



# Prevalence and Clinical Pattern of Acute and Chronic Complications in African Diabetic Patients

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## Authors' contributions

*This work was carried out in collaboration between all authors. Author USJ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MCO and EBP managed the analyses of the study. Authors MCO and EBP managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** The aim of this study was to describe the proportion, profile and clinical pattern of acute and chronic complications associated with diabetes and its potential risk factors.

**Study Design:** This was a retrospective study.

**Place and Duration of Study:** We conducted this study at an Accident and Emergency unit of a tertiary hospital between February 2012 and January 2013.

**Methodology:** Type 1 and Type 2 diabetes patients (18 years and older) that presented with diabetes-related complications within the study duration were studied. The emergency case record of patients who were brought in on account of diabetes complications was identified and information relevant to this research was extracted. Descriptive statistics was used to summarize data, while Chi-Square test was used for the categorical variables. Regression analysis was done to ascertain the risk factors associated with various complications.

**Results:** Two hundred and sixty-two cases of diabetes complication were reported. Males (159, 60.7%) and those in 1-5 years group (89, 34%) were the majority. The mean age was 55.2±13.2 (SD) years, while the mean diabetes duration was 9.9±7.8 (SD) years. A slight majority were hypertensive (138, 52.7%), with mortality reported in five patients (1.9%). Acute complications accounted for 47.3% of the reported cases, with hyperglycaemia being the most common (71, 27.1%). Microvascular complications were

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more common than macrovascular complications (47.8% vs. 19.6%).

**Conclusions:** More efforts focused on education programmes and early diagnosis through mass population screening, good glycaemic control, proper lifestyle modification through dieting and engaging in physical activity can forestall or reduce complications. Furthermore, government should seek ways to subsidize diabetes medication and make it affordable to the less privileged.

*Keywords: Epidemiology; diabetes; complications; clinical pattern.*

## 1. INTRODUCTION

Diabetes is projected to become one of the world's main disabler and killer within the next twenty-five years [1] and the developing countries in Africa are not left out. This can be attributed to increase in urbanization, which has resulted in a continuous generational paradigm shift of lifestyle from the customary African model to a more "western" standard. Also, healthier conventional lifestyles characterised by regular and vigorous physical activity accompanied by sustenance on high fibre whole grain-based diet rich in vegetables and fruits has been replaced by over-reliance on motorised transport and consumption of unhealthy diets rich in carbohydrates, fats, sugars, and salts [2]. The resultant effects of this "adopted" regime is a change in disease patterns with communicable diseases being replaced by non-communicable or life style related diseases like diabetes, obesity, cardiovascular disease and cancer [3].

Worldwide, some 382 million people or 8.3% of adults are estimated to have diabetes with about 80% living in low- and middle-income countries [4]. In Africa, 19.8 million people or 4.9% are estimated to have diabetes in 2013, an increase of 109% from 2012 [4]. Nigeria has a diabetes prevalence rate of 4.99%, while 105,091 deaths are diabetes-related. Although only 8.6% of all deaths in the Africa Region can be attributed to diabetes, in 2013 a staggering 76.4% of those deaths occurred in people under the age of 60 years [4]. Diabetes and its complications are major causes of early death in most countries, with cardiovascular disease being the leading cause of death among people with diabetes. Approximately 5.1 million people aged between 20 and 79 years died from diabetes in 2013, accounting for 8.4% of global all-cause mortality among people in this age group [4]. Moreover, in 2010 about 561 600 were permanently disabled and 6 458 400 experienced temporary disablement [5].

Diabetes mellitus is the most common endocrine disease affecting many different organ systems and over time, presents with a spectrum of syndromes and serious complications. Chronic complications from diabetes can be classified as microvascular or macrovascular. Microvascular complications include neuropathy, nephropathy and retinopathy [6]. Macrovascular complications include cardiovascular disease, cerebrovascular accidents (CVA), and peripheral vascular disease [7]. Acute complications include hyperglycaemia, diabetic ketoacidosis (DKA) and hypoglycemia. In Nigeria as in the rest of sub-Saharan Africa, the late diagnosis of diabetes and lack of regular monitoring of patients coupled with inequalities in accessing care, leads to early presentations of diabetic complications [8]. Also certain cultural beliefs have hindered several individuals with undiagnosed diabetes from getting proper check up and possibly treatment. As the prevalence of diabetes grows in low and middle-income countries, so too does the impact of these costly human and economic complications. Maintaining blood glucose levels, blood pressure and cholesterol close to normal can help delay or prevent diabetes complications [4].

