Original

Treatment Adherence and Glycaemic Control among Patients with Type 2 Diabetes in a Tertiary Facility in Benin City, Nigeria

[1]Timothy Aghogho Ehwarieme, [2]Yetunde Abosede Olawale, [3]Franca Aizenabor Esebame

[1]Department of medical surgical Nursing Faculty of Nursing Science, University of Benin, Benin City Edo State. Nigeria
[2]Achivers College of Nursing Sciences, Akure, Ondo state, Nigeria
[3]Department of maternal and child health, faculty of Nursing Science, University of Benin, Benin City Edo State. Nigeria

Corresponding author: ***Dr.Timothy A. Ehwarieme,*** Department of Medical Surgical Nursing, Faculty of Nursing Science, University of Benin, Benin City, Edo State. Nigeria. timothy.ehwarieme@uniben.edu:+2348060696870

Article history: Received 21 February 2026, Reviewed 11 April 2026, Accepted for publication 20 June 2026

ABSTRACT

Background: Treatment adherence is a major determinant of glycemic control among patients with Type 2 diabetes. Non-adherence can lead to poor blood glucose regulation, increasing the risk of complications. Understanding the factors influencing adherence and its impact on glycemic control is essential for designing effective interventions. The study evaluates the impact of treatment adherence on glycemic control and identifies factors associated with adherence among patients with Type 2 diabetes in a tertiary health facility Benin City, Edo state.

Methods: A descriptive cross-sectional correlation study among 297 patients. A validated structured questionnaire with a Cronbach's alpha reliability of 0.78 and 0.81 was used for data collection. Data analyses were done using descriptive statistics and inferential statistics such as chi-square tests, and multiple logistic regression at 5% significant level.

Results: The study found that 150 (50.5%) of patients had good adherence, 114 (38.4%) had moderate adherence, only 32 (10.8%) had poor adherence. Glycemic control was optimal in 153 (51.4%) of patients, while 114 (38.3%) were hyperglycemic and 30 (10.3%) hypoglycemics. There was a significant association between adherence and glycemic control ($\chi^2 = 25.6$, df = 4, $p < 0.001$). Barriers to adherence included high medication cost (83.6%), side effects of medication (61.8%), and forgetfulness (42.7%).

Conclusion: Treatment adherence is a critical determinant of glycemic control among patients with Type 2 diabetes. Interventions addressing high-cost medications, side effects, forgetfulness, and enhancing patient education and social support are essential to optimize adherence, improve blood glucose outcomes, and reduce the risk of diabetes-related complications.

Keywords: Type 2 diabetes, Treatment adherence, Glycemic control, Blood glucose, Patient education, Self-care

How to cite this article

Ehwarieme TA, Olawale YA, Esebame FA. Treatment Adherence and Glycaemic Control among Patients with Type 2 Diabetes in a Tertiary Facility in Benin City, Nigeria. The Nigerian Health Journal 2026; 26(2):637 – 649. https://doi.org/10.71637/tnhj.v26i2.1354

Print ISSN: 0189-9287 Online ISSN: 2992-345X

INTRODUCTION

Diabetes mellitus (DM) is a major global public health challenge and one of the leading causes of morbidity and mortality worldwide.[1] It is ranked among the top causes of death globally, with its burden increasing at an alarming rate, particularly in low- and middle-income countries. [2,3] The World Health Organization estimated that about 422 million adults were living with diabetes in 2016, a figure that has almost quadrupled since 1980.[4] Projections by the International Diabetes Federation (IDF) indicate that this number will rise to over 640 million by 2040 and may reach 783 million by 2045, reflecting a substantial global increase in prevalence.[5,6,] Notably, approximately 80% of people living with diabetes reside in low- and middle-income countries, where healthcare systems often face significant resource constraints. [2]

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[1] Among its various forms, Type 2 diabetes mellitus (T2DM) is the most prevalent, accounting for more than 90% of all diabetes cases worldwide.[7] The condition is primarily associated with insulin resistance and relative insulin deficiency and is strongly linked to aging, urbanization, sedentary lifestyles, obesity, and unhealthy dietary patterns.[6] If poorly managed, T2DM can lead to serious long-term complications, including cardiovascular disease, kidney failure, neuropathy, retinopathy, and premature death.[1]

Effective management of Type 2 diabetes requires long-term and consistent adherence to treatment regimens, including pharmacotherapy, dietary modification, regular physical activity, and routine blood glucose monitoring.[8] The World Health Organization defines treatment adherence as the extent to which a person's medication-taking behavior, lifestyle changes, and dietary practices correspond with agreed recommendations from a healthcare provider.[1] Adherence to these recommendations is critical for achieving optimal glycemic control, preventing complications, improving quality of life, and reducing healthcare costs.[9] However, adherence remains a major challenge in diabetes care, with global estimates suggesting that only about 50% of patients in developing countries adhere adequately to long-term treatment regimens.[10]

Poor treatment adherence has been consistently linked to inadequate glycemic control and an increased risk of diabetes-related complications.[11,12] Studies have shown that non-adherence may arise from multiple factors, including complex treatment regimens, medication side effects, financial constraints, limited disease knowledge, psychosocial stressors, and inadequate healthcare support.[13,14] Consequently, suboptimal adherence contributes significantly to preventable morbidity, mortality, and escalating healthcare expenditure.[15] Globally, diabetes accounts for substantial health-related costs, with Africa projected to experience the greatest proportional increase in diabetes burden despite contributing the least to global diabetes healthcare spending.[15]

In Nigeria, the burden of diabetes is increasingly recognized as a major public health concern. Although the IDF estimates the national prevalence of diabetes among adults aged 20–69 years to be approximately 1.7%, several studies suggest that this figure grossly underestimates the true burden due to underdiagnosis and the absence of recent nationwide surveys.[16] Reported prevalence rates across different regions of the country range from 2% to 12%, highlighting significant regional variability and the growing magnitude of the problem.[16] Late diagnosis, poor treatment adherence, and limited access to comprehensive diabetes care further exacerbate disease outcomes in the Nigerian context.[14]

