Open Access

SCHOLARENA

SAJ Pharmacy and Pharmacology

RESEARCH ARTICLE

ISSN: 2375-2262

Glycemic Control and Its Determinants among Patients with Type 2 Diabetes in a Specialist Hospital in Northeast, Nigeria

David EA[1*], Aderemi-Williams RI[2], Soremekun RO[2], Nasiru IY[3] and Auta A[4]

[1]*Department of Clinical Pharmacy and Pharmacy Practice, Gombe State University, Nigeria*
[2]*Department of Clinical Pharmacy and Biopharmacy, University of Lagos, Nigeria*
[3]*Pharmacy Department, University of Maiduguri Teaching Hospital, Borno, Nigeria*
[4]*School of Pharmacy and Biomedical Sciences, University of Central Lancashire, Fylde Road, Preston, PR1 2HE, England*

[*]**Corresponding author:** David EA, Department of Clinical Pharmacy and Pharmacy Practice, Gombe State University, Nigeria, Tel: +2348039681589, E-mail: emmagada@yahoo.co.uk

Citation: David EA, Aderemi-Williams RI, Soremekun RO, Nasiru IY, Auta A (2019) Glycemic Control and Its Determinants among Patients with Type 2 Diabetes in a Specialist Hospital in Northeast, Nigeria. SAJ Pharma Pharmacol 6: 105

Abstract

Background: Nigeria currently bears the highest burden of diabetes in Africa. Strict glycemic control is an important strategy employed to delay disease progression and/or prevent complications.

Objectives: To assess glycemic control and its determinants among patients with Type 2 Diabetes Mellitus.

Methods: A retrospective review of patient records, conducted at Gombe State Specialist Hospital, Northeast Nigeria, between May and August, 2018, to assess the level of glycemic control and its determinants among ambulatory type 2 diabetic patients. Descriptive and inferential analyses were performed and p-value < 0.05 was considered significant.

Results: Of the 385 folders assessed, majority (62.6%) were female, and married (95%). Mean age and Body Mass Index were 54years (18-88) and 26.1kg/m2 (11.72-44.92) respectively. About 50% of the patients were overweight and obese, 50.1% had poor glycemic control (FPG <3.9mmol/L and >7mmol/L). Factors associated with glycemic control included marital status (p = 0.016), educational status (p = 0.044), level of physical activity (p = 0.007) and Body Mass Index (p = 0.048). Patients who were married, educated, and engaged in moderate physical activity were more likely to have good glycemic control compared to general population.

Conclusion: Half of the population had poor glucose control, with associated obesity, low education and activity levels. Educational and lifestyle interventions are recommended to address factors associated with poor glucose control in Gombe metropolis.

Keywords: Glycemic Control, Type 2 Diabetes Mellitus, Fasting Blood Glucose, Nigeria

Introduction

Nigeria currently has the highest burden of diabetes mellitus in Africa. The World Health Organization [1] reported that about five million (5,000,000) Nigerians, aged 20 to 79 years had diabetes mellitus in 2015, while 40,815 deaths occurred in the same year [1]. The prevalence is expected to increase, especially in low- and middle-income countries like Nigeria [1,2], due to rapid, unrestrained urbanization, nutrition transition, increased sedentary lifestyles and decreased physical activity [3]. Diabetes was previously rare in Nigeria, but the prevalence has risen from 2.2% to 5%, between 1997 and 2013 respectively [4,5]. A recent systematic review and meta-analysis conducted by Adeloye and collegues in 2017 to estimate the prevalence of T2DM in Nigeria reported that 5.8% of the population had diabetes mellitus [6], suggesting that the predictions of higher prevalence in low- and middle-income countries in the future may be true.

Type 2 diabetes mellitus (T2DM) is the most prevalent form of diabetes, affecting over 90% of diabetes population [7]. It was previously known as non-insulin dependent or adult-onset diabetes mellitus [8], usually characterized by sufficient insulin secretion, but poor utilization by body cells, resulting in insulin resistance [9]. This cascade of events finally causes persistent hyperglycemia and other associated complications, if not promptly diagnosed and properly managed. There are well defined medications in addition to non-pharmacologic strategies for managing T2DM and an overwhelming body of evidence exist in favor of a positive correlation between good glycemic control and reduction in micro vascular and macro vascular complications

among diabetic patients [10]. However, it is unfortunately true that majority of patients with T2DM have poor glycemic control, which often result in preventable complications [8,11-13].

