

## Research Article

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## Sociodemographic and Clinical Characteristics in Newly Diagnosed Type 1 Diabetes: Rural vs. Urban Perspectives from a Specialized Center in Bangladesh

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## Abstract

Type 1 Diabetes Mellitus (T1DM) is a chronic autoimmune disease that primarily affects children and adolescents, leading to insulin deficiency and persistent hyperglycemia. The incidence of T1DM has been rising globally, with significant regional variations. While Europe and North America report the highest rates, Southeast Asia, including Bangladesh, has seen increasing cases. This study aims to compare the sociodemographic and clinical characteristics of newly diagnosed T1DM patients from rural and urban areas of Bangladesh, focusing on factors such as age at diagnosis, family history, and disease presentation. A cross-sectional study was conducted at the Pediatric Diabetes Care and Research Center (PDRC) at BIRDEM Hospital in Dhaka, Bangladesh, from January to December 2019. Retrospective data from 212 newly diagnosed children and adolescents (aged 1-18 years) were analyzed. The study included sociodemographic information (age, sex, residence, family history) and clinical data (DKA at diagnosis, height, weight, fasting blood sugar, HbA1c levels). Most participants (62%) were from rural areas, with a higher proportion from low socioeconomic backgrounds than from urban areas.

Key findings revealed that the age at diagnosis was not significantly different between rural and urban patients, but the age at registration was considerably higher in rural patients, suggesting delays in seeking care. A higher proportion of urban patients reported a family history of Type 2 diabetes. Diabetic ketoacidosis (DKA) was more common at diagnosis in urban patients, while rural patients had significantly higher fasting blood sugar levels, indicating poorer glycemic control. Although HbA1c levels were slightly higher in rural patients, this difference was not statistically significant. This study underscores the disparities in healthcare access and outcomes between rural and urban populations in Bangladesh. Rural patients face challenges related to delayed diagnosis, poor glycemic control, and lower socioeconomic status, which may exacerbate disease progression. The findings highlight the need for targeted interventions to improve healthcare access, diabetes awareness, and early detection, particularly in rural regions, to reduce the burden of T1DM in Bangladesh.

**Keywords:** Type 1 diabetes, rural-urban differences, Bangladesh, socioeconomic status, glycemic control, diabetic ketoacidosis, healthcare access.

## Introduction

Type 1 diabetes mellitus (T1DM) is a chronic autoimmune condition that primarily affects children and adolescents, leading to insulin deficiency and persistent hyperglycemia. With an estimated 1.1 million children and adolescents worldwide living with T1DM, the disease poses a significant public health challenge [1]. The incidence of T1DM has been steadily increasing globally, with a 3–5% annual rise in new cases, with China reporting the lowest rates and Finland having the highest [2]. Although Europe and North America report the highest incidence rates among children aged 0–14 years, Southeast Asia follows closely behind. According to the International Diabetes Federation (IDF) Atlas, approximately 184,000 children under 20 years of age in Southeast Asian (SEA) countries live with T1DM [1]. In Bangladesh, a hospital-based study in Dhaka District revealed a mean T1DM incidence of 1.25 per 100,000 population under 20 years of age [3].

As the incidence of T1DM rises globally, understanding the factors that influence its presentation and management becomes increasingly important, particularly in resource-limited settings where data is scarce. Additionally, there is often a lack of awareness about diabetes among both the general population and healthcare providers, as well as limited access to healthcare facilities, particularly in rural areas [4, 5]. In low- and middle-income countries (LMICs), diabetes is typically classified based on the clinical features of individuals diagnosed with the condition, and some patients may not be easily categorized into a single type of diabetes [6].

Despite the growing prevalence, limited research has focused on how T1DM presents and is managed in different geographic and socioeconomic contexts. Specifically, there is a lack of comprehensive studies comparing the socio-demographic characteristics of newly diagnosed T1DM patients from rural areas. Undoubtedly, there are differences between individuals with type 1 diabetes living in rural and urban areas. Furthermore, it has been reported that the quality of care in rural communities is generally lower than in urban areas, particularly regarding access to specialized endocrine and diabetes care [7–9].

Bangladesh has faced significant challenges in addressing health inequities, particularly between rural and urban regions. Over two-thirds of the population, or more than 66%, resides in rural areas, where access to continuous healthcare services is severely limited [10]. A key issue in these regions is the shortage of qualified healthcare professionals and understaffed medical facilities. This often leads to extended wait times for treatment, which, in turn, compromises the overall quality of care received by patients [11]. In urban areas, healthcare facilities are generally better equipped, with more specialized medical professionals and advanced diagnostic tools, leading to quicker diagnosis and more effective treatment options. However, in rural areas, where health infrastructure is underdeveloped and medical professionals are in short supply, individuals often face delays in seeking care. This delay can result in more advanced stages of illness by the time patients receive treatment, leading to poorer health outcomes.

