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A Study on Clinical Status of Type 2 Diabetes Mellitus in Bangladesh

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Abstract

***Background*:** Type 2 diabetes mellitus (T2DM) is a growing public health concern in Bangladesh, driven by urbanization, lifestyle changes, and dietary habits. Poor glycemic control contributes to complications and imposes a financial burden on the healthcare system. Understanding the clinical factors influencing glycemic control is essential for developing targeted interventions. ***Objective*:** To assess the clinical status of T2DM patients with a focus on glycemic control and its association with demographic and clinical variables. ***Methods*:** This cross-sectional study was conducted at Bangabandhu Sheikh Mujib Medical University, Dhaka, from March 2022 to February 2023. Eighty T2DM patients were recruited based on ADA diagnostic criteria. Glycemic control was classified using HbA1c levels (<7% for adequately controlled, ≥7% for inadequately controlled). Data collection included anthropometric measurements, saliva and blood sampling, and laboratory analyses for HbA1c and salivary A2MG. Statistical analyses were performed using SPSS version 26.0, with significance set at $p<0.05$. ***Results*:** The mean age of participants was 44.1 ± 9.97 years, with no significant age-related difference in glycemic control ($p=0.513$). Gender ($p=0.194$), residence ($p=0.900$), and family history of diabetes ($p=0.637$) showed no significant association with glycemic control. However, BMI was significantly higher in the inadequately controlled group (27.6 ± 3.44 kg/m²) compared to the adequately controlled group (25.2 ± 2.76 kg/m²) ($p=0.002$), highlighting the influence of obesity on glycemic outcomes. ***Conclusion*:** Glycemic control in T2DM patients in Bangladesh is influenced more by clinical factors like BMI than demographic variables. Targeted interventions focusing on weight management and lifestyle modifications are critical for improving glycemic outcomes and reducing diabetes-related complications.

Keywords: Type 2 Diabetes Mellitus, Glycemic Control, BMI, HbA1c, Salivary Biomarkers.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has become a major public health concern in Bangladesh, reflecting a growing global epidemic of non-communicable diseases. Rapid urbanization, sedentary lifestyles, and shifts in dietary habits have contributed to a significant rise in the prevalence of T2DM in the country. Current estimates suggest that over 8 million adults in Bangladesh live with diabetes, with projections indicating a doubling of this number by 2040 if effective interventions are not implemented. This alarming trend underscores the urgent need to strengthen healthcare systems and preventive strategies to combat this metabolic disorder [1-3].

The unique socio-demographic and economic context of Bangladesh exacerbates the burden of T2DM. Many individuals remain undiagnosed due to limited access to healthcare services, particularly in rural areas where healthcare infrastructure is often inadequate. Studies have shown that almost half of the diabetic population in Bangladesh is unaware of their condition, which increases the likelihood of complications such as cardiovascular diseases, neuropathy, and nephropathy. This unawareness and lack of regular monitoring

emphasize the need for community-based screening and education programs [4-6].

Cultural practices and food consumption patterns also play a critical role in the growing prevalence of T2DM in Bangladesh. A traditional diet rich in carbohydrates, combined with low physical activity, contributes significantly to the development of insulin resistance and hyperglycemia. Moreover, the lack of public awareness regarding healthy eating and lifestyle changes perpetuates the cycle of poor glycemic control. Addressing these cultural and behavioral factors is essential for reducing the incidence of diabetes in the population [7-9].

Healthcare costs associated with T2DM management place a substantial financial burden on individuals and the healthcare system in Bangladesh. For many low-income families, the costs of regular monitoring, medication, and consultations are prohibitive, leading to poor disease management. Furthermore, complications resulting from uncontrolled diabetes often require expensive treatments, creating a vicious cycle of financial hardship and deteriorating health outcomes. This situation highlights the need for affordable, accessible, and sustainable healthcare solutions tailored to the country's economic realities [10, 11].

Bangladesh's healthcare system faces additional challenges in managing T2DM due to a shortage of specialized healthcare providers and diagnostic facilities. Although tertiary hospitals in urban areas offer diabetes management services, rural populations often rely on informal care or unqualified practitioners. The disparity in healthcare access creates a significant urban-rural divide in diabetes care, leaving a large segment of the population vulnerable to preventable complications. Initiatives to train healthcare workers and integrate diabetes care into primary healthcare services could help bridge this gap.

Given the rising burden of T2DM in Bangladesh, innovative approaches to diagnosis and management are crucial for improving patient outcomes. Non-invasive diagnostic methods, such as salivary biomarkers, present a promising alternative to traditional blood tests, offering greater accessibility and convenience. By leveraging these advancements and addressing the socio-economic barriers to care, Bangladesh can develop more effective strategies to manage T2DM and mitigate its growing impact on public health.

