

Original Research Paper

Epidemiology of diabetic emergencies in the adult emergency department of a tertiary hospital in South-eastern Nigeria

Running title= Epidemiology of diabetic emergencies in the ED in Nigeria

ABSTRACT

Background: Diabetic emergencies (DE) are life threatening complications of diabetes mellitus (DM). As the case detection of DM increases in Nigeria, adult diabetic Nigerians are likely to be challenged by DE that predispose them to higher risk of disability and premature death.

Aim: The study was aimed at reviewing the epidemiology of diabetic emergencies in the adult emergency department(ED) of a tertiary hospital in South-eastern Nigeria.

Materials and methods: This was a retrospective descriptive study that was conducted on patients who presented with diagnoses of DE to the ED of Federal Medical Centre, Umuahia, Nigeria. The sources of data were from patients' case notes; nurses report books, ED admission registers and medical records. Information collected were age, sex, time of presentation to the ED, month (season) of occurrence, type of DE and associated cardiovascular conditions.

Results: The age ranged from 25 years to 81 years with mean age of 52.2 ± 8.4 years. There were 86 (55.1%) males and 70 (44.9%) females with male to female ratio of 1.2: 1. Eighty-eight (56.4%) of the patients presented during the night time, and eighty-two (52.6%) occurred during dry season. The three most common DCS were hyperglycaemic hyperosmolar state(HHS) (50.6%), diabetic ketoacidosis(DKA) (41.6%) and hypoglycaemic crisis (7.8%). The most commonly associated cardiovascular condition was hypertension.

Conclusion: This study has demonstrated the variable epidemiology of DE with HHS being the commonest hyperglycaemic crises syndrome, hypoglycaemic crisis the least common DE and hypertension the commonest co-morbid cardiovascular condition. The incident occurred predominantly among the males, young adults, during dry season and most of the patients presented at night time. The ED data should inform the need for proactive primary care and diabetic self-management education.

Keywords: Adult Nigerians, diabetic emergencies, emergency department, epidemiology.

33 INTRODUCTION

34 Diabetes mellitus(DM) is a global health problem with variable distribution in
35 developed and developing countries.[1-3] It is an endocrine-metabolic medical disorder in which
36 there is disturbance of energy homeostasis; and chronic hyperglycaemia occurred to the extent
37 that it has adverse effects on health leading to morbidity, premature and unnecessary mortality
38 among humans worldwide.[3,4]

39 The clinico-pathological features of DM are characterized by acute metabolic
40 decompensation such as hyperglycaemic hyposmolar state(HHS) and diabetic
41 ketoacidosis(DKA).[5,6] The acute metabolic complications of DM are associated with volume
42 depletion, absolute or relative insulin deficiency and acid-base derangements with potentially
43 disastrous consequences if not detected early and treated promptly.[7,8] The clinical
44 presentations of diabetic emergencies(DE) are variable and are dependent on the period between
45 the onset of metabolic disturbance and presentation to the emergency department(ED) and
46 involve features of hyperglycaemia, ketoacidosis, precipitating factors and associated clinical
47 conditions.[7-9]

48 The increasing burden of DM is gaining a worldwide attention and the prevalence has
49 been reported to be on the rise globally with varying ethnic and racial distributions.[1,10,11]
50 Research studies have shown also that DM is relentlessly increasing in economically affluent
51 countries and at the same time creeping into middle- and low-income countries.[1,3,11] The
52 regional prevalence of DM in Nigeria has been reportedly variable across and within different
53 parts of the country which could be a reflection of cultural, tribal and food values.[3,12-15]
54 However, various hospital and community-based studies in Nigeria have reported a rising
55 prevalence in urban, semi-urban and rural areas of the country with the number of individuals,

families and communities affected rising with staggering socio-economic costs.[3,12,13] The national prevalence of DM was estimated at 2.2% by the Expert Committee on non-communicable diseases in 1997 [14] and in 2011, World Health Organization estimated the prevalence of DM in Nigeria of 8.5% (6.9% in males and 10.0% in females).[15] In a community-based study in the study area, Abia State, South-east Nigeria prevalence of DM of 3.6% was reported[16] and 4.2% was reported in a hospital-based study.[12]

