Growth Status and Glycemic Control of Diabetic Children in a Tertiary Care Hospital in Dhaka City

Naz F[1], Tayyeb S[2], Zabeen B[3], Choudhury AY[4]

ABSTRACT

Childhood growth is a critical indicator of the health status of a child which also determines the overall developmental potential in adult life. Along with increased risk of developing various co-morbidities, diabetic children remain susceptible to growth delay in terms of height and weight. Thus it is necessary to evaluate their growth status in relation to their glycemic control. This cross sectional study observed 148 sequentially selected diabetic children aged 9 to 15 years, with 5 years diabetes duration attending a tertiary level hospital. Data regarding their anthropometric measurements including height and weight, HbA1c status, diabetic history has been collected. HbA1c level is a significant determinant of height, weight, BMI of the study subjects (p<0.05). The age at diagnosis of diabetes found to have significant impact on the height of the girls and weight of the both boys and girls and also on their HbA1c level, where, in all groups, the age at diagnosis at 5 to 9 years found to have highest proportion of children whose growth was less than the reference range. The duration of diabetes in this study was not related to the anthropometric measurement of the children (p>0.05) although it was significantly associated with the HbA1c level of them (p<0.05). This study results observed growth alteration among children with diabetes in association to their HbA1c level and age at diagnosis, which suggests that, diabetic children should be undertaken for routine monitoring of growth and glycemic control to provide with timely and adequate interventions to prevent growth delay among them.

Keywords: Diabetic children, HbA1c level, Anthropometric measurements, Growth alteration

INTRODUCTION

The increasing incidence of diabetes among children is a growing public health concern.[1] Type 1 diabetes is highly prevalent type of diabetes among children and adolescent diabetic patients and recent study in Bangladesh showed that, out of 100 diabetic individuals (under 22 years), 84 respondents had type 1 diabetes.[2] Per year, the national incidence rate of type 1 diabetes among children (0 to 19 years) has been reported to be at 8 out of 10000.[3] Longitudinal study results observed that, children who developed diabetes earlier the age of 10 years, live nearly 18 years shorter in case of female and nearly 15 years shorter in case of male in comparison to the non-diabetic people.[4] Which emphasizes the necessity of the constancy of management of these patients. Treatment of diabetic children is complicated as it requires lifelong care along with close monitoring of glycemic level and strict adherence to the prescribed management.[5] Marinating the body insulin level through exogenous administration to keep the blood sugar level in control is the mainstream treatment strategy for these patients.[6] It is recommended to keep their HbA1C level lesser than 7.5%.[7] One of the focus treating these diabetic children are to maintain the normal physical development.[8] Research estimation suggests that, poor glycemic control can impact the normal growth of a child in negative way.[9] Growth retardation have been found to be prevalent among 11–14% of diabetic children.[10] Appropriate childhood

1. Dr. Farzana Naz, Medical Officer, BADAS-Paediatric Diabetic Healthcare & Research Center, Diabetic Association of Bangladesh, Dhaka-1000.
2. Dr. Samin Tayyeb, Senior Medical Officer & Additional Coordinator, BADAS-Paediatric Diabetic Healthcare & Research Center, Diabetic Association of Bangladesh, Dhaka-1000.
3. Dr. Bedowra Zabeen, Consultant & Coordinator, BADAS-Paediatric Diabetic Healthcare & Research Center, Diabetic Association of Bangladesh, Dhaka-1000.
4. Dr. Adnan Yusuf Choudhury, Associate Professor and Head, Department of Respiratory Medicine, Mugda Medical College & Hospital, Dhaka-1214.

Address of correspondence: Dr. Farzana Naz, Medical Officer, BADAS-Paediatric Diabetic Healthcare & Research Center, Diabetic Association of Bangladesh, Dhaka-1000. Email: rima_dtr@yahoo.com

growth is essential to reach the full development potential in later life. [11]The absolute mechanism of growth retardation in children with Type I diabetes has not been established yet, although, among these children, IGFs (insulin like growth factors) and IGFBPs (IGF binding proteins) have been found to be notably reduced [12], whereas, IGFs and IGFBPs are important factors for the linear growth.[13]

As childhood is the most vital developing period, thus, rigorous analysis of the overall diabetic status as well as growth competence is very essential to reduce the morbidity and mortality associated with this disorder. Therefore, the present study assessed the height and weight of diabetic children in association to their diabetic status which might aid in understanding the current situation of this disease impact on growth of children in Bangladesh, as, data on this prospect is scarce in our country.

METHODS

Study methods and selection of study subjects: This research work was carried out with a cross sectional study design. 148 Study participants were selected sequentially from the diagnosed cases of type 1 diabetes (age: 9-15 years) with 5yrs diabetes duration, attending the outpatient department of a selected tertiary care level diabetes specialized hospital, who met the selection criteria of the study.

