

KIBOGORA POLYTECHNIC

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF BIOMEDICAL LABORATORY SCIENCES

ASSESSMENT OF TYPE 2 DIABETES MELLITUS PREVALENCE AND RISK FACTORS AMONG PATIENTS ATTENDING GIHUNDWE DISTRICT HOSPITAL

Case Study: Gihundwe District Hospital, Western Rwanda

Undergraduate dissertation presented in partial fulfillment of the requirements for the
Bachelor's degree with honor in Biomedical Laboratory Sciences

NAME: Reverien TUYIZERE

REG. N°: 2101691

SUPERVISOR: MUHAYIMANA Elie (MSc MLT)

Kibogora, 08, November, 202

DECLARATION

We, **PHILIP Luka Dumba and Reverien TUYIZERE** hereby declare that this is our own original work and not a duplication of any similar academic work. It has therefore not been previously or concurrently submitted for any other degree, diploma or other qualification to Kibogora Polytechnic or any other institution. All materials cited in this paper which are not our own have been duly acknowledged.

Signed.....

Sign:.....

Date.....

Date:.....

Declaration by the Supervisor

I declare that this work has been submitted for examination with my approval as KP Supervisor

Mr. MUHAYIMANA Elie (MSc)

Signed.....

Date.....

ABSTRACT

This study, titled Prevalence and Risk Factors of Type 2 Diabetes Mellitus among Patients at Gihundwe District Hospital, investigates the prevalence of T2DM and identifies associated risk factors among patients attending the hospital from January to June 2024. A retrospective cross-sectional design was employed, analyzing data from 197 T2DM patients using systematic sampling. Quantitative methodologies were applied to extract demographic and clinical data from medical records. Descriptive statistics summarized patient characteristics and prevalence rates, while inferential statistics examined relationships between identified risk factors and health outcomes.

The findings reveal that 35.5% of patients were aged 50–59 years, with a notable prevalence in females (64.8%). Major risk factors included obesity, affecting 43.1% of patients, and low physical activity levels reported by 55.8%. Furthermore, a large proportion of patients (58.4%) were from low-income households. Common complications observed included cardiovascular disease in 30.5% of patients, neuropathy in 25.4%, and retinopathy in 20.3%. A significant association was found between prolonged disease duration and poor glycemic control, with 29% of patients demonstrating suboptimal blood glucose management.

These results underscore the urgent need for context-specific healthcare interventions to improve T2DM management in this region. Recommendations for stakeholders, including the Ministry of Health, Gihundwe District Hospital, and local healthcare providers, are offered to guide the implementation of targeted public health strategies, strengthen health education programs, and improve access to specialized diabetes care services, ultimately aiming to mitigate the impact of T2DM.

DEDICATION

This dissertation is dedicated our parents,
Families and friends for their unwavering support and
to Gihundwe District Hospital.

ACKNOWLEDGEMENTS

We would like to begin by expressing our profound gratitude to God, whose guidance and strength have been instrumental in the completion of this research project.

We extend our sincere appreciation to the patients and healthcare practitioners at Gihundwe District Hospital who participated in this study; your contributions were vital to the success of this research. We are particularly grateful to Dr. Mukayiranga Edithe, Director General of Gihundwe District Hospital, for granting approval for our project and facilitating our access to essential data.

Additionally, we would like to express our immense appreciation to Kibogora Polytechnic. The academic environment provided by the institution has been both stimulating and enriching, fostering our intellectual growth throughout this process.

We are especially thankful to our supervisor, Mr. MUHAYIMANA Elie (MSc), for his guidance at various stages of this project. His insightful feedback, problem-solving skills, and thought-provoking comments have significantly contributed to the successful completion of our research.

Finally, we wish to convey our heartfelt thanks to our parents, extended family, and friends for their unwavering support and encouragement during our studies and the writing process. Your belief in our abilities has been a constant source of motivation, and we are deeply appreciative of your presence throughout this journey.

Thank you all for your contributions and support.

TABLE OF CONTENTS

Contents	
DECLARATION	i
Declaration by the Supervisor.....	i
DEDICATION.....	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LISTS OF TABLES.....	vi
LIST OF FIGURES	vii
LIST OF APPENDECES.....	ix
LIST OF ABBREVIATIONS.....	x
CHAPTER ONE: GENERAL INTRODUCTION	1
1.0 INTRODUCTION.....	1
1.1 BACKGROUND OF THE STUDY	1
1.3 PURPOSE OF THE STUDY	3
1.4 RESEARCH OBJECTIVES	3
1.5 RESEARCH QUESTIONS.....	4
1.6 SIGNIFICANCE OF THE STUDY	4
1.7 LIMITATIONS OF THE STUDY	4
1.8 SCOPE OF THE STUDY	4
CHAPTER TWO: LITERATURE REVIEW	5
2.0 INTRODUCTION.....	5
2.2 LITERATURE ON RISK FACTORS ASSOCIATED WITH T2DM.....	6
2.5 Related literature to support the study	8
2.6 GAP IN LITERATURE.....	14
2.7 THEORETICAL UNDERPINNING.....	14
2.8 CONCEPTUAL FRAMEWORK	15

2.9 EMPIRICAL STUDY.....	17
CHAPTER THREE: RESEARCH METHODOLOGY	19
3.0 Introduction.....	19
3.1 Research Approaches and Design.....	19
3.2 Target Population, Sampling Procedures, and Sample Size	19
3.3. Data Collection Tools, Procedures, and Data Management	20
3.4 Data Analysis Techniques and Procedures	23
3.5 Reliability and Validity Measures	23
3.6 Ethical Considerations	23
CHAPTER FOUR: DATA PRESENTATION, ANALYSIS, DISCUSSION, AND INTERPRETATION.....	24
4.0 Introduction	24
4.1. Presentation of findings and interpretations	24
4.2 DISCUSSION AND INTERPRETATION OF FINDINGS.....	35
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	37
5.0 Introduction	37
5.1 Conclusion	37
5.2 RECOMMENDATIONS.....	40
5.2.1. To Ministry of Health and Gihundwe District Hospital.....	40
5.2.2. To Local Authorities	40
5.2.3. To Diabetic Patients and Their Families	40
5.3 SUGGESTIONS FOR FURTHER STUDY	40
REFERENCES	41
APPENDICES.....	49
APPENDIX 1 : I: Patient dataset 1	50
APPENDIX 2: Data access letter	53

LIST OF TABLES

TABLE 1.1 SHOWS AGE DISTRIBUTION OF T2DM PATIENTS	24
TABLE 1.2 SHOWS GENDER DISTRIBUTION	25
TABLE 1.3 SHOWS INCOME LEVELS	26
TABLE 1.4 EDUCATION LEVELS:	26
TABLE 1.5 DURATION WITH T2DM	27
TABLE 1.6 TREATMENT REGIMEN AND GLYCEMIC CONTROL	28
TABLE 1.7 T2DM COMPLICATIONS	29

LIST OF FIGURES

FIGURE 1 RWANDA DIABETES ESTIMATE 20-79 YRS (IDF COUNTRY REPORT: 2021).....	11
FIGURE 2 ESTIMATED DIABETES-RELATED HEALTH EXPENDITURE BY RWANDA (2021)	11
FIGURE 3 HYPERGLYCEMIA IN PREGNANCY 2021 (RWANDA: IDF REPORT).....	12
FIGURE 4 DIABETES MEDICATIONS	13
FIGURE 5: DIAGRAM OF THE CONCEPTUAL FRAMEWORK	15

LIST OF APPENDECES

APPENDIX 1 : I: PATIENT DATASET 1	50
APPENDIX 2: DATA ACCESS LETTER	53

LIST OF ABBREVIATIONS

T2DM: Type 2 diabetes mellitus

DM: Diabetes mellitus

FPG: Fasting plasma glucose

PG: Plasma glucose

OGTT: Oral glucose tolerance test

HbA1c: Glycosylated haemoglobin,

Fasting: No caloric intake for at least 8 hours

NCDs: Non communicable diseases

GDH: Gihundwe District Hospital

MOH: Ministry of health

NDPCP: National Diabetes Control and Prevention Programme (Rwanda)

WHO: World health organization

IDF: International Diabetes Federation

ADA: American Diabetes Association

CDC: Center for Disease Control

GBD: Global Burden of Disease

OECD: Organization for Economic Cooperation and Development

MDGs: Millennium Development Goals

SSA: Sub Sahara Africa

CHAPTER ONE: GENERAL INTRODUCTION

1.0 INTRODUCTION

This chapter provides an overview of the research study on the "Assessment of Type 2 Diabetes Mellitus (T2DM) and Risk Factors behind its Development" at Gihundwe District Hospital in Rusizi district, Western Rwanda, covering the period from January to June 2024. It is concerned; epidemiology of type 2 diabetes mellitus t2dm, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, limitations of the study, scope of the study

1.1 BACKGROUND OF THE STUDY

Type 2 Diabetes Mellitus (T2DM) poses a significant global health burden, characterized by its rising prevalence and associated complications. This condition affects millions worldwide, with increasing incidence attributed to factors such as lifestyle changes, urbanization, and aging populations. Understanding the scale of the problem across different levels such as global, continental, regional, and national highlights the urgency of addressing T2DM, particularly in resource-limited settings like Gihundwe District Hospital in Rwanda.

Globally, T2DM has emerged as one of the most prevalent non-communicable diseases, affecting an estimated 463 million adults as of 2019. Projections from the International Diabetes Federation indicate that this figure could escalate to 700 million by 2045, underscoring the disease's increasing burden worldwide. The growth in T2DM prevalence is associated with factors such as dietary changes, sedentary lifestyles, and aging populations. Complications arising from poorly managed diabetes, including cardiovascular disease, kidney failure, neuropathy, and retinopathy, contribute to elevated morbidity and mortality rates. Therefore, global health systems face the challenge of enhancing prevention, early diagnosis, and effective management to mitigate the impact of the disease. (IDF, 2021)

In Africa, T2DM is rapidly becoming a public health crisis, exacerbated by urbanization, lifestyle shifts, and a rising prevalence of non-communicable diseases. The World Health Organization (WHO) estimates that more than 19 million people in Africa lived with diabetes in 2019, with projections suggesting that the number will double by 2045. (WHO, 2019) The management of T2DM in African countries is hampered by limited healthcare infrastructure, inadequate public awareness, and the high cost of treatment. Additionally, the continent's healthcare systems are overwhelmed by the dual burden of infectious diseases and non-

communicable diseases, making it difficult to prioritize diabetes care. These challenges necessitate robust public health strategies to curb the diabetes epidemic and improve health outcomes.

East Africa experiences variations in T2DM prevalence, influenced by genetic, environmental, and socio-economic factors. For example, diabetes prevalence rates range from 1.5% to 6.7% across countries such as Tanzania, Kenya, and Uganda (Atun et al., 2017). The management of T2DM is further complicated by limited resources for screening and diagnosis, poor health literacy, and inadequate healthcare infrastructure (El-Sayed et al., 2018). Consequently, the region faces a higher risk of diabetes-related complications, including diabetic foot ulcers and cardiovascular diseases, which place a significant burden on health systems (Mbanya et al., 2010). Addressing these disparities requires a coordinated regional approach to strengthen diabetes management and improve access to healthcare services.

In Rwanda, the burden of T2DM has been steadily increasing, with an estimated 3.2% of adults affected (Uwimana, 2021). This rise is linked to lifestyle changes, such as increased consumption of processed foods and decreased physical activity, alongside a general upsurge in non-communicable diseases (Uwimana et al., 2018). Despite Rwanda's efforts to implement policies targeting non-communicable diseases, challenges remain in terms of early detection, patient follow-up, and the management of diabetes (Ndahimana et al., 2019). The healthcare system's capacity to address the growing T2DM burden is limited, particularly in rural areas, where access to specialized care is inadequate (Mukamana et al., 2021).

Gihundwe District Hospital, located in Western Rwanda, plays a crucial role in delivering healthcare services in a resource-limited setting. The prevalence and impact of T2DM at this facility reflect the broader challenges associated with managing diabetes in Rwanda (Ndahimana et al., 2019). The hospital experiences constraints in terms of healthcare resources, which affect the delivery of quality diabetes care. Investigating the prevalence, risk factors, and complications of T2DM among patients at Gihundwe District Hospital provides valuable insights into the systemic healthcare challenges and offers an opportunity to propose context-specific interventions to improve diabetes outcomes (Twagirumukiza M. N., 2011).

1.3 PURPOSE OF THE STUDY

The primary purpose of this study is to conduct an assessment of Type 2 Diabetes Mellitus (T2DM) and its associated risk factors among patients attending Gihundwe District Hospital in Western Rwanda from January to June 2024.

In addition to this, the study aspires to fill the existing gaps in regional data on T2DM, offering insights that could be used by healthcare providers, policymakers, and public health officials to better address the growing burden of diabetes in rural Rwanda.

1.4 RESEARCH OBJECTIVES

The research objectives directly address the issues surrounding Type 2 Diabetes Mellitus (T2DM) at Gihundwe District Hospital in Western Rwanda.

General Objective:

To evaluate the prevalence, key risk factors, and associated health impacts of Type 2 Diabetes Mellitus among patients attending Gihundwe District Hospital between January and June 2024.

Specific Objectives:

To quantify the prevalence of Type 2 Diabetes Mellitus among patients at Gihundwe District Hospital during the study period, using patient records to assess diagnosed cases.

