RESEARCH ARTICLE

PREDICTORS OF GLYCEMIC CONTROL IN CHILDREN WITH TYPE 1 DIABETES MELLITUS

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ARTICLE INFO	**ABSTRACT**

Introduction: Type 1diabetes mellitus is a common chronic endocrine disease with increasing incidence in India. Improved glycemic control in children with type 1 diabetes mellitus delays the progression of microvascular complications.
Aim: To identify the factors and predictors associated with glycemic control in children and adolescents with type 1 diabetes.
Materials and Methods: An analytical cross sectional study was conducted on 40 children with Type 1 diabetes mellitus attending our diabetic clinic. These children were classified as having good glycemic control and poor glycemic control according to the target level of HbA1c <7.5% and >7.5% respectively. Demographic factors and disease-related characteristics were analysed. HbA1C, Serum TSH and lipid profile were done.
Results: Among 40 children enrolled in study mean age was 12.52 years with male: female sex ratio as 1:1.67. We had 11 (27.5%) children with good glycemic control and 29 (72.5%) children with poor glycemic control. Younger age of patient at study, younger age at onset of disease, frequent blood glucose monitoring, good dietary control were associated with good glycemic control in children with Type 1 diabetes. Prolonged duration of disease, higher mean cholesterol, higher triglycerides, higher LDL and low HDL were associated with poor glycemic control.
Conclusion: Younger age of patient at study, younger age at onset of disease, frequent blood glucose monitoring, good dietary control were associated with good glycemic control in children with T1DM. Prolonged duration of disease, higher mean cholesterol, higher triglycerides, higher LDL and low HDL were associated with poor glycemic control in children with Type1 diabetes.

INTRODUCTION

Type 1diabetes mellitus is a common chronic metabolic disease with prevalence of approximately 1in 10000 in the whole population and 1 per 5000 in the 5-16 year age group in India. The Diabetes control and complications trial (DCCT) reported that reduction in chronic hyperglycemia can prevent many of the complications of type 1 diabetes mellitus. Improved glycemic control in children with type 1 diabetes mellitus (T1DM) has proved to delay the onset and slow the progression of microvascular complications by intensification of therapy. The American Diabetes Association (ADA)has published the target HbA1C as < 7.5% for all age groups for good glycemic control. It is a difficult challenge to achieve good glycemic control in these children. There are several foreign studies showing the various risk factors are associated with glycemic control. Some of these include socio-demographic variables such as age of the child, socioeconomic status and family history of diabetes. Other disease related

factors such as age at onset, duration of disease, dietary adherence, good blood glucose monitoring are also associated with glycemic control. There are only a few Indian studies on factors associated with glycemic control in children with type 1 diabetes mellitus. As the diabetes management strategies and the demographic characters differ between countries, it is necessary to assess these variables in our setting. Hence this study was undertaken to identify the factors associated with glycemic control in children and adolescents with diabetes. This will help to implement targeted interventions to improve control in this population and prevent chronic complications.

MATERIALS AND METHODS

An analytical cross sectional study was conducted on children and adolescents with type 1 diabetes mellitus attending our diabetic clinic. After obtaining ethical clearance and informed consent, 40 children were enrolled in study. These children were classified as good glycemic control and poor glycemic control according to the target level of HbA1c < 7.5% or >7.5% respectively according to the American diabetes Association (ADA) guidelines. History was taken from all