Given the chronic nature of Type 2 diabetes and its associated complications, adherence to treatment remains a cornerstone of effective disease management.[17] Evidence from multiple studies indicates that improved adherence is associated with better glycemic control, reduced complications, and lower healthcare utilization, whereas non-adherence leads to poor clinical outcomes and increased disease burden.[8,9] Despite this evidence, adherence rates among patients with T2DM remain suboptimal, underscoring the need for context-specific research to better understand patients' experiences and perceptions of adherence and its impact on clinical outcomes.[18]

Against this backdrop, this study seeks to assess the perceived impact of treatment adherence on glycemic control among patients with Type 2 diabetes attending a tertiary healthcare institution in Benin City, Nigeria. By examining the relationship between adherence behaviors and glycemic outcomes, the study aims to generate evidence that can inform targeted interventions, enhance patient support strategies, and ultimately improve diabetes management and quality of life for individuals living with Type 2 diabetes.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

METHODOLOGY

Research Design: A cross-sectional descriptive correlational research design was adopted to assess the impact of treatment adherence on glycemic control, among patients with type 2 diabetes mellitus. The design involves the collection of data from a population at a single point in time without manipulating study variables. This design was considered appropriate because it allows for the simultaneous assessment of treatment adherence and clinical outcomes, facilitates comparison among participants with varying levels of adherence, and provides timely insight into existing associations between variables.

Research Setting: The study was conducted at the outpatient clinic of the University of Benin Teaching Hospital (UBTH), Edo State, among patients diagnosed with type 2 diabetes mellitus. UBTH was established on May 12, 1973, under the Nigeria National Health Act and is one of the first-generation teaching hospitals in Nigeria. It serves as a major referral center, providing secondary and tertiary healthcare services to Edo State and neighboring states.

Target Population: The target population for this study consisted of all adult outpatients receiving care for type 2 diabetes mellitus at the University of Benin Teaching Hospital, Edo State. According to hospital admission records as of September 2025, the total population of registered type 2 diabetes patients attending the outpatient clinic was 827.

Eligibility Criteria

Inclusion Criteria: Participants eligible for inclusion in the study were:

i. Adults aged 18 years and above with a confirmed diagnosis of type 2 diabetes mellitus, verified through medical records or diagnostic tests.
ii. Patients currently receiving treatment or attending post-treatment follow-up clinics at the outpatient diabetic clinic of UBTH.
iii. Patients who voluntarily consented to participate in the study after adequate explanation of the study objectives.
iv. Patients who could understand and communicate in English or Nigerian Pidgin English.

Exclusion Criteria

The following categories of patients were excluded from the study:

i. Patients diagnosed with type 1 diabetes mellitus or other forms of diabetes aside from type 2 diabetes mellitus.
ii. Patients with diabetic-related dementia or other complications affecting cognitive function, which could impair reliable responses.

Sample Size Determination: The sample size for this study was determined using Yamane Taro's formula (1967) for finite populations.

$$n = \frac{N}{1+N(e)^2}$$

Where:
n = required sample size
N = population size (827)
e = margin of error (0.05)
1 = constant

$$n = \frac{827}{1 + 827(0.05)^2}$$

$$n = \frac{827}{1 + 827(0.0025)}$$

$$n = \frac{827}{3.0675}$$

$$n = 269.6 \approx 270$$

To account for possible non-response or attrition, a 10% attrition rate was added:

$$270 \times \frac{10}{100} = 27$$

$$270 + 27 = 297$$

Therefore, the final sample size for the study was 297 participants.

Sampling Technique: A convenience sampling technique was employed for participant selection. Convenience sampling involves recruiting participants who are readily available and accessible to the researcher at the study location.

Data Collection Instrument: Data were collected using a structured questionnaire designed by the researchers following a review of relevant literature on treatment adherence among patients with type 2 diabetes mellitus. The instrument consisted of four sections (A- Socio-demographic Characteristics, A, B- Level of Treatment Adherence, C- Blood Glucose Profile, and D- factors influencing adherence to diabetes treatment)

Section B: Level of Treatment Adherence to diabetes treatment were measured on a four-point Likert scale of (A = 4, S =3 R =2, N=1). Individual item scores were summed to obtain a total adherence score ranging from 14 to 56, with higher scores indicating better adherence. To determine the level of adherence, each respondent's total score was converted to a percentage using the formula: Percentage Adherence Score = (Respondent's Total Score ÷ 56) × 100 Based on the percentage score, respondents were categorized as follows:

Print ISSN: 0189-9287 Online ISSN: 2992-345X

- Good adherence: ≥ 75% (equivalent to a total score of ≥ 42 points)
- Moderate adherence: 50–74% (equivalent to a total score of 28–41 points)
- Poor adherence**:** < 50% (equivalent to a total score of < 28 points)

Section C: Blood Glucose Profile: documented respondents' blood glucose levels at four time points: one month prior, two weeks prior, one week prior, and current reading. These values were obtained from patient records and/or self-reported measurements and were used to assess
recent trends in glycemic control.

Section D: examined factors influencing adherence to diabetes treatment. It consisted of six items Responses were rated on the same four-point Likert scale (SA = 4 to SD = 1). For factors influencing adherence, mean scores were computed for each item across all respondents. Since the response scale ranged from 1 to 4, the criterion mean was calculated as: (4 + 3 + 2 + 1) ÷ 4 = 2.5. Items with a mean score of 2.5 or above were considered significant factors influencing treatment adherence, while items with a mean score of less than 2.5 were regarded as not significant influences on adherence.

The major study variables are:

1. Treatment adherence to diabetes treatment (primary outcome variable)
2. Blood glucose profile/glycemic control (secondary outcome variable)
3. Factors influencing adherence to diabetes treatment (independent variables)
4. Socio-demographic characteristics (background and control variables)

Validity and reliability of instruments: Content and face validity of the questionnaire were established through expert review by specialists in nursing, diabetes management, and public health, leading to revisions for clarity, relevance, and comprehensiveness. The instrument was pre-tested among 20–25 patients with type 2 diabetes mellitus outside the study sample. Internal consistency reliability was assessed using Cronbach's alpha, yielding coefficients of 0.78 and 0.81 for Sections B and D, respectively, indicating good reliability.