A study conducted at Jazan city, kingdom of Saudi Arabia, comprising of 288 patients with T2DM from different primary health centres reported 74% poor glycemic control, with lack of education, polypharmacy and duration of diabetes as factors responsible for higher glucose levels in the studied population [14]. Another study conducted by Nduati and his colleagues at the Mathari National Teaching Hospital, Nairobi, Kenya, to assess factors associated with glycemic control among patients with T2DM found that a total of 122 participants, representing 81.6% had poor glucose control and the presence of comorbidities was associated with glycemic control [15]. Poor glycemic control was reported in 59.2% of patients in a study conducted by Yigazu and Desse in Southwest, Ethiopia. They also found that level of education and duration of diabetes were significantly associated with glycemic control, while adherence to regular follow up and therapy were independent predictors of glycemic control among patients with T2DM [16]. Furthermore, two recent studies conducted in India reported prevalence of poor glycemic control of 63% and 91.8% respectively, among patients with T2DM and lack of adherence to nutrition and exercise, inadequate knowledge of disease and management, obesity/Body Mass Index (BMI) and diabetes self-care practices as factors associated with poor glucose control [17,18], while researchers from Palestine and another Ethiopian study reported poor glycemic control of 80% and 70.9% respectively, with age, medication adherence, literacy level being significantly associated with glycemic control [19,20].

It is interesting to note that the studies above all reported high prevalence of poor glycemic control (59.2-91.8%), except a longitudinal National Health and Nutrition Examination Survey, conducted in the United States between 2007 and 2010, which reported a prevalence of 12.9% poor glycemic control [21]. Such commendable proportion of good glycemic control (87.1%) may be attributed to availability and access to primary care, better knowledge level, presence of functional health insurances and uniformity in assessing glycemic control [21-23].

Studies designed to assess the level of blood glucose control and associated factors among T2DM patients in Nigeria are relatively scanty. A recent study by Ufuoma and colleagues in Warri, Delta State, South-south Nigeria [24] estimated 58% poor glycemic control among diabetic patients and reported duration of diabetes and inadequate knowledge as factors associated with poor glycemic control. Other studies carried out in Ibadan, South-west and Enugu, South-east Nigeria [25,26] reported lower proportions of poor glycemic control (34-45%), with the exception of a study conducted in a secondary care facility in Ibadan, South-west Nigeria, which reported a poor glycemic control in 65.7% of patients [27] and another study conducted at the Federal Medical Centre, Ado-Ekiti, South-west Nigeria by Ajayi, *et al.* [28], where glycemic control was attained in only 29.3% and 32.5% of patients respectively, using IDF-Europe and ADA criteria, implying that there was poor glycemic control in 70.7% and 67.5% of the diabetic population. Factors associated with glycemic control in the studies above and others conducted by Unadike, *et al.* (South-south, Nigeria), Olayemi and Osazuwa, (South-west, Nigeria), Edah, *et al.* (North central, Nigeria) and Modupe, (South-west, Nigeria), include level of education, duration of diabetes, presence of comorbidities, medication adherence, poor clinic attendance, self-care practice, mental and psychosocial health problems [24,28-32]. It is worthy of note that there is paucity of studies in Nigeria aimed at assessing the prevalence of glycemic control and this is even worse in northern Nigeria. Moreover, of the few studies conducted in the South-west, South-south and South-east [33] of the country, only the study by Ajayi, *et al.*, had up to 300 participants. Ufuoma [27], Edah [31] Modupe [32] and Ngwogu [33] had 200, 180, 80 and 120 patients respectively. Finally, although the study by Edah and colleagues [31] was conducted in Jos, plateau state, North central Nigeria, the focus was to assess self-monitoring of blood glucose. Thus, this study is the first to the best our knowledge to assess glycemic control and its determinants in a cohort of patients attending a diabetes clinic in northern Nigeria and using data of 385 patients.

Methods

Study design and setting

This is a retrospective review of ambulatory diabetic patients' records, conducted at Gombe State Specialist Hospital, Gombe, Northeast Nigeria, to assess the level of glycemic control and associated factors among patients with T2DM. The specialist hospital is the largest state owned health facility in the state, with different clinical units/departments and wards, serving as a referral hospital to the eleven General Hospitals and several primary health care centers in Gombe state. The Specialist Hospital is located at the heart of the state capital and the diabetic clinic holds every Friday.

