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CLINICAL AND METABOLIC PROFILE OF DIABETES MELLITUS IN CHILDREN – ONE YEAR CROSS-SECTIONAL STUDY

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Abstract

Present study was aimed to study clinical presentations, metabolic profile, growth profile, type and prevalence of complications among the diabetic children. This Cross-sectional study was conducted among the 34 patients attending and admitted in our Hospital and District Hospital, Belgaum during the period of April – 04 to March -05. Patients with age less than 18 years and fasting blood sugar more than 126 mg/dl or random blood sugar more 200 mg/dl were included in the study. Patients with age more than 18 years were excluded from the study. All children attending our Hospital & M.R.C and District Hospital, Belgaum who are already diagnosed as Diabetes Mellitus were studied using a pre-designed and pre-tested proforma. Information was collected from the patient or attender or relative about sociodemographic profile, dietary intake and treatment history. In the present study 44.12% had onset of diabetes mellitus at 10 to 14 years age group with male to female ratio of 1.26:1. 20.51% had family history of diabetes and majority (41.18%) were from poor socio economic status. 73.33% were short statured in diabetic duration of more than one year and 31.57% in less than 1 year indicating growth deceleration. No children were obese and taller than the expected age group. 52.94% had poor glycemic control and was not influenced by duration of treatment as non compliance rates were high in the study. Majority presented with classical symptoms of polyuria, polydipsia, polyphagia and diabetic ketoacidosis as initial presentation. 50% had recurrent hospitalization in diabetic duration of more than 1 year. Negligible incidence of chronic complication was noted in the present study.

Keywords: Diabetes Mellitus; Diabetic Children; Type 1 Diabetes Mellitus

Introduction

Diabetes Mellitus has been known since antiquity. The first accurate clinical description of the disease was made by Aretaeus of Cappadocia in the second century A.D., who stated "Diabetes is a wonderful affection, not very frequent among men, being a melting down of the flesh and limbs into the urine". Thomas Willis described the sweet character of the urine in diabetes in the later part of seventeenth century. Diabetes Mellitus was thought to be a single disease entity. The concept that diabetes mellitus is not a single disease, but rather a clinical syndrome characterized by elevated fasting and / or post prandial blood glucose and development of long-term micro vascular, macro vascular and neuropathic changes is of very recent origin and stems from numerous investigations into the epidemiology, genetics, etiology, and pathogenesis of clinical diabetes state.[1] Diabetes Mellitus (DM) is a metabolic syndrome characterized by hyperglycemia as a cardinal biochemical feature. The major forms of diabetes are divided into those caused by deficiency of insulin secretion due to pancreatic β-cell damage (Type-1 DM) and those that are a consequence of insulin resistance occurring at the level of skeletal muscle, liver, adipose tissue with various degrees of β-cell impairment (Type-2 DM). Type-1 DM is the most common endocrine-metabolic disorder of childhood and adolescence. The diseases has a prevalence of approximately 1 in 2500 children at age 5 years to approximately 1 in 300 children by age 18 years. Incidence rates vary widely by country, that as high as 30 to 40 cases per 1,00,000 children in Finland and as low as 1 in 1,00,000 in Japan and China.[2]

There is scant epidemiological data from India, but a recent study from Madras suggests that diabetes in Indian children is present in a frequency of 10.5 per 1,00,000 patient years. Prevalence of childhood diabetes among urban population in India is 0.26 per 1000. Type-1 diabetes constituted nearly 90 to 100% of all children with diabetes.[3] Worldwide, the proportion of childhood and adolescent DM attributable to type 2 DM is increasing. There is 10 fold increase in incidence of type 2 DM between 1982 and 1994. The highest prevalence of type 2 DM in children and adolescents is reported among some American Indian tribes (Pima and First Nation Indians), approximately 20-35 per 1000 population in the 10-19 year age group and 50 per 1000 in the 15-19 year age group.[4] By 2025, India due to its immense population size and high diabetes prevalence will contribute about 57 million diabetics.[5]

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Materials and Methods

All children attending our Hospital and District Hospital Belgaum who are already diagnosed as Diabetic Mellitus were studied using a pre-designed and pre-tested proforma. Information was collected from the patient or attender or relative about sociodemographic profile, dietary intake and treatment history. Socio economic profile was classified according to Modified B. G. Prasad's Classification.[31]

Modified Prasad's classification

Social class	Modified Prasad's classification in the study period 2004-05. (per capita income in Rs. per month)
I	2600 and above
II	1300 – 2599
III	780 – 1299
IV	390 – 779
V	Below 390

As our study period was from 01st April, 2004 to 31st March, 2005, the mean consumer price index (CPI) for that period was taken. A detailed clinical examination of the child was carried out with detailed anthropometric measurements.

- Weight for age was calculated according to Indian Academy of Paediatric Classification of Malnutrition (IAP grades).[32]
- Height was measured using standometer and plotted in the National Centre of Health Statistics (NCHS) graphs using height for age criteria.[2]
- Body Mass Index (BMI) was calculated using the formula.[2]

$$BMI = \frac{\text{Weight (Kgs)}}{(\text{Height in Cm})^2} \times 10{,}000$$

Metabolic profile was done by investigating for the following.

