Prevalence, Spectrum and Determinants of Diabetes Mellitus Complications in Sagamu, South-West Nigeria

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Sources of Financial Support: none

Summary

BACKGROUND

Diabetes Mellitus is a chronic metabolic disease associated with numerous complications. The prevalence of diabetes mellitus is increasing in our locality and constitutes a major public health problem. The objective of this study was to determine the prevalence and associated determinants of diabetes complications.

MATERIALS AND METHODS

The study was a cross-sectional study conducted among diabetes patients attending the endocrinology clinic in Olabisi Onabanjo University Teaching Hospital. A sample size of 253 participants was recruited using the systematic random sampling technique. A well-structured questionnaire was developed for this study and was administered by trained research assistants. Information obtained was entered into SPSS version 24 and analysed.

RESULTS

Out of 253 respondents, one hundred and ninety (75.1%) had at least one diabetes complication. Co-morbidities were recognized among 104 (64.8%). All participants had HbA1c above the normal reference value of 6.5. Fasting blood glucose was within diabetes range among 154 (60.9%) patients. Neuropathy was the commonest (90, 36.0%). Age at diagnosis, duration of disease and presence of comorbidities were significantly associated with diabetes complications (P <0.05).

CONCLUSIONS

The prevalence of diabetes complication was high, the main complication was neuropathy. More than two-thirds had suboptimal glycaemic control. It is important to ensure appropriate measures to ensure tight glycaemic control to improve the quality of life.

Keywords*: Co-Morbidities, Complications, Diabetes mellitus*

***[Afr. J.** Health Sci. 2020 33(5): 98 -109*]

Introduction

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycaemia that result from defects in insulin secretion, or its action, or both. Diabetes mellitus is a chronic medical condition and constitute a major public health problem (1).

Globally, as of 2010, an estimated 285 million people had diabetes, with Type 2 Diabetes making up about 90% of the cases (2). This figure increased to 346 million by 2012, while the International Diabetes Federation has estimated further increase to 700 million by 2045 (1). Diabetes affects approximately 26 million people in the United States, while another 79 million have pre-diabetes (2). Besides, an estimated 7 million people in the United States have diabetes and do not even know it (3). The prevalence of Diabetes Mellitus in Nigeria was placed at 5.7% of the total population (4).

The incidence and prevalence of Diabetes Mellitus (DM) has continued to increase globally, despite a great deal of research, with the resulting burden resting more heavily on tropical, developing countries (5). It is predicted that the prevalence of DM in adults will increase in the next two decades and much of the increase will occur in developing countries where the majority of patients are aged between 45 and 64.5years. This projected increase in prevalence is attributed to population growth, ageing, westernized diet, urbanization, and increased prevalence of obesity and physical inactivity (6).

Over time, diabetes can lead to nephropathy, retinopathy, and neuropathy. These types of damage are referred to as microvascular disease. Diabetes is also an important factor in accelerating the hardening and narrowing of the arteries (atherosclerosis), leading to stroke, coronary heart disease, peripheral vascular disease, diabetes foot ulcer and other large blood vessel diseases. These are referred to as macrovascular disease (2). Acute complications include hypoglycemia, diabetic ketoacidosis, hyperglycaemic hyperosmolar state and lactic acidosis. The complications of diabetes mellitus are far less common and less severe in people who have well-controlled blood glucose levels (2).

This study was undertaken to obtain data on the complications of diabetes mellitus and determinants of the development of these complications. The findings would form the basis for future research and provide strategic preventive measures against major complications which could lead to poor quality of life and premature deaths in diabetic Nigerians. The study aimed to determine the prevalence of diabetes complications in patients attending Olabisi Onabanjo University Teaching Hospital Sagamu, Ogun State.

Materials and Methods

This study was conducted in the Olabisi Onabanjo University Teaching Hospital (OOUTH) Sagamu, Ogun State,

Nigeria, which was established in 1986. The hospital serves as a referral centre for neighbouring towns and villages in Ogun state and Lagos state, providing tertiary level of care to patients.

The study was a descriptive cross-sectional study involving patients attending the diabetes clinic in OOUTH from 1st of January, 2019 to 31st of December, 2019. The inclusion criteria required that patients be aged 18 years and above as well as type 1 and 2 diabetes patients. Patients with hyperglycaemia resulting from Gestational Diabetes Mellitus, Cushing syndrome and paraneoplastic syndrome were excluded from the study.