Participants

Patient records were assessed for relevant information and those with T2DM for more than six months, consistent clinic attendance, on anti-diabetic medications and 18 years and above were selected, while patients with incomplete data, pregnant and type 1 diabetes were excluded from the study.

Patients' folder selection

We hypothesized that 50% of the diabetes population would have poor blood glucose control and thus estimated a sample size of 384. Using simple random sampling method, a total of 385 patient medical records/folders were recruited.

Data collection

Data collection proforma specifically designed for the study was used to collect patient information from eligible folders between May and August, 2018. The information collected include patients' socio-demographic and clinical characteristics comprising of age, gender, weight, height, marital status, level of education, occupation, rate of alcohol consumption and smoking status, family history of diabetes, duration of diabetes, level of physical activity, presence of comorbidities such as hypertension and dyslipidemia, Body Mass Index (BMI), fasting blood glucose and medication history. Level of education was categorized into No Formal Education (NFE), Primary/Secondary and Tertiary, level of activity was classify into low (less than 50 minute per week), moderate (between 50 and 100 minutes per week) and regular (150 minutes per week), BMI was classified as underweight (<18.5kg/m^2), normal weight (18.5-24.9 kg/m^2), Overweight (25-29.9 kg/m^2) and Obese (BMI ≥30 kg/m^2) [34], hypertension is defined as systolic blood pressure (sBP) >140 mmHg, and/or diastolic blood pressure (dBP) >90 mmHg (JNC 8), or taking blood pressure lowering medications and classified as follows: Pre-hypertension: sBP 120-139 mmHg or dBP 80-89 mmHg, Hypertension: sBP ≥140 mm Hg or dBP ≥90mmHg, Stage-I hypertension: sBP ≥140≤160 mmHg or dBP ≥90 ≤100 mmHg, Stage-II hypertension: sBP ≥160 mmHg and/or dBP ≥100 mmHg [35] and fasting blood glucose was defined based on the American Diabetes Association classification or patient taking anti-diabetic medication(s): Fasting plasma glucose (FPG) > 126mg/dL (7.0mmol/L) [8].

Ethical considerations

An application was submitted to and approved by the research and ethics committee of Gombe State Ministry of Health before the commencement of the study and all patient information collected were anonymous handled with absolute confidentiality.

Data management

The data collected were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. Continuous data were expressed in means and range values, while categorical variables were described in frequencies and percentages. The major dependent variable (fasting blood glucose) was tested for association using bivariate regression analysis and factors with p-value less than 0.05 were included in a multivariate regression analysis to identify predictors of glycemic control in the studied population.

Results

Factors	Frequency (n)	Percent (%)
Gender		
Male	144	37.4
Female	241	62.6
Age		
< 40	44	11.4
≥40	341	88.6
Marital Status		
Single	19	4.9
Married	366	95.1
Educational Status		
No formal education (NFE)	193	50.1
Primary/Secondary	100	26.0
Tertiary	92	23.9
Occupation		
Unskilled worker	170	44.2
Skilled worker	95	24.7
Student	15	3.9
No paid worker	105	27.3
Alcohol Consumption		
Occasional/None	385	100.0
Physical Activity Status		
Low	119	30.9
Moderate	168	43.6
Regular	98	25.5
Family history of Diabetes		
No	243	63.3

Factors	Frequency (n)	Percent (%)
Yes	141	36.7
BMI status		
Underweight	16	4.2
Normal weight	172	44.7
Overweight	124	32.2
Obese	73	19.0
Comorbid with Hypertension		
No	56	14.5
Yes	329	85.5

Table 1: Socio-demographic and clinical characteristics of patients with T2DM at GSSH

Factor	N	Minimum	Maximum	Mean ± SEM
Age (Yrs)	385	18.00	88.00	54.07 ± 0.69
Weight (Kg)	385	30.00	115.00	69.35 ± 0.74
Body Mass Index (Kg/m^2)	385	11.72	44.92	26.10 ± 0.28
Duration of Diabetes (Yrs)	385	.58	26.00	7.15 ± 0.23

Table 2: Descriptive Statistics of Selected Background Variables

Status	FPG (mmol/L)	Frequency(n)	Percent (%)	Cumulative Percent (%)
Hypoglycemic	< 3.9	30	7.8	7.8
Normal	3.9 – 7.0	192	49.9	57.7
Hyperglycemic	>7.0	163	42.3	100.0
Total		385	100.0	

