4 per week	0 (0.0)	40 (11.0)		
5-6 per week	0 (0.0)	4 (1.1)		
Daily	0 (0.0)	3 (0.8)		
Alcohol use in the past 30 days				
Yes	0 (0.0)	65 (17.9)		
No	12 (100.0)	298 (82.1)		

According to findings from female FGD 1 and 2, there is a lot of alcohol consumption among the men. Most tend to use the illegal brews found in the village. The female FGD participants raised lack of employment as one of the reasons people indulge in alcohol, this is because they have a lot of time as well as the stress that comes with unemployment. "people take a lot of alcohol because of stress and depression. They also take alcohol for leisure." (Female FGD 2). Idleness is a contributor to alcoholism. "The unemployed citizen will take alcohol on a daily basis while the working class will take alcohol over the weekend only." (Male FGD 1). Other reasons raised included peer pressure and lack of role models for the young men. Findings from all FGDs showed that stress is considered as the main cause of excessive alcohol consumption. The male FGD 1 and 2 reported marital stress as the main cause of excessive alcohol consumption. Family influence was also raised as one of the reasons for alcohol consumption in that if a member of the family take alcohol, then the likelihood of their children indulging in the habit is also high. "Parents do not advise their children accordingly in regards to the harms caused by alcohol abuse." (Male FGD 1). "Poverty is

a major contributor to alcoholism. Poor wages or low income yet they have many responsibilities in the family. They thus opt to use the little income to drown their stress." (Male FGD 1). Alcohol is considered a remedy for certain illnesses such as stress and amoeba. "People use alcohol and smoke cigarettes mostly due to stress, for leisure, some people are addicted and cannot do anything without alcohol, some people say alcohol is medicine for example Chang'aa is said to be medicine for amoeba." (Male FGD 2).

Physical activity

Table 8 presents the number of participants who engage in the different stages of physical activity in the two categories namely, those with undiagnosed DM versus those without DM. A total of 301 of the respondents without DM walk or cycle for more than 10 minutes per day while 12 of the respondents with DM walk or cycle for more than 10 minutes per day. A total of 88 participants without DM participate in vigorous sports and leisure activities while 4 participants with DM take part in vigorous sports and leisure activities.

Table 9 Physical activity and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Performs vigorously intense work				
Yes	6 (50.0)	175 (48.2)	1.00	
No	6 (50.0)	188 (51.8)	0.93 (0.29-2.94)	0.903
Performs moderately intense work				
Yes	2 (16.7)	132 (36.4)	1.00	
No	10 (83.3)	230 (63.4)	2.87 (0.62-13.29)	0.178
Walks or cycles >10 minutes daily				

Yes	12 (100.0)	301 (82.9)		
No	0 (0.0)	62 (17.1)		
Vigorous sports and leisure fitness				
Yes	4 (33.3)	88 (24.2)	1.00	
No	8 (66.7)	275 (75.8)	0.64 (0.19-2.18)	0.475
Moderate sports and leisure fitness				
Yes	0 (0.0)	36 (9.9)		
No	12 (100.0)	327 (90.1)		

Majority of the participants do not participate in any sporting activity. Some of the reasons raised during the FGD include: "There should be regular forums where people are educated on how to prevent the disease even in our schools. The local authorities should also set aside areas where people can exercise." (Male FGD 1). There is lack of knowledge on the essence of physical activity in disease prevention. People exercise but still smoke and take alcohol hence negating the benefits gained during exercise. The FGD participants who exercise reported they exercise because they love certain sports such as football not because they are aware of the health related benefits. Exercise is considered a way of passing time for the youth. "Majority of the old people in the community consider exercise to be for young people hence they don't exercise." Male FGD 1 Parent do not encourage their children to take up sports but instead they push them to study. "Parents do not encourage their children to be involved in sports. They encourage the children to focus on academics and not sports. Sporting activities are considered as a waste of time and are regarded as not important." (Male FGD 1). The people in the community are involved in a lot of manual jobs such as digging which is considered as physical activity. "My work is my exercise. I don't have time

to exercise after work. By evening I am so tired I can't think about exercise." Male FGD 1. The people who tend to exercise have already been diagnosed to have DM or obesity. "Where I live I have not seen people exercising. I know one person who is obese and he has DM, he currently walks as a form of exercise." Male FGD 2 Majority of the female FGD participants do not exercise and are not involved in any manual jobs. The reasons cited for not exercising are lack of knowledge on the importance of exercise. "We don't exercise because we don't know exercise is useful." Female FGD 2).

There are no dedicated exercise facilities in the areas where the FGD participants live. School fields are the only freely available spaces where one can run without paying. "There are no exercise facilities in the area where I live. People in the community do not even advocate for exercise facilities. People do not utilize gyms. There was a gym but it was closed down after a short period because people were not using them. Even if there was a gym, people don't have money to pay for a gym because they have other priorities like food and rent." (Male FGD 1). According to all FGDs, there are no exercise facilities provided by the local authorities. People would have to pay to use the gyms within the residential areas which in itself is a barrier to accessing exercise.

4.6 Physical measurement and undiagnosed DM

As shown in Table 9, 79 participants without DM had a diastolic blood pressure above 90 mmhg while 7 of the DM participants had an elevated blood pressure. Out of the 12 participants with DM, 11 had a high waist to hip ratio. In terms of BMI, 6 were overweight, 1 was obese while 5 had normal BMI.

Table 10 Physical measurements and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Elevated diastolic blood pressure				
<90 mmHg	5 (1.7)	284 (98.3)	1.00	
>90 mmHg	7 (8.1)	79 (91.9)	5.03 (1.56-16.29)	0.007
BMI				
Underweight	0 (0.0)	18 (100.0)	1.00	
Normal	5 (2.8)	175 (97.2)	1.43 (0.16-12.51)	0.747
Overweight	6 (4.9)	117 (95.1)	2.56 (0.30-21.85)	0.389
Obese	1 (2.0)	50 (98.0)		
Extreme obesity	0 (0.0)	3 (100.0)		
Waist circumference				
Normal	8 (3.4)	224 (96.6)	1.00	
High	4 (2.8)	139 (97.2)	0.81 (0.24-2.73)	0.728
Waist hip ratio				
Normal	1 (1.2)	85 (98.8)	1.00	
High	11 (3.8)	278 (96.2)	3.36 (0.43-26.43)	0.249

4.7 Knowledge of DM and undiagnosed DM

Signs and symptoms of DM

As shown in table 11, the symptoms that the participants were aware of are frequent urination (107), excessive thirst (100), and excessive hunger (100). A smaller number of participants were aware about the other symptoms listed in the questionnaire.

