

GROWTH VELOCITY IN CHILDREN WITH TYPE 1 DIABETES MELLITUS AGED 2-18 YEARS ATTENDING MITTAYI CLINIC IN GOVT. TDMC ALAPPUZHA KERALA**Dr. Aiswarya Danesh¹ and Dr. Sunil Daniel^{2*}**¹Junior Resident, Department of Pediatrics, Government T.D. Medical College, Alappuzha.²Associate Professor, Department of Pediatrics, Government T.D. Medical College, Alappuzha.***Corresponding Author: Dr. Sunil Daniel**

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ABSTRACT

Background: Type 1 diabetes mellitus is the commonest metabolic-endocrine disease in children. The absence of physiologic insulin response leads to dysfunctional quantities of growth hormone, insulin-like growth factor I resulting in growth impairment. Growth parameters are important indicators of a child's health and they are influenced by factors like blood glucose control in diabetic children. **Objectives:** 1. To assess growth velocity of children aged 2-18 years with T1DM attending MITTAYI clinic 2. To identify the factors affecting the growth velocity of Type 1 Diabetic children. **Methods:** Longitudinal follow up study done in MITTAYI clinic under Department of pediatrics, Govt. TDMCH Alappuzha. All children in the age group 2-18 years were selected for the study by universal sampling. Anthropometric measurements were taken using standard scales and BMI was measured 3 monthly. Growth velocity of the child was calculated at the end of the year. An average of readings of HbA1C taken 3 monthly was used to describe the metabolic control over a year. Data obtained was analysed using SPSS 26.0v software. **Result:** Study was conducted among 92 children aged 2-18 years registered under MITTAYI clinic in Govt. TDMC Alappuzha. In our study 29(31.5%) children had decreased height velocity. The height velocity was more affected in females ($p=0.021$). Children diagnosed at an early age and having the disease for a longer duration was more affected (p value – 0.036). Height velocity was also affected by HbA1C value (p value - 0.002). Children who were not compliant with the dietary advices and who had increased frequency of missed doses also had decreased height velocity ($p < 0.001$). **Conclusion:** Height velocity was reduced in 31.5 % of our children with T1DM. Weight gain of these children was not much affected. Important factors affecting height velocity in children were early age of diagnosis, longer duration of disease, poor metabolic control, inadequate dietary compliance and irregular insulin administration.

KEYWORDS: T1DM, HbA1C, growth velocity.**INTRODUCTION**

T1DM is an autoimmune disease that is characterized by slowly progressing pancreatic beta-cell destruction, resulting in a reduction of insulin secretion and, over the course of several years, the development of clinically evident insulin-dependent diabetes mellitus.^[1] It is one among the most common chronic endocrine illness in children requiring a complex treatment regimen. In the past few years there has been a significant rise in the number of new cases. Insulin therapy, medical nutritional therapy, planned physical activity and self monitoring of blood glucose and urine ketones are the essential aspects of treatment. There is no medication other than insulin for control of childhood diabetes. The absence of physiologic insulin response leads to dysfunctional quantities of growth hormone, insulin-like growth factor I, and sex hormones, resulting in growth impairment and delayed sexual maturation.^[2] Longitudinal bone growth

proceeds by an orderly differentiation of growth plate chondrocytes from the resting to the proliferative and finally to the hypertrophic stage. Subsequent invasion by blood vessels and osteogenic precursor cells leads to new bone formation and thus bone elongation.^[3] This process is critically dependent on elements of the growth hormone (GH)-insulin-like growth factor 1 (IGF1) axis.^[4] GH directly stimulates chondrocyte proliferation.^[4] The lack of normalization of the IGF1 axis by intensive insulin therapy may reflect additional metabolic alterations contributing to impaired growth in T1DM. A reliable index of long term glycemic control can be provided by measuring glycosylated hemoglobin. It should be usually monitored 3-4 times per year to obtain an idea of long term glycemic control. The main goals of treatment include to keep the child symptom free, ensure normal growth and development, maintain HbA1c as close to the normal range as possible. Many

