

# Glycosylated Hemoglobin Levels and Lipid Profile in Type 1 Diabetes Mellitus and Precipitating Factors in Diabetic Ketoacidosis

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## Abstract

**Background:** Type-1 Diabetes Mellitus is the most common endocrine-metabolic disorder of childhood and adolescence. The disease has a prevalence of approximately 1 in 2500 children at age 5 years to approximately 1 in 300 children by age 18 years. 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. **Objective:** The objectives of this research were to study the levels of glycosylated hemoglobin and lipid profile in type 1 diabetes mellitus in children attending Gandhi Hospital Secunderabad, Telangana and to study the precipitating factors in Diabetic Ketoacidosis (DKA). **Subjects and Methods:** Design: This was a Cross-Sectional study. Duration: One year and six months i.e. from January 2017 to June 2018. Participants: 50 diabetic children of age less than 18 years attending Gandhi Hospital, Secunderabad, Telangana were included in the study. The diabetic cases were studied using a pre-designed and pre-tested proforma. A detailed clinical examination was carried out with detailed anthropometric measurements and necessary lab investigations were done. Metabolic profile was assessed by investigating for blood sugar levels, glycosylated hemoglobin, and lipid profile. Rates, ratios and percentages of presentations and significance were calculated using Chi-square test. **Result:** 48 % cases had onset of diabetes Mellitus at 13-18 years with Male: female ratio of 1.27: 1. 20 % had family history of diabetes. 16 % children had normal nutrition, 20 % children had grade I and grade II, 38% had grade III and 6 % children had grade IV. 54% children had glycosylated hemoglobin level of more than 10% indicating poor glycemic control, 32 % had fair control, and 14 % had good glycosylated hemoglobin levels. 62 % presented with fever, 40 % presented with symptoms of polyuria, polydipsia and polyphagia, 37.5 % presented with vomiting, 18 % children with loose stools, abdominal pain, 20 % children had breathlessness, 6% presented with seizures. 88.9% were diagnosed to have diabetic ketoacidosis as their initial presentation of diabetes mellitus. Causes for precipitating factors of diabetic ketoacidosis were associated infections like pneumonia (22 %) and urinary tract infection (16 %), Non-availability of insulin doses (25%), non-acceptance by child (16.66 %). Recurrent hospitalization in the patients with 5 years diabetic duration was statistically significant. Common causes being hypoglycemia (38 %) recurrent DKA (24 %), pneumonia (12 %) and urinary tract infections (8 %). 23.52% cases were non-compliant. **Conclusion:** More than half of the cases (54%) had poor glycemic control. Majority presented with classical symptoms of polyuria, polydipsia, polyphagia, fever, breathlessness and diabetic ketoacidosis as clinical presentation. Causes for precipitating factors of diabetic ketoacidosis were associated infections like pneumonia and urinary tract infection, non-availability of insulin doses and non-acceptance by child.

**Keywords:** Type 1 Diabetes Mellitus, Children, Glycosylated Hemoglobin, Lipid Profile, Diabetic ketoacidosis, Precipitating Factors.

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## 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.<sup>[1]</sup> 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  $\beta$ -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  $\beta$ -cell impairment (Type-2 DM). Type-1 DM is the most common endocrine-metabolic disorder of childhood and adolescence. The disease 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.<sup>[2]</sup> 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.<sup>[3]</sup> Worldwide, the proportion of childhood and adolescent DM attributable to type 2 DM is increasing. There is 10 fold increases 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.<sup>[4]</sup> By 2025, India due to its immense population size and high diabetes prevalence will contribute about 57 million diabetics.<sup>[5]</sup>

## Subjects and Methods

**Place of Study:** Department of pediatrics, Gandhi Hospital, Secunderabad, Telangana.

**Type of Study:** This was a Cross-Sectional study.

**Sample Collection:** 50 diabetic children of age less than 18 years attending Gandhi Hospital, Secunderabad, Telangana were included in the study.

**Sampling Methods:** Consecutive sampling.

### Inclusion Criteria:

1. Age less than 18 years.
2. All diabetic children [(Fasting blood sugar > 126 mg/dl) or (Random Blood Sugar > 200mg/dl)].

### Exclusion Criteria:

All the children aged more than 18 years were excluded from the study.

**Statistical Methods:** Rates, ratios and percentages of presentations and significance were calculated using Chi-square test.