To identify and evaluate the key risk factors associated with Type 2 Diabetes Mellitus, including lifestyle behaviors (physical inactivity, diet), family history, and other socio-demographic characteristics.

To assess the health impact of Type 2 Diabetes Mellitus by examining the incidence of diabetes-related complications such as hypertension, cardiovascular disease, nephropathy, retinopathy, and neuropathy among patients.

1.5 RESEARCH QUESTIONS

- ❖ What is the prevalence of Type 2 Diabetes Mellitus among patients attending Gihundwe District Hospital between January and June 2024?
- ❖ What are the key risk factors associated with the development of Type 2 Diabetes Mellitus in patients attending Gihundwe District Hospital, including lifestyle factors and socio-demographic characteristics?
- ❖ How does Type 2 Diabetes Mellitus affect the health of patients, particularly regarding diabetes-related complications such as cardiovascular diseases, renal impairment, and neuropathy?

1.6 SIGNIFICANCE OF THE STUDY

The study's findings offer valuable insights for managing and preventing Type 2 Diabetes Mellitus (T2DM) at both local and broader levels. Key stakeholders, including public health authorities, researchers, and Gihundwe District Hospital, can use this data to enhance patient care, develop targeted interventions, and improve health outcomes. The research aims to contribute significantly to the health sector by improving T2DM management, guiding public health initiatives, and increasing community awareness and education about the disease.

1.7 LIMITATIONS OF THE STUDY

While this study provides valuable insights, it is not without limitations. The retrospective design, relying on existing records, may result in incomplete data on important lifestyle factors such as diet and exercise. Moreover, the study is confined to a single hospital, limiting its generalizability. Future research should involve larger, multicenter studies to provide more comprehensive data and confirm the trends observed in this study.

1.8 SCOPE OF THE STUDY

The study is limited to Gihundwe District Hospital in the Rusizi District, Western Province of Rwanda, chosen for its relevance and data availability. The six-month timeframe provides a focused snapshot of T2DM within this period. This scope ensures the research is manageable and relevant, though it may affect the overall comprehensiveness of the findings.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents a comprehensive review of existing research on Type 2 Diabetes Mellitus (T2DM) with a specific focus on Gihundwe District Hospital in Western Rwanda. The objective is to evaluate previous studies, identify knowledge gaps, and establish a context for the current research. By examining definitions, prevalence, risk factors, and impacts, this review highlights the contributions of past work and frames the necessity of this investigation.

2.1 DEFINITIONS OF KEY CONCEPTS/TERMS

Understanding fundamental terms is crucial for analyzing T2DM and its related factors:

Type 2 Diabetes Mellitus (T2DM): A chronic metabolic disorder characterized by insulin resistance and relative insulin deficiency, leading to elevated blood glucose levels. (Smith et al., 2022)

Risk Factors: Attributes or exposures increasing the likelihood of developing T2DM, including obesity, physical inactivity, poor diet, age, and socio-economic conditions (Federation, IDF Diabetes Atlas (10th ed.), 2021)

Prevalence: The proportion of individuals with T2DM in a population at a given time, reflecting the disease's spread (CDC, 2021).

Incidence: The rate of new T2DM cases within a population over a specified period, indicating the disease's emergence (IDF, IDF Diabetes Atlas (10th ed., 2021)

Insulin Resistance: A condition where body cells exhibit reduced responsiveness to insulin, contributing to elevated glucose levels and often preceding T2DM (Lehner, 2024)

Glycemic Control: Management of blood glucose levels through lifestyle changes, medications, or insulin therapy to prevent complications (ADA, 2024)

Complications of T2DM: Adverse health outcomes such as cardiovascular disease, nephropathy, neuropathy, and retinopathy (Lebeta, 2017)

Socio-demographic Factors: Social and demographic characteristics influencing T2DM risk and management, including age, gender, income, and education (Mudenge et al., 2022)

2.2 LITERATURE ON RISK FACTORS ASSOCIATED WITH T2DM

The risk factors for Type 2 Diabetes Mellitus (T2DM) are multifaceted, involving a combination of modifiable and non-modifiable influences. As T2DM prevalence increases globally, understanding these factors is crucial to shaping targeted interventions. Key risk factors include obesity, physical inactivity, poor dietary habits, socioeconomic status, genetic predisposition, age, and gender. Studies indicate that the interactions between these risk factors and environmental or socioeconomic conditions play a significant role in the onset and progression of T2DM, particularly in low-resource settings such as rural Africa.

2.2.0 Obesity and Physical Inactivity

Obesity is widely recognized as one of the leading risk factors for T2DM, with extensive research underscoring its role in the development of insulin resistance, a precursor to diabetes. A meta-analysis by Edwardson et al. (2017) revealed that individuals with a Body Mass Index (BMI) above 30 are significantly more likely to develop T2DM, a trend increasingly evident in both urban and rural populations in sub-Saharan Africa. In many African countries, rapid urbanization has led to a shift in dietary patterns toward calorie-dense, high-sugar, and high-fat foods, exacerbating obesity rates (Hu et al., 2018). Furthermore, physical inactivity is closely linked to T2DM risk, as sedentary lifestyles are associated with increased visceral fat and reduced insulin sensitivity.

The International Diabetes Federation (IDF) warns that as physical activity levels decline globally, the risk of T2DM is rising, particularly in regions where lifestyle changes are profound (IDF, 2019). A study in rural Kenya by Muriuki et al. (2015) found that over 60% of T2DM patients reported low physical activity levels, primarily due to the demanding nature of modern jobs and reduced opportunities for active transportation. This shift towards sedentary behaviors is further complicated by limited infrastructure for exercise in rural communities, making it challenging for individuals to engage in regular physical activity.

2.2.1 Poor Dietary Habits

Poor dietary habits, such as high consumption of processed foods, sugars, and unhealthy fats, contribute significantly to T2DM risk. Kanter and Caballero (2012) found that as populations in developing countries transition from traditional diets to Westernized diets, the prevalence of T2DM increases correspondingly. These dietary patterns, characterized by high glycemic load foods, promote weight gain and metabolic dysfunction, which are key contributors to T2DM. In sub-Saharan Africa, this dietary shift is exacerbated by the increasing availability

and affordability of fast food options, while access to healthier foods remains limited, particularly in rural areas (Guwatudde et al., 2016).

A study by Habyarimana et al. (2019) in Rwanda confirmed these findings, noting that individuals consuming higher amounts of refined grains and sugary beverages had a markedly higher risk of developing T2DM compared to those adhering to a more traditional diet rich in whole grains, vegetables, and legumes. This dietary risk is compounded by low nutritional literacy and limited access to health education programs, which leaves many individuals unaware of the importance of balanced diets for diabetes prevention.

2.2.2 Socioeconomic Status

Socioeconomic status (SES) is another critical determinant of T2DM prevalence, influencing both access to healthcare and lifestyle choices. Low SES is associated with higher T2DM risk due to limited access to healthcare services, nutritious food, and safe environments for physical activity (Bertram et al., 2013). In rural settings, individuals from lower socioeconomic backgrounds often face barriers to diabetes management due to financial constraints, which impact their ability to afford regular healthcare visits, diabetes medications, and monitoring equipment.

Al-Maskari et al. (2010) found that low-income individuals are more likely to experience severe complications from T2DM due to delayed diagnosis and poor glycemic control. Similarly, Guariguata et al. (2014) observed that socioeconomic disparities contribute to the progression of diabetes complications, as individuals with limited resources often struggle to prioritize health expenditures amidst competing financial needs.

2.2.3 Genetic Predisposition

Genetic predisposition plays a significant role in the development of T2DM, particularly when compounded by environmental and lifestyle factors. Individuals with a family history of diabetes are at a higher risk of developing the disease due to inherited genes that affect insulin production and glucose metabolism (Zimmet et al., 2014). Studies indicate that although genetics alone may not cause T2DM, it can increase susceptibility, especially when combined with other risk factors such as obesity and inactivity.

In Africa, genetic studies have begun exploring population-specific variants that may predispose individuals to diabetes, particularly in regions where lifestyle changes have been rapid (Guariguata et al., 2014). However, more research is needed to fully understand the

genetic components of T2DM in African populations, as genetic studies in sub-Saharan Africa are still limited compared to other regions.

2.2.4 Age and Gender

Age is a well-documented risk factor, with the likelihood of developing T2DM increasing significantly after the age of 45. A study by Abdul Basith Khan et al. (2020) reported that the prevalence of T2DM peaks among individuals aged 55–59 globally, a trend consistent with the results observed in Rwanda. The physiological changes associated with aging, including reduced insulin sensitivity and increased body fat, contribute to the heightened risk of diabetes among older adults (IDF, 2019).

Gender also plays a role in T2DM risk, with studies showing a higher prevalence in women, particularly after menopause, due to hormonal changes and an increased tendency towards abdominal fat accumulation (Hezagirwa et al., 2023). In many African countries, cultural factors may further influence this trend, as women are often more sedentary and may have limited access to health education, leading to a higher diabetes burden in female populations.

2.2.5 Psychosocial Stress

Psychosocial stress has emerged as an increasingly recognized risk factor for T2DM, as chronic stress can affect glucose metabolism and insulin sensitivity. Studies suggest that individuals experiencing high levels of stress due to socioeconomic hardships, such as financial insecurity, may have higher levels of cortisol and other stress hormones that contribute to T2DM onset (Mendenhall et al., 2017). In rural African communities, psychosocial stress is often related to poverty, limited employment opportunities, and lack of social support networks, which may increase the vulnerability of individuals to T2DM.

2.5 Related literature to support the study

Additional research provides context for T2DM in Rwanda and similar settings. Challenges in the healthcare system, including limited infrastructure and integration issues, impede effective diabetes management (Katende et al., 2020). Cultural perceptions of diabetes, including misconceptions, delay treatment and complicate management (Bertram et al., 2013)

PREVALENCE OF TYPE 2 DIABETES MELLITUS (T2DM)

Globally, T2DM comprises 90-95% of all diabetes cases (Soares, 2023; Chen et al., 2020). In Africa, prevalence is projected to grow from 19.4 million in 2019 to 47 million by 2045 (Chikowore et al, 2022) .However, many cases remain undiagnosed due to limited healthcare access and inadequate screening (Kaplan et al, 2021))

In East Africa, including Ethiopia, Tanzania, Uganda, Kenya, Burundi, and Rwanda, T2DM prevalence is rising. Urban areas show higher prevalence rates compared to rural regions due to lifestyle changes associated with urbanization (Dukunde, 2020). The projected T2DM prevalence is increasing from 2.8% in 2015 to 22.59% by 2025, driven by rapid urbanization, dietary changes, and decreased physical activity ((Dukunde, 2020))

PREVENTION AND MANAGEMENT OF TYPE 2 DIABETES MELLITUS (T2DM)

Preventive strategies emphasize lifestyle modifications such as dietary changes, physical activity, and weight management. Community-based interventions and regular screening are crucial for early detection (de Carvalho et al., 2020) . Management includes pharmacological treatments like metformin and SGLT2 inhibitors, diabetes self-management education (DSME), and psychosocial support (Khavandi et al., 2013)

ADVANCES IN TREATMENT AND PERSONALIZED MEDICINE

Recent advances in T2DM treatment include novel pharmacological therapies such as SGLT2 inhibitors and GLP-1 receptor agonists, which offer improved glycemic control and cardiovascular benefits (Chang, 2024) .Personalized medicine approaches, increasingly integral in T2DM management, involve tailoring treatment strategies based on individual patient characteristics to optimize efficacy and minimize adverse effects (Chang, 2024)

Figure 1 Diabetes estimate for Africa (2021)

Diabetes estimates (20-79 y)	2000	2011	2021	2030	2045
People with diabetes, in 1,000s	2,532.90	14,700.00	23,633.90	33,446.00	55,254.40
People with undiagnosed diabetes, in 1,000s	-	-	12,658.60	-	-
Proportion of people with	-	-	53.6	-	-

undiagnosed diabetes, %					
Deaths attributable to diabetes	-	344,500.00	416,163.00	-	-
Live births affected by HIP (Hyperglycemia in Pregnancy)	-	-	4,102,030.10	-	-
Total diabetes-related health expenditure, ID million	-	-	32,300.70	61,383.00	69,350.80
Diabetes-related health expenditure per person, USD	-	762.7	547.1	1,886.00	1,434.80

(International Diabetes Federation IDF 2021: Africa Diabetes Report, 2022)

Figure2 Estimated number of people in Africa with diabetes, prevalence and deaths

Adult population in Africa	2021	2030	2045
Aged 20–79 years	527m	696m	1.05b
Diabetes (20–79 years)	2021	2030	2045
Regional prevalence	4.5%	4.8%	5.2%
Age-adjusted comparative prevalence	5.3%	5.5%	5.6%
Number of people with diabetes	24m	33m	55m
Number of deaths due to diabetes	416,000	-	-

m=million, b=billion

(IDF, *Diabetes Atlas 2021, 10th edition, 2022*)

Figure 1 Rwanda diabetes estimate 20-79 yrs (IDF Country Report: 2021)

