Original Research Article

CLINICO-EPIDEMIOLOGICAL PROFILE AND PREDICTORS OF POOR GLYCEMIC CONTROL AMONG TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health problem, and poor glycemic control remains a significant challenge despite advances in therapeutic options. Identifying clinico-epidemiological factors associated with inadequate glycemic control is essential for improving diabetes management. The objective is to assess the clinico-epidemiological profile of patients with Type 2 diabetes mellitus and to identify predictors of poor glycemic control.

Materials and Methods: This hospital-based cross-sectional observational study included 250 patients with Type 2 diabetes mellitus attending a tertiary care center. Demographic, clinical, lifestyle, and treatment-related data were collected using a structured proforma. Glycemic control was assessed using glycated hemoglobin (HbA1c). Poor glycemic control was defined as HbA1c $\geq 7\%$.

Results: Poor glycemic control was observed in 62.4% of patients. Longer duration of diabetes (≥ 5 years), higher body mass index (≥ 25 kg/m²), hypertension, physical inactivity, and poor medication adherence were significantly associated with poor glycemic control ($p < 0.05$). On multivariate analysis, poor medication adherence emerged as the strongest independent predictor, followed by physical inactivity, longer duration of diabetes, hypertension, and obesity.

Conclusion: Poor glycemic control is highly prevalent among patients with Type 2 diabetes mellitus. Identification of modifiable risk factors highlights the need for targeted lifestyle interventions, improved treatment adherence, and individualized diabetes management strategies to achieve optimal glycemic control.

Keywords: Type 2 diabetes mellitus; Glycemic control; HbA1c; Medication adherence; Risk factors.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and relative insulin deficiency and has emerged as a major global public health concern. The prevalence of diabetes has increased rapidly over the past decade, with low- and middle-income countries bearing a disproportionate share of the burden.[1] T2DM accounts for more than 90% of diabetes cases worldwide and is a leading cause of cardiovascular disease, chronic kidney disease, blindness, and premature mortality.[2]

India is experiencing a substantial rise in the prevalence of T2DM due to rapid urbanization, lifestyle transitions, population aging, and genetic susceptibility. Recent national estimates indicate a high and increasing prevalence of diabetes across both urban and rural regions, with a concerning trend toward earlier age of onset.[3] This growing burden poses significant challenges to the healthcare system and underscores the importance of effective disease control strategies.

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Optimal glycemic control is central to the prevention of diabetes-related complications. Glycated hemoglobin (HbA1c) remains the most reliable marker for long-term glycemic control and is strongly associated with the risk of both microvascular and macrovascular complications.[4] Despite the availability of multiple therapeutic options and updated clinical guidelines, a substantial proportion of patients fail to achieve recommended glycemic targets.[5]

Poor glycemic control in T2DM is influenced by a complex interplay of clinico-epidemiological factors. Demographic variables such as age, sex, educational status, and socioeconomic conditions have been shown to affect disease management and outcomes.[6] Clinical factors including duration of diabetes, obesity, hypertension, dyslipidemia, and the presence of comorbidities significantly contribute to inadequate glycemic control. Additionally, treatment-related factors such as therapeutic inertia, polypharmacy, and inappropriate treatment intensification further exacerbate poor outcomes.[7]

Behavioral and lifestyle factors play a crucial role in determining glycemic status. Non-adherence to medications, unhealthy dietary practices, physical inactivity, and lack of regular follow-up have been consistently identified as major predictors of poor glycemic control. 8 In resource-limited settings, these challenges are compounded by limited access to healthcare services, inadequate diabetes education, and financial constraints, leading to delayed diagnosis and suboptimal disease management.

Clinico-epidemiological profiling of patients with T2DM provides valuable insights into disease patterns and risk factors associated with poor glycemic control. Identifying predictors of inadequate control enables clinicians to stratify risk, personalize treatment strategies, and implement targeted interventions aimed at improving outcomes. The present study aims to assess these parameters and identify modifiable risk factors, thereby contributing evidence to support improved clinical decision-making and public health planning.

MATERIALS AND METHODS

Study Design & Setting: A cross-sectional observational study was conducted at a tertiary care teaching hospital in North India over a period of 6 months from June 2025 to November 2025 to assess the clinico-epidemiological profile and predictors of poor glycemic control among patients with Type 2 Diabetes Mellitus attending the outpatient department or admitted to medical wards during the study period.

Study Population & Sample Size: The study population comprised adult patients diagnosed with Type 2 Diabetes Mellitus as per the American Diabetes Association (ADA) criteria. A total of 250 patients with Type 2 Diabetes Mellitus were included

in the study based on convenient sampling technique method.

