

PROGNOSTIC INDICES OF DIABETES MORTALITY

Anthonia Okeoghene Ogbera, MBBS, MPH; Sunny Chinenye, MBBS;
Asabamaka Onyekwere, MBBS; Olufemi Fasanmade, MBBS

Introduction: Diabetes mellitus is an important cause of morbidity and mortality worldwide and the burden associated with it is felt more in developing countries. Communicable diseases, as opposed to non-communicable diseases, remain a top priority in developing countries like Nigeria. This report sets out to highlight the current status of diabetes-related hospitalizations in Nigeria and also to make comparisons with past reports. This goal will be achieved primarily by determining the prognostic factors associated with diabetes mortality and also noting the duration of hospital stay for the major causes of diabetes deaths.

Method: From January through December 2006, subjects with diabetes mellitus (DM) in a tertiary hospital in Nigeria were prospectively studied after admission to assess their short-term outcome which was defined as death. The total mortality, causes of death, associated complications and duration of hospital stay were noted. The predictive factors for DM morbidity were evaluated using chi test, logistic regression. Student's *t* test was computed for quantitative data.

Results: A total of 1,327 subjects were admitted to the Medical wards for the duration of the study and the crude death rate was 11%. DM related admissions made up 206 (15%) of all the medical admissions and the case fatality rate was 33 (16%). The most common reasons for DM admission were hyperglycaemic emergencies (HE), 88 (40%) and hypertension, 44 (21%). The most common causes of deaths were HE, 15 (46%) and DM foot ulcers (DFU), 10 (30%) while DFU and cerebrovascular accident (CVA) had the highest case fatality rates of 28% and 25% respectively. DFU had the most prolonged duration of admission ranging from 15–122 days. DFU, CVD and having type 2 DM were highly predictive of fatal outcomes. The odds ratio and 95% CI for these factors were 4.5 (1.5–12.7), 3.0 (0.9–9.92) and 3.1 (0.7–14) respectively.

Conclusion: DFU and HE are potentially remediable causes of mortality in DM. DFU as seen by the prolonged hospital stay imposes a huge burden on health resources. Better and early intervention of DFU is necessary to reduce the resultant disease burden. (*Ethn Dis.* 2007;17:721–725)

Key Words: Diabetes Mellitus, Hospitalization Length of Stay

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder that is estimated to affect ~150 million people. A doubling of this figure is expected in the near future, especially in the African and Asian continents.^{1–2}

Gross underreporting of DM occurs in African countries and may, in part, be due to the absence of research funding and lack of technical expertise. Nearly a decade ago, the prevalence of DM in Nigeria was 2.2%.³ Isolated reports from some regions of Nigeria have found prevalence rates to range from 0.9–8.3%.^{4,5}

Diabetes mellitus is associated with considerable morbidity and mortality.⁵ In Nigeria, where healthcare services and accessibility are poor, DM is associated with a high disease burden.⁶ People with diabetes have been shown to have higher mortality rates than people without diabetes, although mortality rates depend on the location and the specific group reported.⁷ In Africa, DM probably has the highest morbidity and mortality rates of all chronic non-infective diseases.⁸ Unfortunately, in Nigeria, communicable diseases remain the priority health condition for the Ministry of Health. The importance of noncommunicable diseases as a signifi-

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cant contribution to disease burden in Nigeria is highly underscored. Most of the reports on morbidity and mortality rates of diabetes in Nigeria were made in the 1960s and 1970s and therefore may not reflect the current situation.^{4,9–10} These reports showed that diabetes ketoacidosis was the most common acute complication and cause of DM fatalities.

This study sets out to bridge the information gap on DM in Nigeria; we documented the patterns of DM mortality and morbidity, prognostic factors affecting fatal outcomes, and DM-related hospitalization lengths of stay. The information from this report will be of clinical significance to clinical researchers and clinicians who provide health services for people with DM.

METHODOLOGY

This prospective study was carried out in a tertiary facility in Nigeria. This facility has three medical wards: two male and one female ward. The total bed capacity for the three wards is 63 (25 beds for females and 38 for males). The medical wards cater to people ≥ 12 years of age. This study took place from January to December 2006. The total number of all the medical and DM-related admissions to the medical wards were documented. For the DM-

From the Department of Medicine, Lagos State University Teaching Hospital, Ikeja, Lagos State (AOO, AO, OF); the Department of Medicine, University of Port-Harcourt Teaching Hospital, PortHarcourt (SC), Nigeria.

