Scientific
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Glycemic Control among Medical Outpatients in Enugu: A Cross Sectional Survey

Obinna Donatus Onodugo[1], Birinus Adikaibe Ezeala-Adikaibe[1,2*], Obumneme Benneth Anyim[2], Pascaline Onodugo[1], Ijeoma Nnene Anyim[3], Nkeiruka Chigekwu Mbadiwe[1], Ekenechukwu Young[1], Michael Abonyi[2], Gideon Anigbo[2], Ifeoma Ulasi[1], Uzoma Chukwunonso Okechukwu[2]

[1]Department of Medicine, University of Nigeria Teaching Hospital, Enugu, Nigeria
[2]Department of Medicine, Enugu State University Teaching Hospital, Enugu, Nigeria
[3]Department of Pediatrics, University of Nigeria Teaching Hospital, Enugu, Nigeria
Email: *birinusadikaibe@gmail.com

Abstract

Background: Diabetes in Nigeria presents a rising public health challenge and many cases are probably undetected. Poor glycemic control is a risk factor to both micro and macro vascular complications of diabetes and a major factor in the burden of the disease world-wide. The aim of the present study was to determine the pattern of glycemic control among adult diabetes patients attending a medical outpatient clinic in Enugu. **Methods:** Using a semi-structured questionnaire, we conducted a cross sectional descriptive study of patients with diabetes attending the medical out-patient clinic of one of the tertiary Hospitals in Enugu, Nigeria. Good glycemic control was defined as fasting blood glucose of less than 100 mg/dl. Study duration was 6 months. Statistical analyses were done using SPSS software. **Results:** A total of 119 participants were recruited for the study: 74 (62.2%) females and 45 males (37.8%) with a mean age of 62.2 (11.7) years. The mean systolic and diastolic blood pressure was 138.4 (24.3) mmHg and 81.2 (12.9) mmHg respectively. Eight (6.7%) had a documented history of diabetes-related coma in the past. The mean fasting blood glucose was 127.9 (22.4) mg/dl. Good, fair and poor glycemic control was achieved in 16.8%, 30.3% and 63% (52.9%) respectively. Correlation statistics showed that low level of adherence and abstaining from alcohol/tobacco are correlated with poor glycemic control. **Conclusion:** Majority (52.9%) of patients with diabetes attending a tertiary health center in Enugu, Nigeria has poor glycemic control status. Medication adherence and substance use are correlated with poor control.

Keywords

Diabetes, Glycemic Control, Enugu, Nigeria

1. Introduction

Diabetes is a common non-communicable disorder in South East Nigeria with a current prevalence as high as 11% [1]. Diabetes in the country presents a rising public health challenge [2] [3] [4] and many cases are probably undetected [1] [2] [3]. Poor glycemic control is a risk factor for both micro and macro vascular complications of diabetes. It is also a major factor in the burden of the disease and has been documented in several studies from Sub-Saharan Africa [5]-[11]. Poor glycemic control remains a challenge worldwide even in developed countries [12]-[18].

Good glycemic control has been defined in type 2 diabetes as fasting plasma glucose level of between 80 and 110 mg/dl [19]. Poor glycemic control has been related to factors such as modality of treatment, age, gender, access to care, diet, obesity, systolic blood pressure, physical activity and level of knowledge of patients and their care givers [5] [6] [12] [14] [15] [17]. In many Nigerian communities, there is a high rate of herbal-medication use as well as poor knowledge attitude and practice of diabetes [4] [5] [6] [20].

Documented prevalence of glycemic control varies widely and may reach as high as 79% in some studies depending on methodology used [7] [19] [21] [22] [23] [24] [25]. In Iran more than 64.4% of the patients have poor overall glycemic control [16]. In sub-Saharan Africa including Nigeria this figure has consistently remained high [5] [7] [12] [23] [24]. A study from the Niger Delta region of Nigeria reported a rate of 55% [5] while others have reported rates ranging from 34% - 65.7% [5] [6] [11] [23] [24].

Although most of these studies used HbA1C in their reports, some also used fasting blood glucose measurements. Fasting blood glucose measurement using glucometers is cheaper and readily available. Furthermore, HbA1c could miss out some patients at high risk for diabetic complications following acute changes in blood glucose levels. To the best of our knowledge, only one study has evaluated glycemic control among people living with diabetes in Enugu south-east Nigeria [11]. The aim of the present study was to determine the pattern of glycemic control among adult diabetic patients attending a medical outpatient clinic in Enugu. Detecting the pattern of glycemic control in a hospital setting will form an important public and patient educational tool aimed at prevention of the complications of diabetes.