Table 11 Knowledge of DM-signs and symptoms and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Frequent urination	5 (4.7)	102 (95.3)	1.83 (0.57-5.89)	0.312
Excessive thirst	5 (5.0)	95 (95.0)	2.02 (0.62-6.50)	0.241
Excessive hunger	5 (5.0)	95 (95.0)	2.02 (0.62-6.50)	0.241
Weight loss	1 (2.6)	38 (97.4)	0.78 (0.10-6.19)	0.812
Fatigue	1 (2.9)	33 (97.1)	0.91 (0.11-7.26)	0.928

Predisposing factors

100% of the participants had heard about DM. Based on findings on Table 12, knowledge of the other common predisposing factors was low among the participants. 55 participants without DM knew DM was caused by lack or resistance to insulin, 96 knew about poor diet, while 83 knew about lack of exercise. Amongst those with DM, 1 knew DM was caused by lack or resistance to insulin, 3 knew about poor diet, while 3 knew about lack of exercise.

Table 12 Knowledge of DM-predisposing factors and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Never heard about DM	12 (3.2)	363 (96.8)	1.00 (1.00-1.00)	
DM is caused by lack of insulin or resistance	1 (1.8)	55 (98.2)	0.51 (0.06-4.02)	0.522
DM is related to poor diet	3 (3.0)	96 (97.0)	0.93 (0.25-3.50)	0.911
Lack of exercise is related to DM	3 (3.5)	83 (96.5)	1.12 (0.30-4.25)	0.863

According to all FGDs, DM is caused by eating foods with a lot of sugar. "People believe DM is caused by old age from 65 years and above. I believe anyone can get DM, it is caused by sugary food and lack of exercise." (Male FGD 1). Some people believe it is a curse as reported in Male FGD 1 and Female FGD 1. "There are people who believe it is a curse passed from one generation to another." (Male FGD 1). Stress was reported as a cause of DM across all the FGDs, "DM is caused by stress especially marriage related stress and business related stress. There are a lot of marriage related conflicts, money is one big source of conflict within marriage. The stress then causes DM and hypertension." (Male FGD 2). Some FGD participants did not know what causes DM. "I don't know what causes DM. Nowadays even young people have DM." (Female FGD 2).

Complications of DM

Table 13 shows the knowledge on complications of DM. 77 of the participants without DM had heard about visual impairment, 71 knew about kidney failure, while only 28 knew about stroke. 4 of the participants with DM had heard about visual impairment, 3 knew about kidney failure, while none knew about stroke.

Table 13 Knowledge of DM-complications of DM and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**P**
Visual impairment	4 (4.9)	77 (95.1)	1.86 (0.54-6.33)	0.322
Kidney failure	3 (4.1)	71 (95.9)	1.37 (0.36-5.19)	0.643
Heart failure	1 (2.3)	42 (97.7)	0.69 (0.09-5.52)	0.731
Stroke	0 (0.0)	28 (100.0)	1.00 (1.00-1.00)	

Poor wound healing	5 (6.4)	73 (93.6)	2.84 (0.88-9.20)	0.082
Amputation	5 (6.5)	72 (93.5)	2.89 (0.89-9.36)	0.077

The FGD participants attributed the cause of DM to being fat and high sugar intake. Family history of DM was also mentioned as a risk factor of DM in other family members. There is poor knowledge on the causes, risk factors and complications of DM as indicated in the FGD: "We have heard about DM specifically from neighbors, friends and relatives who are either living with the disease or have died of DM. I have not heard of a forum where people are taught about the disease." (Female FGD 2) "What I have heard from the media is that one gets DM from the food they eat especially food high in sugar, being overweight and as a result of lack of exercise." (Male FGD 2). There is no awareness of DM within the community. "There is no community awareness about DM. The only time people know about DM is when they are diagnosed with DM, that is when they want to know more about it. People are not concerned about it because they are not affected by it." (Male FGD 1). According to findings from all FGDs, there is no DM awareness. The only signs and symptoms that the FGD participants raised were on complications of DM rather than DM itself. This shows they have only interacted with people who have DM complications. "I have never seen or heard anyone educating people on DM. I've never seen any information on DM while visiting a hospital. I have heard about it on radio stations." (Female FGD 2). The participants from all FGDs reported they had seen awareness raised on other health matters such as HIV, Polio, family planning and Cancer but never about DM.

4.8 Diet

Table 14 shows that junk or processed foods were taken more frequently in between meals and not as main meals. Out of the total participants, 75 (20%) reported that their snacks comprised junk/ processed foods and 168 (44.8%) reported that for them snacks comprised a mixture of healthy and junk foods. For breakfast most 282 (75.2%) participants reported having healthy but unbalanced meals while lunch was mostly either healthy/ balanced 191 (50.9%) or healthy/ unbalanced 182 (48.5%) diet. No junk foods were taken during supper and most 271 (72.3%) participants reported having healthy/ balanced diet for supper.

Table 14 Reported dietary intake among adult patient in Thika level 5 Hospital

	Breakfast		**Lunch**		**Supper**		**Snacks**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Healthy and balanced	41	10.9	191	50.9	271	72.3	6	1.6
Healthy not balanced	282	75.2	182	48.5	104	27.7	126	33.6
Junk/processed foods	11	2.9	1	0.3			75	20
Mixture of healthy and junk foods	41	10.9	1	0.3			168	44.8
Total	375	100	375	100	375	100	375	100

A healthy diet included the following; fruit, vegetables, legumes (e.g. lentils and beans), nuts and whole grains, little intake of free sugars and minimal intake of food with saturated fats. Junk food was described as food that was high in calories from macronutrients such as sugar

and/or fat, and sodium, making it hyper-palatable, but with insufficient dietary fiber, protein, or micronutrients such as vitamins and minerals.

Overall, 129 out of the 375 (34%) participants reported that they did not consume any junk or processed food during any of the main meals or snacks served on a typical day. The demographics and physical measurements of these group was compared to that of participants who consumed any junk or processed foods on a routine basis and are presented in tables 15 and 16.

