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FACTORS ASSOCIATED WITH POOR GLYCEMIC SELF-MONITORING AMONG TYPE 2 DIABETES PATIENTS ATTENDING KIGEME DISTRICT HOSPITAL IN RWANDA.

Munezero Joseph¹, Charles Nsanzabera^{1,2},

¹ Department of Public Health, Mount Kenya University, Rwanda

² African institute of Research for Public Health and Development, Burundi, Rwanda

*Correspondence to munezejose@gmail.com

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Abstract

Background Diabetes prevalence among adults has risen globally from 4.6% (151 million) in 2000 to 10.5% (537 million) in 2021, with projections reaching 11.3% (643 million) by 2030. This study aimed to assess the prevalence and determinants of poor Self-Monitoring of Blood Glucose (SMBG) among Type 2 Diabetes patients at Kigeme District Hospital's NCD clinic.

Methods A cross-sectional study was conducted with 217 patients, selected using the Yamane formula. Data were collected through researcher-administered questionnaires and analyzed in SPSS v22. Univariate, bivariate (Fisher's exact test), and multivariate (binary logistic regression) analyses were used to identify associations. Ethical standards, including confidentiality, were maintained. Findings aim to guide targeted interventions and policies.

Results Poor SMBG was reported in 89.1% of patients; only 10.9% practiced it adequately. Females had higher odds of poor SMBG (AoR = 3.761, 95% CI: 1.568–7.930, $p = 0.08$). Lack of physical activity showed a strong association (AoR = 6.900, 95% CI: 4.508–10.646). Farmers and traders were at greater risk (AoR = 8.338, 95% CI: 2.026–21.766). Low knowledge of SMBG was another key factor (AoR = 11.645, 95% CI: 3.992–21.117).

Conclusion Most Type 2 Diabetes patients at Kigeme exhibited poor SMBG. Key associated factors included female gender, inactivity, poor glucose control, rural occupations, limited knowledge, and equipment barriers. The study recommends expanding diabetes education and ensuring access to testing supplies to improve SMBG adherence. **Keywords: Factors, Glycemic Self-Monitoring, Type 2 Diabetes, Kigeme District Hospital, Rwanda.**

Introduction

Globally, the burden of diabetes among adults has more than doubled, rising from 4.6% to 10.5% between 2000 and 2021, with the number of cases increasing from 151 to 537 million (Magliano et al., 2021). Without strong interventions, prevalence could reach 11.3% (643 million) by 2030 and 12.2% (783 million) by 2045, with 94% of cases expected in low- and middle-income countries (LMICs). In the U.S., diabetes rose from 10.2% to 12.1% between 2012 and 2022 (Sulakshan et al., 2024), while NHANES data showed 11.6% prevalence from 2009–2018 (Fang et al., 2023). In China, it's projected to increase from 8.2% to 9.7% by 2030 (Liu et al., 2023). Across 31 European countries, 6.5% had diabetes (Fuentes-Merlos et al., 2021). Although global, the impact is heavier in developing regions—Africa is home to 24 million diabetic adults, projected to reach 55 million by 2045, a 129% increase (Magliano et al., 2021).

Regionally, undiagnosed diabetes rates in Africa vary: 4.43% in Eastern, 4.72% in Western, 4.27% in Northern, and 1.46% in Southern Africa (Dessie et al., 2020). In Rwanda, the IDF estimated a prevalence of 3.16% in 2015, rising to an average of 6.5% by 2021, with urban rates as high as 9.7% and over 297,000 affected (Bavuma et al., 2022; IDF, 2015; World Bank, 2021). This growing burden drives up mortality, disability, and healthcare costs.

Effective diabetes control depends on achieving glycemic control through patient involvement—particularly via Self-Monitoring of Blood Glucose (SMBG). SMBG allows individuals to track glucose levels, guide treatment decisions, and prevent complications (American Diabetes Association, 2020; Pleus et al., 2022). Despite advances in SMBG technology, challenges persist, including cost, accuracy, and access. Poor use of SMBG contributes to poor glycemic control (Magliano et al., 2021; Pleus et al., 2022).

Globally recognized as essential, SMBG remains poorly practiced in sub-Saharan Africa—only 15% adherence was reported in a 2018 review (Stephani et al., 2018). Barriers include low awareness, cost, fear of pain, low motivation, and limited provider support (Al-Keilani et al., 2017; Stephani et al., 2018). System-related issues like clinician knowledge and health literacy also hinder usage.

In Rwanda, recent findings are promising: an RCT showed 63.4% adherence in rural areas, with emphasis on improving record-keeping (Ng'ang'a et al., 2022). However, data on SMBG use and device ownership remain scarce. At Kigeme District Hospital—where blood glucose control is often poor—such data are essential. This study aims to assess the prevalence and determinants of poor SMBG among T2D patients attending the NCD service at Kigeme District Hospital.

Methods

Study design and setting

The study was conducted under a cross-sectional design and a quantitative method in Kigeme district hospital from August to September 2024. The target population was estimated to be 389

diabetics (Kigeme Hospital District, 2024). This study population was composed of males and female aged between 20 to 65 years old who have been enrolled in diabetic self-monitoring program.

Sample size and sampling

The study sample size was calculated based on the formula initiated by Yamane (Khun-inkeeree et al., 2019). The sample size was 198 and corrected with additional of 10% of non-response rate which yielded 217 sample size. However, the final respondents were 202. The used simple random sampling for ensuring the equal chance of study population for being selected.

Study instruments

This work employed a researcher-administered questionnaire to collect pertinent information from the patients. The questionnaire consists of six sections: the first section covers socio-demographic factors. The second section focuses on SMBG and includes relevant components of self-monitoring as the dependent variable. The third section encompasses independent variables, including training on SMBG, knowledge and practices, lifestyle factors, family support, and comorbidities.