Data collection: Data were collected using a structured questionnaire administered either by respondents or trained research assistants, depending on participants' literacy levels and preferences. Written informed consent was obtained after explaining the study purpose and procedures. Data collection was conducted in a private setting to ensure confidentiality and comfort. Completed questionnaires were checked for completeness, coded, and entered into a secure database for analysis.

Data analysis: Data were cleaned and analyzed using SPSS version 28.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized the data, while Chi-square tests and multiple logistic regression examined relationships among variables at a 5% significance level ($p < 0.05$).

Ethical Consideration: Ethical approval (Protocol No. ADM/E 22/A/VOL.VII/1486543280) was obtained from the University of Benin Research Ethics Committee. Written informed consent was secured from all participants, and confidentiality, voluntary participation, and the right to withdraw were upheld throughout the study.

RESULTS

The socio-demographic profile of the respondents

Table 1: Socio-demographic data of respondents

Variables	Freq	Percent %
Age (Mean ± SD= 30.4±6.7)		
< 20 years	25	8.5
20 – 24 years	48	16.2
25-29 years	39	13.1
30 –34 years	85	28.6
35 and above	100	33.6
Gender		
Male	108	36.4
Female	189	63.6
Religion		
Christianity	209	70.5
Islam	53	17.6
Traditional	35	11.9
Ethnicity		
Benin	225	75.7
Urhobo	34	11.4
Igbo	25	8.5
Yoruba	13	4.4
Marital status		
Single	111	36.9
Married	158	53.1
Divorced	30	10
Level of education		
Primary	88	29.5
Secondary	129	43.5
Tertiary	80	27

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Most participants were aged 35 years and above (33.6%), with a mean age of 30.4 ± 6.7years. Females constituted the majority (63.6%), most were Christians (70.5%), of Benin ethnicity (58.2%), and married (53.1%). Secondary education was the most common level attained (43.5%) (Table 1).

Diabetes self-management practices among respondents

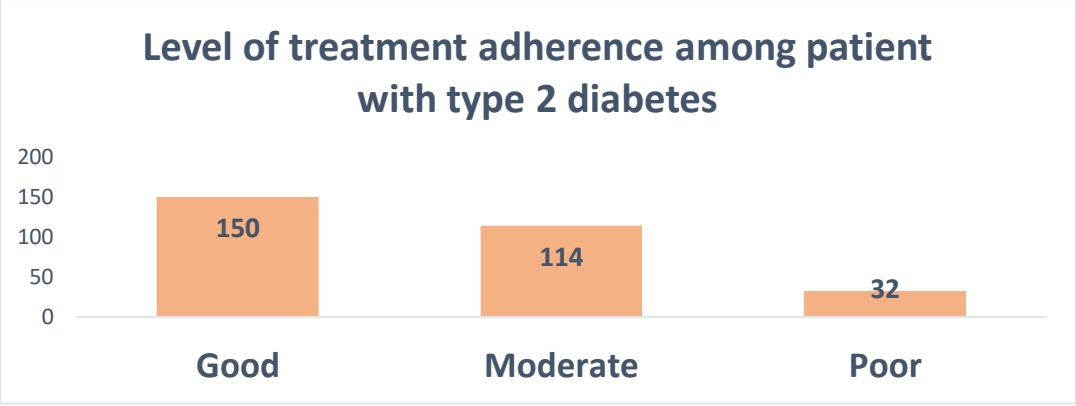
Table 2: Diabetic self-management practices among respondents among respondents

Item	Always	Sometimes	Rarely	Never	Mean	SD	Remark
1. I take prescribed diabetes medications regularly	158 (53.1%)	127 (42.7%)	12(4.2%)	0 (0%)	3.8	0.76	Good
2. I monitor blood sugar as recommended	162 (54.5%)	123 (41.5%)	12(4%)	0(0%)	2.9	0.55	Poor
3. I follow recommended dietary guidelines	178 (60.1%)	89 (29.9%)	27(9%)	3(1%)	3.5	0.70	Good
4. I attend scheduled diabetes clinic appointments	205 (69%)	86 (29%)	6(2%)	0(0%)	3.7	0.74	Good
5. I engage in regular physical activity	152 (51.1%)	120 (40.6%)	25(8.3%)	0(0%)	3.2	0.68	Good
6. I feel confident managing diabetes daily	121 (40.8%)	90(30.1%)	80 (27.1%)	6(2%)	3.5	0.7	Good
7. I check blood sugar levels daily	167 (56.3%)	116(39%)	17(5.7%)	0 (0%)	2.9	0.58	Poor
8. I take diabetes medication as prescribed	219 (73.8%)	75(25.2%)	3(1%)	0 (0%)	3.3	0.69	Good
9. I inspect feet daily for ulcers or injuries	108 (36.5%)	144 (48.3%)	30(10%)	15(5.2%)	3.0	0.70	Good
10. I monitor blood pressure regularly	210 (70.8%)	81 (27.2%)	6(2%)	0(0%)	3.7	0.76	Good
11. I follow a recommended diabetes diet plan	169 (57%)	96(32.4%)	32 (10.6%)	0(0%)	2.9	0.55	Poor
12. I attend all follow-up appointments	134 (45%)	157(53%)	6(2%)	0(0%)	3.0	0.69	Good
13. I exercise regularly for diabetes management	106 (35.6%)	159 (53.7%)	23(7.7%)	9 (3%)	3.2	0.70	Good
14. I recognize and monitor symptoms of high blood sugar	30 (10%)	138 (46.3%)	130 (43.7%)	0 (0%)	2.8	0.56	

(A=4 + S=3 + R=2 + N=1) ÷ 4 = 2.5. Items with a mean score of 2.5 or above were considered good practice while items with a mean score of less than 2.5 were regarded as poor practice

Overall diabetes self-management practices were generally good, with high mean scores for medication adherence (3.3 ± 0.69), clinic attendance (3.7 ± 0.74), dietary practices (3.5 ± 0.70), physical activity (3.2 ± 0.68), blood pressure monitoring (3.7 ± 0.76), and foot inspection (3.0 ± 0.70). However, blood glucose monitoring and adherence to a recommended diet plan were poor, with lower mean scores for routine and daily glucose checks (2.9 ± 0.55–0.58) (Table 2).