Data collection and analysis: Face to face interview was conducted with a semi-structured questionnaire to collect data. Data regarding the age at diagnosis, duration of diabetes and glycemic control in terms of glycosylated hemoglobin (HbA1C) level has been checked and recorded from the medical records. Anthropometric measurements in terms of standing height and weight was measured with standardized technique and BMI of the participants was calculated and recorded. With the recorded measurements, participants were categorized according to the reference growth chart. [14]The collected data were analyzed by IBM SPSS (statistical package for social science) software, version 22. Necessary tabulations, charts and diagrams were drawn for summarizing and easy visual presentation of data.

Ethical considerations: Ethical approval from the respective authority before conducting the study has been taken. After selecting the study participants according to the selection criteria of the study, guardians were approached and their informed written consent has been gathered before collection of data.

RESULTS

Table I: *Height and Weight of the Children (n=148) in Relation to their HbA1c level*

			HbA1c level						
			≤7.50 n=2		7.50to9.00 n=24		≥9.00 n=121		p value
		Total	N	%	N	%	N	%	
Height	Less than reference value	96	2	2.08	11	11.46	83	86.46	0.003
	Normal range	39	0	0.00	6	15.38	33	84.62	
	Greater than reference value	13	0	0.00	7	53.85	6	46.15	
Weight	Less than reference value	92	0	0.00	8	8.70	84	91.30	0.000
	Normal range	36	2	5.56	7	13.00	27	75.00	
	Greater than reference value	20	0	0.00	9	45.00	11	55.00	
BMI	≤24.99	141	2	1.4	19	13.5	120	85.11	0.000
	25.00-29.99	6	0	0	5	83.3	1	16.67	
	≥30.00	1	0	0	0	0	1	100	
Duration of diabetes (years)	≤5	18	2	11.1	4	22.2	12	66.67	0.000
	6-7	67	0	0	4	5.97	63	94.03	
	≥8	63	0	0	16	25.4	47	74.6	
Age at diagnosis (years)	≤4	40	0	0	14	35.00	26	65.00	0.000
	5-9	93	2	2.2	4	4.3	87	93.55	
	≥10	15	0	0	6	40.00	9	60	

Chi-square test was done after adjusting with Fishers exact to reach the value

This study has observed that, the fraction of diabetic boys and girls was 76 (51.4%) and 72 (48.6%) respectively. The HbA1c level among them was below 7.50% for 2 (1.35%), 7.5 to 9% for 24 (16.22%) and above 9% for 121 (81.76%) of them. The height of the children was less than reference value for 96 (64.86%), within normal range for 39 (26.35%) and greater than reference range for 13 (8.78%) of them. Among the children with height less than reference range, 86.46% of them had the HbA1c level 9.0% or more than that. Among the children with height greater than the reference range, 46.15% of them had HbA1c level 9.0% or above. The weight of the children was less than reference value for 92 (62.16%), within normal range for 36 (24.32%) and greater than reference range for 20 (13.51%) of them. Children with HbA1c level of 9.0% or more had 91.3% of the children whose weight was less than the reference range. Observation of the BMI of the children showed that, 85.11% of the children with BMI less than 25 kg/m^2 had the HbA1c level of 9.0% or more.

Children who had diabetes for less than 6 years, among them 66.67% had HbA1c level 9.0% or more, children with diabetes duration 6 to 7 years among them 94.03% had HbA1c level 9.0% or more. Among the children who has been diagnosed with diabetes before the age of 5 years, 65.0% of them had, who had been diagnosed between 5 to 9 years, 93.55% of them and who had been diagnosed at 10 years or later, 60.0% of them had HbA1c level of 9.0% or more. According this study findings, HbA1c status was in significant association with the height, weight and BMI; it was also dependent on the duration of the diabetes as well as the age at diagnosis of diabetes ($p < 0.05$) (Table I).

On evaluation of the growth of the children in relation to their age at diagnosis of diabetes has showed that, the height of the children was significantly associated with the age at diagnosis in case of girl diabetic children. The weight of the children was significantly associated with the age at diagnosis both in case of girls and boys ($p < 0.05$) (Table II).