Dietary habits and demographics

Table 15 shows that there was a significant association between dietary habits and participants' age ($p < 0.001$) but gender was not significantly associated with dietary habits ($p = 0.159$). The older age groups were less likely to report consumption of junk foods (12.5% in 60 years+ and 42.5% in 50-59 years) compared to younger participants (76.9% in 18-29 years, 73.2% in 30-39 years and 60.7% in 40-49 years). Considering gender 94 (61.4%) males reported junk/ processed food consumption compared to 152 (68.5%) females.

Table 15 Dietary habits of survey participants and demographic characteristics

	Consume junk/ processed foods		**P value**
	No	**Yes**	
Age			
18-29 years	33 (23.1)	110 (76.9)	<0.001

30-39 years	30 (26.8)	82 (73.2)	
40-49 years	22 (39.3)	34 (60.7)	
50-59 years	23 (57.5)	17 (42.5)	
60 years+	21 (87.5)	3 (12.5)	
Gender			
Male	59 (38.6)	94 (61.4)	0.159
Female	70 (31.5)	152 (68.5)	

Physical measurements and diet

There was no significant association between BMI and self-reported dietary intake of junk/ processed foods (p = 0.169). Obesity and extreme obesity occurred in 37 (15%) and 2 (0.8%) participants who consumed junk foods compared to 14 (10.9%) and 1 (0.8%) of participants who did not consume junk/ processed foods.

There was a negative significant association between self-reported dietary habit and hypertension (p = 0.03). The proportion of patients consuming junk food who had hypertension was 19.5% compared to 29.5% for those who did not consume junk food. However, it was also noted as reported in table 15 that patient age was significantly associated with dietary practices, and also with hypertension possibly explaining this negative association between dietary habit and hypertension.

Waist circumference (p = 0.067) and waist to hip ratio (p = 0.682) were not significantly associated with dietary habits.

Table 16 Dietary habits of survey participants and physical measurements

	Consume junk/ processed foods		
	No	**Yes**	**P**
Elevated diastolic blood pressure			
<90 mmHg	91 (70.5)	198 (80.5)	0.03
>90 mmHg	38 (29.5)	48 (19.5)	
BMI			
Underweight	2 (1.6)	16 (6.5)	0.169
Normal	68 (52.7)	112 (45.5)	
Overweight	44 (34.1)	79 (32.1)	
Obese	14 (10.9)	37 (15.0)	
Extreme obesity	1 (0.8)	2 (0.8)	
Waist circumference			
Normal	88 (68.2)	144 (58.5)	0.067
High	41 (31.8)	102 (41.5)	
Waist hip ratio			
Normal	28 (21.7)	58 (23.6)	0.682
High	101 (78.3)	188 (76.4)	

According to Male FGD 1, people eat anything without taking into consideration what they are eating. In as much as we are taught about diet in schools, people don't eat a balanced diet. They tend to eat a lot of starch. "I know someone who has DM. What I know is that if someone has DM and they take the medicine and the foods that they are supposed to take, the DM is well controlled. I know that you need to be tested for DM and from there you start taking the foods that are advised. You are also supposed to avoid the things that are not supposed to be taken by people with DM. I've seen someone with DM and they are very healthy, as long as you eat the right foods you should be okay." (Male FGD 2).

Treatment of Diabetes Mellitus (DM)

People seek treatment at referral hospitals because that is where medication for the disease is available. "People seek treatment when it is too late and hence they go to Kenyatta National Hospital (KNH) because the disease is advanced. The small facilities are not well stocked with medication and hence most people prefer to go to the bigger facilities or private hospitals. Some people are poor and do not have money to go to hospital so they go to churches to be prayed for." (Male FGD 1). Due to poor knowledge on DM, some FGD participants reported one can only get DM treatment at KNH or outside the country. "People with DM go to KNH. DM can only be treated at KNH or outside the country." (Female FGD 1). According to Male FGD 2, some people travel far to collect DM medication because the local clinics do not have the DM medication. Some people reported that people with DM take herbs for the disease. "People seek for treatment at the local healthcare facilities, some

take herbs." (Female FGD 1). Some people seek treatment at the pharmacies according to male FGD 1.

4.9 Other risk factors: Family history

Table 10 shows the family history of DM, 33.3% of those with DM had a Family history of DM while 12% of those without DM had a family history of DM. This indicates a strong correlation between having DM and having a close family member with the disease.

Table 17 Family history of DM and undiagnosed DM

	Undiagnosed DM			
	Yes	**No**	**OR (95 % CI)**	**p**
Family history of DM				
No	8 (2.4)	319 (97.6)	1.00	
Yes	4 (8.3)	44 (91.7)	3.63 (1.05-12.54)	0.042

According to the FGDs, participants said they learnt about DM from relatives or neighbors who had the disease. They were also aware that DM runs in families. "People believe DM is hereditary in that if one family member has DM another member in the family can have DM." (Male FGD 1).

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Demographics and undiagnosed DM

With regard to age, patients aged over 60 years and those aged 40-49 years were at least 10 times more likely to have undiagnosed DM compared to the patients in the youngest age group (18-29 years). In a systematic review done, it was observed that the risk of DM increases with aging in overweight individuals, and the risk decreases with a moderate level of physical activity. Aging was considered as triggering the association between independent risk factors and risk of DM (Ismail et al., 2021).

5.2 Prevalence of undiagnosed DM

It was determined that 3.2% of adult patients attending outpatient care had undiagnosed DM. The prevalence reported in the current study is comparable to the projected nationwide estimate of 3.3% for DM in the Kenyan population and the regional prevalence of 4.5% in Africa (IDF, 2021). The finding of a relatively low prevalence of undiagnosed DM was unexpected because the study setting is known to have a higher prevalence (15.4%) of DM in the country and as such the study anticipated a higher prevalence of undiagnosed DM compared to the national estimates of 3.3% (Sarah et al., 2021). This could be because the study focused on newly diagnosed diabetics as compared to other studies that include both the new and known cases of DM. Nonetheless the findings are important considering that initiating DM treatment early is beneficial and the risks of complications associated with undiagnosed DM can range from mild to debilitating and life threatening conditions like limb amputation and DKA (Ali et al., 2022). Separately, with regard to the prevalence of

undiagnosed DM and considering that the African region has the highest prevalence of undiagnosed DM estimated at 53.6% of the global burden (IDF, 2021). The findings reported in this study are important because they represent an initial step towards quantifying and addressing the largest contribution to the worldwide burden of undiagnosed DM.