Identification and treatment these complications are necessary if we are to reduce the incidence of diabetes-related deaths. Furthermore, the effectiveness and efficiency of any diabetes complication prevention programme depends on an adequate and up-to-date epidemiological database. This is lacking in Nigeria at this time, as there is a dearth of published data on diabetes-related complications in the last decade. The few available ones focused on specific complications such as foot ulcers, autonomic neuropathy, retinopathy and microalbuminuria. It is therefore imperative to report on both acute and chronic complications of diabetes to check its prevalence so as to develop locally based evidence-based strategies for their prevention. The aim of this study was to describe the prevalence, profile and clinical pattern of acute and chronic complications associated with diabetes and its potential risk factors.

## **2. METHODS**

This retrospective study included Type 1 and Type 2 diabetes patients (18 years and older) that presented at the Accident and Emergency unit of the Jos University Teaching Hospital (JUTH), Jos, Nigeria with diabetes related complications from February 2012 to January 2013. Jos University Teaching Hospital is the only tertiary hospital in Plateau State, North-central Nigeria. It caters for medical and surgical cases within Plateau State and sometimes receives referrals from neighbouring states. The emergency case record of patients admitted at the Accident and Emergency unit were analysed and those who were brought in on account of diabetes complications were identified and information relevant to this research was extracted and recorded into a predesigned proforma. Information retrieved included sociodemographic data such as age, gender and duration of diabetes. Other relevant data collected were diabetes complication, history of hypertension and compliance with medication.

Data generated were entered and analysed using the Statistical Package for Social Sciences (SPSS) IBM version 17.0. The descriptive statistics of the sociodemographics and clinical variables are expressed as percentages, means and standard deviations, while Chi-Square test was used to test for significance of associations between the predictor and outcome variables in the categorical variables. Regression analysis was done to find out the strength of association of risk factors with specific complication.

## **3. RESULTS**

### **3.1 Clinical Characteristics and Demographics**

Out of 2470 medical cases that was brought to the Accident and Emergency unit within the study period, 262 (10.6%) had diabetes complications. Table 1 shows that majority were males (159, 60.7%), and 103 (39.3%) were female. The mean age was  $55.2 \pm 13.2$  (SD) years. There were 41 (15.6%) with type 1 and 221 (84.4%) with type 2 diabetes. The mean diabetes duration was  $9.9 \pm 7.8$  (SD) years, with those in 1-5 years group being the majority (89, 34%) and those who were diagnosed greater than 15 years ago being the least represented (34, 13%). A slight majority of the patients were hypertensive (138, 52.7%), with mortality reported in five patients (1.9%).

**Table 1. Sociodemographic and clinical characteristics of patients**

<b>Variable</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Age</b>		
18-20 years	2	0.8
21-30 years	12	4.6
31-40 years	28	10.7
41-50 years	49	18.7
51-60 years	83	31.7
61-70 years	66	25.2
71-80 years	15	5.7
81-90 years	7	2.7
<b>Gender</b>		
Male	159	60.7
Female	103	39.3
<b>Type of Diabetes</b>		
Type 1	41	15.6
Type 2	221	84.4
<b>Hypertensive</b>		
Yes	138	52.7
No	124	47.3
<b>Regular on medication</b>		
Yes	110	42.0
No	152	58.0
<b>Duration of Diabetes</b>		
1-5 years	89	34.0
6-10 years	72	27.5
11-15 years	67	25.6
Greater than 15 years	34	13.0