Address correspondence and reprint requests to: Anthonia Okeoghene Ogbera, MPH; Lagos State University Teaching Hospital; Ikeja; Lagos State; Nigeria; 01-7917077; oogbera@yahoo.co.uk

related admissions, we abstracted data including: biodata, admittance diagnosis, comorbidities, length of hospital stay, and mortality data.

The diagnosis of DM was made using the WHO 1999¹¹ criteria for those who did not have a prior history of DM. For those with a prior history of DM, records were checked to ascertain that the 1984 WHO¹² diagnostic criteria for diagnosis of DM were used.

The patients were prospectively studied after admission to assess their hospitalization outcomes. We gathered information at frequent intervals from the wards' registers, which document the admittance diagnosis, information related to hospital stay, and hospitalization outcome. The primary outcome was adverse outcome or death and the risk factors associated with it were studied. Case fatality and crude death rates were computed and the prognostic factors for fatal outcomes were determined. Admission and case fatality data were compared in three age groups; ≤ 34 years of age, 35 to 64 years of age and ≥ 65 years of age. The numbers of those discharged by the attending physicians and those discharged against medical advice were also noted.

Length of hospital stay was computed for those who were discharged by the attending physicians and comparisons were made between the various DM hospitalization diagnoses. Statistic tests used included Student's *t* test, chi square and logistic regression to determine and compare means, comparison of qualitative data and odds ratio. Significance level was set at a *P* value $< .05$. The statistical package used for analysis was SPSS version 11.

This study was approved and consent given by the research and ethics committee of the hospital.

RESULTS

A total of 1,327 subjects were admitted to the medical wards within

Table 1. Reasons for admissions for subjects with DM

Admission diagnosis	Frequency
Hyperglycemic emergencies (HE)	82 (40%)
Poorly controlled blood pressure	44 (21%)
DM foot ulcers (DFU)	36 (17.5%)
Cerebrovascular disease (CVD)	20 (9.8%)
Hypoglycemia	7 (3%)
Peptic ulcer disease (PUD)	6 (3%)
Tropical hand ulcer (TDHS)	2 (1%)
Koch's disease	2 (1%)
Retroviral infection	1 (0.7%)
Chronic renal failure	6 (3%)
TOTAL	206 (100%)

the one-year period of the study. Diabetes mellitus-related admissions made up 206 (15%) of all the medical admissions. The total deaths recorded for the duration of study was 150, thus giving a crude death rate of 11.3%. Of the DM-related admissions, 33 (16%) died, 166 (80%) were discharged, and 7 (4%) insisted on being discharged from the hospital against medical advice.

Some clinical features of hospitalized subjects with DM

The male:female ratio of the medical and DM admissions were 1.1:1 and 1.6:1, respectively. Patients with type 1 DM and type 2 DM made up 26 (13%) and 180 (87%) of the total DM patients hospitalized, respectively. The mean age and standard deviation (SD) of all the DM subjects was 55 (14) years and the range was 17–91 years of age. The mean ages (SD) of the subjects with type 1 DM and type 2 DM were 29 (11) and 59 (6) years, respectively. The difference in ages between subjects with type 1 DM and those with type 2 DM was statistically significant ($P = .000001$).

Hospitalization patterns for DM

Some of the comorbidities – hypertension or poorly controlled blood pressure, peptic ulcer disease, retroviral infection, Koch's disease, and congestive heart failure – occurred in 44 (21%), 6 (3%), 1 (0.5%) 3 (1.5%) and 3(1.5%) of all the DM subjects, re-

spectively. Hyperglycemic emergencies referred to diabetic ketoacidosis (DKA) and hyperosmolar non-ketotic state (HONKS). DKA accounted for 72 (88%) while HONKS accounted for 10 (12%) of all the hyperglycaemic emergencies.

The various hospitalization diagnoses for subjects with DM are shown in Table 1. The mean age (SD) of subjects with hypertension was 61 (12) years of age and the female:male ratio for those with hypertension was 1:1.2. Six DM subjects presented with cerebral vascular accident (CVA) and also had a prior history of hypertension, thus accounting for 30% of all cases of DM and CVA.

