

## Original Article

# Type 2 diabetes in Sudanese children and adolescents

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## ABSTRACT

The objective of this study was to determine the prevalence of T2 DM among children and adolescents attending a paediatric and adolescent diabetic clinic in Khartoum –Sudan and to find out the etiological factors, clinical presentation, management and associated co morbidities. This was a retrospective, descriptive hospital based study. The records of all children attending the clinic at Jabir Abu Izz Diabetic Center from January 2006 to December 2009 were reviewed and those who were diagnosed as type 2 DM were identified. Out of 985 patients 38 (4%) were labeled as having type 2 DM. Out of these, 35 (92.1%) had onset between 11-18 years of age and were all pubertal. Three patients (7.9%) were under 10. Female to male ratio was 1.2: 1. Thirty two (84.2%) were from tribes of Arab origin. There were no cases from tribes of southern Sudan of African

origin. Risk factors for obesity included: diabetes during pregnancy 15 (39.5%), large for dates 16 (43%) small for dates 12(32%), family history of obesity 10 (26.3%), lack of exercise 32 (87.6%), TV watching for long hours 32(84.3%) and consumption of fast foods. Almost 70% were symptomatic at presentation. Co morbidities included hypertension 22(57.9%), microalbuminuria 7 (18.4%), hyperlipidaemia 6(7%) and none had retinopathy. The mean HbA1C was 9.1% gm/dl. This data confirms that T2 DM is emerging as a health problem among children and adolescents in Sudan mostly as a result of obesity particularly among high socioeconomic group in urban areas and more prevalent in certain ethnic groups .

### Key words:

Type 2 diabetes mellitus; adolescents, and children, Sudan

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## INTRODUCTION

Until recently, type 2 diabetes mellitus, was typically regarded as a disease of middle-aged and elderly. However, current data indicate that its prevalence among children and adolescents is increasing particularly among certain ethnic groups [1-4]. This increase has been linked to the rising problem of obesity and physical inactivity. The other risk factors are a family history of type 2 DM, origin from certain ethnic groups, female sex and the onset of puberty [3-4]. Certain areas of the world have been mapped as type 2 DM red zone [5] including Sudan, where the prevalence of type 2 DM has increased from 8.6% in Khartoum State in 1996, to as high as 19% in a recent house-hold survey [6]. However, there are no published data on the prevalence of this problem T2 DM among children and adolescents.

The development of T2 DM in early age is reported to be associated with earlier development of diabetes-related complications in addition to problems of optimal management due to poor compliance, wider issues surrounding general metabolic health and more complex psychosocial barriers [7-10].

In this study we aimed to see determine the prevalence of this problem within the biggest paediatric and adolescent diabetic clinic in Sudan and to see the risk factors. To the best of our knowledge, this is the first publication on this issue from Sudan, which is a relatively poor country that is inhabited by multiethnic population and has recently shown some improvement in the economic status and increase in urbanization.

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## PATIENTS AND METHODS

This retrospective hospital-based cross sectional study was undertaken in children and adolescents endocrinology clinical at Jabir Abul Izz Diabetes Center in Khartoum, the capital city of Sudan. This clinic gets referrals from all parts of Sudan and from all sectors of the community as services are provided

almost free or with nominal fees.

The records of all patients who attended the clinic from January 2006 to December 2009 were reviewed and those who satisfied the diagnostic criteria of type 2 DM were further analyzed. Many factors were considered in classifying the patient as having type 2 DM including symptoms at onset, presence of obesity, acanthosis nigricans, other features of metabolic syndrome, family history of type 2 DM and availability of abnormal insulin, or C-peptide levels as well as treatment given.

Demographic data including age, sex, ethnic background, family history, social history, symptoms at onset, clinical findings including growth data, body mass index, blood pressure, presence of acanthosis nigricans were obtained from the records. Body mass index was calculated and classified using the NCHS BMI cut off points ( $\geq 85^{\text{th}}$  centile overweight and  $\geq 95^{\text{th}}$  centile obese). Hypertension was diagnosed when blood pressure was  $\geq 95^{\text{th}}$  centile for age and sex in more than one occasion.

Investigation results including HbA1C, microalbumin, lipid profile and renal function tests were obtained from the notes. All the patients had ophthalmic assessment at onset and annually thereafter by a trained ophthalmologist – HbA1C and microalbumin were measured using point of care Nyocard method. (AXIS – SHIELD – Norway).

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## RESULTS

During this period, 958 children and adolescents were registered in the clinic. Out of these, 38 (4%), were diagnosed as having type T 2 DM. The vast majority of patients 35 (92.1%) had onset between 11-18 and were pubertal. Interestingly 3 (3%) very obese children had onset between 8-11 years and had family history of obesity and type 2 DM with normal or high C-peptide levels.

Twenty (55.3%) were females and 17 (44.7%) were

males with a ratio of 1.2:1. Thirty two (84.2%) of the cases were from tribes of Arab origin, 2 (5.3%) non-Arab and 4 (10.5%) of mixed races. There were no cases from the African origin tribes of Southern Sudan.