Reliability and validity

Reliability

To ensure reliability, a pilot study was conducted with 10% of participants from a different sector. Cronbach's Alpha was used to assess the tool's consistency, yielding a score of 0.71, indicating acceptable reliability.

Validity

The questionnaire's validity was ensured by aligning it with study objectives and refining it with supervisors. The Content Validity Index (CVI), calculated as relevant items over total items, yielded a valid score of 0.8.

Statistical analysis

Following data collection, the researcher proceeded to clean and input the data into SPSS, in its version 22.0 in order to analyse the data. The modified Bloom's cutoff was applied to categorize percentage data into groups representing good and poor self-monitoring. Patients with 60% and above were categorized as good self-monitoring of blood glucose while patients below 60% were categorized as poor self-monitoring. Descriptive statistical analysis included presenting data using frequency, percentage, mean, and standard deviation.

For further analysis, univariate analysis was employed to explore descriptive statistics. Bivariate analysis utilized the fisher exact test, and significant variables identified were subjected to

adjustment using logistic regression. The significance threshold was measured by a p value below 0.05 at 95% CI.

Ethical consideration

After proposal approval, ethical clearance(Reference number: MKU/ETHICS/23/01/2024) was obtained from Mount Kenya University's IRB. Informed consent was secured from diabetic patients after explaining the study's purpose, risks, benefits, and confidentiality in simple terms. Permission was also granted by Kigeme Hospital leadership. Participants could ask questions, review, and voluntarily sign the consent form, with the option to withdraw at any time. all study data and documents remain strictly confidential.

Study Findings

Table 1 outlines the demographics of 202 T2D patients at Kigeme District Hospital. Most were over 60 (40.1%), with 56.9% male. Married individuals made up 70.8%, and 65.3% had only primary education. Religious affiliations were mainly Protestant (37.6%) and Catholic (35.1%).

The majority (75.7%) were farmers, and 44.6% earned 11,000–29,000 Rwf/month. Most (81.2%) lived in rural areas and were insured under Mutuelle de Santé, reflecting low-income, rural backgrounds.

Table 1. Demographic characteristics of study respondents among patients of Type 2 Diabetes attending NCDs Service at Kigeme District Hospital.

Variables n=202	Frequency	Percentage (%)
Age		
20-40 years	54	26.7
41-60 years	67	33.2
> 60 years	81	40.1
Total	202	100.0
Gender		
Male	115	56.9
Female	87	43.1
Total	202	100.0
Marital Status		
Single	18	8.9
Married	143	70.8
Divorced	2	1.0
Widowed	39	19.3
Total	202	100.0
Education Level		
uneducated	30	14.9
Primary	132	65.3
Secondary	26	12.9
University	14	6.9

Total	202	100.0
Religion		
Catholic	71	35.1
Protestant	76	37.6
Adventist	39	19.3
Muslim	5	2.5
Other	11	5.4
Total	202	100.0
Occupation		
Farmer	153	75.7
Health worker	10	5.0
Teacher	10	5.0
Trader	26	12.9
Other	3	1.5
Total	202	100.0
Income per months		
0-10k Rwf	30	14.9
11-29k Rwf	90	44.6
30-50k Rwf	44	21.8
51-100k Rwf	28	13.9
101-300k Rwf	10	5.0
Total	202	100.0
Residence place		
Urban	38	18.8
Rural	164	81.2
Total	202	100.0
Health insurance		
MUSA	164	81.2
RSSB	22	10.9
MMI	11	5.4
Other	5	2.5
Total	202	100.0

Source: Primary data, 2024

Table 2 summarizes self-monitoring practices among 202 T2D patients at Kigeme District Hospital. Only 13.9% performed daily blood tests, and 12.4% adhered to weekly tests, while over 86% did not follow either routine. Access to weekly testing structures was very limited—only 3% reported having one, and 97% lacked access. Just 10.9% regularly recorded test results, with 89.1% failing to do so. Appointment adherence was relatively better, with 72.8% attending regularly, while 27.2% missed visits. Only 12.9% cleaned the puncture site before testing, indicating poor hygiene practices in SMBG.

Table 2. Self-monitoring blood glucose practicality among the patients of Type 2 Diabetes attending NCDs Service at Kigeme District Hospital.

Variable	Frequency	Percentage (%)
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Respect daily blood test		
Yes	28	13.9
No	174	86.1
Total	202	100.0
Respect weekly blood test		
Yes	25	12.4
No	177	87.6
Total	202	100.0
Having weekly test Structure		
Yes	6	3.0
No	196	97.0
Total	202	100.0
Write all records consistently		
Yes	22	10.9
No	180	89.1
Total	202	100.0
Respect appointment		
Yes	147	72.8
No	55	27.2
Total	202	100.0
Clean area of taking blood		
Yes	26	12.9
No	176	87.1
Total	202	100.0

Source: Primary data, 2024

The findings of this study have shown that the prevalence of poor Self-Monitoring of Blood Glucose among the patients of Type 2 Diabetes attending NCDs Service at Kigeme District Hospital was 89.1% while the good self-monitoring blood glucose (SMBG) was 10.9% as shown in figure 1.

