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Research Article

CLINICAL CHARACTERISTICS AND METABOLIC PROFILE OF PEDIATRIC TYPE 1 DIABETES: AN OBSERVATIONAL STUDY

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ABSTRACT

Objective: To evaluate the clinico-epidemiological and metabolic profile of children aged 6 months to 18 years with Type 1 Diabetes Mellitus (T1DM).

Methods: This observational study was conducted over one year at a tertiary care center in Shimla, Himachal Pradesh. A total of 45 children diagnosed with T1DM according to ISPAD guidelines were enrolled. Baseline clinical characteristics, metabolic parameters, autoantibody profiles, and a 3-month follow-up for glycemic control (HbA1c) were evaluated.

Results: Out of 45 children (mean age 9.64 ± 4.01 years; male to female ratio 1.04:1), 71.11% resided in rural areas and 68.89% were newly diagnosed cases. The most frequent clinical presentation was diabetic ketoacidosis (DKA) in 35.56% of patients, primarily among those newly diagnosed. Baseline glycemic control was poor, characterized by a mean HbA1c of 12.06 ± 2.79%, with 77.8% categorized as having poor control (>10%). At the 3-month follow-up, the mean HbA1c improved to 10.48 ± 2.35%, although 55.56% of the children remained in the poor control category. The mean insulin requirement was 1.08 ± 0.30 IU/kg/day. GAD-65 autoantibodies were positive in 17.78% of the cohort.

Conclusion: Pediatric T1DM in this region frequently presents with DKA at disease onset. While short-term insulin management improves overall HbA1c, suboptimal glycemic control remains highly prevalent, emphasizing the critical need for enhanced early detection and targeted interventions to improve long-term adherence.

KEYWORDS: Diabetes Mellitus, Type 1, Diabetic Ketoacidosis, Glycated Hemoglobin A, Child, Epidemiology.

Introduction

Type 1 Diabetes Mellitus (T1DM) is a chronic metabolic disorder characterized by absolute insulin deficiency resulting from the autoimmune-mediated destruction of pancreatic β-cells[1]. It remains the most common form of diabetes among children and adolescents. The global burden of pediatric T1DM is steadily increasing, with an estimated 1.21 million youth under 20 years of age currently affected worldwide[2]. In India, the prevalence of pediatric T1DM is increasingly recognized due to improving awareness and survival rates[3]. However, clinical studies from low- and middle-income countries demonstrate that affected children frequently experience severe metabolic decompensation, high rates of diabetic ketoacidosis (DKA) at presentation, and sustained poor glycemic control[4].

Persistent suboptimal glycemic control is closely linked to the early onset of chronic microvascular complications, such as microalbuminuria and peripheral neuropathy, which can manifest even within a few years of diagnosis[5,6]. Despite this rising incidence and the substantial socioeconomic challenges associated with long-term pediatric diabetes care, region-specific data remain notably scarce, particularly from the sub-Himalayan and northern regions of India. Understanding the unique demographic and clinical patterns of these specific populations is essential for informing public health strategies and optimizing clinical management. Therefore, this study was conducted to characterize the clinico-epidemiological pattern and metabolic profile of T1DM in children aged 6 months to 18 years.

Materials and Methods

This facility-based observational study was conducted in the Department of Paediatrics at Indira Gandhi Medical College (IGMC), Shimla, Himachal Pradesh, over a period of one year. The study protocol was approved by the Institutional Ethical Committee. Written informed consent was obtained from the parents or guardians of all participants, along with informed assent where applicable, prior to enrolment.

Being time bound study, a formal *a priori* statistical sample size calculation was not performed. Instead, the study included all consecutive children aged 6 months to 18 years who presented to the outpatient department or were admitted to the indoor facilities with symptoms suggestive of Type 1 Diabetes Mellitus (T1DM). Diagnosis was established based on the International Society for Pediatric and Adolescent Diabetes (ISPAD) 2018 guidelines[7], defined by a fasting blood glucose ≥126 mg/dL, random blood glucose ≥200 mg/dL, or HbA1c ≥6.5%. Patients were excluded if they had Type 2, monogenic, neonatal, or secondary diabetes. Additional exclusions comprised children with chronic organ failure, genetic syndromes, or those taking medications that significantly alter metabolic profiles, such as systemic corticosteroids. Finally, patients lacking informed consent or having incomplete clinical and metabolic data were excluded.