Diabetes mellitus is also one of the most common indications for hospital admission and case fatality in Nigeria [8,17-22] and other parts of the world such as Australia [23], India[24] and South Africa.[25]. In Nigeria, DM constitutes a significant cause of medical admissions due to poorly-controlled blood glucose and other chronic complications of DM: In Enugu state, South-east Nigeria DM constituted 13.4% of medical admissions[17], and in Port Harcourt, South-south Nigeria, DM contributed to 82.0% of endocrine-related medical admissions.[18] Case fatality of DM has been reported in different regions of the country: In Port Harcourt, South-south Nigeria, case fatality of 17.2% was reported [19]; 22.6% was reported in Lagos, South-west Nigeria [20]; 40% was reported in Ilesa[21], South west Nigeria; 3.4% was reported in Ekiti, South-west Nigeria[22]; 23.7% was reported in Enugu, South-east Nigeria[17] and 3.6% was reported in Benin, South-south Nigeria.[8]

Diabetes crises syndrome(DCS) or diabetic emergencies is therefore an important contributor to ED hospitalizations especially in nations in socio-economic and demographic transitions where there are limited options for standard diabetic care.[17,24,25] In Nigerian Africans, DM constituted 7.4% of cause of emergency hospitalizations among geriatric Nigerians in a rural hospital in Imo State, South-east Nigeria[26]; 32.0% ED admission was reported in Lagos, South-west Nigeria[27] and ED mortality of 16.3% was reported in adult

emergency department of a tertiary health centre in Ido-Ekiti, South-west Nigeria[28] with hyperglycaemic hyperosmolar state and diabetic ketoacidosis constituting 8.9% and 3.6% of endocrine-related ED death.[7]

The prevalence and pattern of hyperglycaemic emergencies have been reported among diabetic patients in Nigeria[7,8,27,29] and other parts of the world like Australia,[23] India[24] and South Africa.[25] In a retrospective study in Benin, South-south Nigeria, prevalence of hyperglycaemic hyperosmolar state of 58.3% and diabetic ketoacidosis of 41.7% was reported[8]; hyperglycaemic hyperosmolar state of 50.0% and diabetic ketoacidosis of 31.0% was reported in a prospective study in Benin, South-south, Nigeria[29]; hyperglycaemic hyperosmolar state of 64.1% and diabetic ketoacidosis of 5.3% was reported in Ido Ekiti; South-west Nigeria[7]; hyperglycaemic hyperosmolar state of 15.0% and diabetic ketoacidosis of 85.0% was reported in Lagos, South-west Nigeria.[27] In other parts of the world such as Australia, the prevalence of diabetic ketoacidosis of 55.0% and hyperglycaemic hyperosmolar state 15.0% was reported[23] while in South Africa, diabetic ketoacidosis of 70.7% and hyperglycaemic hyperosmolar state 29.3% were reported. [25]

As a chronic metabolic disease requiring long term complex care, optimal management of DM involves the patients taking their prescribed anti-diabetic medications regularly, adhere to recommended diet and exercise plan as well as keeping a diary of their daily blood glucose measurements.[4,12,13,30] However, there is increasing concerns for the rising incidence of DE[4], poor blood glucose control [4] and poor knowledge of diabetes self-management among diabetic patients in the study area[4,13,31,32] and this calls for situational analysis of the epidemiological profile of diabetic patients that presented to the ED of the hospital with the aim of informing the need for proactive primary-oriented care and diabetes self-

102 management education. It is based on this premise that the authors were motivated to review
103 epidemiology of DE in the adult ED of a tertiary hospital in a resource-limited environment of
104 South-eastern Nigeria.

105 **MATERIALS AND METHODS**

106 **Study design**

107 This was a descriptive study that involved retrospective review of all cases of diabetic
108 emergencies that presented at the Emergency Department of Federal Medical Centre, Umuahia, a
109 tertiary hospital situated in South-eastern Nigeria from January 2008 to December 2012.

110 **Study area and setting**

111 The study was carried out at the Emergency Department of Federal Medical Centre,
112 Umuahia, capital of Abia State, South-eastern Nigeria. Abia State is endowed with abundant
113 mineral and agricultural resources with supply of professionals, skilled, semi-skilled and
114 unskilled manpower. Until recently, Umuahia metropolitan City has witnessed an upsurge in the
115 number of banks, hotels, junk food restaurants in addition to the changing socio-behavioural
116 lifestyles.