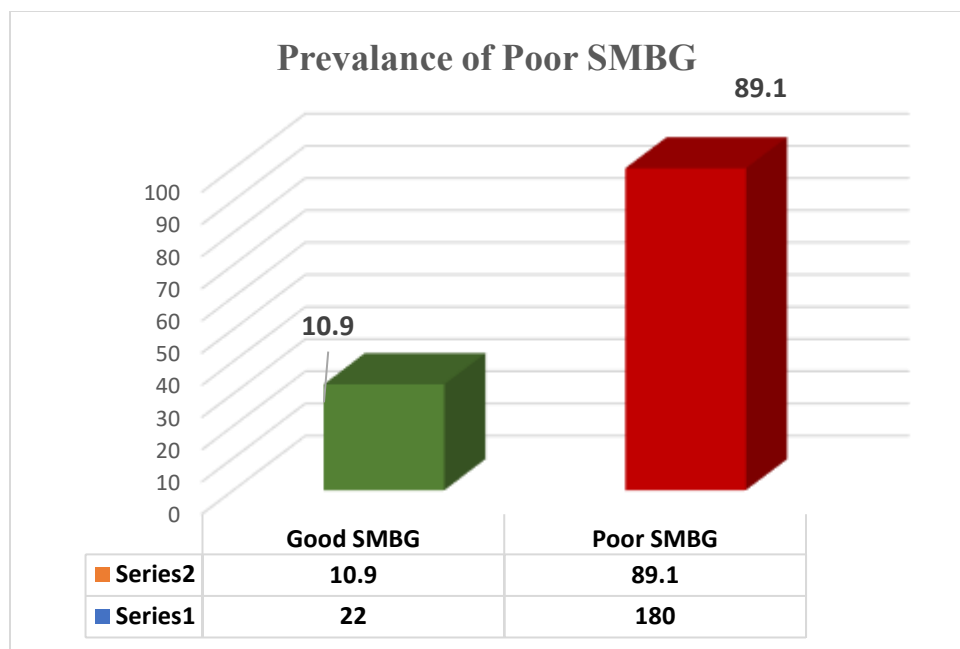


Figure 4.1: Prevalence of Poor Self-monitoring of blood glucose

Table 3. Bivariate analysis of socio-demographic factors associated with poor Self-monitoring of blood glucose among the patients of Type 2 Diabetes attending NCDs Service at Kigeme District Hospital.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Age					0.043
20-40 yrs	10(5.0)	44(21.8)	54(26.7)		
41-60 yrs	8(4.0)	59(29.2)	67(33.2)		
> 60 yrs	4(2.0)	77(38.1)	81(40.1)		
Total	22(10.9)	180(89.1)	202(100.0)		
Gender					<0.001
Male	21(10.4)	94(46.5)	115(56.9)		
Female	1(0.5)	86(42.6)	87(43.1)		
Total	22(10.9)	180(89.1)	202(100.0)		
Marital Status					0.420
Single	4(2.0)	14(6.9)	18(8.9)		
Married	14(6.9)	129(63.9)	143(70.8)		
Divorced	0(0.0)	2(1.0)	2(1.0)		
Widowed	4(2.0)	35(17.3)	39(19.3)		

Total	22(10.9)	180(89.1)	202(100.0)	
Education Level				<0.001
uneducated	0(0.0)	30(14.9)	30(14.9)	
Primary	9(4.5)	123(60.9)	132(65.3)	
Secondary	10(5.0)	16(7.9)	26(12.9)	
University	3(1.5)	11(5.4)	14(6.9%)	
Total	22(10.9)	180(89.1)	202(100.0)	
Occupation				<0.001
Farmer	3(1.5)	150(74.3)	153(75.7)	
Health worker	10(5.0)	0(0.0)	10(5.0)	
Teacher	4(2.0)	6(3.0)	10()	
Trader	4()	22()	26()	
Other	1()	2()	3()	
Total	22(10.9)	180(89.1)	202(100.0)	
Income per months				<0.001
0-10k Rwf	1(0.5)	29(14.4)	30(14.9)	
11-29k Rwf	0(0.0)	90(44.6)	90(44.6)	
30-50k Rwf	9(4.5)	35(17.3)	44(21.8)	
51-100k Rwf	8(4.0)	20(9.9)	28(13.9)	
101-300k Rwf	4(2.0)	6(3.0)	10(5.0)	
Total	22(10.9)	180(89.1)	202(100.0)	
Religion				0.213
Catholic	7(3.5)	64(31.7)	71(35.1)	
Protestant	5(2.5)	71(35.1)	76(37.6)	
Adventist	6(3.0)	33(16.3)	39(19.3)	
Muslim	1(0.5)	4(2.0)	5(2.5)	
Other	3(1.5)	8(4.0)	11(5.4)	
Total	22(10.9)	180(89.1)	202(100.0)	
Residence place				0.282
Urban	6(3.0)	32(15.8)	38(18.8)	
Rural	16(7.9)	148(73.3)	164(81.2)	
Total	22(10.9)	180(89.1)	202(100.0)	
Health insurance				0.004
MUSA	12(5.9)	152(75.2)	164(81.2)	
RSSB	7(3.5)	15(7.4)	22(10.9)	
MMI	2(1.0)	9(4.5)	11(5.4)	
Other	1(0.5)	4(2.0)	5(2.5)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 3 shows bivariate analysis of factors linked to SMBG. Age was significant ($p = 0.043$); poor SMBG was highest in those over 60 (38.1%) and lowest in the 20–40 age group (21.8%), indicating worsening with age. Gender had a strong association ($p < 0.001$); males had slightly higher poor SMBG (46.5%) and better good SMBG than females. Marital status was not significant ($p =$

0.420), though poor SMBG was most common among married (63.9%) and widowed (17.3%) patients.

Education was significant ($p < 0.001$); those with primary education had the highest poor SMBG (60.9%), while none of the uneducated had good SMBG. Secondary and university education correlated with better outcomes. Occupation was significant ($p < 0.001$); farmers had the highest poor SMBG (74.3%), while all health workers had good SMBG, showing occupational impact.

