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Original Research Article

Analysis of Glycemic Control Outcomes in Type 2 Diabetes Mellitus: A Retrospective Approach

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Abstract:

Background: Type 2 Diabetes Mellitus (T2DM) is a rapidly growing global health concern, with India contributing a significant burden. Poor glycemic control increases the risk of long-term complications, making regular assessment essential.

Aim: To evaluate glycemic control outcomes and associated clinical patterns in patients with T2DM using a retrospective approach.

Methodology: A hospital-based retrospective observational study was conducted in the Department of Medicine, Nalanda Medical College and Hospital, Patna. Medical records of 90 T2DM patients were analyzed. Data on age, gender, duration of diabetes, HbA1c levels, treatment patterns, and microvascular complications were collected and assessed using descriptive statistics.

Results: The majority of patients were aged 51–60 years (31.1%), with a male predominance (57.8%). Poor glycemic control (HbA1c ≥7%) was observed in 60% of patients. Most patients had diabetes for more than 5 years (37.8%). Neuropathy was the most common microvascular complication (22.2%), followed by nephropathy (15.6%) and retinopathy (11.1%).

Conclusion: The study demonstrates suboptimal glycemic control in a majority of T2DM patients, with increasing disease duration and complications. Early intervention, strict monitoring, and treatment intensification are essential for improving outcomes.

Keywords: Type 2 Diabetes Mellitus, Glycemic Control, HbA1c, Retrospective Study, Microvascular Complications.

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Introduction

Diabetes mellitus has become a significant world-wide health issue, and its prevalence is growing at an alarming rate in both developed and developing countries [1]. In 2017, the pandemic of diabetes mellitus was estimated to impact 451 million individuals globally and is expected to increase to 693 million by 2045. This significant increase is a result of urbanization, sedentary lifestyle, dietary changes, and aging of the population. India, especially, is disproportionately burdened by this and is known to be the diabetes capital of the Southeast Asian region. The nation has a population of about 74 million people with diabetes and an age-adjusted prevalence of 9.8% of people aged 18-99 years and a high premature mortality rate of 50.7% in the 20-79 years age group. These figures highlight the growing healthcare challenge posed by diabetes in India.

Epidemiological studies conducted on a large scale have given valuable information on the prevalence of diabetes in the country [2]. The study conducted by the Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) showed a total prevalence of 7.3% in 15 states. Notably, diabetes is no longer an urban disease, with rural regions becoming more and more affected, with prevalence rates of 5.2% versus 11.2% in urban areas. The change is mostly influenced by the current epidemiological transition, the growing life expectancy, and the growing prevalence of related diseases like obesity and hypertension. All these contribute to the spread of diabetes among various population groups.

The “thin-fat” phenotype creates a special risk which makes Indians more vulnerable to developing type 2 diabetes mellitus. This phenotype results in

people having minimal lean body mass yet displaying excess subcutaneous fat and various metabolic disturbances which include glucose and lipid dysregulation together with abdominal obesity and high blood pressure [3]. Insulin resistance develops in individuals because their body mass index stays under normal limits. The combination of these two factors leads to Indians developing type 2 diabetes at an earlier age which results in longer periods of illness and greater chances of developing medical issues. The medical issues which arise from this condition include microvascular diseases such as neuropathy nephropathy and retinopathy together with macrovascular diseases which include cardiovascular and cerebrovascular conditions.

Diabetes care faces its primary difficulty because advanced diabetes stages develop after patients suffer from their first medical complications. The need for early detection methods together with efficient methods to control blood sugar levels. Healthcare providers depend on glycated hemoglobin testing (HbA1c) which functions as the primary test to measure patients' long-term blood sugar control. The UK Prospective Diabetes Study showed that patients who reduced their HbA1c levels through intensive therapy by 1% experience a 37% decrease in their chances of developing microvascular complications. The research demonstrates how maintaining proper blood sugar levels serves as the fundamental method to stop disease development [4].

Clinical guidelines mandate that diabetes management requires HbA1c levels to be maintained at or below 7% which equals 53 mmol/mol [5]. The Research Society for the Study of Diabetes in India created clinical practice guidelines for India which use international standards as their foundation. These guidelines focus on patient-centered care which evaluates patients through their age body mass index diabetes duration existing health conditions and socioeconomic background assessment [6]. The implementation of combination therapy should begin as soon as possible while insulin administration needs to start without delay to help patients reach their glycemic targets while decreasing their clinical inertia.