### 3.2 Acute Complications

Acute complications accounted for 47.3% (124) of the reported cases of diabetes complications. Hyperglycaemia was the most common (71, 27.1%) acute complication, followed by DKA (32, 12.2%) and hypoglycaemia (21, 8.0%). Younger age was significantly associated with DKA ( $p=.00$ ) and hypoglycaemia ( $p=.00$ ), hyperglycaemia was associated with middle age to young elderly (41-70 years) ( $p=.04$ ). Poor compliance with medications was associated with hyperglycemia ( $p=.00$ ) and DKA ( $p=.03$ ). Furthermore, new diabetes was also associated with hyperglycaemia ( $p=.00$ ), hypoglycaemia ( $p=.00$ ) and DKA ( $p=.00$ ). Type 1 diabetes was associated with DKA ( $p=.04$ ) and hypoglycaemia ( $P=.00$ ), while type 2 diabetes was associated with hyperglycaemia ( $p=.00$ ).

### 3.3 Chronic Complications

Chronic complications made up a slight majority of the reported cases of diabetes complications (138, 52.7%). Microvascular complications was the most reported chronic complication (66, 47.8%), followed by foot ulcers (28, 20.3%) and macrovascular complications (27, 19.6%). Diabetes was associated with an infectious syndrome in 12.3% (17) of the chronic cases, with sepsis being the most common (13, 76.5%). Retinopathy was found in 17.2%, nephropathy in 16.1%, peripheral neuropathy in 24.7%, autonomic

neuropathy in 14.0%, cerebrovascular accident in 6.5%, cardiovascular complications in 21.5%.

Macrovascular complications was associated with poor compliance with medication ( $p=.02$ ) and being hypertensive ( $p=.00$ ), while microvascular complications was associated with duration of diabetes mellitus ( $p=.03$ ). Age was associated with both microvascular ( $p=.00$ ) and macrovascular complications ( $p=.00$ ).

There was a significant difference between the duration of diabetes and diabetic microvascular complications such as autonomic neuropathy ( $p=.00$ ), retinopathy ( $p=.03$ ), nephropathy ( $p=.00$ ) and peripheral neuropathy ( $p=.00$ ). Age correlated with peripheral neuropathy ( $p=.00$ ) and retinopathy ( $p=.00$ ), while poor compliance with medication was associated with nephropathy ( $p=.04$ ). Type of diabetes was associated with nephropathy ( $p=.04$ ) and peripheral neuropathy ( $p=.01$ ). There was a significant difference between duration of diabetes and macrovascular complications such as cerebrovascular accidents ( $p=.01$ ), ischemic heart disease (IHD) ( $p=.00$ ) and sepsis ( $p=.00$ ). Ischemic heart disease was significantly associated with being hypertensive ( $p=.04$ ), older age ( $p=.03$ ) and compliance with medication ( $p=.03$ ).

#### **4. DISCUSSION**

In Nigeria as in other developing countries, the prevailing burden of communicable and infectious diseases is already heaping enormous pressure on the health care system. Therefore the rise of non-communicable diseases such as diabetes mellitus only adds to the high economic burden on the health system. A major resultant effect of this economic burden will be poor management of diabetes, leading to diverse acute and chronic complications and even deaths. It therefore requires identification of diabetes as a public health priority by raising awareness on prevention and management initiatives, gaining political attention and seeking for financial investment. This will subsequently produce better health outcomes, health gain and improved quality of life for diabetics.

The high proportion of type 2 diabetics in this study (221, 84.4%) is in line with other studies in Africa which have reported type 2 prevalence rates of between 76% and 90% [9, 10]. This can be attributed to the rising levels of obesity, physical inactivity and change in diet patterns. Even though diabetes affects more elderly than young adults in developed countries [11], our study found a relatively younger age ( $55\pm 13$  years) and diabetes duration ( $9\pm 7$  years). This is plausibly due to differences in geography, for example the life expectancy is higher in western climes as compared to Africa. Earlier, a study carried out in six sub-Saharan African countries, found a mean age of  $53\pm 16$  years and a mean duration of diabetes of  $8\pm 6$  years [12]. Also a recent report by the international Diabestes Federation [4] shows that almost half of all adults with diabetes are between the ages of 40 and 59 years, with more than 80% of them living in low- and middle-income countries. We found a higher male to female ratio, a finding which is at variance with other African studies [8,9,11,12]. While most of these studies were cross-sectional, ours was retrospective and may have contributed to this contrast.