Level of adherence to diabetic self-management practices among respondents



Good adherence: ≥ 75% of the maximum score (≥ 42 points) Moderate adherence: 50–74% of the maximum score (28–41 points) Poor adherence: < 50% of the maximum score (< 28 points)

Figure 1: Shows level of treatment adherence among patient with type 2 diabetes.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Figure 1 shows that 150 respondents (50.5%) had a good level of adherence, while 114 (38.4%) demonstrated a fair/moderate level of adherence. In contrast, 32 respondents (10.8%) had a poor level of adherence.

Respondents reported Fasting Blood Glucose Ranges Across Four Time Periods

Table 3: Respondents reported Fasting Blood Glucose Ranges Across Four Time Periods (n = 297)

Time Period	Fasting Blood Glucose Range (mg/dL)	Frequency	Percentage (%)
One Month Prior	80–130 (*target range for fasting blood glucose*)	140	47.1
	<70 (Hypoglycaemia)	38	12.8
	>130 (Hyperglycaemia)	119	40.1
Two Weeks Prior	80–130 (*target range for fasting blood glucose*)	148	49.8
	<70 (Hypoglycaemia)	34	11.4
	>130 (Hyperglycaemia)	115	38.8
One Week Prior	80–130 (*target range for fasting blood glucose*)	155	52.2
	<70 (Hypoglycaemia)	30	10.1
	>130 (Hyperglycaemia)	112	37.7
Current Reading	80–130 (*target range for fasting blood glucose*)	153	51.4
	<70 (Hypoglycaemia)	31	10.3
	>130 (Hyperglycaemia)	114	38.3

fasting blood glucose levels were interpreted based on ADA glycaemic targets as hypoglycaemia (<70 mg/dL), target range for fasting blood glucose (80–130 mg/dL), and hyperglycaemia (>130 mg/dL).[37]

The proportion of patients with *target range for fasting blood glucose* increased from 47.1% one month prior to 52.2% one week prior, with a slight decline to 51.4% at the current reading. Hypoglycaemia decreased over time (12.8% to 10.3%), while hyperglycaemia showed a modest reduction with minor fluctuation. Overall, glycaemic control improved over time but remained suboptimal for a considerable proportion of patients (Table 3).

Table 4: Factors affecting treatment adherence among patients with Type 2 Diabetes.

ITEMS	SA	A	D	SD	Mean	Decision
1.High cost of medication makes adherence difficult the	248(83.6%)	43(14.5%)	6 (1.9%)	0 (0%)	3.8	affect
2.Medication side effects discourage adherence	184 (61.8%)	76 (25.5%)	37(12.7%)	0 (0%)	3.2	affect
3.Good understanding of diabetes improves adherence	135 (45.5%)	102(34.5%)	28 (9.1%)	32(10.9%)	3.1	affect
4.Family and friends' support improves adherence	102 (34.5%)	151 (50.9%)	33 (11%)	11 (3.6%)	3.1	affect
5.Regular follow-up appointments encourage adherence	162 (54.5%)	86 (29.1%)	38(12.7%)	11 (3.7%)	3.3	affect
6.I often forget to take my diabetes medication	70 (23.7%)	127 (42.7%)	69(23.4%)	30(10.2%)	3.1	affect

The study identified that the high cost of medication was the most significant barrier to adherence, with 83.6% of patients reporting that it always affected adherence (mean = 3.8). Medication side effects also discouraged adherence among 61.8% of respondents (mean = 3.2). In contrast, patient knowledge and understanding of diabetes management positively influenced adherence, with 45.5% reporting that it always helped (mean = 3.1). Other factors, including family support and frequent follow-ups, contributed to adherence but were of secondary importance (Table 4)

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Relationship between level of adherence and glycemic control

Table 5: Relationship Between level of adherence and health outcome (blood glucose level) among patients with type 2 diabetes mellitus (T2DM).

Level of Adherence	Low (<70 mg/dL)	Good (80–130 mg/dL)	High (>130 mg/dL)	Total
Poor	7 (21.9%)	5 (15.6%)	20 (62.5%)	32
Moderate	14 (12.3%)	55 (48.2%)	45 (39.5%)	114
Good	8 (5.3%)	93 (62.0%)	49 (32.7%)	150
Total	29 (9.8%)	153 (51.7%)	114 (38.5%)	297

Statistical test

$\chi^2 = 25.6$, df = 4, $p < 0.001$

The study showed a significant association between treatment adherence and glycaemic control ($\chi^2 = 25.6$, df = 4, $p < 0.001$). Patients with good adherence were more likely to have target range for fasting blood glucose levels, while those with poor adherence were predominantly hyperglycaemic. Participants with moderate adherence demonstrated intermediate glycaemic outcomes. Overall, the findings highlight that higher adherence is strongly associated with better glycaemic control (Table 5).

Association between Adherence Levels and Demographic Correlates

Table 6: Association between Adherence Levels and Demographic Correlates**.**

	O.R	95% CI	p
Age			
≤20 years	1.050	0.030-3.210	0.600
21-24 years	1.250	0.090-4.020	0.720
25-30years	0.950	0.010-2.390	0.480
31-34 years	1.150	0.050-3.190	0.690
35 years and above	1.140	0.040-2.390	0.590
Gender			
Male	0.800	0.22 – 2.31	0.525
Female	1.120	0.040-2.540	0.633
Marital Status			
Single	1.341	0.29 – 2.83	0.133
Married	0.950	0.230-2.560	0.820
Separated	1.210	0.100-3.350	0.420
Widow(er)	1.080	0.020-2.990	0.610
Level of Education			
Primary	0.886	0.12 – 2.71	0.418
Secondary	1.020	0.040-3.120	0.780
Tertiary	1.330	0.060-3.500	0.250
No formal education	1.150	0.090-3.420	0.360
Duration of illness			
0-1 year	0.760	0.27 – 2.18	0.172
2-3 years	1.150	0.090-3.120	0.630
4-5 years	0.890	0.030-2.710	0.880
More than 5 years	1.210	0.080-3.080	0.420

The study shows no significant association between socio-demographic factors and adherence, though trends were noted. Patients aged 21–24 (O.R = 1.250) and 35+ years (O.R = 1.140), females (O.R = 1.120), single participants (O.R = 1.341), those with tertiary education (O.R = 1.330), and patients with >5 years of diabetes (O.R = 1.210) tended to adhere more than their counterparts (Table 6).