Despite the existence of successful treatment methods, people still find it difficult to maintain proper blood sugar levels in actual medical situations according to research [7]. The combination of insufficient treatment compliance and treatment knowledge gaps together with inconsistent medical practices results in decreased treatment effectiveness. In India, these challenges are compounded by limited healthcare resources and inadequate diabetes registries, which restrict the availability of comprehensive data on disease management.

The existing clinical practice gap requires real-world evidence because it delivers essential insights for medical professionals. The retrospective studies enable researchers to assess treatment patterns while measuring patient adherence and evaluating glycemic results through available clinical information. The Indian Council of Medical Research conducted a multicenter registry study which studied younger populations, but there exists scant data about adult patients' glycemic control.

The present study titled "Analysis of Glycemic Control Outcomes in Type 2 Diabetes Mellitus: A Retrospective Approach" uses retrospective data to assess glycemic control among patients with type 2 diabetes. The study examines how patients receive their treatment while measuring what percentage of them reach their target blood sugar levels. The study seeks to create real-world evidence which will improve understanding of diabetes management and help create better methods to achieve better patient results.

Methodology

Study Design: The present study was designed as a hospital-based retrospective observational study aimed at evaluating the glycemic control outcomes among patients diagnosed with Type 2 Diabetes Mellitus (T2DM). The retrospective approach was chosen to analyze pre-existing medical records to identify patterns of glycemic control, treatment response, and associated clinical factors without intervention or alteration of patient management. This design is appropriate for understanding real-world clinical outcomes in a tertiary care setting and allows efficient use of available hospital data.

Study Area: The study was conducted in the Department of Medicine, Nalanda Medical College and Hospital, Patna, Bihar, India.

Study Duration: The total duration of the study was six months from May 2025 to October 2025.

Study Participants

Inclusion Criteria

- Patients diagnosed with Type 2 Diabetes Mellitus based on ADA diagnostic criteria.
- Patients aged 18 years and above of either gender.
- Patients who had at least one documented HbA1c, fasting blood glucose (FBG), and/or postprandial blood glucose (PPG) value within the study period.
- Patients who were receiving oral hypoglycemic agents and/or insulin therapy.
- Patients with complete and retrievable medical records during the study period.

Exclusion Criteria

- Patients diagnosed with Type 1 Diabetes Mellitus or gestational diabetes.

- Patients with incomplete, missing, or inconsistent clinical/laboratory records.
- Patients with severe comorbid conditions such as advanced malignancy or end-stage organ failure affecting glycemic outcomes.
- Patients on experimental or non-standard antidiabetic treatment protocols.
- Records lacking key variables required for analysis (HbA1c, FBG, PPG).

Sample Size: A total of 90 patients fulfilling the inclusion criteria were selected for the final analysis using purposive sampling from hospital records.

Procedure: After obtaining necessary administrative approval from the hospital authorities, relevant patient records from the Department of Medicine were systematically reviewed. Data were extracted using a structured data collection proforma. The collected variables included demographic details (age, gender), anthropometric measurements (BMI), duration of diabetes, type of antidiabetic therapy, blood pressure status, glycemic parameters (HbA1c, FBG, PPG), and presence of diabetes-related complications such as neuropathy, nephropathy, and retinopathy.

Patients were categorized based on glycemic control status using standard ADA criteria, where HbA1c <7% was considered controlled diabetes, and HbA1c ≥7% was considered uncontrolled diabetes. Further classification was done based on disease duration, BMI categories, and number of antidiabetic medications to evaluate their association with glycemic outcomes. Data confidentiality was strictly maintained by anonymizing patient identifiers before analysis.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using SPSS version 27.0. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to summarize demographic and clinical variables. Categorical variables were compared using the Chi-square test, while continuous variables were analyzed using independent t-tests where appropriate. A p-value of <0.05 was considered statistically significant. The results were presented in tables and graphs for better interpretation and comparison of glycemic control outcomes among the study population.