Notwithstanding the issues related to DM prevalence discussed above, it is possible that the current study underestimated the prevalence of undiagnosed DM because the study reported an overall prevalence of DM as opposed to an age adjusted prevalence. A previous study in Kenya determined that the age adjusted prevalence of DM was 4.0% corresponding to a slightly higher estimate compared to that reported in Thika Level 5 (IDF, 2021). To overcome this limitation in this study, age-specific prevalence rates for undiagnosed DM were calculated and these age-specific estimates provided evidence of an age effect on DM prevalence with prevalence ranging from 0.7% in patients 18-29 years and 16.7% in patients aged 60 years and above.

5.3 Behavioral measurements and undiagnosed DM

This section is on the behavioral measurements that were assessed in this study.

5.3.1 Level of physical activity and undiagnosed DM

This study did not establish significant association between undiagnosed DM and level of physical activity. The study demonstrated a high level of physical activity among the participants as 84.3% of the participants reported to walk or cycle for more than 10 minutes per day. Other studies have reported a high level (92.3%) of physical activity among the participants with DM and those without DM (Gichu et al., 2018). However, there was a low level of vigorous and moderate sports and leisure activities recorded in this study. Several

factors associated with urbanization can deter individuals from becoming more active, because of the fear of crime and violence in outdoor sections, high-density traffic, and lack of parks, sidewalks and sports/recreation areas or facilities.

5.3.2 Alcohol and tobacco consumption and undiagnosed DM

This research did not find significant correlation between undiagnosed DM and alcohol and tobacco consumption. In this study, 38% of the participants had ever used alcohol and 10% had ever used tobacco products. This could be due to participant self-report of behavioral patterns like alcohol and tobacco consumption. This approach could result in reporting bias especially for question related to the quantities consumed and frequency of consumption. In a Study on alcohol consumption and cigarette smoking it was shown that Smoking and alcohol intake status was not significantly associated with DM (Anthony et al., 2021).

The lack of an effect of the behavioral measurements on DM in the current study could be attributed to the approach adopted for measuring lifestyle risk factors for DM which were based on participant self-reporting of behavioral patterns like alcohol and tobacco consumption. This approach could result in reporting bias especially for question related to the quantities consumed and frequency of consumption.

5.4 Level of knowledge on DM

This study did not establish significant connection between undiagnosed DM and patient knowledge about DM. A hundred percent of the participants had heard about DM based on the results from the questionnaire. Knowledge of the other common predisposing factors was low among the participants. A total of 55 participants without DM knew DM was caused by lack of insulin or resistance to insulin, 96 knew about poor diet, while 83 knew about lack

of exercise. Amongst those with DM, one knew DM was caused by lack or resistance to insulin, three knew about poor diet, while three knew about lack of exercise. A study conducted in London, UK showed that half of participants had adequate or good awareness about the symptoms, risk factors and lifestyle choices commonly associated with DM, yet the study still highlighted gaps in awareness among the remaining proportion of participants (Kayyali et al., 2019).

5.5 Physical measurements and undiagnosed DM

In the present analysis three factors namely elevated blood pressure, age, and a family history of DM showed significant associations with prevalence of undiagnosed DM. Patients with elevated blood pressure (diastolic BP > 90mmHg) were at five times higher risk of undiagnosed DM compared to those with normal blood pressure, a finding that is consistent with a study conducted that showed that 76.3% of patients with DM also had Hypertension (Yildiz et al., 2020).

Other physical measurements such as Waist to Hip Ratio were not associated with increased risk for DM in this study. These factors have however been widely associated with DM in previous studies to the extent that some of these factors associated with sedentary lifestyles for example out-of-range physical measurements are considered to be well established risk factors for DM. Waist Circumference and Waist to Hip ratio were closely related to DM than BMI among study participants ≥ 40 years of age, especially in females (Zhang et al., 2021). The lack of an effect of the waist hip measurements on DM in the current study could be attributed to having few cases for comparison of these risk factors resulting in lack of adequate power to support statistical analysis of the risk factors. Future studies adopting case

control designs for rare outcomes should be used to confirm whether the known risk factors of diagnosed DM are also important in predicting undiagnosed DM.

In common with the association between undiagnosed DM and elevated blood pressure, the finding of an association between age and undiagnosed DM has been documented in previous studies where elevated blood pressure was more common in patients with DM but also DM was also more common in elevated blood pressure than in the general population. Therefore, there is a chicken-egg relationship between elevated blood pressure and DM (Jia et al., 2021).

5.6 Other risk factors associated with undiagnosed DM; family history

In this study, participants with a family history of DM were at least 3 times more likely to have undiagnosed DM compared to the patients with no known family history of DM. In a different study conducted in Kenya, having a first degree relative with DM was associated with over three times higher odds of T2D with 50% reduction in odds after adjustment for all covariates. (Anthony et al., 2021).

5.7 Summary of main findings

The main findings in the study showed that three factors namely elevated Diastolic blood pressure >90 mmhg, age above 60 years, and a family history of DM showed significant associations with prevalence of undiagnosed DM. Patients with elevated blood pressure (diastolic BP > 90mmHg) were at five times higher risk of undiagnosed DM compared to those with normal blood pressure while participants with a family history of DM were 3 times more likely to have undiagnosed DM compared to the patients with no known family history of DM.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusions

This study documented the prevalence of undiagnosed DM as 3.2% conforming to existing regional and national projections. Elevated Diastolic blood pressure >90 mmhg, family history of DM in a first degree relative and advancing age above 60 years showed significant association with undiagnosed DM.

There is a high level of physical activity, however, vigorous sports and leisure activity is low. One of the reasons cited for lack of involvement in vigorous sports and leisure activity is lack of the facilities and space needed. When there is a lack of leisure facilities such as sports complexes, gyms or recreational centers in the community, persons with undiagnosed DM may not have access to suitable venues for engaging in physical activities. This limited availability often discourages them from partaking in vigorous sports or leisure activities.

There is little knowledge on DM and associated risk factors as most of the knowledge is from relatives or neighbors with DM.

6.2 Recommendations

Based on the outcomes and inferences, the study gives these recommendations with regards to the prevalence of undiagnosed DM and associated risk factors among adults.