**Ethical Approval:** Approval was taken from the Institutional Ethics Committee prior to commencement of the study.

## Results

Fifty children were included in our study. Youngest diabetic encountered in our study was 1 year old male child.

**Table 1: Age Distribution**

Age distribution	Number	%
1-6 Yrs.	7	14%
7-12 Yrs.	19	38%
13-18Yrs.	24	48%

[Table 1] shows Age distribution of diabetes mellitus among the study participants. Majority of the cases (48%) had diabetes mellitus in the age group of 13 – 18 years followed by 38% in 7 to 12 years, 14% in 1 -6 years.

**Table 2: Sex Incidence in Type 1 diabetes mellitus**

Sex	No. of Cases	Percentage
Male	28	56%
Female	22	44%

[Table 2] shows the sex incidence in diabetes mellitus among the study participants. In the present study male preponderance was noted (56%) with Male: Female ratio of 1.27:1.

**Table 3: Duration of Diabetes Mellitus**

Duration	No. of Cases	Percentage
< 1 Year	11	22%
1 – 2 Years	09	18%
2 – 3 Years	06	12%
3 – 4 Years	10	20%
4 - 5 Years	06	12%
>5 Years	08	16%

[Table 3] shows duration of diabetes mellitus among the study participants. 22% had less than 1 year of diabetic duration, 18 % of the cases had 1 to 2 years, 12% had 2 to 3 years and 3 to 4 years duration was seen in 3-4 years, 4-5 years duration of diabetes mellitus was seen in 12% and more than 5 years duration was seen in 16 % of cases.

**Table 4: Family history of Type 1 diabetes mellitus**

History	No. of Cases	Percentage
First degree relatives	03	6%
Second degree relatives	07	14%
Total		20%

[Table 4] shows family history of diabetes mellitus among the study participants. Out 50 cases only 10 (20%) had family history of diabetes mellitus. 03 (6%) cases had first degree relatives and remaining 07 (14%) cases were second degree relatives. No incidence of diabetes in siblings was found in the present study

**Table 5: Consanguinity in Type 1 diabetes mellitus**

Consanguinity	No. of Cases	Percentage
Second degree consanguineous	13	26 %
Non consanguineous	37	74 %

[Table 5] shows consanguinity in diabetes mellitus. Out of 50 cases only 13 had consanguineous family history and rest of cases (74%) were non consanguineous.

**Table 6: Clinical profile**

Clinical profile	No. of Cases	Percentage
Fever	31	62%
Polyuria, polyphagia and polydipsia	20	40%
Vomiting	15	37.5%
Abdominal pain	09	18%
Breathlessness	10	20%
Loose stools	09	18%

Drowsiness	07	14%
Coma	02	4%
Seizures	03	6%

The clinical profile in the present study is classical symptoms of polyuria and polydipsia (40 %), Drowsiness(14%), Fever (62%), Vomiting's (37.5%), Pain abdomen (18%), breathlessness (20%), Coma (4 %) and Seizures (6%)

**Table 7: Infections Associated**

Infections	No. of Cases	Percentage
Urinary tract infection	08	16%
Pneumonia	11	22%
Candidiasis	02	4%
Skin infection	03	6%
Sepsis	02	4%

The associated infections in the present study are pneumonia (22 %), urinary tract infections (16 %), candidiasis (4%) skin infection (6 %), and sepsis (4%). One female child had thyroid swelling but her thyroid profile was normal so labeled as pubertal goiter.

**Table 8: Precipitating factors of DKA**

Precipitating factors of DKA	No. of Cases	Percentage
Due to intercurrent infection	07	58.33%
Due to non-availability of insulin (because of financial restraint)	03	25%
Non acceptance by the Child	02	16.66%

The precipitating factors of diabetic ketoacidosis were due to intercurrent infections, child refusal and non-availability of insulin due to financial constraint. There was no incidence of parental negligence of the child's conditions.

**Table 9: Recurrent Hospitalizations**

Other problems	No. of Cases	Percentage
Recurrent hospitalization	24	48%
Hypoglycemic episodes	19	38%
Recurrent diabetic ketoacidosis	12	24%
Pneumonia	06	12%
Urinary tract infection	04	8%

In the present study we noted 48 % got admitted more than once. Causes for recurrent hospitalization were hypoglycemia (38 %), diabetic ketoacidosis (24 %) and pneumonia (12 %), urinary tract infections (8%).

