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Factors Associated with Blood Glucose Control among Diabetes Patients who are Under Follow-up in Public Health Facilities of kirehe district, rwanda

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ABSTRACT

Poor blood glucose control remains a major public health challenge, contributing to severe complications and premature mortality among patients with diabetes mellitus. The purpose of this study was to examine the prevalence and factors associated with blood glucose control among diabetes patients enrolled in Non-Communicable Disease (NCD) clinics in public health facilities of Kirehe District, Rwanda. The specific objectives are to identify socio-demographic, clinical, and behavioral predictors of glycemic control, determined factors associated with poor blood glucose control among patients with comorbid conditions such as hypertension and renal impairment, and assessed factors influencing patients' knowledge and behavioral practices toward blood glucose management. The study addressed limited evidence on glycemic control and its determinants among diabetes patients in rural Kirehe District. Its findings provide context-specific evidence to guide healthcare providers, policymakers, patient education, resource allocation, and future research toward improved diabetes management and outcomes. A cross-sectional descriptive study design was employed among 313 diabetes patients attending follow-up care in Kirehe District Hospital and selected health centers. Participants were selected using purposive sampling for the qualitative and consecutive sampling for quantitative component. Primary data were collected using structured questionnaires, while clinical data including HbA1c, blood pressure, and renal function indicators were extracted from electronic medical records. Data were analyzed using SPSS version 25. Descriptive statistics, chi-square tests, and binary logistic regression were used. Statistical significance was set at $p < 0.05$. The study found that 38.7% of patients achieved optimal glycemic control (HbA1c <7%), while 61.3% had poor blood glucose control. Bivariate analysis showed significant associations between glycemic control and socio-demographic factors including gender ($\chi^2 = 4.38$, $p = 0.036$), age ($\chi^2 = 13.62$, $p = 0.003$), education level ($\chi^2 = 16.48$, $p < 0.001$), and occupation ($\chi^2 = 8.27$, $p = 0.041$). Clinical factors significantly associated included duration of diabetes ($\chi^2 = 14.91$, $p < 0.001$), BMI ($\chi^2 = 12.07$, $p = 0.007$), hypertension ($\chi^2 = 18.84$, $p < 0.001$), renal impairment ($\chi^2 = 9.26$, $p = 0.002$), and clinic attendance ($\chi^2 = 15.37$, $p < 0.001$). Behavioral factors significantly associated were medication adherence ($\chi^2 = 28.41$, $p < 0.001$), physical activity ($\chi^2 = 17.62$, $p < 0.001$), diet ($\chi^2 = 11.48$, $p = 0.001$), alcohol use ($\chi^2 = 6.18$, $p = 0.013$), and diabetes knowledge ($\chi^2 = 10.36$, $p = 0.001$). Multivariable logistic regression identified independent predictors of poor glycemic control. These included female gender (AOR = 1.5, 95% CI: 1.0–2.5), age above 60 years (AOR = 2.4, 95% CI: 1.2–4.9), no formal education (AOR = 2.8, 95% CI: 1.3–5.8), duration of diabetes >5 years (AOR = 2.3, 95% CI: 1.3–4.0), obesity (AOR = 3.2, 95%

CI: 1.5–6.8), hypertension (AOR = 2.1, 95% CI: 1.2–3.6), irregular clinic visits (AOR = 3.6, 95% CI: 1.9–6.9), alcohol consumption (AOR = 1.9, 95% CI: 1.0–3.5), physical inactivity (AOR = 3.1, 95% CI: 1.7–5.6), poor medication adherence (AOR = 6.5, 95% CI: 3.2–13.1), and insufficient diabetes knowledge (AOR = 2.2, 95% CI: 1.2–4.0). The study concludes that poor glycemic control is highly prevalent in Kirehe District and is driven by interrelated socio-demographic, clinical, and behavioral factors, with medication non-adherence being the strongest predictor. The study recommends strengthening diabetes education, improving adherence support, enhancing regular monitoring, and integrating lifestyle modification programs within NCD services. Policymakers should prioritize improved access to HbA1c testing and strengthen community-based diabetes management interventions.

1.0 Introduction

Optimal blood glucose control is essential for effective diabetes management and for reducing complications, mortality, and poor quality of life among people living with diabetes mellitus. Glycated hemoglobin (HbA1c), with a recommended target of less than 7% for most adults, is widely used to assess long-term glycemic control and prevent both microvascular and macrovascular complications (ADA, 2024; WHO, 2023). Despite established clinical guidelines, a large proportion of patients globally fail to achieve optimal glycemic control, particularly in low- and middle-income countries (IDF, 2023). In sub-Saharan Africa, poor control persists due to late diagnosis, inadequate diabetes education, irregular follow-up, and socioeconomic barriers affecting adherence (Adebayo et al., 2022; Ngaruiya et al., 2023). In Rwanda, although non-communicable disease services have been expanded, many patients remain poorly controlled (MoH, 2024; RBC, 2024). However, in Kirehe District, limited evidence exists on the level and determinants of glycemic control, hindering targeted interventions and effective diabetes management strategies.