- Fasting blood sugar
- Post prandial blood sugar
- Glycoslated haemoglobin

HBA_{1C} normal levels in control of DM[16]

The glycemic control was labeled normal, good, fair, unsatisfactory and poor according to their glycoslated haemoglobin levels.

Range	HBA1C Levels
< 5.60%	Normal
5.6 – 7%	Good
7 – 8%	Fair
8 – 10%	Unsatisfactory
> 10%	Poor

- Lipid profile
  - Serum Total Cholesterol level of more than 200 mg/dL was considered to be high and less than 200 mg/dL was normal.[33]

TRIGLYCERIDE LEVEL CLASSIFICATION	
Less than 150 mg/dL	Normal
150-199 mg/dL	Borderline-high
200-499 mg/dL	High
500 mg/dL	Or higher Very high

- Renal function test
- Urine examination for albumin, sugar and microscopy: Urine sugar was estimated by Benedicts test.[34]
  - Blue colour : Nil
  - Green colour : + (0.1- 0.5 g/dl)
  - Yellow colour : ++ (0.5- 1.0 g/dl)
  - Orange colour : +++ (1.0- 1.5 g/dl)
  - Brick red colour : ++++ (1.5- 2.0 g/dl)
- Fundoscopy
- USG Abdomen was done in all the cases and abnormalities of pancreas were specially looked for.
- X-ray Chest and abdomen
- ECG

Statistical methods: Rates, ratios and percentages of presentations and significance was calculated using Chi-square test.

Results

The present study was conducted during the period of April-2004 to March-2005 at our Hospital and District Hospital, Belgaum. 34 children were included in our study. Youngest diabetic encountered in our study was 3 years old female child.

Table No. I Age of onset of diabetes mellitus

Age Group	No. of Cases	Percentage
0 – 4 Years	02	05.80%
5 – 9 Years	07	20.59%
10 – 14 Years	15	44.12%
15 – 18 Years	20	29.40%

Fig.1: Age of onset of diabetes mellitus

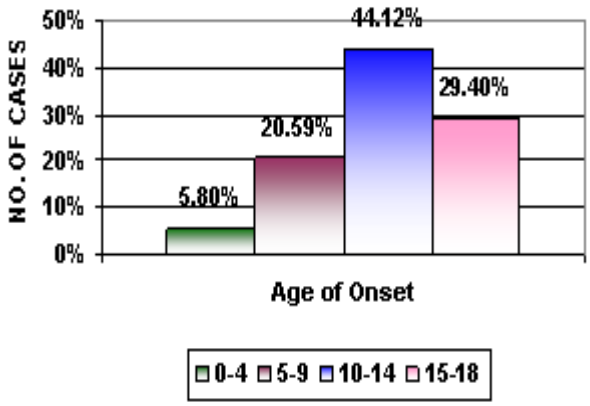


Table No. I shows Age of onset of diabetes mellitus among the study participants. Majority of the cases (44.12%) had onset of diabetes mellitus in the age group of 10 – 14 years followed by 29.4% in 15 to 18 years, 20.59% in 5 to 9 years and 5.8% in upto 4 years age group.

Table No. II Sex incidence in diabetes mellitus

Sex	No. of Cases	Percentage
Male	19	55.88%
Female	15	44.12%

Fig. 2: Sex incidence in diabetes mellitus

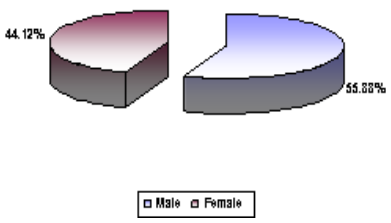


Table No. II shows the sex incidence in diabetes mellitus among the study participants. In the present study male preponderance was noted (55.88%) with Male: Female ratio of 1.26:1.

Table No. III Duration of diabetes mellitus

Duration	No. of Cases	Percentage
Newly Diagnosed	13	38.23%
< 1 Year	06	17.64%
1 – 2 Years	03	08.82%
2 – 3 Years	05	14.70%
3 – 4 Years	05	14.70%
4 - 5 Years	02	05.88%

Fig. 3: Duration of diabetes mellitus

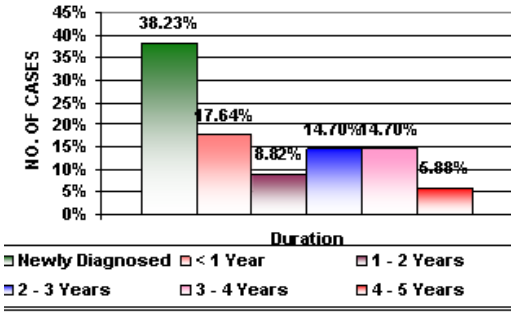


Table No. III shows duration of diabetes mellitus among the study participants. 13 children were newly diagnosed as diabetic during our study and remaining cases were diagnosed earlier and were on the treatment. In the remaining 17.64% had less than 1 year of diabetic duration, 8.82% of the cases had 1 to 2 years, 14.70% had 2 to 3 years and 3 to 4 years respectively and 5.88% had 4 to 5 years of duration.