Inclusion & Exclusion Criteria

Patients aged ≥18 years with diagnosis of Type 2 Diabetes Mellitus, on treatment for diabetes for at least 6 months and willing to participate were included in the study. However Patients with Type 1 diabetes mellitus, gestational diabetes, or other specific types of diabetes, Pregnant women or Patients with acute illnesses that could influence glycemic status (e.g., sepsis, acute myocardial infarction) were excluded from the study.

Data Collection: Patient demographic details and other relevant data was collected using a pre-designed and pre-tested structured proforma. Information obtained included:

- Demographic details: age, sex, residence, educational status, socioeconomic status
- Clinical details: duration of diabetes, family history, comorbidities (hypertension, dyslipidemia), body mass index (BMI)
- Lifestyle factors: physical activity, dietary habits, smoking and alcohol consumption
- Treatment details: type of antidiabetic therapy (oral hypoglycemic agents/insulin/combination), adherence to treatment

Anthropometric Measurements: Height and weight were measured using standardized techniques. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m²) and classified according to WHO criteria.

Laboratory Investigations: Venous blood samples were collected under aseptic precautions for the following investigations:

- Fasting plasma glucose
- Post-prandial plasma glucose
- Glycated hemoglobin (HbA1c)

Definition of Glycemic Control

Glycemic control was assessed based on HbA1c levels:

- Good glycemic control: HbA1c < 7%
- Poor glycemic control: HbA1c ≥ 7% (as per ADA recommendations)

Outcome Measures: The primary outcome measure was poor glycemic control (HbA1c ≥ 7%).

Secondary outcomes included identification of clinico-epidemiological predictors associated with poor glycemic control.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software version 21. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. Multivariate logistic regression analysis was performed to identify independent predictors of poor glycemic control. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants (n = 250)

Variable	Frequency	Percentage (%)
Age group (years)		
<40	32	12.8
40–59	138	55.2
≥60	80	32.0
Gender		
Male	142	56.8
Female	108	43.2
Residence		
Urban	162	64.8
Rural	88	35.2

Most patients were aged 40–59 years, with a male predominance. Urban residents constituted nearly two-thirds of the study population.

Table 2: Clinical and Lifestyle Profile of Patients

Variable	Frequency	Percentage (%)
Duration of diabetes ≥5 years	158	63.2
BMI ≥25 kg/m²	146	58.4
Hypertension	132	52.8
Dyslipidemia	118	47.2
Physical inactivity	164	65.6
Poor medication adherence	102	40.8

A majority of patients had long-standing diabetes, were overweight/obese, and had associated comorbidities, particularly hypertension and dyslipidemia.

Table 3: Distribution of Glycemic Control Based on HbA1c

Glycemic status	HbA1c (%)	Frequency	Percentage (%)
Good control	<7	94	37.6
Poor control	≥7	156	62.4

Nearly two-thirds (62.4%) of patients had poor glycemic control, indicating a substantial unmet need for improved diabetes management.

Table 4: Association of Selected Factors with Poor Glycemic Control

Variable	Poor control n (%)	Good control n (%)	p-value
Duration ≥5 years	118 (74.7)	40 (42.6)	<0.001
BMI ≥25 kg/m²	102 (69.9)	44 (46.8)	0.002
Hypertension	96 (72.7)	36 (38.3)	<0.001
Physical inactivity	124 (75.6)	40 (42.6)	<0.001
Poor adherence	92 (90.2)	10 (10.6)	<0.001

Longer duration of diabetes, overweight/obesity, hypertension, physical inactivity, and poor medication adherence showed a statistically significant association with poor glycemic control.

Table 5: Multivariate Logistic Regression Analysis for Predictors of Poor Glycemic Control

Variable	Adjusted OR	95% CI	p-value
Duration ≥5 years	2.6	1.5–4.4	0.001
BMI ≥25 kg/m²	1.9	1.1–3.2	0.018
Hypertension	2.3	1.3–3.9	0.003
Physical inactivity	2.8	1.6–4.8	<0.001
Poor medication adherence	5.6	2.7–11.4	<0.001

On multivariate analysis, poor medication adherence emerged as the strongest independent predictor of poor glycemic control, followed by physical inactivity, longer duration of diabetes, hypertension, and increased BMI.
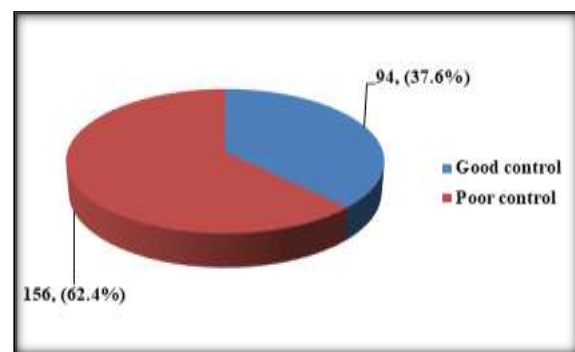

