Diabetes Mellitus in Childhood and Adolescence: Analysis of Clinical Data of Patients Seen in a Nigerian Teaching Hospital

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ABSTRACT

Background: The clinical profile of African children and adolescents with diabetes mellitus is known to differ from that of their non-African counterparts.

Objective: To present an analysis of the clinical data of children and adolescents with diabetes mellitus seen in a Nigerian teaching hospital between 2005 and 2011 and highlight the management challenges encountered.

Methods: In this retrospective study, the case notes of all children and adolescents with diabetes mellitus seen in the Paediatric Endocrine-Metabolic Clinic and of those admitted into the paediatric wards of the University of Benin Teaching Hospital (UBTH), Benin City, Nigeria were audited. Information extracted included age, sex, presenting features, educational attainment of parents, occupation of parents, insulin management, complications and outcome of patients. The clinic attendance registers of the Department of Child Health, UBTH was examined to obtain information on total number of patients seen by all the units in the department between 2005 and 2011.

Results: Seventeen (0.2%) of the 8,350 cases seen during the period under review had diabetes mellitus, representing 2 per 1000 cases with a male-to-female ratio of 1: 1.8. The mean age at presentation was 12.8±2.9 years for both sexes combined. The mean body mass index (BMI) was 18.6±2.5 kg/m^2. Diabetic ketoacidosis (DKA) was the initial presentation in 9(52.9%) of cases. The mean duration of symptoms before presentation was 2.7±1.8 months. Only 10(58.8%) of the 17 patients had glucose meter for self-monitoring of blood glucose at home. Of the 17 patients, 6(35.3%) had documented evidence of hypoglycaemia. During the period under review, 4(23.5%) were re-admitted; of which 3 were for DKA. Seven (41.2%) of the parents had difficulty procuring insulin on a regular basis.

Conclusion: In the present study, the unique clinical features observed among children with diabetes mellitus were late presentation, high number of cases presenting with DKA and requiring re-admission. The major management challenges included difficulty procuring insulin on a regular basis and inability to acquire a glucose meter with test strips for self-monitoring of blood glucose at home.

Keywords

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Introduction

Diabetes mellitus (DM) is the commonest endocrine disorder in childhood with chronic hyperglycaemia as the cardinal biochemical feature.[1,2] Diagnosis of DM is based on the

presence of its cardinal signs (polyuria, polydipsia and weight loss) and a fasting blood glucose level of 126 mg/dl (7.0 mmol/L) and above or a random blood glucose of 200 mg/dl (11.1 mmol/L) and above on two separate occasions.[1,2]

The incidence of new cases of DM varies with geographical location, being highest in Finland and Sweden (40 per 100,000 children per year) and lowest in Japan (less than one per 100,000 children per year).[2] In Africa, the estimated incidence varied from 1.5 per 100,000 in Tanzania to 20 per 100,000 in Morocco.[3,4] The reported prevalence in Nigeria was 0.33 per 1,000.[5] Given that these prevalence and incidence figures were documented decades ago,[6-9] they may have changed. Reports from African countries indicate that the incidence of DM is increasing.[6-9] Some important demographic and socioeconomic factors may differ from country to country with health implications.

The clinical profile of African children and adolescents with DM is known to show certain variations in its clinical spectrum from that observed among their non-African counterparts.[5,10-12] For instance, equal sex prevalence has been documented in temperate countries while studies in sub-Saharan African countries like Ethiopia, Sudan, Nigeria and Libya reported higher prevalence in girls than boys.[6,13-15] Another study in Nigeria found the prevalence to higher in boys than girls.[11] In Tunisia, no gender difference was observed.[16] Although it is generally believed that socioeconomic status has no influence on prevalence, a study from Nigeria reported a higher prevalence among children from poor homes.[11] Studies from Tunisia, Ethiopia and Sudan reported that ketoacidosis was the commonest mode of presentation.[10,13,17] A study in Sweden among children aged 0-14 years reported that the annual variation in incidence of diabetes mellitus was considerable.[12]

The purpose of this study is to present an analysis of the clinical data of children and adolescents with diabetes mellitus seen in a Nigerian teaching hospital between 2005 and 2011 and highlight the management challenges encountered.

Subjects and Methods

The study was conducted in the Department of Child Health, University of Benin Teaching Hospital (UBTH), Benin City, Nigeria and involved all children and adolescents with diabetes mellitus seen between 2005 and 2011. Majority of the patients seen in the Paediatric Endocrine-Metabolic Clinic of UBTH come from Edo State and the neighbouring states of Delta, Ondo and Kogi. The clinic receives referrals from both within and outside the hospital (UBTH). The Paediatric Endocrine-Metabolic unit consists of the medical team (comprising one Consultant, 2 Senior Registrars, 2 Registrars, and 4 House Officers) and all the Nursing Staff (52) working in the Paediatric ward. The bed capacity of the Paediatric ward is 56.