In Bangladesh, rural and urban populations often experience significant disparities in healthcare access and socioeconomic status, which can impact the timing of diagnosis, disease severity at presentation, and subsequent management. This study aims to compare the sociodemographic and clinical characteristics of newly diagnosed Type 1 Diabetes Mellitus (T1DM) patients from both rural and urban areas, using data from a specialized diabetes center.

## Methods

### Study Design

The Diabetic Association of Bangladesh (BADAS) provides essential and affordable healthcare for individuals with diabetes through an extensive network, including 109 healthcare facilities and 332 accredited diabetes centers nationwide [12]. BIRDEM is the largest hospital in BADAS and serves as a tertiary care referral center. Pediatric Diabetes Care and Research Center (PDRC) a specialized diabetes care center, located in BIRDEM Hospital provides specialized care for children with diabetes and is supported by the Changing Diabetes in Children (CDiC) [12, 13] and Life for a Child (LFAC) [12, 14] programs. Notably, the

BADAS Pediatric Diabetes Centre (PDRC) at BIRDEM is the only multidisciplinary center dedicated to pediatric diabetes care in the country. This was a cross-sectional study conducted at PDRC. The study aimed to compare the sociodemographic and clinical characteristics of newly registered Type 1 diabetes mellitus (T1DM) patients from rural and urban areas of Dhaka and other districts in Bangladesh. Data were collected retrospectively for patients who were newly registered at the center between January to December 2019.

### Inclusion and Exclusion Criteria

The study included all children and adolescents aged 1 to 18 years who were newly diagnosed with T1DM at the center during the study period. Patients with a confirmed diagnosis of T1DM based on local criteria were eligible for inclusion [15]. Retrospective records were reviewed, including data on sociodemographic details (age, sex, residence, family history) and clinical details such as DKA at presentation, height, weight, fasting blood sugar (FBS), and HbA1c levels. Patients with a diagnosis of Type 2 diabetes or other types were excluded from the study.

### Data Collection

Data were extracted from the clinic's electronic health records and patient files.

### Statistical Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Comparisons between rural and urban groups were performed using appropriate statistical tests. For continuous variables, an independent t-test was used if data were normally distributed, or the Mann-Whitney U test was used for non-normally distributed data. For categorical variables, the chi-square test or Fisher's exact test was used, as appropriate. A p-value of <0.05 was considered statistically significant. Data analysis was performed using the SPSS 26 version.

### Ethical Considerations

The study was conducted by the ethical principles outlined in the Declaration of Helsinki. All patient data was anonymized, and confidentiality was maintained throughout the study. Informed consent was obtained from the parents or guardians of the pediatric patients before data collection.

## Results

A total of 212 patients were included in the study, with the majority being female (57%) (Table 1). The median age at diagnosis was 10.7 years (interquartile range: 8.0–13.0 years). The median age at registration was 12.0 [9.1–14.7]

**Table 1: Demographic characteristics of children and adolescents.**

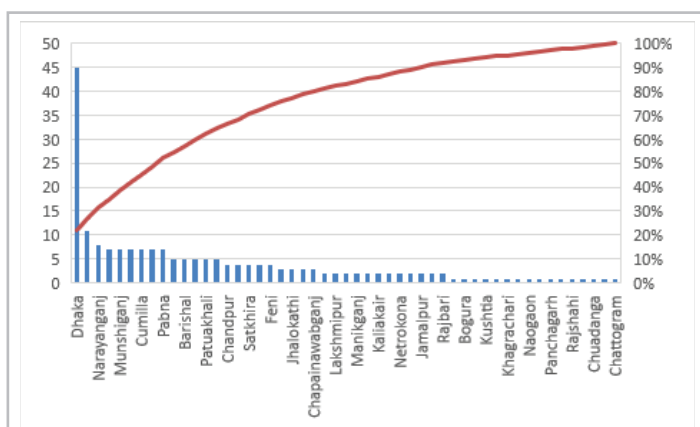
Characteristics	Frequency	Percentage (%)
<b>Gender (n=212)</b>		
Female	120	(57.0)
Male	92	(43.0)
<b>Age at Diagnosis(years)(n=162)</b>		
Age 14-18	22	13.6
Age 10–14	66	40.7
Age 5-10	55	34.0
Age < 5	19	11.7
<b>Residence (n=212)</b>		
Urban	81	38.0
Rural	131	62.0
<b>Socioeconomic Status(n=159)</b>		
Low	88	55.3
Middle	28	17.6
Upper middle	43	27.0
<b>Family History of T2 Diabetes(n=158)</b>		
Present	107	58.4
Absent	76	41.5

