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Assessment of Factors affecting Glycaemic Control among Adult Diabetics: Optimizing Care for Diabetic Patients

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ABSTRACT

Diabetes mellitus is a global health challenge. The aim of management of these patients is to achieve good glycaemic control thereby preventing complications and improving their quality of life. Elucidation of factors that will improve glycaemic control is therefore important. This study aimed to assess the factors that affect glycaemic control among type 2 diabetics (T2DM) attending the General Out-Patient Clinic (GOPC) of the Federal Medical Centre, Makurdi. This was a cross-sectional study of 359 diabetic patients aged 18 years and above who had been on treatment for at least three months. Informed consent was obtained. Data was collected by an interviewer-administered questionnaire. Data was analyzed with the Statistical Package for Social Sciences (SPSS) version 18. There were 180 males (50.1 %) and 179 females (49.9 %). The mean age of the patients was 56.05 ± 10.32 years. The proportion of those with good glycaemic control was 58%. The respondents' age, level of education, occupation, ethnicity, religion and average monthly income had statistically significant association with glycaemic control. Adequate physical activity was an independent predictor of good glycaemic control. More effort should be made on counselling type 2 diabetics on the importance of adequate physical activity.

***Keywords**: Diabetes mellitus, Glycaemic control.*

INTRODUCTION

Diabetes mellitus is a growing epidemic in both developed and developing countries.[1] The spectacular increase in the incidence and prevalence of this chronic disease is destined to have enormous impact on mortality, morbidity and health care resources.[1, 2] The International Diabetes Federation (IDF), in 2017, estimated that there were 425 million people worldwide living with diabetes, with 80% living in low and middle income countries.[1] This figure is expected to increase to 629 million by 2045.[1] Diabetes mellitus (DM) is the second leading cause of years of life lost to premature death and the fourth leading cause of years lived with disability.[3] Nigeria being the most populous African country has the highest number of people with diabetes in the African region.[1] For Nigeria, the prevalence of

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the IDF.[1]

Diabetes mellitus is the most common endocrine and metabolic disorder and has a profound influence on carbohydrate, lipid and protein metabolism.[3] Diabetes mellitus is a multisystem disease that requires multifaceted management approach with the aim of maintaining good glycaemic control.[1]

However, there is the challenge of achieving and sustaining optimal glycaemic state in order to forestall untoward alterations of the quality of life of these patients.[4] Many studies done have shown the importance of tight blood glucose control in preventing or delaying the progression of complications in DM patients.[5,6]

Diabetes is prevalent across all socio-economic strata, ethnic groups, age groups, weight categories, in individuals of various eating patterns and levels of physical activity.[1-3]

The acceptable levels of good glycaemic control has been defined to be fasting blood glucose of 70 - 130 mg/dL (3.9 – 7.2 mmol/L) and glycated haemoglobin (HbA1c) of < 7%.[3] Diabetes mellitus as a chronic disease and its long-term effect on the quality of life of affected individuals pose a huge burden on the patient, family and healthcare system.[1,7] Hence, there is need to address possible reasons for this trend to improve the overall wellbeing of these patients.

MATERIALS AND METHODS

This was a cross-sectional analytical study involving 359 diabetic patients aged 18 years and above who had been on treatment for at least three months and were selected by systematic sampling technique. The minimum sample size required was calculated using the Leslie and Kish formula for single proportion.[8]

$$N = Z^2pq/d^2$$

Where

N = Minimum sample size

Z = A constant at 95% confidence level = 1.96

p = Proportion in the target population estimated to have a particular characteristic of interest (which is good glycaemic control) in another study from Ilorin, Nigeria 36%.[9]

q = 1- p (ie 1 – 0.36) = 0.64

d = Desired precision of 5% = 0.05

$$N = \frac{1.96^2 \times 0.36 \times 0.64}{(0.05)^2} = 354$$

Since the total number of patients is < 10000, the sample size was corrected using the formula; [8]

$$nf = \frac{n}{1 + (n)/N}$$

Where

n_f is desired sample size for a population < 10000.

n is the desired sample size for a population > 10000 which is 354.