Hyperglycemia was the most common acute complication affecting more than a quarter of the patients, with type 2 diabetes patients being mostly predisposed. Hyperglycaemic state was significantly associated with newly diagnosed diabetes and poor glycaemic control resulting from lack of adherence to medication. Previous studies in Africa have revealed that history of hyperglycaemia was significantly associated with newly diagnosed diabetes [9,13].

Newly diagnosed patients with diabetes are less likely to be knowledgeable about hyperglycaemia, including how to detect its signs and symptoms which is necessary to avert hospitalizations. This can be attributed to widespread poor knowledge about diabetes and its complications, resulting from either illiteracy or a dearth of diabetes education by health professionals. Patient education is extremely important and education programs can reduce rates of admissions from acute hyperglycemic episodes.

Hypoglycemia is the leading limiting factor in the glycemic management of type 1 and insulin-treated type 2 diabetes [14] and may be an obstacle to the use of insulin [15]. In Nigeria, hypoglycemia is the most frequently documented problems encountered by persons on insulin [16]. This may portend more problems as the individual who may abandon his medication out of fear of developing hypoglycaemia, will only be at risk of developing further complications. The preponderance of hypoglycaemia in younger age groups and new diabetes in this study may plausibly be linked to naiveté and poor knowledge of insulin use in relation to physical activity, food intake (delayed or skipped meals) and variation in absorption of circulating insulin from subcutaneous depots. While teaching diabetics to balance insulin use with carbohydrate intake and exercise is necessary, it may not always be an adequate approach due to natural defects such as hypoglycemia-associated autonomic failure [17]. Appropriate education regarding diabetes management and self-care, self-monitoring of blood glucose, and recognition of factors that may precipitate hypoglycaemia is an essential component of diabetes management for insulin requiring patients with diabetes.

In some individuals, particularly those with type 1 diabetes, diabetic ketoacidosis may be one of the initial manifestations of diabetes. In our study, DKA was significantly associated with newly diagnosed and type 1 diabetic. Precipitating factors for DKA in those with established diabetes include infection, other acute illnesses, lack of diabetes education and training, noncompliance, poor self-care, inadequate glucose monitoring, psychological problems, and indeterminate causes [18,19]. While prevention remains the most important aspect of managing DKA in known diabetic persons, regular glucose monitoring and recognition of the disorder is advocated for individuals who are at risk of developing diabetes to forestall the occurrence of DKA. A few studies have shown reductions in DKA hospitalizations accompanying patient education, follow-up care, and increased access to medical advice [20].

This findings further increases pressure on policy makers to establish and strengthen diabetes education programmes among the population, particularly as morbidity and mortality from acute diabetic complications remains very high in sub-Saharan Africa [13,21]. Furthermore, errors in management as shown by poor adherence to medication may be due to poor financial status of diabetics in sub-Saharan Africa [11] who may have problems paying for medications and monitoring supplies. It is imperative that diabetes medications be subsidized for the benefit of those who cannot afford it as it is done for communicable diseases such as HIV, considering that diabetes is reaching an epidemic status. The above measures will not only prevent acute complications, but serve to forestall the development and progression of a number of chronic complications associated with acute complications such as hyperglycaemia [22,23].

Microvascular complications were more frequent than macrovascular complications, a finding which agrees with other studies both regional [24] and international [25]. Also, that foot ulcers were more reported than macrovascular complications agrees with an earlier report in Nigeria [26] which attributes 15% of hospital admissions for diabetes to foot ulcers. In Nigeria, many individuals are not diagnosed with diabetes until they develop foot ulcers

and report to the hospital probably due to widespread poor knowledge of diabetes and its complications. Foot ulcers and amputations will therefore continue to increase because undiagnosed diabetics are oblivious of appropriate foot care and foot ulcer prevention strategies. Also with peripheral neuropathy the main risk factor in the pathogenesis of foot ulceration in diabetic patients [27] being the commonest microvascular complication in this study, only further adds to the burden of foot ulcers.