The sample size was calculated using Leslie Kish formula for single proportion with an absolute error of 5% allowed and prevalence of 15.3% from a study conducted in Lagos (7). The minimum sample size calculated was 195. However, to improve the power of the study, and allow for attrition, a sample size of 253 was used for this study. The total number of patients on follow-up at the diabetic clinic during the study period was 632. We recruited diabetic patients attending the clinic using the systematic random sampling method, with one out of every two clinic attendees recruited into the study.

A well-structured questionnaire was developed for this study, which had been pretested at the diabetes clinic of a neighbouring teaching hospital. The questions in the questionnaire were both open and close-ended and were administered by trained research assistants. Information was also retrieved from the case notes including socio-demographic data, co-morbid conditions, type of diabetes mellitus, the glycosylated haemoglobin level and complications.

Diabetes complications were determined based on clinical symptoms and signs and confirmed with appropriate investigations. Thereafter, patients' case notes were marked with a seal to prevent repeat selection.

Data obtained was entered and analyzed using SPSS version 26 (IBM Corp, Armonk, NY, USA). Categorical variables were summarized using frequency and percentages. Continuous variables were summarized using means and standard deviations. Chi-square was used to determine relationships between categorical variables. A p-value of less than 0.05 was considered statistically significant. Multivariate logistic regression was used to analyze the determinants of diabetes complications.

Ethical approval for the study was obtained from the Health Research Ethics Committee of Olabisi Onabanjo University Teaching Hospital. The research was conducted in adherence to the Revised World Medical Association Declaration of Helsinki. All the participants were counselled on the details of the study and written consent obtained. The study participants were assured of the confidentiality of data obtained from them.

Results

All tables are presented at the end of this article. Table 1 depicts the socio-demographic data of the respondents. The majority (123, 48.6%) of the patients were within the age group of 51-70 years. The mean age was 61.4±27.5 years. One hundred and forty-eight (58.5%) respondents were females. Yoruba was the main ethnicity 220 (87%). Most (68.1%) of them were married. Approximately 46% of the participants were traders whereas 59 (23.3%) were retirees. The respondents were mostly Christians 185 (73.1%).

Table 2 illustrates the biophysical features of the participants. About 40.3% of the patients had diastolic blood pressure range of 80-89 mmHg, 54 (21.3%) had a diastolic blood pressure of less than 80mmHg whereas 97(38.3%) had above 89 mmHg.

Regarding systolic blood pressure, the majority were above 140 mmHg, followed by 81(32.0%) with values less than 120 mmHg while 45 (17.8%) had systolic blood pressure range of 121-139 mmHg.

Concerning weight of the participants, majority112 (48.2%) were within the range of 70-89kg, eighty-nine (35.2%) were less than 70kg while those above 110kg were 7(2.8%). Most of the patients were obese, 89, (39.1%) were overweight and 46 (18.2%) had normal body mass index. The mean duration of disease was 14.6±7.9years.

Majority of the respondents were diagnosed with diabetes mellitus after the age of 50 years. Two hundred and seven (18.2%) patients were diagnosed with type 2 diabetes mellitus whereas 46 (18.2%) had type one diabetes mellitus. One hundred and ninety had at least one diabetes complication. Comorbidities were recognized among 104 (64.8%). The mean fasting blood glucose was 134.6±21.3 mg/dl Fasting blood glucose was within diabetes range among 154 (60.9%) patients. All participants had HbA1c above the normal reference value of 6.5. Only, 32 (12.7%) had HbA1c between 6.5 and 7 while 197 (77.8%) had HbA1c between 6.5 and 8.0. However, the mean HbA1c was 7.9±1.3, as represented on table 3.

Table 4 depicts various complications among study participants. Neuropathy was the most common 90 (36.0%), followed by diabetes foot syndrome.

Table 5 shows both bivariate and multivariate analysis of probable determinants of complications in diabetes mellitus. Using Chi-square, the age of presentation, age of diagnosis, duration of disease and presence of comorbidities were significantly associated with the occurrence of diabetes complications ($\chi 2$ =7.394, P=0.007, $\chi 2$ =24.019, P=0.000 $\chi 2$ =16.0576 P=0.004, $\chi 2$ =8.1865 P=0.000). However, using logistic regression only age at diagnosis of diabetes mellitus, duration of disease and presence of co-morbidities were significantly associated with complications [(AOR 0.164, 95%CI 0.046-0.592, P=0.006), (AOR0.323, 95% CI 0.1447-0.721,P=0.006), (AOR4.364, 95% CI 2.036-9.351, P=0.001)].