In this retrospective study, the case notes of all children and adolescents with diabetes mellitus seen in Paediatric Endocrine-Metabolic Clinic and those admitted into the paediatric wards were audited. Information extracted included age, sex, presenting features, educational attainment of parents, occupation of parents, insulin management, complications, and outcome of patient. The socio-economic status of the patients' parents was determined using the criteria suggested by Ogunlesi *et al.*[18] This was analyzed via combining the highest educational attainment, occupation and income of the parents (based on the mean income of each educational qualification and occupation). In this Social Classification System, Groups I and II represent high socioeconomic class, Group III represents middle socioeconomic class while Groups IV and V represent low socioeconomic class. In this way,

the subjects were categorized into high, middle and low socioeconomic classes. The paediatric clinic attendance registers of the Department of Child Health, UBTH was examined to obtain information on the total number of new cases seen (by all the units in the department) between 2005 and 2011. Statistical analysis involved calculation of percentages, ratios, means, and confidence intervals.

Results

Among a total of 8,350 new cases seen during the 7-year period under review, 17 (0.2%) had diabetes mellitus, representing 2 per 1000 new cases. Male-to-female ratio was 1:1.8. The mean age at presentation was as follows: boys 11.0±4.2 years; girls 13.5±1.6 years; and both sexes combined 12.8±2.9 years. Mean age at presentation: boys versus girls t= 1.28 p>0.05. The mean body mass index (BMI) was 18.6±2.5 kg/m^2 with 6(35.3%) having a BMI below 19.0 kg/m^2. None of the subjects had BMI > 25 kg/m^2. The age group distribution of the patients with diabetes mellitus was as follows: 1-4 years 0 (0.0%); 5-9 years 2(11.8%); 10-14 years 10(58.8%); and 15-19 years 5(29.4%); Table 1. As shown in Table 1, the male-to-female ratio was 1:2.4. Diabetic ketoacidosis was the initial mode of presentation in 9(52.9%) of cases (Table 2). The mean number of blood glucose measurements per day was 2.6±0.9. As shown in Table 3, the point-of-admission mean blood glucose value was 27.8±12.1 mmol/L. Over half of the families (52.9%) of the subjects belonged to the middle social class while 11.8% belonged to high social class and 35.3% belonged to low social class. The mean duration of symptoms before presentation was 2.7±1.8 months. Majority (88.2%) of the patients had symptoms for 1 month and above before presentation. The distribution of duration of symptoms before presentation were as follows: < 1 month 11.8%; 1-3 months 41.2%; 4-6 months 29.4%; and > 6 months 17.6%. The frequency of the presenting clinical features is displayed in Figure 1. Among the cardinal features of diabetes mellitus, polyuria usually prompts the parents to seek medical care. Three (33.3%) mothers of the 9 patients who presented with diabetic ketoacidosis admitted they did not know that diabetes mellitus can occur in children. Two (11.8%) of the 17 patients with diabetes had positive family history of diabetes mellitus. In both cases, it was the mother who was diabetic. Only 10(58.8%) of the 17 patients had a glucose meter for self-monitoring of blood glucose at home. Four out of the 10 had difficulty procuring the test strips on a regular basis. One (8.3%) of the 12 girls with diabetes mellitus had delayed pubertal maturation; Tanner Stage II at the age of 15 years. She has not attained menarche and weighed 29 Kg, with BMI 16.0 kg/m^2. In addition, she had vaginal candidiasis. Of the 17 patients, 6(35.3%) had a documented evidence of hypoglycaemia during hospital admission. The total daily insulin dose per patient ranged from 12

Table 1: *Age and gender distribution of patients with diabetes mellitus*

Age group at presentation	Gender		
	Male No(%)	Female No(%)	Both sexes No(%)
Below 10 years	2(33.3)	0(0)	2(11.8)
10-12 years	0(0)	3(27.3)	3(17.6)
13-15 years	3(50.0)	8(72.7)	11(64.7)
Above 15 years	1(16.7)	0(0)	1(5.9)
Total	**6(100.0)**	**11(100.0)**	**17(100.0)**

T able 2: *Mode of presentation of 17 children with diabetes mellitus*

Mode of presentation	No (%)	Mean blood glucose (mmol /L) at presentation	Mean age at presentation(years)
DKA	9(52.9)	29.4±8.7	11.1±4.8
Classical DM symptoms	4(23.5)	21.3±7.1	14.7±1.2
Referrals	3(17.7)	24.8±8.9	13.6±1.7
Routine medical examination	1(5.9)	13.3±0.0	14.0±0.0
Total	**17(100.0)**	**27.8±10.8**	**12.8±2.9**

