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Risk factors for type 2 diabetes mellitus in adolescents secondary school students in Port Harcourt, Nigeria

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Abstract: *Background:* The prevalence of Type 2 diabetes mellitus (T2 DM) in children and adolescents is on the increase, therefore, prevention and early detection are important.
Objective: To assess for easily identifiable risk factors (overweight/obesity, hypertension, Impaired Fasting Glucose (IFG) and family history of diabetes) for T2DM in adolescents in public secondary schools
Result: Eight hundred and eighty adolescents aged 10 to 19 years were screened and 124(14.1%) were overweight/obese. 457 (51.9%) of students had none of the risk factors while 272(30.9%) had at least one risk factor. Using the American Diabetes Association criteria for identification of those at risk for T2DM, 21(2.4%) were identified. The frequency of presence of risk factors was more in females (3.3%), mid adolescent age group (3.1%) and those with positive family history of diabetes. These findings were however not statistically significant. There was a statistically significant association between presence of hypertension and impaired fasting glucose and risk factor for type 2 DM.
Conclusion: The significant risk factors identified in this study were prehypertension/hypertension and impaired fasting blood glucose.

Key words: Adolescence, Risk factors, Type 2 diabetes mellitus

Introduction

In the past, type 2 diabetes mellitus was considered as a disease of adults[1]. However, in the last decade, a worldwide increase in prevalence of type 2 diabetes in both adults and children has been reported[2]. The rise in the incidence of type2 DM has mirrored the rise in prevalence of obesity in both developed and developing countries and this is attributed to a more sedentary lifestyle and high consumption of refined foods[3]. In a report by The World Health Organization in 2003 in Geneva on screening for type 2 DM, it predicted that there will be at least 350million people in the world with type 2 DM by the year 2030 [4].

There is paucity of information on the epidemiology of type 2 DM in children in Nigeria. However, studies mainly from America has shown that in children type 2 DM represents 8 to 45% of new cases and is commonly diagnosed between the ages of 12 and 16 years and in those with positive family history of Type 2 DM. [5, 6] The cause of type 2DM is multifactorial and include behavioral, social and environmental factors which unmask an underlying genetic susceptibility[7].
The susceptibility and risk factors for type 2 DM in children has been fueled by the epidemic of obesity which is now spreading even to the developing countries[8]. In the light of increasing morbidity and mortality associated with Type 2 DM in children[9], the American Diabetes Association (ADA) developed guidelines to identify children that are at risk and will require screening. Based on these guidelines, children who are overweight or obese and have any two of the following factors: family history of type 2 DM, ethnic minority and signs of insulin resistance or associated conditions (hypertension, acanthosis nigricans, features of polycystic ovarian syndrome, hypercholesterolemia, and prediabetes) should be referred for testing[10]

Type 2 DM is associated with chronic complications such as micro vascular damage with end stage kidney failure, blindness, and amputation which has huge financial cost. Early detection, prompt and adequate management can prevent and halt progression of these complications. Studies on type 2 DM and risk factors for type 2 DM in African children are scarce. The aim of this study is to report the prevalence of some easily identifiable risk factors of type 2 DM amongst secondary school students aged 10 to 19 years in Port Harcourt, Nigeria.

Methodology

This report is based on a cross sectional study of secondary school students in Port Harcourt. It is part of an ongoing study on prediabetes in secondary schools in Port Harcourt Local Government Area (LGA) of Rivers State, Nigeria. It was carried out in 6 public secondary schools over eight weeks, March to May, 2013.
Port Harcourt is the capital of Rivers State, a major industrial area of the Niger Delta region of Nigeria with a huge oil exploration and urbanization. Rivers State has an estimated population of 5.3million, using the 2006 census[11]. The PH LGA is one of the largest local Government Areas in the State.