117 The Emergency Department of Federal Medical Centre, Umuahia, Nigeria serves as a
118 surgical and medical unit within the setting of the tertiary hospital. All cases of diabetic
119 emergencies are first seen at the Emergency Department of the Medical Centre before they are
120 admitted into the hospital wards for further management.

121

122

123 **Selection criteria**

124 The inclusion criteria were the availability of required data on the case notes of patients
125 who were admitted and managed for diabetic emergencies while patients who were brought in
126 dead with history suggestive of diabetic emergencies were excluded from the study. The brought
127 in dead were not recorded in the registers of Emergency Department of the hospital.

128 **Methods**

129 Data collection was done using data collection proforma which was developed for the
130 study by the authors through detailed review of literature on diabetic emergencies [1-9,23-29,33-
131 35]. The secondary sources of data were Emergency Department admission registers and case
132 folders of patients who were managed for diabetic emergencies. These were supplemented with
133 data from nurses report note books. The epidemiological profile of patients who had diagnoses of
134 diabetic emergencies were focused on patient's age, sex, time of presentation to the ED of the
135 hospital, season (month) of occurrence, type of diabetic emergencies and associated
136 cardiovascular conditions.

137 **Operational definition of research variables**

138 Adult patients were classified based on their age into young adults who were aged 18-
139 59 years and elderly patients who were aged 60 years and more.[36] The seasons of occurrence
140 were categorized into two: rainy and dry or harmattan seasons based on the Nigerian seasonal
141 expression [36]. Dry or harmattan season is the period from November to March while rainy
142 season refers to the period from April to October [36]. The time of presentation to the ED was
143 divided into two: day time was defined inclusively as the time from 6.00am to 6.00pm Nigerian
144 time while night time refers exclusively to the time from 6.00pm to 6.00am Nigerian time [37].

145 **Ethical approval**

146 Ethical certificate was obtained from the Health Research and Ethics Committee of the
147 hospital.

148 **Statistical analysis**

149 The results generated were analysed using software Statistical Package for Social Sciences
150 (SPSS) version 13.0, Microsoft Corporation, Inc. Chicago, IL, USA for the calculation of mean,
151 frequencies and percentages.

152 **RESULTS**

153 The age of the patients who presented with diabetic crises syndrome ranged from 25 years
154 to 81 years with mean age of 52.2 ± 8.4 years. There were 86 (55.1%) males and 70 (44.9%)
155 females with male to female ratio of 1.2: 1 [Table 1].

156 Eighty-eight (56.4%) of the diabetic patients presented during the night time (6pm-6am
157 exclusive, Nigeria time) while sixty-eight (43.6%) presented during the day time [Table 2].

158 Eighty-two (52.6%) of the diabetic crises syndrome occurred during dry (harmattan)
159 Nigeria season while seventy-four (47.4%) happened during rainy season [Table 3].

160 Seventy-nine (50.6%) of the cases of diabetic crises syndrome were due to
161 hyperglycaemic hyperosmolar state, sixty-five (41.6%) was diabetic ketoacidosis and twelve
162 (7.8%) resulted from hypoglycaemic crisis [Table 4].

163 The most common associated cardiovascular condition was hypertension (58.3%). Others
164 were hypertensive heart failure (35.3%) and cerebrovascular accident (27.6%) [Table 5].

DISCUSSION

This study has demonstrated that diabetic crises syndrome occurred predominantly among young adults aged 18-59 years when compared with their elderly counterparts. The age of occurrence of diabetic emergencies in this study could be a reflection of the age of patients that bear the greatest burden of diabetes mellitus in developing nations like Nigeria with persons under the age of 60 years having greater complications of diabetes mellitus. [1,3,33] The finding of this study is also in consonance with age predilection for diabetic emergencies reported in some parts of Nigeria such as in Benin, South-south Nigeria[8,29]; Lagos, South-west Nigeria,[27] and Ido-Ekiti, South-west Nigeria.[7,28] Although type 2 diabetes mellitus was previously described as the disease of the old age but recent evidence showed that younger age groups are affected particularly in high risk population and they are likely to present with acute metabolic complications of diabetes mellitus.[1,23,34,35] Moreover, elderly diabetic patients in Nigeria are more likely to have more formal and informal support especially family support in taking medications, following meal pattern when compared with the young adults who are largely independent, socially and economically active.[12,13,38,39] The young adult diabetic patients are more likely to have greater aggregates and clusters of lifestyle risk factors that affect good glycaemic control when compared to the elderly diabetic counterparts.[4,12,13,23,39] The finding of this study therefore underscores the need for proactive interventions for diabetic emergencies to be applied through life course in the management of diabetes mellitus, particularly from the younger adult diabetic patients and maintained up to older diabetic patient population especially in a resource-poor environment where there are limited options for a healthy living and appropriate diabetic care.

