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Correlates of type 2 diabetes mellitus and the glycemic profile of patients attending the Medical Outpatient Clinic of Specialist Hospital, Sokoto, Nigeria

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ABSTRACT

Background: Several disease conditions and lifestyle behaviors have been identified as correlates of diabetes mellitus. **Aim**: This study aimed to determine the correlates of type 2 diabetes mellitus and the glycemic profile of patients attending the Medical Outpatient Clinic of Specialist Hospital, Sokoto, Nigeria. **Materials and Methods:** This was a cross-sectional study among 300 patients selected by systematic sampling technique. Anthropometric measurement, blood pressure measurement, and estimation of fasting plasma glucose and lipid profile were done for the participants in addition to questionnaire administration. Data were analyzed using IBM SPSS version 20 statistical computer software package. **Results**: About a tenth, 37 (12.3%) of the 300 participants currently smoke cigarette, close to a fifth consumed alcohol in the last 12 months (17.3%) and 30 days (15.7%), and majority of them consume fatty foods (67.7%), and eat less than 3 servings of fruits (76.7%) and vegetables (52.7%) daily, Less than half of participants (47.3%) do moderate intensity work, and less than a fifth of them (16.3%) engage in regular moderate intensity sport and leisure activities. Majority of participants (75.0%), reported being on treatment for hypertension, about a third had raised blood pressure (35.0%) and were overweight (38.7%); 12.0% were obese, 20.3% had elevated cholesterol, while 45.3% had poor glycemic control. **Conclusion**: This study showed high prevalence of the behavioral and metabolic risk factors (correlates) of type 2 diabetes mellitus among the participants with a high proportion of them having poor glycemic control. Diabetes care providers should comprehensively address the correlates of the disease and not just focus on administration of medications.

Keywords: Type 2 diabetes mellitus, correlates, glycemic profile, patients

INTRODUCTION

Type 2 diabetes mellitus accounts for 90% of cases of diabetes mellitus globally with an estimated 415 million adults aged over 18 years living with the disease in 2015, and it is projected that by 2040, 642 million adults will have diabetes.[1,2] In the past 3 decades the global prevalence of diabetes has grown from 4.7% in 1980 to 8.5% in 2014 but the rise was higher in low- and middle-income countries than in high-income countries.[3]

The burden of non-communicable diseases for which diabetes is a major component was initially presumed to be restricted to the developed nations of the world. However, emerging evidences have continued to indicate that the surge in the developing nations is overtaking those of the developed nations.[4] Fourteen million people had diabetes in Africa in 2015 and the figure is projected to reach 34 million by 2040; this indicates an expected 142% rise in prevalence in Africa as compared to 52% increase in the rest of the world.[5]

The African Region has the highest proportion of undiagnosed diabetes in the world with over two-thirds (66.7%) of people with diabetes being unaware that they have the disease. Also, more than 321,100 deaths in the African Region were attributed to diabetes, with most (79.0%) of the deaths occurring in people under the age of 60 years (the highest proportion for any region) in 2015.[2] The prevalence of diabetes mellitus in Nigeria increased from 2.2% in 1997 to 5.0% in 2013; although, the current prevalence of diabetes in Nigeria is unknown, it has been estimated to be in the region of 8-10%.[6]

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Diabetes has health, social, and psychological implications. It is the leading cause of non-traumatic amputations, blindness, and end-stage renal disease; and it is also one of the principal causes of death from cardiovascular complications such as myocardial infarction.[1] Prolonged uncontrolled high blood sugar causes damage to the heart, blood vessels, kidneys, eyes and nervous system which can lead to disability and premature death.[3] Diabetic nephropathy is the leading cause of end-stage renal disease in the Western world. It is also emerging as a major cause of end-stage renal disease (ESRD) in sub-Saharan Africa.[7] A study in Nigeria reported 5% prevalence of ESRD among diabetes,[8] while another study[9] reported that patients with diabetes undergoing dialysis have a 22% and 15% higher mortality at one year and five years respectively, when compared with patients without diabetes.[9] Diabetes like other chronic illnesses disrupts the physical, psychological, and social balance of an individual's life. The disruption results from the physical limitations imposed on the affected individuals by the disease, as well as from the social and cultural implications of living with diabetes.[5]