Table No. IV Family history of diabetes mellitus

History	No. of Cases	Percentage
First degree relatives	02	05.80%
Second degree relatives	05	14.71%
TOTAL		20.51%

Table No. IV shows family history of diabetes mellitus among the study participants. Out 34 cases only 6 (20.51%) had family history of diabetes mellitus. 02 (5.80%) cases had first degree relatives and remaining 05 (14.71%) cases were second degree relatives. No incidence of diabetes in siblings was found in the present study.

Table No. V Consanguinity in diabetes mellitus

Consanguinity	No. of Cases	Percentage
Second degree consanguineous	08	25.53%
Non consanguineous	26	76.47%

Table No. V shows consanguinity in diabetes mellitus. Out of 34 cases only 8 had consanguineous family history and rest of cases (76.47%) were non consanguineous.

Table No. VI Socio economic history (Classified according to modified Prasad's classification)

Socio Economic Status	No. of Cases	Percentage
Class – I	01	02.94%
Class – II	05	14.71%
Class – III	06	17.65%
Class – IV	08	23.53%
Class – V	14	41.18%

Table No. VI shows socio-economic status of the study participants. Majority (41.18%) cases were in Class V followed by 23.53% in Class IV, 17.65% in Class III, 14.71% in Class II and least being 2.94% in Class I according to Modified Prasads Classification.

Table No. VII Education of parents

Education	No. of Cases	Percentage
Illiterate	13	38.24%
Primary	05	14.71%
Secondary	11	32.35%
Graduate	06	17.65%

Table No. VII depicts the Educational profile in the parents of study participants. Generally education of father was considered and mother's education was considered only in case of death of the father (03 cases). Majority (38.24%) of the cases were illiterates. Remaining, 32.35% had secondary, 17.65% had graduation and 14.71% had only primary education.

Type of diabetes mellitus

All the study participants were Type-I diabetes mellitus. By definition no child was observed to have Type-II Diabetes Mellitus.

Table No. VIII Nutritional status-
a. IAP Grades

Nutritional Status	No. of Cases	Percentage
Normal	06	17.65%
Grade I	07	20.59%
Grade II	07	20.59%
Grade III	13	38.24%
Grade IV	01	02.94%

Fig. 4: Nutritional status- IAP Grades

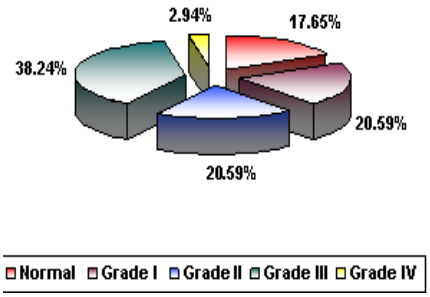


Table No. VIIIa shows the nutritional status of the study participants. Out of 34 study participants 17.65% had normal nutrition, 20.59% had Grade I and Grade II, 28.24% had Grade III and 2.94 had Grade IV malnutrition as per IAP Grades.

b. Nutritional status (NCHS Standards)

Nutritional Status	No. of Cases	Percentage
< 3rd Percentile	22	64.70%
3 to 10 Percentile	04	11.76%
10 to 25 percentile	03	08.80%
25 to 75 percentile	00	00.00%
75 to 90 percentile	01	02.94%

Fig.5: Nutritional status- NCHS Standards

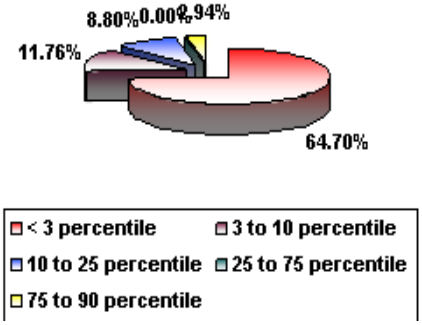


Table No. VIIIb shows nutritional status of the study participants as per the NCHS grades. In the present study majority (64.70%) cases were noted in less than 3rd percentile. 11.76% were in 3rd to 10th percentile, 8.80% in 10th to 25th percentile and least being 2.94% in 75th to 90th percentile. No study participants were reported in 25th to 75th percentile.