Table 3: Glycemic Status of T2DM Patient at GSSH

Class of Drug	Frequency (n)	Percent (%)
Anti-diabetic medications	373	96.9
Blood Pressure Medications	340	88.3
Lipid Lowering Medications	17	4.4
Other medications	308	80.0

Table 4: Pattern of class of drug prescribed

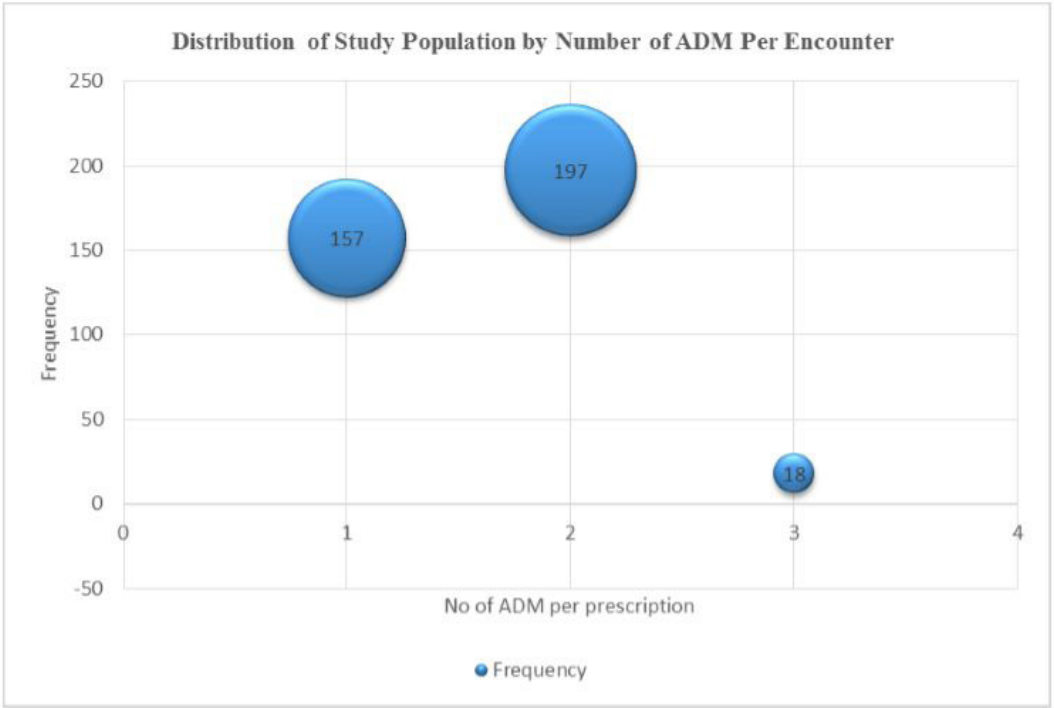

Figure 1: Distribution of patients by number of ADM per encounter

Factors	Total	F (%) with control	COR (95 % CI)	*P value*
Gender				
Male	144	69 (47.90)	Reference	
Female	241	123 (51.0)	1.133 (0.750 – 1.713)	.554
Age				
< 40	44	20 (45.5)	Reference	
≥40	341	172 (50.4)	1.221 (0.650 – 2.294)	.534
Marital Status				
Single	19	4 (21.1)	Reference	
Married	366	188 (51.4)	3.961 (1.290 – 12.161)	.016*
Educational Status				
No formal education (NFE)	193	86 (44.6)	Reference	
Primary/Secondary	100	57 (57.0)	1.649 (1.013 – 2.684)	.044*
Tertiary	92	49 (53.3)	1.418 (0.861 – 2.334)	.170
Occupation				
Unskilled worker	170	86 (50.6)	1.170 (0.406 – 3.370)	.771
Skilled worker	95	46 (48.4)	1.073 (0.360 – 3.195)	.899
Student	15	7 (46.7)	Reference	
No paid worker	105	53 (50.5)	1.165 (0.394 – 3.444)	.783
Physical Activity Status				
Low	119	48 (40.3)	Reference	
Moderate	168	95 (56.5)	1.925 (1.195 – 3.100)	.007*
Regular	98	49 (50.0	1.479 (0.863 – 2.537)	.155
Family history of Diabetes				
No	243	120 (49.4)	Reference	
Yes	141	72 (51.1)	1.070 (0.706 – 1.620)	.751
BMI status				
Underweight	16	10 (62.5)	3.013 (0.983 – 9.232)	.054
Normal weight	172	85 (49.4)	1.766 (1.004 – 3.106)	.048*
Overweight	124	71 (57.3)	2.422 (1.333 – 4.398)	.004*
Obese	73	26 (35.6)	Reference	
Comorbid with Hypertension				
No	56	29 (51.8)	1.094 (0.620 – 1.920)	.757
Yes	329	163 (49.5)	Reference	
Duration of Diabetes (yrs.)				
< 5	121	67 (55.4)	1.380 (0.895 – 2.126)	.144
≥ 5	264	125 (47.3)	Reference	
No of ADM				
One	157	95 (60.5)	2.194 (1.431 – 3.366)	.001*
Two	197	81 (41.1)	Reference	
Three	18	9 (50.0)	1.432 (0.545 – 3.765)	.466
Lipid lowering medication				
No	368	182 (49.5)	Reference	
Yes	17	10 (58.8)	1.460 (0.544 – 3.918)	.453