**Table 10: HBA1C levels in the study**

HBA1C levels	No. of Cases	Percentage
< 6.0 %	00	00.00%
(6.5 –7.5%)	07	14%
(7.6- 10%)	16	32%
> 10%)	27	54%

54 % of diabetic children have shown poor control, 32 % had fair control, 14 % had good glycosylated hemoglobin levels.

**Table 11: lipid profile**

Serum Triglycerides Levels	No. of Cases	Percentage
< 150	37	74 %
150 -200	08	16%
>200	00	00%

In the present study lipid profile of all the children was analyzed by their serum cholesterol and triglycerides. No child had hypercholesterolemia (> 200 mg/dL). 74 % children had triglyceride levels below 150 mg/dL, 16 % were in the range of 150 – 199 and no child had high level of triglycerides

**Tests of Statistical Significance**

**Table 12: Age at presentation and glyceimic control P-value: 0.18**

Age at presentation	Good control	Poor control	Total
<9yrs.	07	04	11
>9yrs.	16	23	39

**Table 13: Sex distribution and glyceimic control P-value=0.0052**

Sex distribution	Good control	Poor control	Total
Female	15	07	22
Male	08	20	28
Total	23	27	50

**Table 14: Duration of diabetes and Glyceimic control P value=0.19**

Duration of diabetes	Good control	Poor control	Total Number
<5 years	21	21	42
>5 years	02	06	08
Total	23	27	50

**Table 15: DKA and Glyceimic control P-value=0.109**

		Glyceimic control		Total	
		Good	Poor		
DKA	Absent	Number	12(24%)	26(52%)	38
	Present	Number	1(2%)	11(22%)	
		Number	13	37	

**Table 16: Recurrent hospitalizations in type1 diabetes mellitus P-value=0.01**

Recurrent hospitalizations	<5 years of duration	>5 years of duration	Total
Present	17	07	24
Absent	25	01	26
Total	42	08	50

**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. The primary objective of the study was to analyze the HbA1C levels, lipid profile in type 1 diabetes mellitus in children and precipitating factors in diabetic ketoacidosis. This study included 50 children with type 1 diabetes mellitus. In the present study peak incidence was in

age group of 13 – 18 years (48 %). Male predominance was encountered with male to female ratio 1.27:1. In a similar study peak age at diagnosis was 11 years in girls and between 11 to 18 years in boys and female predominance was present.<sup>[6]</sup> Age was found to be significant factor of glyceamic control. Patients with poor glyceamic had higher mean of age 12 than the group with good glyceamic control. Vanelli et al,<sup>[7]</sup> who studied children and adolescents with diabetes and found that increasing age was associated with a higher mean HbA1c. It was noticed in this study that males (40%) had poor glyceamic control when compared to females whereas female patients aged >12 years had poor glyceamic control than males of the same age group in the result that has been recorded by Setoodeh et al.<sup>[8]</sup> In the present study, 42 % of the children in the group with duration of disease < 5 years had a good glyceamic control and 12 % had poor control with duration of disease > 5 years. In the present study 20 % had family history of diabetes mellitus. 6 % had first degree diabetic relatives and 14 % had second degree relatives. 26 % children had second degree consanguineous family history. A similar study conducted at Chennai showed 6.14% incidence of diabetes in the siblings and 20.52% of second-degree consanguineous family history.<sup>[9]</sup> Out of 50 study participants 16 % had normal nutrition, 20 % had Grade I and Grade II, 38 % had Grade III and 6 % had Grade IV malnutrition as per IAP Grades. 8 children had normal nutrition. 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.<sup>[9]</sup>

In the present study 24 % were diagnosed to have diabetic ketoacidosis as their cause of admission. The clinical manifestations of diabetic ketoacidosis were classic symptoms of polyuria, polydipsia with breathlessness (20%), vomiting's (37.5%), abdominal pain (18 %), drowsiness (14 %), comatose (4 %) and convulsions (6%). Different studies have mentioned higher incidence of diabetic ketoacidosis in 77% (Likitmaskul Set al),<sup>[6]</sup> 69% (Poovazhagi V et al),<sup>[9]</sup> and 79% (Pinkey JH et al),<sup>[10]</sup> as initial presentation. HBA1C level in the present study showed 54% to be of poor glyceamic control, 32 % fair control and 14 % had good control. Two different studies showed 50% (Poovazhagi V et al),<sup>[9]</sup> and 28% (Soliman et al),<sup>[11]</sup> poor glyceamic control respectively. In the present study recurrent hospitalization noted in diabetic children with duration of less than five years is 1.69±0.89 and more than five years is 1.87 ± 1.12 which is statistically significant (P= 0.01).