This study has shown that higher proportion of male patients presented with diabetic emergencies. Although gender similarities and differences have been reported for type 2 diabetes mellitus [1,3] and diabetic emergencies[23-25] in different parts of the world but male patients bear greater burden of diabetic emergency hospitalizations in Nigeria.[7,28,29] The higher prevalence of diabetic emergencies among the male diabetic patients in this study could be due to socio-behavioural and family factors.[12,13,40] However, male diabetic patients in the study area are more likely to engage in behavioural and lifestyle activities like moderate-excessive alcohol consumptions[13,33,41] and tobacco use[13,33,41] that could lead to poor blood glucose control and precipitation of diabetic crises syndrome. Of great concern in the study area is that men who had diabetes mellitus are generally more reluctant to seek treatment, non-adherent with prescribed medications and diets and attend hospitals when complications of acute metabolic decompensation have occurred.[4,13] The findings of this study therefore beckons for an urgent need for further hospital and community-driven research studies in order to understand the disparity in the gender-related emergency department presentations of diabetic patients in the study area.

Eighty-eight (56.4%) cases of diabetic emergencies presented to the Emergency Department at night time (6pm-6am exclusive). Globally, the occurrence of diabetic emergencies varies throughout the day from time to time.[42-44] However, not much is known about 24-hour time trend in the incidence of diabetic emergencies in Nigeria. The higher frequency of night presentations to the ED in this study could be attributed to delay in decision to go to hospital resulting from self-medications or delay in inter-health facility transfer of patients due to poorly equipped peripheral public and private hospital resources in the study area.[26,36,37] The elucidation of the association between diabetic emergencies and time of the day is very

quintessential in various aspects of health care for diabetic emergencies and may be a necessary denominator in describing patient-related factors in access to emergency department services particularly in a resource-poor settings where there are limited options for standard diabetic care. This appears to be one of the ways adult Nigerians will benefit from pre-hospital and hospital diabetic care in emergencies as well as prevention of diabetes-related emergency department disability and premature death.

This study has shown that eighty-two (52.6%) diabetic emergencies occurred during dry or harmattan season in Nigeria. Globally, the incidence of diabetic emergencies varies from one geo-ecological region to another and from season to season. [42,43,45] Although diabetic emergencies occurred preferentially during the dry season in this study but the evidence for a link between acute metabolic complications of diabetes mellitus and seasons of the year in Nigeria remained largely unknown and unreported in biomedical literature. However, during dry season in Nigeria, the climatic weather condition is hot with severe unfavourable ambient temperature like heat.[36,37] This may result in excessive perspiration thus predisposing to dehydration which could provoke hyperglycaemic crises syndrome among diabetic Nigerians. The role of seasonality in the occurrence of diabetic emergencies in Nigeria cannot be gainsaid in this study and this calls for further research study in other to explore the effects of season of the year on diabetic emergencies in greater detail. This will provide a resounding knowledge of the seasonality in the occurrence of diabetic emergencies for consultative purposes.