Several disease conditions and lifestyles behaviors have been identified as correlates of diabetes by being risk factors for the occurrence of the disease, negatively affect glycemic control, or increase the risk of complications arising from it. Both hypertension and diabetes coexist frequently and Type 2 diabetes mellitus (Type 2 DM) is almost 2.5 times more likely to develop in subjects with hypertension than in subjects with normal blood pressure.[10] The prevalence of hypertension among diabetics in Nigeria was estimated to range from 20 -40%,[11] but a multicenter study in Nigeria reported 58% prevalence of hypertension among diabetics.[12]

Smoking is both a risk factor for the development of Type 2 DM and also of poor glycemic control. Smoking-related risk of diabetes increases with the number of cigarettes smoked, and men and women who smoked greater than 2 packs per day have a greater than 45% and 74% risk for diabetes than men and women who never smoked respectively.[13] In addition, evidence from studies showed that smokers have a higher risk to be insulin resistant, exhibit several aspects of the insulin resistance syndrome, and develop type 2 DM.[14-16]

Physical inactivity is a risk factor for Type 2 DM, and improvement in physical activity has been found to improve blood glucose control, and prevent or delay onset of type 2 DM.[17] Dyslipidemia increases diabetic patients' risk of developing cardiovascular disease (CVD), and controlling blood lipid with the use of statin has been shown to help in the primary and secondary prevention of CVD and also coronary heart disease (CHD) in diabetic patients.[18]

Obesity is an important risk factor for type 2 DM, and glycemic control programs mostly entail weight reduction. It has been estimated that about 90% of patients who develop type 2 diabetes mellitus are obese,[19] reports from studies conducted in Nigeria showed very high prevalence of obesity among diabetic patients. A study conducted among type 2 diabetics in Ibadan, South-west Nigeria reported that majority of the patients (83%) were either overweight or obese,[20] while another study by Adebisi et al.,[21] reported 71.1 and 55.3% of obesity among female and male diabetic patients respectively.

Studies conducted in Nigeria and other places majorly reported poor glycemic control in patients with Type 2 DM. In a study conducted among Saudi Arabians with diabetes, poor glycaemic control was seen in 42% of the subjects.[22] In Nairobi, Kenya, Otieno et al.,[23] found that majority of persons with diabetes had poor glycaemic control, and this was presumed to be due to inadequate medication and poor life style modification. In a study conducted in Benin, Nigeria[24] poor glycemic control was found in 46% of the patients, while 63% of the subjects in another study in Calabar, Nigeria[25] had poor glycemic control.

Information on the drivers of the disease and the pattern of glycemic control in patients with Type 2 DM would be useful to policymakers and care providers in designing appropriate strategies for the prevention and control of the disease, and very importantly in achieving optimal treatment outcomes in these patients. This study was conducted to determine the correlates of type 2 diabetes mellitus and the glycemic profile of patients attending the Medical Outpatient Clinic of Specialist Hospital, Sokoto, Nigeria.

MATERIALS AND METHODS

Study Design, Population and Area

A cross-sectional study was conducted among diabetic patients attending the Medical Outpatient Clinic of Specialist Hospital, Sokoto, Nigeria in October and November 2017. All consenting diabetic patients were considered eligible for enrollment into the study. Those with type 1 diabetes mellitus, those with cognitive impairments and those who needed to be admitted for being medically unstable were excluded.

Sample Size Estimation and Sampling Technique

The sample size was estimated at 307 using the statistical formula for calculating the sample size for descriptive studies,[26] a 72.4% prevalence of dyslipidaemia among patients with type 2 diabetes mellitus in a previous study,[11] and a precision level of 5%. The eligible participants were selected by systematic sampling technique using the list of patients attending the diabetes and hypertension clinics during the study period to constitute the sampling frame. One of 10 patients was recruited over a period of three months at the end of which 310 patients were recruited.

Data Collection

The methods of data collection comprised of personal interview, physical and biochemical assessments. A structured interviewer-administered questionnaire was used to obtain information on the socio-demographic characteristics of the study participants and behavioral measurements. The questions on behavioural measurements were adapted from the WHO STEPS Instrument (Core and Expanded).[27] The questionnaire was pretested on 20 diabetic patients attending the Family Clinic of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria, the necessary adjustment was effected based on the observations made during the pretesting.