Objective: To assess clinical status of type 2 diabetes mellitus.

METHODOLOGY

Study Design and Setting

This study adopted a cross-sectional comparative design. It was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, specifically in the Department of Laboratory Medicine and the Department of Endocrinology. The research spanned from March 2022 to February 2023, following approval from the Institutional Review Board (IRB).

Study Population

The research included patients diagnosed with type 2 diabetes mellitus (T2DM) who visited the outpatient (OPD) and inpatient (IPD) units of the Department of Endocrinology at BSMMU. Participants were selected based on the 2022 diagnostic criteria established by the American Diabetes Association (ADA). T2DM patients with HbA1c levels below 7% were classified as having adequately controlled diabetes, while those with HbA1c levels of 7% or higher were categorized as inadequately controlled.

Sample Size Calculation

The sample size was determined using sensitivity-based calculations, with the following parameters:

- Anticipated sensitivity: 91.7% (Nsr-Allah *et al*., 2019)
- Significance level (α): 5%
- Z1-α/2: 1.96 (standard normal deviate)
- Desired precision (L): 10%
- Prevalence: 40% (estimated prevalence of diabetes in a hospital setting)

The calculation yielded a sample size of approximately 73 patients. Accounting for a 9% non-response rate, the final sample size was rounded up to 80 participants.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients diagnosed with T2DM
- Aged 18 years or older
- Both male and female participants

Exclusion Criteria:

- Liver disease
- Nephrotic syndrome
- Chronic kidney disease (stage 4 or above)
- Rheumatoid arthritis
- Hemoglobinopathies or severe anemia
- History of blood transfusion
- Chronic inflammatory conditions of the oral cavity
- Autoimmune or collagen vascular disorders affecting the mouth
- Pregnancy

Data Collection Procedure

Data collection commenced after ethical clearance from the IRB. Participants were approached during their OPD and IPD visits, and informed consent was obtained in both verbal and written forms. Information was gathered through face-to-face interviews using a semi-structured questionnaire in English and Bengali. Physical measurements, including height, weight, and BMI, were recorded. Saliva samples were collected under supervision, alongside venous blood samples for HbA1c analysis. The entire process for each participant took approximately 35–40 minutes.

Laboratory Procedures

For saliva collection, participants were instructed to rinse their mouths with water before collecting saliva into sterile containers over a 5-minute period. Blood samples for HbA1c testing were drawn from the antecubital vein into EDTA tubes. Saliva samples were centrifuged at 3000 rpm for 10 minutes at 4°C, and the supernatant was stored at -20°C. Salivary A2MG levels were measured using an enzyme-linked immunosorbent assay (ELISA), while HbA1c levels were analyzed with a Siemens Dimension EXL automated biochemistry analyzer using photometric techniques.

Data Analysis and Statistical Methods

The data were processed and analyzed using SPSS version 26.0. Quantitative variables were expressed as means and standard deviations, while categorical variables were summarized as frequencies and percentages. Statistical tests included the unpaired t-test for continuous variables, chi-square tests for categorical data, and Mann-Whitney U tests for non-parametric distributions. Relationships between salivary A2MG, HbA1c, and other clinical variables were assessed using Spearman's rank and Pearson's correlation coefficients. Diagnostic accuracy of salivary A2MG was evaluated using sensitivity, specificity, positive predictive value, negative predictive value, and receiver operating characteristic (ROC) curve analysis.

Ethical Considerations and Confidentiality

Patient confidentiality was upheld throughout the study. Each participant was assigned a unique identification number to anonymize their data. Informed consent ensured participants understood their rights, including the ability to withdraw from the study at any time without repercussions. Personal information was strictly safeguarded, maintaining compliance with ethical standards.

RESULTS

Table shows the distribution of patients with T2 DM according to their age groups and their glycemic control status. The table reveals that the majority of participants were in the age range of 41-50 years, with 40.6% of them being adequately controlled and 31.3% inadequately controlled. There was no significant difference in the mean age between the adequately controlled group (mean age=43.2±9.72 years) and inadequately controlled group (mean age=44.7±10.2 years) (p=0.513).

Table 1: Age distribution of the participants (N=80)

Age group (years)	Adequately controlled (HbA1c <7%) (n=32)	Inadequately controlled (HbA1c ≥7%) (n=48)	Total (N=80)	p-value
<30	4(12.5%)	5(10.4%)	9(11.3%)	
31-40	9(28.1%)	14(29.2%)	23(28.7%)	
41-50	13(40.6%)	15(31.3%)	28(35.0%)	
51-60	5(15.6%)	11(22.9%)	16(20.0%)	
>60	1(3.1%)	3(6.3%)	4(5.0%)	
Total	32(100.0%)	48(100.0%)	80(100.0%)	
Mean±SD (years)	43.2±9.72	44.7±10.2	44.1±9.97	0.513^{ns}

p-value obtained by Unpaired t-test, p <0.05 considered as a level of significance
ns = not significant

Table shows the gender distribution of the participants with T2 DM based on their glycemic control status. Out of the total 80 participants, 58.8% were female and 41.2% were male. In the group of adequately controlled T2 DM patients, there were 16 males (50.0%) and 16 females (50.0%). In contrast, among the inadequately controlled T2 DM patients, there were 17 males (35.4%) and 31 females (64.6%). The difference in glycemic control between males and females was not statistically significant (p=0.194).