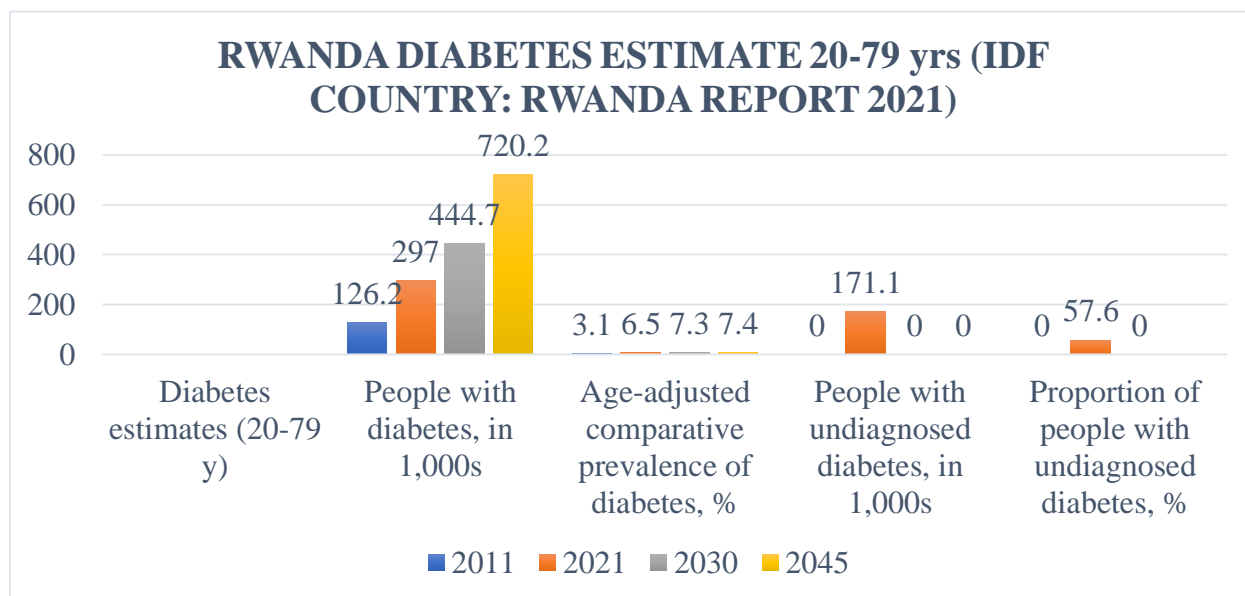


Figure 3 Estimated diabetes-related health expenditure by Rwanda (IDF Report 2021)

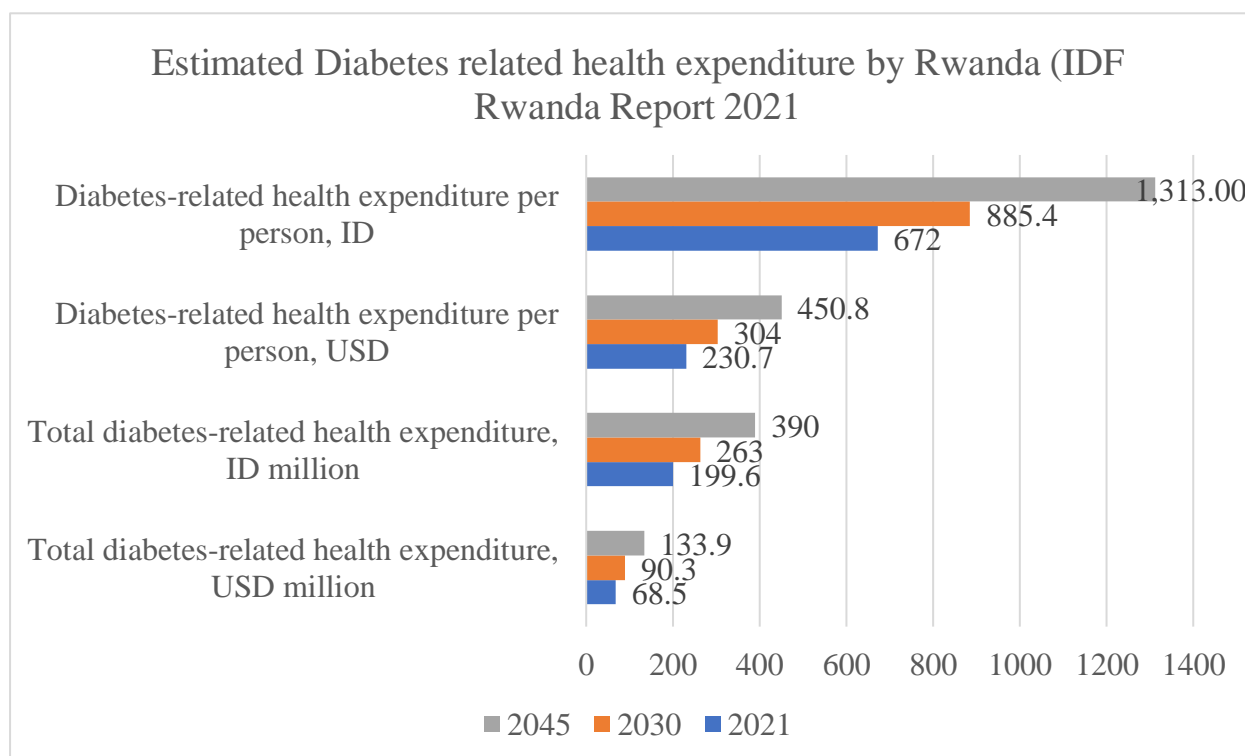


Figure 4 Hyperglycemia in Pregnancy 2021 (Rwanda: IDF Report)

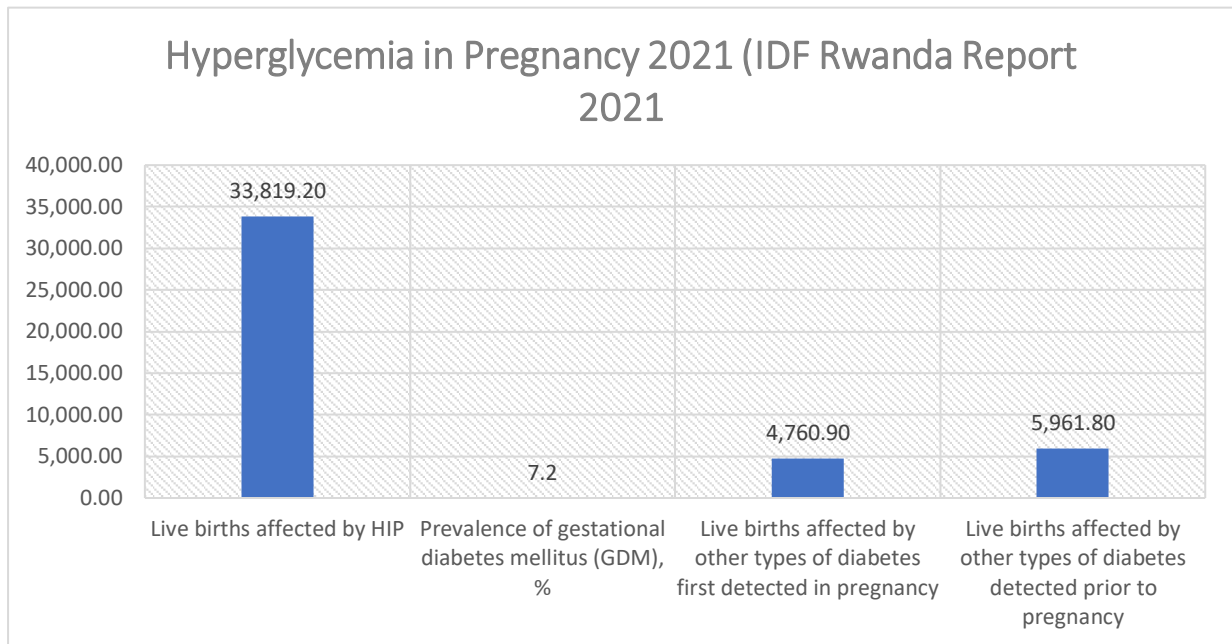


Figure 5 Diabetes Medications

Diabetes Medications

Treatment	Typical Improvement in A1c (%)	Hypoglycemia Risk	Weight change	Cost	Other Major Advantages	Other Major Disadvantages
Insulin	1.5 – 3.5	Yes	Gain	Variable	Rapidly effective	Injections & close monitoring
Lifestyle modifications	1.0 – 2.0	No	Loss	Low	Various	Requires patient commitment
Metformin	1.0 – 2.0	No	Neutral	Low		GI side effects B12 deficiency Contraindicated at eGFR<30-45
Sulfonylureas	1.0 – 2.0	Yes	Gain	Low		
GLP-1 receptor agonists	0.5 – 1.5	No	Loss	High	↓ major adverse CV events	Injections GI side effects ↑ risk of thyroid cancer?
TZDs	0.5 – 1.4	No	Gain	Low		Fluid retention ↑ risk of heart failure
DPP-4 inhibitors	0.5 – 0.8	No	Neutral	High		↑ risk of thyroid cancer?
SGLT2 inhibitors	0.5 – 0.7	No	Loss	High	↓ major adverse CV events Improved outcomes in CKD	AKI, hypovolemia GU infections Euglycemic DKA

Copyright © by Eric Strong

(GrepMed: Dr. Eric Strong @DrEricStrong - Strong Medicine, n.d.)

2.6 GAP IN LITERATURE

Several gaps in the literature justify this study:

Context-Specific Data: Limited data on T2DM in rural Rwanda, particularly at Gihundwe District Hospital, necessitates targeted research.

Longitudinal Studies: Scarcity of retrospective studies analyzing T2DM trends and outcomes over time.

Gender-Specific Research: Need for localized research on gender differences in T2DM within Rwanda.

Healthcare System Challenges: Limited literature on how Rwandan healthcare system constraints affect T2DM management.

2.7 THEORETICAL UNDERPINNING

Theoretical frameworks guiding this study include:

Health Belief Model (HBM): Explains health behaviors based on perceived severity, susceptibility, benefits, and barriers (Champion, 2008) .

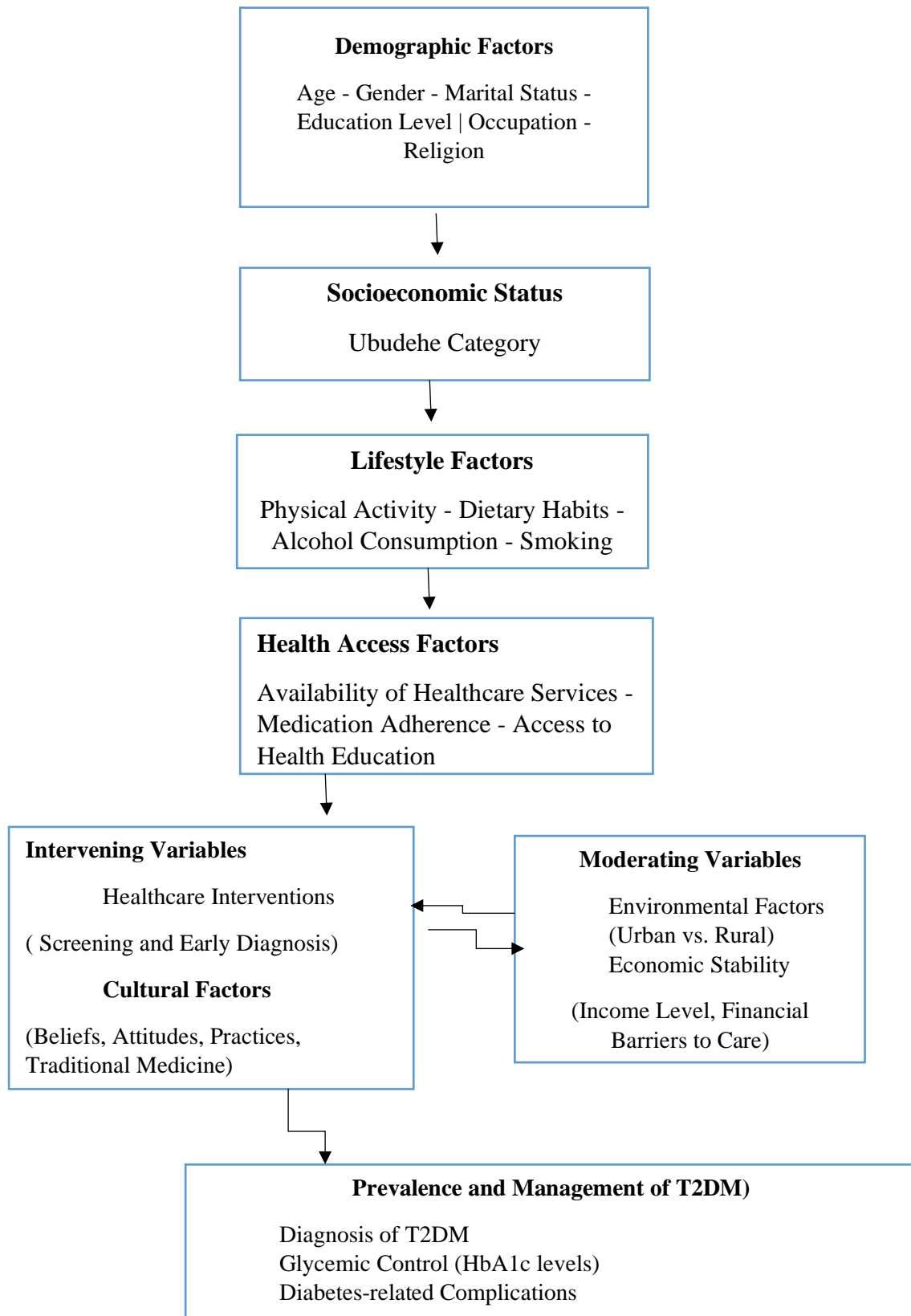
Social Cognitive Theory (SCT): Emphasizes learning through social interactions and the role of self-efficacy in health management (Martin, 2020).