1.2 Purpose of the study

To assess the prevalence and factors associated with blood glucose control among diabetes patients under follow-up in public health facilities of Kirehe District, Rwanda, in 2026.

1.3 Objectives of the Study

1. To determine the prevalence of optimal glycemic control defined as HbA1c < 7 %, among diabetes patients under follow-up in public health facilities of Kirehe District.
2. To determine the association between socio-demographic characteristics and blood glucose control among diabetes patients under follow-up in Kirehe District public health facilities.
3. To examine the association between clinical factors and blood glucose control among diabetes patients under follow-up in Kirehe District public health facilities.
4. To evaluate the association between behavioral factors and blood glucose control among diabetes patients under follow-up in Kirehe District public health facilities.

2.1 Empirical Literature

2.1.1 Prevalence of Optimal Glycemic Control among Diabetes Patients

Globally, the International Diabetes Federation (2023) reports that only 30–40% of people living with diabetes achieve HbA1c <7%. Even in high-income countries with advanced healthcare systems such as the United States, United Kingdom, and Germany, studies indicate that only about 35–45% of patients meet recommended glycemic targets (Holt et al., 2022). This persistent gap is attributed to complex factors such as treatment adherence difficulties, disease progression, and comorbidities among older patients. In

Asia, similar patterns are observed. Nguyen et al. (2021) found that only 32% of elderly diabetic patients in Vietnam achieved optimal glycemic control, with rural populations performing worse due to limited healthcare access and low health literacy. In India, Kumar and Singh (2022) reported control rates ranging between 30% and 38% in urban settings, with significantly lower rates in rural populations.

In Africa, the situation is more concerning. Studies show that only 20–35% of diabetes patients achieve HbA1c targets (El-Masri & Khalil, 2021; Mensah & Owusu, 2021). Sub-Saharan Africa reports even lower control levels due to weak health systems, medication shortages, and limited diabetes education services (Adebayo et al., 2022). In East Africa, studies conducted in Kenya, Uganda, and Tanzania reveal that only 22–30% of patients achieve optimal glycemic control (Okoro & Mwangi, 2023).

In Rwanda, national data from the Rwanda Biomedical Center (2024) indicates that approximately 28% of patients achieve HbA1c <7%. Urban areas such as Kigali report slightly higher rates (30–35%), while rural districts show lower performance due to limited laboratory monitoring and follow-up challenges (Rugira et al., 2023). In Kirehe District, available health reports suggest that only 25–32% of patients achieve optimal glycemic control, indicating a significant public health concern requiring targeted intervention (RBC, 2024).

2.1.2 Socio-Demographic Factors and Blood Glucose Control

Globally, older age is consistently associated with poorer glycemic control due to physiological decline, multiple comorbidities, and increased medication burden (Holt et al., 2022). Gender differences have also been reported, with some studies suggesting that females demonstrate better adherence, although outcomes vary across settings (Becker, 2022). Education level is strongly associated with diabetes outcomes, as educated patients are more likely to understand disease management and adhere to treatment guidelines (Nguyen et al., 2021). Income level is another key determinant. Patients with higher income levels tend to achieve better glycemic control due to improved access to medication, glucose monitoring tools, and healthier diets, while low-income patients face affordability barriers (Kumar & Singh, 2022). Marital status and family support also positively influence adherence and glycemic control (Nguyen et al., 2021).

In Africa, similar patterns are evident. Mensah and Owusu (2021) found that low education, rural residence, and poverty are strongly associated with poor glycemic control. In East Africa, Okoro and Mwangi (2023) reported that urban residence and higher education significantly improve HbA1c outcomes. In Rwanda, Rugira et al. (2023) observed that patients with higher education and stable employment are more likely to achieve optimal control. In rural districts such as Kirehe, socio-demographic barriers are more pronounced due to transportation difficulties, limited education, and low income, all of which negatively affect diabetes management (RBC, 2024).

2.1.3 Clinical Factors and Blood Glucose Control

Globally, longer duration of diabetes is associated with poorer glycemic control due to progressive beta-cell dysfunction and insulin resistance (ADA, 2024). Comorbidities such as hypertension, chronic kidney disease, and cardiovascular disease further complicate management and reduce the likelihood of achieving target HbA1c levels (Holt et al., 2022). Treatment regimens also play a role. Complex regimens involving multiple medications or insulin therapy may reduce adherence, particularly among elderly patients (Becker, 2022). Additionally, patients with a history of diabetes complications such as neuropathy or retinopathy are more likely to experience poor glycemic control due to disease progression and psychological burden (Nathan et al., 2022).