Twenty seven patients (71.1%) were from the central Sudan, 6 (15.8%) the North, 3 (7.9%) the West and 2 (5.3%) from the East. Most of the cases, 33 (86.8%) were coming from Urban areas. Twenty one (55.3%) of them were from high social class, 13 (34.2%) moderate and only 4 (10.5%) from low social class.

Thirty five (92%) had family history of type 2 diabetes mellitus.

Twenty nine (76.3%) of the cases were obese, 8 (21.1%) overweight and only one (2.6%) had normal BMI. Only 4 (10.5%) were stunted. Thirty one cases (81.6%) had acanthosis nigricans. Table (1) shows the identified obesity risk factors. Sedentary life and consumption of fast foods were the commonest factors. Of interest is that 12 (32%) were born small for dates and only 10 (26.3%) had positive family history of obesity.

**Table 1: Obesity risk factors among patients with type 2 diabetes (n = 38)**

Risk factor	n (%)
Diabetes during pregnancy	15 (39.5)
Large for dates	16 (43)
Small for dates	12 (32)
Bottle-feeding	2 (5.3)
Family history of obesity	10 (26.3)
Long hours of TV watching	32 (84.3)
Lack of regular exercise	31 (87.6)
Consumption of fast foods	32 (84.3%)

Almost 70% of the cases were symptomatic at presentation with polyuria, polydipsia and weight loss being the commonest. About 28% were labeled as having ketoacidosis at presentation. Eleven cases (28.9%) were asymptomatic and detected accidentally on screening for their obesity. In addition to history and physical examination, type T2 DM was confirmed in 26 (68.4%) by measuring c-peptide level, the rest 22 (31.6%) were diagnosed clinically.

Cases were managed by a multidisciplinary team following the recommendations discussed elsewhere

(32) [11]. Diet and exercise were prescribed for all: Metformin alone was added in 18 (47.4%), metformin plus insulin 8 (21.1%), glibenclamide 1 (2.6%), insulin plus metformin plus glibenclamide in 3 (7.9%) and 2 (5.3%) were controlled without medications. The HbA1C level of the cases in their last clinic visit is shown in table 2. The mean HbA1C was 9.1%.

Table 3 shows the encountered comorbidities. There was a relatively high incidence of hypertension (57.8%) and no retinopathy.

**Table 2: Hb A<sub>1c</sub> levels among type 2 diabetic patients in their last visit**

Hb A <sub>1c</sub>	n (%)
< 6.5	1 (2.6)
< 7.5	11 (28.9)
7.6 – 9	12 (31.6)
> 9	14 (36.8)

**Table 3: Complications encountered in the study population**

Complication	n (%)
Hypertension	22 (57.8)
Microalbuminuria	7 (18.4)
Hyperlipidemia	6 (17)
Peripheral neuropathy	6 (15.2)
Abnormal liver function	0 (0)
Retinopathy	0 (0)

## DISCUSSION

Type 2 diabetes mellitus in children and adolescents is emerging as a global epidemic. It was first described in Pima adolescents in 1979[10]. In United States, Type 2 diabetes mellitus currently represents 8-45% of all diabetes reported among children and adolescents [11]. The rising prevalence of the disease has now been reported from various parts of the world including Australia, New Zealand, Japan, Hong Kong, United Kingdom, Libya, Bangladesh [12] as well as the Arabian Gulf[13].

In Sudan, one publication has shown that the prevalence of type 2 DM among adults has increased up to 19%[6]. Our study is the first study on children and adolescents. It has shown that Type 2 diabetes is emerging among this age group and the prevalence is 4%. This is similar to figures reported from UK [14] and Netherland [15], but lower than those reported from United States [11], New South Wales [17] and United Arab Emirates [13]. This increase in

prevalence is said to be multifactorial.

The female preponderance, pubertal onset of the disease and strong family history of Type 2 diabetes observed in our study is comparable to the pattern of Type 2 diabetes mellitus observed in other studies [11, 13, 14, 16].

Most of our cases (84.2%) originated from tribes of Arab origin and there were no cases from Nilotic tribes of southern Sudan. Recent review on epidemiology of diabetes worldwide has suggested that possibly Arab ethnicity is at a higher risk of developing type 2 diabetes [5]. Possibly people from southern Sudan are genetically less prone to develop Type 2 diabetes mellitus. However this needs further research.

It is suggested that the increase in incidence of Type 2 diabetes mellitus is mostly related to obesity. In United States 85% of affected type 2 children and adolescents are either overweight or obese at diagnosis. This is similar to the experience from other parts of the world including United Arab Emirates [13]. Unlike reports

from India [18] where 50% of type 2 diabetic children were found to be not obese, or overweight, only one of our patients (2.6%) had normal weight. Possibly, we miss diagnosing Type 2 diabetes mellitus in non-obese children.