Table No. IX Height (NCHS Standards)

Height	No. of Cases	Percentage
< 3rd Percentile	12	35.29%
3 to 10 Percentile	08	23.53%
10 to 25 percentile	09	26.47%
25 to 50 percentile	02	05.88%
50 to 75 percentile	01	02.94%
75 to 90 percentile	02	05.88%
90 to 97 percentile	00	00.00%
> 97 percentile	00	00.00%

Fig. 5: Height

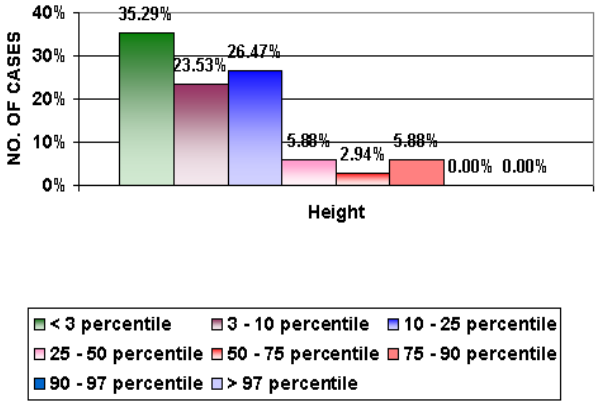


Table No. 9 shows height of the study participants. In the present study (35.29%) were short (i.e. < 3rd percentile). 23.53% were in 3rd to 10th percentile, 26.47% were in 10th to 25th percentile, 5.88% were in 25th to 50th percentile, 2.94% were in 50th to 75th percentile and no patient was taller than the expected. Out of 34 children in the study, 5 children had normal nutrition. 17 children had acute malnourishment and 12 children were chronically malnourished.

Table No. X Body mass index

Body mass index	No. of Cases	Percentage
< 3rd Percentile	22	64.71%
3 to 10 Percentile	03	08.82%
10 to 25 percentile	00	00.00%
25 to 50 percentile	07	20.59%
50 to 75 percentile	01	02.94%
75 to 90 percentile	01	02.94%

Fig. 7: Body mass index

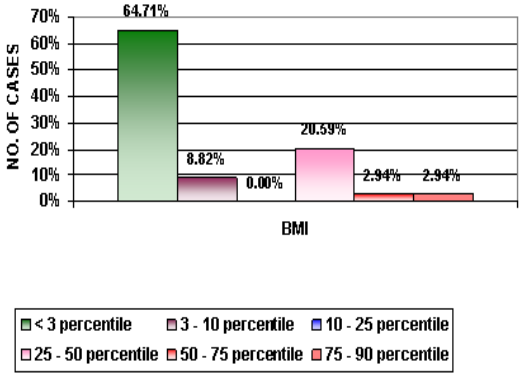


Table No. X shows body mass index of the study participants. 64.71% were in less than 3rd percentile, 8.82% were in 3rd to 10th percentile, 20.59% were in 25th to 50th percentile, 2.94% patients were in 50th to 75th percentile and 2.94% patients were 75th to 90th percentile. Obesity was not noted in the present study.

Table No. XI Clinical profile

Clinical profile	No. of Cases	Percentage
Polyuria, polyphagia and polydipsia	31	91.10%
Lethargy	06	19.35%
Drowsiness	07	20.58%
Fever	03	08.82%
Weightloss	27	79.41%
Vomiting	09	26.47%
Abdominal pain	09	26.47%
Abdominal distension	03	08.82%
Giddiness	09	26.47%
Breathlessness	10	29.41%
Coma	02	05.88%
Loose stools	02	05.88%
Seizures	03	08.82%

The clinical profile in the present study are classical symptoms of polyuria and polydipsia (91.10%), lethargy (19.35%), Drowsiness (20.58%), Fever (8.82%), weight loss (79.41%), vomiting (26.47%), pain abdomen (26.47%) abdominal distension (8.82%), Giddiness (26.47%), breathlessness (29.47%), Coma (5.88%) and Seizures (8.82%). In one child who presented with focal convulsions CT scan showed right parieto frontal infarct.

Table No. XII Infections associated

Infections	No. of Cases	Percentage
Urinary tract infection	02	05.88%
Candidiasis	01	02.94%
Pneumonia	04	11.76%
Skin infection	01	02.94%
Sepsis	01	02.94%
Chicken pox	01	02.94%
Mumps	02	05.88%

The associated infections in the present study are pneumonia (11.76%), urinary tract infections (5.88%), mumps (5.88%), oral candidiasis (2.94%) skin infection (2.94%). One female child had thyroid swelling but her thyroid profile was normal so labeled as pubertal goiter.

Insulin requirement

The average insulin requirement in newly diagnosed diabetes mellitus was 0.9 $\pm$ 0.32 and in known diabetic patients average was 1.1 $\pm$ 0.4 unit / kg / day in the present study.

Table No. XIII Reason for non compliance

Reason for missing insulin	No. of Cases	Percentage
Due to intercurrent infection	04	11.70%
Due to non availability of insulin (because of financial restraint)	07	20.50%
Child refusal	03	08.80%

In our study 8 patients were non compliant (23.52%). The reasons for non compliance were due to intercurrent infections, child refusal and majority because of non availability of insulin due to financial constraint as more than 70% of the patients were from poor socio economic status. There was no incidence of parental negligence of the child's conditions.

Table No. XIV Compliance with the literacy of the parents

Education	Compliant	Non Compliant	Percentage of Non Compliance
Illiterate	9	4	30.76%
Literate	17	4	19.04%

The children of the parents who were illiterate 30.76% were non compliant with the treatment whereas in literate 19.04% were non compliant.