In Africa, El-Masri and Khalil (2021) reported that comorbid conditions significantly reduce glycemic control rates. Mensah and Owusu (2021) found that polypharmacy and long disease duration are major predictors of poor outcomes. In East Africa, Okoro and Mwangi (2023) observed that patients with advanced disease stages and complications have significantly higher HbA1c levels. In Rwanda, Rugira et al. (2023) reported that hypertension and long diabetes duration are strongly associated with poor glycemic control. In Kirehe District, clinical challenges such as limited HbA1c monitoring and irregular follow-up worsen outcomes among patients with comorbidities (RBC, 2024).

2.1.4 Behavioral Factors and Blood Glucose Control

Globally, adherence to medication, healthy diet, and physical activity are strongly associated with optimal glycemic control (ADA, 2024). Poor dietary habits, sedentary lifestyles, smoking, and alcohol consumption contribute significantly to uncontrolled blood glucose levels (Holt et al., 2022). In high-income countries, structured lifestyle programs and self-monitoring improve HbA1c outcomes significantly (Becker, 2022). In Asia, Nguyen et al. (2021) found that regular physical activity and dietary compliance significantly improve glycemic control.

In Africa, behavioral challenges are more pronounced due to food insecurity and limited diabetes education. Mensah and Owusu (2021) reported that poor dietary habits and low physical activity levels are strongly associated with poor glycemic control. In East Africa, Okoro and Mwangi (2023) highlighted medication non-adherence as a major determinant of poor outcomes.In Rwanda, Rugira et al. (2023) found that medication adherence, diet, and physical activity are the strongest predictors of HbA1c control. In Kirehe District, behavioral challenges such as irregular medication intake, poor diet, and limited diabetes education significantly contribute to poor glycemic outcomes (RBC, 2024).

2.2 Theoretical Framework

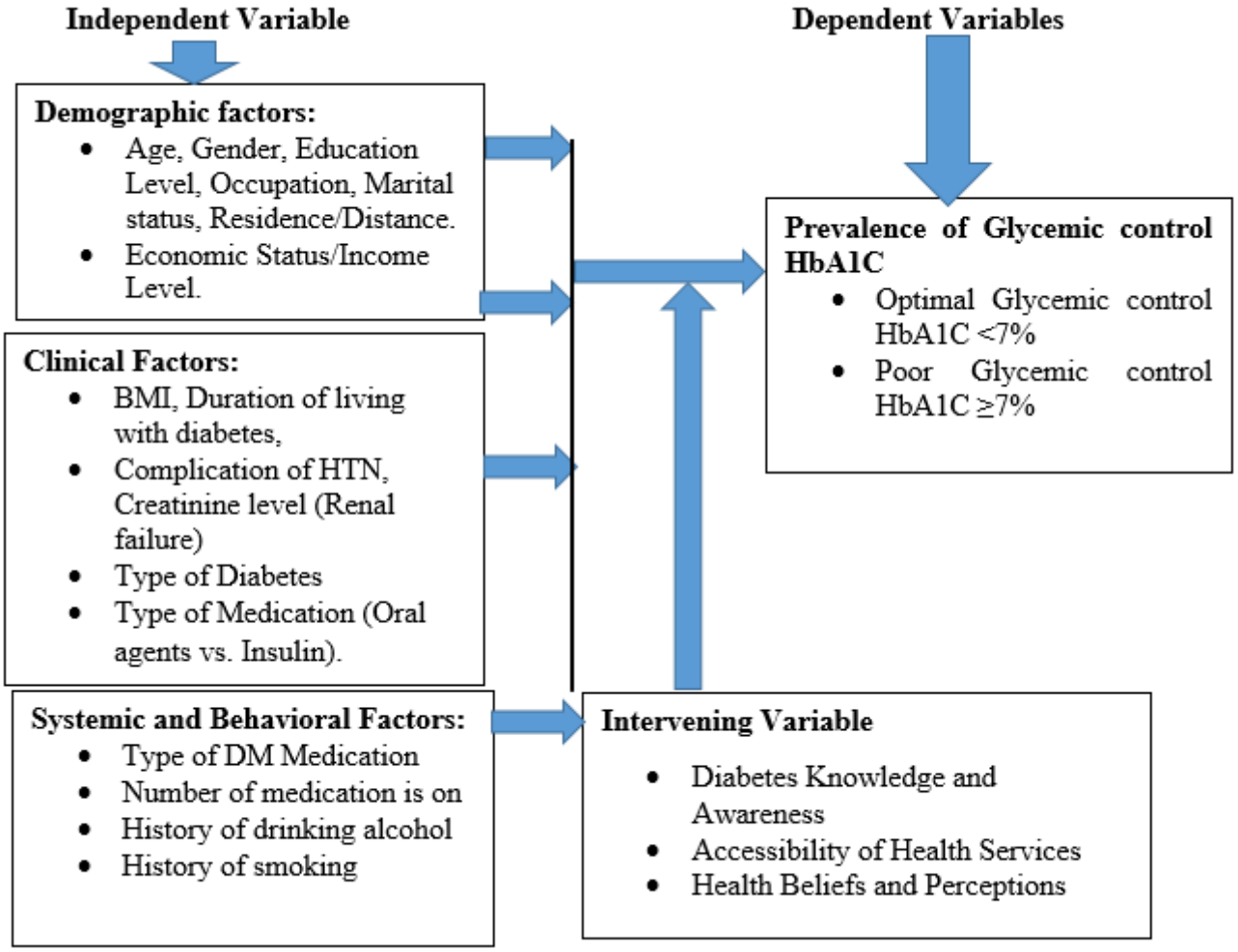
The theoretical foundation of this study is the Health Belief Model (HBM), a widely used psychological framework developed in the 1950s and refined by Rosenstock (1974) and Janz and Becker (1984), which explains why individuals adopt or fail to adopt health-promoting behaviors. In diabetes management, the HBM helps to explain patients' engagement in behaviors necessary for achieving optimal glycemic control (HbA1c < 7%) (ADA, 2026).