studies in the literature have shown that pediatric patients with T1DM frequently present some abnormalities in their growth hormone (GH)/insulin-like growth factor-1 (IGF-1) axis compared to their healthy peers. According to many previous studies it is seen that there is some extent of growth impairment in T1DM patients of prepubertal and pubertal age, and this impairment seems to be influenced by suboptimal glycemic control and disease duration. Growth parameters are important indicators of a child's overall health, and they are influenced by factors like blood glucose control in diabetic children. Data on growth parameters of Indian diabetic children is scarce. The rationale of the study is to identify the growth pattern of these children and the factors affecting it so that early interventions or guidance can be given to the parents as well as children to prevent abnormalities in growth and development.

METHOD

A longitudinal follow up study was initiated after getting approval from the Institutional Research and Ethics Committee. The study was done in MITTAYI clinic under Department of pediatrics, Govt. TDMCH Alappuzha. All children in the age group 2-18 years attending MITTAYI clinic were selected for the study by universal sampling method. The sample size was calculated using prevalence $4PQ/d2 = n$. Prevalence of decreased growth velocity according to study^[3] was 35%. The minimum sample size needed for the study was 91. All the registered children who are willing to participate will be taken up for the study. 102 children were included initially, 10 lost follow up due to transfer to other MITTAYI centres. Study was conducted among 92 children. Details needed for the study was collected with the help of proforma, physical examination, anthropometric measurements using electronic digital scale, stadiometer, non- stretchable tape. Anthropometric measurements was taken using standard scales. This was done every 3 months by the same observer and converted to centiles using contemporary Indian references. Growth velocity of the child was calculated at the end of the

year. Blood sample was collected to measure HbA1C. An average of readings taken 3 monthly was used to describe the metabolic control over a year.

The data obtained was analysed using SPSS 26.0v statistical software. All continuous variables are expressed as mean and standard deviation. All categorical variables are expressed in frequency and percentage. To find the association between variables Chi square test with Pearson chi square value was used. MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram. p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

This study was conducted among 92 children with T1DM aged 2-18 years registered under MITTAYI clinic in Govt. TDMC Alappuzha. Out of 92 subjects 44(47.8%) were females and the rest 48(52.2%) were males. 48.9% belong to the age group 10-14 years. Among the subjects 46 (50%) children were diagnosed at an age between 6<10 years. 40(43.5%) children had been diagnosed with T1DM for a duration of 3-6 years. Out of 92 subjects 62(67.4%) did not miss any doses whereas 30(32.6%) missed the doses. 82(89.1%) children had regular follow up whereas 10(10.9%) had irregular follow-up. It was also found that 51(55.4%) had good dietary compliance whereas 41(44.6%) had poor dietary compliance. It was observed that the weight gain was not much affected during the study period. The number of children with weight between 10th-97th centile increased to 86(93.5%) from 72(78.3%) by the end of the study. Out of 92 subject 63(68.5%) children had normal height velocity and the rest 29(31.5%) of children had decreased height velocity. All of our study subjects belonged to suboptimal or high risk metabolic control group. 37(40.2%) children had sub-optimal HbA1C value and the rest 55(59.8%) belongs to high risk HbA1C group.

Table 1: Association between Height Velocity and Sex.

Height Velocity	SEX		p – value
	Femalen (%)	Malen (%)	
Normal	25 (39.7%)	38 (60.3%)	0.021
Decreased	19 (65.5%)	10 (34.5%)	

Among the 29 subjects with Decreased height velocity 19(65.5%) were females and 10(34.5%) were males. Out

of 63 subjects with Normal height velocity 25(39.7%) were females and the rest 38(60.3%) were males.

Table 2: Association between Height Velocity and Age Group.