N is total number of diabetic patients which is 4116.

$$nf = \frac{354}{1 + 354/4116} = 326 \text{ patients}$$

When 10% of the minimum sample size (326) for anticipated non-response, incompletely filled data and missing questionnaires was added (32.6), the sample size was 359 patients.

All patients who presented were given health education on regular eye check, foot care, nutrition, alcohol moderation and avoidance of smoking. Those who were very ill and pregnant women were excluded. Ethical clearance was obtained from the Ethical committee of FMC, Makurdi. Data was collected by interviewer-administered questionnaire. Fasting blood glucose assay was done for all respondents. The data was analyzed with the Statistical Package for Social Sciences (SPSS) version 18.

RESULTS

Table 1 shows respondents' socio-demographic characteristics. The age range of the respondents was 35-77 years. The mean age of the respondents was 56.05 ± 10.32 years. The distribution of males (50.1%) and females (49.9%) was close. Most of the respondents were married (n=239, 66.6%). Slightly more than four-fifths of the respondents had either secondary education (n=113, 31.5%) or tertiary education (n=182, 50.7%). On occupation, the highest proportion were the unskilled (n=100, 27.9%), while skilled workers had the least frequency (n=18, 5%)

Table 1 Socio-demographic characteristics of the respondents (n=359)

Socio-demographic characteristics	Frequency	Percent
Age (in years)		
35-44	46	12.8
45-54	118	32.9
55-64	131	36.5
65-74	47	13.1
75-84	17	4.7
Mean(SD)= 56.05 (10.32)		
Gender		
Male	180	50.1
Female	179	49.9
Marital status		
Single	16	4.5
Married	239	66.5
Separated	24	6.7
Divorced	2	0.6
Widowed	69	19.2
Co-habiting	9	2.5
Level of education		
None	9	2.5
Primary	55	15.3
Secondary	113	31.5
Tertiary	182	50.7

**others includes, Yoruba, Igbo, Hausa etc.*

Table 1 Continued

Table 1 Socio- demographic characteristics of the respondents (n=359)

Socio - demographic characteristics	Frequency	Percent
Occupation		
Professional	23	6.4
Clerical	66	18.4
Artisan	31	8.6
Skilled	18	5.0
Semiskilled	31	8.6
Unskilled	100	27.9
Unemployed	90	25.1
Ethnicity		
Tiv	150	41.8
Idoma	106	29.5
Igede	32	8.9
Others*	71	19.8
Religion		
Christianity	326	90.8
Islam	32	8.9
Traditional	1	0.3
Average monthly income in Naira (₦)		
Less than 18,000	49	13.6
18,000-58,999	177	49.4
59,000-99,999	77	21.4
100,000 and above	56	15.6

**others includes, Yoruba, Igbo, Hausa etc.*

Most of the respondents were Tiv (n=150, 41.8 %) and majority of the participants were Christians (n=326, 90.8 %). Nearly half (n=177, 49.3 %) of the total population earned between ₦ 18,000 and ₦58,999.

Table 2. Relevant diabetes history and blood pressure status of the respondents

Variables	Frequency	Percent
Family history of diabetes (years)		
Yes	195	54.3
No	164	45.7
Duration of diabetes diagnosis (years)		
<1	26	7.2
1-5	187	52.1
6-10	107	29.8
>10	39	10.9
Duration on medication(s) in years		
<1	54	15.0
1-5	223	62.1
6-10	65	18.1
>10	17	4.7
Number of medication(s)		
One medication	220	61.3
Two medications	134	37.3
Three medications	5	1.4
Current smoking status		
Yes	50	13.9
No	309	86.1
Category of alcohol intake		
No intake	220	61.3
Significant	27	7.5
Not significant	112	31.2
Category of physical activity		
Adequate	124	34.5
Inadequate	235	65.5
Blood pressure status		
Normal	309	86.1
Hypertensive	50	13.9

Table 2 describes the relevant diabetes history, category of physical activity and blood pressure status of the study participants. More than half of the subjects had family history of diabetes (n=195, 54.3%). Nearly two-thirds of the respondents had been taking medications for between one and five years (n= 223, 62.1%). Most were taking one type of medication (n=220, 61.3%). Slightly more than half of the respondents had been diagnosed with diabetes between one and five years before the study (n= 187, 52.1%).