Ethical approval was obtained from the Ethics Committee of the University of Port Harcourt Teaching Hospital. Permission was obtained from the Rivers State Ministry of Education and the head teachers of schools selected. Assent and consent were also obtained from students and parents, respectively.
Students aged 10 to 19 years were selected from six public secondary schools in the Port Harcourt LGA, using a multistage sampling from a list of 67 schools categorized into three districts provided by the Rivers state Ministry of Education a total of six public schools with two each from each district were selected. Using a prevalence of 50% due to the various risk factors considered, a minimum sample size of 1180 was recruited from the three districts in a simple proportion for which a total of 880 students met inclusion criteria and were analyzed. We assessed four risk factors namely overweight/obesity, impaired fasting blood glucose (IFG), hypertension and family history of diabetes. Plasma cholesterol and triglyceride levels and evidence of polycystic ovarian syndrome in girls were not assessed for due to financial constraints.

Data collection was carried out by the investigators and trained field assistants who are medical officers of the University Teaching Hospital.
A pretested self-administered questionnaire was used to obtain information on bio data, medical and family history of diabetes mellitus for recruited students. Standing height was measured to the nearest 0.1cm using a wall mounted stadiometer calibrated up to two meters. Weight in Kg to the nearest 0.1Kg without shoes was taken by an electronic weighing scale (Seca Alpha Model 777). The scale was calibrated weekly and checked for zero adjustment after each reading. Each anthropometry was assigned specifically to two members of the trained staff for uniformity and to avoid inter observer errors. The fasting blood glucose levels of the participants were determined.

The Body Mass Index (BMI) of each of the participant was computed from the height and weight. Individual BMI percentiles was determined for each subject based on age and sex and categorized into underweight (BMI $< 5^{th}$ percentile), normal weight (BMI$> 5^{th}$ percentile but less than 85^{th} percentile), overweight (BMI $\geq 85^{th}$ percentile but less than 95^{th} percentile) and obesity (BMI $\geq 95^{th}$ percentile).[12] Blood pressure percentiles based on age and sex was also determined and classified into prehypertension (BP$\geq 90^{th}$ to $<95^{th}$ Percentile), hypertension ($\geq 95^{th}$ percentile) and normal blood pressure ($< 90^{th}$ percentile).[13] Prehypertension and hypertension were combined and analysed as hypertension.
Fasting blood glucose level of each of the participants was determined following 8 to 10 hours overnight fasting instruction, using the Accu-chek Active Roche Diagnostics glucometer. Results were classified based on the ISPAD criteria into normal, impaired fasting glucose and diabetic range glucose level. Impaired fasting glucose (IFG) is defined by the ISPAD as fasting blood glucose of 5.6 -6.9mmol/l (100 -125mg/dl).[14]Accuracy of the glucometers was checked each morning using the Accu-chek control solutions.

Determination of risk factor for type 2 diabetes is as described by the American Diabetes Association (ADA).[10] According to the ADA, children who are overweight or obese and have any two of the following factors: family history of type 2 DM, ethnic minority and signs of insulin resistance or associated conditions (hypertension, acanthosis nigricans, features of polycystic ovarian syndrome, hypercholesterolemia, Prediabetes) should be referred for testing[10].
All data were entered into an excel sheet and analyzed using SPSS version 17. Results were presented in cross tabulations and frequency tables. The age, sex, family history of DM, hypertension and fasting blood glucose status of adolescents at risk were compared with those of their counterparts who are not at risk. Significance level was determined by Pearson Chi square test and Level of statistical significance was considered at P value <0.05.

Result

Of the 880 participants, 577(65.6%) were females. The mean age of students studied was 15.01± 2.1 years. There was no statistically significant difference between the mean age of males (15.69±2.3) and mean age of females (14.65± 2.6). As shown in Table 1, 47.5% of the participants were in the mid adolescent age group 13 to 15.9years. Overall 124(14.1%) of the students were overweight and obese with BMI $\geq 85^{th}$ percentile. The highest prevalence of overweight was found among individuals with the following characteristics: females 17.7%, age between 13 and 15.9years 16.5%, IFG 21.1%, hypertension 22.8% and positive family history of DM 18.2%. Among the participants, 99(11.2%) reported positive family history of diabetes mellitus, 219 (24.9%) had prehypertension and hypertension and 152 (17.3%) had IFG.

Table 2 shows the distribution of risk factors among the participants. Overall, about half 457(51.9%) of participants did not have any of the risks factor. Two (0.2%) participants had all four risk factors that were assessed.