Policy recommendations

To healthcare providers: This study had demonstrated that approximately 1 in every 33 individuals presenting in the OPD will have undiagnosed DM. The study recommends that

patients presenting to OPD with risk factors of DM should undergo routine screening to ensure early diagnosis and treatment of DM. The screening for DM should target patients with elevated blood pressure, those with advanced age especially after 60 years and those with a family history of DM because these factors are significantly associated with undiagnosed DM. Routine screening helps in the early detection and diagnosis of DM. Many persons with DM may be asymptomatic or have mild symptoms in the early stages of the disease. By screening patients with risk factors, healthcare providers can identify individuals with undiagnosed DM and initiate timely interventions and treatment.

Healthcare providers must also intensify routine screening because it is cost-effective in the long run. Early detection and management of DM helps prevent or delay complications that require costly medical interventions, hospitalizations, and long-term healthcare. By identifying and treating DM at an early stage, healthcare providers can potentially reduce the economic burden associated with DM care and complications. It is also crucial to note that routine screening for DM risk factors aligns with public health goals of intervention and control of non-communicable diseases. By implementing screening programs, healthcare providers contribute to population-level disease surveillance and management. Identifying individuals with DM risk factors and offering appropriate interventions can have a positive impact on the overall health of the population, reduce the prevalence of undiagnosed DM and help in achieving public health targets.

To ensure that healthcare providers provide necessary screening routines, policies must be intensified towards capacity building and training. This includes continuous medical education programs, workshops, and skill-building initiatives that enhance healthcare providers' knowledge and skills in DM prevention, diagnosis, treatment and management.

The policies should also address the need for specialized training for healthcare professionals in specific areas such as DM education, foot care, and DM-related complications

The Ministry of Health should carry out campaigns to educate people on DM with the focus being on the modifiable risk factors. Majority of the participants learnt about DM from a relative or a neighbor as opposed to from healthcare workers or the media. One of the reasons that the Ministry of Health needs to intensify campaigns is for awareness creation and prevention. Education campaigns play an important role in raising awareness about DM and its modifiable factors. By disseminating information about lifestyle factors that contribute to the development of DM, such as sedentary lifestyle, unhealthy diet, obesity, and smoking, individuals can make informed decisions and take proactive steps to prevent onset of DM. Education empowers individuals to adopt healthier behaviors, make positive lifestyle changes and reduce their risk of developing DM.

By promoting healthy eating, regular physical activity, weight management, and smoking cessation, campaigns can empower individuals to take actionable steps to minimize their risk. Education and awareness can promote behavior change and encourage individuals to make positive choices that contribute to the prevention of DM.

To the government through Ministry of Land, Housing and Urban Development: Develop policies that encourage availing of parks, sidewalks and sports/recreation facilities near residential areas. Sidewalks, parks, and recreation facilities near residential areas will provide opportunities for physical activity and exercise. Accessible and well-designed parks with amenities such as walking paths, playgrounds and sports facilities will encourage individuals and families to engage in regular physical activity. Such policies will help

combat sedentary lifestyles and contribute to improved public health outcomes by promoting active living and reducing the risk of NCDs including obesity, cardiovascular disease and DM. Also important to note is that parks and recreational facilities serve as community gathering spaces that foster social interactions and promote community engagement. By developing policies that encourage the building of these amenities near residential areas, both county government of Kiambu and the national government can create opportunities for neighbors to connect, socialize and participate in shared recreational activities. The lack of facilities was cited as one of the reasons people do not engage in vigorous sports and leisure activities.

Areas for Further Research

Case-control studies need to be undertaken to confirm the association between undiagnosed DM and the established risk factors for DM including physical measurement, physical activities, and lifestyle habits.

To carry out studies that study diet habits in terms of quantities and the specific foods taken under direct observation to eliminate recall bias, and self-reporting bias. This study did not quantify the foods eaten and it involved self-reporting which is a limitation to the study.

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APPENDICES

Appendix 1: Informed Consent Form

Part A

Introduction and purpose of the study

You are invited to participate in a research study conducted by Eddah Mwihaki from Moi University. The purpose of this research is to identify how common DM mellitus is amongst people visiting Thika Level 5 hospital. This will in turn assist with making recommendations on testing for the disease in people visiting the hospital, hence ensuring early detection of the disease.

I am doing research on the cases of undetected DM mellitus in people who have visited the hospital and the factors that put one at an increased risk of having the disease. DM is very common in this region of Kenya. This consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask me or another researcher in my team.

Title

Prevalence of undiagnosed DM mellitus and associated risk factors of the disease among adults in Thika level 5 hospital outpatient department.

Study procedures

You will be asked a number of questions relating to the study. Weight, height, abdominal circumference and a random blood sugar will be measured. A random blood sugar measures the level of sugar in your blood when you have eaten in the past eight hours. A random blood

sugar above 7.8mmol/l indicates a high likelihood of being Diabetic. However, the random blood sugar is not used as a measure of diagnosing DM hence the reason why you will be asked to return at a later date for a fasting blood sugar which can then be used to diagnose the disease. You will be required not to eat for at least 8 hours before the test. Transport will be provided by the researcher should you be asked to return for the fasting blood sugar. It is important to come for the subsequent test when asked as it will help to confirm whether you have DM or not. If you are found to be diabetic, you will be referred to the Thika level 5 hospital DM clinic for further treatment.

Risks/discomforts

There are no risks to the participants in this study. Pain due to a small prick with needles is one of the discomforts expected.

Direct benefits to participants

There will be free weight and blood pressure measurement; Body mass index will be calculated. Participants will be educated on DM and risk factors associated with DM. The results of the blood sugar level will be provided to you and referral will be done to ensure proper treatment for those found with the disease.

Study costs

There will be no direct cash transfer to study participants except for those returning for a second test whose transport costs will be reimbursed.

Alternative to participation

The participants may withdraw from participating in this study at any time with no penalties.

Confidentiality

All information gathered will only be used for purposes of study only. Questionnaires will be coded to ensure confidentiality. The questionnaires will be kept under lock and key and destroyed after eight months upon completion of this study.

Voluntariness

Participation in this study is voluntary. It is important that you answer all questions but you may end this interview at any time. You do not have to answer any questions that you do not want. Exit from the study at any time will not implicate you of any wrong doing.