Height Velocity	AGE_GROUP				p – value
	2-<6 n (%)	6-<10n (%)	10-<14n (%)	14-18n (%)	
Normal	0 (0.0%)	12 (19.0%)	34 (54.0%)	17 (27.0%)	0.019
Decreased	2 (6.9%)	2 (6.9%)	11 (37.9%)	14 (48.3%)	

Out of 29 children with decreased Height Velocity 48.3% & 37.9% belongs to age group 14-18 years and

10-<14 years.

Table 3: Association between Height Velocity and Age at Diagnosis.

Height Velocity	Age at diagnosis				p – value
	2-<6 n (%)	6-<10n (%)	10-<14n (%)	14-18n (%)	
Normal	13 (20.6%)	33 (52.4%)	17 (27.0%)	0 (0%)	0.009
Decreased	12 (41.4 %)	13 (44.8%)	2 (6.9%)	2 (6.9%)	

Height velocity was more decreased in children who were diagnosed with T1DM at an early age.

Table 4: Association between Height velocity and Duration of DM.

Height Velocity	Duration of DM				p – value
	(0-<3)n (%)	(3-<6)n (%)	(6-<9)n (%)	(9-12)n (%)	
Normal	28 (44.4%)	25 (39.7%)	6 (9.5%)	4 (6.3%)	0.036
Decreased	5 (17.2%)	15 (51.7%)	3 (10.3%)	6 (20.7%)	

In our study height velocity was found to be more affected in children who had longer duration (more than 3 years) of the disease than children with shorter duration (less than 3 years) of disease.

Table 5: Association between Height Velocity and Missed Dose.

Height Velocity	MISSED DOSE		p – value
	NO n (%)	YESn (%)	
Normal	57 (90.5%)	6 (9.5%)	<0.001
Decreased	5 (17.2%)	24 (82.8%)	

Among the 29 subjects with Decreased Height Velocity 5(17.2%) did not miss their dose and 24(82.8%) missed their dose. Out of 63 subjects with normal height velocity, 57(90.5%) did not miss their dose and the rest 6 (9.5%) missed their dose.

Table 6: Association between Height Velocity and Dietary compliance.

Height Velocity	DIETARY COMPLIANCE		p – value
	GOODn (%)	POORn (%)	
Normal	43 (68.3%)	20 (31.7%)	<0.001
Decreased	8 (27.6%)	21 (72.4%)	

Among the 29 subjects with decreased height velocity 21(72.4%) had poor dietary compliance and 8(27.6%) had good dietary compliance. Out of 63 subjects with normal height velocity 43(68.3%) have good dietary compliance and the rest 20(31.7%) had poor dietary compliance.

Table 7: Association between Height Velocity and HbA1C.

Height Velocity	HbA1C		p – value
	SUBOPTIMALn (%)	HIGH RISKn (%)	
Normal	37 (58.7%)	26 (41.3%)	0.002
Decreased	7 (24.1%)	22 (75.9%)	

Among the 29 subjects with Decreased height velocity 7(24.1%) had suboptimal HbA1C and the rest 22(75.9%) had high risk HbA1C. Out of 63 subjects with Normal height velocity 37(58.7%) had suboptimal HbA1C and the rest 26(41.3%) had high risk HbA1C.

DISCUSSION

As the incidence of type 1 diabetes (T1DM) continues to rise, complications including impairment of childhood growth remain a major concern. Despite advances in medical care of children with T1DM, growth remains sub-optimal in this population and likely reflects ongoing

metabolic derangement linked with classic microvascular diabetic complications.^[5]

This study was conducted among 92 children with T1DM aged 2-18 years registered under MITTAYI clinic in Govt. TDMC Alappuzha.

Among the subjects 47.8% were females and 52.2% were male. The mean age of children was 12.98 ± 2.81 with a minimum age of 5 and maximum of 17 years. The mean age at diagnosis was found to be 8.40 ± 2.62 years. The mean duration of diabetes among our children was

4.58 ± 3.01 years. Out of 92 subjects 62(67.4%) did not missed any doses whereas 30(32.6%) missed the doses and 82(89.1%) had regular follow up whereas 10(10.9%) had irregular follow-up. Out of 92 subjects 51(55.4%) had good dietary compliance whereas 41(44.6%) had poor dietary compliance.