The model comprises six key constructs. Perceived susceptibility refers to a patient's belief about their risk of diabetes complications such as stroke or kidney failure, which may vary with age and education. Perceived severity reflects understanding of the seriousness of uncontrolled diabetes and its long-term consequences. Perceived benefits relate to beliefs that adherence to medication, diet, and physical activity improves blood glucose control. Perceived barriers include challenges such as transport costs, food insecurity, and limited access to health services in Kirehe District, which may hinder adherence. Cues to action involve triggers such as health education, reminders, or symptoms that prompt care-seeking behavior. Self-efficacy refers to confidence in managing diabetes self-care activities, which strongly influences adherence and glycemic outcomes. In this study, poor glycemic control (HbA1c ≥ 7%) is viewed as a failure in these behavioral pathways. The HBM therefore provides a comprehensive framework for understanding how socio-demographic, clinical, and behavioral factors interact to influence blood glucose control in Kirehe District, guiding targeted interventions.

2.3 Conceptual Framework

Although existing studies have established that the prevalence of type 2 diabetes among elderly populations is influenced by socioeconomic factors, such as income, education, and access to healthcare,

there remains a critical gap in understanding how these factors interact with mitigation measures to affect blood glucose control.



Source: American Diabetes Association (2026)

This study, therefore, conceptualizes blood glucose control (measured by HbA1c levels) as the dependent variable, influenced directly by independent factors including socio-demographic characteristics, clinical factors, and behavioral practices. Intervening factors, such as knowledge of diabetes, self-efficacy, and accessibility of NCD services, may modify these relationships, either enhancing or constraining effective glycemic control. By explicitly linking these variables, the framework provides a visual and theoretical representation of the pathways through which individual, clinical, and contextual factors contribute to optimal or suboptimal diabetes management among patients under follow-up in Kirehe District public health facilities.

3. Research Methodology and Design

3.1 Research Methodology

This study adopted a quantitative research methodology to examine factors associated with blood glucose control among diabetes patients under follow-up in public health facilities of Kirehe District, Rwanda. Quantitative methodology is appropriate for studies that aim to measure variables numerically, test hypotheses, and establish statistical relationships between dependent and independent variables (Hammarberg et al., 2021; Creswell & Creswell, 2024). In this study, the dependent variable was blood

glucose control (measured using HbA1c), while independent variables included socio-demographic, clinical, and behavioral factors. A quantitative approach was considered most suitable because it allows for objective measurement of glycemic control levels and supports generalization of findings within the study population. It also enables the use of statistical models such as logistic regression to identify predictors of poor glycemic control. The study combined secondary data from Electronic Medical Records (EMR) and primary data from structured questionnaires. This integration improved data completeness, triangulation, and validity by combining clinical laboratory outcomes with patient-reported behaviors and socio-economic characteristics (Bolarinwa, 2020; Jackson et al., 2023).

3.2 Study Design

A cross-sectional study design was employed. A cross-sectional design involves collecting data at a single point in time to assess both exposure and outcome variables simultaneously (Setia, 2016; Mann, 2021). This design is widely used in epidemiological studies because it is efficient, cost-effective, and appropriate for estimating prevalence and examining associations between variables. In this study, the cross-sectional design was used to determine the prevalence of optimal glycemic control (HbA1c <7%) and to examine its association with socio-demographic, clinical, and behavioral factors among diabetes patients in Kirehe District. The design allowed the researcher to capture a snapshot of patients' health status and influencing factors during routine follow-up care. The study also incorporated retrospective EMR data covering HbA1c records from 2015 to 2022 alongside primary survey data collected during the study period. This hybrid approach strengthened the depth of analysis by linking long-term clinical outcomes with current behavioral and socio-economic conditions (Creswell & Creswell, 2024).

