

Glycaemic control and its association with socio-demographic factors, sleep quality and comorbidities among adult patients with Type 2 diabetes mellitus attending outpatient clinics of A Tertiary Hospital Southwest Nigeria.

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Abstract

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Background: Type 2 diabetes mellitus (T2DM) is globally a major non-communicable disease associated with chronic hyperglycaemia, complications, disability, and increasing healthcare costs. Evidence on glycaemic control among rural and mixed populations in Nigeria remains limited. The study determined the prevalence of good glycaemic control and its association with sociodemographic characteristics, sleep quality and comorbidities among patients with T2DM attending outpatient clinics of a tertiary hospital in rural southwest Nigeria.

Methods: A cross-sectional study was conducted across three outpatient clinics, over three months among 371 adult patients with T2DM. Data were obtained using interviewer-administered questionnaire and medical records, the Pittsburgh Sleep Quality Index, Morisky Medication Adherence Scale-8, and a modified Morisky dietary-adherence scale. Respondents' BMI and glycated haemoglobin were measured. Chi-square and multivariable logistic-regression analyses were performed using 95% confidence intervals at a 5% significance level.

Results: The prevalence of good glycaemic control was 48.0%. Good glycaemic control was independently associated with age below 40 years (AOR = 3.134, 95% CI: 1.054–9.314, $p = 0.040$), high income (AOR = 2.114, 95% CI: 1.124–3.977, $p = 0.020$), good sleep quality (AOR = 3.370, 95% CI: 1.459–7.851, $p < 0.001$), absence of obesity (AOR = 2.492, 95% CI: 1.274–4.876, $p = 0.008$), absence of comorbidities (AOR = 2.766, 95% CI: 1.121–4.365, $p = 0.032$), good medication adherence (AOR = 2.459, 95% CI: 1.236–4.315, $p = 0.029$), good dietary adherence (AOR = 3.277, 95% CI: 1.296–6.047, $p = 0.041$) and short duration of diabetes diagnosis (AOR = 3.819, 95% CI: 1.302–9.164, $p = 0.039$).

Conclusion: Slightly more than half of participants had poor glycaemic control. Good glycaemic control was independently associated with younger age, higher income, good sleep quality, absence of obesity and comorbidities, medication and dietary adherence, and shorter duration of diabetes. Targeted diabetes management should promote sleep improvement, weight management, treatment adherence, and healthy dietary practices.

Keywords: Prevalence, poor glycaemic control, sleep quality comorbidity, Adult T2DM

Introduction

Background

Diabetes mellitus, and type 2 diabetes mellitus (T2DM) in particular, has become one of the most consequential non-communicable diseases globally, driving premature death, long-term disability, and rising healthcare expenditure.¹ The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels.²

The prevalence of Diabetes Mellitus (DM) is increasing worldwide, with an estimated prevalence of 9.3% (463 million) of the global adult population in 2019; and an unsettling projection of 10.2% (578 million) and 10.9% (700 million) by the years 2030 and 2045, respectively.³ Type 2 diabetes Mellitus (T2DM) constitutes approximately 85% to 95% of all cases of diabetes globally, with a

growing proportion in developing countries as the result of increases in urbanization, sedentary lifestyles, aging populations, and unhealthy behavioral patterns.⁴ The disease prevalence of Type 2 diabetes mellitus in Nigeria is estimated at 5.77%, with the higher proportions in the south–south region and the lowest rate seen in the north-western region.⁵

The main goal of Diabetes management is to achieve the optimal glycaemic control,⁴ which is defined as glycated haemoglobin (HbA1c) <7% or a fasting plasma glucose range of (3.9–7.2mmol/l).²

Existing research have identified sleep quality among other factors such as sociodemographic characteristics, presence of comorbidities, obesity, medication adherence as predictive factors of the pattern of glycaemic control among patients with T2DM.^{4,6}

