

Prevalence of Diabetes and Prediabetes among School Children aged 10- 16 years old in North and South Dhaka

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Keywords: *Prevalence, Diabetes, prediabetes, children, Bangladesh*

1. INTRODUCTION

The epidemic of diabetes is one of the major concerns for public health globally, and it is projected that 700 million adults aged 20-79 will have diabetes by 2045.¹ Recent evidence suggests that prevalence of childhood diabetes is increasing. Around 1.1 million children and adolescents are estimated to have type 1 diabetes mellitus (T1DM).¹ The highest incidence of T1DM (children 0–14 years) is estimated to be in Europe and North America, with South-east Asia closely following the trend at third position. According to IDF atlas, the estimated number of children with T1DM under 20 years in South East Asian (SEA) countries, is 184 000.¹ Although type 1 diabetes remains the most common form of diabetes in young people in many populations, but type 2 diabetes has become an increasingly important public health concern globally among children in high risk ethnic populations.^{2,3} The early onset of T2D in children makes lifetime exposure to hyperglycemia longer and consequently causes a greater risk for long-term complications.⁴ Risk factors for developing childhood T2D are similar to those for adulthood, such as obesity, family history and ethnicity.⁵

In Bangladesh, bulk of care to diabetes is provided by the Diabetic Association of Bangladesh (BADAS), which works as an extended hand of Government of Bangladesh. Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), which is the

central institute of BADAS, providing care to diabetes patients including children with diabetes. Though T2D has been studied in adult populations; nevertheless, limited information is available to estimate the prevalence of diabetes among children in Bangladesh. Hence the prevalence of T1DM or T2 DM in children is uncertain, with no published data on national disease burden. There has been an upward trend in the number of newly diagnosed children with DM. In a recent hospital-based study showed that in Dhaka District mean T1D incidence of 1.25/100,000 population <20 years.⁶ The number of children with type 2 diabetes increased more than 7-fold from 2010 (2%) to 2015 (14%) found in a study done in BIRDEM.⁷ Hence this study aimed to estimate the prevalence of Prediabetes and diabetes in type 1 and type 2 diabetes among school children aged 10-16 years in Dhaka district. Results of the study would add more epidemiological information about diabetes and prediabetes in children in developing countries as well as inform public health interventions in Bangladesh.

2. MATERIALS AND METHODS

The Diabetic Association of Bangladesh led the study, and data was collected from January to March 2017. A school-based sampling frame was designed. Four schools were chosen from considering the distribution of schools in different regions of Dhaka city (North, and South). The sample was randomly selected with respect to the population of the respective school and the class. Children who were

studying at grade five to ten of the selected schools were recruited for the study.

Participants of the study were students who met the following criteria: (1) aged from 10 to 16 years old at the time of survey; (2) willing to participate in the study; and provide signed consent form by their parent or legal guardian. Students who did not meet the inclusion criteria or who wished to withdraw from the study at any stage were replaced by the next student in the class roster.

3. DATA COLLECTION PROCEDURES

3.1. First stage

A study participation invitation letter and consent form for parents were sent to the family of all selected children several days before the survey date. The parents were asked to fill the questionnaire and the consent forms at home and return it to the school. Data was collected in the mornings at the selected schools. A written questionnaire was filled by the child or volunteers focusing on the following:

Age, gender, family history of DM, food habit, any physical activity etc. These children were then subjected to the detection of estimation of random blood glucose.

3.2. Second Stage

Students were first screened by interviewers to check if they had met all inclusion criteria then anthropometric measurements and capillary random blood glucose were done. All anthropometric measurements were performed according to a written standardized protocol. Data collectors were participated in standard training conducted by the BIRDEM hospital to make sure data was collected properly according to the protocol. They collected a capillary blood sample of students. They used the glucose meter One Touch Verio Pro+ (LifeScan, Inc.) to measure capillary blood glucose (CBG).

3.3. Third Stage

Children with positive glucose test were referred to the BIRDEM hospital for further evaluation by Oral Glucose Tolerance Test (OGTT) where blood glucose was measured in the laboratory. The definition for IFG, impaired glucose tolerance (IGT) and diabetes was based on the criteria of American Diabetes Association (ADA) and International Society for Pediatric and Adolescent Diabetes (ISPAD).^{8,9} Diabetes was diagnosed if FPG was ≥ 7.0 mmol/l (126 mg/dl) or 2 h- post glucose (h PG) was ≥ 11.1

mmol/l (200 mg/dl). The cut-off points for the diagnosis of prediabetes and diabetes were based on the ISPAD and American Diabetes Association criteria, IFG, if FPG is between 5.6–6.9 mmol/L with 2hPG < 7.8 mmol/l after OGTT and IGT if 2hPG after OGTT was between 7.8–11.0 mmol/l with FPG (< 5.6 mmol/l (100 mg/dl) respectively.^{8,9} The OGTT was performed as described by WHO, using glucose of 1.75 g/kg of body weight to a maximum of 75 g dissolved in water.¹⁰