Table No. XV Recurrent Hospitalisations

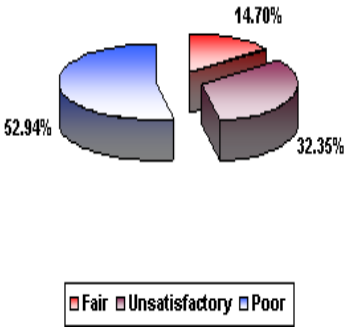
Other problems	No. of Cases	Percentage
Recurrent hospitalization	17	50.00%
Hypoglycemic episodes	09	37.20%
Recurrent diabetic ketoacidosis	08	23.50%
Pneumonia	04	11.76%

In the present study we noted 50% got admitted more than once. Causes for recurrent hospitalization were hypoglycemia (37.20%), diabetic ketoacidosis (23.50%) and pneumonia (11.76%).

Table No. XVI HBA1C levels in the study

HBA_{1C} levels	No. of Cases	Percentage
Normal (< 5.60%)	00	00.00%
Good (5.6 – 7%)	00	00.00%
Fair (7 – 8%)	05	14.70%
Unsatisfactory (8 – 10%)	11	32.35%
Poor (> 10%)	18	52.94%

Fig. 8: HBA1C levels in study



52.94% of diabetic children showed poor control, 14.70% had fair control, 33.35% had unsatisfactory glycoslated haemoglobin levels.

Table No. XVII Glycemic control with duration of treatment

Duration of Treatment	No. of Cases	Mean HBA_{1C} Levels
Newly Diagnosed	13	11.83 ± 3.44%
< 1 Year	06	12.90 ± 3.68%
1 – 2 Years	03	11.16 ± 3.11%
2 – 3 Years	05	9.87 ± 3.03%
3 – 4 Years	05	8.98 ± 1.00%
4 - 5 Years	02	11.00 ± 3.39%

In the present study the average glycoslated haemoglobin in newly diagnosed cases was 11.83 ± 3.44% with less than 1 year treatment 12.90 ± 3.68%, 1 to 2 year of treatment 11.16 ± 3.11%, 2 to 3 years of treatment 9.87 ± 3.03%, 3 to 4 years treatment 8.98 ± 1.00% and in 2 diabetics on treatment for more than 5 years showed glycoslated haemoglobin of 8.6% and 13.4%.

Table No. XVIII Fasting blood sugar level

Fasting Blood Sugar	No. of Cases	Percentage
130 - 200 mg/dl	06	17.64%
200 – 300 mg/dl	13	38.23%
300 – 400 mg/dl	10	29.41%
> 400 mg/dl	05	14.70%

Table No. XVI shows various ranges of fasting blood sugar. 17.64% were in the range of 130 – 200 mg/dl, 38.23% in 200 – 300 mg/dl, 29.41% in 300 – 400 mg/dl and 14.70% had more than 400 mg/dl fasting blood sugar levels.

Table No. XIX Post prandial blood sugar levels

Post prandial blood sugar levels	No. of Cases	Percentage
200 – 300 mg/dl	04	17.76%
300 – 400 mg/dl	15	44.11%
> 400 mg/dl	15	44.11%

Table No. XVII shows various ranges of post prandial blood sugar. 17.76% were in the range of 200 – 300 mg/dl, 44.11% in 300 – 400 mg/dl, 44.41% had more than 400 mg/dl post prandial blood sugar levels.

Table No. XX Urine sugar levels

Urine Sugar Levels	No. of Cases	Percentage
Orange (1.0- 1.5 g/dl)	18	52.94%
Brick Red (1.5- 2.0 g/dl)	04	11.76%
Green (0.1- 0.5 g/dl)	01	02.94%
Yellow (0.5- 1.0 g/dl)	03	8.82%
Absent	07	20.58%

In the present study urine sugar analysis done by Benedict's Test showed orange precipitate in 52.94%, Brick Red precipitate in 11.76%, Green precipitate in 2.95%, yellow precipitate in 8.82% and nil in 20.58%. Urine albumin was absent in all the patients.

Lipid profile

In the present study lipid profile of all the children was analysed by their serum cholesterol and triglycerides. No child had hypercholesterolemia (> 200 mg/dL). 73.52% children had triglyceride levels below 150 mg/dL, 11.64% were in the range of 150 – 199 and one child had high level of triglycerides.

Table No. XXI Serum Urea

Serum Urea	No. of Cases	Percentage
< 40 mg/dl	31	91.78%
> 40 mg/dl	03	08.82%

In the present study 03 children had urea level more than 40 mg/dL, the creatinine values were normal except for 1 aged 16 years with diabetic duration of 1 year whose serum urea level was 112 mg/dL, serum creatinine 1.20 mg/dL, albuminuria present with bilateral grade II renal parenchymal change in the ultrasonography.