DKA=Diabetic ketoacidosis; DM= Diabetes mellitus

Table 3: *Distribution of mean blood glucose values in 17 children admitted for diabetes mellitus.*

Variable	Mean blood glucose (mmol/L)
Point-of-admission random blood glucose	27.8±10.9
Fasting blood glucose 48 hours post admission	14.2±9.5
Fasting blood glucose 7 days post admission	12.1±9.1
Fasting blood glucose 3 weeks post admission	9.8±6.2

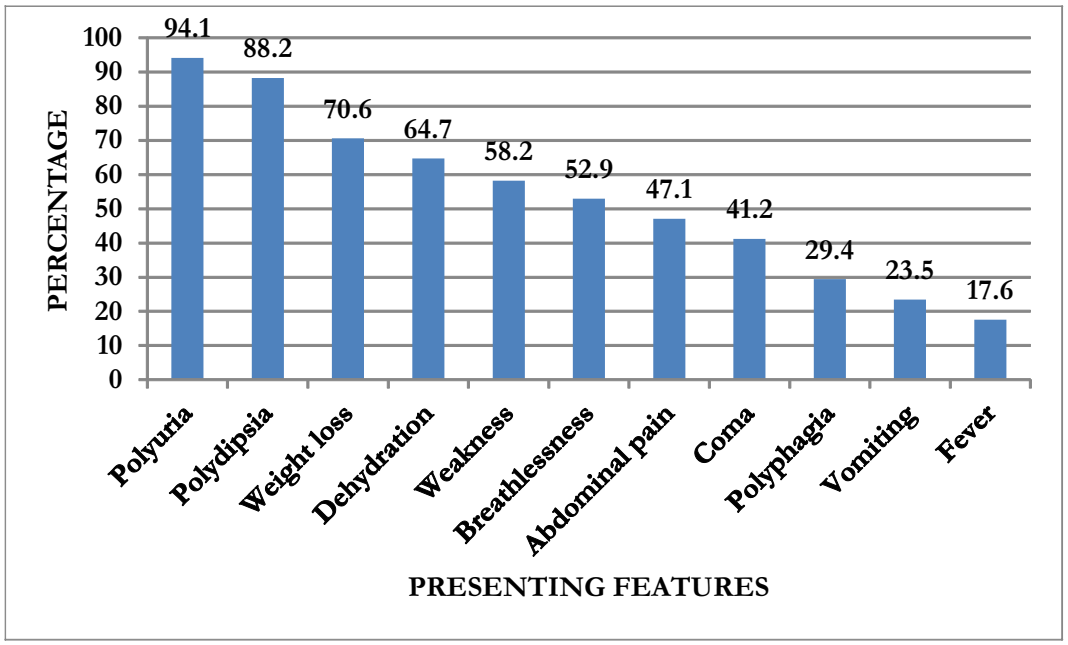

Figure 1: *Prevalence of presenting clinical features of 17 children with diabetes mellitus*

to 35 Units with an average of 26.5 Units per patient per day. Some parents (41.2%) had difficulty procuring insulin because of financial constraints. During the period under review, 4(23.5%) were re-admitted; 3(17.6%) for diabetic ketoacidosis (DKA) and 1(5.9%) following discharge against medical advice (DAMA) and subsequent clinical deterioration. One of the three patients with DKA required two re-admissions. The three patients re-admitted for DKA were due to patient error (omission of insulin following advert by a drug company that sells natural products in one case and claim of cure by a spiritual healing home in the remaining two cases). Of the 4 patients re-admitted, 3 were females and one was a male.

Discussion

The prevalence (2 per 1000 new cases) of diabetes mellitus found in the present study is higher than 0.33 per 1000 reported by Afoke et al among Nigerian Igbo school children. [5]The difference might be explained by differences in population, methodology, setting and timing of study. It is noteworthy that the present study was hospital-based while the study by Afoke et al [5]was community-based. Another hospital-based study in Abakaliki, Nigeria reported a lower prevalence than that of the present study.[19] The higher prevalence reported here might be explained by the difference in the denominators used. In the present study, the denominator was new cases only (resulting in a smaller denominator) while in the study in Abakaliki, the denominator was all cases (both old and new cases), with a resultant lower prevalence figure. Another study from the northern part of Nigeria reported a higher prevalence of 3.1 per 1000 cases, suggesting that there might be some regional variation in prevalence within the same country.[20] The prevalence found in this study compared favourably with that reported from Tanzania.[3] The prevalence of diabetes mellitus observed in the present study and in previous studies conducted in other black African countries were generally lower than the prevalence reported from European countries. The low prevalence observed in black African countries like Nigeria might be explained by various factors such as death from other causes, different genetic susceptibility, and absence of toxin in food additives.[21] Indeed it has been reported that the incidence of type 1 diabetes mellitus was higher in children of black origin living in Europe compared to those living in the African continent; an observation attributed to exposure to environmental diabetogenic agents.[3]