Recent studies have demonstrated that poor sleep quality has a

deleterious effect on glycaemic control in patients with T2DM as sleep deprivation causes interference with the normal circadian cycle thereby disrupting the endocrine and sympathovagal balance.^{7,8} Sleep deprivation has also been found to increase cortisol and other stress hormone levels, thus inducing insulin resistance and elevating blood glucose.⁸ Comorbidities such as hypertension, chronic kidney disease (CKD), dyslipidemia, obesity are common among patients with T2DM, and have been linked to poorer glycaemic control.⁴

Globally and locally, a vast wealth of research has been carried out on glycaemic control among patients with T2DM. Nonetheless, there remains a dearth of data on glycaemic control and its association with sociodemographic factors, sleep quality and comorbid conditions. The balance of research conducted on prevalence of glycaemic control and its associated factors among patients with T2DM in Nigeria and other parts of sub-Saharan Africa has been disproportionately skewed in favor of the urban areas, to the neglect of the rural dwelling populations. Hence further research is expedient, especially among rural dwelling populations.

This study was therefore conducted to determine the level of glycaemic control and its relationship with sociodemographic factors, sleep quality, comorbid conditions, medication adherence, dietary adherence, and duration of diabetes among patients with type 2 diabetes mellitus attending a tertiary hospital in Southwest Nigeria. The findings may inform interventions aimed at improving glycaemic outcomes.

Methods

Study location:

The study was carried out at the General Outpatient Clinic (GOC) of the Federal Teaching Hospital, Ido-Ekiti (FETHI) and its annexes, over a three-month period. The Federal Teaching Hospital Ido-Ekiti (FETHI) is a tertiary health facility owned by the Federal Government, situated in Ido-Ekiti, Ido-Osi Local Government Area of Ekiti State, Southwest Nigeria. According to the most recent 2006 population census, the population of Ido-Osi Local Government Area was estimated at 339,000 with an annual growth rate of 3.2%.⁹ There are four (4) annexes of the hospital which are in Ado-Ekiti, Ise-Ekiti, Igogo-Ekiti and Ilawe Ekiti which are spread across the three (3) senatorial districts of the state

Study population: The study population comprised all adult patients with a confirmed diagnosis of T2DM who were registered and receiving care at GOC, Ado-Ekiti and Ilawe annexes

Study design: This was a cross-sectional study to determine the prevalence of poor glycaemic control and its associated factors among patients with T2DM in the study area.

Inclusion criteria:

This included adult patients, at least 18 years old, who consented to partake in the study by signing the consent form, had a clinical diagnosis of T2DM, who had been attending clinic and on anti-diabetic medications for at least three months before the study.

Exclusion criteria:

This included patients who were pregnant, had mental illness, required emergency care, or had been diagnosed with Obstructive Sleep Apnea (OSA)

Sample Size Calculation

The sample size shall be determined using this formula.¹⁰

$$n_0 = \frac{Z^2 P(1-P)}{d^2}$$

n_0 = the required sample size, Z = the standard deviation, set at 1.96 for a 95% confidence level,

P = prevalence of poor glycaemic control = 40.0%. (Based on a previous study conducted in Ekiti State, Nigeria.⁴)

e = the desired precision or margin of error usually set at 5%

Substituting the values in the formula:

$$n_0 = \frac{(1.96)^2 \times 0.4(1-0.40)}{(0.05)^2} =$$

$$n_0 = 369.$$

However, since the population is less than 10,000

$$n = n_0 / (1 + n_0/N)$$

N = (The total number of registered adult T2DM patients who attended the three clinics in 2023) = 4030

$$\text{Therefore } n = 369 / (1 + (369/4030))$$

$$n = 338. \text{ By adding 10\% attrition rate, } n = 371$$

Sampling frame/sampling technique:

An updated clinic register (electronic and manual) showed 4,030 recorded follow-up visits by patients with T2DM across the three clinics in the preceding year. This corresponded to approximately 1,008 visits over a three-month period: 608 (60%) at the GOC, 300 (30%) at the Ado-Ekiti Annex, and 100 (10%) at the Ilawe-Ekiti Annex. Proportionate allocation yielded sample sizes of 223, 111, and 37, respectively. The three-month attendance of 1,008 served as the sampling frame. The sampling interval was $k = N/n = 1,008/371 \approx 3$.