3.3 Location of the Study

The study was conducted in Kirehe District, located in Eastern Province of Rwanda and bordering Tanzania and Burundi. The district covers approximately 1,176 km² and has an estimated population of about 460,860 people. It is predominantly rural, with limited access to specialized healthcare services compared to urban districts. The study was conducted in all public health facilities providing diabetes care, including Kirehe District Hospital and selected health centers offering Non-Communicable Disease (NCD) clinic services. These facilities provide routine diabetes follow-up, medication refills, laboratory monitoring, and patient education. Kirehe District Hospital operates a dedicated NCD clinic that manages chronic diseases such as diabetes and hypertension. Health centers conduct scheduled NCD clinic days where patients receive follow-up care and medications. Community health workers also support patient follow-up and linkage to care. This setting was appropriate because it represents a typical rural healthcare environment in Rwanda, where challenges such as long travel distances, limited laboratory capacity, and socioeconomic barriers may influence diabetes outcomes. Studying all public facilities ensured a comprehensive understanding of glycemic control in the district.

3.4 Target Population

The target population consisted of all adult patients diagnosed with Type 1 or Type 2 diabetes mellitus who were enrolled in NCD clinics in public health facilities of Kirehe District and were under active follow-up during the study period. This population was appropriate because NCD clinics provide structured follow-up, enabling consistent monitoring of clinical outcomes such as HbA1c, as well as documentation of treatment history and comorbid conditions (ADA, 2024; WHO, 2023). Patients were included if they had at least six documented HbA1c measurements recorded in the EMR system between January 2015 and December 2022. This ensured reliable estimation of long-term glycemic control.

Patients who had moved out of the district, were lost to follow-up, or deceased were excluded due to incomplete data.

Inclusion criteria:

- Diagnosed with Type 1 or Type 2 diabetes
- Age ≥18 years
- Enrolled in NCD clinic follow-up
- At least six HbA1c records available
- Provided informed consent

Exclusion criteria:

- Incomplete medical records
- Less than six HbA1c readings
- Transferred, lost to follow-up, or deceased patients

3.5 Sampling Techniques and Sample Size

The sample size was determined using Fisher's et al. (1991) formula:

$n = (Z^2pq) / d^2$

Where:

- Z = 1.96 (95% confidence level)
- p = 0.5 (assumed prevalence of optimal control)
- q = 1 – p = 0.5
- d = 0.05 (margin of error)

n = 384

Since the target population (N = 1200) is less than 10,000, correction was applied:

nf = n / (1 + (n/N)) nf = 384 / (1 + 384/1200) nf ≈ 313 respondents. Thus, the final sample size was 313 diabetes patients.

The study used a combination of purposive and convenience sampling techniques. Purposive sampling ensured inclusion of patients meeting eligibility criteria, while convenience sampling allowed recruitment of participants available during clinic visits. Eligible patients were consecutively recruited from NCD clinics across selected health facilities until the required sample size was achieved. Although probability sampling was not used, efforts were made to reduce selection bias by including participants from multiple facilities and different clinic days.

3.6 Research Instruments

Data collection involved two instruments:

1. **EMR extraction checklist (secondary data):** Used to collect clinical data such as HbA1c, BMI, medications, comorbidities, and renal function.
2. **Structured questionnaire (primary data):** Used to collect socio-demographic, behavioral, and adherence-related information.

This dual approach improved data triangulation and strengthened validity (Mwangi et al., 2022; Niyonzima & Uwimana, 2023). A pilot study was conducted in a neighboring district using 30 patients. It tested clarity of questions, time required, and feasibility of linking EMR and questionnaire data. Necessary adjustments were made before actual data collection. Validity was ensured through expert review and content validation. Reliability was tested using Cronbach's alpha (≥0.70). Test-retest reliability was also assessed. Trustworthiness was enhanced through triangulation of EMR and questionnaire data and use of

standardized procedures. Data were collected using EMR extraction and interviewer-administered questionnaires. Unique patient codes ensured confidentiality while linking datasets.

3.6 Data Analysis

Data was entered into SPSS version 21. Descriptive statistics (frequencies, percentages, means) summarized characteristics. Chi-square tests assessed associations. Variables with $p < 0.20$ were included in logistic regression. Adjusted odds ratios (AOR) with 95% CI were used, with significance at $p < 0.05$. Ethical approval was obtained from Mount Kenya University and relevant district authorities. Informed consent was obtained from all participants. Confidentiality, voluntary participation, and data protection were strictly observed throughout the study.