A vast majority of the respondents did not smoke cigarette (n=309, 86.1 %). More than half of the participants did not ingest alcohol (n= 220, 61.3%). Adequate physical activity was found in slightly above a third of the respondents (n=124, 34.5%).

Glycaemic Control Status of the Respondents

Figure 1 shows that 208 (58%) of the participants had good glycaemic control.

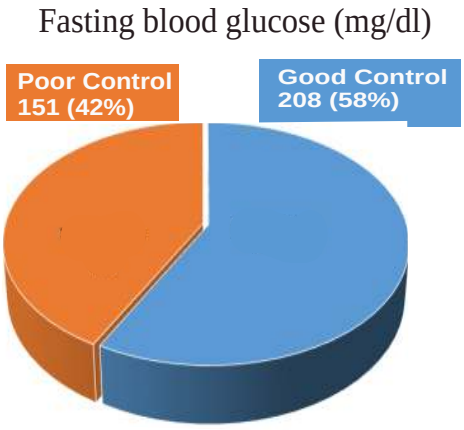

Figure 1. A pie chart showing the glycaemic control status of the respondents

Table 3. Association between socio -demographic variables and glycaemic control

Socio-demographic characteristics	Fasting blood glucose		Test statistics	Df	P-value
	Good control n=208 n (%)	Poor control n=151 n (%)			
Age (in years)+			χ^2=15.83	4	0.003*
35-44	29(63.0)	17(37.0)			
45-54	81(68.6)	37(31.4)			
55-64	72(55.0)	59(45.0)			
65-74	17(36.2)	30(63.8)			
75-84	9(52.9)	8(47.1)			
Gender+			χ^2=2.72	1	0.099
Male	112(62.2)	68(37.8)			
Female	96(53.6)	83(46.4)			
Marital status			Fisher's exact=6.06	5	0.281
Single	11(68.8)	5(31.3)			
Married	134(56.1)	105(43.9)			
Separated	18(75.0)	6(25.0)			
Divorced	1(50.0)	1(50.0)			
Widowed	37(53.6)	32(46.4)			
Co-habiting	7(77.8)	2(22.2)			
Level of education+			χ^2=17.81	3	<0.01*
None	5(55.6)	4(44.4)			
Primary	25(45.5)	30(54.5)			
Secondary	53(46.9)	60(53.1)			
Tertiary	125(68.7)	57(31.3)			
Occupation+			χ^2=28.84	6	<0.01*
Professional	18(78.3)	5(21.7)			
Clerical	45(68.2)	21(31.8)			
Artisan	21(67.7)	10(32.3)			
Skilled	10(55.6)	8(44.4)			
Semiskilled	22(71.0)	9(29.0)			
Unskilled	60(60.0)	40(40.0)			
Unemployed	32(35.6)	58(64.4)			
Ethnicity+			χ^2=8.76	3	0.033*
Tiv	82(54.7)	68(45.3)			
Idoma	73(68.9)	33(31.1)			
Igede	14(43.8)	18(56.3)			
Others*	39(54.9)	32(45.1)			
Religion+			Fisher's exact=7.31	2	0.011*
Christianity	196(60.1)	130(39.9)			
Islam	12(37.5)	20(62.5)			
Traditional	0(0.0)	1(100.0)			
Average monthly income in Naira (₦)+			χ^2=11.96	3	0.008*
Less than 18,000	18(36.7)	31(63.3)			
18,000-58,999	104(58.8)	73(41.2)			
59,000-99,999	48(62.3)	29(37.7)			
100,000 and above	38(67.9)	18(32.1)			

***significant** + eligible for input in logistic regression model ($p < 0.1$)

Table 3 depicts the bivariate analysis of the socio-demographic characteristics of the participants and glycaemic control. Those aged 45-54 years (68.6%, n=81) had the highest proportion of glycaemic control. The prevalence of good glycaemic control was higher in the male respondents. Those with tertiary education had the highest prevalence of good glycaemic control. Respondents with the highest prevalence of good glycaemic control were the professionals.