The procedure involved selecting the first respondent in each clinic, every clinic day with simple random sampling by balloting. Subsequently, every third patient was recruited into the study by systematic random sampling. The procedure was repeated each day in all three clinics until the total sample size of 371 was reached.

Study variables: The primary outcome measure was the degree of glycaemic control assessed through the measurement of HbA1c levels. The independent variables were sociodemographic profiles, sleep quality presence of comorbidities.

Research Instruments and study protocol:

An interviewer-administered semi structured questionnaire was used to obtain:

1. Participants' sociodemographic characteristics such as age, sex, marital status, religion, ethnicity, occupation, education, and income level, and to assess the duration of diagnosis of T2DM.
2. Assessment of sleep quality. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI).¹¹ It comprises of 19 self-rated questions, which are grouped into seven component scores, and weighted equally on a 0-3 scale. The seven sleep components are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. The seven component scores are added to obtain the global PSQI score of between 0 and 21

with higher scores indicating poorer sleep quality.¹¹ A cut-off score of six (6) or more represents poor sleep quality.¹¹

3. Assessment of comorbidities, duration of diabetes diagnosis and duration of treatment. Data on presence of any of the following comorbidities; Hypertension, Dyslipidaemia and Chronic Kidney Disease (CKD) were obtained from the respondents' medical records and obesity was calculated from anthropometric measurements. Data on time of diagnosis of T2DM and commencement of medications were also obtained.
4. HbA1c Measurement: After an overnight fast, 4ml venous blood samples were collected from each participant into EDTA tubes and taken to FETHI laboratory for the analysis of HbA1c using immunochemically on a DCA 2000 HbA1c auto analyzer, using kits supplied by Boehringer Mannheim (Germany).¹² Commercially prepared standards and control samples were used to ensure accuracy of the test results. Glycated haemoglobin (HbA1c) < 7.0% ($\leq 53\text{mmol/mol}$) was categorised as good glycaemic control, according to the American Diabetes Association recommendations.²

5. Anthropometric Evaluation (BMI Determination):

Height: The height of participants was measured to the nearest 0.1cm using a Leicester portable Stadiometer. The participants were barefooted and without headgear or cap when measurements were taken.

Weight: The weight of participants was measured using the Seca 874 digital floor scale which has a capacity of 200kg.

The participants were in light clothing and without shoes while the measurement was taken.

BMI is calculated as follows: $\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$

Medication Adherence: Medication adherence was assessed using Morisky Medication Adherence scale-8 (MMAS-8).¹³ The MMAS-8 consists of eight questions. The first seven are answered with a "Yes" or "No" format, and the eighth question is answered using a 5-point Likert scale. It is scored from 0 to 8 with higher scores indicating better adherence. Respondents who scored ≥ 6 were considered adherent.¹³

Dietary Adherence The modified Morisky dietary adherence scale was used to assess dietary compliance.¹⁴ It is 10-item tool, with each response scored as 1 or 0 for 'Yes' or 'No' respectively, giving a total possible individual score of 10/10. The mean of the individual scores was calculated. Respondents who had individual scores above the mean were classified as dietary adherent.¹⁴

The questionnaire was pretested at the nearby tertiary health facility in the State with 10% (40 respondents) of the sample size and modifications to questionnaire were made after feedback from the pretest. The questionnaire was composed in English language and translated to Yoruba and subsequently translated back to English language by a competent Linguist in both languages. The study was reported to conform to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.¹⁵

Data analysis:

Data was entered and cleaned on Microsoft Excel, and was analyzed

on IBM SPSS version 26. Excel was first used to handle any missing numbers, eliminate duplicates, and check for errors. The pattern of respondents' glycaemic control, sociodemographic factors, sleep quality, comorbidity pattern, medication adherence, dietary adherence and duration of diabetes diagnosis were computed by SPSS and displayed as straightforward tables. Chi-square tests were used to assess whether good glycaemic control differed across sociodemographic characteristics, sleep quality patterns, comorbidity patterns, medication-adherence categories, dietary adherence categories and durations of diagnosis of diabetes mellitus. After controlling for possible confounders, multivariable logistic regression was used to determine factors associated with good glycaemic control using adjusted odds ratios at 95% Confidence Interval. A p-value of < 0.05 was taken as statistically significant.