4. Presentation of Findings

The study achieved a response rate of 100%, with all 313 targeted diabetes patients successfully participating in the study and having complete Electronic Medical Record (EMR) data available for extraction. The high response rate was achieved through conducting data collection during scheduled NCD clinic visits and ensuring close collaboration with healthcare providers in the participating public health facilities.

4.1 Prevalence of Optimal Blood Glucose Control among Diabetes Patients Under Follow-up in Public Health Facilities of Kirehe District, Rwanda

Blood glucose control was assessed using HbA1c values extracted from the Electronic Medical Record (EMR) system. Optimal glycemic control was defined as HbA1c < 7%, while poor glycemic control was defined as HbA1c ≥ 7%.

Table 1 Prevalence of blood glucose control among diabetes patients (n = 313)

Glycemic control status	Frequency (%)
Optimal glycemic control (HbA1c <7%)	121 (38.7)
Poor glycemic control (HbA1c ≥7%)	192 (61.3)

Source: Secondary Data (EMR), 2026

Table 1 shows the prevalence of blood glucose control among diabetes patients under follow-up in public health facilities of Kirehe District. Out of the 313 respondents included in the study, 121 patients (38.7%) achieved optimal glycemic control with HbA1c levels below 7%, while the majority, 192 patients (61.3%), had poor glycemic control with HbA1c levels equal to or greater than 7%. The findings indicate that poor blood glucose control remains a major challenge among diabetes patients in Kirehe District. The high proportion of patients with uncontrolled blood glucose levels suggests potential gaps in medication adherence, lifestyle modification, regular monitoring, and healthcare access. Poor glycemic control increases the risk of diabetes-related complications including cardiovascular diseases, kidney disease, neuropathy, and visual impairment.

Table 2 Distribution of HbA1c levels among diabetes patients (n = 313)

HbA1c category	Frequency (%)
< 7% (Optimal control)	121 (38.7)
7–8.9% (Moderately uncontrolled)	103 (32.9)
≥ 9% (Severely uncontrolled)	89 (28.4)

Source: Secondary Data (EMR), 2026

Table 2 presents the distribution of HbA1c levels among diabetes patients under follow-up in Kirehe District. The findings revealed that 32.9% of respondents had moderately uncontrolled blood glucose levels with HbA1c values ranging between 7% and 8.9%, while 28.4% had severely uncontrolled glycemic levels with HbA1c values of 9% or above. The results suggest that a substantial proportion of diabetes patients were at increased risk of developing serious long-term complications associated with persistent hyperglycemia.

4.3 Factors Associated with Blood Glucose Control among Diabetes Patients Under Follow-up in Public Health Facilities of Kirehe District, Rwanda

This section presents the association between selected socio-demographic, clinical, behavioral, and healthcare-related factors and blood glucose control among diabetes patients under follow-up in public health facilities of Kirehe District. Chi-square tests were used to assess associations between independent variables and glycemic control status.

Table 3 Association between socio-demographic factors and blood glucose control (n = 313)

Variable	Poor Glycemic Control n (%)	χ^2	p-value
Gender			
Male	74 (54.4)		
Female	118 (66.7)	4.38	0.036
Age group			
18–30 years	18 (42.9)		
31–45 years	42 (53.2)		
46–60 years	82 (67.8)	13.62	0.003
Above 60 years	50 (70.4)		
Education level			
No formal education	58 (78.4)		
Primary	83 (64.8)		
Secondary	38 (48.1)		
Tertiary	13 (40.6)	16.48	<0.001
Occupation			
Farmer	104 (69.8)		
Business	37 (54.4)		
Employed	26 (48.1)		
Unemployed	25 (59.5)	8.27	0.041

Source: Primary and Secondary Data, 2026

Table 3 presents the association between socio-demographic characteristics and blood glucose control among diabetes patients under follow-up in Kirehe District. Female respondents had a significantly higher prevalence of poor glycemic control (66.7%) compared to males (54.4%), with $\chi^2 = 4.38$ and $p = 0.036$.The findings further revealed that poor glycemic control increased with age. Respondents aged above 60 years had the highest prevalence of poor glycemic control (70.4%), followed by those aged 46–60 years (67.8%). In contrast, younger respondents aged 18–30 years had the lowest prevalence of poor glycemic control (42.9%). The association between age group and glycemic control was statistically significant ($\chi^2 = 13.62$,

p = 0.003). Education level was also significantly associated with blood glucose control ($\chi^2 = 16.48$, $p < 0.001$). Respondents with no formal education exhibited the highest prevalence of poor glycemic control (78.4%), while those with tertiary education had the lowest prevalence (40.6%). This suggests that higher educational attainment may improve understanding of diabetes management and adherence to treatment recommendations. Occupation was significantly associated with glycemic control ($\chi^2 = 8.27$, $p = 0.041$). Farmers had the highest prevalence of poor glycemic control (69.8%), possibly due to limited healthcare access, financial constraints, and demanding work conditions that interfere with diabetes management practices.