Table 2: Gender distribution of the participants (N=80)

Gender	Adequately controlled (HbA1c <7%) (n=32)	Inadequately controlled (HbA1c ≥7%) (n=48)	Total (N=80)	p-value
Male	16(50.0%)	17(35.4%)	33(41.2%)	0.194^{ns}
Female	16(50.0%)	31(64.6%)	47(58.8%)	
Total	32(100.0%)	48(100.0%)	80(100.0%)	

p-value obtained by Chi-square test, p <0.05 considered as a level of significance
ns = not significant

Table shows distribution of the patients with T2 DM based on their area of residence and their glycemic control status. Among total participants, 63.75% were from rural area and 36.25% were from urban area. In the group of adequately controlled T2 DM, 34.37% were from urban area and 65.63% were from rural area. In contrast, among the inadequately controlled T2 DM group, 37.5% lived in urban area and 62.5% lived in rural area. The difference in glycemic control between urban and rural resident was not statistically significant (p=0.900).

Table 3: Distribution of the participants according to residence (N=80)

Residence	Adequately controlled (HbA1c <7%) (n=32)	Inadequately controlled (HbA1c ≥7%) (n=48)	Total N=80	p-value
Uraban	11 (34.37%)	18 (37.5%)	29(36.25%)	0.900[ns]
Rural	21 (65.63%)	30 (62.5%)	51(63.75%)	
Total	32 (100%)	48 (100%)	80 (100%)	

p-value obtained by Chi-square test, p<0.05 considered as a level of significance
ns = not significant

Table shows the distribution of the participants with T2 DM based on their family history of diabetes and their glycemic control status. Among the total participants, 62.5% had a positive family history of diabetes. In the group of adequately controlled T2 DM patients, 65.6% had a family history of diabetes, and 60.4% of inadequately controlled T2 DM patients also had a family history of diabetes. These findings suggest that having a family history of diabetes does not appear to have a significant impact on glycemic control in T2 DM patients (p=0.637).

Table 4: Distribution of the participants according to family history of T2 DM (N=80)

Family history of DM	Adequately controlled (HbA1c <7%) (n=32)	Inadequately controlled (HbA1c ≥7%) (n=48)	Total (N=80)	p-value
Yes	21(65.6%)	29(60.4%)	50(62.5%)	0.637[ns]
No	11(34.4%)	19(39.6%)	30(37.5%)	
Total	32(100.0%)	48(100.0%)	80(100.0%)	

p-value obtained by Chi-square test, p <0.05 considered as a level of significance
ns = not significant

Table 4 shows the distribution of the patients with T2 DM based on their Body Mass Index (BMI) and their glycemic control status. Among the total participants, 57.5% had a BMI from 25 -29.9 kg/m^2 In the group of adequately controlled T2 DM patients, 3.1% had a BMI less than 18.5 kg/m^2, 43.8% had a BMI from 18.5 to 24.99 kg/m^2, 50.0% had a BMI from 25 to 29.99 kg/m^2, and 3.1% had a BMI of 30 and above kg/m^2. In inadequately controlled T2 DM patients, no participants had a BMI less than 18.5 kg/m2, 18.8% had a BMI from 18.5 to 24.99 kg/m^2, 62.5% had a BMI from 25 to 29.99 kg/m^2, and 18.8% had a BMI of 30 and above kg/m^2. There was a statistically significant difference in mean BMI between the adequately controlled group (mean BMI=25.2±2.76 kg/m^2) and the inadequately controlled group (mean BMI=27.6±3.44 kg/m^2) (p=0.002). This suggests that higher BMI values are associated with poorer glycemic control in patients with T2 DM.

