Original Article

Growth Indices among Children and Adolescents with Type 1 Diabetes - Baghdad – Iraq, 2013

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Summary:

Background: Type 1 diabetes mellitus is one of the most common chronic endocrine disorders of childhood, growth impairment is one of its long−term consequences

Objective: To study the anthropometric indices among children with type 1diabetes.

Patients and Methods: All children with type 1diabetes attending Diabetic Clinic at Children Welfare Teaching Hospital-Baghdad, during 1/1 – 31/5/2013were included in this cross sectional study. Demographic data, disease information, and type of presentation were obtained directly through patient's interviews. The weight in kilogram and height in centimeter were measured for each child and their anthropometric indices were classified according to World Health Organization indicators, 1997.

Results: A total of 253 children with type 1diabetes were studied, 51.8% were females, 47.9% developed the disease at 5-9 years of age, and 52.6% presented with classical signs and symptoms. Stunting /sever stunting was 15% with male predominance, higher among older age group (10-20 y), wasting/ sever wasting was 19.4% with male predominance, higher among older age group (10-20 y), over weight/ obese was 3.6% with females predominant and higher among younger age group.

Conclusion: Wasting/ sever wasting and stunting /sever stunting were the highest growth problems among diabetic children with male predominance and higher among older age group at diagnosis.

Key words: type 1 diabetes, children, growth.

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Introduction:

Type 1diabetes (T1D) is a chronic illness characterized by the body's inability to produce insulin due to the autoimmune destruction of the β - cells in the pancreas. Most pediatric patients with diabetes have type 1 and a lifetime dependence on exogenous insulin. The classical symptoms are polyuria, polydipsia, polyphagia and weight loss (1). Different environmental factors affect the occurrence of T1D, yet evidence revealed that race as well as sex has its share. Studies reveled that males are at greater risk in regions of high incidence, particularly older males, whose incidence rates often showed seasonal variation and females appeared to be at a greater risk in low-incidence regions (2, 3). It is well recognized that growth is seriously impaired in cases of very poorly controlled diabetes. What is less certain, however, is whether diabetes influences growth or limits adult height in children treated conventionally in whom the disease is fairly well controlled. There are some discrepancies in the findings of various researchers as some found that in patients with type 1diabetes there was a decrease in adult height compared with their identical non-affected twins. Growth delay although observed by others yet they noticed that children with a fairly high degree of metabolic control showed normal growth rate (4).Impairment of growth and development decreased with major advances in diabetes care. During the last decade, there were some studies reporting positive growth characteristics in diabetic children. However, growth deceleration during the course of the disease has been reported in various countries around the world, such as Austria, Brazil, Czech Republic, Germany, and Sudan (5). In Iraq very limited studies were conducted among children with diabetes and no previous reports on the effect of the disease on their growth and development as most of the studies were concerned with health - related quality of life of diabetic adolescents (6), the importance of coping behavior to perceived diabetic worries, which in turn affects the metabolic control (7), the intellectual development of diabetic children and their school performance (8). In the current study we aimed to assess the anthropometric indices among children and adolescents with type 1diabetes.

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Patients and methods:

The study was carried out at Children Welfare Teaching Hospital – Medical City Health Directorate, from the first of January 2013 to the end of May 2013. Children with type one diabetes mellitus (Diabetic children, diagnosis stated by physician clinically and confirmed with blood glucose tests, aged up to 20 years)) attending the Diabetic Clinic at Children Welfare Teaching Hospital were included in the study. The pediatric diabetic clinic received patients once weekly; the services are delivered by a well trained medical and paramedical

staff supervised by a consultant pediatrician. Anthropometric measurements were measured by the investigator at the time of interview to study the effect of the disease on their growth indices. Investigator visited the diabetic clinic once weekly, for five hours.

Data Collection Tool:

Permission was obtained from the parents/ family member accompanied the patients before starting the interview which was carried out with parents/ family member as well as patient. Data was collected and organized in a special data collecting form prepared by the researcher based on the information available at the patients' records provided by the diabetic clinic,

including: demographic data; Name, age, sex, date of birth and address (residence), disease information; date of diagnosis, age at diagnosis, type of presentation at time of diagnosis (classical presentation including polyuria, polydypsia and loss of weight, or diabetic ketoacidosis with or without coma.

Anthropometric measurements;

Standing height for children above two years: was measured to the nearest 0.1 centimeter. handmade wall mounted scale was used, the child stood shoeless with the heels and back in contact with the wall, his head was held so that he looked straight forward.

Supine length for children up to 2 years of age:

a special table was used with fixed head board and a sliding foot board copy of the handmade scale was applied to the table. The measure was taken with the child lying on the table.