Table 4 Association between clinical factors and blood glucose control (n = 313)

Variable	Poor Glycemic Control n (%)	χ^2	p-value
Duration of diabetes			
≤ 5 years	86 (50.3)		
> 5 years	106 (74.6)	14.91	<0.001
BMI category			
Normal weight	63 (47.7)		
Overweight	71 (73.2)		
Obese	45 (80.4)	12.07	0.007
Hypertension			
Yes	93 (78.8)		
No	99 (59.6)	18.84	<0.001
Renal impairment			
Yes	49 (79.0)		
No	143 (57.0)	9.26	0.002
Frequency of clinic visits			
Regular visits	121 (53.1)		
Irregular visits	71 (83.5)	15.37	<0.001

Source: Secondary Data (EMR), 2026

Table 4 presents the association between clinical characteristics and blood glucose control among diabetes patients. Respondents who had lived with diabetes for more than five years had a significantly higher prevalence of poor glycemic control (74.6%) compared to those with shorter disease duration (50.3%), $\chi^2 = 14.91$, $p < 0.001$. Body mass index was significantly associated with blood glucose control ($\chi^2 = 12.07$, $p = 0.007$). Obese respondents had the highest prevalence of poor glycemic control (80.4%), followed by overweight respondents (73.2%). The presence of hypertension significantly increased the prevalence of poor glycemic control (78.8%) compared to respondents without hypertension (59.6%), $\chi^2 = 18.84$, $p < 0.001$. Similarly, respondents with renal impairment experienced significantly higher levels of poor glycemic control (79.0%) than those with normal renal function (57.0%), $\chi^2 = 9.26$, $p = 0.002$. Clinic attendance patterns were also significantly associated with glycemic control. Respondents with irregular NCD clinic visits had a markedly higher prevalence of poor glycemic control (83.5%) compared to those attending clinics regularly (53.1%), $\chi^2 = 15.37$, $p < 0.001$.

4.4 Multivariable Logistic Regression Analysis of Factors Associated with Poor Blood Glucose Control among Diabetes Patients Under Follow-up in Public Health Facilities of Kirehe District, Rwanda

Variables with p-values less than 0.20 in the bivariate analysis were entered into the multivariable logistic regression model. Crude Odds Ratios (COR), Adjusted Odds Ratios (AOR), 95% Confidence Intervals (CI), and p-values were computed to determine the strength and significance of associations.

5. Discussion of Findings

The discussion focuses on the prevalence of blood glucose control and the socio-demographic, clinical, and behavioral factors associated with glycemic control among diabetes patients under follow-up in public health facilities of Kirehe District, Rwanda.

5.1 Prevalence of Optimal Blood Glucose Control among Diabetes Patients Under Follow-up in Public Health Facilities of Kirehe District

The study found that 38.7% of diabetes patients achieved optimal glycemic control, while 61.3% had poor glycemic control. These findings indicate that more than half of the patients under follow-up in Kirehe District were not meeting recommended blood glucose targets. This reflects persistent challenges in diabetes management, including suboptimal adherence to treatment, unhealthy lifestyle practices, limited self-management knowledge, and irregular continuity of care. These findings are consistent with evidence from Sub-Saharan Africa, where poor glycemic control remains highly prevalent. Assefa et al. (2022) reported that over 60% of diabetes patients in African settings fail to achieve HbA1c targets, mainly due to weak health systems and inadequate self-care practices. Similarly, Gebreyohannes et al. (2021) in Ethiopia found that approximately two-thirds of patients had uncontrolled diabetes despite being on treatment. Comparable patterns are observed in East Africa. Mwangi et al. (2022) in Kenya reported that only about one-third of patients achieved optimal glycemic control, while Namusisi et al. (2023) in Uganda highlighted that poor control exceeded 50% in rural facilities. In Rwanda, Niyonzima and Uwimana (2023) also reported high levels of uncontrolled diabetes among patients attending referral hospitals, attributing this to financial constraints, inadequate education, and inconsistent follow-up. The relatively low rate of optimal glycemic control in Kirehe District may be explained by its rural context, where access to diabetes education, laboratory monitoring, and specialist care is limited. Poor glycemic control increases the risk of complications such as cardiovascular disease, neuropathy, kidney failure, and premature mortality. These findings emphasize the need for strengthened diabetes education, improved follow-up systems, and enhanced behavioral interventions.