Income mattered ($p < 0.001$); lower earners (<30,000 Rwf/month) had poorer SMBG, while those earning more showed better adherence. Health insurance was significant ($p = 0.004$); MUSA members had the highest poor SMBG (75.2%), followed by RSSB (7.4%), suggesting insurance type affects SMBG access

Table. 4. Bivariate analysis of Diabetes factors associated with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Family history of type 2 diabetes					0.247
Yes	6(3.0)	72(35.6)	78(38.6)		
No	16(7.9)	108(53.5)	124(61.4)		
Total	22(10.9)	180(89.1)	202(100.0)		
History of gestational diabetes in years					0.429
Yes	0(0.0)	5(2.5)	5(2.5)		
No	22(10.9)	175(86.6)	197(97.5)		
Total	22(10.9)	180(89.1)	202(100.0)		
Name of drugs patients takes					0.146
Metformin	6(3.0)	86(42.6)	92(45.5)		
Metformin & Daonil	8(4.0)	55(27.2%)	63()		
Insulin	8(4.0)	39(19.3)	47(23.3)		
Total	22(10.9)	180(89.1)	202(100.0)		
Insulin treated					0.246
Yes	9(4.5)	52(25.7)	61(30.2)		
No	13(6.4)	128(63.4)	141(69.8)		
Total	22(10.9)	180(89.1)	202(100.0)		
Diabetes duration					0.172
1-5yrs	11(5.4)	51(25.2)	62(30.7)		
6-10yrs	6(3.0)	82(40.6)	88(43.6)		
11-20yrs	5(2.5)	43(21.3)	48(23.8)		
>20 yrs	0(0.0)	4(2.0)	4(2.0)		

Total	22(10.9)	180(89.1)	202(100.0)	
Diabetes duration				0.732
1-10yrs	17(8.4)	133(65.8)	150(74.3)	
>10yrs	5(2.5)	47(23.3)	52(25.7)	
Total	22(10.9)	180(89.1)	202(100.0)	
Glycemia1 control				0.717
FPG control	3(1.5)	30(14.9)	33(16.3)	
FPG not controlled	19(9.4)	150(74.3)	169(83.7)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 4 displays the bivariate analysis of diabetes-related factors associated with poor self-monitoring of blood glucose (SMBG) among 202 patients at Kigeme District Hospital, presenting the following results: Family history of type 2 diabetes did not show a statistically significant association with SMBG ($p = 0.247$). However, patients without a family history of type 2 diabetes had a higher rate of poor SMBG (53.5%) compared to those with a family history (35.6%).

History of gestational diabetes also showed no significant association with SMBG ($p = 0.429$). Of the five patients with a history of gestational diabetes, all exhibited poor SMBG, but due to the small sample size, this association was not statistically meaningful. The type of drugs patients take was not significantly associated with SMBG ($p = 0.146$). However, patients taking Metformin alone had the highest rate of poor SMBG (42.6%), followed by those taking both Metformin and Daonil (27.2%) and those on insulin (19.3%). Insulin treatment did not show a statistically significant association with SMBG ($p = 0.246$). However, patients not on insulin exhibited a higher rate of poor SMBG (63.4%) compared to those on insulin (25.7%).

Diabetes duration, categorized by years since diagnosis, was not significantly associated with SMBG ($p = 0.172$). Patients who had been diagnosed with diabetes for 6-10 years had the highest rate of poor SMBG (40.6%), followed by those diagnosed for 1-5 years (25.2%). Interestingly, those with a diabetes duration of more than 20 years exhibited the lowest rate of poor SMBG (2.0%). When looking at a simplified classification of diabetes duration (1-10 years vs. more than 10 years), there was still no significant association with SMBG ($p = 0.732$). Patients with a duration of 1-10 years had a higher rate of poor SMBG (65.8%) compared to those with more than 10 years (23.3%). Lastly, glycemic control, measured through fasting plasma glucose (FPG), showed no significant association with SMBG ($p = 0.717$). Patients with uncontrolled FPG had a much higher rate of poor SMBG (74.3%) compared to those with controlled FPG (14.9%).

Table 5. Bivariate analysis of reason of skipping blood test with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	SMBG Total (%)		

Reason2: Lack of support				0.091
Yes	0(0.0)	21(10.4)	21(10.4)	
No	22(10.9)	159(78.7)	181(89.6)	
Total	22(10.9)	180(89.1)	202(100.0)	
Reason3: Forgetfulness				0.1
Yes	0(0.0)	20()	20(9.9)	
No	22(10.9)	160(79.2)	182(90.1)	
Total	22(10.9)	180(89.1)	202(100.0)	
Reason4: Unfunctional machine, lack of strips or lost machine				<0.001
Yes	2(1.0)	122(60.4)	124(61.4)	
No	20(9.9)	58(28.7)	78(38.6)	
Total	22(10.9)	180(89.1)	202(100.0)	
Reason5: Other reasons				0.283
Yes	0(0.0)	9(4.5)	9(4.5)	
No	22(10.9)	171(84.7)	193(95.5)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 5 displays the reasons for skipping blood tests and their link to poor SMBG among 202 patients. Only one variable, machine issue (broken meters, missing strips) was strongly associated with poor SMBG ($p < 0.001$). Patients facing these problems had a 60.4% rate of poor SMBG, compared to 28.7% among those without such issues. Other factors like lack of support ($p = 0.091$) and forgetfulness ($p = 0.1$) showed no significant association with poor SMBG.