In keeping with previous studies in Nigeria,[14,19] the present study showed that there was a female preponderance. This is not surprising as studies from other African countries have reported a higher prevalence of diabetes mellitus in girls than boys.[6,7,13] Various explanations have been proffered for the female preponderance. Bella, for instance, attributed it to the higher frequency of HLAB8/DR3 halotype in females, a halotype associated with autoimmune disorders including antibodies to islet cell of the pancreas.[14] This view has been strongly challenged by the report of Oli et al[22] which showed that HLAB8 haloytype and pancreatic islet cell antibodies were both absent among Nigerians with diabetes mellitus. On the other hand, Bloch et al[23] postulated that there was a relative increased incidence in females at the time of puberty due to the pubertal growth spurt induced by gonadal steroid together with increased pubertal growth hormone secretion, antagonizing insulin action and unmasking evolving diabetes. Yet other investigators stated that a female excess is seen in ethnic groups with low risk for diabetes, particularly among non-Caucasians.[24] Since Nigerian Africans are a relatively low risk ethnic group, this might apply to them, explaining the higher frequency in girls compared to boys.

In the present study, the mean age at presentation (12.8 years) was higher than the 11.4 years reported in Abakaliki but lower than 17.8 years reported in Ibadan.[11,19] The mean age at presentation in Sweden was 8.2 years. [12] The reason for these differences is not clear. The lower age at presentation observed in this study compared to the study in Ibadan might be explained by difference in age groups studied. The present study involved patients aged from 5 to 17 years whereas the study from Ibadan involved patients age from 10 to 20 years. The low mean age at presentation reported from Sweden suggests that diabetes mellitus occurs at a younger age in Sweden compared to Nigeria.[12] Bella in his study concluded that insulin-dependent diabetes rarely occurred in patients below 10 years old in Nigeria.[14] The mean age at presentation reported from Tunisia was 7 years.[17]

As has been observed in other studies in developing countries,[11,19] late presentation was observed in the present study. This observation might be due to multiple factors, such as general lack of awareness among the local communities of the signs and symptoms of diabetes mellitus in children, missed diagnosis and the tendency to wait and see if the presenting features will resolve spontaneously with time.[9, 10] It was observed in the present study that 52.9% of the patients presented for the first time in diabetic ketoacidosis (DKA). This finding is in consonance with 55.3% reported from Saudi Arabia.[25] Several other previous studies from developing countries have reported DKA as a mode of initial presentation in DM but with varying percentages, ranging from 30 to 88%.[10,19,26] The association between DKA and late presentation was revealed in a Tanzanian study.[3] The high prevalence of DKA as a presenting feature might be due lack of awareness with regard to occurrence of diabetes mellitus in children, high rate of concomitant infections and poverty. This view was supported by three mothers whose children presented with DKA in the present study and who admitted they did not know diabetes mellitus can occur in children, indicating the need for public health education to raise awareness concerning childhood diabetes mellitus.

In the present study, some of the complications documented included DKA, hypoglycaemia , vaginal candidiasis, and delayed pubertal maturation with late attainment of menarche. One of the patients was at Tanner stage II at the age of 15 years and has not attained menarche. These findings are not surprising as they have been documented in previous studies. In this patient, pubertal development was accepted as delayed because it has been documented that the mean age for achieving Tanner stage II for breast development in girls is 11.15±1.10 years and pubic hair is 11.69±1.21 years. [27] The lack of attainment of menarche might be related to the low BMI as a critical weight has been documented as one of the determinants of age of attainment menarche.[27]

With regard to the challenges of management, the principal challenges included lack of laboratory facility for determination of glycosylated haemoglobin level for long-term monitoring, inability (due to financial constraints)to acquire a glucose meter and the test strips for self-monitoring of blood glucose at home, and limited supply of insulin with the attendant high cost. Regular supply of insulin at an affordable cost is necessary for delivery of good quality care to children and adolescents with diabetes mellitus. In this regard, the National Health Insurance Scheme Initiative in some African countries is a welcome development as it is capable of protecting the patients' parents from huge financial cost.[28] Children and adolescents with diabetes mellitus should be captured in this scheme to enhance the quality of care being provided to this category of patients.

One limitation of the study was the relatively

small sample size. It is suggested that a multicenter study to increase the sample size in necessary to add more value to the observed findings. Nonetheless, the study highlighted some important observations concerning DM in Benin City.

In conclusion, a high frequency of DKA as initial presenting clinical feature of DM, difficulty procuring insulin on a regular basis and poor self-monitoring of blood glucose at home were the important observations. A more intensive health education of the populace concerning diabetes mellitus and provision of insulin at a subsidized price are advocated.

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