Based on the ADA guideline, 21(2.4%) of the students were identified as at risk for type 2 DM[10]. Table 3 shows that there was no statistically significant gender difference in relation to presence of risk for type 2 DM. In assessing the difference between the age groups, the age 10 to 12.9 years was used as the reference group. There was no significant difference found between the students in the three age groups as shown in Table 3. Participants with family history of diabetes mellitus were more likely to be at risk for type 2 DM; however this difference was not statistically significant. (p = 0.558). A highly significant difference was found between participants with impaired fasting glucose compared with those with normal blood glucose. (p<0.0001) A significant difference was found for hypertension. (p<0.0001) Children with prehypertension or hypertension were 34% more likely to be at risk for type 2 DM.

Children identified to be at risk for type 2 DM were referred to the Paediatric endocrinology unit of the University Teaching Hospital for counselling and further evaluation and follow up.

Table1: Demographic Characteristics, Fasting blood glucose, Blood pressure, and Family history of Diabetes mellitus and overweight status of school children

Variable	N (%)	Overweight (BMI >85th Percentile)
Age(yrs.)		
10-12.9	139(15.8)	17(12.2)
13-15.9	418(47.5)	69(16.5)
16 -19	323 (36.7)	38 (11.8)
Gender		
Male	303(34.4)	22(7.3)
Female	577(65.6)	102(17.7)
Fasting blood glucose		
Normal	727(82.6)	92(12.7)
IFG	152(17.3)	32(21.1)
Diabetic	1(0.001)	0(0)
Blood Pressure		
Normal	661(75.1)	74(11.2)
Prehypertension/Hypertension	219(24.9)	50(22.8)
Family History of DM		
Positive	99(11.2)	18(18.2)
Negative	781(88.8)	106(13.6)

IFG (Impaired fasting glucose), BMI (Body mass index), DM (Diabetes mellitus)

Table 2: Distribution of participants according to number of risk factors present

Number of risk factors present	Male	Female	Total (%)
None	171	286	457(51.9)
One factor	94	178	272(30.9)
Two factor	30	80	128(14.5)
Three Factors	8	26	21(2.4)
Four Factors	0	6	2(0.2)

Table 3: Gender, Age, Blood pressure, Blood glucose and Family history of diabetes by Risk group

	At risk for Type 2 DM (% of total)	Not at Risk (% of total)	OR	P value
Total	21(2.4)	858(97.5)		
Gender				
Male	2(0.6)	301(99.3)		
Female	19(3.3)	558(96.7)	0.20	0.289
Age group				
10-12.9	2(1.4)	137(98.6)		
13-15.9	13(3.1)	405(96.9)	0.45	0.304
16-19	6(1.9)	317(98.1)	0.77	0.752
FH of DM				
Negative	8(1.0)	773(99.0)		
Positive	13(13.1)	86(86.9)	14.9	0.558
BP				
Normal	5 (0.8)	656(99.2)		
Hypertension	16(7.3)	203(92.7)	10.34	<0.0001
Blood glucose				
Normal	7(1.0)	721(99.0)		
IFG	14(9.2)	138(90.8)	0.1	< 0.0001

FH– Family history, BP-Blood pressure

Discussion

This study shows a low prevalence of risk factors for T2DM in adolescents in public secondary schools in Port Harcourt using the ADA criteria. This finding is not consistent with reports from developed countries which are usually higher[9,10,15]. In a study in Texas USA on prevalence of risk factors for type 2 DM in children aged 8 to 13 years, 22.6% of children aged 10 to 12 years were at risk for type 2 DM according to the ADA criteria, [9] this was much higher than the 1.4% found in children aged 10-12.9 years in our study. In Nigeria, no study has been done on prevalence of risk factors for Type 2 DM in adolescents. Studies in adults in Africa have however shown that risk factors for Type 2 DM are prevalent and the prevalence of Type 2 DM is increasing[16,17]. Reports on Type 2 DM in children and adolescents in developing countries and in Africa is still scarce, in a report in Sudan, prevalence of Type 2 DM in children aged 11 to 18 years was 4%.The risk factors common amongst the children with Type 2DM were obesity, positive family history of diabetes and hypertension[18]. In children, overweight is the risk factor most strongly associated with the development of T2DM[9]. In Africa, there is a shift from underweight to overweight along with rapid socioeconomic and nutritional transition particularly in urban population[19,20]. In this study, 14.1% of students were overweight and obese, higher than earlier findings from Nigerian adolescents with sex specific prevalence ranging between 0 to 8.1% for males and 1.3 to 8.1% for females[21]. Also in a Systematic review of evidence of overweight and obesity in school aged children and youths in South Africa, a combined prevalence of overweight and obesity was 13.1% similar to the rate reported in this study[22]. About 85% of children with type 2 DM are overweight or obese with development of insulin resistance and toxicity to beta cells due to high levels of free fatty acids in obese