2. Methods

We conducted a cross sectional descriptive study of patients with diabetes who were attending the medical out-patient clinic of the Enugu State University of Science and Technology Teaching Hospital Enugu, Enugu Nigeria. At the time of the study, the hospital had 350 beds distributed among the various specialties with 50 inpatient beds for adult admissions for medical cases. All consecutive consenting patients with were recruited. Diabetes was considered the primary

diagnosis in all cases and any other disease in the patients as a comorbidity. Patients with acute febrile illness, diabetic ulcers, first hospital visit for diabetes or taking steroid were excluded. Patients with symptoms suggestive of acute complications of diabetes were also excluded.

Ethical clearance was obtained from the ethics committee of the Enugu State University Teaching Hospital. Ethical conduct was maintained during data collection and throughout the research process. Informed consent was obtained from each study participant. Study duration was 6 months (June to November 2013).

2.1. Study Design

Data was obtained using a semi-structured questionnaire designed by one of the authors (E_ABA) after reviewing similar studies [6] [9] [11] [15] [16]. The full methodology of the study has been reported elsewhere (see appendix) [20]. Data on selected sociodemographic characteristics and lifestyle behaviors including smoking, drinking and use of herbal/traditional medicine. Past medical history was obtained from the subjects and confirmed from the case notes. All participants were interviewed in the clinic after they had rested in a sitting position for 5 - 10 minutes. Blood pressure was measured thrice by means of mercury sphygmomanometer (Chris Aloy®) according to the guidelines of the European Society of Hypertension [26]. Fasting blood glucose was measured using a glucometer (Fine test premium, Infobia Co. Ltd., Dongan-gu, South Korea) after overnight fasting. Fasting blood glucose was obtained once during recruitment in all the patients.

2.2. Definition of Terms

Diabetes was defined as documented evidence of previous diabetes and/or use of hypoglycemic agents in patients' case notes. Patients attending their first hospital visit for diabetes were excluded. Fasting blood glucose < 110 mg/dl was considered as good control, 110 - 125 mg/dl as fair and FBS ≥ 126 mg/dl as poor control.

Weight was measured using a bathroom scale in kilograms. Height was measured in centimeters with the patient standing erect on a flat surface. Body mass index (BMI) was calculated as weight (Kg) divided by squared height (m^2).

A patient was considered to have hypertension if the systolic blood pressure (SBP) was ≥140 mmHg and/or diastolic blood pressure (DBP) of ≥90 mmHg and/or recorded use of anti-hypertensive drugs. Recent tobacco and alcohol use were defined as use of tobacco in any form and consumption of alcohol within the last 4 weeks. Occupation was defined as the primary job which takes at least 50% of the working hours in a week. Other medical co-morbidities were defined using standard criteria or past medical history diagnosed by a qualified personnel (doctors). Level of education was the individual's highest educational (formal) attainment.

2.3. Study Instruments

The Morinsky-Green Medication adherence scale [27] was used to estimate medication adherence. Answers consistent with adherence were scored as 0 and answers consistent with non-adherence were scored as 1. For the purpose of the index study the scores are tallied and graded into high adherence (0 - 2), medium adherence (3 - 5) and low adherence (6 - 8).

2.4. Statistical Methods

For database management and statistical analyses, SPSS version23 (IBM Corporation, New York, USA) was used. Data were presented in tables. For continuous variables, mean values and standard deviation were calculated. Rates were expressed as percentages. Categorical values were compared using the Chi Square test. Mean values were compared using the independent t-test. In all, p value of <0.05 was regarded as statistically significant. Conclusions were drawn at 95% confidence interval.

3. Results

Characteristics of the Participants

A total of 119 cases of diabetes who have attended the clinic at least more than once were recruited for the study. They were made of 74 (62.2%) females and 45 males (37.8%) (Table 1). The mean age (sd) of the patients was 62.2 (11.7) years with a range of 36 to 89 years. The age distribution is shown in Figure 1. Males were older than females by 10 years (P < 0.01). Although females were shorter (P < 0.01), they had a higher mean BMI (P < 0.01). Patients came equally from both urban and rural areas. The level of education, occupation and other characteristics of the population are also shown in Table 1. The mean systolic and diastolic blood pressure was similar in bother sexes. Medical history showed that most had hypertension 101 (84.9%) and chronic headache 52 (43.7%). Eight (6.7%) had a documented history of diabetes-related coma in the past. Of all comorbidities only Parkinson disease was commoner in males (P = 0.03). Seventeen (14.3%) patients were current tobacco users, 90 (75.6%) used herbal or alternative medicine in one form or the other in the past and 33 (27.7%) used alcohol. Medication adherence measured by the Morinsky-Green Medication adherence scale is shown in Table 1. Adherence was similar in males and females (P = 0.6).