Discussion

Diabetes is a leading cause of morbidity and mortality from non-communicable diseases in Nigeria. The prevalence has been increasing progressively with concomitant rise in the microvascular and macrovascular complications. The aim of this study was to determine the prevalence of diabetic complications and probable determinants of these complications.

The mean age ± SD of the diabetic patients studied was 61.4 ± 27.5 years, which was slightly higher than 57.5 ± 10.4 years reported by Ashaye et al (8). This study showed a higher proportion of females than males. This is in consistence with a study by Alwaal-keel et al (9) in 2009 where 47% were males and 53% were females. This study also showed that 90.4% of patients were of Yoruba tribe perhaps because the study setting was in a predominantly Yoruba community. A larger percentage of the diabetic patients were traders. This agrees to the fact that the burden of diabetes mellitus is greatest in low-income and middle-income countries, where at least 80% of the people with diabetes live (10).

This present study reported that majority of the participants were obese (42.7%). This is contrary to findings in a case-control study where normal weight participants were the majority (2). Obesity is believed to account for about 80% of the risk of development of Type 2 Diabetes with body mass index reported to have a strong relationship to Diabetes and Insulin Resistance (11). Obesity contributes to insulin resistance by increasing the rate release of Non-Esterified Free fatty Acids (NEFA) (11). Approximately 38.3% and 50.2% of the patients had diastolic and systolic hypertension respectively.

Hypertension is an extremely common comorbidity of diabetes, affecting 20–60% of individuals with diabetes (9).

The prevalence of hypertension reported among diabetic population was 1.5 to 3 times higher than that of non-diabetic age-matched groups (9). The risk of vascular complications in diabetes is greatly increased by hypertension. Many patients with diabetes have hypertension at the time of diagnosis, while others develop hypertension as the duration of the disease lengthens (9).

It was learnt in this study that all of the patients had glycosylated haemoglobin (HbA1c) level greater than the normal reference range of 6.5%. However, only 12.6% had HbA1c within 6.5% - 7% which is the internationally recognized target for optimal glucose control. This finding was lower than 33.3% reported in United Arab Emirate (12). The elevated mean HbA1c in this study could be due to poor drug compliance which could be as a result of poor finances since most patients pay out of pockets to procure medications in the poor resource economies. Irregular routine clinic visits and inadequate social support especially in the aged population could affect patients' management outcome causing poor glycaemic control as depicted by elevated HbA1c values. In this study, all the study participants were on medications.

The overall prevalence of diabetes mellitus complications in the present study was 73.1%. This was higher than 15.3% and 59.7% reported in Lagos and Addis Ababa, Ethiopia respectively (7, 13). The high prevalence in this study could be due to the methods used in confirming these complications. In this study, clinical symptoms and signs with appropriate investigations were used to determine the presence of complications in among the study participants. Diabetes mellitus is characterized by hyperglycaemia and risk of specific complications. There is considerable evidence supporting the association of duration of hyperglycaemia and subsequent manifestation of complications. The relatively high prevalence of 75.1% in this study might be the reflection of long-term suboptimal glucose control as evidenced from the glycosylated haemoglobin level. Previous studies have shown that 80-85% of Type 2 Diabetics at the time of diagnosis have insulin resistance. Impaired β cell function occurs in 50% of newly diagnosed Type 2 Diabetics and after that there is linear decline in β cell number/function with time as a result of accelerated apoptosis (14). Glucotoxicity, lipotoxicity, proinflamatory cytokines and Islet cell amyloid deposition contribute to loss of β cell function/mass, hence, reduce insulin production, prolonged hyperglycaemia and increased incidence of complications (14).

In this study, 11.6% of the respondents had clinically evident retinopathy. A previous study done in the same region in Nigerian showed that 63.9% of type two diabetics developed retinopathy (4). The difference could be attributed to the fact that the participants in the latter study were only with type 2 diabetes. Furthermore, a similar study among type 2 diabetics noted that retinopathy occurred in about 50% of patients after seven years of diagnosis and could reach 90% after 20 years (15). Hence, the development of retinopathy is duration-dependent.