Weight measurement: calibrated scale (Seca) was used which was standardized by two standard five kilogram weights to the point of 5Kg and 10Kg before every day work. For children below two years another scale supplied with a basket was used (Seca) and was standardized in the same manner. The weight was taken with the child shoeless and jacketless to the nearest 0.25Kg. We compared the points plotted on the child's growth charts with the z-score lines to determine whether they indicate a growth problem. Measurements in the shaded boxes are in the normal range.

Table A: World Health Organization Growth Indicators (9)

Z-score	Growth indicators			
	Length/height For – age	Weight-for- age	Weight-for Length/height	BMI-for-age
Above 3	See note 1	See note 2	Obese	Obese
Above 2			Over weight	Over weight
Above 1			Possible risk of over weight (See note 3)	Possible risk of over weight(See note 3)
0(median)				
Below -1				
Below -2	Stunted (See note 4)	Under weight	Wasted	Wasted
Below -3	Severely stunted (See note 4)	Severely Under weight (see note 5)	Severely wasted	Severely wasted

1. A child in this range is very tall.
2. A child whose weight-for-age falls in this range may have a growth problem, but this is better assessed from weight-for-length/height or BMI-for-age.
3. A plotted point above 1 shows possible risk. A trend towards the 2 z-score line shows definite risk.
4. It is possible for a stunted or severely stunted child to become overweight.
5. This is referred to as very low weight in Integrated Management of Childhood Illnesses training modules (10).

Statistical analysis:

The Statistical Package for Social Sciences (SPSS version 21) was used for statistical analysis. Epi Info version 3.5.3 was used for calculating nutritional indices using the CDC2000 reference population. Discrete variables presented as numbers and percentages and continuous variables presented as mean ± SD (standard deviation). Chi square test for independence was used to test the statistical significance of association between 2 categorical variables and student's t test for two independent samples was used to test the significance in observed difference in mean of continuous variables between 2 groups. Findings with P value less than 0.05 will be considered statistically significant.

Results:

During the study period; 253 children with type 1 diabetes mellitus attending the Diabetic Clinic at Children Welfare Teaching Hospital were studied. Table 1 showed that 122 of the patients were males (48.2%), 131 were females (51.8%) with a male: female ratio of 0.9:1.

Regarding their age; More than half of the patients (54.1%) were ten years and more during interview, whereas 34.4% of the children were diagnosed at 5-9 years of age. The presenting complaint was classical (polyurea, polydepsea and weight loss or failure to thrive) in more than half of the studied children (52.6%) (table 1).

Table 1: Characteristics of the studied children

Variables	Children with type 1DM	
	No.	%
Gender		
Males	122	48.2
Females	131	51.8
Total	253	100.0
Age at interview (in years)		
< 5	29	11.5
5 – 9	87	34.4
10+	137	54.1
Total	253	100.0
Age at diagnosis (in years)		
< 5	55	21.7
5 – 9	121	47.9
10+	77	30.4
Total	253	100.0
Presenting Complaint		
Classical signs & symptoms of DM	133	52.6
Diabetic ketoacidosis	120	47.4
Total	253	100.0

The Height for Age Z score (HAZ) revealed that 7.9% were severely stunted, 7.1% were stunted with and 5.1% were very tall. As for BMI for age Z / WHZ it was found that 8.7% of children were classified as severely wasted, 10.7% were wasted, 2.8% were overweight and only 0.8% were obese (table 2).

Table 2: Distribution of the studied patients by their growth / nutritional indices

Indices	N	%	95% CI
HAZ			
Severe stunting	20	7.9	(4.6 - 11.2)
Stunting	18	7.1	(4 - 10.2)
Normal	202	79.9	
Very tall	13	5.1	(2.4 - 7.8)
Total	253	100.0	
BMI for age Z/ WHZ			
Severe wasting	22	8.7	(5.2 - 12.2)
Wasting	27	10.7	(7 - 14.4)
Normal	159	62.8	
Possible risk of overweight	36	14.2	(9.9 - 18.5)
Overweight	7	2.8	(0.8 - 4.8)
Obese	2	0.8	***
Total	253	100.0	

*** Small sample size (no results)
HAZ= Height for Age Z score
BMI= Body Mass Index
WHZ= Weight for Height Z score

Table 3: Distribution of diabetic children by gender and their growth / nutritional indicators

Indices	Gender				P			
	Male (122)		Female (131)					
	N	%	N	%				
HAZ								
Stunting/severe stunting	20	16.4	18	13.7	0.56[NS]*			
Normal	95	77.9	107	81.7				
Very tall	7	5.7	6	4.6	0.68[NS]*			
Total	122	100.0	131	100.0				
Range	(-4.47 to 5.47)		(-5.23 to 5.53)					
Mean ± SD	-0.4±1.8		-0.3 ±1.8		0.55NS**			
BMI for age Z / WHZ								
Wasting / severe wasting	25	20.5	24	18.3	0.66[NS]*			
Normal / possible risk of overweight	95	77.9	100	76.3				
Overweight / obese	2	1.6	7	5.3	0.11[NS]*			
Total	122	100.0	131	100.0				
Range	(-11.8 to 3.2)		(-7.9 to 4.1)					
Mean ± SD	-0.9 ± 2		-0.5 ± 1.7		0.14NS**			