Ethical Consideration: Approval for this study was sought from the Ethics and Research Committee of the Federal Teaching Hospital, Ido-Ekiti (with approval number ERC/2024/08/13/1154A, dated 9th October, 2024) before commencement of the study. Informed consent in form of written or thumbprint was taken from each participant. Confidentiality was maintained throughout the study by not revealing the identity of the participant. Access to the data was restricted and only accessible to the researcher. The participant was told that they were free to withdraw from the study at any time without interference with their care. The study was at no cost to the participant.

RESULTS

A total of 371 participants were included in the study. The majority were aged 40–59 years (237, 63.9%) and ≥ 60 years (112, 30.2%). Females constituted 206 (55.5%) of the study population. Traders (113, 30.5%) were the predominant occupation. Over one-third (134, 36.1%) had tertiary education. More than half (196, 52.8%) earned below the national minimum wage of ₦70,000 monthly.

Table 1. Socio-demographic characteristics of respondents (N = 371)

Variable	Frequency (n)	Percentage (%)
Age (in years)		
<40	22	5.9
40–59	237	63.9
≥ 60	112	30.2
Mean age $\pm$ SD	54.8 $\pm$ 9.5	
Sex		
Male	165	44.5
Female	206	55.5
Marital status		
Single	34	9.2
Married	259	69.8
Separated/Divorced	17	4.6
Widowed	61	16.4
Religion		
Christianity	287	77.4
Islam	72	19.4
Traditional/Other	12	3.2
Ethnicity		
Yoruba	281	75.7
Igbo	42	11.3
Hausa	19	5.1
Other	29	7.8
Educational level		
Non-formal	35	9.4
Primary	82	22.1
Secondary	120	32.3
Tertiary	134	36.1

Occupation		
Retired/dependent/unemployed	89	24.0
Artisan	57	15.4
Business/trading	113	30.5
Civil servant	76	20.5
Farming	36	9.7
Level of income		
< ₦70,000	196	52.8
₦70,000–₦100,000	109	29.4
> ₦100,000	66	17.8
Place of domicile		
Rural	160	43.1
Urban	211	56.9

Overall, 178 (48.0%) participants had good glycaemic control, while 193 (52.0%) had poor glycaemic control. The mean HbA1c level was $7.7 \pm 1.7\%$ as in Table 2.

Table 2. Level of glycaemic control of respondents (N=371)

Variable	Frequency (n)	Percentage (%)
Level of glycaemic control (HbA1c)		
Good (<7%)	178	48.0
Poor ($\geq 7\%$)	193	52.0
Mean HbA1c $\pm$ SD (%)	7.7 $\pm$ 1.7	

Among the sociodemographic factors, there was a statistically significant association between glycaemic control and age ($\chi^2 = 7.462$, $p = 0.024$), and income level ($\chi^2 = 6.593$, $p = 0.037$), as shown in Table 3.

Table 3. Association between sociodemographic characteristics and glycaemic control (N=371)