The mean fasting blood glucose is shown in Table 1 and the distribution in Figure 2. Good blood glucose control (<110 mg/dl) was only achieved in 16.8% while another 30.3% had a fair control and 63 (52.9%) achieved poor glycemic control. The distribution of glycemic control was not statistically significant in any of the categories considered (Table 2).

Correlation statistics using Spearman Rho statistic showed that low level of adherence and abstaining from alcohol/tobacco correlated with poor glycemic control (Table 3).

Table 1. Patients' characteristics and other variables.

Characteristic	Females	Males	Total	P-value
N (%)	74 (62.2)	45 (37.8)	119 (100)	<0.01
Age, years mean ± sd	58.4 ± 11.2	68.2 ± 10.1	62.2 (11.7)	<0.01
Height, cm mean ± sd	158.1 ± 6.3	162.3 ± 8	159.7 (7.3)	<0.01
Weight, kg mean ± sd	71.4 ± 15.2	68.9 ± 11.4	70.4 (13.9)	0.34
Body mass index, kg/m^2 mean ± sd	28.6 ± 5.8	26.1 ± 3.8	27.6 (5.2)	0.01
Place of residence n, (%)				
Urban	55 (74.3)	31 (68.9)	86 (72.3)	
Rural	14 (31.1)	19 (25.7)	33 (27.7)	0.52
Level of education n, (%)				
Primary	28 (37.4)	22 (50)	50 (42.4)	
Secondary	4 (5.4)	9 (20.5)	13 (11)	
Tertiary	42 (56.8)	13 (29.5)	55 (46.6)	<0.01
Occupation n, (%)				
Retired	11 (15.3)	24 (54.5)	35 (30.2)	
Office workers	21 (29.4)	5 (11.4)	26 (22.4)	
Business	19 (26.4)	4 (9.1)	23 (19.8)	
Farmers	11 (15.3)	3 (6.8)	14 (12.1)	
Artisans	1 (1.4)	8 (18.2)	9 (7.8)	
Unemployed	11 (14.9)	1 (2.2)	12 (10.1)	
Peripheral hemodynamics, mean ± sd				
Systolic pressure, mm Hg	138.3 ± 25.3	138.6 ± 23.8	138.4 (24.3)	0.95
Diastolic pressure, mm Hg	81.6 ± 11.8	80.5 ± 14.7	81.2 (12.9)	0.65
Measurements on blood, mean ± sd				
Glucose, mg/dl	128 ± 22.7	127.7 ± 22.4	127.9 (22.4)	0.95
Medical history n, (%)				
Hypertension	62 (83.8)	39 (86.7)	101 (84.9)	0.67
Chronic headache	32 (43.2)	20 (44.4)	52 (43.7)	0.9
Arthritis	43 (58.1)	25 (55.6)	68 (57.1)	0.79
Stroke	8 (10.8)	5 (11.1)	13 (10.9)	0.96
Parkinson's disease	3 (4.1)	7 (15.6)	9 (7.6)	0.03
Heart failure	6 (8.1	5 (11.1)	11 (9.2)	0.58
Others	11 (24.4)	9 (12.2)	20 (16.8)	<0.01
Past History of Diabetic Coma n, (%)	4 (5.4)	4 (8.9)	8 (6.7)	0.46
Lifestyle n, (%)				
Current use of tobacco, n (%)	5 (6.8)	12 (26.7)	17 (14.3)	<0.01
Used herbal medicine	**57 (77)**	**33 (73.3)**	**90 (75.6)**	**0.65**
Use of alcohol,	20 (27)	13 (28.9)	33 (27.7)	0.84
Morinsky Adherence Score n, (%)				
High (0 - 2)	46 (62.2)	29 (64.4)	75 (63)	
Medium (3 - 5)	21 (28.4)	14 (31.1)	35 (29.4)	
Low (6 - 8)	7 (9.5)	2 (4.4)	9 (7.6)	0.6

P-values are for the sex differences.

Table 2. Level of glycemic control among the participants.