Table 4 shows the association between respondents' relevant diabetes history, blood pressure status and fasting blood glucose control. Participants with adequate physical activity had higher prevalence of good glycaemic control (76.6%, n=95). Respondents with normal blood pressure had a higher prevalence of good glycaemic control (61.5%, n=190).

Table 4. Relationship between relevant diabetes history, blood pressure status and glycaemic control

Variables	Fasting blood glucose				
	Good control n=208 n (%)	Poor control n=151 n (%)	Test statistics	Df	P-value
Family history of diabetes			χ^2=0.42	1	0.517
Yes	116(59.5)	79(40.5)			
No	92(56.1)	72(43.9)			
Duration of diabetes diagnosis (years)+			χ^2=11.11	3	0.011*
<1	15(57.7)	11(42.3)			
1-5	123(65.8)	64(34.2)			
6-10	53(49.5)	54(50.5)			
>10	17(43.6)	22(56.4)			
Duration on medication(s) in years+			χ^2=6.94	3	0.074
<1	33(61.1)	21(38.9)			
1-5	137(61.4)	86(38.6)			
6-10	32(49.2)	33(50.8)			
>10	6(35.3)	11(64.7)			
Number of medication(s)+			χ^2=9.47	2	0.009*
One medication	137(62.3)	83(37.7)			
Two medications	66(49.3)	68(50.7)			
Three medications	5(100.0)	0(0.0)			
Current smoking status			χ^2=2.36	1	0.125
Yes	24(48.0)	26(52.0)			
No	184(59.5)	125(40.5)			
Category of alcohol intake			χ^2=0.58	2	0.749
No intake	127(57.7)	93(42.3)			
Significant	14(51.9)	13(48.1)			
Not significant	67(59.8)	45(40.2)			
Category of physical activity+			χ^2=27.11	1	<0.01*
Adequate	95(76.6)	29(23.4)			
Inadequate	113(48.1)	122(51.9)			
Blood pressure status+			χ^2=11.47	1	0.001*
Normal	190(61.5)	119(38.5)			
Hypertensive	18(36.0)	32(64.0)			

***significant** + eligible for input in logistic regression model (p < 0.1)*

Table 5: Logistic regression model of independent variables predicting glycaemic control

Variable	Adjusted odds ratio (aOR)	95% confidence interval (CI)	P-value
Age (in years)			
35-44*	1.00		
45-54	1.49	0.50 – 4.46	0.47
55-64	1.12	0.34 – 3.63	0.86
65-74	0.93	0.21 – 4.00	0.92
75-84	2.92	0.44 – 19.57	0.27
Gender			
Male	0.73	0.41 – 1.32	0.30
Female*	1.00		
Level of education			
None*	1.00		
Primary	0.63	0.12 – 3.35	0.59
Secondary	0.51	0.10 – 2.57	0.41
Tertiary	1.14	0.21 – 6.14	0.88
Occupation			
Professional	3.17	0.56 – 17.80	
Clerical	1.64	0.44 – 6.14	0.46
Artisan	1.36	0.35 – 5.21	0.65
Skilled	0.54	0.13 – 2.34	0.41
Semiskilled	2.06	0.60 – 7.16	0.25
Unskilled	1.20	0.47 – 3.07	0.71
Unemployed*	1.00		0.47
Ethnicity			
Tiv	0.65	0.29 – 1.46	0.30
Idoma	1.55	0.66 – 3.60	0.31
Igede	0.57	0.187 – 1.71	0.31
Others*	1.00		0.48
Religion			
Christianity*	1.00		
Islam	0.57	0.20 – 1.58	0.28
Traditional	0.00		1.00
Average monthly income Naira(₦)			
Less than 18,000*	1.00		
18,000-58,999	0.91	0.33 – 2.49	0.85
59,000-99,999	0.82	0.25 -2.63	0.73
	0.52	0.13 – 2.11	0.36