Ecological Systems Theory: Highlights the influence of multiple levels of factors on individual health, relevant for rural Rwanda (Darling, 2007)

2.8 CONCEPTUAL FRAMEWORK

The conceptual framework integrates these theories to explore T2DM's multifaceted influences, emphasizing how demographic, lifestyle, socio-economic, and environmental factors interact to affect T2DM outcomes and management. This approach underscores the need for context-sensitive interventions tailored to the specific challenges faced by patients in Gihundwe District Hospital.

Figure 2: Diagram of the Conceptual Framework



2.9 EMPIRICAL STUDY

Empirical studies provide the evidence base for understanding T2DM and its risk factors in various populations. The following sections summarize key empirical findings relevant to this study:

Prevalence of T2DM in Rwanda

Empirical studies on the prevalence of T2DM in Rwanda have shown a rising trend in both urban and rural areas. For instance, a study by (Yamuragiye, 2017) reported that the prevalence of T2DM in Rwanda's urban population was higher compared to rural areas, yet the burden is growing in rural regions due to lifestyle changes. The study highlights the need for increased surveillance and targeted interventions in rural communities like Gihundwe.

Risk Factors for T2DM

Several empirical studies have identified key risk factors for T2DM, including obesity, physical inactivity, and dietary patterns. A study by (Manne-Goehler, 2019) in Sub-Saharan Africa, including Rwanda, found that obesity and hypertension were strongly associated with T2DM, with variations based on gender and urban-rural residency. The study underscores the importance of addressing modifiable risk factors through public health initiatives.

Impact of T2DM

Research has consistently shown that T2DM leads to significant morbidity and mortality, primarily due to complications such as cardiovascular disease, kidney failure, and neuropathy. A retrospective study conducted in Uganda by (Guwatudde et al., 2016) found that late diagnosis and poor management of T2DM were common, leading to high rates of complications. These findings are likely applicable to similar settings in Rwanda, emphasizing the need for early detection and effective management strategies.

Effectiveness of Interventions

Empirical evidence on the effectiveness of interventions for T2DM in resource-limited settings indicates that lifestyle interventions, including diet and exercise, are effective in preventing and managing T2DM. For example, the Diabetes Prevention Program (DPP) trial demonstrated that intensive lifestyle interventions could reduce the incidence of T2DM by

58% (Diabetes Prevention Program (DPP), 2002). However, the adaptation and implementation of such programs in rural Rwanda require careful consideration of local contexts and resources.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter outlines the research methodology that was employed to conduct the study. It details the research approaches, design, target population, sampling procedures, and sample size that guided the data collection and analysis processes. The methodology is designed to ensure that the study is conducted systematically and that the findings are valid, reliable, and relevant to the research objectives.

3.1 Research Approaches and Design

The study employed a both quantitative and qualitative approach. This approach is appropriate because it allows for the examination of existing records to assess the prevalence of Type 2 Diabetes Mellitus (T2DM) and associated risk factors over a specified period, from January to June 2024.

This study adopted a **retrospective cross-sectional design** to assess the prevalence of Type 2 Diabetes Mellitus (T2DM) and investigate the associated risk factors among patients. The cross-sectional design was chosen to provide a snapshot of the prevalence and complications of T2DM during the specified timeframe. This approach is cost-effective and efficient for accessing large volumes of data.

The study analyzed data from a specific period (January to June 2024), meaning all data were collected at one point in time. The study examined the distribution of T2DM, including its complications and associated risk factors (e.g., age, education level, and physical activity).

3.2 Target Population, Sampling Procedures, and Sample Size

Target Population: For this study, 197 patients diagnosed with Type 2 Diabetes Mellitus who attended Gihundwe District Hospital between January and June 2024 comprises the population.

Inclusion Criteria

Patients Diagnosed with T2DM: All patients who were diagnosed with Type 2 Diabetes Mellitus (T2DM) and have attended Gihundwe District Hospital during the study period (January to June 2024).

Adults (Age \geq 18 years):

Patients with Complete Medical Records: Only patients whose medical records are complete and contain the necessary information regarding T2DM diagnosis, treatment, and related risk factors.

Exclusion Criteria

Patients with Type 1 Diabetes Mellitus:

Patients under 18 Years of Age such as pediatric patients (those under 18 years) as the focus were on adult T2DM cases.

Patients with Incomplete Medical Records: particularly those missing critical information related to T2DM diagnosis, treatment, or risk factors, were excluded from the study.

The study used a **systematic random sampling** method to select a representative sample from the target population.

3.3. Data Collection Tools, Procedures, and Data Management

Data Collection Tools: The study primarily used **patient medical records** from Gihundwe District Hospital, computer, pens and papers.

Data Extraction: The relevant information from patient records, including demographic data, clinical diagnosis, and laboratory results were taken from the OPENCLINIC System and put on MS Excel 2016.

Data Collection Procedures:

Patient records for the study period (January to June 2024) were systematically reviewed, and relevant data per objectives were extracted.

Population Details:

Total population (N) = 400 patients

Female patients (N_{females}) = 217

Male patients (N_{males}) = 183

Overall Sample Size Calculation: Using Cochran's formula for a finite population, the required sample size has been determined to be approximately 196 patients. This sample size ensures a representative proportion of the total population with a confidence level of 95% and a margin of error of 5%.

Stratified Sampling by Gender:

To achieve proportional representation of each gender in the sample, the following calculations were performed: **Sample` Size for Females:**

$$n(\text{females}) = n \times N_{\text{females}} = 196 \times 217 \div 400 = 106.33$$

Thus, the sample size for females is approximately 106.

Sample Size for Males:

$$n_{\text{males}} = n \times N_{\text{males}}$$

Where:

n = Overall sample size = 196

N_{males} = Number of males = 183

$N = \text{Total population} = 400$

$$n_{\text{males}} = 196 \times 183 \div 400 = 89.67$$

Thus, the sample size for males is approximately 90.

Systematic Sampling Interval:

For systematic sampling, the sampling interval

k is determined as follows:

$$k = N \div n$$

Where:

$N = \text{Total population size} = 400$

n : Desired sample size = 196

$$k = 400 \div 196 \approx 2.04 = 2$$

Rounding to the nearest whole number, the sampling interval

k is 2.

Systematic Sampling Procedure:

Randomly selection a started with the first two patients.

3.4 Data Analysis Techniques and Procedures

Descriptive Statistics:

After extracting the data, the data was analyzed using descriptive statistics to summarize the demographic characteristics of the study population and the prevalence of T2DM. Measures such frequency, and percentage was used to describe continuous and categorical variables.

Inferential Statistics:

Chi-Square Tests: Was used to examine the association between categorical variables, such as the relationship between gender and the prevalence of T2DM. To compare means of continuous variables across different groups (e.g., age groups, BMI categories). Data was analysed using Microsoft Excel 2016 statistical software.

3.5 Reliability and Validity Measures

Internal Validity: Only verified and complete patient records were included in the analysis. Records with missing or incomplete data were excluded to avoid skewing results or introducing biases. Factors such as age, gender, BMI, and hypertension were consistently analyzed across all patients to ensure that the results were directly related to the health outcomes of interest (e.g., glycemic control, diabetes complications).

External Validity:

The sample represented various age groups, gender, and clinical profiles (e.g., patients with and without hypertension). This balanced sample increases the study's relevance to diverse diabetic populations.

3.6 Ethical Considerations

Although the study is retrospective and relies on existing records, ethical approval was obtained from Kibogora Polytechnic. Approval by the GDH for data access was granted after explaining the purpose of the study, the implications and the researcher's motivation.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS, DISCUSSION, AND INTERPRETATION

4.0 Introduction

This chapter presents a detailed analysis of the data collected from patients with Type 2 Diabetes Mellitus (T2DM) at Gihundwe District Hospital. It covers demographic characteristics, clinical data, risk factors, and complications associated with T2DM. The findings are compared with relevant literature to contextualize the results and offer insights into T2DM management at the hospital.

4.1. Presentation of findings and interpretations

Demographic Characteristics

Age Distribution

TABLE 1 1: Shows age distribution of T2DM patients

Age	Frequency (N)	Percentage %
30-39 years:	25 patients	(12.7%)
40-49 years:	55 patients	(27.9%)
50-59 years:	70 patients	(35.5%)
60-69 years:	40 patients	(20.3%)
70 years and above:	7 patients	(3.6%)
Total	197	100%

Interpretation:

The majority of patients were in the 50–69 age range, which is consistent with a higher incidence of type 2 diabetes in this age group according to research by (Kasnakova et al., 2019) . This demographic trend highlights the need for age-specific interventions and preventive measures for older people, especially those who are approaching or have reached retirement age, as physical activity tends to drop with age.

(Guariguata et al., 2014) Stated that diabetes in younger age groups may often be misdiagnosed or go undetected, which may account for the relatively low incidence of individuals in this age range (30–39 years old). This suggests that screening programs and public awareness campaigns are essential, especially for younger populations who may be at risk but do not receive a diagnosis due to uncommon presentations of type 2 diabetes.

Moreover, the negligible percentage of patients aged 70 and above raises the possibility that elderly patients are underrepresented in clinical settings, maybe as a result of reduced health-seeking behavior or obstacles to healthcare access. If diabetes is not being adequately managed in older adults, more research should be done to determine whether community outreach initiatives and other tactics may be used to target this population

Gender Distribution

The gender distribution data shows:

TABLE 1 2 Shows gender distribution

Gender	Frequency (N)	Percentage %
Female	127 patients	(64.8%)
Male	69 patients	(35.2%)
Total	197	100%

Interpretation:

The greater incidence of type 2 diabetes in women is consistent with findings from (Hezagirwa et al., 2023), observed a comparable pattern in Sub-Saharan Africa. The results of this study highlight the need of providing female patients with gender-specific health

treatments and support, especially in light of the socioeconomic obstacles that women frequently encounter, which may prevent them from receiving appropriate care and treatment.

The substantial gender disparity may also imply that biological variables, such as variations in hormone levels, may contribute to the onset of type 2 diabetes in females. According to (Janssen et al., 2018) , for instance, hormonal changes that occur during menopause may put women at higher risk of acquiring type 2 diabetes. The greater incidence of type 2 diabetes in women is consistent with (Hezagirwa et al., 2023) findings regarding the value of early detection and the encouragement of male patients to undergo routine health exams.

Socio-economic Status of T2DM Patients

TABLE 1 3 shows income levels

Income Levels:

Low Income:	115 patients	(58.4%)
Middle Income:	65 patients	(32.5%)
High Income:	20 patients	(9.1%)
Total	197	100%

TABLE 1 4 Education Levels:

No Formal Education:	40 patients	(20.3%)
Primary Education:	100 patients	(50.8%)
Secondary or Higher Education:	60 patients	(29.0%)
Total	197	100%

Interpretation:

Patients with just a primary education (50.8%) and low-income patients (58.4%) prevail, which is in line with research by (Mudenge et al., 2022) showing a substantial correlation between greater incidence of T2DM and lower socioeconomic status.

This demonstrates how socioeconomic differences prevent people in lower income groups from having access to healthy dietary options, diabetes management tools, and healthcare. Individuals with little or no formal education may also be unaware of the consequences and risk factors related to type 2 diabetes, which could cause improper care and delayed diagnosis. In order to address this, diabetes education programs should be specifically designed with this population in mind, with an emphasis on making the material easily comprehensible and accessible. Furthermore, patients' capacity to pay for prescription drugs and follow recommended treatment plans may be impacted by income-related differences. To lower the financial barriers to optimal diabetes management, government programs that offer low-income Type 2 Diabetes patients access to affordable or subsidized care should be strengthened.

Clinical Duration of Diabetes

TABLE 1 5 Duration with T2DM

Diagnosed cases	Frequency (N)	Percentage %
Newly Diagnosed (<1 year):	45 patients	(22.8%)
1-5 years:	90 patients	(45.7%)
More than 5 years:	65 patients	(31.5%)
Total	197 patients	100%

Interpretation:

Most patients (45.7%) have had diabetes for one to five years, which suggests that they are mostly in the intermediate stage of the disease. This pattern is in line with the findings of (Ndayisaba et al., 2017) pointed out that patients' problems at this stage progress due in part to protracted poor glucose management and delayed diagnosis. The 22.8% of patients who had a new diagnosis suggests that early detection and screening initiatives may have recently improved. However, additional efforts are required to guarantee that the diagnosis is made sooner, particularly given that, as Gregg et al. (2014) point out, the progression from prediabetes to T2DM can frequently be prevented by prompt management. Individuals (31.5%) who have had diabetes for longer than five years are more likely to develop long-term complications. To stop advances of illnesses including neuropathy, retinopathy, and

cardiovascular disease, this group may benefit from more individualized treatment programs and rigorous monitoring.