Variable	Controlled n (%)	Uncontrolled n (%)	χ^2	p-value
Age (in years)				
<40	15 (68.2)	7 (31.8)	7.462	0.024*
40–59	119 (50.2)	118 (49.8)		
≥60	44 (39.3)	68 (60.7)		
Sex				
Male	80 (48.5)	85 (51.5)	0.031	0.861
Female	98 (47.6)	108 (52.4)		
Marital status				
Single	19 (55.9)	15 (44.1)	3.204	0.361
Married	128 (49.4)	131 (50.6)		
Separated/Divorced	7 (41.2)	10 (58.8)		
Widowed	24 (39.3)	37 (60.7)		
Religion				
Christianity	131 (45.6)	156 (54.4)	2.798	0.247
Islam	40 (55.6)	32 (44.4)		
Traditional/Other	7 (58.3)	5 (41.7)		
Ethnicity				
Yoruba	142 (50.5)	139 (49.5)	3.922	0.270
Igbo	19 (45.2)	23 (54.8)		
Hausa	7 (36.8)	12 (63.2)		
Other	10 (34.5)	19 (65.5)		
Educational level				
Non-formal	17 (48.6)	18 (51.4)	1.746	0.627
Primary	36 (43.9)	46 (56.1)		
Secondary	55 (45.8)	65 (54.2)		
Tertiary	70 (52.2)	64 (47.8)		
Occupation				
Retired/dependent/unemployed	41 (46.1)	48 (53.9)	2.088	0.719
Artisan	32 (56.1)	25 (43.9)		
Business/trading	51 (45.1)	62 (54.9)		
Civil servant	36 (47.4)	40 (52.6)		
Farming	18 (50.0)	18 (50.0)		
Level of income				
< ₦70,000	82 (41.8)	114 (58.2)	6.593	0.037*
₦70,000–₦100,000	58 (53.2)	51 (46.8)		
> ₦100,000	38 (57.6)	28 (42.4)		
Place of domicile				
Urban	100 (47.4)	111 (52.6)	0.067	0.796
Rural	78 (48.8)	82 (51.2)		

There was a statistically significant association between glycaemic control and sleep quality ($\chi^2 = 21.751$, $p < 0.001$), number of comorbidities ($\chi^2 = 12.049$, $p = 0.007$). Hypertension ($\chi^2 = 4.173$, $p = 0.041$) and Obesity ($\chi^2 = 8.303$, $p = 0.004$) as comorbidities, medication adherence ($\chi^2 = 5.493$, $p = 0.019$), dietary adherence ($\chi^2 =$

$= 3.984$, $p = 0.046$), duration of diabetes diagnosis ($\chi^2 = 17.182$, $p = 0.001$), duration on diabetic medications ($\chi^2 = 14.490$, $p = 0.002$), as shown in table 4.

Table 4. Association between sleep quality, comorbidity pattern, medication adherence, dietary adherence, duration of diagnosis, duration on medications and glycaemic control (N=371)

Variable	Controlled n (%)	Uncontrolled n (%)	χ^2	p-value
Sleep quality				
Good sleep (PSQI ≤ 5)	97 (62.2)	59 (37.8)	21.751	<0.001*
Poor sleep (PSQI > 5)	81 (37.7)	134 (62.3)		
Type of comorbidity				
Hypertension	37 (38.9)	58 (61.1)	4.173	0.041*
Obesity	37 (35.9)	66 (64.1)	8.303	0.004*
Dyslipidaemia	64 (44.8)	79 (55.2)	0.969	0.325
Chronic kidney disease (CKD)	10 (47.6)	11 (52.4)	0.001	0.973
Number of comorbidities				
0	70 (58.3)	50 (41.7)	12.049	0.007*
1	74 (48.1)	80 (51.9)		
2	28 (33.7)	55 (66.3)		
>2	6 (42.9)	8 (57.1)		
Medication adherence				
Good	85 (55.2)	69 (44.8)	5.493	0.019*
Poor	93 (42.9)	124 (57.1)		
Dietary adherence				
Good	75 (54.7)	62 (45.3)	3.984	0.046*
Poor	103 (44.0)	131 (56.0)		
Duration of diabetes diagnosis (years)				
<1	28 (51.9)	26 (48.1)	17.182	0.001*
1–5	90 (55.9)	71 (44.1)		
6–10	41 (48.2)	44 (51.8)		
>10	19 (26.8)	52 (73.2)		
Duration on diabetes medication (years)				
<1	59 (48.4)	63 (51.6)	14.490	0.002*
1–5	73 (57.9)	53 (42.1)		
6–10	32 (45.1)	39 (54.9)		
>10	14 (26.9)	38 (73.1)		