Variable	Level of control			P-value
	Good control	Fair	Poor	
Total	20 (16.8)	36 (30.3)	63 (52.9)	
Male	10 (22.2)	11 (30.6)	24 (38.1)	
Female	10 (13.5)	25 (33.8)	39 (61.9)	0.36
BMI				
<18.5	1 (20)	3 (60)	1 (20)	
18.5 - 24.9	7 (19.4)	7 (19.4)	22 (61.1)	
25 - 29.9	6 (13)	12 (26.1)	28 (60)	
≥30	6 (18.8)	14 (43.8)	12 (37.5)	0.17
Age Group (years)	-	-	-	-
36 - 49	-	3 (20)	12 (80)	
50 - 59	4 (12.1)	13 (39.4)	16 (48.5)	
60 - 69	10 (24.4)	12 (29.3)	19 (46.3)	
≥70	6 (20)	8 (26.7)	16 (25.4)	0.19
Place of residence				
Urban	12 (14)	31 (36)	43 (50)	
Rural	8 (24.2)	5 (15.2)	20 (60.6)	0.07
Level of education				
Primary	10 (20)	12 (24)	28 (56)	
Secondary	3 (23.1)	1 (7.7)	9 (69.2)	
Tertiary	7 (12.7)	22 (40)	26 (47.3)	0.15
Occupation				
Working	9 (12.5)	25 (34.7)	38 (52.8)	
Unemployed	2 (16.7)	3 (25)	7 (58.3)	
Retired	9 (25.7)	8 (22.9)	18 (51.4)	0.45
Comorbidity	-	-	-	-
None-one	5 (17.2)	5 (17.2)	19 (65.5)	
Two-Three	13 (17.3)	25 (33.3)	37 (49.3)	
Four-five	2 (13.3)	6 (40)	7 (46.3)	0.32

Table 3. Correlates of good/fair glycemic control in the patients.

|	R (P-value)
Age	−0.05 (0.58)
Gender (male 1, female 0)	−0.01 (0.95)
Body Mass Index	−0.04 (0.67)
Occupational status (1 working, 0 not working)	−0.00 (0.97)
Level of education (1 primary, 2 secondary, 3 tertiary)	−0.12 (0.18)
Residence (1 urban, 0 rural)	0.01 (0.3)
Level of adherence (1 high, 2 moderate, 3 low)	0.19 (0.04)
Substance use* (2, both, 1 either, 0 none)	−0.19 (0.04)
Presence of comorbidities (1 yes, 0 no)	−0.06 (0.49)
History of coma (1 yes, 0 no)	0.05 (0.58)

*Use of alcohol and/or tobacco.

Age distribution of the patients
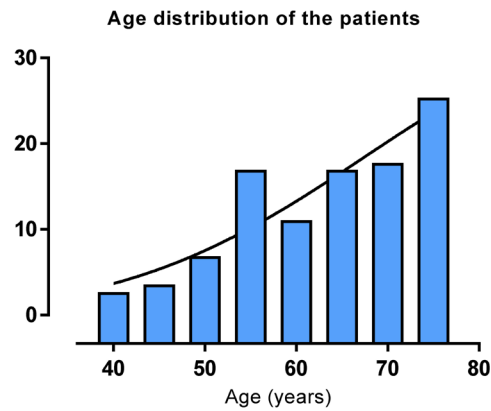
Figure 1. Age distribution of the patients.

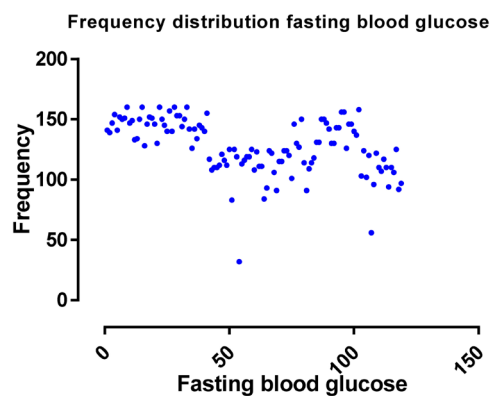**Frequency distribution fasting blood glucose**

Figure 2. Distribution of fasting Blood glucose in the study population.

4. Discussion

The findings of this study reveal an overall poor glycemic control among medical out-patients in one of the major hospitals in Enugu metropolis. A total of 63 (52.9%) had poor control. Glycemic control was similar in males and females, in all age groups and all categories studied. It was slightly better among rural dwellers. Only the poor medication adherence and non-substance use correlated with poor control.