Figure 1: Distribution of Glycemic Control among Study Participants
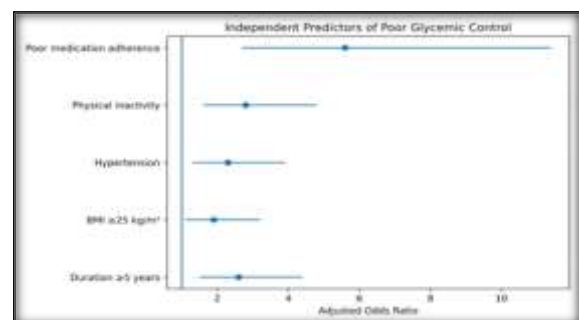

Figure 2: Forest plot showing independent predictors of poor glycemic control among Type 2 diabetes mellitus patients

The forest plot depicts adjusted odds ratios with 95% confidence intervals for independent predictors of poor glycemic control. Poor medication adherence showed the strongest association, followed by physical inactivity, longer duration of diabetes, hypertension, and higher BMI. All variables demonstrated statistically significant associations (p < 0.05).

DISCUSSION

The findings reveal that 62.4% of patients had poor glycemic control (HbA1c ≥7%), highlighting the persistent challenge of achieving optimal glycemic targets despite the availability of effective therapeutic options. Similar proportions of poor glycemic control have been quoted by International Diabetes Federation,[1] 2021 and by Fang M et al,[9] in 2021 underscoring the global nature of this problem, particularly in low- and middle-income countries.

The majority of patients in the present study belonged to the 40–59-year age group, with a male predominance. This demographic pattern is consistent with recent findings of Tandon et al 3 in 2021 indicating a rising burden of T2DM among middle-aged adults, likely due to urbanization, sedentary lifestyles, and dietary transitions. Urban residents constituted nearly two-thirds of the study population, reflecting the higher prevalence of diabetes in urban settings reported by Anjana et al in 2023.[10]

A significant association was observed between longer duration of diabetes (≥5 years) and poor glycemic control. Patients with longer disease duration were more than twice as likely to have poor control, a finding supported by previous studies demonstrating progressive β-cell dysfunction over time and increased difficulty in maintaining glycemic targets as similar findings reported by Khunti et al in 2021 and Lingvay et al in 2022.[5,7] This highlights the importance of early diagnosis and timely intensification of therapy.

Obesity, as reflected by BMI ≥25 kg/m², was significantly associated with poor glycemic control in both univariate and multivariate analyses. Excess adiposity contributes to insulin resistance and has been consistently identified as a major determinant of inadequate glycemic control in T2DM patients.[11]

Similarly, hypertension, present in more than half of the study population, emerged as an independent predictor of poor glycemic control. The coexistence of hypertension and diabetes reflects shared pathophysiological mechanisms and further complicates disease management.[6]

Lifestyle factors played a crucial role in determining glycemic outcomes. Physical inactivity was strongly associated with poor glycemic control and remained an independent predictor on multivariate analysis. Regular physical activity improves insulin sensitivity and glycemic control, and its absence significantly worsens metabolic outcomes as quoted by Colberg et al in 2022.[12] This finding emphasizes the need for structured lifestyle modification programs as an integral component of diabetes management.

Among all variables studied, poor medication adherence emerged as the strongest independent predictor of poor glycemic control, with patients exhibiting non-adherence having markedly higher odds of inadequate control. This observation aligns with recent evidence indicating that suboptimal adherence is a key contributor to therapeutic failure in T2DM, particularly in resource-limited settings where factors such as cost, polypharmacy, and inadequate patient education prevail.[8,13]

Overall, the findings of this study reinforce the multifactorial nature of poor glycemic control in T2DM. The predominance of modifiable risk factors such as obesity, physical inactivity, and medication non-adherence suggests that targeted interventions focusing on lifestyle modification, patient education, and adherence support could substantially improve glycemic outcomes. Clinico-epidemiological profiling, as demonstrated in this study, is therefore essential for identifying high-risk individuals and optimizing diabetes care strategies in tertiary care and resource-constrained settings.

Recommendations
1. Regular monitoring of HbA1c and early identification of patients with poor glycemic control should be emphasized in routine clinical practice.
2. Structured lifestyle modification programs focusing on physical activity, diet, and weight management should be integrated into diabetes care.
3. Interventions to improve medication adherence, including patient education and counseling, should be strengthened.

Limitations
1. The cross-sectional design limits the ability to establish a causal relationship between identified predictors and poor glycemic control.
2. Lifestyle factors and medication adherence were assessed based on self-reported information, which may be subject to recall and reporting bias.
3. Biochemical parameters other than HbA1c were not analyzed in detail, which may have provided additional insights.

CONCLUSION

This study demonstrates a high prevalence of poor glycemic control among patients with Type 2 diabetes mellitus. Longer duration of disease, obesity, hypertension, physical inactivity, and poor medication adherence were significant predictors.

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