Table 5: Distribution of the participants according to BMI (kg/m^2) (N=80)

BMI (kg/m^2)	Adequately controlled (HbA1c <7%) (n=32)	Inadequately controlled (HbA1c ≥7%) (n=48)	Total (N=80)	p-value
<18.5	1(3.1%)	0(0.0%)	1(1.3%)	
18.5 to 24.99	14(43.8%)	9(18.8%)	23(28.7%)	
25 to 29.99	16(50.0%)	30(62.5%)	46(57.5%)	
30 and above	1(3.1%)	9(18.8%)	10(12.5%)	
Total	32(100.0%)	48(100.0%)	80(100.0%)	
Mean±SD (kg/m^2)	25.2±2.76	27.6±3.44	26.6±3.38	0.002[s]

p-value obtained by Unpaired t-test, p <0.05 considered as a level of significance
s = significant

Table-5 shows the distribution of patients (N=80) according to the duration of DM and their glycemic control status. Among the total participants, mean duration of DM was 3.32±2.87 years. The mean duration of DM was 2.76 ± 2.04 years for adequately controlled patients and 3.70 ± 3.28 years for inadequately controlled patients. The results show that a higher percentage of patients with DM had duration of 1-5 years were in both adequately and inadequately controlled compared to those with DM duration of ≤1

year and ≥5 years. However, there was no statistically significant difference in the duration of DM between the adequately and inadequately controlled group (p= 0.150).

Table 6: Distribution of the participants according to the duration of DM (N=80)

Duration of DM	Group A (n=32)	Group B (n=48)	Total (N=80)	p-value
≤1 years	10(31.3%)	14(29.2%)	24(30.0%)	
1- 5 years	17(53.1%)	26(54.2%)	43(53.8%)	
≥5 years	5(15.6%)	8(16.7%)	13(16.3%)	
Total	32(100.0%)	48(100.0%)	80(100.0%)	
Mean±SD	2.76±2.04	3.70±3.28	3.32±2.87	0.150^{ns}

p-value obtained by Unpaired t-test, p <0.05 considered as a level of significance
ns = not significant
Group A: Adequately controlled (HbA1c <7%)
Group B: Inadequately controlled (HbA1c ≥7%)

DISCUSSION

The age distribution of participants in this study showed that most were aged 41-50 years, consistent with previous studies identifying this as a peak age range for T2DM prevalence in South Asia. However, the lack of significant difference in mean age between adequately and inadequately controlled groups (p=0.513) mirrors findings in studies which reported no correlation between age and glycemic control. [12] These results suggest that while age is a common risk factor for T2DM, it may not directly impact the ability to achieve glycemic control.

The gender distribution showed a higher proportion of females (58.8%) among the participants, a trend commonly observed in studies of T2DM in Bangladesh and other low- to middle-income countries. Despite this, there was no statistically significant difference in glycemic control between males and females (p=0.194), aligning with findings from studies conducted in neighboring countries. For example, a study in India also reported no significant gender-based differences in HbA1c levels, indicating that gender may not play a major role in glycemic control when other factors are considered [13].

The majority of participants in this study were from rural areas (63.75%), reflecting the population distribution of Bangladesh. Glycemic control did not differ significantly between rural and urban residents (p=0.900), a finding consistent with research which showed similar glycemic outcomes in rural and urban settings when access to healthcare facilities was comparable [14]. However, disparities in healthcare access and education levels between rural and urban areas remain an important consideration for long-term diabetes management strategies.

A positive family history of diabetes was noted in 62.5% of participants, but it did not significantly influence glycemic control (p=0.637). This finding contrasts with studies in Western populations where a strong familial link has been associated with poorer glycemic outcomes. The difference may stem from varying genetic, cultural, and environmental factors in the Bangladeshi context, suggesting that while family history is a recognized risk factor for T2DM, its role in glycemic control may be less pronounced in this population.

The study found a significant relationship between BMI and glycemic control, with higher BMI values being associated with poorer control (p=0.002). This aligns with global research, including studies which demonstrated that obesity is a critical determinant of glycemic control due to its impact on insulin resistance [15]. The high prevalence of overweight and obese individuals in both adequately and inadequately controlled groups underscores the importance of targeting BMI reduction in diabetes management programs.

Overall, these findings highlight the multifactorial nature of glycemic control in T2DM. While demographic factors such as age, gender, and residence showed no significant impact on control status, clinical variables such as BMI demonstrated a clear association. These results emphasize the need for personalized, multifaceted approaches to diabetes management, particularly focusing on weight management and lifestyle interventions. Future research should explore the interplay of genetic, environmental, and behavioral factors to develop targeted strategies for improving glycemic control in this population.

CONCLUSION

In conclusion, our study highlights the multifactorial nature of glycemic control in patients with type 2 diabetes mellitus (T2DM) in Bangladesh. While demographic factors such as age, gender, residence, and family history of diabetes showed no significant association with glycemic control, clinical parameters like BMI were strongly correlated, with higher BMI values being linked to poorer control. These findings underscore the importance of prioritizing weight management and lifestyle modifications as key strategies in diabetes care. Tailored interventions addressing modifiable risk factors are essential for improving

glycemic outcomes and reducing the burden of diabetes-related complications in this population.

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