Table 6. Bivariate analysis of Training on SMBG from health facility with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Trained on SMBG					<0.001
Yes	13(6.4)	0(0.0)	13(6.4)		
No	9(4.5)	180(89.1)	189(93.6)		
Total	22(10.9)	180(89.1)	202(100.0)		
Number of trainings					<0.001
None	8(4.0)	178(88.1)	186(92.1)		
1 training	8(4.0)	2(1.0)	10(5.0)		
2 Trainings	4(2.0%)	0(0.0)	4(2.0)		
3 Trainings	2(1.0)	0(0.0)	2(1.0)		
Total	22(10.9)	180(89.1)	202(100.0)		

Source: Primary data, 2024

Table 6 presents the bivariate analysis of the impact of training on self-monitoring of blood glucose (SMBG) from health facilities and its association with poor SMBG. The analysis is based on 202 participants, and the findings are summarized as follows: The first variable, training on SMBG, shows a significant association with SMBG behavior ($p < 0.001$). Among the participants who received training, none had poor SMBG (0%), while 6.4% demonstrated good SMBG. In contrast, 89.1% of those who did not receive training had poor SMBG.

The second variable, number of trainings, also shows a statistically significant association with SMBG ($p < 0.001$). Those who did not attend any training sessions had an 88.1% rate of poor SMBG, while those who received one training session showed a very low rate of poor SMBG (1%). Participants who received two or more training sessions (2 or 3) had no poor SMBG at all.

Table 7. Bivariate analysis of SMBG Knowledge associated with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Know what SMBG is					0.042
Yes	22(10.9)	151(74.8)	173(85.6)		
No	0(0.0)	29(14.4)	29(14.4)		
Total	22(10.9)	180(89.1)	202(100.0)		
Know where to take blood sample					0.542
Yes	22(10.9)	177(87.6%)	199(98.5)		
No	0(0.0)	3(1.5%)	3(1.5)		
Total	22(10.9)	180(89.1)	202(100.0)		

Know why to take blood sample on indicate part of your body				<0.001
Yes	4(2.0)	0(0.0)	4(2.0)	
No	18(8.9)	180(89.1)	198(98.0)	
Total	22(10.9)	180(89.1)	202(100.0)	
Know how to read the results				<0.001
Yes	19(9.4)	35(17.3)	54(26.7)	
No	3(1.5)	145(71.8)	148(73.3)	
Total	22(10.9)	180(89.1)	202(100.0)	
Understanding self-glycemic control goal				0.01
Yes	22(10.9)	143(70.8)	165(81.7)	
No	0(0.0)	37(18.3)	37(18.3)	
Total	22(10.9)	180(89.1)	202(100.0)	
Overall Knowledge				0.004
High Knowledge	21(10.4%)	117(57.9)	138(68.3)	
Low Knowledge	1(0.5)	63(31.2)	64(31.7)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 7 presents knowledge factors associated with SMBG. Knowing what SMBG is was significant ($p = 0.042$); 10.9% of those aware had good SMBG, while all unaware (14.4%) had poor SMBG. Knowing where to take blood wasn't significant ($p = 0.542$); though 98.5% knew, it didn't improve SMBG outcomes. A strong link existed for knowing why a specific sampling site matters ($p < 0.001$); all who knew had good SMBG.

Understanding how to read results was also significant ($p < 0.001$); 9.4% with this skill had good SMBG vs. 1.5% without. Knowledge of glycemic goals was linked to better SMBG ($p = 0.01$); all aware participants had good practices. Overall knowledge was significant ($p = 0.004$); high-knowledge participants had better outcomes than those with low knowledge.

Table 8. Bivariate analysis of Lifestyle and behavioral factors associated with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Alcohol Intake					0.490
Yes	7(3.5)	45(22.3)	52(25.7)		
No	15(7.4)	135(66.8)	150(74.3)		
Total	22(10.9)	180(89.1)	202(100.0)		

Perform Physical activities at least 75 to 150 min a week				<0.001
Yes	11(5.4)	13(6.4)	24(11.9)	
No	11(5.4)	167(82.7)	178(88.1)	
Total	22(10.9)	180(89.1)	202(100.0)	
Eat fried food				0.006
Yes	6(3.0)	15(7.4)	21(10.4)	
No	16(7.9)	165(81.7)	181(89.6)	
Total	22(10.9)	180(89.1)	202(100.0)	
Eat sufficient vegetables				0.008
Yes	17(8.4)	85(42.1)	102(50.5)	
No	5(2.5)	95(47.0)	100(49.5)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 8 analyzes lifestyle factors linked to poor SMBG in 202 patients. Alcohol use showed no significant effect ($p = 0.490$). Drinkers had 3.5% good SMBG; non-drinkers, 7.4%.

Physical activity was strongly linked to SMBG ($p < 0.001$). Those active 75–150 minutes/week had balanced SMBG rates; inactive patients had 82.7% poor SMBG. Fried food intake affected SMBG ($p = 0.006$). Only 3% of consumers had good SMBG; 7.9% of non-consumers did.

Vegetable consumption improved SMBG ($p = 0.008$). 8.4% with sufficient intake had good SMBG; only 2.5% without enough vegetables did.

Table 9. Bivariate analysis of comorbidities factors associated with poor Self-monitoring of blood glucose.