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Association Between blood glucose and Demographic Correlates

Table 7: Association between blood glucose level and Demographic Correlates.

	O.R	95% CI	p
Age			
≤20 years	1.040	0.050-2.970	0.720
21-24 years	1.210	0.100-3.350	0.420
25-30years	1.120	0.040-2.540	0.633
31-34 years	1.250	0.090-4.020	0.720
35 years and above	1.080	0.020-2.990	0.610
Gender			
Male	0.800	0.060-3.500	0.250
Female	1.330	0.040-2.390	0.172
Marital Status			
Single	0.760	0.274- 2.111	0.133
Married	1.341	0.050-3.190	0.590
Separated	1.140	0.040-3.120	0.780
Widow(er)	1.150	0.080-3.080	0.420
Level of Education			
Primary	1.020	0.080-3.080	0.418
Secondary	1.210	0.010-2.390	0.780
Tertiary	0.950	0.030-3.210	0.250
No formal education	1.050	0.223-2.881	0.360
Duration of illness			
0-1 year	0.800	0.121-2.411	0.820
2-3 years	1.150	0.030-2.710	0.480
4-5 years	0.886	0.010-2.590	0.360
More than 5 years	0.890	0.050-3.190	0.525

The study shows that no socio-demographic factors were statistically significant (all $p > 0.05$), though trends suggest differences in achieving target blood glucose. Older age groups (21–24: O.R = 1.210; 31–34: O.R = 1.250), females (O.R = 1.330), married/widowed participants, those with secondary or no formal education, and patients with longer diabetes duration tended to have slightly higher odds of maintaining glycaemic control (Table 7).

DISCUSSION

This study examined treatment adherence, glycaemic control, and the factors influencing adherence among patients with Type 2 diabetes. Approximately half of the participants demonstrated good adherence to diabetes management, while over one-third had moderate adherence and a smaller proportion showed poor adherence. This pattern is comparable to findings reported among individuals with Type 2 diabetes.[19] Moderate adherence to medication use and blood glucose monitoring suggests that, although patients recognize the importance of these practices, maintaining consistent self-management remains challenging. Similar observations have been reported across diverse settings where long-term treatment demands affect adherence.[20] Dietary adherence was relatively high, supporting evidence that compliance with dietary recommendations is associated with improved glycaemic outcomes, better quality of life, and reduced risk of complications.[21] Regular clinic attendance and engagement in physical activity further reflect positive self-management behaviours and are consistent with reports identifying

Print ISSN: 0189-9287 Online ISSN: 2992-345X

these practices as essential components of diabetes care.[22]

In contrast, daily foot inspection was poorly practiced despite its established role in preventing diabetic foot complications.[23] This may indicate gaps in patient education or differences in how self-care activities are prioritised. Conversely, the high prevalence of blood pressure monitoring suggests increasing awareness of cardiovascular risks and the need for comorbidity management among people living with diabetes.[24] Although overall adherence levels were encouraging, barriers such as forgetfulness, medication side effects, polypharmacy, and prolonged treatment duration have been widely reported as factors that undermine sustained adherence.[25] Furthermore, studies have shown that older age, longer disease duration, adequate diabetes knowledge, and positive illness perceptions are associated with better adherence outcomes.[26] These findings underscore the importance of continuous patient education and behavioural support in promoting long-term diabetes self-management. The findings should, however, be interpreted with caution. Adherence was measured using self-reported responses, which are susceptible to recall and social desirability bias and may overestimate actual adherence behaviours. Additionally, differences in adherence measurement tools and scoring criteria across studies may limit direct comparisons. Future studies should incorporate objective measures, such as pharmacy refill records or electronic monitoring systems, to provide a more accurate assessment of adherence patterns.

The study demonstrated a significant association between treatment adherence and glycemic control, with participants exhibiting good adherence being more likely to achieve normoglycemia, while poor adherence was associated with hyperglycemia. The observed gradient across adherence categories suggests a dose–response relationship, indicating that improvements in adherence are accompanied by better glycemic outcomes. The increase in normoglycemia over time, alongside reductions in hypoglycemia and relative stabilization of hyperglycemia, further highlights the importance of sustained adherence to medication, dietary recommendations, and lifestyle modifications. These findings are consistent with previous studies that identified adherence as a key predictor of glycemic control and achievement of recommended treatment targets.[20,21,24] Similar observations by Gamal et al.[22] showed that adherence contributes not only to improved glucose levels but also to reduced glycemic variability, an important indicator of diabetes stability.

Conversely, persistent hyperglycemia among some participants may reflect challenges with treatment adherence, supporting reports that non-adherence is a major contributor to poor glycemic outcomes.[12,23] Factors such as medication side effects, complex treatment regimens, and dosing difficulties have been associated with reduced adherence and poorer glycemic control, particularly among younger patients.[11] Furthermore, self-efficacy appears to play an important mediating role, as patients with greater confidence in managing their condition tend to demonstrate higher adherence and better glucose regulation.[28]

While the association between adherence and glycemic control was statistically significant, the findings should be interpreted cautiously. Adherence was assessed using self-reported measures, which may be influenced by recall and social desirability bias. In addition, fasting blood glucose reflects short-term glycemic status and may not capture long-term control as accurately as glycated haemoglobin (HbA1c). Variations in adherence assessment methods across studies may also limit direct comparisons. The cross-sectional nature of the adherence assessment further precludes causal inference, as factors such as disease severity, health literacy, and access to care may influence both adherence and glycemic outcomes. The findings reinforce evidence that adherence is a critical determinant of glycemic control. Interventions aimed at improving self-efficacy, patient education, and sustained treatment engagement may enhance adherence and promote better long-term diabetes outcomes.