Table II : *Height and Weight of the Boys (n=76) and Girls (n=72) in Relation to Their Age at Diagnosis of Diabetes*

	Age at Diagnosis			Less than referencevalue		Normal Range		Greater than referencevalue		p value
	Years		Total	N	%	N	%	N	%	
Height	Girls	≤4	18	6	33.3	11	61.1	1	5.56	0.006
		5-9	41	26	63.4	14	34.1	1	2.44	
		≥10	13	9	69.2	1	7.7	3	23.08	
	Boys	≤4	22	16	72.7	2	9.1	4	18.18	0.445
		5-9	52	37	71.2	11	21.2	4	7.69	
		≥10	2	2	100	0	0	0	0	
Weight	Girls	≤4	18	9	50	9	50	0	0	0.011
		5-9	41	22	53.7	13	31.7	6	14.63	
		≥10	13	3	23.1	4	30.8	6	46.15	
	Boys	≤4	22	14	63.6	3	13.6	5	22.73	0.012
		5-9	52	44	84.6	6	11.5	2	3.85	
		≥10	2	0	0	1	50	1	50	

Chi-square test was done after adjusting with Fishers exact to reach the value

Table III: *Height and Weight of the Boys (n=76) and Girls (n=72) in Relation to The Duration of Diabetes*

	Duration			Less than referencevalue		Normal Range		Greater than referencevalue		p value
		Years	Total	N	%	N	%	N	%	
Height	Girls	≤5	8	8	100	0	0	0	0	0.059
		6-7	33	20	60.6	11	33.3	2	6.06	
		≥8	31	13	41.9	15	48.4	3	9.68	
	Boys	≤5	10	7	70.0	3	30.0	0	0.00	0.251
		6-7	34	27	79.4	5	14.7	2	5.88	
		≥8	32	21	65.6	5	15.6	6	18.75	
Weight	Girls	≤5	8	4	50	1	12.5	3	37.5	0.166
		6-7	33	15	45.5	11	33.3	7	21.21	
		≥8	31	15	48.4	14	45.2	2	6.45	
	Boys	≤5	10	7	70	3	30	0	0	0.299
		6-7	34	28	82.4	3	8.8	3	8.82	
		≥8	32	23	71.9	4	12.5	5	15.63	

Chi-square test was done after adjusting with Fishers exact to reach the value

The impact of duration of diabetes on the anthropometric measurements have been tried to observed. It has been seen that, the duration of diabetes was not in statistically notable in regard of height or weight among diabetic boys or girls (p>0.05) (Table III).

DISCUSSION

Childhood is the important developmental period where proper growth is attributed by adequacy of endocrine function, as well as nutrition obtainability. [15] Being the most common endocrine disorder among children, type 1 diabetes itself interferes with nutrient metabolism, thus increases the probability of growth impediment among them. [16] It has been observed that, the diabetic children under this study were in poor control of glycemic status in most instances ((81.76%), which also found to be a significant determinant of short stature (86.46%), poor weight (91.30%), poor BMI (85.11%) among the children (p<0.05). Comparable to this finding, another study found that, among the diabetic children, poor HbA1c level group of children gained less height than the children with fair metabolic control. [17] Likewise weight also found to be affected in case of diabetic children compared to that of the non-diabetic children in other study. [18] Also, poor metabolic control observed to be concomitant with poor BMI in a long term retrospective study on 5 to 17 years old diabetic children. [19]

In this study, the age at diagnosis found to be in significant association with the height and weight of the girls and with the weight of the boys (p<0.05). Previous study results showed that, diabetic children with prepubertal onset of diabetes had lower final height than the diabetic children who had the diabetic onset at the puberty or after that. [17] Lower weight for age of the children was not found to be significantly affected by age at diagnosis of diabetes in other studies, although younger age of onset observed to be prevalent with lower weight for age z score in comparison to their control (p>0.05). [20] In our study, age at onset also was significantly associated with the glycemic control which is similar to other study observation, where it was concluded that, younger age at onset of diabetes found to be a predictor of poor growth and poor glycemic control. [21] In this study, the duration of diabetes was not in significant relation to the anthropometric findings of the children, which was parallel with the findings of another study. [22]

CONCLUSION

Glycemic control as well as age at diagnosis found to be important factor to impact the growth among the children with type 1 diabetes. It is recommended to conduct large scale follow up study to assess the growth among the children, who have the onset of diabetes during their pre-pubetrtal to pubertal period. These children also require to be under strict

supervision so as to avoid growth retardation among them and also to prevent poor glycemic control associated acute and long term complications.

REFERENCES

1. Dabelea D, Mayer-Davis EJ, Saydah S, Imperatore G, Linder B, Divers J, et al. Prevalence of Type 1 and Type 2 Diabetes Among Children and Adolescents From 2001 to 2009. JAMA. 2014;311(17):1778–86.

2. Zabeen B, Govender D, Hassan Z, Noble JA, Lane JA, Mack SJ, et al. Clinical features, biochemistry and HLA-DRB1 status in children and adolescents with diabetes in Dhaka, Bangladesh. Diabetes Res Clin Pract. 2019;158:107894.