** Reference group*

Table 5 Continued

Logistic regression model of independent variables predicting glycaemic control

Variables	Adjusted odds ratio (aOR)	95% confidence interval (CI)	P-value
Duration of diabetes diagnosis(years)			
<1	0.55	0.10 – 3.00	0.49
1-5	0.76	0.21 – 2.78	0.68
6-10	0.63	0.20 – 2.03	0.44
>10*	1.00		
Duration on medication (years)			
<1	9.98	1.33 – 74.76	0.03+
1-5	9.13	1.55 – 53.72	0.01+
6-10	8.49	1.60 – 45.13	0.01+
>10*	1.00		
Number of medication(s)			
One medication	0.00		0.99
Two medications	0.00		0.99
Three medications	1.00		
Category of physical activity			
Adequate	1.77	1.96 -3.27	0.01+
Inadequate*	1.00		
Blood pressure status			
Normal	2.01	0.92 – 4.40	0.08
Hypertensive*	1.00		

** Reference group + statistically significant*

Table 5 is a logistic regression analysis done to determine the independent predictors of glycaemic control amongst the study participants.T hose aged 75-84 years were nearly three times more likely to have good glycaemic control. Men were less likely to have good glycaemic control compared to females. Those with tertiary education were more likely to achieve good glycaemic control. The odds of having good glycaemic control was higher among those whose occupation was in the professional cadre (aOR = 3.17, CI = 0.56 – 17.80, p = 0.19). The odds of achieving good glycaemic control decreased as the average monthly income of the respondent increased. The odds of having good glycaemic control was higher among those with adequate physical activity.

DISCUSSION

Variations in glycaemic control have been reported in several studies, hence this study. The age range of the respondents was 35-77 years and the mean age of the respondents was 56.05 ± 10.32 years. The mean age of the respondents could be attributed to the fact that diabetes is more commonly diagnosed in middle-aged and elderly individuals.[10] There was an almost equal distribution of males (50.1%, n=180) and females (49.9%, 179).

The prevalence of good glycaemic control among the study participants was 58%. This is lower than 64% and 86.1% respectively obtained from a multicentre observational epidemiological study in Russia and a nationwide stratified multistage study in the United States.[11,12] The poor state of health care system in

Nigeria compared to Russia and the United States which are developed countries with better health system, may account for the disparity in good glycaemic control. Other findings from studies on prevalence of good glycaemic control among type two diabetics include Saudi Arabia (25.1%)[7] and Cameroun (26%).[13]

The prevalence of glycaemic control of 58% obtained in this study was close to 61.7% obtained from a cross sectional study of 120 type 2 DM patients at a primary care clinic in Umuahia, Nigeria.[14] Otekiewebia and colleagues in a cross-sectional study among 98 T2DM patients attending the Family Medicine clinic at a tertiary hospital in Lagos, Nigeria reported a higher proportion of good glycaemic control at 75.5%.[15] These levels of good glycaemic control may be because the patients were cared for in tertiary hospitals by likely multidisciplinary specialists who can contribute their knowledge to the patient's care.

There was a statistically significant relationship on bivariate analysis between the age of the respondents and glycaemic control. Those aged 45-54 years had the highest prevalence of good glycaemic control compared to other age groups. This may be because those aged 45-54 may be actively working at their various occupations and may be more financially buoyant to afford medical care, hence the finding in this study. On multivariate analysis, those aged 75-84 years were nearly three times more likely to have good glycaemic control but it was not statistically significant. This is in tandem with some studies done in China[16] and Palestine[17] where those that were much older had higher likelihood of achieving good glycaemic control but is at variance with the finding from a study conducted in Fiji.[18] The probable reason for the present finding may be because older persons have more maturity to follow their physicians' counselling on self-care practices.