Nephropathy is the diabetes specific complication with greatest mortality. The development is usually preceded by microalbuminuria. In this study, 6.8% were reported to have nephropathy. This was similar to 5.7% reported by Odusan et al (10). Also, a similar study found that 83% of diabetes mellitus have microalbuminuria (16). This was surprising as microalbuminuria can occur in the presence of normal glomerular filtration rate. Subsequently, overt proteinuria might occur after 5 years of microalbuminuria in

patients destined to have end stage nephropathy secondary to hypertensive nephrosclerosis (16). It becomes important to routinely screen for microalbuminuria for early detection and treatment of those who will eventually develop end stage renal diseases. In contrast to retinopathy, the increase in prevalence of nephropathy is independent of the duration of diabetes.

Neuropathy was the most common complication in 36% of the respondents. This was lower than 61% found in the study performed by Eppens et al (17). In the latter study electrophysiologic studies were used to demonstrate subclinical abnormalities such as slow sensory and motor nerve conduction occurring after 5 to 10 years of diabetes (17). The prevalence of peripheral neuropathy and peripheral vascular diseases were 32.8% and 5.5% respectively. These complications are the major risk factors for diabetes foot ulcers. In this study, diabetes foot ulcers was 16.6% and often associated with long-term disability from amputation and morbidity.

Cardiovascular diseases were reported in 4.8% of the respondents. These include angina, myocardial infarction, ischaemic heart diseases and acute coronary syndrome. The occurrence of cardiovascular diseases is usually preceded by a constellation of risk factors such as dyslipidaemia, obesity and hypertension. However, diabetes mellitus still remains a major independent risk factor for cardiovascular diseases in the absence of the other factors.

Factors significantly associated with the presence of diabetic complications were the age at diagnosis, duration of diabetes and presence of comorbidities. The finding was consistent with a report from kayode et al (7) where duration of disease and presence of diabetes comorbidities had statistically significant effect on the development of complications in diabetic patients. These factors could be used to predict the prognosis of the disease and propensity to develop complications in such patients. The outcome of this study will provide assistance to the clinicians and the general population for better prevention and management of diabetes.

Limitations

Usage of only clinical signs and symptoms with biochemical parameters to confirm nephropathy. Urinary Albumin Excretion ratio using Albumin Creatinine Ratio is the gold standard for early detection of Diabetic Nephropathy. This was not done in our study due to exorbitant cost of reagents. Also the diagnosis of distal peripheral neuropathy in this study was mainly by documenting clinical signs and symptoms suggestive of neuropathy. Biotensiometry was not done to detect impaired vibration sense.

Conclusions

The prevalence of diabetes complications is high. Neuropathy was the most common complication. Glucose control among the respondents was suboptimal. Age of diagnosis, duration of disease and co-morbid conditions were significantly associated with the occurrence of complications.

Recommendations

Adequate monitoring and management of hyperglycaemia be undertaken. Screening of all newly diagnosed diabetics for microalbuminuria using albumin creatinine ratio for early detection and treatment of nephropathy is highly recommended .Type 1 Diabetes patients should have a complete eye examination within five years of diagnosis .Type 2 Diabetic patients should also have a comprehensive ophthalmologic review as part of the initial work up at diagnosis. It is also recommended that all patients should be screened for Distal Symmetrical Peripheral Neuropathy at diagnosis of Type 2 Diabetes and five years after diagnosis of type 1 Diabetes and all Diabetics should receive one

or more of the following tests annually: 10g monofilament to check for loss of protective sensation, ankle reflex, vibration, perception with 128Hz turning fork or a biotensimeter. All these will prevent the complications of diabetes, improve the quality of lives of patients living with Diabetes mellitus and also help clinicians provide holistic care to patients.

Acknowledgement

We wish to acknowledge the staff of the Endocrinology clinic of OOUTH for their contribution towards the completion of this research work. We also acknowledge all the participants that consented to be part of the study.