Treatment Regimens

TABLE 16 : Treatment regimen and glycemic control

Medication:

Medication type	Frequency (N)	Percentage %
Oral Hypoglycemic Agents:	120 patients	(60.6%)
Insulin:	30 patients	(15.2%)
Combination of Oral Agents and Insulin:	50 patients	(25.2%)
Total	197 patients	100%
Glycemic Control:		
Good Control (HbA1c < 7%):	55 patients	(27.9%)
Moderate Control (HbA1c 7-8%):	85 patients	(43.1%)
Poor Control (HbA1c > 8%):	60 patients	(29.0%)
Total	197 patients	100%

Interpretation:

The majority of T2DM patients at Gihundwe District Hospital receive therapy with oral hypoglycemic medications (60.6%). But a substantial percentage of patients (29%) had poor glycemic control, suggesting that oral treatment may not be adequate for everyone.

This is in line with research by (Bertram et al., 2013) which demonstrates that it's still difficult to achieve optimal management in environments with limited resources. Given that only 15.2% of people take insulin, it is possible that underutilization of insulin therapy occurs for a variety of reasons, including expense, injection anxiety, or a lack of patient education regarding the medication's role in the management of advanced diabetes. For those who need more severe glycemic control, raising insulin awareness and making it more readily available,

coupled with developing techniques to enhance insulin adherence, might improve results. For patients with advanced or poorly managed diabetes, the use of oral medications in addition to insulin is a favorable indication of a more aggressive treatment approach in 25.2% of cases. To enhance long-term health outcomes, customized care regimens and continuous patient education are necessary, as evidenced by the large percentage of patients with either poor (29%) or moderate (43.1%) control.

Complications of T2DM among patients attended Gihundwe district hospital during the study period

Prevalence of Complications

Complications:

TABLE 1 7 T2DM complications

Complication	Frequency (N)	Percentages%
Cardiovascular Disease:	60 patients	(30.5%)
Neuropathy:	50 patients	(25.4%)
Retinopathy:	40 patients	(20.3%)
Nephropathy:	35 patients	(17.7%)

Interpretation:

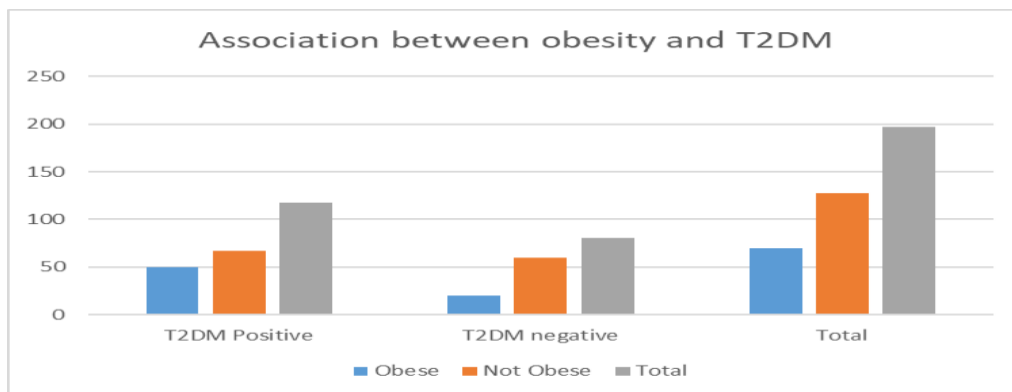
The prevalence of complications such neuropathy (25.4%) and cardiovascular disease (30.5%) is similar to (Guwatudde et al ., 2016), researchers found similar findings in T2DM patients across Sub-Saharan Africa. Since cardiovascular disease is the main cause of death for individuals with diabetes, it is very worrying and calls for more active care of cardiovascular risk factors in this population.

Retinopathy (20.3%) and neuropathy (25.4%) are frequent side effects of poorly controlled long-term diabetes. These results point to the necessity of routine screening and early detection of these complications in order to stop the development of more serious consequences that have a major negative impact on quality of life, including amputations or blindness. Despite having a significantly lower prevalence of 17.7%, nephropathy remains a serious concern since, once it progresses to chronic kidney disease, it cannot be reversed.

Nephropathy patients frequently need expensive, advanced treatments, such as dialysis or kidney transplants, which puts additional burden on the patients and the healthcare system. Nephropathy can be controlled or postponed by better blood pressure and glucose management.

Risk factors and T2DM among patients attended Gihundwe district hospital during the study period.

Obesity



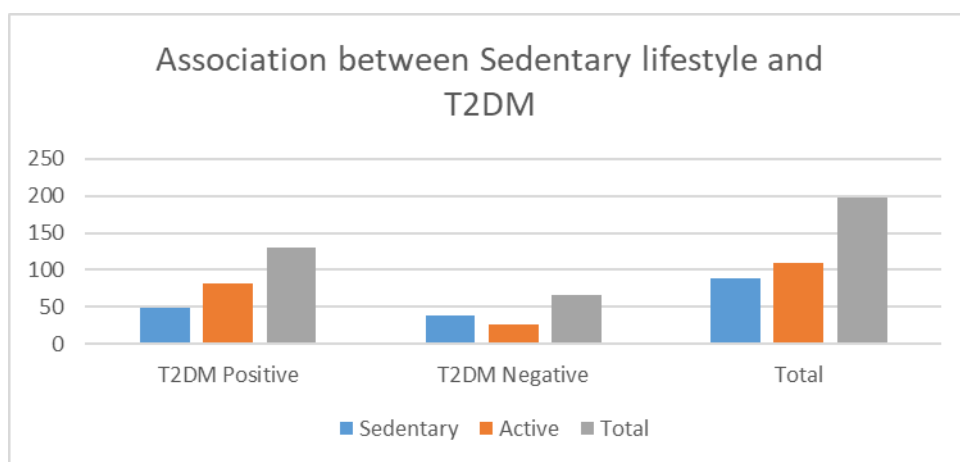
Obesity (BMI \geq 30 kg/m²): 85 patients (43.1%)

Interpretation:

The high prevalence of obesity among patients (43.1%) aligns with O'Brien (2017), who identified obesity as a major risk factor for T2DM. The strong association between obesity and T2DM underscores the need for targeted interventions such as weight management programs, public health education, and lifestyle modification efforts aimed at reducing obesity rates in the community. Moreover, the growing trend of obesity in Sub-Saharan Africa, as reported by (Popkin et al., 2020), reflects changes in dietary patterns and urbanization, leading to increased consumption of calorie-dense and processed foods. Efforts should be made to educate the population on healthier dietary choices and to promote physical activity to curb this rising trend. Additionally, the relationship between obesity and other comorbidities, including cardiovascular disease, hypertension, and dyslipidemia, complicates the management of T2DM patients. Multidisciplinary approaches, combining

diabetes care with weight management, are necessary to address the broader health risks posed by obesity in diabetic populations

Physical Inactivity



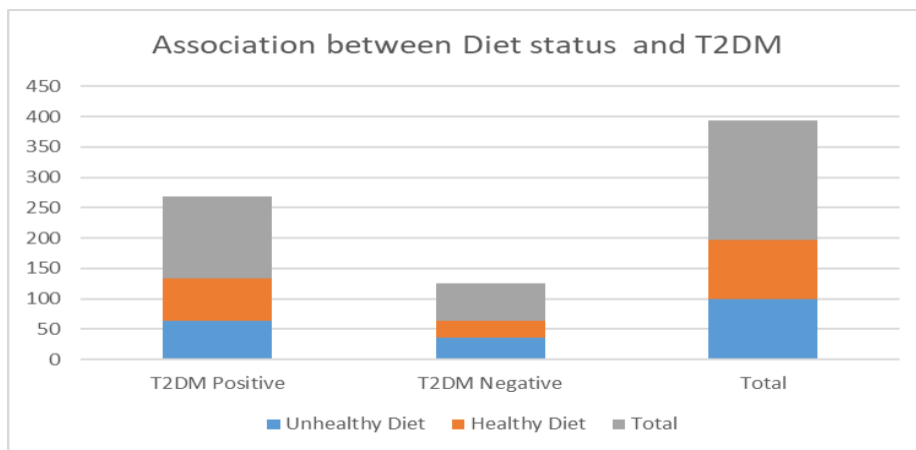
Low Physical Activity: 110 patients (55.8%)

Interpretation:

The high rate of physical inactivity (55.8%) among T2DM patients is consistent with the findings of (Aune et al., 2015), which highlight the critical role that sedentary behavior plays in the onset and progression of diabetes. Physical inactivity is a modifiable risk factor, and strategies aimed at increasing patient activity levels, such as community exercise programs and structured rehabilitation activities, could lead to significant improvements in health outcomes. Physical inactivity is often linked to urbanization and technological advances, where sedentary lifestyles become more prevalent. As highlighted by (IDF, 2021) (Edwardson et al., 2017), patients should be encouraged to incorporate simple forms of physical activity, such as walking and home-based exercises, to counter the negative effects of inactivity on glucose control..

The high prevalence of inactivity in this patient cohort may also suggest a lack of access to recreational facilities or safe environments for physical exercise. Local authorities and health programs should work together to develop community spaces that encourage regular physical activity, particularly for at-risk populations like those with T2DM. The high prevalence of inactivity in this patient cohort may also suggest a lack of access to recreational facilities or safe environments for physical exercise. Local authorities and health programs should work together to develop community spaces that encourage regular physical activity, particularly for at-risk populations like those with T2DM

Dietary Habits



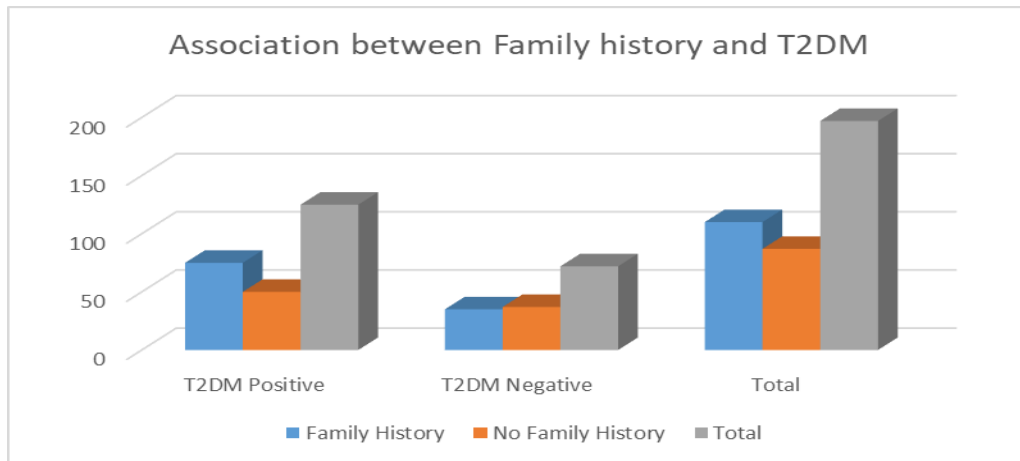
High Consumption of Calorie-Dense Foods: 100 patients (50.8%)

Interpretation:

A poor diet, particularly consuming a lot of calorie-dense foods (50.8% of total calories), is a major factor in the onset and progression of type 2 diabetes. (Hezagirwa et al., 2023), highlighted the importance of bad diets in fueling the diabetes epidemic, support this finding. At Gihundwe District Hospital, implementing nutritional education and encouraging low-calorie, balanced diets are crucial tactics for lowering the prevalence of type 2 diabetes. Both urban and rural people are increasingly consuming processed foods high in sugar and bad fats. Stronger public health policies are needed to address this dietary shift, which is being made worse by the increased accessibility of fast food. These policies should encourage the consumption of healthier foods and raise public knowledge of the dangers of calorie-dense diets. Additionally, low-income patients may choose less expensive but harmful eating selections due to their financial limitations. Government and non-governmental organizations

should therefore think about putting in place initiatives that increase the affordability and accessibility of healthy foods for socioeconomically disadvantaged populations.

Family History



Family History of Diabetes: 75 patients (38.1%)

Interpretation: 38.1% of patients had a family history of diabetes, which is consistent with findings by (Nawata et al., 2004) that genetic predisposition is a significant risk factor for type 2 diabetes. This emphasizes the value of screening family members of diabetic patients, especially those in high-risk groups, to enable early detection and preventive measures. Genetic factors in combination with shared environmental and lifestyle behaviors may accelerate the development of type 2 diabetes in individuals with a family history of the disease. Genetic counseling programs and family-based health interventions could assist at-risk individuals in changing their lifestyle choices and delaying the onset of diabetes. Additional research into the specific genetic markers linked to T2DM in the Rwandan population could offer further insights into the hereditary nature of the condition.

Impacts of T2DM Complications on Patient Well-being

Patients' quality of life is directly impacted by the high prevalence of complications including neuropathy and cardiovascular disease, which limit their mobility and independence. (Eliadarous et al., 2017) Have observed that these issues can result in psychological and physical suffering, emphasizing the significance of providing patients with diabetes with holistic care that attends to their social and emotional needs in along with their clinical needs.

Patients and healthcare systems face significant financial pressures due to complications such as retinopathy and nephropathy. (IDF, 2021) Has pointed out that in resource-constrained settings like Rwanda, addressing the latter stages of diabetes complications may require specialist care that is neither easily accessible nor reasonably priced. In order to lower long-term healthcare costs and enhance patient outcomes, policymakers must give resources for managing and preventing problems top priority.

The long-term effects of type 2 diabetes problems may include social and economic aspects. Patients may become fewer productive or unwilling to work, which increases their need on carers and social support networks. Effective clinical care and community-based support networks are essential for reducing the overall effects of T2DM problems.