HAZ= Height for Age Z score
BMI= Body Mass Index
WHZ= Weight for Height Z score

Table 3 showed that the difference in mean HAZ score between males and females was statistically not significant (Student's t test, p = 0.55), and although the percentage of stunting and severe stunting was slightly higher among males yet the association was statistically not significant ($\chi 2$ test, df=1, P= 0.56). Same results was found among very tall children and their gender ($\chi 2$ test, df=1, P= 0.68). The mean body Mass index (BMI) for age Z score /Weight for height Z score (WHZ) was obviously higher among female (Z= - 0.5) compared to male (Z= -0.9) but the difference observed failed to reach the level of statistically significant difference, and neither the association between gender and being wasted/severely wasted was statistically significant ($\chi 2$ test, df=1, P= 0.66) nor the association between gender and being overweight/obese ($\chi 2$ test, df=1, P= 0.11).

Table 4: The growth/nutritional indicators by age group

Indices	Age group (years)						P
	<5		5-9		10-20		
	N	%	N	%	N	%	
HAZ							
Stunting / severe stunting	**5**	**9.1**	**14**	**11.6**	**19**	**24.7**	**0.016***
Normal	**42**	**76.4**	**102**	**84.3**	**58**	**75.3**	
Very tall	**8**	**14.5**	**5**	**4.1**	**0**	**0.0**	**<0.002#**
Total	**55**	**100.0**	**121**	**100.0**	**77**	**100.0**	
r=-0.38 P<0.001							
BMI for age Z/WHZ							
Wasting / severe wasting	**11**	**20.0**	**18**	**14.9**	**20**	**26.0**	**0.15[NS]***
Normal / possible risk of overweight	**40**	**72.7**	**100**	**82.6**	**55**	**71.4**	
Overweight / obese	**4**	**7.3**	**3**	**2.5**	**2**	**2.6**	**0.24[NS]***
Total	**55**	**100.0**	**121**	**100.0**	**77**	**100.0**	
r=-0.134 P=0.033							

*Tested by Chi square test, ** Tested by ANOVA test, # Chi square test with Yates correction
HAZ= Height for Age Z score
BMI= Body Mass Index
WHZ= Weight for Height Z score

As shown in table 4, the relative frequency for being stunted/ severely stunted was lowest in the youngest age group (9.1% in less than 5 years) and increase with age to reach its highest frequency in the oldest age group (24.7% in those 10-20 years of age). The relative frequency for being very tall was highest in the youngest age group (14.5%) and decrease with age as none was found in the oldest age group (0%). The association between age group and being very tall was statistically significant (p<0.002). The association between age group and being stunted/severely stunted was statiscally significant (p=0.016), the mean HAZ was highest in less than 5 years age group(z=0.6) and decreases with increasing age to reach its lowest value in those 10-20 years of age(z=-1.2),the difference observed between the three age groups was statistically significant. There was statiscally significant weak (negative) indirect linear correlation between HAZ and age. The relative frequency for being wasted/severely wasted was lowest in 5-9 age group(14.9%) to reach its highest frequency in 10-20 years age group(26%),the association between age group for being wasted/severely wasted was not statistically significant(p=0.15). The relative frequency for being overweight/obese was lowest in 5-9 age group (2.5%) to reach its highest frequency in less than 5 years age group (7.3%), the association between age group for being overweight/obese was not statistically significant(p=0.24). The mean BMI for age Z /WHZ was highest in less than 5 years age group(z=-0.5) and decreases with increasing age to reach its lowest value in those 10-20 years group(z=-1), the difference in mean BMI for age Z /WHZ between the three age groups was not statistically significant(p=0.34).there was a statistically significant very weak (negative) indirect linear correlation between BMI for age Z /WHZ and age (table 4 and figure 1).