On multivariable logistic regression analysis after controlling for possible confounders, younger respondents aged (<40 years) had significantly higher odds of good glycaemic control compared to those aged ≥ 60 years (AOR = 3.134, 95% CI: 1.054–9.314, $p = 0.040$). Also, participants with higher monthly income (AOR = 2.114, 95% CI: 1.124–3.977, $p = 0.020$), good sleep quality (AOR = 3.370, 95% CI: 1.459–7.851, $p < 0.001$), absence of obesity (AOR = 2.492, 95% CI: 1.274–4.876, $p = 0.008$), absence of comorbidities (AOR = 2.766, 95% CI: 1.121–4.365, $p = 0.032$), good medication adherence (AOR = 2.459, 95% CI: 1.236–4.315, $p = 0.029$), good dietary adherence (AOR = 3.277, 95% CI: 1.296–6.047, $p = 0.041$) and short duration of diabetes diagnosis (AOR = 3.819, 95% CI: 1.301–9.164, $p = 0.039$) were more likely to have good glycaemic control when compared with their counterparts, as shown in Table 5.

Table 5. Multiple logistic regression analysis of factors associated with good control among respondents (N=371)

Variable	AOR	95% CI	p-value
Age (in years)			
<40	3.134	1.054–9.314	0.040*
40–59	1.272	0.764–2.118	0.354
≥ 60	Reference	-	-
Level of income			
< ₦70,000	Reference	-	-
₦70,000–₦100,000	1.622	0.958–2.746	0.072
> ₦100,000	2.114	1.124–3.977	0.020*
Sleep quality			
Good sleep (PSQI ≤ 5)	3.370	1.459–7.851	<0.001*
Poor sleep (PSQI > 5)	Reference	-	-

Hypertension			
Yes	Reference	-	-
No	1.266	0.643–2.493	0.494
Obesity			
Yes	Reference	-	-
No	2.492	1.274–4.876	0.008*
Number of comorbidities			
0	2.766	1.121–4.365	0.032*
1	0.546	0.146–2.046	0.369
2	0.436	0.123–1.550	0.200
>2	Reference	-	-
Medication adherence			
Good	2.459	1.236–4.315	0.029*
Poor	Reference	-	-
Dietary adherence			
Good	3.277	1.296–6.047	0.041*
Poor	Reference	-	-
Duration of diabetes diagnosis (years)			
<1	3.819	1.302–9.164	0.039*
1–5	3.638	0.966–13.709	0.056
6–10	2.052	0.625–6.740	0.236
>10	Reference	-	-
Duration on diabetes medication (years)			
<1	0.745	0.172–3.222	0.693
1–5	1.309	0.300–5.706	0.720
6–10	1.171	0.318–4.310	0.813
>10	Reference	-	-

AOR = Adjusted Odds Ratio; CI = Confidence Interval. Variables with $p < 0.05$ from the bivariate analysis were included in the multivariable model to obtain AORs. Reference categories are indicated as such. $p < 0.05$ was considered significant.

DISCUSSION

In this study, the mean age of the respondents was 54.8 ± 9.5 years. This is comparable to the mean age observed from several previous studies on glycaemic control.^{4,7,16} The mean age is expected for a chronic disease that affects mostly individuals of middle age.^{4,16}

The study showed that less than half (48.0%) of the respondents had good glycaemic control, using glycated haemoglobin (HbA1c) of $< 7\%$ as the benchmark for glycaemic control. This is comparable to studies conducted in Enugu, South-east Nigeria by Onodugo et al (47.1%),¹⁷ Gombe, North-east, Nigeria by David et al (49.9%)¹⁸ This consistency may be attributed to similar study designs, the studies being conducted in tertiary health institutions and similar sociodemographic characteristics of respondents. In contrast, significantly higher prevalences were observed from other studies within Nigeria with Enugu by Abonyi et al (67.8%),¹ Ido-Ekiti by Ibrahim et al (60%),⁴ and abroad in the USA by Ali et al (87.1%)¹⁹. The more favorable outcomes in the USA may be attributed to higher per capita income, and more efficient health insurance schemes.