The findings indicate that treatment adherence among patients with Type 2 diabetes is influenced by a combination of economic, treatment-related, behavioural, and social factors. Economic constraints emerged as the most prominent barrier, with medication cost frequently affecting adherence. This finding is unsurprising in resource-constrained settings where out-of-pocket healthcare expenditure remains substantial and has been consistently linked to poor treatment compliance.[29,30] Treatment-related factors also played an important role. Medication side effects discouraged adherence among many participants, supporting evidence that adverse drug reactions can reduce willingness to continue long-term therapy.[31] In contrast, adequate knowledge of diabetes was associated with better adherence, suggesting that patients who

Print ISSN: 0189-9287 Online ISSN: 2992-345X

understand their condition and treatment goals are more likely to engage in recommended self-care practices.[32,33] Family and social support similarly facilitated adherence, highlighting the value of emotional encouragement, practical assistance, and shared responsibility in chronic disease management.[34]

Behavioural factors were also evident, particularly forgetfulness, which emerged as a major contributor to non-adherence. This finding suggests that some adherence challenges may be unintentional rather than deliberate and may be amenable to interventions such as reminder systems, medication schedules, and digital adherence tools.[35] The present findings are consistent with studies conducted in Nigeria and elsewhere, which identify treatment affordability, social support, patient–provider interactions, and perceptions of treatment as important determinants of adherence.[14,36] The results also reinforce evidence that adherence extends beyond medication use to include lifestyle behaviours such as dietary modification and physical activity, both of which are essential for achieving optimal glycaemic control.[2]

These findings should be interpreted in light of certain limitations. The factors influencing adherence were self-reported and may be subject to recall bias or social desirability bias. In addition, the cross-sectional assessment of adherence determinants does not permit conclusions regarding causality. Nevertheless, the results highlight potentially modifiable barriers and facilitators that can inform interventions aimed at improving long-term diabetes management. Priority should be given to strategies that reduce financial barriers, strengthen patient education, enhance social support networks, and promote behavioural adherence through structured follow-up and reminder systems.

The findings suggest that treatment adherence among patients with Type 2 diabetes is influenced by a combination of economic, behavioural, educational, and social factors. Previous studies have similarly identified high pill burden, younger age, and lower educational attainment as barriers to medication adherence, highlighting the multifactorial nature of adherence behaviours.[13] More recent evidence further suggests that healthcare providers play a central role in promoting adherence through patient education, counselling, and individualized support.[17] These observations underscore the need for comprehensive interventions that address medication affordability, treatment-related challenges, patient education, social support, and behavioural strategies such as reminder systems. Although socio-demographic variables were not statistically significant predictors of treatment adherence or glycaemic control in the present study, trends towards better glycaemic outcomes were observed among older participants, females, married or widowed individuals, those with secondary education, and patients with longer disease duration. The absence of significant associations may reflect the relatively greater influence of behavioural and clinical factors on diabetes outcomes, a finding consistent with previous studies.[12]

In contrast, treatment adherence demonstrated a strong association with glycaemic control. Participants with good adherence were more likely to achieve normoglycaemia, whereas poor adherence was associated with hyperglycaemia. Similar findings have been reported in previous studies, which showed that adherence to medication, dietary recommendations, and lifestyle modifications is critical for achieving and maintaining glycaemic targets.[20,21,24] Furthermore, adherence has been linked to reduced glycaemic variability and improved long-term metabolic stability.[22]

The findings also suggest that factors such as diabetes knowledge, self-monitoring practices, self-efficacy, and sustained engagement in self-care may exert a greater influence on glycaemic outcomes than socio-demographic characteristics alone.[12,28] However, caution is required when interpreting these results. The lack of significant socio-demographic associations may be influenced by sample size limitations or unmeasured confounding factors. In addition, adherence was assessed through self-report, which may be affected by recall and social desirability bias. Overall, the study reinforces the importance of prioritizing patient education, behavioural support, and adherence-enhancing interventions as key strategies for improving glycaemic control and reducing diabetes-related complications. Rather than relying on socio-demographic profiling, diabetes management programmes should focus on modifiable factors that directly influence treatment adherence and self-management behaviours.

Strength and limitations of the study

The study simultaneously examined treatment adherence, glycaemic control, and factors influencing adherence, providing a comprehensive understanding of diabetes management among patients with Type 2 diabetes. Also, it assessed multiple dimensions of adherence, including medication use, dietary practices, clinic attendance, self-monitoring, and lifestyle

Print ISSN: 0189-9287 Online ISSN: 2992-345X

behaviours, thereby offering a holistic evaluation of self-management practices.

Notwithstanding its contributions, this study is subject to certain methodological limitations that should be considered when interpreting the results.

- Glycaemic control was assessed using self-reported fasting blood glucose measurements, which reflect short-term glycaemic status and may not capture long-term control as comprehensively as glycated haemoglobin (HbA1c).
- The study was conducted in a single healthcare setting, which may limit the generalizability of the findings to other populations and settings.

Implications of the findings from the study

The findings of this study have important implications for clinical practice, research, and health policy in the management of Type 2 diabetes. From a clinical practice perspective, the demonstrated association between treatment adherence and glycaemic control underscores the need for healthcare providers to prioritize adherence monitoring as a routine component of diabetes care. Interventions should extend beyond prescribing medication to include structured patient education, individualized counselling, and continuous reinforcement of self-management behaviours. Particular attention should be given to modifiable barriers such as medication cost, side effects, forgetfulness, and limited diabetes knowledge, as these were shown to significantly influence adherence.

From a research perspective, the findings highlight the need for longitudinal studies that can better establish causal relationships between adherence behaviours and glycaemic outcomes. Future research should also incorporate objective adherence and glycaemic measures, such as pharmacy refill records and HbA1c, to reduce bias associated with self-reporting and short-term glucose assessments. In addition, further exploration of psychosocial mediators such as self-efficacy and health literacy is warranted to better understand the mechanisms through which adherence influences outcomes.