*Factors with significant association with good glycemic control

Table 5: Factors Influencing Glycemic Control

Factors	Total	F (%) with control	AOR (95 % CI)	*P value*
Marital Status				
Single	19	4 (21.1)	Reference	
Married	366	188 (51.4)	4.816 (1.486 – 15.610)	.009*
Educational Status				

Factors	Total	F (%) with control	AOR (95 % CI)	*P value*
No formal education (NFE)	193	86 (44.6)	Reference	
Primary/Secondary	100	57 (57.0)	1.951 (1.138 – 3.344)	.015*
Tertiary	92	49 (53.3)	1.666 (0.970 - 2.862)	.064
Physical Activity Status				
Low	119	48 (40.3)	Reference	
Moderate	168	95 (56.5)	1.785 (1.057 – 3.015)	.030*
Regular	98	49 (50.0	1.474 (0.821 – 2.646)	.193
BMI status				
Underweight	16	10 (62.5)	3.848 (1.157 - 12.805)	.028*
Normal weight	172	85 (49.4)	2.146 (1.126 - 4.090)	.020*
Overweight	124	71 (57.3)	3.133 (1.576 - 6.225)	.001*
Obese	73	26 (35.6)	Reference	
Duration of Diabetes (yrs.)				
< 5	121	67 (55.4)	1.549 (0.985 – 2.505)	.074
≥ 5	264	125 (47.3)	Reference	
No of ADM				
One	157	95 (60.5)	2.090 (1.325 – 3.298)	.002*
Two	197	81 (41.1)	Reference	
Three	18	9 (50.0)	1.741 (0.611 – 4.963)	.299
Lipid lowering medication				
No	368	182 (49.5)	Reference	
Yes	17	10 (58.8)	4.223 (1.331 -13.400)	.014*

*Predictors of good glycemic control

Table 6: Predictors of Glycemic Control

Discussion

Strict glycemic control is an important and a foremost strategy in the management of patients with T2DM, to prevent or delay disease progression and reduce the risk of developing diabetes complications. In this study, we assessed the level of glycemic control and its determinants among ambulatory patients with T2DM in Gombe State Specialist Hospital, Northeast Nigeria. The prevalence of poor glycemic control in the current study was 50.1%, which is comparable to results of studies previously carried out in other parts of the country [24-33], with poor glucose control ranging from 34% to 70.1%. This may be due to similarity in socio-demographic characteristics of urban settings in Nigeria, irrespective of whether it is located in the Southern or Northern part of the country. Negligible differences may exist in the literacy level, health-seeking behaviors and purchasing power by urban dwellers. The reported prevalence of poor glycemic control in studies conducted in Jazan City (Kingdom of Saudi Arabia), Kenya, Palestine, Ethiopia and India were 74%, 81.6%, 80%, 59-70.9% and 63-91.8% respectively [14-20], which are quite higher than the prevalence observed in our study. Study setting, design, and use of glycated haemoglobin (A1C) as a more reliable measure, sample size, and other demographic characteristics may have accounted for differences observed in our results and reports from the countries mentioned above. In contrast, the poor glucose control among T2DM in our study was about four times higher than a 3 years report (2007-2010) of a study conducted in the United States of America, which reported 12.9% poor glycemic control [21]. Such commendable result was possibly achieved because of better access to primary care, better knowledge level, presence of working health insurances and uniformity in assessing glycemic control for physicians [21-23].