ECG: All the 34 patient had normal ECG

X-ray abdomen: 31 patients has normal X-ray abdomen whereas three (8.82%) had evidence of ascites. No pancreatic fibrocalculus was noted in our study.

Table No. XXII Ultrasonography of Abdomen

USG Abdomen	No. of Cases	Percentage
Normal	25	73.52%
Atrophic pancreas	01	02.94%
Ascites	06	17.64%
Renal change	01	02.94%

73.52% of the study participants had normal ultrasonography findings, 17.60% had ascites, 2.94% had renal change and 2.94% had atrophic pancreas.

Fundoscopy: None of the children had retinal changes on fundoscopy in the present study.

Table No. XXIII Comparison of data with respect to duration of diabetes

Criteria	< 1 Year	> 1 Year	P Value
Short Stature	31.57%	73.33%	0.026*
Fasting Blood Glucose	323.26 ± 134.58	285.33 ± 83.56	0.347
Glycoslated Hb	12.16 ± 3.45	10.30 ± 2.46	0.409
Recurrent Hospitalisation	1.32 ± 0.75	2.53 ± 0.99	0.000*

* (P value < 0.05) Statistically significant

In the present study short stature noted in diabetic duration of less than one year is 31.57% and more than one year is 73.33% which is statistically significant (x^2 = 4.295, df = 1, P= 0.026).The mean fasting blood glucose in less than 1 year of diabetes was 323.26 ± 134.58 and 285.33 ± 83.56 in more than 1 year which is not statistically significant. (t = 0.954, df = 32, P= 0.347). The glycoslated haemoglobin in less than 1 year of diabetes was 12.16 ± 3.45 and 10.30 ± 2.46 in more than 1 year which is not statistically significant. (x^2 = 0.680, df = 1, P= 0.409). In the present study recurrent hospitalization noted in diabetic duration of less than one year is 1.32 ± 0.75 and more than one year is 2.53 ± 0.99 which is statistically significant (t = 4.058, df = 32, P= 0.000).

Table No. XXIV Glycemic Control according to duration of diabetes

Duration of Diabetes	Glycoslated Haemoglobin					
	Fair		Unsatisfactory		Poor	
	No.	%	No.	%	No.	%
Newly diagnosed	00	00	05	14.70%	08	23.52%
< 1 Year	01	2.94%	00	00	03	8.82%
> 1 Year	04	11.74%	06	17.64%	07	20.58%

The glycemic control in newly diagnosed patients was poor in 23.52% and unsatisfactory in 14.70%. In diabetic duration of more than 1 year 20.58% had poor, 17.64% had unsatisfactory and 11.74% had poor glycemic control. Significance could not be made as the sample size was inadequate.

Table No. XXV Glycemic control in growth

Height of the Patient	Glycoslated Haemoglobin					
	Fair		Unsatisfactory		Poor	
	No.	%	No.	%	No.	%
< 3rd Percentile	02	13.30%	05	33.30%	08	53.40%
3rd – 97th percentile	03	15.80%	06	31.60%	10	52.60%

44.11% were short statured according to height plotted in NCHS charts. 13.3% had fair, 33.30% had unsatisfactory and 53.40% had poor glycemic control. In diabetic children whose height was not effected the glycemic control were 15.80% fair, 31.60% had unsatisfactory and 52.60% had poor glycemic control. This was not statistically significant (x2 = 0.043, df = 2, P = 0.978).

Discussion

Diabetes Mellitus is one of the chronic diseases of children and youth worldwide. Very little is known about the magnitude or determinants of childhood and youth onset diabetes in India. In the present study peak incidence was in age group of 10 – 14 years (44.12%). Male predominance was encountered with male to female ratio 1.26:1. In a similar studies peak age at diagnosis was 11 years in girls and between 11 to 18 years in boys and female predominance was present.[3,12]. In the present study 20.51% had family history of diabetes mellitus. 5.80% had first degree diabetic relatives and 14.71% had second degree relatives. 23.53% children had second degree consanguineous family history. No incidence of diabetes was found in the siblings. In a similar study conducted at Chennai showed 6.14% incidence of diabetes in the siblings and 20.52% of second degree consanguineous family history.[16] In a similar study of 110 diabetic children at Saudi Arabia had showed their parents were often related, 31% being first degree cousins and 12% second degree cousins. First degree family history was positive for type I diabetes in 28%. Among these siblings accounted for 26.00%.[35] In another study 23.00% had consanguineous family history.[36] In the present study majority patients were from poor socio-economic class. 41.18% were in class V, 23.53% in class IV, 17.65% were in class III, 14.71% in Class II and 2.94% were in class I according to modified B.G. Prasad's Classification.