Students who were diagnosed with diabetes were assessed by a Paediatric Endocrinologist to confirm the status of diabetes (type 1 or type 2 diabetes) by further examinations and local criteria.^{11,12}

4. STATISTICAL ANALYSES

Descriptive statistics were used to summarize the data, with frequencies and percentages for categorical variables and means or medians for quantitative variables. Characteristics of participants related to diabetes and prediabetes were compared between groups using chi-square or Fisher exact tests for categorical variables. A significant level of $p < 0.05$ was used for all statistical tests.

5. RESULTS

The studied school students were 1406 who were eligible with the inclusion criteria. Among them 51.6% were girls and 48.4% were boys. Their median age was 14.0 [13.0-15.0] years. While considering the school area, 576 participants were from north and 830 from south region. Most of the participants were at 14 to 15 years old age group whereas lowest was in 10 to 11 years old group ($p < .0001$). Family history of diabetes was present in 396 (30.6%) patients among 38.0% in north region compared to 21.3% in south region ($p < .0001$) [Table 1].

The Median weight, BMI and waist circumference were significantly higher in study participants from north than the south region ($p < .0001$) [Table 2]. The prevalence of overweight and obesity was 3.5% and 6.5% in our study population. While comparing two regions we found that overweight and obesity were significantly higher (12.2% vs 2.3% and 6.4% vs 1.3%) in north region ($p = .0001$) and median central obesity (waist / height ratio) in student was higher in north than south regions ($p < .001$) [Table 2].

Table 1. Demographic characteristics of school children in two regions

Characteristics	North (576)	South (830)	Total	P value
Age				
10	25(4.3)	10(1.2)	35	
11	35(5.9)	45(5.4)	80	
12	52 (9.0)	135(16.3)	187	
13	67(11.7)	193(23.3)	260	
14	108 (18.8)	236(28.4)	344	
15	163(28.3.)	146(17.6)	309	
16	126(21.9)	65(7.8)	191	.0001
Sex				
Male	382 (66.3)	298(35.9)	680	
Female	194(33.7)	532(64.1)	726	.0001
Family history of diabetes				
Yes	219(38.0)	177(21.3)	396	
No	275(47.7)	622(75.0)	897	
Unknown	77(14.2)	31(3.7)	108	.0001

Table 2. Clinical characteristics of students in different school regions

Characteristics	North	South	P value
Weight	49.0[42.0-57.0]	39.0[34.0-44.0]	.0001
Height	159[149-166]	158[150-163]	.0001
BMI	19.5[17.1-22.0]	18.7[16.9-20.8]	.0001
Underweight	83 (14.4)	152 (18.3)	
Normal	351(60.9)	644 (77.6)	
Overweight	70 (12.2)	19 (2.3)	
Obesity	37 (6.4)	11 (1.3)	.0001
Waist circumference	68.0[62.0-75.0]	66.0[61.0-71.5]	.0001
Hip circumference	84.3[79.0-89.5]	82.0[77.0-86.0]	.0001
Waist/height ratio	0.43[0.40-0.47]	0.43[0.40-0.46]	.0001
Median RBS	5.5[5.1-5.8]	5.5[5.1-5.9]	.163

Median random blood glucose was 5.5 [5.1-5.9] mmol/L in the study participants. Prevalence of diabetes among school children was 0.3%; majority cases were newly diagnosed. The newly identified diabetes cases were further examined by physicians and were categorized as one new type 2 diabetes and two old and one new type 1 diabetes. Prevalence of type 1 diabetes was 0.2% and type 2 diabetes was 0.07%. Twelve participants (0.9%) were

diagnosed with Prediabetes condition. Prevalence of diabetes was equal in male and female (0.3%) whereas prevalence of prediabetes was 0.9% in males and 0.8% in females. The prevalence of prediabetes differed between the two regions of Dhaka [1.2% vs 0.6%] (p.219). While considering the age groups, the older age group (13- 16 years old) having the higher percentage of prediabetes (p .069). [Table 3]

Table 3. Comparison of Prediabetes and no diabetes

	Prediabetes Yes (n=12)	No (n=1394)	P value
	Region		
North	7(1.2)	569(98.8)	
South	5(0.6)	825(99.4)	.219
Sex			
Male	6(0.9)	674(99.1)	
Female	6(0.8)	720(99.2)	.909
Age group			
10 to 12 years	0(0)	301(100)	
13 to 16 years	12(1.1)	1093 (98.9)	.069
BMI	19.5[17.0-21.9]	16.9[15.5-18.7]	.906
Waist/Height ratio	0.43[0.40-0.47]	0.40[0.38-0.44]	.985