In our study 29(31.5%) children had decreased height velocity. In retrospective cross sectional case control study by Parthasarathy et.al^[3] 35% children had low height velocity. But it was seen that there was no significant affect in the weight gain of these children during the study period. It was noted that there was an increase in the number of children who were overweight/obese by the end of one year. At the beginning of our study there were 7(7.6%) children who were overweight and 6(6.5%) were obese, whereas by the end of one year the percentage of children who were overweight was increased to 13.0%. In a study conducted by Palomo Atance et al the prevalence of overweight and obesity was found to be 28.69% and 18.26%, respectively.^[6] According to our study the height velocity was more affected in girls than boys ($p=0.021$). Similar results were found in a cross sectional study conducted by Ahmed et al($P < 0.02$). We could find statistically significant association between age of onset of disease and height velocity. Children who were diagnosed at an early age had lower height velocity compared to children who were diagnosed at a later age, p value was 0.009. This result was comparable with previous study conducted by Vaman Khadilkar et al.^[2] In a study conducted by Holl et al^[7] it was found that growth reduction was more pronounced in patients diagnosed before the onset of puberty.

It was also found that the height velocity of children who were having the disease for a longer duration was more affected than those with shorter duration (p value – 0.036). Height velocity was also affected by metabolic control i.e HbA1C value (p value -0.002). These results were comparable with the study conducted by Vaman Khadilkar et al ($P=0.020$, $P=0.001$).

In a cross sectional study done by Ahmed et al.^[8] HbA_{1c} correlated negatively with height velocity in both sexes ($r = -0.35$, $P = 0.03$). It was also noted that the height velocity was more affected in children with high risk metabolic control when compared to children in sub optimal group. 22 children (75.9%) in high risk group had decreased velocity whereas there were 7 (24.1%) children with decreased growth velocity in sub optimal group. In a study conducted by Gunczler et al, 79 patients with T1DM were studied and children were divided into better controlled, HbA1C < 9%, 30 children (Group A) and worse controlled, $\geq 9\%$, 49 patients (Group B). Growth velocity was significantly lower in the worse controlled patients when compared to the better controlled subjects.^[9] In our study group children who were not compliant with the dietary advices were also found to have decreased height velocity ($p = <0.001$)

and children who had increased frequency of missed doses also had decreased height velocity ($p = <0.001$). A cohort study of 72 Sudanese diabetic children, 7-13 years of age at diagnosis showed that the growth velocity between diagnosis and final height was slow. The retardation in physical growth and pubertal development was positively correlated with the duration of diabetes before the onset of puberty and glycated haemoglobin (HbA1c) concentration. The majority of their patients showed a remarkable, progressive weight gain during puberty, which was more evident in girls.^[10]

There are various studies in literature which suggest that the modern insulin therapy and strict metabolic control can decrease the risk of growth failure in these children.^[11]

Our study suggests that children with diabetes had lower height velocity. Longer disease duration, female sex and poor metabolic control were associated with lower height velocity. It is critical to monitor and improve metabolic control in children diagnosed at younger years as they seem to be at higher risk for long-term growth failure.

CONCLUSION

Linear growth velocity was reduced in 31.5 % of our children with T1DM. But weight gain of these children was not much affected. They were found to have gaining weight normally. The important factors affecting height velocity in children were poor metabolic control, inadequate dietary compliance and irregular insulin administration. Among children with poor metabolic control, children in high risk group were more affected than sub optimal group. Children diagnosed at an early age was at higher risk of decreased growth when compared to children who are diagnosed at a later age. Dietary non-compliance along with poor metabolic control led to decreased height velocity in these children. It is important to monitor and improve metabolic control in children diagnosed at younger years as they seem to be at higher risk for long-term growth failure.

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CONFLICT OF INTEREST

There are no conflicts of interests.

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