Short stature was noted in 31.57% of diabetic duration less than one year and 73.33% in duration more than one year which is statistically significant (x^2 = 4.295, df = 1, P= 0.026). This indicates subsequent growth deceleration with increase in duration of diabetes. None of the children were taller than the expected age group. Contrasting data exist on height of diabetic children at onset of the disease, impact of the disease on final height and on relation between the overall metabolic control expressed as HBA_1C and height gain. 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.[17] Whereas study conducted in Chennai had not shown significant difference in stature on diagnosis.[37] Glycemic control in relation to growth of the patient was not statistically significant (x^2 = 0.043, df=2, P = 0.978). In diabetic children whose height was effected (44.11%) had their glycoslated haemoglobin values in the range of fair (13.3%), unsatisfactory (33.3%) and poor in 53.40%. This finding is similar to study done at Madrid.[38] Out of 34 study participants 17.65% had normal nutrition, 20.59% had Grade I and Grade II, 28.24% had Grade III and 2.94% had Grade IV malnutrition as per IAP Grades. 6 children had normal nutrition, 16 children had acute malnourishment and 12 children were chronically malnourished. The above findings were corroborated with a study which showed 24.36% had normal nutrition, 20.50% had grade I, 29.48% had grade II, 21.79% had grade III and 3.84% had grade IV malnourishment.[16] Body mass index of the study participants showed 64.71% were in less than 3rd percentile, 8.82% in 3rd to 10th percentile, 20.59% in 25th to 50th percentile, 2.94% patients were in 50th to 75th and 75th to 90th percentile. None of the children were obese in the present study. Studies mention that body mass index was slightly increased at the first observation in children of both sexes and weight gain after introduction of insulin therapy especially, females gained weight over proportionally afterwards.[17] A South Indian study corroborate with our findings where they also did not have incidence of obesity in the diabetic children.[16] Another Boston study concluded that when weight loss or inadequate weight gain with worsening glycemic control occur the possibility of insulin omission must be explored.[39] In the present study the clinical profile were classical symptoms of polyuria, polydipsia and polyphagia (91.10%), weight loss (79.41%), breathlessness (29.47%), vomiting (26.47%), pain abdomen (26.41%), drowsiness (20.58%), lethargy (19.35%), seizures (8.82%), fever (8.62%) and coma (5.88%). The findings are in concordant with several studies.[11,15]

In the present study 88.9% were diagnosed to have diabetic ketoacidosis as their initial presentation of diabetes mellitus. The clinical manifestation of diabetic ketoacidosis were classic symptoms of polyuria, polydipsia with breathlessness (29.41%), vomiting (26.47%), abdominal pain (26.4%), drowsiness (20.58%), lethargy (19.35%), comatose (5.88%) and convulsions (5.88%). 8 children who were on treatment were rehospitalised for diabetic ketoacidosis. Causes for recurrent diabetic ketoacidosis were missing of insulin doses (20.5%), associated infections like pneumonia (11.76%) and urinary tract infection (5.88%). Diabetic ketoacidosis is a metabolic complication resulting from marked insulin deficiency. The commonest clinical presentation consists of vomiting, polyuria, dehydration with Kussmaul's respiration with acidosis, leading to coma if not treated. The known incidence of ketoacidosis at diagnosis of diabetes in children and adolescents varies from 10% to 40%.[2] Different studies have mentioned higher incidence of diabetic ketoacidosis in 77%,[12] 79%[40] and 69%[16] as initial presentation.

In the present study 3 children (8.8%) had preceding history of viral illness before onset of diabetes. One child had chickenpox, two others had mumps suggesting infection as one of the probable cause for onset of diabetes. The role of viral infections in etiology of type I diabetes mellitus is controversial, Coxsackie B_3, Coxsackie B_4, cytomegalovirus, rubella and mumps can infect human β cells of pancreas.[2] Other associated infections encountered were urinary tract infections (5.88%), oral candidiasis (2.94%), pneumonia (11.70%), skin infection (2.94%) and septicemia (2.94%). These findings were different from study where in urinary tract infections incidence was 27%, candidiasis 23%, pneumonia 14.60% and viral exanthema 4.16%.[16] $HBA1_C$ level in the present study showed 52.94% to be of poor glycemic control, 32.35% unsatisfactory control and 14.70% had fair control. Two different studies showed 50%[16] and 28%[20] poor glycemic control respectively. The glycoslated haemoglobin in less than 1 year of diabetes duration was 12.16 ± 3.45% and 10.30 ± 2.46% in more than 1 year of diabetic duration which is not statistically significant (P value 0.409). Present study showed the mean glycoslated haemoglobin in newly diagnosed cases as 11.83%, with less than 1 year of treatment 12.90%, with 1 to 2 years of treatment 11.16%, with 2 to 3 years of treatment 9.87%, with 3 to 4 years treatment 8.98% and with 4 to 5 years of treatment 11.00%. Studies revealed that there was lack of association between changes in the glycemic control and changes in therapeutic regimen. However significant correlation was found with the duration of diabetes. Low socio-economic level is related to poor

glycemic control. Factors such as attitude of treatment teams, self care behaviours, education or patient satisfaction may be more directly related to outcomes than the insulin regimens.[41] In the present study recurrent hospitalization noted in diabetic children with duration of less than one year is 1.32 ± 0.75 and more than one year is 2.53 ± 0.99 which is statistically significant (t = 4.058, df = 32, P= 0.000). Recurrent hospitalization (50.00%) was noted. Causes for recurrent admissions were hypoglycemia (37.20%), recurrent DKA (23.5%), pneumonia (11.76%) and seizures (8.80%). 37.2% of hypoglycemic episodes were experienced in diabetics of more than 1 year of duration in the present study. Similar findings were reported.[18]