At the opposite end of the spectrum, much lower prevalences of good glycaemic control were reported in Nnewi by Anioke et al (16.7%)²⁰, Owerri by Egwim et al (23.1%)¹⁶ and Lagos by Omotosho et al (32.8%).²¹ The variation observed when compared with other research having lower prevalence may be due to methodological differences in determining glycaemic control. Nonetheless, the low prevalence of good glycaemic control in this study highlights the growing burden and challenges experienced by patients with type 2 diabetes mellitus in Nigeria. Therefore, concerned stakeholders should facilitate

targeted health interventions aimed at improving the management of patients with Type 2 diabetes mellitus in south west Nigeria.

After controlling for possible confounders, factors such as age (< 40 years), high level of income ($> \text{₦}100,000$ monthly), good sleep quality, absence of comorbidities, good medication adherence, good dietary adherence, short duration of diagnosis of diabetes mellitus (1 year) were associated with good glycaemic control in this research. Previous reports on the association between sociodemographic characteristics and glycaemic control among patients with Type 2 diabetes mellitus have been inconsistent.^{4,21} The results of this study showed that patients aged 40 years and below were more likely to have good glycaemic control compared to older population groups. These findings were consistent with the outcomes reported in other previous studies.^{4,6} This is attributable to the reduced risk of multiple comorbidities among young people, which would undermine glycaemic control. As age increases, challenges with achieving glycaemic control in type 2 diabetes patients tend to occur, due to impaired insulin secretion from dysfunction of pancreatic β cells.²⁰ Contrarily, some other studies have reported that patients with type 2 diabetes who were of a younger age had increased risk for poor glycaemic control. This may be due to risky lifestyle choices and poor adherence to treatment among younger population as opposed to the elderly.¹⁶ Other studies conducted within Nigeria found no significant association between age and glycaemic control.^{17,18} Therefore, further research is needed to fully comprehend the influence of ages on glycaemic control among patients with Diabetes.

The study findings also showed that higher levels of income had a positive association with improved glycaemic control, as respondents with higher income levels had a tendency towards good glycaemic control and this association was statistically significant. The enhancing influence of high income on optimal glycated haemoglobin status among patients with type 2 diabetes has been similar in several studies.^{4,22} Individuals with higher income have been linked with easier access to quality healthcare, ability to afford good nutrition, procure medications and follow up with doctors' recommendations.⁶ type 2 diabetes is a disease often associated with chronic medical conditions and requires substantial financial resources for its management. Other previous studies have revealed that there is progressive improvement in patient's glycaemic control with increased levels of patient's income.¹⁶

This study identified a positive correlation between good sleep quality and optimal HbA1c levels in patients with type 2 diabetes, indicating that as sleep quality improved, patient's levels of glycated haemoglobin tend to reduce. This finding corresponds to the findings of several studies on the relationship between sleep quality and blood glucose regulation. Ayinla et al in Ilorin, Nigeria, Shibawbaw et al in Ethiopia both reported better glycaemic status with improved sleep quality among their respondents.^{7,23}

This observed association between sleep quality and glycaemic control is due to the effect of sleep on improving insulin sensitivity, reduction in levels of cortisol and other stress hormones, and reduction in systemic inflammation.²⁴ Insufficient sleep negatively affects glycaemic management in people with diabetes by disrupting normal circadian rhythms and altering endocrine, autonomic, and metabolic regulation.^{7,8} Sleep deprivation may also raise cortisol levels, promoting insulin resistance and increasing blood glucose.⁸ However, the findings in this

study are at variance with the findings of Chavalit et al²⁵ in Thailand, who found no significant association between sleep quality and glycaemic control among patients with Diabetes. They elucidated that the physiological impact of sleep quality may primarily influence fluctuations in glucose levels only on a short-term basis as observed with fasting blood glucose, with minimal effect on long-term glycemic status, as reflected by HbA1c.²⁵

The absence of obesity as a comorbid condition was especially identified amongst other comorbidities as a significant factor for good glycaemic control, as respondents who did not suffer from obesity were more than twice as likely to have good glycaemic control than their counterparts who suffered from the disease. This observation aligns with empirical evidence from existing research that documented an association between obesity and impaired glycaemic control.²⁶ The physiological mechanism behind this association is the release of pro-inflammatory cytokines including tumor necrosis factor alpha (TNF- α) and interleukin-6 (IL-6) from the adipocytes in obese patients, which interfere with insulin receptors, leading to insulin resistance and consequently higher HbA1c levels.²⁷ Lifestyle modifications targeted at reduction in body mass index (BMI) such as dietary discretion, portion control and increased physical activity are recommended for incorporation into management plans for patients with diabetes to improve treatment outcomes.