Weight was measured with shoes off to the nearest 0.5kg using a Seca Optimal scale; it was validated with a standard weight and corrected for zero error. Height was measured without shoes to the nearest 0.5cm using a stadiometer. Blood pressure was measured using a sphygmomanometer (Dekamet MG3, England) and stethoscope (Littman quality) with all tight clothing and other similar materials removed from the arm and in the sitting position. The first measurement was taken after the participant had rested for at least 10 minutes in a sitting position with the arm rested on a table such that the middle of the forearm is about the level of the heart. The second measurement was taken at the end of the interview; the mean of the 2 readings was used in the analysis. Acucheck glucometer was used for blood sugar analysis; capillary whole blood was obtained from the participants early in the morning after an overnight fast. Rayto RT-9200 semi-auto chemistry analyzer (spectrophotometer) was used for analysis of fasting serum total cholesterol.

Three resident doctors, two nurses and two laboratory scientists assisted in data collection after pre-training on the study objectives, selection of participants and use of survey instruments.

Operational definition of terms

Body mass index (BMI) was calculated as weight (kg) divided by height^2 (m^2) and used as marker for overweight and obesity.[28] Underweight was defined as BMI less than 18.5kg/m^2, normal weight was defined as BMI of 18.5 to 24.9kg/m^2, overweight was defined as BMI of 25.0 to 29.9kg/m^2, while obesity was defined as BMI of 30.0kg/m^2 and above. Poor glycemic control was defined using the WHO criteria[29] for diabetes mellitus as fasting plasma whole glucose $\geq$ 6.1mmol/l, while good glycemic control was defined as fasting plasma whole glucose $<$ 6.1 mmol/l. Hypercholesterolaemia was defined using the American Heart Association criteria[30] as fasting serum Total cholesterol (Tc) $\geq$ 5.2mmol/l (200mg/dl). Hypertension was defined using the World Health Organization (WHO) and International Society of Hypertension (ISH) criteria[31] as systolic blood pressure (SBP) $\geq$ 140mmHg and/or diastolic blood pressure (DBP) $\geq$ 90mmHg, or both, or self reported antihypertensive medication during the past 1 week.

Data Analysis

Data were analyzed using IBM SPSS version 20 computer statistical software package. Quantitative variables were summarized using mean and standard deviation, while qualitative variables were summarized using frequencies and percentages. Frequency distribution tables were constructed; and cross tabulations were done to examine the relationship between categorical variables. The chi-square test was used to compare differences between proportions. All levels of significance were set at $p < 0.05$.

Ethical Consideration

Institutional ethical clearance was obtained from the Ethical Committee of Sokoto State Ministry of Health, Sokoto, Nigeria. Permission to conduct the study was obtained from the Management of the hospital, and informed consent was obtained from the participants before commencing questionnaire administration.

RESULTS

Socio-demographic characteristics of participants

Out of the 310 questionnaires administered, 300 were adequately completed and found suitable for analysis, giving a response rate of 96.8%. The ages of the participants ranged from 30 to 79 years (mean = 58.9 $\pm$ 10.1 years), and a larger proportion 131 (43.7%) of the 300 participants were aged 60 to 69 years. Majority of participants were females (69.0%), married (74.9%), and almost all of them were Muslims (93.7%). Majority of participants had primary education and below (58.7%),

and a larger proportion of them (41.7%) were traders. Majority of participants (62.3%) reside in urban communities (Table 1).

Table 1: Socio-demographic characteristics of participants

Variables	Frequency (%) n = 300
Age group (years)	
30-39	9 (3.0)
40-49	54 (18.0)
50-59	71 (23.7)
60-69	131 (43.7)
≥70	35 (11.7)
Sex	
Female	207 (69.0)
Male	93 (31.0)
Religion	
Islam	281 (93.7)
Christianity	19 (6.3)
Marital status (n = 239)	
Single	11 (4.6)
Married	179 (74.9)
Separated	4 (1.7)
Divorced	12 (5.0)
Widowed	33 (13.8)
Level of education	
Primary and below	176 (58.7)
Secondary	56 (18.7)
Tertiary	68 (22.7)
Occupation	
Farmer	82 (27.3)
Trader	125 (41.7)
Civil servant	71 (23.7)
Others	22 (7.3)
Place of residence	
Urban	187 (62.3)
Rural	113 (37.7)

Participants' behavioral risk profile

About a tenth, 37 (12.3%) of the 300 participants currently smoke cigarette, while about a third of them (33.3%) gave history of exposure to environmental tobacco smoke. Close to a fifth of participants consumed alcohol in the last 12 months (17.3%) and 30 days (15.7%). Majority of participants practiced unhealthy dietary habits such as consuming fatty food daily (67.7%), and eating less than 3 servings of fruits (76.7%) and vegetables (52.7%) daily. Less than half of participants (47.3%) do moderate intensity work, and less than a fifth of them (16.3%) engage in regular moderate intensity sport and activities (Table 2).