Unlike the practice and recommendations in the United States, investigations such as serum insulin or C-peptide level are not easily available in many developing countries and therefore the diagnosis has to be made on clinical grounds. In our center, which is a teaching hospital, c-peptide was done in only 76% of the patients and was found to be normal or high. . Four (10.5%) of the obese diabetic patients were stunted and were said to have been small in their infancy. About 24% of patients in this study were said to have been small for dates. Many studies have shown that small for dates infants are more likely to develop metabolic syndrome including Type 2 diabetes than others [19,20]. Experience in South Africa and other countries like China, Russia and Brazil have shown that increased adverse ramifications of childhood undernutritions recognized later in life, and include impaired cognitive development, poorer educational achievement and greater risk of obesity [21, 22].

Studies on type 2 diabetes have shown that urbanization, sedentary life and watching TV for long-time are important risk factors. In our study 86.8% of cases were from urban areas and 32 (84.3%) were watching TV for more than two hours per day. These factors were incriminated as one of the important factors contributing to the increase in incidence for obesity among school children in Khartoum[23]. Unfortunately in Khartoum as well as in other states exercise classes have been cancelled in many schools and many of the play grounds have been replaced by buildings making facilities for exercising more difficult.

In this study, 32% of the patients were large for gestational age and 43% gave history of maternal gestational diabetes. This is similar to the experience

elsewhere [24,25].

Controversial results have been published on the association of breast feeding and obesity. In Pima Indians exclusively breastfed infants had significantly lower rates of type 2 diabetes than those exclusively bottle fed [26] whereas in other studies neither breastfeeding nor its duration were correlated with indicators of obesity [27]. In our study, 65.8% were exclusively breastfed, yet developed overweight or obesity

In many Western countries obesity is seen among low socioeconomic classes due to consumption of high calorie fast foods [11]. However, in developing countries it is seen more among moderate and high socioeconomic classes [27]. In our group, 89.5% were from moderate and high socioeconomic classes. Unlike the experience in the United Arab Emirates [13] where 64% of their patients were asymptomatic at presentation, 70% of our cases were symptomatic with 2.8% having ketoacidosis and 11 (28.9%) were detected accidentally. Possibly this was due to lack of awareness and regular screening of obese children for diabetes mellitus. Perhaps what we are seeing in the hospital is the tip of the iceberg therefore we concur with American Academy of diabetes recommendations for screening overweight children aged 10 years or more with family history of diabetes and or signs of insulin resistance for diabetes. [11].

Several complications have been reported among children and adolescents with type 2 diabetes. Krakoff [28] looked at studied the incidence of retinopathy and nephropathy among Pima Indians diagnosed with type 2 diabetes < 20 years. Though nephropathy was found to be common, unlike adult onset form, retinopathy did not appear among youth-onset cases until at least 5 years after the diagnosis is established. In our series, 7 (18.4%) had microalbuminuria but none of the cases had retinopathy. High prevalence of hypertension [29] and lipid abnormalities [19] have been observed among type 2 diabetic children

from various ethnic groups including Arabs [13]. Hypertension is an important co morbidity of type 2 diabetes in youth and is a major risk factor for nephropathy and atherosclerosis, therefore, warrants follow up and treatment with weight control, life-style change and medications including ACE inhibitors and others [13]. In this study 22 (57.9%) were found to have high blood pressure (documented 3 times) which is a relatively high figure. Whether Sudanese youth are more prone to develop hypertension is a subject worth's looking into.

Hyperlipidemia is well known co morbidity in youth with type 2 diabetes and should be treated with diet, exercise and if no improvement HMG Co A reductase inhibitors can be added. In our series six (17%) had hyperlipidemia that necessitated treatment.

The treatment algorithm for type 2 diabetes in the children and adolescents is well discussed elsewhere [29], it includes diet, exercise, metformin and insulin. Use of other oral hypoglycemic drugs in children is still debatable. Our patients were treated on this line. Recently we have started introducing insulin earlier and more long-acting insulin analogs are being used more.

In conclusion, in spite of its limitations as a hospital-based retrospective case series, this study has shown,

and for the first time, that type 2 diabetes mellitus is emerging as a problem among youth in Sudan. Practically all diabetes cases in children were previously treated as type 1 diabetes mellitus. In countries with limited diagnostic facilities for assaying c-peptide, insulin or antibodies, diagnosis is usually made on clinical basis. Sometimes it might become difficult to differentiate between types of diabetes particularly in obese type I cases, non immune type I cases, MODY and others. We believe if in doubt cases should be treated as type I till specific diagnosis is made based on laboratory findings or the clinical course of the case. Further community based studies including other parts of Sudan including the rural areas and various ethnic groups are needed to see the magnitude of the problem, and active steps should be taken to prevent the rising incidence of obesity. Sudan being a country that is inhabited by multiethnic groups is a virgin soil for genetic studies in this area.

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