Recurrent hospitalization (48.00%) was noted. Causes for recurrent admissions were hypoglycemia (38%), recurrent DKA(24%), pneumonia(12%) and Urinary tract infections (8%). 38 % of hypoglycemic episodes were experienced in diabetics of more than 1 year of duration in the present study. Similar findings were reported.<sup>[12]</sup> In the present study, precipitating factors of diabetic ketoacidosis were

intercurrent infection (58.33%) non availability of insulin because of financial constraints (25 %), and non-acceptance of child (16.66 %). 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. In literate parents also few children were non-compliant. Educational status of the parents is associated with the compliance of treatment and overall glyceamic control.<sup>[13]</sup>

In the present study lipid profile of all the children was analyzed 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.<sup>9</sup> Increased levels of cholesterol and triglycerides are more commonly associated with Type 2 diabetes mellitus.<sup>[14]</sup>

## Conclusion

More than half of the cases(54%) had poor glyceamic control. Majority presented with classical symptoms of polyuria, polydipsia, polyphagia, fever, breathlessness and diabetic ketoacidosis as clinical presentation. Causes for precipitating factors of diabetic ketoacidosis were associated infections like pneumonia and urinary tract infection, non-availability of insulin doses and non- acceptance by child.

## References

1. Lebovitz HE. Etiology and pathogenesis of Diabetes Mellitus. *Pediatrics Clinics of North America* 1984; 31(3):521-30.
2. Nelson WE, Behrman RF, Kliegman RM, Arvin AM. Nelson's Textbook of pediatrics: Diabetes Mellitus. 17th Ed. USA: W. B. Saunders Company; 2004.
3. Ramachandran A, Snehalatha C, Krishnaswamy CV. Incidence of IDDM in children in urban population in southern India. *Madras IDDM Registry Group Madras, South India. Diabetes Res ClinPract* 1996 Oct; 34(2): 79- 82.
4. Bhatia V. IAP National Task Force for Childhood Prevention of Adult Diseases: Insulin Resistance and Type 2 Diabetes Mellitus in Childhood. *Indian Pediatrics* 2004; 41:443-57.
5. King H, Aulart RE, Herman WH, Global burden of diabetes 1995-2025: *Diabetes care* 1998, 21 :1414-31.
6. Likitmaskul S, Angsusingha K, Morris S, Kiattisakthavee P, Chaichanwatanakul K, Tuchinda C. Type 1 diabetes in Thai children aged 0-14 years. *J Med Assoc Thai* 1999 Aug; 82(8):826-32.
7. Vanelli M et al. Nationwide cross sectional survey of 3560 children and adolescents with Diabetes in Italy. *J. Endocrinol Invest* 2005; 28:692-9
8. SetoodehA et al. Female sex as a risk factor for glyceamic control and complications in Iranian patients with type one diabetes mellitus. *Iran J Pediat* 2011; 21: 373-8.
9. Poovazhagi V, Thangavelu S, Parivadini S, Ramadevi P. Clinical profile of childhood diabetes Mellitus from a tertiary care hospital in Chennai. *Proceedings of 41st National Conference of the Indian Academy of Pediatrics: 2004 Jan 8th - 11thChennai.*
10. Pinkey JH, Bingley PJ, Cawtell PA, Dungen DB, Gale EA. Presentation and progress of childhood diabetes mellitus: A prospective population-based study. *The Bart's Oxford study group. Diabetologia* 1994 Jan; 31(1):70-4
11. Soliman AT, al Salmi, Asfour M. Mode of presentation and progress of childhood diabetes in Sultanate of Oman. *J. Trop Pediatr* 1997;

- 43(3):128- 32
12. Karp MM. Hypoglycemia in diabetic children and adolescence. Indian J Pediatr 1989 Nov-Dec; 56 (Suppl 1):S93-8.
13. Danne T, Mortensen HB, Hougaard P, Lynggard H, Aanstoot H, Chiarelli F et al. Persistent differences among centres over 3 years in glyemic control and hypoglycemia in a study of 3,805 children and adolescents with type 1 diabetes from the Hvidore study group. Diabetes Care 2001; 24: 1342-7
14. Burant CF. Medical Management of Type 2 Diabetes: Diagnosis and classification. 5th Ed. Bangalore: Panther Publishers Private Limited; 2004

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