Participants' metabolic risk and glycemic profile

Majority of participants reported being on treatment for hypertension (75.0%) and diabetes mellitus (76.7%), while more than a quarter of them (28.0%) gave history of deaths due to heart attack among their relatives. More than a third of participants had raised blood pressure (35.3%) and were overweight (38.7%), about a tenth (12.0%) were obese, while about a fifth of them (20.3%) had elevated cholesterol level. Only about half, 164 (54.7%) of the 300 participants had good glycemic control (Table 3).

The proportion of participants with good glycemic control was significantly higher among urban residents (67.9%) as compared to rural residents (32.7%), χ^2= 24.720, $p < 0.001$; and among participants that engage in regular moderate intensity sport and fitness activities (71.4%) as compared to those who do not (51.4%), χ^2= 6.640, $p = 0.010$ (Table 4).

Table 2: Participants' behavioral risk profile

Variables	Frequency (%) n = 300
Tobacco use	
Ever smoked cigarette	74 (24.7)
Currently smoke cigarette	37 (12.3)
Present in a closed area with smokers in the last 30 days	100 (33.3)
Alcohol consumption	
Ever consumed alcohol	52 (17.3)
Consumed alcohol in the last 12 months	52 (17.3)
Consumed alcohol in the last 30 days	47 (15.7)
Dietary pattern	
Consume fatty food daily	203 (67.7)
Eat less than 3 servings of fruits daily	230 (76.7)
Eat less than 3 servings of vegetables daily	158 (52.7)
Means of transport to work daily	
Trek to work	88 (29.3)
Bicycle	34 (11.3)
Motorcycle	111 (37.0)
Car	67 (22.3)
Other physical activities	
Engage in regular moderate intensity sport and activities	49 (16.3)
Do moderate intensity work	142 (47.3)

Table 3: Participants' metabolic risk and glycemic profile

Variables	Frequency (%) n = 300
Medical History	
Relative(s) died of heart attack	84 (28.0)
On treatment for hypertension	225 (75.0)
On treatment for diabetes	230 (76.7)
Blood pressure status	
Normal	194 (64.7)
Raised	106 (35.3)
BMI status	
Underweight	10 (3.3)
Normal	129 (43.0)
Overweight	116 (38.7)
Obese	36 (12.0)
Serum cholesterol status	
Normal	239 (79.7)
Elevated	61 (20.3)
Glycemic control status	
Good	164 (54.7)
Poor	136 (45.3)

Table 4: Factors associated with good glycemic control among participants

Variables	Glycemic control status		Test of significance
	Good Frequency (%)	Poor Frequency (%)	
Age (years)			
< 60	80 (59.7)	54 (40.3)	χ^2= 2.477,
≥60	84 (50.6)	82 (49.4)	p = 0.116
Sex			
Male	107 (51.7)	100 (48.3)	χ^2= 2.386,
Female	57 (61.3)	36 (38.7)	p = 0.122
Education			
Primary and below	94 (53.4)	82 (46.6)	χ^2= 0.272,
Secondary and tertiary	70 (56.5)	54 (43.5)	p = 0.602
Place of residence			
Urban	127 (67.9)*	60 (32.1)	χ^2= 24.720,
Rural	37 (32.7)	76 (67.3)	p < 0.001
Engage in moderate intensity sport and fitness activities			
Yes	35 (71.4)*	14 (28.6)	χ^2= 6.640,
No	129 (51.4)	122 (48.6)	p = 0.010

DISCUSSION

This study assessed the correlates of type 2 diabetes mellitus and the glycemic profile of patients attending the Medical Outpatient Clinic of Specialist Hospital, Sokoto, Nigeria. The 12.3% prevalence of current cigarette smoking among the participants in this study is in tandem with the 15.7% prevalence of alcohol consumption in the last 30 days by them. Although, the participants were predominantly Moslems and Islam forbids alcohol consumption, cigarette smoking and alcohol consumption have been found to be closely related. However, the 12.3% prevalence of cigarette smoking among the participants in this study is substantially lower than the 28.4% prevalence obtained in a previous study among diabetics in Sokoto, Nigeria,[11] and it suggests a fall in the prevalence of cigarette smoking in the area.