Respondents who were adherent to oral hypoglycemic agents in this study were found to be two and half (2.45) times more likely to have good glycaemic control compared to others who were not adherent to medications. This observation is compatible with outcomes reported in other studies.^{4,16} The reason good medication adherence among the study participants may be due to their higher levels of formal education, good patient-doctor relationship, better health literacy, and reduced pill count. According to previous research, other factors associated with good medication adherence are with older age, better understanding of disease, simpler treatment regimens, minimal side-effects and easy access to medications.¹³ This observation highlights the necessity for focused actions, such as sustained patient education and wider health insurance coverage to enhance management outcomes among patients with Diabetes.

In correlation with earlier research, this study revealed a direct relationship between dietary adherence and good glycaemic control,^{6,23} as evidenced by respondents with good dietary adherence being more than three times as likely to exhibit good glycaemic control than the respondents with poor adherence. The adherence to dietary regimen may be due to emphasis on health education and counselling given to patients by clinicians at the tertiary health facility, easy access to natural healthy foods, and reduced consumption of junk foods in the rural areas. Previous studies found that dietary adherence was significantly associated with younger age and formal education. Education may improve patients' capacity to understand, interpret, and apply dietary advice, while increasing age may create cognitive or memory-related challenges to sustaining a recommended meal plan.¹⁴ This finding reinforces the pertinence of focused patient education on lifestyle modification as a mainstay of clinical management of chronic illnesses.

Furthermore, the study showed that patients with shorter duration of diabetes (< 1 year) were about four times more likely to exhibit good glycaemic control in contrast to other patients with longer duration of diagnosis of diabetes. This finding is in tandem with previous studies.^{1,6,22} This is explained by the progressive nature of the disease, as beta cells function decline over time, insulin resistance may persist or worsen, making blood glucose harder to control with the treatment that previously worked.⁶

Also, the compounding financial burden increases, of continued medication purchases, clinic visits, monitoring, and management of complications can strain household resources, leading to declining treatment adherence and glycaemic control.²²

STRENGTHS AND LIMITATIONS

The study had several strengths. Systematic random sampling helped reduce selection bias. Participants represented a broad sociodemographic spectrum, including urban and rural populations across the three senatorial districts of the state. Glycaemic control was assessed using HbA1c, an established measure of longer-term glycaemic status.

The study had some limitations. First, its cross-sectional design precluded causal inference; longitudinal studies are therefore recommended. Second, sleep quality was assessed using a self-reported questionnaire rather than objective measures such as polysomnography or actigraphy. In addition, some potentially relevant factors, including lifestyle behaviours and the number and types of medications used, were not assessed. Community-based cohort studies examining these and other factors may further clarify determinants of glycaemic control.

CONCLUSION

This study has revealed a prevalence of 48.0% of good glycaemic control and identified young age, higher income, good sleep quality, absence of comorbidities, good medication adherence, good dietary adherence and shorter duration of disease as factors associated with good glycaemic control. These findings are pertinent for clinicians, stakeholders and policy makers to recommend and execute targeted interventions at improving the rate of good glycaemic control and overall outcome of management of Type 2 diabetes mellitus.

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Availability of data and materials: The datasets for this study would be made available from the corresponding author on request.

Consent for publication: Not applicable.

Ethical consideration: Approval for this study was sought from the Ethics and Research Committee of the Federal Teaching Hospital, Ido-Ekiti (with approval number ERC/2024/08/13/1154A, dated 9th October, 2024) before commencement of the study

Consent to participate: Written informed consent either by appending signature or thumb print was obtained from each participant

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