Hospitalization duration of diabetic admissions

The mean (SD) hospital stay of DM admissions was 23 (17 days) and the range of this duration was 4–122 days. The mean (SD) of length of hospital stay and range for DM foot ulceration (DFU) was 51(27) days, ranging from 15–122 days. Length of stay for diabetes ketoacidosis and cerebrovascular disease were 13 (7) and 30 (8) days, respectively. For subjects with DM who were admitted for control of elevated blood pressure, the mean (SD) length of hospital stay was 21(10) days. The length of stay for those admitted with DKA, CVA and hypertension were compared with that of DFU; statistically significant differences of .00001, .03 and .000001 were found.

Table 2. Causes of deaths in DM subjects

Causes of death	% of total DM deaths	Case fatality rate
HE	15 (46%)	18%
CVA	5 (16%)	25%
DFU	10 (30%)	28%
Hypoglycemia	1 (3%)	14%
CRF	1 (3%)	16%
Bleeding PUD	1(3%)	16%

HE= Hyperglycemic emergencies; CVA=cerebral vascular accident; DFU=diabetic foot ulcer; CRF=chronic renal failure; PUD=peptic ulcer disease.

Diabetes Mellitus-Related Mortality

The total medical deaths recorded during the study was 150, thus giving a crude death rate of 11.3%. The male:female ratio of those who died is 1.6:1 and the mean age of the DM patients who died was 58 (14) years.

Diabetes mellitus-related deaths made up 22% or one of five of all the medical deaths. The case fatality rate for DM was 33 (16%) and the male:female ratio of the DM-associated mortality was 2:1. There was no significant difference between the case fatality rate and the crude death rate ($P < .05$). Type 1 DM accounted for 2(6%) of all deaths while type 2 DM accounted for 31(94%) of all deaths. The causes of DM deaths and case fatality rates are showed in Table 2.

Diabetes mellitus foot ulceration was found to be the most important factor affecting fatal outcome of DM. The odds ratio and 95% confidence interval (CI) for DFU were 4.46 and 1.5–12.7. The odds ratio and CI for CVA, type 2 DM, DKA, being male, elderly and hypertensive were 3, 0.9–9.92; 3.16, 0.703–14; 2.51, 0.9–6.39; 1.52, 0.68–3.37; and 0.286, 0.08–0.99, respectively. Only 1 (17%) of the DM subjects with CVA and a prior history of hypertension died.

Two times more males than females with DM died and this difference was statistically significant (χ^2 [2] test = 17.7 ($P = .0008$).

Clinical features, morbidity and mortality data of the subjects according to the age classes are shown in Table 3.

DISCUSSION

Diabetes mellitus is a significant contributor to medical morbidity and mortality worldwide; it is even more apparent in developing countries like Nigeria.^{12–13} The determination of the risk factors that are predictive of DM mortality are important in view of prevailing shortcomings such as management capacity and resource availability in the region for the management of DM. In this report, DM admissions accounted for 15% of all medical admissions and 22% of all medical deaths. These facts demonstrate a worsening condition for DM-related admissions and deaths in Nigeria. An earlier study by Ogbera et al¹⁴ reported cumulative DM admission rates and death rates of 10% and 7.6%, respectively. These figures were obtained from a 10-year survey from 1990–2000.¹⁴ The findings of this report are not

surprising given the projected worldwide increase in the prevalence of DM, especially in developing countries.^{1–2} With this projected increase in prevalence rates in DM, the morbidity and mortality rates are expected to assume an upward trend especially in regions of the world where healthcare services are at best sub-optimal for the rapidly expanding populations.

In our study, the majority of hospitalized subjects had type 2 DM and their mean age was 55 years. This overwhelming preponderance of type 2 DM is in conformity with global views concerning the predominance of type 2 DM among diabetics.¹²

More than half of the DM subjects were admitted for management of hyperglycemic emergencies of which DKA and severe hypertension were predominant. Although the duration of DM was not documented in this report, it is pertinent to note that a small percentage (10%) of those presenting with hyperglycemic emergencies were only diagnosed at presentation with acute complication of DM. Arterial hypertension is a common cardiovascular disease in Africans and carries high mortality and morbidity rates. Reported prevalence rates of hypertension in Nigerians with DM range from 29–40%.^{15–16} Because hypertension was not recorded in subjects <35 years of age, it is thus not surprising that the mean age of DM subjects with hypertension was found to be 61 years.