Individuals with FBG greater than 125 mg/dl are at greater risk of developing chronic complications of diabetes and other cardiovascular complications like strokes and myocardial infarction [19]. Therefore, poor glycemic control status in diabetic patients should be considered a target for public health authorities as well as health educationists.

The rate of poor glycemic control in the index study is within the range reported in Nigeria and the sub-continent [5]-[11] [21] [23] [25]. Unlike in most of these studies, we used fasting blood glucose as an indicator of control instead of HbA1C. Although fasting blood glucose offers only a narrow window into the overall blood glucose level of the patient, it is often the most available method of checking glycemic control in our setting and often more likely to be available at home, health centers and most private hospitals. It therefore forms the basis for

day to day management of patients and adjustment of medications.

Females and younger patients had non-statistical higher rates of poor control. This is similar to previous studies [5] [15] [16] [28] [29]. The reasons for relationship between age, gender and glycemic control may be multifaceted. Better glycemic control has been associated with the duration of diabetes [17] and by implication older individuals. Other factors such as multiple comorbidities in older individual, use of multiple medications and hence increased pill burden, dependency and poverty may all be contributory. The high proportion of females reported in this study may be attributed to fact that females were also younger who are known to be less adherent and have poor health seeking behaviour [30] [31]. The index report is similar to a previous study from Iran [15].

Rural dwellers also had a non-significant higher rate good glycemic control when compared to urban dwellers. Reasons for this may be attitudinal which may be linked to pressure from family members and relatives to try one cure after the other as well as prevalent poor knowledge and practice of diabetes [5] [6]. The non-significant finding between urban and rural dwellers is similar to was reported from other studies [6] [16].

There was no significant difference between patients who were employed and those who were not at the time of the study. The relationship between employment status and affordability of health care may not always be straightforward. It is important to remember that most patients in the African context have very high rates of social support and may not be fully responsible for their medical bills [32]. Furthermore, being actively engaged during working hours may interfere with taking medications especially insulin.

Similar to other studies BMI did not correlate with glycemic control [15] [16]. One suggested reason for the lack of correlation between BMI and glycemic control was the fact that patients with diabetes gain weight with age irrespective of glucose control [16].

Glycemic control also did not differ significantly between patients with different levels of education. Several studies have reported that formal education significantly improves adherence [31] [33] [34] which may contribute to glycemic control. However, higher level of education does not necessarily enhance the understanding of the disease and its complications [35].

An interesting finding is the negative correlation of substance use (alcohol and tobacco) with poor glycemic control. It is interesting to note that neither of these substances correlated with glycemic control alone but did so when combined. Reasons for this are not clear because of the limitations of the index study. It is an established fact that both tobacco and alcohol may worsen the cardiovascular complications of diabetes just as poor glycemic control. Hence one may be inclined to suggest that those who had poor control and/or who presented with complications were more likely to abstain. In Saudi Arabia, researchers also did not find any correlation between smoking and glycemic control [16]. The history of previous diabetic coma was recorded in few cases and

did not correlate with the level of glycemic control. Diabetic Keto-acidosis has been reported to predict poor long term glycemic control in children [36] [37]. Previous history of coma in the index study may not only reflect poor control but also severity at diagnosis due to high level of unawareness. Medical comorbidities were common among our patients because of their age distribution. Comorbidities increase pill load leading to drug fatigue and hence non-adherence to medications including anti diabetic drugs. However, there was no correlation between the number of associated comorbidities and level of control which is similar to some studies [38].

Improving glycemic control remains a key factor in the management of diabetes and prevention of complications. In a region with high levels of infectious diseases and growing burden of metabolic disorders the measures towards improving glycemic control cannot be overemphasized. The apparent lack of significant correlates in this study suggests that the answer to this problem may lie elsewhere—patients education and lifestyle changes that are associated with it.

5. Limitations

This study has some limitations. First, the time between the previous estimation of FPG and the current FPG was not the same for all patients. Secondly, as previously stated HbA1c is more useful in estimating long term control. Thirdly, our study did not include data on diet and lifestyle changes required in the management of such patients. Furthermore, we recruited patients from a teaching hospital set-up which may include many cases of difficult-to-manage cases as well as complicated cases of diabetes which in turn may limit the generalization of our findings.

6. Conclusion

The majority of the patients in the current study had poor glycemic control status. The level of medication adherence and substance use are correlated with poor control. The index study suggests that many factors may be related to glycemic control which may include patients' education and drug selection. Further research should be conducted to evaluate patient and physician centered factors in glycemic control.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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