5.2 Socio-Deographic Factors Associated with Blood Glucose Control

The study found that age, gender, education level, and occupation were significantly associated with glycemic control. Older patients (above 60 years) were more likely to have poor glycemic control. This may be due to reduced physical activity, increased comorbidities, and declining self-care capacity. Similar findings were reported by Assefa et al. (2022), who noted that older age is associated with reduced adherence and poorer metabolic control. Gender differences were also observed, with female patients more likely to experience poor glycemic control. This may be attributed to household responsibilities, reduced time for self-care, and hormonal influences affecting glucose regulation. Mwangi et al. (2022) similarly reported poorer outcomes among female patients in rural Kenya. Education level significantly influenced outcomes. Patients with no formal education had poorer glycemic control compared to those with secondary or higher education. This is linked to low health literacy and reduced understanding of diabetes

management. Gebreyohannes et al. (2021) confirmed that education improves adherence and self-management behaviors. Occupation also influenced outcomes, with farmers and informal workers more likely to have poor control. This may be related to financial constraints, irregular clinic attendance, and physically demanding work schedules that interfere with treatment adherence.

5.3 Clinical Factors Associated with Blood Glucose Control

Clinical factors such as duration of diabetes, BMI, hypertension, renal impairment, and clinic attendance were significantly associated with glycemic control. Patients with diabetes duration above five years had poorer glycemic outcomes, likely due to disease progression, treatment fatigue, and declining pancreatic function. Similar findings were reported by Gebreyohannes et al. (2021), who linked long disease duration with reduced glycemic control. Overweight and obese patients had higher levels of poor control, reflecting the role of insulin resistance in obesity. Namusisi et al. (2023) similarly found that elevated BMI significantly worsens glycemic outcomes. Hypertension and renal impairment were also associated with poor control, reflecting the burden of multimorbidity. Niyonzima and Uwimana (2023) highlighted that coexisting chronic conditions complicate treatment adherence and metabolic regulation. Irregular clinic attendance was strongly linked to poor glycemic control, emphasizing the importance of continuous monitoring, medication adjustment, and patient education. Mwangi et al. (2022) similarly found that regular follow-up improves glycemic outcomes through enhanced clinical support.

5.4 Behavioral and Healthcare Access Factors Associated with Blood Glucose Control

Behavioral factors were among the strongest determinants of glycemic control. Poor medication adherence was significantly associated with uncontrolled blood glucose, confirming that adherence remains central to diabetes management. Mwangi et al. (2022) reported similar findings in Kenya. Physical inactivity was also associated with poor control due to reduced insulin sensitivity. Regular exercise improves glucose uptake and metabolic balance, while sedentary behavior increases hyperglycemia risk. Unhealthy dietary habits, particularly high intake of sugary and processed foods, were strongly associated with poor glycemic outcomes. Alcohol consumption also contributed to poor control by affecting medication effectiveness and glucose metabolism. Low diabetes knowledge was another key determinant, indicating that insufficient health education undermines self-care behaviors. Gebreyohannes et al. (2021) similarly emphasized the role of diabetes literacy in achieving glycemic targets. Finally, poor access to healthcare services, including missed appointments and medication access barriers, significantly contributed to uncontrolled diabetes. This highlights the importance of strengthening primary healthcare systems, improving drug availability, and promoting patient-centered follow-up systems.

6. Conclusions and Recommendations

The study concludes that poor blood glucose control is highly prevalent among diabetes patients under follow-up in public health facilities of Kirehe District, with more than half of patients failing to achieve optimal glycemic targets. This indicates persistent challenges in achieving effective long-term diabetes management in a rural setting. Socio-demographic factors such as older age, female gender, low education level, and occupation significantly influence glycemic control. These groups are more vulnerable to poor outcomes and require targeted, equity-focused interventions to improve self-management and treatment adherence. Clinical factors including long duration of diabetes, obesity, hypertension, renal impairment, and irregular clinic attendance were also found to significantly contribute to poor glycemic control. These findings highlight the importance of integrated chronic disease management and consistent follow-up care within Non-Communicable Disease (NCD) services. Behavioral and healthcare access factors—

particularly poor medication adherence, physical inactivity, unhealthy dietary practices, alcohol consumption, and low diabetes knowledge were identified as major modifiable determinants. This suggests that strengthening patient education and lifestyle modification programs could substantially improve outcomes.

The paper recommends that health facilities should strengthen diabetes education, reinforce routine HbA1c monitoring, and prioritize high-risk groups through tailored counselling and integrated care. The Ministry of Health should expand community-based awareness, improve NCD service capacity, and ensure equitable access to medicines and testing. Future research should examine psychosocial determinants and evaluate digital health interventions to improve adherence and glycemic outcomes in rural Rwanda.

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