The case fatality rate of 16% is higher than the crude mortality rate of all the medical admissions (11%), but this difference was not statistically significant. The case fatality rate for DM was lower than that reported by the author¹⁴ previously and Ndububa¹⁷ et al

Table 3. Morbidity and mortality data according to the age groups

Age Classes	DM admissions	Hypertension	DM-related deaths
<34 years	20 (10%)	0	2 (6%)
35–64 years	116 (56%)	23 (52%)	19 (57.6%)
>65 years	70 (34%)	21 (48%)	12 (36.4%)

who reported rates of 22% and 21%, respectively. More male deaths than female deaths were recorded, thus being male was found to be predictive of a fatal DM outcome. An overwhelming majority (94%) of the DM-related deaths occurred in those with type 2 DM; type 2 DM had a prognostic impact on DM death. Hyperglycemic emergencies were found to be the most common reasons for DM-related admissions and deaths, following trends found throughout the African continent.¹⁸⁻²¹ The case fatality rate for HE in this report is lower than that reported by the author in a previous study.¹⁴ In the present study, 87% of DM patients had type 2; the remaining patients had type 1 diabetes. The overall incidence of DKA was, however, 88%, which suggests that the majority of hyperglycemic emergencies in Nigerian type 2 patients were DKA. This finding is contrary to findings from the United States and Europe where the majority of hyperglycemic emergencies in type 2 patients are due to HONKS. In a review of 138 admissions to the University Diabetes Treatment Center at Parkland Memorial Hospital in Dallas for moderate-to-severe DKA, only 30 (0.2%) had type 2 diabetes, based on treatment history and/or autoantibody status.²² This observed difference may be partly due to poor characterization of DM and the hyperglycemic emergencies in Nigeria.

Diabetes foot ulceration, which was the second most common cause of death, had the highest case fatality rate. This entity is recognized as one of the most devastating complications of DM, which imposes a heavy burden on DM patients. The reported prevalence rates of DFU in Nigeria range from 9.5%–14%.²³⁻²⁵ In a previous report, the author had earlier reported a high case fatality rate (53%) for hospitalized patients with DFU.²⁴ Some of the reasons for this high rate of fatality for those admitted with DFU range from late presentation, erroneous traditional beliefs, and high costs of treatment. In

this study, DFU was found to be highly predictive of a fatal outcome as indicated by an odds ratio of 4.46 and 95% CI of 1.5–12.7 ($P=.005$).

Cerebral vascular accident (CVA) accounted for 16% of all DM deaths and had the second highest case fatality rate. It was also highly predictive of fatal DM outcome.

The significance of DFU as contributory to a high disease burden is further validated by the findings of prolonged hospitalization. The mean length of hospital stay for subjects with DM was 51 days. This duration of hospitalization was higher than any of other major causes of DM deaths and the difference was statistically significant. The presence of hypertension was not a significant contributory factor to DM outcome; only one of the subjects with CVA died. This finding is contrary to a Nigerian study of 51 hypertensive and 54 normotensive type 2 diabetic Nigerians in which stroke-associated deaths occurred in 8 subjects (7.6%), and all the stroke-related deaths occurred in the hypertensive group causes of death.²⁶

CONCLUSION

This study has shown that predictive factors for DM mortality include diabetes foot ulceration, hyperglycaemic emergencies, type 2 DM, being male and being elderly. The outcomes seen in this report may be attributed to poor glycemic control, as well as poor guidelines for management.

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which may be attributed largely to better DM awareness, better management modalities and improved access to insulin than what was common a few decades ago.

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AUTHOR CONTRIBUTIONS

Design concept of study: Ogbera, Onyekwere, Fasanmade
Acquisition of data: Ogbera, Chinenye, Fasanmade
Data analysis and interpretation: Ogbera, Fasanmade
Manuscript draft: Ogbera, Chinenye, Onyekwere, Fasanmade
Statistical expertise: Ogbera
Acquisition of funding: Fasanmade
Administrative, technical, or material assistance: Onyekwere, Fasanmade
Supervision: Chinenye, Fasanmade