The unadjusted analysis of the relationship between glycemic control and patients socio-demographic characteristics showed that being married, attaining primary or secondary education, engaging in moderate physical activity and the use of a single anti-diabetic medication were significantly associated with good glycemic control ($p < 0.05$). This is consistent with results obtained from studies conducted in Kenya, Ethiopia, India, Palestine and other parts of Nigeria [15,18-20]. Married patients were expected to have better support from their spouses and other family members in terms of clinic attendance, adherence to recommended nutrition and prescribed medications. The level of assimilation and understanding is usually enhanced by one's educational exposure, thus it is not strange that both the current study and previous ones confirmed that attaining primary or secondary educational status was likely to improve glycemic control [16]. However, the lack of association between tertiary education and good glycemic control remains a paradox. Graduated physical activity of up to 150 minutes per week is usually prescribed for most diabetic patients [31], especially when commodities like obesity and hypertension are present. Patients with moderate activity status had a significantly good glycemic control ($p = .007$) compared to those with low and regular physical activity levels. While it is expected that patients with low physical activity level may have poor glycemic control as corroborated by other studies [32-39], we suspect that the

few patients with hypoglycemia (Table 3) may have engaged in higher than recommended activity level, resulting in the lack of association between regular activity and glycemic control. Hypertension was popular (85.5%) in this study, but not significantly associated with glycemic control. However, it is suspected to have contributed to the high level of poor glycemic control observed among the patients with T2DM in State Specialist Hospital, Gombe. In contrast to previous study results, the current study found a unilateral association between underweight, normal weight, overweight and obesity with glycemic control. This may be due to poor reporting of patients' lipid profile.

Finally, the use of multiple diabetic medications contributed to the high prevalence of poor glucose control in the current study. This may be due to psycho-social problems of belief and loss of interest, occasioned by the quantity of medications to be taken concomitantly by the patients [14,16-20,32,35].

Factors that emerged as independent predictors of good glycemic control in this study include the use of lipid lowering medications, in addition to marital status, primary and secondary education, moderate activity level and the use of single anti-diabetic medication. Thus, it was more likely for patients on lipid lowering agents, married, with primary and secondary education, engaged in moderate physical activity and taking mono anti-diabetic agent to have better blood glucose control compared to the general population. This is corroborated by a study conducted by Kassahun and colleagues in Southwest Ethiopia, which found that T2DM patients with no formal education had higher odds of poor glycemic control and thus more likely to have poor control compared to educated patients [20]. Also, in line with our findings, a Japanese study reported that the absence of lipid lowering agents was a predictor of poor glycemic control [40], which is partly, explained by the presence of free fatty acids in general circulation and their adverse effect on insulin sensitivity and glucose utilization [9]. Contrary to some studies conducted in South south Nigeria, Ghana, Ethiopia, India, Palestine, our study did not identify patients' age, duration of diabetes and hypertension as predictors of glycemic control [19,36,38,39,41]. This may be due to differences in study setting, study design, number of participants, use of Glycated hemoglobin, ethnicity, climate and nutrition.

It is important to note that the results discussed in our study are real life population data and reflects the actual glycemic status of T2DM patients attending the diabetes clinic at Gombe State Specialist Hospital, during the study period. Nonetheless, caution must be exercised in applying the findings of this study due to the limitations below: fasting blood glucose and not glycated haemoglobin (A1C) was used as monitoring indicator for glycemic control, it is a single facility-based study, no face-to-face contact with the patients to allow for interview, and although there are evidence in literature that adherence to prescribed medications and lifestyle modifications are independent predictors of good glycemic control [42,43], such data were not available. Finally, a retrospective survey of patient records may not be sufficient to establish a causal relationship between glucose control and its determinant.

Conclusion

The proportion of T2DM patients with poor blood glucose control is remarkable (50.1%). Factors found to significantly influence glycemic control in the current study are marital status, educational status, level of physical activity, BMI status and pill burden, while the use of lipid lowering agents, in addition to the five factors mentioned earlier are independent predictors of good glycemic control. Educational and lifestyle interventions are recommended to address implicated factors in order to improve glucose control among diabetic patients in Gombe metropolis.

Recommendation

In view of the limitations above, it is recommend that research aimed at assessing patient adherence to prescribed medications and modifiable risk factors, patients' self-care practices, knowledge of disease and medications should be designed and implemented. Furthermore, educational and pharmaceutical care intervention strategies should be developed and implemented by healthcare providers to improve glycemic control among patients with T2DM, as this will ultimately delay or reduce risk of developing diabetes complications.