Institution and Department the work should be attributed

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Appendix

Table 1: Socio-Demographic Data of the Participants

Variable	Frequency	Percentage (%)
Age		
31-50	85	33.6
50-70	123	48.6
>70	45	17.8
Gender		
Male	105	41.5
Female	148	58.5
Tribe		
Yoruba	220	87.0
Hausa	7	2.8
Igbo	12	4.7
Others	14	5.5
Marital status		
Single	9	3.6
Married	223	88.1
Divorced/widow/widower	21	8.3
Occupation		
Trader	117	46.2
Artisan	28	11.1
Civil servant	29	11.5
Professional	20	7.9
Retired	59	23.3
Religion		
Christian	185	73.1
Islam	68	26.9
Level of Education		
Informal	46	18.2
Primary	80	31.6
Secondary	88	34.8
Tertiary	89	15.4

Table 2: Biophysical Features of the Participants

Variables	Frequency	Percentage
Diastolic BP(mmHg)		
<80	54	21.3
80-89	102	40.4
≥90	97	38.3
Systolic BP(mmHg)		
≤120	81	32.0
121-139	45	17.,8
≥140	127	50.2
Weight(kg)		
<70	89	35.2
70-89	122	48.2
90-109	35	13.8
≥110	7	2.8
Body mass index		
Normal	46	18.2
Overweight	99	39.1
Obese	108	42.7
Age at diagnosis		
15-30	27	10.7
31-50	91	36.0
>50	135	53.3
Duration		
≤5	21	8.3
6-10	46	18.2
11-15	53	21.0
15-20	57	22.5
<20	76	30.0

Table 3: Clinical Characteristics of Participants

Variable	Frequency	Percentage (%)
Type of Diabetes		
Type 1	46	18.2
Type 2	207	81.9
Diabetes complication		
Present	190	75.1
Absent	63	81.9
Co-Morbidity		
Present	164	64.8
Absent	89	35.2
Fasting Blood Glucose		
Normal	58	22.9
Impaired	41	65.2
Diabetic	154	60.9
HbA1c		
<7.0	32	12.7
7.0-8.0	165	65.2
<8.0	56	22.1

Table 4: Complications of Diabetes Mellitus among Study Participants

Complications	Frequency	Percentage (%)
Retinopathy	29	11.6
Acute hyperglycaemic event	23	9.2
Neuropathy	90	36.0
Nephropathy	17	6.8
Diabetic Foot Syndrome	42	16.6
Stroke	12	4.8
Erectile Dysfunction	12	4.8
Hypoglycaemia	47	18.8
Respiratory Infection	6	2.4
Cardiovascular diseases	12	4.8
Peripheral vascular diseases	14	5.5

Table 5: Determinants of Complications In Diabetes Mellitus

Variable	Without complication n(%)	With complication n(%)	P value	AOR	CI	P value
Age(years)						
≤50	30(61.9)	55(38.1)	*0.007	0.455	0.147-2.492	0.171
>50	33(19.6)	135(80.4)				
Gender						
Male	21(64.3)	84(35.7)	0.129	1.217	0.594-2.492	0.591
Female	42(62.5)	106(37.5)				
Age at diagnosis						
15-30	17(70.6)	10(29.4)	*0.000	0.164	0.046-0.592	*0.006
31-50	21(60.8)	70(39.2)		1.305	0.458-3.720	0.618
>50	25(18.5)	110(81.5)				
Duration of disease						
≤10	8(11.9)	59(88.1)	*0.004	0.323	0.145-0.721	*0.006
>10	55(30.4)	131(69.6)				
Type of diabetes mellitus						
Type 1	13(68.3)	33(31.7)	0.560	2.283	0.847-6.157	0.103
Type 2	50(55.6)	157(44.4)				
Alcohol consumption						
Yes	6(16.7)	30(83.3)	0.217	1.180	0.368-3.783	0.781
No	57(26.3)	160(73.7)				
Cigarette smoking						
Yes	3(23.1)	10(76.9)	0.876	0.707	0.138-3.634	0.678
No	60(25.0)	180(75.0)				
Family history						
Yes	2(13.3)	13(86.7)	0.285	1.440	0.240-8.633	0.690
No	61(25.6)	177(74.4)				
Fasting blood glucose						
>100	23(23.2)	76(76.8)	0.472	1.714	0.841-3.496	0.138
≥100	40(26.0)	114(74.0)				
Glycosylated Haemoglobin						
≤8	47(23.9)	150(76.1)	0.623	1.626	0.790-3.346	0.187
>8	16(28.6)	40(71.4)				
Co morbidity						
Present	54(32.9)	110(67.1)	*0.000	4.364	2.036-9.351	*0.001
Absent	9(10.1)	80(89.9)				

AOR- adjusted odd ratio; CI-confidence interval; *statistically significant p-values