A detailed history, including socio demographic details, perinatal history, and feeding practices, was collected using a pretested, semi-structured interview schedule. Socioeconomic status was categorized using the modified Kuppuswamy scale. Anthropometric measurements were recorded by a trained pediatric resident and expressed as standard deviation scores according to WHO standards. A thorough general and systemic clinical examination was performed for each participant. Baseline investigations included evaluation of glycemic parameters (fasting and random blood glucose, HbA1c) and C-peptide levels. Following recruitment, all children received standard treatment as per ISPAD guidelines and were maintained on a basal-bolus insulin regimen.

Patients were followed up after three months to monitor glycemic control. Parents were instructed to perform self-monitoring of blood glucose (SMBG) at home four times daily and maintain records of blood glucose and insulin dosages in patient diaries. At the follow-up visit, anthropometric parameters were reassessed, and baseline laboratory investigations, including HbA1c, were repeated. Episodes of hypoglycemia and diabetic ketoacidosis (DKA) during the study period were also documented.

Statistical Analysis

Data was entered into Microsoft Excel and analyzed using Epi Info software version 7. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as means and standard deviations.

Results

A total of 45 children diagnosed with Type 1 Diabetes Mellitus (T1DM) were enrolled in the study. The mean (SD) age of the cohort was 9.64 (4.01) years, with the highest proportion of patients belonging to the school-age group (42.22%). There was a near-equal gender distribution with 23 (51.11%) males and 22 (48.89%) females. A majority of the children (71.11%) resided in rural areas, and more than half (57.78%) belonged to the lower-middle socioeconomic class. Baseline demographic characteristics are summarized in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics of Children with Type 1 Diabetes Mellitus (N=45)

Parameter	Frequency (%) / Mean (SD)
Age (years), Mean (SD)	9.64 (4.01)
Age Group, n (%)	
Toddler (<3 years)	1 (2.22)
Preschool (3–5 years)	11 (24.44)
School-age (6–12 years)	19 (42.22)
Adolescent (>12 years)	14 (31.11)
Gender, n (%)	
Male	23 (51.11)
Female	22 (48.89)
Residence, n (%)	
Rural	32 (71.11)
Urban	13 (28.89)
Socioeconomic Status, n (%)	
Lower Middle	26 (57.78)
Upper Lower	12 (26.67)
Upper Middle	5 (11.11)
Lower	2 (4.44)
Diagnosis Status, n (%)	
Newly Diagnosed	31 (68.89)

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Previously Diagnosed	14 (31.11)
Clinical Presentation, n (%)	
Diabetic Ketoacidosis (DKA)	16 (35.56)
Polyuria ± Polydipsia ± Polyphagia	15 (33.33)
Lethargy	4 (8.89)

At the time of enrolment, 31 (68.89%) children were newly diagnosed cases, while 14 (31.11%) were previously diagnosed. Diabetic ketoacidosis (DKA) was the most frequent mode of presentation, observed in 16 (35.56%) children, of which 11 (68.75%) were newly diagnosed. The mean (SD) body mass index (BMI) of the study population was 15.2 (3.59) kg/m².

The baseline metabolic profile revealed severe hyperglycemia with a mean (SD) fasting blood glucose of 302.64 (78.89) mg/dL and a random blood sugar of 359.64 (109.14) mg/dL. The mean (SD) HbA1c at presentation was 12.06 (2.79) %, with 35 (77.8%) children having HbA1c >10%. Autoantibody screening demonstrated GAD-65 positivity in 8 (17.78%) children. Additionally, TPO and tTG IgA antibodies were positive in 2 (4.44%) and 6 (13.33%) children, respectively. Clinical and metabolic parameters are detailed in Table 2.