**Table 2: Demographic characteristics among urban and rural areas.**

	Urban	Rural	P value
Age at Diagnosis (n=161)	10.0[7.0-12.3]	11.0[8.0-13.3]	0.175
Age at Registration(n=209)	10.6[7.0-13.0]	12.0[9.0-15.0]	0.0001
<b>Sex (n=212)</b>			
Male	29(36.0)	63(48.0)	
female	52(64.0)	68(52.0)	0.079
<b>Socioeconomic status(n=159)</b>			
Poor	27(35.0)	61(74.3)	
Lower middle income	15(19.4)	13(16.0)	
Upper middle income	35 (45.4)	8 (9.7)	0.0001
<b>Family history of diabetes (n= 183)</b>			
Yes	52(64.0)	55(51)	
No	27 (36.0)	53(49)	0.0001

years and the median age at diagnosis was 10.7 [8.0–13.0]. Approximately half of the patients (40.7%) were diagnosed between 10 and 14 years, and 11.7% were below five years (Table 1). Most patients (62.0%) were from rural areas, while (38.0%) were from urban areas. Among the districts, Dhaka was the most common (Figure 1). Regarding socioeconomic status, 55.3% were classified as having a low socioeconomic status, while 27.0% of patients came from upper-middle socioeconomic backgrounds. A family history of diabetes was reported in 58.4% of cases, while 41.5% had no family history of the condition (Table 1).

We compared the characteristics of patients between rural and urban areas. Although the age at diagnosis was not significantly different, the age at registration at the



**Figure 1:** Geographic Distribution of Children and Adolescents with Type 1 Diabetes.

**Table 3:** Clinical characteristics among urban and rural areas.

	Urban	Rural	P value
Diabetes duration (n=212)	.00[.00-2.0]	.00[.00-7.0]	0.035
DKA at diagnosis(n=155)			
Yes	20(26.6)	12(15.0)	
No	55(73.3)	68(85.0)	0.0001
Blood pressure			
Systolic	100[90-110]	90[90-100]	0.050
Diastolic	60[60-70]	60[60-70]	0.273
Height	140.0[123.0-150.0]	139.0[124.7-146.0]	0.867
Weight	34.3[24.3-44.5]	28.0[20.7-35.0]	0.585
BMI	16.7[14.0-19.0]	15.5[13.6-18.3]	0.200
TDD (Total daily dose)	37.0[24.0-52.5]	38.0[26.0-46.0]	0.544
FBS	13.6[9.6-16.8]	17.6[15.0-21.2]	0.021
HbA1c	12.8[10.2-14.8]	14.0[11.0-15.0]	0.202

registration, socioeconomic status, and the occurrence of diabetic ketoacidosis (DKA) at presentation.

The study found that most newly diagnosed patients were female (57%), which aligns with the findings of other studies that report a slight female predominance in the gender distribution of T1DM [3,16]. However, this trend can vary depending on the region and population under study [17]. The study revealed that most patients were from rural areas (62.0%), with the remaining coming from urban regions. This distribution aligns with the general trend observed in Bangladesh, where rural areas often face limited healthcare infrastructure and access to specialized care. Consequently, patients from rural regions tend to present at urban centers for diagnosis and treatment. Interestingly, Dhaka emerged as the most common district of origin, which is expected given that it is the capital with the highest concentration of healthcare facilities. This finding underscores the centralization of medical care in Bangladesh, highlighting the need for patients from rural areas to travel to urban centers for specialized diabetes care.

When comparing the regions, the sex distribution was similar between rural and urban individuals, with a higher proportion of females in both groups. The proportion of females was slightly higher in urban areas compared to rural areas although this difference was not statistically significant. This aligns with global trends, where the gender distribution of T1D can vary across different populations. The higher prevalence of female cases is consistent with data from other countries with lower incidence rates of T1D [16]. Various studies have indicated significant variations in the age and gender of individuals presenting with T1D, along with notable differences in the incidence of the disease between urban and rural areas [18-21].

We observed that diabetes was diagnosed at a relatively older age among rural individuals compared to those from urban areas. Additionally, rural patients were older at the time of enrollment, in the statistically significant center. This may explain why traveling to the center was more challenging for them due to the greater distance from rural areas. The age distribution in rural areas was like patterns reported in other low-resource countries, including African and South Asian populations [22-25]. In contrast, the peak age of onset for T1D is typically earlier in European populations [16, 26].

One of the most striking findings in this study was the significant difference in socioeconomic status between rural and urban patients. A larger proportion of rural patients came from low socioeconomic backgrounds compared to urban patients and this difference was statistically significant. This discrepancy may reflect

center was significantly higher in rural patients (Table 2). Most patients came from low socioeconomic backgrounds, particularly those from rural areas, and this difference was statistically significant. A higher proportion of patients with a family history of Type 2 diabetes were found in Dhaka and nearby urban areas, and this difference was also statistically significant. Diabetic ketoacidosis (DKA) at diagnosis was more commonly reported in urban areas while fasting blood sugar (FBS) levels were statistically higher in rural areas (Table 3).