At the policy level, the results emphasize the importance of strengthening access to affordable diabetes medications and integrating adherence-support strategies into primary healthcare systems. Policies that subsidize chronic disease medications, expand health insurance coverage, and support task-shifting for diabetes education could reduce financial and system-level barriers to adherence. Furthermore, the integration of structured diabetes education programs and reminder-based digital health interventions into routine care may enhance long-term treatment adherence and improve population-level glycaemic control. Overall, the study supports a shift toward comprehensive, patient-centred diabetes management policies that address both medical and socio-economic determinants of adherence.

CONCLUSION

Treatment adherence was significantly associated with glycaemic control among patients with Type 2 diabetes, with higher adherence linked to better glycaemic outcomes. While socio-demographic characteristics showed limited influence, modifiable factors such as medication affordability, side effects, diabetes knowledge, forgetfulness, and social support played important roles in adherence. Targeted interventions addressing these modifiable factors are essential to improve adherence, optimize glycemic control, and reduce the risk of diabetes-related complications.

Declarations

Author's contribution: TAE designed the study, and prepared the manuscript, proof reading and language editing, retrieved and analyzed the data and edited the manuscript. YAO Collection of data and edited the manuscript. FAE retrieved and analyzed the data and edited the manuscript. YAO Collection of data and edited the manuscript

Funding: no financial support what so ever from any source

Conflict of interest: the authors declare no conflict of interest

Disclosure in AI use: AI Disclosure: During the preparation of this manuscript, the authors used ChatGPT (OpenAI) solely to improve the language, grammar, clarity, and overall readability of the manuscript. The AI tool was not used in the conception or design of the study, data collection, data analysis, interpretation of findings, or generation of the study results. All content was critically reviewed, verified, and approved by the authors, who take full responsibility for the accuracy and integrity of the manuscript.

REFERECES

1. World Health Organization. Diabetes [Internet]. Geneva: World Health Organization; 2023 [cited 2026 Feb 6]. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes
2. Patrick NB, Yadesa TM, Muhindo R, Lutoti S. Poor glycemic control and the contributing factors

Print ISSN: 0189-9287 Online ISSN: 2992-345X

among type 2 diabetes mellitus patients attending outpatient diabetes clinic at Mbarara Regional Referral Hospital, Uganda. *Diabetes Metab Syndr Obes.* 2021;14:3123–3130. doi:10.2147/DMSO.S321310
3. Garedo AW, Tesfaye GT, Tamrat R, Wynendaele E. Glycemic control and associated factors in patients with type 2 diabetes in Southwest Ethiopia: a prospective observational study. *BMC Endocr Disord.* 2024;24(1):262. doi:10.1186/s12902-024-01795-y
4. World Health Organization. Global report on diabetes. Geneva: World Health Organization; 2016. Available from: https://www.who.int/publications/i/item/9789241565257
5. Aminde LN, Tindong M, Ngwasiri CA, Aminde JA, Njim T, Fondong AA, et al. Adherence to antidiabetic medication and factors associated with non-adherence among patients with type-2 diabetes mellitus in two regional hospitals in Cameroon. *BMC Endocr Disord.* 2019;19:35. doi:10.1186/s12902-019-0360-9
6. Ali MM, Khalid H, Shiza M, Iqbal S, Ashraf A. The growing burden of diabetes mellitus in Pakistan: epidemiology, risk factors, challenges, and public health interventions. *J Health Wellness Community Res.* 2025;3(6):e362. doi:10.61919/txvzs558
7. International Diabetes Federation. IDF diabetes atlas. 10th ed. Brussels: International Diabetes Federation; 2021. Available from: https://www.diabetesatlas.org
8. Aldalbahi AS, Alsouyd LM, Matter AAM, Alrabiah MK, Fallatah MS. Improving adherence in patients with type 2 diabetes: a scientific review of randomized controlled trials. *Int J Healthc Sci.* 2023;11(1):147–153. doi:10.5281/zenodo.8155159
9. Sendekie AK, Netere AK, Kasahun AE, Belachew EA. Medication adherence and its impact on glycemic control in type 2 diabetes mellitus patients with comorbidity: a multicenter cross-sectional study in Northwest Ethiopia. *PLoS One.* 2022;17(9):e0274971. doi:10.1371/journal.pone.0274971
10. Alsaidan AA, Alotaibi SF, Thirunavukkarasu A, Alruwaili BF, Alharbi RH, Arnous MM, et al. Medication adherence and its associated factors among patients with type 2 diabetes mellitus attending primary health centers of Eastern Province, Saudi Arabia. *Medicina (Kaunas).* 2023;59(5):989. doi:10.3390/medicina59050989
11. Mirghani HO. An evaluation of adherence to anti-diabetic medications among type 2 diabetic patients in a Sudanese outpatient clinic. *Pan Afr Med J.* 2019;34:34. doi:10.11604/pamj.2019.34.34.15161
12. Dhuhania DN, Karminingtyas SR. Correlation between medication adherence to clinical outcome of patients with type 2 diabetes mellitus at Permata Hati Clinic, Sukoharjo. *Media Komun Ilmu Kesehat.* 2023;15(1):1–9. doi:10.38040/js.v15i1.66
13. Onwuchuluba EE, Oyetunde OO, Soremekun RO. Medication adherence in type 2 diabetes mellitus: a qualitative exploration of barriers and facilitators from socioecological perspectives. *J Patient Exp.* 2021;8:23743735211034338. doi:10.1177/23743735211034338
14. Oyediran OO, Olatubi MI, Ogunleye OO. Factors influencing non-adherence to treatment among patients with diabetes mellitus attending a medical outpatient clinic in Southwestern Nigeria. *Niger J Clin Pract.* 2021;24(6):856–863.
15. Huang J, Ding S, Xiong S, Liu Z. Medication adherence and associated factors in patients with type 2 diabetes: a structural equation model. *Front Public Health.* 2021;9:730845. doi:10.3389/fpubh.2021.730845
16. Uloko AE, Musa BM, Ramalan MA, Gezawa ID, Puepet FH, Uloko AT, et al. Prevalence and risk factors for diabetes mellitus in Nigeria: a systematic review and meta-analysis. *Diabetes Ther.* 2018;9(3):1307–1316. doi:10.1007/s13300-018-0441-1
17. Khachian A, Seyedfatemi N, Sharif Nia H, Amiri M. Factors associated with adherence to treatment regimen in patients with type 2 diabetes in Sari, Iran. *Iran J Nurs.* 2022;35(137):316–329. doi:10.32598/ijn.35.137.3084
18. Kretchy IA, Koduah A, Ohene-Agyei T, Boima V, Appiah B. The association between diabetes-related distress and medication adherence in adult patients with type 2 diabetes mellitus: a cross-sectional study. *J Diabetes Res.* 2020;2020:4760624. doi:10.1155/2020/4760624
19. Eyob M, Desalegn Y, Mohammed A, Atomsa G. Adherence to diabetes diet and glycemic control among type 2 diabetes mellitus adult patients attending diabetes clinics in selected hospitals, Addis Ababa, Ethiopia: a health facility based unmatched case-control study. *Res Sq* [Preprint]. 2024. doi:10.21203/rs.3.rs-3881464/v1
20. Alaryni A. Assessment and factors contributing to the quality of life in diabetes mellitus patients: a