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cases on demographic factors and disease-related characteristics. Dietary adherence was assessed by use of a 24 hour dietary recall. All meals eaten in the last 24 hour prior to the visit at clinic was asked and adherence was based on scores. Examination was done with emphasis on weight, height and BMI. Serum TSH was done using chemiluminescence method and lipid profile was assayed by spectrophotometry. HbA1C was analysed for all patients using high partition liquid chromatography (HPLC). Factors associated with glycemic control were analyzed.
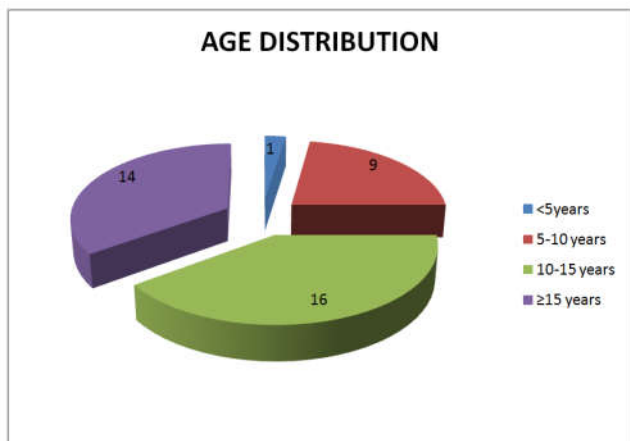
Graph 1. Age distribution of patients
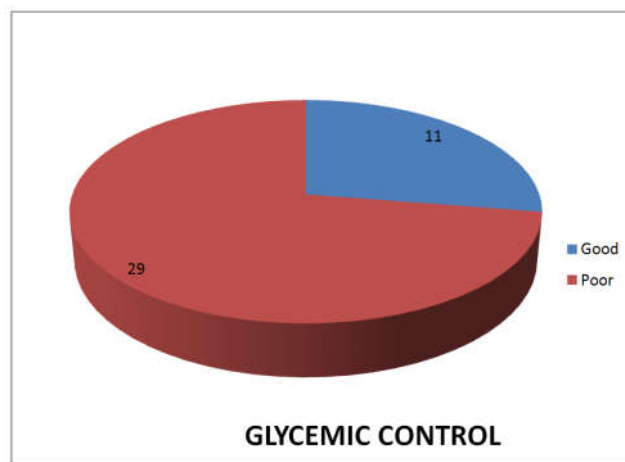
Graph 2. No. of children with good and poor glycemic control

RESULTS

40 children with type 1 diabetes Mellitus of age <18 years were enrolled in the study. 25 were females (62.5 %) compared to 15 males (37.5%). Majority of children with type 1 diabetes mellitus were in 10- 15 years of age group. Minimum age was 3years and maximum age was 17 years. Mean age was 12.52 years. Among 40 children 11(27.5%) were of good glycemic control defined as HbA1c $\leq$ 7.5% and

Table 1. Association between age and glycemic control

Age	Good (HbA1c $\leq$ 7.5%)	Poor (HbA1c > 7.5%)	Total	
<10years	7 (70%)	3 (30%)	10	
10-15years	3 (18.75%)	13 (81.25%)	16	P value =
$\geq$15years	1 (7.14%)	13 (92.86%)	14	0.00054
Total	11	29	40	significant

Table 2. Association between age at onset of disease and glycemic control

Age at onset	Good control	Poor control	Total	
< 5years	5 (55.6%)	4 (44.4%)	9	
5-10 years	4 (28.6%)	10 (71.4%)	14	p value = 0.01
$\geq$10 years	2 (11.8%)	15 (88.2%)	17	
Total	11	29	40	significant

Table 3. Association between glucose check frequency and glycemic control

Glucose check	Good control	Poor control	Total	
Once a week	9 (60%)	6 (40%)	15	
Once a month	2 (12.5%)	14 (87.5%)	16	p value= 0.0003
Irregular	0 (0%)	9 (100%)	9	significant
Total	11	29	40	

Table 4. Association between diet control and glycemic control

	Good control	Poor control	Total	
Good	5	2	7	
Average	5	13	18	p value = 0.00526
Poor	1	14	15	significant
Total	11	29	40	

Table 5. Association between lipid profile and glycemic control

Variable	Group		Mean difference	P value	Significance
	Good control	Poor control			
Triglycerides	91.5±20.3	122.14±69.0	-30.6	0.159	NS
Total cholesterol	134±20.1	167.34±42.9	-33.3	0.019	Significant
HDL	52.73±7.8	47.3±11.1	5.5	0.145	NS
LDL	84.8±20.1	102.9±34.7	-18.1	0.114	NS

29 (72.5%) were of poor glycemic control. Mean HbA1c level was 9.3%. Minimum HbA1c was 6% and maximum was 16%. Age stratification was done as < 10 years, 10-15 years and more than 15 years as puberty changes begin at 10 years. Children under 10 years were associated with good glycemic control than older children. As age advanced there was worsening of glycemic control which was statistically significant (p value = 0.00054) (Table 1). Good glycemic control was associated with younger age at onset of disease (55.56%). Children 10 years or more at onset of disease were more presented in the group of poor control (88.2%), and this was statistically significant (p value = 0.01) (Table 2). Patients with frequent blood glucose monitoring were associated with good glycemic control. Irregular blood glucose monitoring was associated with poor glycemic control which was also statistically significant (p value = 0.0003) (Table 3). Good dietary control was also associated with good glycemic control (p value = 0.00526) (Table 4). Mean value of total cholesterol was raised in poor glycemic control group than in good glycemic control group and was statistically significant (p value = 0.019). Mean values of triglycerides and LDL were raised and HDL was low in poor glycemic control group compared to good glycemic control group, but not statistically significant (Table 5).