3. Bangladesh country report 2010 — 2045 [Internet]. [cited 2020 Mar 18]. Available from: https://diabetesatlas.org/data/

4. Rawshani A, Sattar N, Franzén S, Rawshani A, Hattersley AT, Svensson A-M, et al. Excess mortality and cardiovascular disease in young adults with type 1 diabetes in relation to age at onset: a nationwide, register-based cohort study. Lancet Lond Engl. 2018;392(10146):477–86.

5. Kayirangwa A, Rutagarama F, Stafford D, McCall N. Assessment of Growth among Children with Type 1 Diabetes Mellitus: A Cross-Sectional Study of Factors Contributing to Stunting. J Diabetes Metab [Internet]. 2018 [cited 2021 Aug 1];09(04). Available from: https://www.omicsonline.org/open-access/assessment-of-growth-among-children-with-type-1-diabetes-mellitus-a-crosssectional-study-of-factors-contributing-to-stunting-2155-6156-1000793-100862.html

6. Malik FS, Taplin CE. Insulin therapy in children and adolescents with type 1 diabetes. Paediatr Drugs. 2014;16(2):141–50.

7. Chiang JL, Kirkman MS, Laffel LMB, Peters AL. Type 1 Diabetes Through the Life Span: A Position Statement of the American Diabetes Association. Diabetes Care. 2014;37(7):2034–54.

8. Beck JK, Cogen FR. Outpatient Management of Pediatric Type 1 Diabetes. J Pediatr Pharmacol Ther JPPT. 2015;20(5):344–57.

9. Wise JE, Kolb EL, Sauder SE. Effect of glycemic control on growth velocity in children with IDDM. Diabetes Care. 1992;15(7):826–30.

10. Virmani A, Shah P, Setia S, Singh GR. Why must Indian diabetic children continue to have retarded growth? Acta Paediatr Oslo Nor 1992. 1995;84(3):354–5.

11. Sudfeld CR, McCoy DC, Danaei G, Fink G, Ezzati M, Andrews KG, et al. Linear Growth and Child Development in Low- and Middle-Income Countries: A Meta-Analysis. Pediatrics. 2015 May 1;135(5):e1266–75.

12. Cianfarani S, Bonfanti R, Bitti ML, Germani D, Boemi S, Chiumello G, et al. Growth and insulin-like growth factors (IGFs) in children with insulin-dependent diabetes mellitus at the onset of disease: evidence for normal growth, age dependency of the IGF system alterations, and presence of a small (approximately 18-kilodalton) IGF-binding protein-3 fragment in serum. J Clin Endocrinol Metab. 2000;85(11):4162–7.

13. Virmani A. Growth disorders in type 1 diabetes: an Indian experience. Indian J Endocrinol Metab. 2015; 19(Suppl 1):S64–7.

14. Disabled World. Average Height to Weight Chart: Babies to Teenagers [Internet]. Disabled World. 2017 [cited 2021 Jul 29]. Available from: https://www.disabled-world.com/calculators-charts/height-weight-teens.php

15. Nilsson O, Marino R, De Luca F, Phillip M, Baron J. Endocrine regulation of the growth plate. Horm Res. 2005;64(4):157–65.

16. Mitchell DM. Growth in patients with type 1 diabetes. Curr Opin Endocrinol Diabetes Obes. 2017; 24(1):67–72.

17. Holl RW, Grabert M, Heinze E, Sorgo W, Debatin KM. Age at onset and long-term metabolic control affect height in type-1 diabetes mellitus. Eur J Pediatr. 1998;157(12):972–7.

18. Khadilkar VV, Parthasarathy LS, Mallade BB, Khadilkar AV, Chiplonkar SA, Borade AB. Growth status of children and adolescents with type 1 diabetes mellitus. Indian J Endocrinol Metab. 2013; 17(6):1057–60.

19. Högel J, Grabert M, Sorgo W, Wudy S, Gaus W, Heinze E. Hemoglobin A1c and body mass index in children and adolescents with IDDM. An observational study from 1976-1995. Exp Clin Endocrinol Diabetes Off J Ger Soc Endocrinol Ger Diabetes Assoc. 2000;108(2):76–80.

20. Khadilkar VV, Parthasarathy LS, Mallade BB, Khadilkar AV, Chiplonkar SA, Borade AB. Growth status of children and adolescents with type 1 diabetes mellitus. Indian J Endocrinol Metab. 2013;17(6):1057–60.

21. Danne T, Kordonouri O, Enders I, Weber B. Factors Influencing Height and Weight Development in Children With Diabetes: Results of the Berlin Retinopathy Study. Diabetes Care. 1997;20(3): 281–5.

22. Aljuhani F, Al - Agha A, Almunami B, Meftah E, Sultan R, Sultan R, et al. Growth status of children and adolescents with type 1 diabetes mellitus in. Curr Pediatr Res. 2018;249–54.