Contacts

In case of any queries or concerns, please contact the researcher on:

- Cell phone No.+254717484755 Email: carom0316@gmail.com or
- IREC, The chairperson, P.O. BOX 3-30100, Eldoret. Kenya Email: irec@mtrh.or.ke

Part B: Consent Declaration.

Please ensure this study has been explained to you and that you have comprehended fully what is involved before consenting to participate. It is also important for you to understand your role as a study participant and discomfort likely to be caused before getting involved.

I ---------- agree to participate in this study that is aimed at determining level of undetected DM mellitus and associated risk factors among adults in Thika Level 5 hospital outpatient department.

I have read the information and fully understood my role. I understand that blood sample will be taken from me for testing of DM and that blood sampling will be painful as it involves needle injection. I also understand that participation in this study is voluntary and I can withdraw at any time without being implicated of any wrong doing.

Participant signature/thumbprint ----------

Date ----------

Researcher's signature ----------

Date ----------

A: Fomu ya Ridhaa

Maelezo na kusudi la utafiti

Ningetaka kukualika kushiriki katika utafiti ninaofanya. Jina langu ni Eddah Mwihaki mwanafunzi kutoka chuo kikuu cha Moi. Kusudi la utafiti huu ni kuamua Kiwango cha ugonjwa wa kisukari ambao haujatambuliwa na mambo ya hatari kwa ugonjwa miongoni mwa watu wazima katika hospitali kuu ya Thika idara ya wagonjwa wanaotibiwa wakirudi nyumbani. Matokeo ya utafiti huu yatasaidia kwa kugunduliwa mapema ugonjwa wa kisukari ambao unadhuru watu wengi katika sehemu hii ya Kenya. Iwapo kuna jambo ambalo hujaelewa unaweza kufafanuliwa na watafiti wakati wowote unapouliza.

Jina la utafiti

Kiwango cha ugonjwa wa kisukari ambao haujatambuliwa na mambo ya hatari kwa ugonjwa miongoni mwa watu wazima katika hospitali kuu ya Thika idara ya wagonjwa wanaotibiwa wakirudi nyumbani.

Taratibu ya utafiti

Utaulizwa idadi ya maswali yanayohusiana na utafiti. Uzito, urefu, mduara ya tumbo na kipimo cha sukari kwenye damu zitapimwa. Wale walio na kipimo cha sukari kwenye damu zaidi ya 7.8 mmol/l watatakiwa kurudi kupimwa tena damu wakiwa katika hali ya kufunga. Kipimo cha sukari kwenye damu wakati mtu amekula masaa nane yaliyopita kikiwa zaidi ya 7.8mmol/l kumaanisha kuna uwezekano mkubwa wakuwa na ugonjwa wa kisukari na ndio sababu sukari yako ikiwa juu ya 7.8 mmol/l utaagizwa kurudi tena ukuwa umefunga kwa masaa nane ili tumime sukari kwenye damu tena.

Kipimo cha sukari ukiwa katika hali ya kufunga hutumika kutambua ugunjwa wa kisukari. Wale watakao agizwa kurudi siku ya pili watapokea nauli kutoka kwa mtafiti.

Hatari

Hakuna hatari inayojulikana kuhusishwa na utafiti huu.Uchungu kutokana na kutolewa damu kidogo utakuwepo.

Faida

Faida ya moja kwa moja kwako ni eti utapata kupimwa kiwango cha sukari katika damu yako. Ushiriki wako utasaidia kujua zaidi kuhusu ugonjwa wa kisukari katika eneo la Thika.

Ulinzi wasiri

Hatutakuwa na kubadilishana habari kuhusu wewe kwa mtu yeyote nje ya timu ya utafiti.Taarifa yoyote utapatiana haitatumia jina lako, itatumia nambari. Mtafiti mkuu peke yake ndio ataweza kufungia kwa kufuli na ufunguo na hatatolea mtu mwingine yeyote.

Ushiriki wa hiari

Ushiriki wako katika utafiti huu ni hiari. Unaweza kuchagua kukosa kushiriki na unaweza kuondoa idhini yako ya kushiriki wakati wowote.

Mawasiliano

Kwa swali lolote wasiliana na mtafiti mkuu:

- Numbari ya simu ya mkono +254717484755 Email: carom0316@gmail.com ama
- IREC, Mwenyekiti, Sanduku la posta 3-30100, Eldoret. Kenya Email: irec@mtrh.or.ke

B: Ridhaa Tamko

Tafadhali hakikisha umeelezwa kuhusu utafiti huu na ukaelewa kabla ya kutia sahihi. Ni muhimu kujua madhara yoyote yanayotokana na utafiti huu.

Mimi ---------- nakubali kushiriki katika utafiti huu unao elekeza kuamua Kiwango cha ugonjwa wa kisukari ambao haujatambuliwa na mambo ya hatari kwa ugonjwa miongoni mwa watu wazima katika hospitali kuu ya Thika idara ya wagonjwa wanaotibiwa wakirudi nyumbani.

Nimeelezwa umuhimu wangu katika utafiti huu. Naelewa kuwa kiwango kidogo cha damu kitachukuliwa ili kupima ugonjwa wa kisukari. Naelewa kuwa kuhusika katika utafiti huu ni kwa hiyari yangu na ninaweza kujiondoa kwa utafiti huu wakati wowote bila kudhurumiwa kwa njia yoyote ile.

Sahihi / kidole cha mshiriki ----------Tarehe…….

Sahihi ya mtafiti----------Tarehe……

Appendix 2: Questionnaire

Title

PREVALENCE AND RISK FACTORS FOR UNDIAGNOSED DIABETES MELLITUS AMONG PATIENTS SEEN IN THIKA LEVEL 5 HOSPITAL IN KIAMBU COUNTY, KENYA

Participants code:

Interviewers name:

Date:

Step 1 Demographic information:

Question	Response	code
Sex	**Male** **female**	**C1a**
For female: Are you pregnant	**Last menstrual period**	**C1b**
Date of birth	**Dd/mm/yr**	**C2**
Age	**Years:**	**C3**
Level of education	**No schooling** **Primary** **Secondary** **Tertiary**	**C4**

Step 1 Behavioral measurements:

Tobacco use

Question	Response	code
Do you currently smoke any **tobacco products**, such as cigarettes, cigars or pipes?	**Yes** **No**	**T1**
Do you currently smoke tobacco products **daily**?	**Yes** **No**	**T2**
If yes, how old were you when you **first started** smoking daily?	**Years:** **Don't know:**	**T3**
On average, **how many** of the following do you smoke each day?	Manufactured cigarettes: … Hand-rolled cigarettes: … Pipes full of tobacco: … Other(specify): …	**T4**

Alcohol use

Question	Response	code
Have you **ever** consumed an alcoholic drink such as beer,	**Yes** **No**	**A1a**

wine, spirits, fermented cider or *other local alcoholic drink*?		
Have you consumed an alcoholic drink within the **past 12 months**?	**Yes** **No**	**A1b**
During the past 12 months, **how frequently** have you had at least one alcoholic drink?	Daily 5-6 days per week 1-4 days per week 1-3 days per month Less than once a month	**A2**
Have you consumed an alcoholic drink within the **past 30 days**?	**Yes** **No**	**A3**
During the past 30 days, on how many **occasions** did you have at least one alcoholic drink?	**Number: …** **Don't know:**	**A4**
During the past 30 days, when you drank alcohol, **on average**, how many **standard alcoholic drinks** did you have during one drinking occasion?	**Number: …** **Don't know:**	**A5**
During the past 30 days, what was the **largest number** of standard alcoholic drinks you had on a single occasion, counting all types of alcoholic drinks together?	**Largest number: …** **Don't know**	**A6**
During the past 30 days, how many times did you have for **men**: **five or more** for **women**: **four or more** standard alcoholic drinks in a single drinking occasion?	**Number: …** **Don't know:**	**A7**

Physical activity

Question	**Response**	**code**
Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work]* for at least 10 minutes continuously?	**Yes:** **No:**	**P1**
In a typical week, on how many days do you do	**Number of days;…**	**P2**

vigorous-intensity activities as part of your work?		
How much time do you spend doing vigorous-intensity activities at work on a typical day?	**Number of Hours: …** **Minutes:…**	**P3**
Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads]* for at least 10 minutes continuously?	**Yes:** **No:**	**P4**
In a typical week, on how many days do you do moderate-intensity activities as part of your work?	**Number of days:…**	**P5**
How much time do you spend doing moderate-intensity activities at work on a typical day?	**Number of Hours:** **Minutes:…**	**P6**
Do you walk or use a bicycle *(pedal cycle)* for at least 10 minutes continuously to get to and from places?	**Yes:** **No:**	**P7**
In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	**Number of days:…**	**P8**
How much time do you spend walking or bicycling for travel on a typical day?	**Number of Hours: …** **Minutes:…**	**P9**
Do you do any vigorous-intensity sports, fitness or recreational *(leisure)* activities that cause large increases in breathing or heart rate like *[running or football]* for at least 10 minutes continuously?	**Yes:** **No:**	**P10**
In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational *(leisure)* activities?	**Number of days:…**	**P11**
How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	**Number of hours: …** **Minutes:…**	**P12**

Do you do any moderate-intensity sports, fitness or recreational *(leisure)* activities that cause a small increase in breathing or heart rate such as brisk walking, *[cycling, swimming, volleyball]* for at least 10 minutes continuously?	**Yes:** **No:**	**P13**
In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational *(leisure)* activities?	**Number of days:…**	**P14**
How much time do you spend doing moderate-intensity sports, fitness or recreational *(leisure)* activities on a typical day?	**Number of hours:…** **Minutes:…**	**P15**
How much time do you usually spend sitting or reclining on a typical day?	**Number of Hours:…** **Minutes:…**	**P16**

History of raised blood pressure

Question	**Response**	**code**
Have you ever had your blood pressure measured by a doctor or other health worker?	**Yes:** **No:**	**H1**
Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	**Yes:** **No:**	**H2a**
Have you been told in the past 12 months?	**Yes:** **No:**	**H2b**
Are you currently receiving any of the following treatments/advice for high blood pressure prescribed by a doctor or other health worker?		
1. Drugs (medication) that you have taken in the past two weeks	**Yes** **no**	**H3a**
2. Advice to reduce salt intake	**Yes** **no**	**H3b**
3. Advice or treatment to lose weight	**Yes** **no**	**H3c**

4. Advice or treatment to stop smoking	**Yes** **no**	**H3d**
5. Advice to start or do more exercise	**Yes** **no**	**H3e**
Have you ever seen a traditional healer for raised blood pressure or hypertension	**Yes** **no**	**H4**
Are you currently taking any herbal or traditional remedy for your raised blood pressure?	**Yes** **no**	**H5**

History of DM

Question	**Response**	**code**
Have you ever had your blood sugar measured by a doctor or other health worker?	**Yes** **No**	**H6**
Have you ever been told by a doctor or other health worker that you have raised blood sugar or DM?	**Yes** **no**	**H7a**
Does any member of your family have DM?	**Yes** **no**	**H7b**

Step 2 Physical measurements

Measurement	**Result**	**code**
Height	**In cms**	**M1**
weight	**In kgs**	**M2**
BMI	**Weight(kgs)/height(m)**	
Waist circumference	**In cm**	**M3**
Blood pressure	**In mmhg systolic** **Diastolic**	**M4a**
Prior blood pressure if available	**In mmhg systolic** **Diastolic**	**M4b**
Hip circumference	**In cms**	**M6**

Step 3 Biochemical measurement

Blood sugar

Question/ measurement	**Response/ result**	**Code**
During the past 12 hours have you had anything to eat or drink, other than water?	**Yes** **No**	**B1**
Time of day blood specimen taken (24 hour clock)		**B2**
Random blood glucose	**In mmol/l**	**B3**
Fasting blood glucose?	**In mmol/l**	**B4**

Diet

What do you eat for: (list)

Meal	carbohydrates	proteins	vitamins
Breakfast			
Lunch			
Supper			
Others			

Knowledge of DM

1. What is DM mellitus and what are its causes/risk factors?
   Don't know/never heard about it
   Heard about it
   Lack of insulin/ Failure of the body to use insulin
   Lack of exercise/sedentary lifestyle
   Poor diet
   Other description
2. Signs and symptoms of DM mellitus:
   Frequent urination
   Excessive thirst
   Excessive hunger
   Weight loss
   Fatigue
   Other description
3. Knowledge of complications of DM:
   Loss of Vision
   Kidney Failure
   Heart Failure
   Stroke
   Poor Healing of Wound
   Amputation.
4. Sources of above knowledge:
   Persons with DM
   Mass media
   Health worker
   School
   Other