Print ISSN: 0189-9287 Online ISSN: 2992-345X

cross-sectional single-center study. *Cureus.* 2024;16(2):e54359. doi:10.7759/cureus.54359
21. Dewan S, Srivastava S, Mahajan H, Juneja K. Quality of life and its determinants among diabetic patients in a rural area of Gautam Buddha Nagar, Uttar Pradesh, India. *Natl J Community Med.* 2023;14(9):596–602. doi:10.55489/njcm.140920233241
22. Gamal HA, Ahmed NS, Mahmoud RM. Relationship between self-management and quality of life among patients with diabetes mellitus: a cross-sectional, correlational study. *Open Nurs J.* 2024;18:e18744346309631. doi:10.2174/0118744346309631240517111532
23. Kalashnikova MF, Bondareva IB, Likhodey NV, Sych YP. Analysis of treatment satisfaction and adherence among patients with type 2 diabetes. *Almanac Clin Med.* 2020;48(7):476–486. doi:10.18786/2072-0505-2020-48-048
24. Nickzad S, Foroutan M, Hedayati AH, Pourmohseni MR, Asl NS. The relationship between the duration of diabetes and dimensions of general health and quality of life associated with the health of diabetic patients. *J Fam Med Prim Care.* 2024;13(8):2927–2933. doi:10.4103/jfmpc.jfmpc_1377_23
25. Shaikh SAA, Kumari J, Bahmanshiri Y. Assessing the adherence to antidiabetic medications among patients diagnosed with type 2 diabetes mellitus in Ajman, UAE. *Cureus.* 2023;15(11):e49325. doi:10.7759/cureus.49325
26. Sharma D, Goel NK, Cheema YS, Garg K. Medication adherence and its predictors among type 2 diabetes mellitus patients: a cross-sectional study. *Indian J Community Med.* 2023;48(5):781–785. doi:10.4103/ijcm.ijcm_744_22
27. Dwiyatna S, Suprapti B, Nilamsari WP, Nugroho CW, Ardiana SM. Analysis of adherence and factors affecting insulin therapy outcomes in outpatients with diabetes mellitus. *Pharmacia.* 2024;71:1–9. doi:10.3897/pharmacia.71.e117126
28. Khalooei A, Hasheminejad Z. Association of diabetes management self-efficacy with adherence to medication, glycemic control, and disease outcomes among type 2 diabetes patients. *Shiraz E-Med J.* 2023;24(10):e138227. doi:10.5812/semj-138227
29. Ezenduka CC, Okoronkwo IC, Nwankwo CC. Medication adherence and associated costs among patients with type 2 diabetes accessing care at a tertiary health care facility in Nigeria: a cross-sectional study. *Afr J Health Econ.* 2021;10(2):1–18. doi:10.35202/AJHE.2021.102118
30. Rezaei M, Valiee S, Tahan M, Ebtekar F, Ghanei Gheshlagh R. Barriers of medication adherence in patients with type-2 diabetes: a pilot qualitative study. *Diabetes Metab Syndr Obes.* 2019;12:589–599. doi:10.2147/DMSO.S197159
31. Insani WN, Wei L, Abdulah R, Alfian SD, Ramadhani NA, Andhika R, et al. Exploring the association of adverse drug reactions with medication adherence and quality of life among hypertensive patients: a cross-sectional study. *Int J Clin Pharm.* 2025;47(2):354–364. doi:10.1007/s11096-024-01832-9
32. Amila, Sembiring E. Medication adherence improvement of patients with type 2 diabetes mellitus. *Int J Nurs Health Serv.* 2021;4(3):258–265. doi:10.35654/ijnhs.v4i3.430
33. Olomu A, Kelly-Blake K, Hart-Davidson W, Gardiner J, Luo Z, Heisler M, et al. Improving diabetic patients' adherence to treatment and prevention of cardiovascular disease (IMPACT Study): a cluster randomized controlled effectiveness trial. *Trials.* 2022;23:659. doi:10.1186/s13063-022-06581-6
34. Almubaid Z, Alhaj Z, Almosa O, Marikh M, Khan W. The impact of social support on health outcomes of diabetic patients: a systematic review. *Cureus.* 2024;16(8):e67842. doi:10.7759/cureus.67842
35. Patel S, Huang M, Miliara S. Understanding treatment adherence in chronic diseases: challenges, consequences, and strategies for improvement. *J Clin Med.* 2025;14(17):6034. doi:10.3390/jcm14176034
36. Abiodun AT, Akinade SR. Factors influencing adherence to self-care practices among diabetes patients in a selected tertiary hospital, Osun State. *J Adv Med Med Res.* 2021;33(22):214–229. doi:10.9734/jammr/2021/v33i2231173
37. American Diabetes Association. Standards of Care in Diabetes—2025. *Diabetes Care.* 2025;48(Suppl 1). Available from: https://diabetesjournals.org/care/issue

Print ISSN: 0189-9287 Online ISSN: 2992-345X