References

1. World Health Organization Executive summary: Global reports on diabetes 2014.

2. Guariguata L, Whitingb DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE (2014) Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract 103: 137-49.

3. Hu FB (2011) Globalization of Diabetes: The role of diet, lifestyle, and genes. Diabetes Care 34: 1249-57.

4. Akinkugbe OO (1997) Non-communicable diseases in Nigeria: national survey (Final Report) on hypertension, coronary heart disease, diabetes mellitus, haemoglobinopathies, G6PD deficiency and anaemia. Lagos: Federal Ministry of Health and Social Services – National Expert Committee on Non-Communicable Diseases.

5. International Diabetes Federation. Facts and figures 2013.

6. Adeloye D, Ige JO, Aderemi AV, Adeleye N, Amoo EO, et al. (2017) Estimating the prevalence, hospitalisation and mortality from type 2 diabetes mellitus in Nigeria: a systematic review and meta-analysis. BMJ Open 7: 1-16.

7. World Health Organization (WHO). Diabetes prevalence.

8. American Diabetes Association (2010) Diagnosis and classification of diabetes mellitus. Diabetes Care 33: S62-9.

9. Boden G, Shulman GI (2002) Free fatty acids in obesity and type 2 diabetes: defining their role in the development of insulin resistance and beta-cell dysfunction. Eur J Clin Invest 32: 14-23.

10. Yurong Z, Gang H, Zuyi Y, Liwei C (2012) Glycosylated Hemoglobin in Relationship to Cardiovascular Outcomes and death in Patients with Type 2 Diabetes: A Systematic Review and Meta-Analysis. PLoS One. 7: e42551.

11. Haffner SM, Lehto S, Ronnemaa T, Pyorala K, Laakso M (1998) Mortality from coronary heart disease in subjects with typediabetes and in nondiabetic subjects with and without prior myocardial infarction. N Engl J Med 339: 229-34.

12. UK Prospective Diabetes Study (UKPDS) Group (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 352: 837-53.

13. Selvin E, Marinopoulos S, Berkenblit G (2004) Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med 141: 421-31.

14. Badedi M, Solan Y, Darraj H, Sabai A, Mahfouz M, et al. (2016) Factors Associated with Long-Term Control of Type 2 Diabetes Mellitus. J Diabetes Res 2016: 1-8.

15. Nduati NJ, Simon K, Eva N, Lawrence M (2016) Factors Associated With Glycemic Control among Type 2 Diabetes Patients Attending Mathari National Teaching Hospital, Nairobi Kenya. J Endocrinol Diabetes 3: 1-11.

16. Yiguza DM, Desse TA (2017) Glycemic control and associated factors among type 2 diabetic patients at Shanan Gibe Hospital, Southwest Ethiopia. BMC Res Notes 10: 1-6.

17. De P, Banu S, Muthukumar D (2018) Predictors of poor glycemic control in type 2 diabetic patients in South Indian population. Int J Res Med Sci 6: 545-50.

18. Kakade AA, Mohanty IR and Rai S (2018) Assessment of factors associated with poor glycemic control among patients with Type II Diabetes mellitus. Integr Obesity Diabetes 4: 1-6.

19. Radwan M, Elsous A, Al-Sharif H, Mustafa AA (2018) Glycemic control among primary care patients with type 2 diabetes mellitus in the Gaza Strip, Palestine. Ther Adv Endocrinol Metab 9: 3-14.

20. Kassahun T, Eshetie T, Gesesew H (2016) Factors associated with glycemic control among adult patients with type 2 diabetes mellitus: a cross-sectional survey in Ethiopia. BMC Res Notes 9:78.

21. Ali MK, Bullard KM, Imperatore G, Barker L, Gregg EW (2018) Characteristics associated with poor glycemic control among adults with self-reported diagnosed diabetes-National Health and Nutrition Examination Survey, United States, 2007–2010. MMWR Suppl 61: 32-7.

22. Islam SM, Niessen LW, Seissler J, Ferrari U, Biswas T, et al. (2015) Diabetes knowledge and glycemic control among patients with type 2 diabetes in Bangladesh. SpringerPlus 4: 284.