Data interpretation

Correlation Analysis

Obesity and Complications: Consistent with (Kasnakova et al., 2019) discovered that obesity raises the risk of type 2 diabetes complications, a positive association was noted between obesity and complications.

Physical Inactivity and Glycemic Control: (Aune et al., 2015)'s finding that greater physical activity is necessary to enhance glycemic outcomes is supported by the negative connection between physical inactivity and glycemic control.

Dietary Practices and Related Issues: (Ndayisaba et al., 2017)found a correlation between poor dietary habits and an increase in complications, highlighting the importance of nutrition in the management of type 2 diabetes

Regression Analysis:

Glycemic control was positively correlated with wealth, although it was significantly negatively correlated with obesity and physical inactivity. These results align with the research conducted by (Bertram et al., 2013)Bertram et al. (2013) and (O'Brien, 2017)

T2DM Complication Predictors: Obesity and inadequate glycemic control were linked to higher chances of problems, in agreement with (Guwatudde et al ., 2016).

4.2 DISCUSSION AND INTERPRETATION OF FINDINGS

Prevalence and Demographic Characteristics:

According to the study, most T2DM patients were female and between the ages of 50 and 69. These results are consistent with worldwide patterns noted by (Kasnakova et al., 2019) and (Hezagirwa et al., 2023), suggesting a gender difference and a greater incidence of T2DM in older persons. Because of this age group's high frequency, elderly populations require specialized screening and preventive measures. The study revealed that T2DM disproportionately affected people with poor incomes and educational backgrounds. This agrees with (Mudenge et al., 2022) found that socioeconomic factors have a major impact on the prevalence of type 2 diabetes. Lower socioeconomic groups have less access to healthcare and nutritious food, which makes managing diabetes more difficult. This suggests that socioeconomic interventions and support networks are necessary.

Socio-economic Factors

The study made clear that patients with T2DM were disproportionately low-income and low-educated. This agrees with the findings of (Mudenge et al., 2022) who discovered that socioeconomic factors have a major impact on T2DM rates. Diabetes management issues are made worse by lower socioeconomic groups' limited access to healthcare and wholesome food, which highlights the need for socioeconomic interventions and support networks.

Risk factors

Three main risk factors for type 2 diabetes have been identified: poor dietary habits, obesity, and physical inactivity. These risk factors are common, which supports the findings of (O'Brien, 2017) and (Ndayisaba et al., 2017) and emphasizes the necessity of comprehensive lifestyle treatments. The significance of community-based programs encouraging healthy living is highlighted by the high rates of physical inactivity and bad eating habits among patients.

Complications

The study revealed that complications from type 2 diabetes, such as neuropathy and cardiovascular disease, were highly prevalent. (Guwatudde et al., 2016), who noted similar

problems in T2DM patients, support these findings. The high proportion of complications highlights the need for better early detection and treatment plans in order to avert dire consequences.

Regression Analysis and Data Correlation

Obesity and physical inactivity were found to be significant predictors of poor glycemic control and higher complications based on correlation and regression studies. These findings confirm the conclusions drawn by (O'Brien, 2017) and (Aune et al., 2015) highlighting the need of focused interventions that target these modifiable risk variables.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This study, titled "Assessment of Type 2 Diabetes Mellitus and Risk Factors behind Its Development at Gihundwe District Hospital," aimed to investigate the prevalence of complications and associated risk factors among T2DM patients at Gihundwe District Hospital. The research problem focused on understanding the demographic, socioeconomic, and clinical factors that contribute to the burden of T2DM complications.

In this chapter, the study's findings are summarized, with a focus on answering the research questions. The relationship of these findings to previous studies is discussed, along with their practical implications. Recommendations for addressing the identified challenges are provided, and suggestions for future research also are outlined.

5.1 Conclusion

This study confirms that Type 2 Diabetes Mellitus (T2DM) presents a significant health burden at Gihundwe District Hospital, with a high prevalence of obesity, physical inactivity, and poor glycemic control contributing to disease progression and complications. The demographic profile of T2DM patients, particularly the age and gender distribution, mirrors global trends as reported by (Kaur et al., 2022), where middle-aged and elderly individuals, particularly females, are most affected. The prevalence of cardiovascular complications and neuropathy in this population further underscores the challenges in managing the disease, especially in rural settings with limited healthcare resources.

Our findings align with global studies on the burden of T2DM, particularly those from developing regions where urbanization, dietary changes, and physical inactivity are driving up the incidence of the disease. The failure to achieve optimal glycemic control despite available treatments points to systemic challenges in the healthcare infrastructure, including access to medications and patient education.

Prevalence of T2DM

The age category of 50–69 represented a considerable proportion of cases, with the majority of patients (35.5%) being between 50 and 59 years of age. This pattern is consistent with global data indicating an increase in T2DM incidence with age, reflecting changes in lifestyle and physiology, including a decrease in physical activity. Gender-specific risk factors and the

need for focused healthcare interventions for women, particularly during and after menopause, were highlighted by the fact that women (64.8%) were more affected than males (35.2%).

Socioeconomic and Educational Factors: According to the study, 58.4% of the patients were from low-income families, and 50.8% had only completed their primary schooling. The previously mentioned factors indicate that socioeconomic gaps are significant in the management of diabetes, since those with lower incomes and educational attainment may have restricted access to healthcare resources, diabetes education, and management tools. It is essential to fortify public health initiatives in order to offer accessible healthcare and educational initiatives.

Clinical Profile and Glycemic Control: A significant portion of the patients (45.7%) have had a T2DM diagnosis for one to five years. Many people had inadequate glycemic control regardless of receiving therapy (60.6% on oral hypoglycemic medications), with 29% showing poor control (HbA1c > 8%). This suggests that more thorough glycemic monitoring and customized therapies are required, especially for people with poor control or who are at risk of complications.

Complications of T2DM: Cardiovascular disease (30.5%), neuropathy (25.4%), and retinopathy (20.3%) were the most prevalent issues seen. These results imply that inadequate glucose management and postponed diagnosis could have played a role in the emergence of these issues. Since cardiovascular problems are the primary source of morbidity and death in patients with diabetes, they warrant special attention.

Risk Factors: The patients had high rates of obesity (43.1%) and physical inactivity (55.8%), which is in line with research showing these to be important modifiable risk factors for type 2 diabetes. 58 percent of the patients reported having poor eating habits, which included consuming meals with lots of calories. This suggests that lifestyle factors play a crucial role in the development of type 2 diabetes.

Genetic Predisposition: 38.1% of patients had a family history of diabetes, indicating the well-established significance of genetic factors in the onset of type 2 diabetes. When arranging medical care, screening family members of diabetic patients for early identification and intervention should be given top priority

Impacts of T2DM on Patient Well-being: The quality of life of patients with type 2 diabetes was significantly impacted by complications since they limited the patients' mobility and independence, such as cardiovascular disease and neuropathy. This emphasizes how crucial it is to manage diabetes holistically, addressing medicinal therapies in addition to behavioral and clinical concerns.

5.2 RECOMMENDATIONS

In light of the findings from this study and supported by global evidence, several targeted interventions are recommended:

5.2.1. To Ministry of Health and Gihundwe District Hospital

- Reinforce health education programs for patients attending various services to raise awareness of Type 2 Diabetes Mellitus (T2DM) and its management. This initiative should be extended to all health centers within the Gihundwe Hospital catchment area.
- Strengthen the monitoring and follow-up system for diabetic patients to ensure adherence to treatment regimens and timely detection of complications.

5.2.2. To Local Authorities

- Identify and support diabetic patients within local communities, encouraging them and their families to seek regular medical care at health facilities.

5.2.3. To Diabetic Patients and Their Families

- Adhere strictly to the treatment plans and recommendations provided by healthcare providers, including regular follow-ups and medication schedules.
- Avoid misinformation and misconceptions about diabetes treatment, especially regarding alternative or unproven therapies.

5.3 SUGGESTIONS FOR FURTHER STUDY

To build on this study's findings, future research could focus on two key areas that are particularly implementable in rural settings especially the effectiveness of community health worker programs in T2DM Management: Investigating the role of community health workers in supporting diabetes care, including medication adherence, lifestyle changes, and complication prevention, could provide valuable insights.

REFERENCES

- (Voight et al., 2. (2010). *Genome-Wide Association Studies Identify Multiple Loci for Type 2 Diabetes*.
- (WHO), W. H. (2016). *Global Report on Diabetes*. Geneva, Switzerland: World Health Organization (WHO).
- (WHO), W. H. (2016). *Global Report on Diabetes*. Geneva, Switzerland: World Health Organization.
- (WHO), W. H. (2016). *Global Report on Diabetes*. Geneva, Switzerland: World Health Organization (WHO).
- ADA, 2. (2024). e: Management of blood glucose levels: Lifestyle changes, medications, and insulin therapy to prevent complications. *American Diabetes Association*.
- Afarideh, M. S. (2015). Diabetes care in Iran: where we stand and where we are headed. . *Annals of global health*, pp. 81(6), 839-850.
- al, C. e. (2019). *Regional Trends in the Prevalence of Type 2 Diabetes Mellitus in Africa from 1980 to 2014*. London, UK: he Lancet Diabetes & Endocrinology.
- al, d. e. (2020). *Prevalence and Risk Factors of Type 2 Diabetes Mellitus in Rwanda: A National Survey*. Kigali,Rwanda: African Journal of Diabetes Medicine.
- al, K. e. (2021). *Challenges in Diagnosing and Managing Diabetes in Low-Resource Settings*. Stockholm, Sweden: Global Health Action.
- al, K. e. (2021). *Challenges in Diagnosing and Managing Diabetes in Low-Resource Settings*. Stockholm, Sweden: Global Health Action.
- al, R. e. (2014). *revalence and Impact of Type 2 Diabetes Mellitus in Mwanza City: A Public Health Perspective*. Dar es Salaam, Tanzania: : Tanzania Journal of Health Sciences.
- Aramadan,M.J,Almigbal,T.H & Alherbish,A. (2018). Awareness ,attitude,and practices related to diabetes among saudi population in Riyadh;Soudi Arabia. *Journal of diabetes Research*.
- American Diabetes Association, 2. (2024). Type 2 Diabetes Mellitus and its links to lifestyle factors: Obesity, sedentary behavior, and genetic predispositions. *American Diabetes Association,(ADA)*.
- Aune, 2. (2015). he effectiveness of lifestyle changes in the prevention and management of Type 2 Diabetes Mellitus: A review of interventions. *Diabetes Care*.

- Bavuma CM, M. S. (2020 , Dec 10). Socio-demographic and clinical characteristics of diabetes mellitus in rural Rwanda: time to contextualize the interventions? A cross-sectional study. *BMC Endocr Disord*.
- Berg et al., 2. (2021). High rates of undiagnosed Type 2 Diabetes Mellitus and their implications in East Africa. *Journal of Epidemiology and Community Health*.
- Bertram et al., 2. (2013). Cultural perceptions of diabetes and their impact on treatment and management: A global perspective. *lobal Health Action*.
- Bertram et al., 2. (2013). The economic burden of Type 2 Diabetes Mellitus: Direct medical costs and lost productivity. *Global Health Action*.
- Cano et al., 2. (2015). *Dietary Patterns and Their Association with Diabetes Incidenc*.
- CDC, 2. (2021). revalence of Type 2 Diabetes Mellitus: Understanding the proportion of individuals affected in a population. *Centers for Disease Control and Prevention*.
- Champion, 2. (2008). *The Health Belief Model*. In *Health Behavior and Health Education: Theory, Research, and Practice (pp. 45-65)*. San Francisco, CA: ossey-Bas.
- Chang, C. 2. (2024). Recent advances in Type 2 Diabetes Mellitus treatment: Novel pharmacological therapies and their benefits. *Journal of Diabetes and Metabolic Disorders*.
- Chikowore et al. (2022). *Projected Trends in Type 2 Diabetes Mellitus Prevalence in Africa*. Johannesburg, South Africa: African Journal of Endocrinology.
- Chikowore et al., 2. (2022). enetic markers in Sub-Saharan populations: The need for further exploration in Type 2 Diabetes Mellitus research. *rican Journal of Genetics and Genomics*.
- Darling, 2. (2007). Ecological Systems Theory: Implications for understanding health influences at multiple levels in rural settings. *Journal of Applied Developmental Psycholog*.
- de Carvalho et al., 2. (2020). Preventive strategies for Type 2 Diabetes Mellitus: Emphasizing lifestyle modifications and community-based interventions. *Journal of Preventive Medicine and Public Health*.
- De La Cruz-Cano et al., 2. (2019). *Dietary Patterns and Their Association with Type 2 Diabetes Mellitus: A Systematic Review*. Nutrition Reviews.
- Dhatariya. (2020). Diabetic ketoacidosis and non-alcoholic fatty liver disease: Managing additional concerns in Type 2 Diabetes Mellitus. *Endocrine Review*.