DISCUSSION

The Diabetes Control and Complications Trial (DCCT), a prospective randomized controlled trial on type 1 diabetes patients reported that improved glycemic control is associated with significantly decreased rates of microvascular (retinopathy, diabetic kidney disease and neuropathic) complications. The recommended target for glycemic control (from ISPAD and ADA recommendations) is HbA1c less than 7.5%. Only 27.5 % children achieved this target in the present study. Similar finding was reported by Ngwiri *et al* according to whom only 28% of children and adolescents with type 1 diabetes mellitus had reasonable control. In the present study, there was significant association between age and glycemic control. Children at older age group were associated with poor glycemic control than those at younger group and hence glycemic control decreases with advancement of age. This was comparable with a cross sectional study by Noorani *et al* in Tanzania, which stated that children aged less than 10 years were found to have a significantly better glycemic control. According to Vanelli *et al*, patients aged more than 15 years were 2.5 times more likely to be uncontrolled than younger patients. Adolescents with T1DM have been reported to have poor glycemic control. The poor glycemic control with increasing age may be due to the pubertal changes, including the acceleration and cessation of somatic growth, the development of secondary sexual characteristics, and the hormonal changes that happen at this age. According to Clements *et al* patients diagnosed at older ages, experienced greater deterioration in glycemic control during the first 5 years after diagnosis than younger patients inspite of initial better glycemic control. Svensson *et al* stated that the prepubertal duration is protective in diabetic children and onset of diabetes before the age of 5 years maybe associated with delay in the occurrence of complications. Duration of the disease had significant association with glycemic control. Patients with shorter duration of disease (< 5 years) had better glycemic control than patients with longer duration of disease was statistically significant. This was in agreement with the study done by Craig *et al* who reported that the duration of

diabetes was the strongest and most significant predictor of disease control. The study concluded that diabetic children of 6-10 years duration were eight times more vulnerable to be uncontrolled as compared to students with lesser duration of disease after adjusting other variables. This was explained by the fact that the longer the duration of diabetes, the difficulty for the patient to continue monitoring the blood glucose level and adjust to the regimen of treatment, diet and exercise. Mohammed *et al* stated that it may also be due to progressive loss of beta cell function.

Children with frequent blood glucose monitoring had significant better glycemic control than children with irregular blood glucose monitoring. Miller *et al* stated that a higher number of self monitoring of blood glucose (SMBG) measurements per day was strongly associated with a lower HbA1c level adjusted p value < 0.001, in all age-groups and in both insulin pump and injection users. Thus SMBG is an essential tool in diabetes management for guiding nutrition therapy, preventing hypoglycemia, and adjusting insulin doses. Mehta *et al*. reported that greater dietary adherence was associated with lower HbA1c among youth with type 1 diabetes and thus good glycemic control. In the present study mean value of total cholesterol was raised in poor glycemic control group than in good glycemic control group and was statistically significant (p value = 0.019). Mean values of triglycerides and LDL were raised and HDL was low in poor glycemic control group compared to good glycemic control group, but not statistically significant. Mahs *et al* in their study on serum lipid levels in 682 children with type 1 diabetes found that hemoglobin A1c value was significantly related to total cholesterol and non-HDL cholesterol levels. In our study, 27.5% had high triglycerides, 10% had high total cholesterol, 10% had low HDL and 10% had high LDL. Abnormal lipid profile was associated with poor glycemic control, but although not statistically significant in our study showed a trend towards significance (p value =0.11)

Conclusion

Younger age of patient at study, younger age at onset of disease, frequent blood glucose monitoring, good dietary control were associated with good glycemic control in children with type 1 diabetes mellitus. Prolonged duration of disease, higher mean cholesterol, higher triglycerides, higher LDL and low HDL were associated with poor glycemic control in children with Type1 diabetes. Thus adolescents, children with pubertal age at onset of disease, prolonged duration of disease should be given more focussed care by health care professionals for better glycemic control. This includes frequent counselling to the patient and the caregivers by a trained psychologist with regard to their emotional and family problems. Frequent reinforcements are required for adherence to diet, exercise and insulin regimen prescribed.

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