Table II: Baseline Metabolic and Autoantibody Profile (N=45)

Parameter	Value
BMI (kg/m²), Mean (SD)	15.2 (3.59)
Fasting Blood Glucose (mg/dL), Mean (SD)	302.64 (78.89)
Random Blood Sugar (mg/dL), Mean (SD)	359.64 (109.14)
C-peptide (ng/mL), Mean (SD)	0.79 (0.16)
HbA1c at Presentation (%), Mean (SD)	12.06 (2.79)
Glycemic Control at Presentation, n (%)	
Poor Control (>10%)	35 (77.8)
Fair Control (7.6–9.9%)	9 (20.0)
Good Control (<7.5%)	1 (2.2)
Insulin Requirement (IU/kg/day), Mean (SD)	1.08 (0.30)
Autoantibody Positivity, n (%)	
GAD-65	8 (17.78)
tTG IgA	6 (13.33)
TPO	2 (4.44)
HbA1c at 3-Month Follow-up (%), Mean (SD)	10.48 (2.35)

All patients were managed with a basal-bolus insulin regimen, requiring a mean (SD) insulin dose of 1.08 (0.30) IU/kg/day. At the 3-month follow-up, the mean (SD) HbA1c improved to 10.48 (2.35) %. Despite this improvement, 25 (55.56%) children remained in the poor glycemic control category. A statistically significant association was observed between gender and glycemic control at follow-up (P=0.008).

Discussion

This study evaluated the clinic epidemiological and metabolic profile of children with Type 1 Diabetes Mellitus (T1DM) in a sub-Himalayan tertiary care setting. The study cohort predominantly comprised school-aged children with a mean age of 9.64 years, a near-equal gender distribution, and a high representation from rural and lower-middle socioeconomic backgrounds. A significant proportion of patients presented with diabetic ketoacidosis (DKA) at diagnosis, and while short-term insulin therapy improved overall glycemic control, the majority remained in the poor control category.

The mean age at presentation in our cohort (9.64 ± 4.01 years) aligns closely with similar regional studies by Karki et al.[4] and Muktan et al.[5], who reported mean ages of 9.7 and 9.5 years, respectively. This clustering indicates a consistent epidemiological pattern wherein pediatric T1DM most commonly manifests during mid-childhood. We observed no significant gender predisposition, which is consistent with large registry data reported by Hockett et al. [8], though it contrasts with the male predominance noted in some regional cohorts[5,9]. The high proportion of children from rural areas (71.11%) mirrors findings by Veerappan et al.[10], highlighting disparities in healthcare access and the reliance of peripheral populations on tertiary centers for specialized pediatric endocrine care[11].

Classical osmotic symptoms were common, yet over one-third of our cohort (35.56%) presented with DKA. While this rate is lower than the 74% and 54.1% reported by Chauhan et al.[12] and Karki et al.[4], it remains a substantial burden. The high frequency of DKA, particularly among newly diagnosed cases (68.75% of all DKA presentations), it is evident that persistent gaps in community awareness and delayed recognition of early symptoms in primary care settings remain critical challenges[13].

Metabolically, our patients demonstrated severe baseline hyperglycemia with a mean HbA1c of 12.06%, comparable to the 12.7% reported by Veerappan et al.[10] and 11.1% by Najem et al.[14]. Following 3 months of basal-bolus insulin therapy, the mean HbA1c improved to 10.48%. Similar trends of reduction post-intervention were reported by Dayal et al.[15]. However, despite this improvement, 55.56% of our patients remained in the poor glycemic control category (>10%). This persistent suboptimal control, echoing findings by Shibeshi et al.[16], highlights the complex challenges of T1DM management in resource-limited settings, where factors such as dietary adherence, insulin storage, and the frequency of self-monitoring heavily influence outcomes.

The strengths of this study include its real-world tertiary care setting and the incorporation of follow-up data to assess

short-term glycemic trajectories. However, the study has certain limitations. The hospital-based nature and small sample size limit the epidemiological generalizability of the incidence data. Furthermore, financial constraints restricted autoantibody testing primarily to GAD-65, preventing a comprehensive immunological profiling (e.g., IAA and IA-2). Finally, the short follow-up duration precludes the assessment of long-term complication trajectories.

In conclusion, pediatric T1DM in this region frequently presents late with acute metabolic complications. While insulin therapy yields short-term glycemic improvements, sustained optimal control remains elusive. Enhanced primary care screening, structured diabetes education, and robust socioeconomic support systems are imperative to mitigate acute presentations and improve long-term metabolic outcomes in these children.