Complications of diabetes can be prevented by adhering to medication regimen which results in good glycemic control, prompt treatment of hypertension and appropriate lifestyle modification among others. In this study, macrovascular complications were associated with poor compliance with medications (which translates to poor glycemic control) and hypertension. More than 70% of people with diabetes have high blood pressure or are being treated with medications for hypertension [7], a major risk factor for cardiovascular disease among diabetics who have a poorer outcome as compared to non diabetics [28]. The 10 mm Hg decrease in blood pressure needed to reduce a person's risk for any diabetic complication by up to 12% [29] can only be achieved through good glycemic control, proper dieting along with physical activity and adherence to both diabetes and anti-hypertensive medications. In Nigeria, programmes to promote adoption of healthy activity schedules are lacking, despite the acknowledged benefits of exercise for people with diabetes. This is probably due to over dependence on pharmacological interventions, even though it has been shown that risk factor prevalence for diabetes complications remains high even where pharmacological intervention is available [9]. While advocating for good glycaemic control, diabetes educators should promote and encourage adoption of physical activity in addition to devoted medication regimen and dieting.

The prevalence of the investigated chronic diabetic complications was found to increase with age in this study, a finding which is consistent with the results of other studies [30,31]. Also majority of the microvascular and macrovascular complications (especially CVA and IHD) was positively associated with the duration of disease, irrespective of the patients' age, a finding previously reported in another study [30]. Even though we cannot conclude that duration of diabetes is a risk factor for chronic complications due to the limitations of retrospective study on causation, the results point to the fact that it may be safe to consider duration of diabetes as a potential risk factor for the development of chronic complications. This will aid to focus more attention on prevention of diabetic chronic complications in patients with longer disease duration. With the association of hyperglycemia with type 2 diabetes in this study, it is not surprising that neuropathy was more common among type 2 diabetics since the primary risk factor for diabetic peripheral neuropathy is hyperglycemia [32]. Nephropathy was more prevalent in newly diagnosed type 2 probably because the actual onset of type 2 diabetes may precede its clinical diagnosis by many years [33]. Since the presence of albuminuria may not necessarily be specific for the presence of diabetic nephropathy, medical and health professionals should also be on the lookout for diabetes mellitus where there is albuminuria.

A few of the reported cases of diabetes complications in our centre was associated with infection, with sepsis being the majority. Studies have reported a 2.5-fold increased risk for hospitalization with sepsis in diabetic individuals compared to the general population [34], and a two to three fold increased risk of bacteremia and sepsis originating from the urinary tract compared with those without diabetes [35]. It is worrisome that future estimate of diabetes trends have not considered infections as a risk factor for diabetes complications, since the potential impact of these associations could affect the future diabetes burden. It is

vital that awareness of these associations be promoted so that complementary and integrated programmes in these disease areas can be planned [36].

The prevalence of diabetes complications can be reduced by a multidisciplinary approach from physicians, dieticians and physical therapists with the patient playing a pivotal role because emphasis on changing lifestyle alone may create management problems for the individual. While the physician deals with the pharmacological aspects and modifies medication according to the blood glucose level that may be affected by the alteration in the patients diet by the dietician, the physical therapists advices and integrates an optimum exercise regimen in accordance with the patients' blood glucose. The individual is at the focal point of ensuring prompt and regular blood glucose level checks to generate data that will aid health professionals in adjusting medication, insulin, food and physical activity levels accordingly.

## **5. CONCLUSION**

This study has brought to the fore the prevalence and pattern of acute and chronic diabetes complications in an African population where diabetes education, early diagnosis and complications preventive strategies are sorely lacking. Acute complications was associated with younger age, type of diabetes and poor adherence to medication, while chronic complications was associated with older age, duration of diabetes, being hypertensive and poor compliance with medication. Early diagnosis is of utmost importance in the prevention of diabetes complications especially in sub-Saharan Africa and Nigeria in particular where knowledge of diabetes is inadequate. Furthermore, awareness on prevention of complications should be raised among patients who have already been diagnosed with diabetes though a multidisciplinary approach from physicians, dieticians and physical therapists.

## **CONSENT**

Not applicable.

## **ETHICAL APPROVAL**

We hereby declare that the study protocol have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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