Variables n=202	Overall Self-monitoring of blood glucose			Fisher exact test	P-value
	Good SMBG (%)	Poor SMBG (%)	Total (%)		
Hypertension					0.308
Yes	8(4.0)	47(23.3)	55(27.2)		
No	14(6.9)	133(65.8)	147(72.8)		
Total	22(10.9)	180(89.1)	202(100.0)		
CVDs					0.209
Yes	1(0.5)	2(1.0)	3(1.5)		
No	21(10.4)	178(88.1)	199(98.5)		
Total	22(10.9)	180(89.1)	202(100.0)		
Obesity					0.882
Yes	1(0.5)	7(3.5)	8(4.0)		
No	21(10.4)	173(85.6)	194(96.0)		
Total	22(10.9)	180(89.1)	202(100.0)		
Mental Health issues					0.726

Yes	0(0.0)	1(0.5)	1(0.5)	
No	22(10.9)	179(88.6)	201(99.5)	
Total	22(10.9)	180(89.1)	202(100.0)	
Cancer				0.004
Yes	1(0.5)	0(0.0)	1(0.5)	
No	21(10.4)	180(89.1)	201(99.5)	
Total	22(10.9)	180(89.1)	202(100.0)	
HBV				0.002
Yes	2(1.0)	1(0.5)	3(1.5)	
No	20(9.9)	179(88.6)	199(98.5)	
Total	22(10.9)	180(89.1)	202(100.0)	
HCV				0.480
Yes	0(0.0)	4(2.0)	4(2.0)	
No	22(10.9)	176(87.1)	198(98.0)	
Total	22(10.9)	180(89.1)	202(100.0)	
Kidney disease				0.726
Yes	0(0.0)	1(0.5)	1(0.5)	
No	22(10.9)	179(88.6)	201(99.5)	
Total	22(10.9)	180(89.1)	202(100.0)	

Source: Primary data, 2024

Table 9 shows bivariate analysis of comorbidities linked to poor SMBG among 202 participants. Hypertension wasn't significantly associated with SMBG ($p = 0.308$); 4.0% with hypertension had good SMBG vs. 6.9% without. Cardiovascular diseases (CVDs) were rare (1.5%) and not linked to SMBG ($p = 0.209$). Obesity also showed no significant effect ($p = 0.882$). Mental health issues were similarly not associated ($p = 0.726$).

Cancer showed a significant negative impact on SMBG ($p = 0.004$), with only 0.5% of cancer patients having good SMBG compared to 10.4% without cancer. Hepatitis B virus (HBV) was also significantly linked to poor SMBG ($p = 0.002$), with 1.0% of HBV patients having good SMBG versus 9.9% without HBV. Hepatitis C virus (HCV) and kidney disease showed no significant SMBG association ($p = 0.480$ and 0.726). All participants with kidney disease had poor SMBG.

Table 10. Multivariate analysis of factors associated with poor Self-monitoring of blood glucose.

Variables N=202	Poor Self-monitoring of blood glucose		P-value
	AoR	95%CI	
Gender			
Male	Ref		
Female	3.761	1.568-7.930	0.08
Physical activities			
Yes	Ref		
No	6.900	4.508-10.646	0.002
Fasting plasma glucose control			

Yes	Ref		
No	9.208	3.828-16.518	0.02
Occupation (Farmer& traders)			
No	Ref		
Yes	8.338	2.026-21.766	0.04
Income			
Yes	Ref		
No	1.780	0.174-5.759	0.9
Knowledge on SMBG			
High level of knowledge	Ref		
Low level of knowledge	11.645	3.992-21.117	0.01
Reason of skipping test (Unfunctional, lack of strips or lost the machine)			
No	Ref		
Yes	13.698	6.077-25.442	0.001

Source: Primary data, 2024

Table 10 presents the multivariate analysis of factors associated with poor self-monitoring of blood glucose (SMBG) among the 202 participants in this study. The analysis aims to identify various predictors of poor SMBG while controlling other variables, providing adjusted odds ratios (AoR) and corresponding 95% confidence intervals (95% CI).

Physical activities also showed a strong association with poor SMBG. Participants who do not engage in physical activities have an AoR of 6.900, with a 95% CI of 4.508 to 10.646. The p-value of 0.002 confirms that lack of physical activity is a significant predictor of poor SMBG.

Fasting plasma glucose control is another critical factor. Participants who do not achieve fasting plasma glucose control have an AoR of 9.208, indicating a significant association with poor SMBG (95% CI: 3.828–16.518). The p-value of 0.02 suggests a strong relationship, highlighting the importance of effective glucose management.

The analysis also examined occupation, specifically comparing farmers and traders to other occupations. Those in these occupations have an AoR of 8.338, with a confidence interval ranging from 2.026 to 21.766. This association is statistically significant with a p-value of 0.04, indicating that occupation can significantly impact SMBG practices.

The analysis of knowledge on SMBG reveals that participants with a low level of knowledge have an AoR of 11.645, suggesting a significantly higher likelihood of poor SMBG compared to those with a high level of knowledge (95% CI: 3.992–21.117). The p-value of 0.01 confirms that knowledge is a critical determinant of SMBG behavior.

Finally, the reason for skipping tests, specifically for those who report issues such as an unfunctional meter, lack of test strips, or lost devices, is associated with an AoR of 13.698 (95% CI: 6.077–25.442). The p-value of 0.001 highlights this factor as a significant barrier to proper SMBG practices.

Discussion

Socio-Demographic Factors

This study found that 40.1% of T2D patients were over 60, similar to Adane et al. (2023), who reported 43.5% in Ethiopia, confirming the disease's prevalence among older adults. Males accounted for 56.9%, closely matching the 55% reported by Oluwaseun et al. (2022) in Nigeria. A high proportion of married patients (70.8%) suggests that social support may enhance disease management, as also noted by Nkhata et al. (2021), who found better outcomes among 68% of married individuals with chronic conditions.