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Conflict of Interest

None

References

1. Atkinson MA, Eisenbarth GS, Michels AW. Type 1 diabetes. Lancet. 2014;383(9911):69-82. doi: 10.1016/S0140-6736(13)60591-7.
2. Lezzi M, Aloi C, Salina A, Fragola M, Bassi M, Strati MF, et al. Diabetes Mellitus Diagnosed in Childhood and Adolescence With Negative Autoimmunity: Results of Genetic Investigation. Front Endocrinol (Lausanne). 2022;13:894878. doi: 10.3389/fendo.2022.894878.
3. Virmani A. Type 1 Diabetes in India: The Numbers Show the Way Ahead. Indian Pediatr. 2019;56(3):189-90.
4. Muktan D, Tamang Ghising L, Singh RR. Clinical profile of type 1 diabetes mellitus among children in eastern part of Nepal. Int J Contemp Pediatr. 2019;6(2):583-7. doi: 10.18203/2349-3291.ijcp20190691.
5. Karki ST, Yadav AK, Joshi P, Karki BB, Mall D. Clinical presentation and course of Type 1 diabetes: A Hospital based longitudinal study over a period of ten years. J Diabetes Endocrinol Assoc Nepal. 2025;9(2):18-24. doi: 10.3126/jdean.v9i2.83001.
6. Gururaju D, Akhila R, Pooja RKM. A Study on Clinical Profile of Children with Peripheral Neuropathy and Type 1 Diabetes Mellitus. Res J Med Sci. 2024;18:679-82. doi: 10.36478/makrjms.2024.9.679.682.
7. Donaghue KC, Marcovecchio ML, Wadwa RP, Chew EY, Wong TY, Calliari LE, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Microvascular and macrovascular complications in children and adolescents. Pediatr Diabetes. 2018;19 Suppl 27:262-74. doi: 10.1111/pedi.12742.
8. Hockett CW, Praveen PA, Ong TC, Amutha A, Isom SP, Jensen ET, et al. Clinical profile at diagnosis with youth-onset type 1 and type 2 diabetes in two pediatric diabetes registries: SEARCH (United States) and YDR (India). Pediatr Diabetes. 2021;22(1):22-30. doi: 10.1111/pedi.12981.
9. Gomase SV, Biswal PK. Clinical Profile of Type 1 Diabetes Mellitus in Children less than 18 years age, in a Tertiary Care Centre, Bhilai, Chhattisgarh, India: A Cross-sectional Study. J Clin Diagn Res. 2023;17:SC01-5. doi: 10.7860/JCDR/2023/58298.18114.
10. Veerappan VS, Karupanan R. Comparative Study of Clinico-demographic Characteristics and Glycemic Control in Urban and Rural Children with Type 1 Diabetes Mellitus. Ann Child Health. 2025;2:1-5. doi: 10.25259/ACH_6_2024.
11. Hirschler V, Benitez A, Marassi AE, Arrigo A, Andres E, Codner E, et al. Clinical and Demographic Characteristics Associated with Type 1 Diabetes Distress in Latin American Children. J Pediatr Clin Pract. 2025; 17:200173. doi: 10.1016/j.jpedcp.2025.200173.
12. Chauhan AV, Pathak G, Khare P. Study of clinical profile and treatment of type 1 diabetes mellitus in pediatric patients at a tertiary care centre. Int J Contemp Pediatr. 2023; 10:18-22.
13. Kumar M, Manjusha K. Precipitating factors, clinical profile and metabolic abnormalities of diabetic ketoacidosis in children with Type 1 Diabetes and their role in predicting the outcome. J Evid Based Med Healthc. 2017;4(8):393-400. doi: 10.18410/jebmh.
14. Najem S, Majaliwa ES, Ramaiya K, Swai ABM, Jasem D, Ludvigsson J. Glycemic control and complications of type 1 diabetes among children in Tanzania. J Clin Transl Endocrinol. 2020; 23:100245. doi: 10.1016/j.jcte.2020.100245.
15. Dayal D, Yadav J, Kumar R, Gupta S, Yadav A, Nanda P. Glycaemic control and factors affecting it in type 1 diabetes in children: experience from a tertiary care centre in India. Pediatr Endocrinol Diabetes Metab. 2022;28(4):281-6. doi: 10.5114/pedm.2022.118326.
16. Shibeshi MS, Daba AK, Meiso KM, Tadesse BT. Glycemic control among children and adolescents with diabetes in Southern Ethiopia: a cross-sectional study. BMC Endocr Disord. 2022;22(1):161. doi: 10.1186/s12902-022-01070-y.

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