Gender exhibited no significant association with glycaemic control on bivariate analysis. Females were found to have lower prevalence of good glycaemic control compared to males in this study. This finding was in consonance with observations in Russia[12] and Palestine[17] where females had lower prevalence of good glycaemic control. Gender-related differences in body fat distribution and hormones, as well as slower glucose absorption in women, may contribute to this finding among females.[19, 20] Gender inequalities in the society where most women may not be empowered financially to take adequate care of their health needs or may want to put the needs of family members first before theirs may also account for this finding. A reverse scenario has been reported from studies in Brazil [21] and Turkey[22] where higher prevalence of good glycaemic control was found among females. This may be due to better health-seeking behaviour among women. Marital status showed no statistically significant association with glycaemic control in the present study. This was unlike the finding by Kayar and colleagues who had a statistically significant relationship between being married and good glycaemic control.[22]

The level of education showed a statistically significant relationship with glycaemic control on bivariate analysis. Those with tertiary education were more likely to achieve good glycaemic control but it was not statistically significant on multivariate analysis and shared the same outcome with some studies.[22, 23] A possible reason for this present finding may be a tendency for people with a higher educational level to be able to understand treatment regimens and adjuncts to care. On the contrary, studies in China and Brazil found no such association.[16, 21]

Occupation showed statistically significant association with glycaemic control corroborating with studies in United States,[11] and Abuja, Nigeria.[24] The odds of having good glycaemic control was slightly more than three times higher among those whose occupation was in the professional cadre. This may be because the professionals may be more educated and more financially buoyant, and hence be able to afford care.

Ethnicity showed a statistically significant relationship with good glycaemic control. The Idoma respondents were more likely to achieve glycaemic control. A State-

wide (Benue State) study may give more information on this finding. Nevertheless, ethnicity/race has been found to have impact on diabetic outcomes. Heidemann and colleagues revealed that race was an independent risk factor for controlling glycaemic index.[25]

Religion showed a statistically significant association with glycaemic control. Christians had a higher proportion of good glycaemic control which may have been due to their higher prevalence in the study population. However, certain religious rites such as fasting may affect diabetes management. Amadi and colleagues found that diabetics with religious beliefs had higher proportion of good glycaemic control than those with none.[26] Such religious benefits can have effect on glycaemic control as it can serve as coping mechanism.

There was a statistically significant relationship between average monthly income and glycaemic control which is dissimilar with a study in Abuja, Nigeria.[24] The odds of achieving good glycaemic control decreased as the average monthly income of the respondent increased. This trend may be attributed to unhealthy eating pattern and low level of physical activity by those with high income.

In this study, there was no association between family history of T2DM and glycaemic control. The reason for this may be because all the participants were regular with their clinic visits and received similar counselling on lifestyle modification and adherence. Alzaheb and colleagues found a substantially greater risk of poor glycaemic control in those having a family history of T2DM.[7] The odds of having good glycaemic control was higher in people who had been diagnosed for longer duration (> 10 years). This may be because those diagnosed for longer duration may have more knowledge of their management regimen over time and hence achieve good glycaemic control.

In this study, the odds of having good glycaemic control was higher among those using three anti-diabetic medications. This may be because those who may need three anti-diabetic medications may be more careful to follow their management regimen because of fear of further worsening of their health.

Smoking showed no association with glycaemic control in this present study. Pan *et al* identified smoking as one of the significant predictors of good glycaemic control.[27] The reason for the present finding may be because only current smoking status was assessed. Duration and quantity of smoking was not considered. In tandem with the finding by Jialin and colleagues, hypertension adversely affected glycaemic control in this study.[16] In the present study, those who had normal blood pressure were twice likely to achieve good glycaemic control. Hypertension as a comorbidity may make it difficult for patients to achieve good glycaemic control due to increased health costs.

Adequate physical activity was an independent predictor of good glycaemic control. The odds of having good glycaemic control was nearly two times more among those with adequate physical activity compared to those with inadequate physical activity. The reason for this finding may be improved glucose metabolism through activation of glucose transport.[28]

Diabetes mellitus continues to pose a health burden in the society. These findings can contribute to the care of the patients.

CONCLUSION

Adequate physical activity has been identified in this study to be an independent predictor of good glycaemic control.

Recommendation: Physicians should increase counselling on adequate physical activity when managing these patients.

Limitation: There may have been recall bias by some of the respondents. Like other cross-sectional designs where exposures and outcomes are measured at the same time, there is inherent weakness or difficulty in ascertaining temporal relationship.

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