Others

1. Phone Number for those coming later for a fasting blood sugar:

Appendix 3: Focus Group Discussion Guide

Date

Venue

Number of participants

Starting time

Ending time

Questions

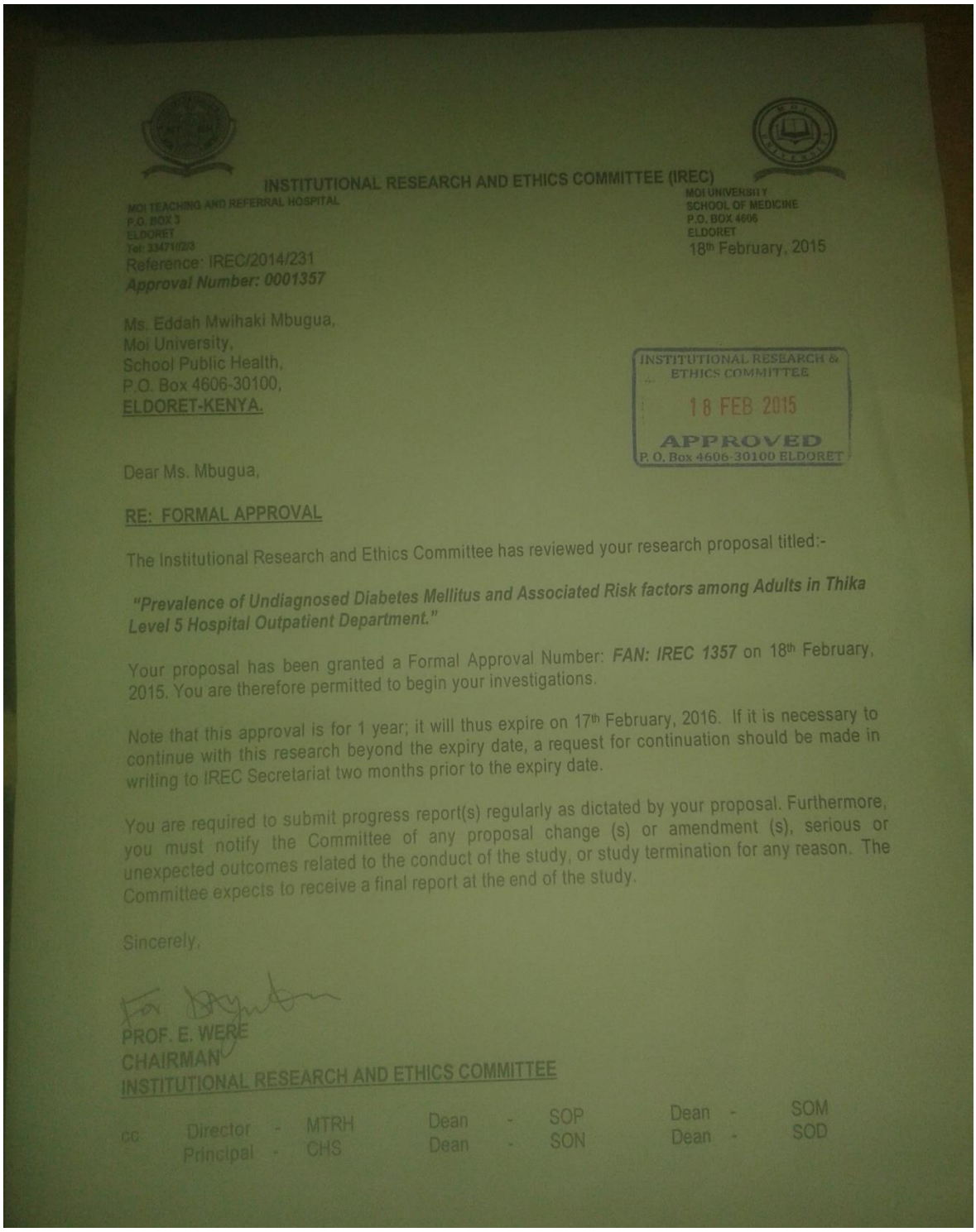
Knowledge

1. Is there community awareness on DM?
2. Has there been any DM awareness campaign in the community?
3. What is the perception of the community on causes of DM?
4. Where do members of the community seek treatment for DM?

Risk factors

5. What has the community and authorities done to reduce risk factors of DM? Any health interventions in the community?
6. Are members of the community involved in any form of physical activity?
7. Are there facilities that enable members to exercise?
8. What are the reasons for excessive consumption of alcohol and smoking in the community?

Appendix 4: IREC approval



INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2014/231
Approval Number: 0001357

18th February, 2015

Ms. Eddah Mwihaki Mbugua,
Moi University,
School Public Health,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
18 FEB 2015
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Ms. Mbugua,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Prevalence of Undiagnosed Diabetes Mellitus and Associated Risk factors among Adults in Thika Level 5 Hospital Outpatient Department."

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1357*** on 18th February, 2015. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 17th February, 2016. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc. Director - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

Appendix 5: FGD summary of findings

Table 3:FGD Summary of Findings.				
	MALE		**FEMALE**	
Knowledge	**FGD 1**	**FGD 2**	**FGD 1**	**FGD 2**
1. Is there community awareness on DM?	No. We learn about DM from friends and relatives who have the disease.	No. There are no formal campaigns on DM	No. We hardly know about the disease other than that it is caused by sugar intake.	There is limited knowledge.
2. Has there been any DM awareness campaign in the community?	No	No	No	No
			At the health centers	
3. What is the perception of the community on causes of DM?	Sugar	Sugar. Being fat.	High sugar intake	Family history
4. Where do members of the community seek treatment for DM?	Health Centre	Health Centre	Health Centre	Health Centre
Risk factors				
1. Health interventions in the community	No	no	Don't know	no

2. Physical activities in the community	Manual labor. We don't see the need to exercise.	Mostly manual labor at construction sites. There are no accessible exercise facilities.	Manual labor	Manual labor. Walking to work and other errands
3. Exercise facilities	No.	They are not accessible	No.	No.
4. Reasons for excessive use of alcohol	Idleness. Social pass time activity.	Availability of cheap alcohol	Lack of jobs	Peer pressure Lack of good role models. Young men learn how to take alcohol from their father and other relatives