Low education was prevalent, with 65.3% completing only primary school—comparable to 62% in Gonzalez et al. (2023). Most participants were farmers (75.7%), consistent with Mwaikambo et al. (2022), who reported 73% in Tanzania, highlighting rural barriers to care. Additionally, 81.2% relied on Mutuelle de Santé, aligning with Chukwuma et al. (2023) on the importance of community insurance in low-income settings. These findings emphasize the need for tailored education and service delivery for rural T2D populations.

Prevalence of Poor Self-Monitoring of Blood Glucose (SMBG)

Our study revealed that 89.1% of participants had poor SMBG practices, with only 10.9% showing adequate monitoring. This high prevalence of inadequate SMBG is mirrored in other settings: Mwaikambo et al. (2022) found that 87.4% of Tanzanian T2D patients had poor SMBG, while Adane et al. (2023) reported 85% in Ethiopia. The similarity across these studies indicates a persistent and widespread challenge in SMBG adherence in resource-limited settings.

Factors Associated with Poor SMBG

Poor SMBG was linked to several factors. Female patients were more likely to report poor SMBG (AoR = 3.761), similar to (Pamungkas et al., 2019) Owusu et al. (2022), who found higher odds among women, possibly due to cultural and access barriers. Physical inactivity significantly increased the risk (AoR = 6.900), aligning with Alshahrani et al. (2023), where 70% of inactive patients had poor monitoring.

Poor fasting glucose control (AoR = 9.208) echoed Iftikhar et al. (2024), highlighting the relationship between glycemic status and SMBG. Farmers and traders had higher odds (AoR = 8.338), these findings are consistent with various study in Africa, Asia and US where living in rural area was linked with poverty, lack of materials and and lack of awareness which hinder diabetes management (Grant et al., 2016; Chang et al., 2019; Adhikari et al., 2021; Ma et al., 2023) This study showed that Low SMBG knowledge (AoR = 11.645) was significantly associated with poor SMBG which is consistent to the Ugandan study where low level of knowledge was found to be a barrier to self-diabetic management (Chang et al., 2019).

matched Badu et al., where only 30% had sufficient understanding.

Equipment shortages (AoR = 13.698) were a major barrier, stressing the need for accessible tools and patient education in low-resource settings. This is in line with the study done in Ethiopia where diabetic self-management was hampered by the lack of organization and test materials (Letta et al., 2021).

Study Limitations

Unlike multi-center or national studies, this research was conducted in a single district hospital, limiting generalizability. Additionally, reliance on self-reported SMBG introduces potential recall bias, and the cross-sectional design restricts causal interpretation. Variables like mental health or detailed socioeconomic status were not examined, which may influence SMBG behavior.

Study Implications

The findings suggest that, although many challenges in diabetes management are shared across low-resource settings, addressing them requires context-specific strategies. Gender-sensitive education, promotion of physical activity, support for occupationally burdened individuals, and provision of SMBG tools are urgently needed. Policy efforts should also prioritize strengthening health literacy and reducing structural barriers to self-care for patients with T2D in Rwanda and similar contexts.

Conclusion

The study reveals that the great majority of patients with Type 2 Diabetes attending the NCDs Service at Kigeme District Hospital exhibited poor Self-Monitoring of Blood Glucose. In addition, several factors are significantly associated with poor SMBG. Notably, gender (females), lack of physical activity, poor fasting plasma glucose control, occupation (farmers and traders), low knowledge of SMBG, and practical barriers to testing (such as equipment issues) all contribute to the likelihood of poor SMBG.

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Contributions

“MJ played a role in conception of the study. MJ analyzed and interpreted data, and MJ was the major contributor in writing the manuscript. CN edited, revised, and approved the final manuscript”.

References

- Adane, M., et al. (2023). Socio-Demographic and Clinical Characteristics of Type 2 Diabetes Patients in Ethiopia. *Diabetes Research and Clinical Practice*, 198, 110121

- Adhikari, M., Devkota, H.R. & Cesuroglu, T. Barriers to and facilitators of diabetes self-management practices in Rupandehi, Nepal- multiple stakeholders' perspective. *BMC Public Health* 21, 1269 (2021). <https://doi.org/10.1186/s12889-021-11308-4>
- Al-Keilani, M. S., Almomani, B. A., Al-Sawalha, N. A., & Shhabat, B. A. (2017). Self-monitoring of blood glucose among patients with diabetes in Jordan: Perception, adherence, and influential factors. *Diabetes Research and Clinical Practice*, 126, 79–85. <https://doi.org/10.1016/j.diabres.2017.01.005>
- Alshahrani, F., et al. (2023). Physical activity and self-monitoring of blood glucose in diabetic patients: A Saudi Arabian study. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 17(1), 245-250
- American Diabetes Association. (2020). Diabetes Technology: Standards of Medical Care in Diabetes—2021. *Diabetes Care*, 44(Supplement_1), S85–S99. <https://doi.org/10.2337/dc21-S007>
- Badu, E., et al. (2023). Knowledge and practices of self-monitoring blood glucose among diabetic patients in Ghana: Implications for health education. *BMC Endocrine Disorders*, 23(1), 150
- Bavuma, C. M., Niyibizi, J. B., Bitunguhari, L., Musafi, S., McQuillan, R. (2022). Prevalence and characteristics associated with diabetes mellitus and impaired fasting glucose among people aged 15 to 64 years in rural and urban Rwanda: Secondary data analysis of World Health Organization surveillance data. *The Pan African Medical Journal*, 41(115), Article 115. <https://doi.org/10.11604/pamj.2022.41.115.30682>
- Chang, H., Hawley, N.L., Kalyesubula, R. et al. Challenges to hypertension and diabetes management in rural Uganda: a qualitative study with patients, village health team members, and health care professionals. *Int J Equity Health* 18, 38 (2019). <https://doi.org/10.1186/s12939-019-0934-1>
- Chukwuma, J. et al. (2023). The Role of Community Health Insurance in Accessing Healthcare among Rural Populations in Africa. *International Journal of Health Services*, 53(1), 112-127
- Dessie, G., Mulugeta, H., Amare, D. et al. A systematic analysis on prevalence and sub-regional distribution of undiagnosed diabetes mellitus among adults in African countries. *J Diabetes MetabDisord* 19, 1931–1941 (2020). <https://doi.org/10.1007/s40200-020-00635-9>