individuals[23].

In this study, although the prevalence of those at risk for Type 2 DM using the ADA criteria was low, prevalence of individual risk factors and combination of risk factors were worrisome. In this study, about a quarter of the students had at least one risk factor and about 2.4% had three risk factors and only 0.2% had four risk factors. In a study done in Brazil amongst public secondary school adolescents aged 12 to 17 years, 7.5% of students had three risk factors and 1% had four risk factors[24]. In another study on risk factors for T2DM amongst adolescents aged 12 to 17 years in private schools in Brazil the prevalence of individual risk factors were higher than in our study and the study in Brazil done in public secondary schools showing that students from private schools were more vulnerable to development of type 2 DM[25]. In America, a progressive increase in prevalence of overweight and obesity noted over the years especially in minority ethnic groups and people of low income have been blamed for the increase in prevalence of Type 2 DM[9]. The increase in weight is due to an improvement in standard of living experienced at this time. The low prevalence rate therefore documented in this study may be the beginning of the rise with better assess to energy dense foods and transformation to more sedentary lifestyle experienced in many developing countries in Africa such as Nigeria[16,17].

Family history of diabetes mellitus is a very important risk factor for development of Type 2 Diabetes mellitus[18,26]. Data from our study show that approximately one out of every ten participant had a positive family history of DM. In this study, although more students with family history of DM were at risk for type 2 DM, this was not statistically significant. The finding in this report is however much lower than the report from the Brazilian study where about half of the children studied had a positive family history which may have accounted for the higher prevalence of risk factors[24].

Other risk factors evaluated were blood pressure and fasting blood glucose levels. In this study, about one quarter of the students had prehypertension and hypertension; although this is a concern, however the rate may partially be accounted for by the anxiety created by the study amongst the students and there is need for follow up. In the study on Type 2DM in Sudanese children and adolescents, more than fifty percent of the adolescents with Type 2 DM had hypertension[18]. A considerable percentage of the children also had impaired fasting glucose based on the ISPAD criteria[14], 17.3% of the students had impaired fasting glucose also referred to as prediabetes. IFG is a feature of insulin resistance that may eventually progress to diabetes mellitus. It is usually commoner in overweight adolescents as was seen in this study where about a fifth of the adolescents with IFG were overweight compared to 13% in normal weight adolescents.

There is need to avert the consequences of the increasing incidence of Type 2 DM in children and adolescents, research has shown that the higher the number of risk factors, the higher the probability of acquiring the disease[27]. In individuals with risk factors, it has been reported that changes in lifestyle can reduce the chances of progression to Type 2 DM by 58% over a period of 3 years. Such changes in lifestyle are aimed at reducing and maintaining a normal weight, increased consumption of fiber, restriction of fat, especially saturated fat and increased regular physical exercise[28].

Conclusion

Conclusion The prevalence of risk factors for type 2 DM according to the ADA criteria amongst students in Public secondary schools in Port Harcourt, Southern Nigeria was 2.4%. Prevalence of individual risk factors are of concern and presence of one or more risk factors is highly prevalent and seen in about half of the students studied.

Considering the profile of risk factors recorded in this study, there should be creation of awareness amongst health workers and the general public and need for public policies in schools, homes, health care centres to prevent and control the increasing prevalence of these risk factors.

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