This study has shown that the most common hyperglycaemic crises syndrome was hyperglycaemic hyperosmolar syndrome. This finding is in tandem but differs in magnitude with the pattern of hyperglycaemic emergencies reported in different parts of Nigeria with hyperglycaemic hyperosmolar state accounting for substantial cause of emergency department

hyperglycaemic hospitalizations followed by diabetic ketoacidosis.[7,8,29] However, this pattern is in contrast with the reports from Lagos, South-west Nigeria [27] and other parts of the world like Johannesburg, South Africa,[25] Chandigarh, India[24] and Victoria, Australia[23]. In a prospective study in Benin, South-south Nigeria, hyperglycaemic hyperosmolar state constituted 50.0% of diabetic hyperglycaemic crises with diabetic ketoacidosis contributing 31.0%;[29] hyperglycaemic hyperosmolar state of 58.3% and diabetic ketoacidosis of 41.7% were reported in a retrospective study in Benin, South-south Nigeria;[8] while in Ido-Ekiti, South-west hyperglycaemic hyperosmolar state constituted 64.1% of emergency hyperglycaemic presentations followed by diabetic ketoacidosis of 5.3%.[7] In contrast, diabetic ketoacidosis of 85.0% and hyperglycaemic hyperosmolar state of 15.0% were reported in Lagos, South-west Nigeria[27], diabetic ketoacidosis of 70.7% and hyperglycaemic hyperosmolar state of 29.3% were reported in Johannesburg, South Africa; whilst in Victoria,[25] Australia, diabetic ketoacidosis of 55.0% and hyperglycaemic hyperosmolar state of 15.0% were reported.[23] Although blood glucose control can be achieved successfully through adherence with medications and lifestyle modifications but the ultimate goal of diabetic management is to prevent the attainment of blood glucose at which emergency presentation would be considered and development of diabetic complications inevitable.[4,13,33] Research studies in Nigeria have shown that adequate blood glucose control[4,33] and lifestyle modifications[13,33] occur only in a fraction of treated diabetic Nigerians. The findings of this study has buttressed the reports that despite widespread awareness of the benefits of goal blood glucose control, concerns regarding its control to the recommended target level constitutes a major cause of worry in diabetic management in the sub-region.[4,13,30,33] Given all the complexities of physician-related and patient-related factors in the optimal management of diabetic patients in Nigeria, it appears

evident that a co-ordinated multi-disciplinary and cross-disciplinary approach is needed in order to reduce acute metabolic complications of diabetes in the study area. This requires a dedicated and efficient primary-oriented care for diabetic patients. It is therefore not sufficient to prescribe anti-diabetic medications and lifestyle regimen during clinical encounter with diabetic patients, inquiry about adherence to recommended medications and other diverse care should constitute an important care package for diabetic patients. Since hyperglycaemic emergencies are life-threatening with high risk of mortality, health professionals attending to diabetic patients should be aware of these subtleties as they will affect the quality of care rendered to diabetic patients.

Twelve (7.8%) of the diabetic emergencies was due to hypoglycaemia. Hypoglycaemic crisis syndrome has been reported among diabetic patients in Nigeria[4,7] and in other studies like the United Kingdom Prospective Diabetic Study.[46] The goal of management of diabetes mellitus is to prevent acute blood glucose fluctuations and to reduce the risk of long-term complications.[3,34,46] The reasonable objective of treatment is therefore to approach normal glycaemic excursions without provoking severe or frequent hypoglycaemia.[4,47] Generally, the control of blood glucose is determined by several factors such as patient-related, family-related, and health professional-related factors.[4,12,13] For effective management of type 2 diabetes mellitus, it is imperative that holistic approach is adopted taking into consideration the prescribed lifestyles amidst other diabetic management protocols. Although hypoglycaemic crisis has array of subjective complaints or warning symptoms [48] that may antedate the occurrence of hypoglycaemic coma but the odds associated with diagnostic utility of warning symptoms should always consider the possibility of hyperglycaemic crises.[7,8] Evidence has shown that tight glycaemic control is rarely achieved safely without provoking hypoglycaemic episodes and this could be potentially harmful. [46,47,49,50] It is therefore vital for patients, care givers and

significant others to be educated on warning symptoms of hypoglycaemia and appropriate urgent interventions at home or workplace[49] or during performance of religious rites.[50] Since the risk of hypoglycaemic event outweighs the changes in the surrogate diabetic clinical endpoints,[46] prevention of hypoglycaemia should be one of the primary care concerns in addition to controlling the effects of hyperglycaemia.[4,7,46,47,50] The result of this study therefore brings to the fore, the issue of diabetic self-management education among Nigerian diabetic patients. It is therefore pertinent for physicians to be aware of the variables that cause hypoglycaemic crisis in order to determine appropriate interventional measures as well as adopting a patient-centred approach to the management of diabetes mellitus in the sub-region.[51] The knowledge of these facts is crucial and critical for optimal care of diabetic Nigerians and this will enable diabetic Nigerians benefit from remarkable increase in longevity reportedly observed among diabetic patients in developed countries.