6. DISCUSSION

The results showed that the prevalence of diabetes was 0.3% with prevalence of type 1 diabetes was 0.2% and type 2 diabetes was 0.07%. There is wide variation in prevalence of T1D around the globe. The prevalence of type 1 diabetes in a study done in school children in Vietnam was 0.7% and in Mysore in India was 0.6%. whereas a study done by Asha Bai, et al. in 1982 on 3515 children aged 5-15 years with oral glucose tolerance test, no cases of diabetes were found.^{13,14,15} In a population-based study of physician diagnosed diabetes in US youth <20 years, the prevalence of undiagnosed type 2 diabetes was 0.4 %.¹⁶ Incidence is highest in European and some Arab populations, and lowest in some countries in the Western Pacific Region and South America^{9,17,18} In our recent hospital-based study done in BIRDEM we found T1D incidence of 1.25/100,000 population <20 y in Dhaka District.⁶

Prevalence of type 2 diabetes was 0.07% which was much lower than the prevalence among Brazilian school children aged 12-17 years old in 2013-2014 (3.3%) and slightly lower than the prevalence reported in the USA in 2009 among children aged 10-19 years old (0.046%).^{19,20} This data collection in our study was done six years back that may be the reason of lower number of patients though we have observed recently the increasing prevalence of T2D among children observed in some countries.²¹

Prevalence of Prediabetes was 0.9% in the study participants which was even higher in north region than south of Dhaka (1.2% vs 0.6%). Risk factor for prediabetes in children and adolescents is closely related to childhood obesity. In our study participants, we also observed a higher prevalence of overweight children.

The increased urbanization, increase consumption of fast food with sedentary life style in children might be the risk factors of increase trend of Prediabetes and type 2 diabetes in children.⁶ There are very few publications on the natural history of type 2 diabetes in children. Several case series suggests that children also have an asymptomatic phase similar to adults, during which the disease can be diagnosed.²² The rate of progression is influenced by various factors like high BMI, hypercholesterolemia, high blood pressure, family history of diabetes, pubertal status of the adolescents.^{14,23,24} In our study population one third of study participants (30.6%) had family history, a substantial

number had high BMI and central obesity though other risk factors like high blood pressure or hypercholesterolemia, were not measured.

The Median weight, BMI and waist circumference were also significantly higher in study participants from north than the south region of Dhaka. While considering central obesity in student, it was higher in north than south regions. In our previous study done in district school the prevalence of overweight was 23% and abdominal obesity was 26%.²⁵ Our study data was around six years back and we involved the schools from different sites of Dhaka city which may be the reason of low prevalence than our recent study done in a single district school.

The prevalence of overweight and obesity in a study done was 11% and 5%, respectively in concordance with other school-based data in India, which demonstrated prevalence of obesity in the range of 5.6% to 24% among children and adolescents.²⁶⁻²⁹

The limitation of study was it was a cross-sectional school-based study. The data utilized in the study was a period of time in school going children. The sample size for estimation of prevalence of prediabetes and for studying the association of risk factors may not be adequate. This study has brought out important points for further studies with sufficiently larger samples to confirm the epidemiological consistency of the observations made in this study.

7. CONCLUSION

The study suggests that while the prevalence of type 1, type 2 diabetes and prediabetes in children in Dhaka is comparatively lower than in some other countries, there is a regional variation within the city that requires further attention. The focus is on identifying at-risk individuals early to prevent or delay the onset of type 2 diabetes in children.

8. ACKNOWLEDGEMENTS

We would like to acknowledge the 'Changing Diabetes in Children Program (CDiC) of the Diabetic Association of Bangladesh for their support.

9. AUTHOR CONTRIBUTIONS

Conceptualization: BZ, KH Formal analysis and investigation: BZ, KH, F N, S T Writing - original draft preparation: BZ, KH, JN Writing - review and editing: BZ, JN, KA.

10. CONFLICT OF INTEREST

The authors report no conflicts of interest for preparation of this manuscript, only funding has been received for the screening purpose of this study from CDiC project.

11. FUNDING INFORMATION

The authors declared that they have not has received any financial support.

12. ETHICAL APPROVAL

The study was carried out in accordance with the ethical principles and the Helsinki Declaration. The study protocol was approved by the Ethics Committee of Diabetic Association of Bangladesh.

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Citation: Bedowra Zabeen. *Prevalence of Diabetes and Prediabetes among School Children aged 10- 16 years old in North and South Dhaka. ARC Journal of Diabetes and Endocrinology*. 2024; 9(1):14-19. DOI: <http://dx.doi.org/10.20431/2455-5983.0901003>.

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