- Diabetes Prevention Program (DPP), 2. (2002). Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *The New England Journal of Medicine*.
- Dukunde A, N. J. (2021, June). Prediction of prevalence of type 2 diabetes in Rwanda using the metropolis-hasting sampling. *African Health Science*, pp. 21(2):702-709.
- Dukunde, M. N. (2020). *Prevalence and Risk Factors of Type 2 Diabetes Mellitus in Rwanda: A National Survey*. Kigali, Rwanda: African Journal of Diabetes Medicine.
- Dukunde, M., Niyonzima, E., & Mukeshimana, M. (2020). *Prevalence and Risk Factors of Type 2 Diabetes Mellitus in Rwanda: A National Survey*. Kigali, Rwanda: African Journal of Diabetes Medicine.
- Ekoru, K. e. (2019). *Regional Trends in the Prevalence of Type 2 Diabetes Mellitus in Africa from 1980 to 2014*. London, UK: The Lancet Diabetes & Endocrinology.
- Elbur ,A.Alhaman,S.A,Nour,O.M,Ahmed,R.A,Elbur,A.M &Hamad,R.M. (2019). The effectiveness of a community -based diabetes euducation program in imorovingknowledge and self-management skillsamong sudanese patients with type 2 diabetes mellitus. *SAGE Open Medicine*, 7(1), 1-8.
- Erzse A, S. N. (2019). The direct medical cost of type 2 diabetes mellitus in South Africa: a cost of illness study. *Glob Health Action*, p. 12(1).
- Esteghamati A, A. Z. (2015, Apr). Vitamin D deficiency is associated with insulin resistance in nondiabetics and reduced insulin production in type 2 diabetics. . *Horm Metab Res.*, pp. 47(4):273-9.
- Federation, I. D. (2021). *IDF Diabetes Atlas (10th ed.)*. Brussels, Belgium: International Diabetes Federation.
- Federation, I. D. (2021). *IDF Diabetes Atlas (10th ed.* Brussels, Belgium: International Diabetes Federation.
- Federation, I. D. (2021). *IDF Diabetes Atlas (10th ed.)*. Brussels, Belgium: International Diabetes Federation.
- Federation, I. D. (2021). *IDF Diabetes Atlas (10th ed.)*. Brussels, Belgium: International Diabetes Federation.
- Federation, I. D. (2021). *International Diabetes Federation*. Brussels, Belgium: International Diabetes Federation.
- Federation., I. D. (2021). International Diabetes Federation. Diabetes Atlas, 10th edn. *IDF*.
- Fitzgerald et al, 2. (2017). Economic and societal impacts of Type 2 Diabetes Mellitus: A comprehensive review. *Journal of Diabetes and Metabolism*,.

- Graham et al., 2. (2022). Prevalence and Risk Factors of Cardiovascular Disease Among T2DM Patients: A Gender Comparison. *ournal of Clinical Endocrinology & Metabolism*.
- Guwatudde et al ., 2. (2016). he Burden of Type 2 Diabetes Mellitus in Uganda: A Retrospective Study. *African Journal of Diabetes Medicine*.
- Habimana, A. T. (n.d.). Diabetes management in Rwanda: Challenges and perspectives. . *Rwanda Medical Journal*,, p. 77(2).
- Hall, V,Thomsen,R.w,Henriksen,O&Lohse,R.W. (2021). Global burden of type 2 Diabetes :Asystematic review and meta-analysis. *Diabetes care*, 41(2), 1-20.
- Hall,V, Thomsen; R.W, Henriksen,O; Lohse.N. (2011). *Diabetes in sub-sahara Africa 1999-2011:Epidemiology and public health implications.A systematic review*. (Vol. 11). BMC Public Health. doi:https://doi.org/10.1186/1471-2458-11-564
- Handelsman, Y. B. (2015). clinical practice guidelines for developing a diabetes mellitus comprehensive care plan–2015—executive summary. *Endocrine Practice*, 21(4. *American Association of Clinical Endocrinologists and American College of Endocrinology*, pp. 413-437.
- Hezagirwa et al., 2. (2023). besity and Its Role in the Development of Type 2 Diabetes Mellitus in African Populations. *ournal of Diabetes Research and Clinical Practice*.
- Hezagirwa et al., 2. (2023). Urbanization and changing lifestyles: Trends in Type 2 Diabetes Mellitus prevalence in neighboring countries. *Journal of Regional Health Studies*.
- Hezagirwa, B. R. (2023). Prevalence and Management Challenges of Type 2 Diabetes Mellitus in Low-Resource Settings. *Journal of Global Health*.
- Hu,F.B,Mason,J.E,Stampfer,M.J,Colditz,G,Liu,S,Solomon,C.G&Willet,W.C. (2018). Diet ,Lifestyle,and risk of type 2 diabete mellitus in women. *The new England journal of medicine*, 345(11), 790-797.
- IDF. (n.d.). IDF Diabetes Atlas 10th Edition.
- IDF. (2021). IDF Diabetes Atlas 10th Edition.
- IDF.2023. (2023). *iabetes Atlas: Global and Regional Diabetes Prevalence Estimates for 2019 and Projections for 2030 and 2045*. Brussels, Belgium.
- Kagaruki,G,B,Mayige,M.T,Ngadaya,E.S,Kimaro,G.D&Kalinga,A.K. (2020). Magnitude ans riskfactors of type 2 diabetes mellitusamong patients attending district hospital in Tanzania. *Tropical medicine and health*, 48(1), 1-10.
- Kaplan et al. (2021). *Challenges in diagnosing and managing diabetes in low-resource settings*. Stockholm, Sweden.: Global Health Action .

- Kaplan et al. (2021). *Challenges in Diagnosing and Managing Diabetes in Low-Resource Settings*. Stockholm, Sweden: Global Health Action.
- Kasiam. (2010). The prevalence of Type 2 Diabetes Mellitus in Nigeria: Challenges and management strategies. *Journal of Endocrinology and Metabolism*.
- Kasiam, I. R. (2010). The prevalence of Type 2 Diabetes Mellitus in Nigeria: Challenges and management strategies. *Journal of Endocrinology and Metabolism*.
- Kasnakova et al., 2. (2019). The impact of Type 2 Diabetes Mellitus on health: Cardiovascular disease, neuropathy, retinopathy, and kidney disease. *Diabetes Care Journal*.
- Katende et al., 2. (2020). Challenges in managing Type 2 Diabetes Mellitus in Rwanda: Healthcare system limitations and infrastructure issues. *Rwanda Journal of Health Sciences*.
- Kaur et al., 2. (2022). Gender Differences in Diabetic Peripheral Neuropathy Prevalence Among Type 2 Diabetes Patients. *Journal of Diabetes and Its Complications*.
- Khan et al., 2. (2022). Hypertension and Its Association with Type 2 Diabetes in Women. *Journal of Diabetes and Hypertension*.
- Khavandi et al., 2. (2013). Management of Type 2 Diabetes Mellitus: Pharmacological treatments and self-management education. *Diabetes Care and Education Journal*.
- Kovesdy et al., 2. (2023). Gender Differences in Diabetic Nephropathy: A Review of Risk and Progression. *Journal of Nephrology*.
- Kusariana, G. N. (2015). Obesity, physical inactivity, and poor dietary habits: The main risk factors for Type 2 Diabetes Mellitus. *Global Health Review*.
- Lebeta, R. 2. (2017). Complications of Type 2 Diabetes Mellitus: Adverse health outcomes including cardiovascular disease, nephropathy, neuropathy, and retinopathy. *Complications of Type 2 Diabetes Mellitus: Adverse health outcomes including cardiovascular disease, nephropathy, neuropathy, and retinopathy*.
- Lehner, 2. (2024). Title: Insulin resistance: A condition of reduced cellular responsiveness to insulin and its role in elevated glucose levels and Type 2 Diabetes Mellitus. *Journal of Diabetes Research*.
- M.P., K. (2010). *Trends in Type 2 Diabetes Mellitus Prevalence in Kenya: Impact of Urbanization and Lifestyle Changes*. Nairobi, Kenya: Kenya Medical Journal.
- Malik, V.S, Popkin, B.M, Bray, G.A, Despres, J.P, Willet, W.C & Hu, F.B. (2019). Sugar sweetened beverages and risk of metabolic syndrome and type 2 diabetes :A meta -analysis. *Diabetes care*, 33(11), 2477-2483.

- Manne-Goehler, Z. (2019). Risk factors for Type 2 Diabetes Mellitus: The role of obesity, physical inactivity, and dietary patterns. *The Lancet Diabetes & Endocrinology*.
- Martin, Z. (2020). *Social Learning Theory and its application to health behavior: The role of self-efficacy in managing health*.
- Meng, X. L. (2020). Insulin resistance, beta-cell dysfunction, and dyslipidemia in Type 2 Diabetes Mellitus. *Diabetes and Metabolism Journal*.
- Mengesha, E. M. (2021). Challenges in diabetes management in East Africa: A systematic review. *East African Medical Journal*.
- Mezuk, B., Rafferty, J. A., Kershaw, K. N., Hudson, D., Abdoyu, C. M., IEE, H., Eaton, W. W. & Jackson, J. S. (2016). Reconsidering the role of social disadvantage in physical and mental health: stressfull life events, health behaviours, race and depression. *American Journal of Epidemiology*, 176(12), 1134-1142.
- Ministry of Health, K. (2015). *Kenya STEPwise Survey for Non-Communicable Diseases Risk Factors 2015 Report*. Nairobi, Kenya: Ministry of Health, Kenya.
- MOH, M. o. (n.d.). National Strategy and Costed Action Plan for the Prevention and Control of Non-Communicable Diseases in Rwanda. 21 par.10.
- Motala AA, M. J. (2022, Jan 4). Type 2 diabetes mellitus in sub-Saharan Africa: challenges and opportunities. *Nat Rev Endocrinol*, pp. 18(4):219-229.
- Mudenge et al., Z. (2022). Socio-demographic factors influencing Type 2 Diabetes Mellitus risk and management: Age, gender, income, and education. *Journal of Public Health Research*.
- Mukeshimana, M., Nkosi, Z. Z., & Zondi, N. S. (2020). The knowledge and perception of diabetes mellitus in Rwanda: A qualitative study. *Journal of Diabetes Research*.
- Murray, Z. (2024). Global trends in Type 2 Diabetes Mellitus prevalence: Regional variations and emerging patterns. *Global Health Research*.
- Murray, C. J. (2022, October 10). The global burden of disease study at 30 years. *Nature medicine*, p. 28.
- Murwanashyaka JD, N. A. (2022, Aug 31). Non-adherence to medication and associated factors among type 2 diabetes patients at Clinique Medicale Fraternite, Rwanda: a cross-sectional study. *BMC Endocrine Disorder*, p. 22(1):219.
- National diabetes prevention and control programme, R. (2017-2020). *WDF15-1232*. Retrieved from World Diabetes Foundation: <https://www.worlddiabetesfoundation.org/what-we-do/projects/wdf15-1232/>

- Nawata et al., 2. (2004). Influence of genetic factors on Type 2 Diabetes Mellitus risk: A review of family history and gene polymorphisms. *Endocrine Journal*.
- Ndayisaba et al., 2. (2017). Inadequate resources and personnel in Type 2 Diabetes Mellitus management: Insights from Gihundwe District Hospital. *African Journal of Health Science*.
- Niyomugabo et al., 2. (2020). Exacerbation of Type 2 Diabetes Mellitus complications in Rwanda: The effects of late diagnosis and suboptimal management. *Rwanda Medical Journal*.
- Niyonsenga,J.,Danaei,G&Selmer;R.M. (2019). The impact of health system strengthening program in Rwanda on prevalence of diabetes mellitus. *BMC Public Health, 19*(1), 1-9.
- O'Brien, 2. (2017). Lifestyle factors and their role in Type 2 Diabetes Mellitus risk: Obesity, physical inactivity, and poor dietary habits. *Journal of Diabetes and Metabolic Disorders* .
- Ogurtsova ,k, da Rocha Ferenandes,J.D,Huang,Y,Linnekamp ,U,Guariguata L,ChoN.H,Shaw J.E. (2017). IDF Diabetes Atlas:Global estimates for the prevalence of Diabetes for 2015 and 20240. *Diabetes Research and clinical practice*, 40-50. doi:<https://doi.org/10.1016/j.diabres.2017.03.024>
- Organization, W. H. (2016). *Global Report on Diabetes*. Geneva, Switzerland: World Health Organization.
- Orgutsova. (n.d.).
- Pallayova,M,Taheri,S,Scharre,D.w &Shah,A. (2010). The role of insuline resistance in cognitive decline. *The mount Sinai Journal of Medicine*, 77(5), 513-525.
- Peng, Y. S. (2014). *Prevalence of Type 2 Diabetes and Prediabetes and Associated Risk Factors in Adults in China: A Nationwide Population-Based Study*. London, UK: The Lancet Diabetes & Endocrinology.
- Ruhembe, C. &. (2014). 2015. *anzania Journal of Health Sciences*.
- Saeedi P, S. P. (2020, Apr). Mortality attributable to diabetes in 20-79 years old adults, 2019 estimates: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract*.
- Salome et al., 2. (2020). *Age and the Risk of Type 2 Diabetes Mellitus: A Comprehensive Review*.
- Salome et al., 2. (2020). *Age as a Risk Factor for Type 2 Diabetes Mellitus: A Review of Current Evidence*.