Mean insulin requirement in age group of 0-5 years was 0.6 units/kg/day, 5-12 years was 0.9 units/kg/day and in 12 – 18 years of age 1.0 unit/kg/day. Average insulin requirement in newly diagnosed patient was 0.8 units/kg/day and old cases of diabetic was 1.075 units/kg/day. Several factors influence the daily insulin dose per kilogram of body weight. The dose is usually higher in pubertal children. It is higher in those who have to restore greater deficits of body glycogen, protein and fat stores and who therefore have higher initial caloric requirement. On the other hand, most children with new onset diabetes have some residual β cell function (the "honeymoon" period), which reduces exogenous insulin needs.[2] Similar studies showed 1 to 1.75 units/kg/day[15] and 1 to 2 units/kg/day[16] as mean insulin requirements. In the present study, non compliance was noted in 23.52%. Reasons were non availability of insulin because of financial constraints (20.50%), intercurrent infection (11.7%) and child refusal (8.8%). This is because most patients were from poor socio-economic group. No incidence of parental negligence of child was noted in our study. The children of the parents who were illiterate were more non compliant with the treatment (30.76%). In literate parents 19.04% children were non compliant. Educational status of the parents is associated with the compliance of treatment and overall glycemic control.[41]

In the present study lipid profile of all the children was analysed by their serum cholesterol and triglycerides. No child had hypercholesterolemia (> 200 mg/dL) or high levels of triglycerides (> 200 mg/dL). These findings were similar with the lipid profile of the study at Chennai.[16] Increased levels of cholesterol and triglycerides are more commonly associated with Type 2 diabetes mellitus[7]. In the present study, ultrasonography was normal in 73.52%, ascites in 17.6% and 2.9% had atrophic pancreas. Atrophic pancreas signifies the immunological mediated destruction of β cells of pancreas in pathogenesis of type I diabetes. Ascites could be due to malnourishment, underlying liver disorder, tuberculosis and pancreatitis. The exact cause of ascites could not be made out.[42] In the present study none of the patient had diabetic retinopathy, neuropathy and cardiomyopathy. Only one child had evidence of albuminuria and grade II parenchymal changes of kidney on ultrasonography. The incidence of chronic complication was negligible as maximum duration of diabetes in present study was 4 to 5 years. It takes 8 to 10 years of diabetic duration for background retinopathy, 10 to 20 years for neuropathy and 5 to 6 years for nephropathy.[2] Similar findings were noted in a study[16] whereas another study on 617 patients of IDDM age less than 20 years reported 13.4% retinopathy, 7.1% nephropathy, 3% neuropathy and 0.5% ischemic heart disease. The detection of chronic complication in the above mentioned study may be due to larger sample size and long term follow-up.[37]

Conclusion

44.12% had onset of diabetes Mellitus at 10-14 years with Male: female ratio of 1.26: 1. 20.51% had family history of diabetes. Majority patients (41.18%) were from poor socio-economic status. 73.33% were short statured in diabetic duration of more than one year and 31.57% in less than one year which is statistically significant indicating growth deceleration with duration. None of the children were taller than the expected age group. 17.64% children had normal nutrition, 47.05% children had acute malnourishment and 35.29% children had chronic malnourishment. No child was obese. 52.94% children had glycoslated haemoglobin level of more than 10% indicating poor glycemic control, 14.70% had fair control, 33.35% had unsatisfactory glycoslated haemoglobin levels. Glycemic control in relation to growth of the patient was not statistically significant. 91.10% presented with classical symptoms of polyuria, polydipsia and polyphagia. 88.9% were diagnosed to have diabetic ketoacidosis as their initial presentation of diabetes mellitus. Causes for recurrent diabetic ketoacidosis were missing of insulin doses (20.5%), associated infections like pneumonia (11.76%) and urinary tract infection (5.88%). Recurrent hospitalization in the patients with 1 year diabetic duration was statistically significant. Common causes being recurrent DKA (23.50%), hypoglycemia (37.20%), pneumonia (11.76%) and seizure (8.80%). 8.30% has preceding history of viral exanthema probably implying infection as one of the cause for onset of diabetes mellitus. The associated infections were pneumonia (11.76%), urinary tract infections (5.88%), septicemia (2.94%), oral candidiasis (2.94%) skin infection (2.94%). Average insulin requirement in newly diagnosed patient was 0.8 units/kg/day and old cases of diabetes was 1.075 units/kg/day. 23.52% were non compliant. Missing of insulin dose due to financial constraints was the main cause of non compliance. No case of

parental negligence of the child was found. Incidence of chronic complications like retinopathy, neuropathy and cardiomyopathy were not found in the present study.

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