## Discussion

This study provides an in-depth comparison of clinical and sociodemographic parameters between Type 1 Diabetes Mellitus (T1DM) patients from urban and rural areas. Our findings reveal several key differences in clinical outcomes, highlighting the potential influence of geographic location on the diagnosis, presentation, and management of T1DM in Bangladesh. The analysis revealed significant differences in several factors, including age at

differences in access to healthcare, education, and resources in urban versus rural areas. Type 1 diabetes is closely linked to poverty and indicators of undernutrition, with these associations being particularly pronounced in rural populations [14, 18, 25, 27].

The impact of socioeconomic status on the timely diagnosis and management of T1DM in Bangladesh underscores the need for targeted public health interventions aimed at improving access to diabetes care and education, especially for low-income populations in both urban and rural areas. A significant difference was observed in the prevalence of family history of type 2 diabetes between urban and rural patients. Family history was present in 64% of urban patients compared to only 51% of rural patients. This finding suggests that urban patients may have better access to healthcare, leading to earlier diagnoses of family members, and therefore, greater awareness of the familial nature of the disease. Urban populations may also have more opportunities to receive diabetes-related education, which could lead to a higher reporting of family history. This could reflect the increased prevalence of Type 2 diabetes in urban populations, possibly due to lifestyle factors such as poor diet, physical inactivity, and obesity. Family history is an important risk factor for T1DM, and the presence of a family history of Type 2 diabetes may suggest a higher awareness of diabetes in urban families, leading to better recognition and management of the disease.

The study observed a significant difference in the duration of diabetes between urban and rural patients, with rural patients having a longer duration of diabetes at the time of registration at the center. This reflects delayed registration, which is often more common in rural areas due to limited access to healthcare facilities and awareness.

The occurrence of diabetic ketoacidosis (DKA) at diagnosis was significantly higher in urban patients. Although previous analyses have shown that the frequency of diabetic ketoacidosis (DKA) at diagnosis increases with a higher degree of poverty [28-31]. Our finding is somewhat unexpected, as rural patients are typically thought to face more barriers in accessing healthcare and might be diagnosed later. The higher rates of DKA in urban areas could be attributed to several factors, including greater awareness and more frequent health checks leading to earlier diagnosis in urban centers, but also potentially due to differences in healthcare practices or the availability of emergency care. In contrast, rural patients may have delayed presentation, leading to a lower recorded incidence of DKA.

Fasting blood sugar levels were significantly higher in rural patients. This finding suggests that rural patients

might have poorer glycemic control, possibly due to the longer travel times required to reach the healthcare center, which can lead to increased fasting blood glucose levels. Finally, HbA1c levels were slightly higher in rural patients though the difference was not statistically significant. This trend is consistent with our findings of poorer glycemic control in rural patients, which could be attributed to the challenges mentioned earlier. However, the difference was not large enough to reach statistical significance, suggesting that while there may be a trend toward worse control in rural populations, other factors might also be influencing these results. A similar finding was observed in the study Results from the German Multicenter DPV Registry which reported comparable trends in glycemic control across different socioeconomic groups [31].

### Study Limitations

This study has several limitations that should be considered when interpreting the results. First, the data were collected retrospectively from a single specialized center, which may not fully represent the broader population of T1DM patients in Bangladesh. The study also relied on clinic-based data, which could be biased toward patients who are more likely to seek care at a specialized facility, potentially missing patients who are undiagnosed or who are managed at other centers. Furthermore, socioeconomic status was self-reported, and there may have been variations in how patients classified themselves. A strength of this analysis is the use of a large multicenter registry highly representative of pediatric diabetes in our country.

### Conclusion

In conclusion, this study highlights significant differences in the sociodemographic and clinical characteristics of newly diagnosed T1DM patients from rural and urban areas of Bangladesh. The findings suggest that urban patients tend to have better access to healthcare, with higher awareness of family history, while rural patients, especially those from low socioeconomic backgrounds, face barriers to timely diagnosis and treatment. Addressing these disparities through targeted public health interventions, improving healthcare infrastructure in rural areas, and increasing diabetes awareness could help improve early detection and management of T1DM, ultimately reducing the burden of the disease in both rural and urban populations in Bangladesh.

**Author Contributions:** BZ and KH conceptualized and BZ wrote the paper. MR, KH, and KA revised the text and BZ finally edited and approved the final manuscript.

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## Ethical Approval and Patient Consent

All procedures performed in studies involving human participants were by the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards

**Data availability:** The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy and ethical restrictions.

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