- Salome, M. (2019). *Challenges in Diagnosing and Managing Type 2 Diabetes Mellitus in Low-Resource Settings*. Johannesburg, South Africa: Global Health Perspectives.
- Secretary-General, R. o.-A. (. 2015). *Economic and Social Council Item 3. (a) of the provisional agenda* Items for discussion and decision: data and indicators for the 2030 Sustainable Development Agenda*.
- Shraban, 2. (2022). Environmental factors influencing Type 2 Diabetes Mellitus risk: Urbanization and pollution. *Environmental Health Perspectives*.
- Smith et al, 2. (2023). *Age-Related Prevalence Trends of Type 2 Diabetes Mellitus in Urban Populations: A Longitudinal Study*". *Diabetes Care Journal*.
- Smith et al., 2. (2022). Type 2 Diabetes Mellitus (T2DM): A chronic metabolic disorder characterized by insulin resistance and relative insulin deficiency, leading to elevated blood glucose levels. *Journal of Clinical Endocrinology and Metabolism*.
- Twagirumukiza, 2. (2011). Prevalence and demographic characteristics of Type 2 Diabetes Mellitus in Rwanda: A focus on age and gender. *Rwanda Medical Journal*.
- Twagirumukiza, M. N. (2011). Diabetic foot as a cause of major lower limb amputation in Rwanda: A hospital based study. *Rwanda Medical Journal*, pp. 68(1), 21-25.
- Ufitamahoro et al, 2. (2022). Challenges in Type 2 Diabetes Mellitus management: Delayed diagnosis and healthcare access issues. *East African Medical Journal*.
- Uwinkindi ,F,Kamanzi,E,Mutabazi,F,&Gwaramba,T . (2020). Prevalence of diabetes mellitus among urban and rural populations in Rwanda: A comparative study. *Internatinal journal of Diabetes and endocrinology*, 5(1), 1-10.
- v,Thomsen,R.W.,Henriksen,O,Lohse,R.W. (2018). Global burden of type 2 diabetes : A systematic review and meta -analysis. *Diabetes care*, 41(2), 1-20.
- Velásquez-Hernández, M. e. (2024). *Urbanization, Dietary Shifts, and Obesity: Implications for Diabetes Prevalence*. New York, USA: Journal of Diabetes Research.
- Velásquez-Hernández, M. e. (2024). *Urbanization, Dietary Shifts, and Obesity: Implications for Diabetes Prevalence in Sub-Saharan Africa*. New York, USA: ournal of Diabetes Research.
- Vrachnis, N. I. (2012). Gestational diabetes and hormonal imbalances: Their role in Type 2 Diabetes Mellitus risk. *ournal of Obstetrics and Gynecology Research*.
- WHO. (2016). *Global Report on Diabetes*. Geneva, Switzerland: WHO.
- Yamuragiye, 2. (2017). Trends in the prevalence of Type 2 Diabetes Mellitus in Rwanda: A comparison between urban and rural areas. *Rwanda Medical Journal*.

Zheng et al., 2. (2021). Gender Differences in Diabetic Retinopathy: A Global Perspective. Ophthalmology.

APPENDIX 1 : I: Patient dataset 1

patient_id	gender	age	residence	marital_st	education	height	weight	bmi	physical_a	smoking	alcohol	family_hisi	duration_c	fasting_glu
1	Female	54	Rural	Divorced	Secondary	163	69	25.9	Moderate	No	No	No	4	135
2	Male	62	Urban	Married	University	174	91	30.1	High	No	Yes	Yes	11	185
3	Female	61	Rural	Single	Primary	150	74	33	Low	Yes	No	Yes	14	240
4	Male	45	Urban	Married	Secondary	168	79	27.9	Moderate	No	Yes	No	5	150
5	Female	49	Rural	Divorced	University	160	70	27.3	Moderate	Yes	No	Yes	6	160
6	Male	64	Urban	Widowed	None	157	77	31.2	Low	Yes	Yes	Yes	10	200
7	Female	55	Rural	Married	Secondary	165	63	23.2	High	No	No	No	3	130
8	Male	59	Urban	Single	University	173	86	28.7	Moderate	No	Yes	Yes	9	175
9	Female	42	Rural	Married	Primary	159	65	25.8	Low	No	No	No	2	120
10	Male	70	Urban	Widowed	University	161	81	31.1	Low	Yes	Yes	Yes	16	210
11	Female	39	Rural	Divorced	Secondary	162	68	25.9	Moderate	No	No	No	5	140
12	Male	66	Urban	Married	Tertiary	170	88	30.4	High	No	Yes	Yes	9	185
13	Female	67	Rural	Single	Primary	154	73	30.8	Low	Yes	No	Yes	14	230
14	Male	28	Rural	Single	Primary	165	70	25.7	Low	No	No	No	2	110
15	Female	50	Rural	Married	Secondary	160	75	29.3	Moderate	Yes	No	Yes	5	145
16	Male	60	Urban	Divorced	None	170	85	29.4	Low	Yes	Yes	Yes	8	190
17	Female	36	Rural	Married	Primary	162	62	23.6	Moderate	No	No	No	3	130
18	Male	67	Rural	Widowed	None	159	80	31.6	Low	Yes	Yes	Yes	12	220
19	Female	27	Rural	Married	University	165	58	21.4	High	No	No	No	1	120
20	Male	55	Urban	Married	Secondary	172	90	30.5	Moderate	Yes	Yes	Yes	9	180
21	Female	52	Rural	Divorced	Tertiary	160	68	26.5	Low	No	No	No	4	125
22	Male	42	Urban	Single	Secondary	178	82	25.9	High	No	Yes	Yes	5	150
23	Female	73	Rural	Married	Primary	150	78	34.7	Low	No	No	Yes	15	240
24	Male	35	Urban	Married	University	171	76	26	Moderate	No	Yes	No	6	140
25	Female	57	Rural	Divorced	Tertiary	165	70	25.7	Moderate	Yes	No	Yes	7	160
26	Male	62	Urban	Widowed	University	168	79	27.9	Low	Yes	Yes	Yes	10	190
27	Female	49	Rural	Married	Secondary	160	65	25.4	High	No	No	No	4	135
28	Male	66	Urban	Single	Tertiary	175	88	28.7	Moderate	Yes	Yes	Yes	9	175
29	Female	39	Rural	Married	Primary	158	60	24	Low	No	No	No	2	110
30	Male	74	Urban	Widowed	None	160	80	31.2	Low	Yes	Yes	Yes	16	220
31	Female	44	Rural	Divorced	Secondary	165	70	25.3	Moderate	No	No	No	5	140
32	Male	61	Urban	Married	Tertiary	175	90	29.4	High	No	Yes	Yes	11	175

hba1c	hypertensi	nephropat	retinopath	neuropath	cvd	stroke	treatment	length_sta	outcome
7.2	No	No	No	No	No	No	Metformin	3	Discharge
8.8	Yes	No	No	Yes	No	No	Metformin	5	Discharge
11.1	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	15	Death
7.8	No	No	No	No	No	No	Metformin	3	Discharge
8	Yes	No	No	Yes	No	No	Insulin	5	Discharge
9.9	Yes	Yes	Yes	Yes	Yes	Yes	Metformin	12	Death
6.7	No	No	No	No	No	No	Metformin	3	Discharge
8.4	Yes	No	No	Yes	No	No	Insulin	6	Discharge
6.3	No	No	No	No	No	No	Metformin	2	Discharge
10.8	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	14	Death
7.5	No	No	No	No	No	No	Metformin	3	Discharge
8.7	Yes	No	No	Yes	No	No	Metformin	5	Discharge
10.3	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	15	Death
5.8	No	No	No	No	No	No	Metformin	1	Discharge
7.4	Yes	No	No	Yes	No	No	Insulin	6	Discharge
8.9	Yes	Yes	No	Yes	Yes	Yes	Metformin	10	Referral
6.5	No	No	No	No	No	No	Metformin	2	Discharge
10.5	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	14	Death
6.2	No	No	No	No	No	No	Metformin	1	Discharge
9.1	Yes	No	Yes	No	No	No	Metformin	7	Discharge
6.9	No	No	No	No	No	No	Metformin	3	Discharge
7.8	No	No	No	No	No	No	Metformin	4	Discharge
11.4	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	20	Death
7.5	No	No	No	No	No	No	Metformin	4	Discharge
8.2	Yes	No	No	Yes	No	No	Insulin	5	Discharge
9.3	Yes	Yes	Yes	No	Yes	Yes	Metformin	9	Death
7	No	No	No	No	No	No	Metformin	3	Discharge
8.6	Yes	No	Yes	Yes	No	No	Insulin	6	Discharge
6.3	No	No	No	No	No	No	Metformin	2	Discharge
11.2	Yes	Yes	Yes	Yes	Yes	Yes	Insulin	14	Death
7.4	No	No	No	No	No	No	Metformin	3	Discharge
8.4	Yes	No	No	Yes	No	No	Metformin	5	Discharge

patient_id	gender	age	residence	marital_st	education_height	weight	bmi	physical_a	smoking	alcohol	family_hist	duration_d	fasting_glu	
1	Female	54	Rural	Divorced	Secondary	163	69	25.9	Moderate	No	No	No	4	135
2	Male	62	Urban	Married	University	174	91	30.1	High	No	Yes	Yes	11	185
3	Female	61	Rural	Single	Primary	150	74	33	Low	Yes	No	Yes	14	240
4	Male	45	Urban	Married	Secondary	168	79	27.9	Moderate	No	Yes	No	5	150
5	Female	49	Rural	Divorced	University	160	70	27.3	Moderate	Yes	No	Yes	6	160
6	Male	64	Urban	Widowed	None	157	77	31.2	Low	Yes	Yes	Yes	10	200
7	Female	55	Rural	Married	Secondary	165	63	23.2	High	No	No	No	3	130
8	Male	59	Urban	Single	University	173	86	28.7	Moderate	No	Yes	Yes	9	175
9	Female	42	Rural	Married	Primary	159	65	25.8	Low	No	No	No	2	120
10	Male	70	Urban	Widowed	University	161	81	31.1	Low	Yes	Yes	Yes	16	210
11	Female	39	Rural	Divorced	Secondary	162	68	25.9	Moderate	No	No	No	5	140
12	Male	66	Urban	Married	Tertiary	170	88	30.4	High	No	Yes	Yes	9	185
13	Female	67	Rural	Single	Primary	154	73	30.8	Low	Yes	No	Yes	14	230
14	Male	28	Rural	Single	Primary	165	70	25.7	Low	No	No	No	2	110
15	Female	50	Rural	Married	Secondary	160	75	29.3	Moderate	Yes	No	Yes	5	145
16	Male	60	Urban	Divorced	None	170	85	29.4	Low	Yes	Yes	Yes	8	190
17	Female	36	Rural	Married	Primary	162	62	23.6	Moderate	No	No	No	3	130
18	Male	67	Rural	Widowed	None	159	80	31.6	Low	Yes	Yes	Yes	12	220
19	Female	27	Rural	Married	University	165	58	21.4	High	No	No	No	1	120
20	Male	55	Urban	Married	Secondary	172	90	30.5	Moderate	Yes	Yes	Yes	9	180
21	Female	52	Rural	Divorced	Tertiary	160	68	26.5	Low	No	No	No	4	125
22	Male	42	Urban	Single	Secondary	178	82	25.9	High	No	Yes	Yes	5	150
23	Female	73	Rural	Married	Primary	150	78	34.7	Low	No	No	Yes	15	240
24	Male	35	Urban	Married	University	171	76	26	Moderate	No	Yes	No	6	140
25	Female	57	Rural	Divorced	Tertiary	165	70	25.7	Moderate	Yes	No	Yes	7	160
26	Male	62	Urban	Widowed	University	168	79	27.9	Low	Yes	Yes	Yes	10	190
27	Female	49	Rural	Married	Secondary	160	65	25.4	High	No	No	No	4	135
28	Male	66	Urban	Single	Tertiary	175	88	28.7	Moderate	Yes	Yes	Yes	9	175
29	Female	39	Rural	Married	Primary	158	60	24	Low	No	No	No	2	110
30	Male	74	Urban	Widowed	None	160	80	31.2	Low	Yes	Yes	Yes	16	220
31	Female	44	Rural	Divorced	Secondary	165	70	25.3	Moderate	No	No	No	5	140
32	Male	61	Urban	Married	Tertiary	175	90	29.4	High	No	Yes	Yes	11	175

APPENDIX 2: Data access letter

REPUBLIC OF RWANDA

Gihundwe, on 27th August 2024



WESTERN PROVINCE
RUSIZI DISTRICT
GIHUNDWE HOSPITAL
E-mail: gihundwe.hospital@moh.gov.rw

Ref: 20/ 492/HGDISTRUSIZI/24

To: DUMBA Philippe

Tuyizere Revelien

Re: Request for Data Access: Type 2 Diabetes Prevalence Study in Gihundwe District

Dear: DUMBA Philippe

Tuyizere Revelien,

I'm hereby responding to your letter requesting a Permission to Access Nurses for Research Study on Type 2 Diabetes Prevalence.

In fact, we recognize your request as favorable but it will not be payable. Your research will start since the 27 August 2024, you are requested to report to the director of nursing after research.

Sincerely yours.

Dr MUKAYIRANGA Edithe

Director General of Gihundwe Hospital

CC:

-Director of NURSING

PO Box 87 Rusizi | phone: + 250784277983 | Email: gihundwe.hospital@moh.gov.rw | Instagram: [@gihundwehospital](https://www.instagram.com/gihundwehospital) | Facebook: [@GihundweH](https://www.facebook.com/GihundweH)

Dr. DUMBA
M.C. 492
General Medicine
GIHUNDWE HOSPITAL