Discussion:

Type 1 diabetes mellitus is one of the most common chronic endocrine disorders of childhood, with well−known short− and long−term consequences (10). In the current study, nearly half (47.9%) of the studied children developed the illness between 5-9 years of age, 30.4% developed it at 10 years of age and more and only 21.7% of them were less than five years of age at diagnosis, nearly the same results were found by Kadhim M.A., during 1996 in his clinico-epidemiological descriptive study of T1D (11) that was conducted at the same hospital (24.7% developed the disease before 5 years of age, 42.4% developed the illness between 5-10 years of age and 32.9% developed it after 10 years of age). Salman et al, (12) who studied childhood

diabetes in Saudi Arabia during 1991 mentioned two peaks of age for the onset of diabetes among children, one around 5-7 years and another 11-14 years. The slight increase in incidence at age below 5 years and the first peak at school age, both of them were due to increase exposure to the infectious agents at age of school and nursery. The second peak occurs at pubertal age due to increase gonadal steroid secretion and increase pubertal growth hormone secretion which antagonize insulin action and also emotional stress accompanying with puberty is an associated factor which increases pubertal incidence of T1DM (13).The same conclusion was reached by Kadhim MA, 1996, from Iraq(11). In general, the incidence of T1DM increases with age, the incidence peak is at puberty (3). Regarding sex distribution, the current study showed a slight female excess (51.8%), such a female preponderance was also observed in Saudi Arabia where 53.6% of the diabetic children were females (12). On the contrary Abdulla M. A. (14), previously during 1989 showed a male preponderance with male to female ratio of 1.3:1 in Riyadh, Saudi Arabia. Kadhim M.A., during 1996, found that male to female ratio was nearly 1:1 (51% males and 49% females) (11). Although female/male ratio in T1DM patients is generally reported to be equal, many studies reported that the condition might be slightly frequent either in boys or in girls (15). Overall, the frequency is reported to be higher in boys from high incidence countries and higher in girls from low incidence countries (16-18). Others stated that although girls and boys are equally affected, yet after the pubertal years, the incidence rate significantly drops in young women, but remains relatively high in young adult males up to the age 29-35 years (3). The clinical presentation in more than half of the cases (52.6%) in the present study was the classical signs and symptoms whereas in Salman et al. study DKA was the most common clinical presentation 67.3% (12). In Iraq Kadhim found that 72.4% of the studied children presented with the classical symptoms of diabetes and 26.6% only presented with DKA among them 45.3% were diagnosed before five years of age (11).These differences may be attributed to the level of awareness among parents regarding diabetes in children, improvement of health services and early diagnosis. Regarding anthropometric indices, in the current study HAZ showed that 79.9% of the studied children were with normal height for age, stunting/severe stunting was found in 15% of diabetic children, more among males (16.4%) than female (13.7%), 5.1% of the children were very tall (5.7% males and 4.6% female). Stipancic G. et al.(19), in their case control study regarding growth disorders in children with type 1 diabetes mellitus in Zagreb (Croatia) found that children with T1D were significantly taller than controls especially among those diagnosed between the ages of 4-9.5 years. Other researchers also reported that diabetic children were taller (20, 21), or shorter, or having the same height in relation to the control group or national standard. Other scientists stated that the height depend upon the age at diagnosis of diabetes (19, 22). In our study among children who were diagnosed in pre puberty i.e. at the age less than 10 years, 18.6% of them were very tall, these result coincide with the result of other studies (22, 23). Being taller at the time of diagnosis could be attributed to taller parental stature (21). On studying growth data in large series of 587 children and adolescents with type 1 diabetes mellitus, Lebl J. et al. stated that "Diabetic children are taller close to the diabetes onset, which may be due to the synchronization of onset of diabetic symptoms with the mid-childhood growth spurt or the pubertal growth spurt accompanied by elevated growth hormone and/or androgen levels and increased insulin resistance. The subsequent growth deceleration may represent a physiological lag-down growth. This concept is supported by normal adult heights following growth deceleration (20). In our study, it was found that those with onset of disease at puberty i.e. age >10 years were significantly stunted/ severe stunted (24.7%).Similar findings were found by other researchers (22, 23). This result can be attributed to the increase in pubertal growth hormone secretion which antagonizes insulin action (13) yet puberty neither begins at the same time in all children nor does it develop at the same rate which may explain the gender differences. In the current study BMI indicated that obese /overweight were obvious in 3.6% of diabetic children, with female predominant (5.3%) and it was higher among younger age group (7.3% among < 5 years of age). This is on the one hand, on the other wasting /severe wasting was found in 19.4% of the studied children with male predominance (20.5%) and it was higher among older age group (26%). Since a profound loss of body mass and dehydration precedes the onset of disease, it is very difficult to determine the level of nourishment before the onset of disease. The maintained BMI in younger children can result from the faster progression of diabetes and shorter period of symptoms that lead to as lighter loss of body mass. It is also possible that these children were adipose before the onset of diabetes which as –an external factor-can cause hyperinsulinisim, accelerated growth, and it can help to bring about diabetes. In older patient profound loss of body mass and lower BMI at onset indicate a slow progression and longer duration of symptoms (19). On conclusion; Diabetic children, both boys and girls, showed variable degrees of impaired growth when compared to standard deviation score adopted by WHO. Planned and properly implanted educational programs to the whole family members regarding dietary knowledge is vital in maintaining normal growth among growing children and adolescents with type 1 diabetes and decreasing long and short term complications

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