Hypertension was the commonest cardiovascular condition associated with diabetic crises syndrome in this study. The finding of this study is in tandem with the epidemiological pattern of diabetes mellitus in Nigeria with hypertension being the most commonly associated co-morbid condition.[7,8,28,33] Although the prevalence of diabetes mellitus is influenced by aggregates of risk factors but the role of the dysmetabolism resulting from cardio-metabolic syndrome remains relevant in the aetio-pathogenesis.[12,41,52] With the rising burden of hypertension among the Nigerian populace,[52,53] the trend in the diabetic co-morbid concordance with hypertension continues unabated. There is therefore need to identify the co-existence of diabetes and hypertension among Nigerian diabetics in order to offer appropriate diabetic care in addition to other diverse cardiovascular health education, promotion and maintenance which are often neglected in the study area.

303 **Implications of the study**

304 Emergency department care is one of the mainstay medical services in the survival of
 305 patients that need acute medical care particularly patients who presented with diabetic crises
 306 syndrome. In Nigeria, diabetic crises syndromes are important cause of emergency department
 307 hospitalizations. Of great concern in the study area is the myth that disability or death whether
 308 protracted or sudden from diabetic emergencies are frequently attributed to spells on the
 309 individual and the family. More so, diabetic emergencies constitute significant indications for
 310 healer shopping and patronage of traditional herbal and spiritual homes in the study area. More
 311 worrisome is the fact that a large gap remains between burden of diabetic emergencies and
 312 epidemiological profile of their presentations to the emergency department of Nigerian hospitals.
 313 The findings of this study will therefore beckon on the need for enhanced interventional
 314 measures for acute manifestations of dysglycaemic emergencies in the study area.

315 **Limitations of the study**

316 The limitations of the study are principally those inherent to retrospective study using
 317 secondary data sources and this affected the type of data collected for epidemiological
 318 elaboration of the ED diabetic emergencies. More so, the data collected relied on the accuracy of
 319 the records. However, there is possibility that patients who were not diagnosed correctly were
 320 excluded from the study. In addition, there could be limitation of diagnostic errors resulting in
 321 misclassification of hyperglycaemic crises syndrome owing to poor standardization of laboratory
 322 diagnostic facilities.

323

324

CONCLUSION

This study has demonstrated the variable epidemiology of diabetic crises syndrome with hyperglycaemic hyperosmolar state being the most common hyperglycaemic crises syndrome and hypoglycaemic crisis the least common diabetic crises syndromes. The incident occurred predominantly among the males, young adults, during dry season and most of the patients presented at night time. The ED data should therefore inform the need for proactive primary care, diabetic self-management education and other diverse diabetic services.

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Table 1. Age and sex distribution of patients with diabetic crises syndrome

Age group(years)	Sex	
	Male	Female
	Number(%)	Number(%)
18 – 59	46(53.5)	36(51.4)
≥ 60	40(46.5)	34(48.6)

478 Table 2: Distribution of diabetic emergencies by time of presentation to the Emergency Department

479

Time of presentation to ED	Number (%)
Day time(6am – 6pm inclusive)	68(43.6)
Night time(6pm – 6am exclusive)	88(56.4)

480

481 Table 3: Distribution of diabetic emergencies by season of occurrence

482

Season of occurrence of diabetic emergencies	Number(%)
Dry (Harmattan)	82(52.6)
Rainy	74(47.4)

483 Table 4: Types of diabetic crises syndrome among the patients

Diabetic crises syndrome	Number(%)
Hyperglycaemic hyperosmolar syndrome	79(50.6)
Diabetic ketoacidosis	65(41.6)
Hypoglycaemic crisis	12(7.8)

484

485 Table 5: Associated cardiovascular conditions of diabetic emergencies among the patients

Cardiovascular conditions*	Number(%)
Hypertension	91(58.3)
Heart failure	55(35.3)
Cerebrovascular accident	43(27.6)

486 *Multiple cardiovascular conditions were recorded for some patients