23. Wee HL, Ho HK, Li SC (2002) Public awareness of diabetes mellitus in Singapore. Singapore Med J 43: 128-34.

24. Ufuoma C, Godwin YD, Kester AD, Ngozi JC (2016) Determinants of glycemic control among persons with type 2 diabetes mellitus in Niger Delta. Sahel Med J 19: 190-5.

25. Okafor CI, Ofoegbu EN (2012) Control to goal of cardiometabolic risk factors among Nigerians living with type 2 diabetes mellitus. Niger J Clin Pract 15:15-8.

26. Yusuff KB, Obe O, Joseph BY (2008) Adherence to anti-diabetic drug therapy and self-management practices among type-2 diabetics in Nigeria. Pharm World Sci 30: 876-83.

27. Adisa R, Fakeye TO, Fasanmade A (2011) Medication adherence among ambulatory patients with type 2 diabetes in a tertiary healthcare setting in Southwestern Nigeria. Pharm Pract (Granada) 9: 72-81.

28. Ajayi EA, Ajayi AO, Olalekan OE (2010) Treatment to targets in type 2 diabetics: analysis of out-patients practice at a remote Western Nigerian hospital. Internet J Med Update 5: 8-14.

29. Unadike BC, Eregie A, Ohwovoriole AE (2010) Glycaemic control amongst persons with diabetes mellitus in Benin City. Niger Med J 51: 164-6.

30. Olayemi IA, Osazuwa F (2014) Prevalence of poor glycaemic control among Nigerian female diabetics. Niger J Exp Clin Biosci 2: 67-8.

31. Edah JO, Odoh G, Kumtap CY, Onwukeme OC, Okpala UC, et al. (2016) Self-monitoring of blood glucose in Jos, Nigeria. J M Tropics 18: 28-32.

32. Modupe AO (2017) Self-care and glycemic control among Type 2 diabetes patients in a secondary health care in south west, Nigeria. Arch Gen Intern Med 1: 48.

33. Ngwogu KO, Mba IEK, Ngwogu AC (2012) Glycaemic control amongst diabetic mellitus patients in Umuahia metroppolis, abia state, Nigeria. Int J Basic Appl Innovative Res IJBAIR 1: 98-104.

34. Third report of the National Cholesterol Education Program (NCEP): (2002) Expert panel on Detection, Evaluation and Treatment of High Blood Cholesterol in adults (Adult Treatment Panel III) Final Report. Circulation 106: 3143.

35. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW (American Diabetes Association) (2016) Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association. Diabetes Care 39: 2065-79.

36. Park JH, Lee YE (2015) Effects of exercise on glycemic control in type 2 diabetes mellitus in Koreans: the fifth Korea National Health and Nutrition Examination Survey (KNHANES V). J Phys Ther Sci 27: 3559-64.

37. Bohn B, Herbst A, Pfeifer M, Krakow D, Zimny S (American Diabetes Association) (2015) Impact of Physical Activity on Glycemic Control and Prevalence of Cardiovascular Risk Factors in Adults with Type 1 Diabetes: A Cross-sectional Multicenter Study of 18,028 Patients. Diabetes Care 38:1536-43.

38. Adeniyi AF, Ogwumike OO, Oguntola DA, Adeleye JO (2015) Interrelationship among physical activity, quality of life, clinical and sociodemographic characteristics in a sample of Nigerian patients with type 2 diabetes. Afr J Physiother Rehabil Sci 7: 12-8.

39. Biru TT (2017) Glycemic Control and its Determinants among Ambulatory Patients with Type 2 Diabetes. J Diabetes Metab 8: 8.

40. Hu H, Hori A, Nishiura C, Sasaki N, Okazaki H, et al. (2016) Hba1c, Blood Pressure, and Lipid Control in People with Diabetes: Japan Epidemiology Collaboration on Occupational Health Study. PLoS One 11: e0159071.

41. Tekalegn Y, Addissie A, Kebede T, Ayele W (2018) Magnitude of glycemic control and its associated factors among patients with type 2 diabetes at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. PLoS One 13: e0193442.

42. Awodele O and Osuolale JA (2015) Medication adherence in type 2 diabetes patients: study of patients in Alimosho General Hospital, Igando, Lagos, Nigeria. Afr Health Sci 15: 513-22.

43. Shao H, Chen G, Zhu C, Chen Y, Liu Y, He Y, Jin H (2017) Effect of pharmaceutical care on clinical outcomes of outpatients with type 2 diabetes mellitus. Patients Prefer Adherence 11: 897-903.