- Fang L, Sheng H, Tan Y, Zhang Q.(2023) Prevalence of diabetes in the USA from the perspective of demographic characteristics, physical indicators and living habits based on NHANES 2009-2018. *Front Endocrinol (Lausanne)*. Mar 7;14:1088882. doi: 10.3389/fendo.2023.1088882. PMID: 36960397; PMCID: PMC10028205.
- Fuentes-Merlos Á, Orozco-Beltrán D, Quesada Rico JA, Reina R. Quality-of-Life Determinants in People with Diabetes Mellitus in Europe. *Int J Environ Res Public Health*. 2021 Jun 28;18(13):6929. doi: 10.3390/ijerph18136929. PMID: 34203455; PMCID: PMC8297329.
- Grant JS, Steadman LA. Barriers to Diabetes Self-Management Among Rural Individuals in the Workplace. *Workplace Health & Safety*. 2016;64(6):243-248. doi:10.1177/2165079916628877
- Gonzalez, J. S., et al. (2023). Health Literacy and Its Impact on Diabetes Self-Management in Low- and Middle-Income Countries. *BMC Public Health*, 23, 123.
- Iftikhar, M., et al. (2024). Relationship between fasting plasma glucose control and self-monitoring of blood glucose among diabetic patients in Pakistan. *Pakistan Journal of Medical Sciences*, 40(2), 125-130
- International Diabetes Federation. (2015). IDF DIABETES ATLAS Seventh Edition 2015. www.diabetesatlas.org
- Letta S, Aga F, Yadeta TA, Geda B, Dessie Y. Barriers to Diabetes Patients' Self-Care Practices in Eastern Ethiopia: A Qualitative Study from the Health Care Providers Perspective. *Diabetes Metab Syndr Obes*. 2021 Oct 22;14:4335-4349. doi: 10.2147/DMSO.S335731. PMID: 34712054; PMCID: PMC8547594.
- Liu et al. (2023). Projected rapid growth in diabetes disease burden and economic burden in China: a spatio-temporal study from 2020 to 2030. *Lancet*, DOI:<https://doi.org/10.1016/j.lanwpc.2023.100700>
- Ma, X., Fan, W., Zhang, X. et al. The urban-rural disparities and factors associated with the utilization of public health services among diabetes patients in China. *BMC Public Health* 23, 2290 (2023). <https://doi.org/10.1186/s12889-023-17198-y>
- Magliano, D., Boyko, E. J., & IDF Diabetes Atlas 10th edition scientific committee. (2021). IDF diabetes Atlas (10th edition). International Diabetes Federation.
- Mwaikambo, L., et al. (2022). Socioeconomic Determinants of Diabetes Management in Rural Tanzania. *Diabetes Care*, 45(5), 1063-1070.

- Ng'ang'a, L., Ngoga, G., Dusabeyezu, S., Hedt-Gauthier, B., Harerimana, E., Niyonsenga, S. (2022). Feasibility and effectiveness of self-monitoring of blood glucose among insulin-dependent patients with type 2 diabetes: Open randomized control trial in three rural districts in Rwanda. *BMC Endocrine Disorders*, 22(1). <https://doi.org/10.1186/s12902-022-01162-9>
- Nkhata, R. et al. (2021). Marital Status and Health Outcomes among Patients with Chronic Conditions. *Global Health Action*, 14(1), 1951234.
- Oluwaseun, O., et al. (2022). Gender Differences in the Prevalence of Type 2 Diabetes: A Study from Nigeria. *Journal of Diabetes Research*, 2022, 8854623
- Pamungkas, R. A., Chamroonsawasdi, K., Vatanasomboon, P., & Charupoonphol, P. (2020). Barriers to Effective Diabetes Mellitus Self-Management (DMSM) Practice for Glycemic Uncontrolled Type 2 Diabetes Mellitus (T2DM): A Socio Cultural Context of Indonesian Communities in West Sulawesi. *European Journal of Investigation in Health, Psychology and Education*, 10(1), 250-261. <https://doi.org/10.3390/ejihpe10010020>
- Pleus, S., Freckmann, G., Schauer, S., Heinemann, L., Ziegler, R., Ji, L., Mohan, V., Calliari, L. E., & Hinzmann, R. (2022). Self-Monitoring of Blood Glucose as an Integral Part in the Management of People with Type 2 Diabetes Mellitus. *Diabetes Therapy*, 13(5), 829–846. <https://doi.org/10.1007/s13300-022-01254-8>
- Stephani, V., Opoku, D., & Beran, D. (2018). Self-management of diabetes in Sub-Saharan Africa: A systematic review. *BMC Public Health*, 18(1), 1148. <https://doi.org/10.1186/s12889-018-6050-0>
- Sulakshan Neupane, Wojciech J. Florkowski, Chandra Dhakal.(2024). Trends and Disparities in Diabetes Prevalence in the United States from 2012 to 2022. DOI:<https://doi.org/10.1016/j.amepre.2024.04.010>
- The World Bank. (2021). Diabetes prevalence (% of population ages 20 to 79)—Rwanda. World Bank Open Data. <https://data.worldbank.org>