Studies conducted among diabetics in other places also reported high prevalence of cigarette smoking and alcohol consumption. While a study conducted among diabetics in Bangladesh reported 33.0% prevalence of cigarette smoking,[32] another study in Tamil Nadu reported a strong positive association (OR = 4.21, 95%CI = 2.41-7.35, p < 0.001) between alcohol consumption and diabetes mellitus.[33] It is therefore necessary for care providers to make education of their patients on the behavioral risk factors of non-communicable diseases (particularly cigarette smoking and alcohol consumption) an essential component of their services.

The sub-optimal levels of physical activities among the respondents in this study with less than half (47.3%) engaging in moderate intensity work and less than a fifth (16.3%) engaging in moderate intensity sport and leisure activities are similar to the findings in a study conducted in Bangladesh[32] in which 22 and 30% of respondents were involved in medium- and high-intensity physical activities respectively. The large proportion of respondents that consume less than 3 servings of vegetables per week in this study is in consonance with the finding in a previous study conducted among traders in Sokoto, Nigeria[34] and another study conducted in Lagos, Nigeria[35] which reported that 68.7 and 82.9% of respondents respectively consume less than 3 servings of vegetables per week.

While the high prevalence of self-reported hypertension (75.0%) among the respondents in this study provides additional evidence in support of the strong association that has been established between hypertension and type 2 diabetes mellitus in several studies,[10-12] it is much higher than the 30, 54.2 and 58% prevalence of hypertension among diabetic patients in studies conducted in Ilorin, Nigeria[36] Benin-City, Nigeria[37] and another multi-center study in Nigeria[12] respectively.

Although, the 12.0 and 20.3% prevalence of obesity and elevated cholesterol respectively among the respondents in this study compare well with the similarly high prevalence of obesity and elevated cholesterol in studies conducted among diabetic patients in Nigeria[11,20,21] they are much higher than the national average obesity and elevated cholesterol prevalence rates of 8.5 and 16.1% respectively,[38] thus highlighting the higher risk of obesity and elevated cholesterol among diabetic patients as compared to the populace, and the need to address these conditions comprehensively in interventions for the

control and prevention of non-communicable diseases in Nigeria.

The finding of close to half of the respondents in this study (45.3%) having poor glycemic control is similar to the findings in studies in Nigeria including Benin, Nigeria[24] and Calabar, Nigeria[25] which reported that 46 and 63% of respondents respectively had poor glycemic control. Similarly, high prevalence of poor glycemic was reported in studies conducted in other places including Saudi Arabia[22] and Nairobi, Kenya[23] and it was majorly attributed to inadequate medication and poor life-style modification. The finding of a significantly ($p < 0.05$) higher proportion of respondents that engage in moderate intensity sport and fitness activities (71.4%) in this study having good glycemic control as compared to those who do not (51.4%) is consistent with the documented effect of physical activity in improving blood sugar control in diabetic patients.[17]

Also, the significantly ($p < 0.05$) higher proportion of respondents that reside in urban communities (67.9%) in this study having good glycemic control as compared to those who reside in rural communities (32.7%) could be due to differences in access to health care services (particularly medications and information) between the residents of these communities. Similar to the findings in this study, a study conducted in Northern Iran[39] had established associations between physical activity, place of residence and glycemic control. The high prevalence of poor glycemic control in this study calls for concern, in view of its effects on disease progression and onset of complications, with dire consequences on the patients, their families and the country; and it underscores the need for diabetes care providers to comprehensively address the correlates of the disease (specifically its behavioural and metabolic risk factors), and not just focus on administration of medications.

CONCLUSION

This study showed high prevalence of the behavioral and metabolic risk factors (correlates) of type 2 diabetes mellitus among the participants; and with a high proportion of them having poor glycemic control. Diabetes care providers should comprehensively address the correlates of the disease and not just focus on administration of medications.

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Nil.

Conflict of interest

None declared.

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