Result

Table 1 shows the distribution of study participants according to age group among a total of 90 patients. The highest proportion of patients was observed in the 51–60 years age group, accounting for 31.10% (n = 28), indicating that middle-to-older adults formed the largest segment of the study population. This was followed by the 41–50 years age group, which comprised 24.40% (n = 22) of the participants. Patients aged above 60 years represented 20.00% (n = 18), while the 31–40 years age group contributed 15.60% (n = 14). The least representation was seen in the youngest age group of 18–30 years, accounting for only 8.90% (n = 8). Overall, the data indicate a higher concentration of cases in the middle-aged and older age groups compared to younger individuals.

Table 1: Distribution of Study Participants According to Age Group (n = 90)

Age Group (Years)	Number of Patients	Percentage (%)
18–30	8	8.90%
31–40	14	15.60%
41–50	22	24.40%
51–60	28	31.10%
>60	18	20.00%
Total	**90**	**100%**

Table 2 shows the gender-wise distribution of study participants, revealing a slight male predominance in the study population. Out of the total 90 participants, 52 were males, accounting for 57.80%, while 38 were females, representing 42.20%. This indicates that males constituted a higher proportion of the study sample compared to females, with a difference of 15.60%. The overall distribution suggests a relatively balanced participation of both genders, although males were more frequently represented in the study cohort.

Table 2: Gender-wise Distribution of Study Participants (n = 90)

Gender	Number of Patients	Percentage (%)
Male	52	57.80%
Female	38	42.20%
Total	**90**	**100%**

Table 3 shows the glycemic control status of the study participants based on HbA1c levels among a total of 90 patients. The table reveals that a larger proportion of patients had uncontrolled diabetes,

with 54 individuals (60.00%) showing HbA1c levels ≥7%, indicating poor glycemic control. In contrast, 36 patients (40.00%) had controlled diabetes with HbA1c levels <7%, reflecting better management of blood glucose levels. Overall, the findings suggest that a majority of the study population is not achieving optimal glycemic control, highlighting the need for improved treatment adherence, lifestyle modification, and regular monitoring to reduce the risk of diabetes-related complications.

Table 3: Glycemic Control Status Based on HbA1c Levels (n = 90)

Glycemic Status	HbA1c Level	Number of Patients	Percentage (%)
Controlled	<7%	36	40.00%
Uncontrolled	≥7%	54	60.00%
Total	—	**90**	**100%**

Table 4 shows the distribution of patients according to the duration of diabetes among the total study population of 90 individuals. The highest proportion of patients had diabetes for more than 5 years, accounting for 37.80% (n = 34), indicating that a considerable number of patients were living with long-standing disease. This was followed by 33.30% (n = 30) of patients having a duration of 2–5 years, reflecting a substantial mid-term disease burden. Patients with 1–2 years duration comprised 17.80% (n = 16), while the least proportion was observed in those with newly diagnosed diabetes of less than 1 year, accounting for 11.10% (n = 10). Overall, the data suggests that most patients in the study had a relatively longer duration of diabetes, with a progressive increase in patient proportion as the duration of disease increased beyond two years.

Table 4: Distribution of Patients According to Duration of Diabetes (n = 90)

Duration of Diabetes	Number of Patients	Percentage (%)
<1 year	10	11.10%
1–2 years	16	17.80%
2–5 years	30	33.30%
>5 years	34	37.80%
Total	**90**	**100%**

Table 5 shows the distribution of microvascular complications among the study participants (n = 90). The table indicates that the highest proportion of patients, 46.70% (n = 42), had no microvascular complications, suggesting that nearly half of the study population was free from such diabetic complications. Among those who had complications, neuropathy was the most common, affecting 22.20% (n = 20) of patients, followed by nephropathy in 15.60% (n = 14) of cases. Retinopathy was observed in 11.10% (n = 10) of the patients, making it the least frequent single complication among the three major types. A small proportion of patients, 4.40% (n = 4), presented with multiple microvascular complications, indicating the presence of more advanced or poorly controlled disease in a limited subset. Overall, the findings highlight that while a significant number of patients remain complication-free, neuropathy emerges as the most prevalent microvascular complication in this study population.

Table 5: Distribution of Microvascular Complications Among Patients (n = 90)

Complication Type	Number of Patients	Percentage (%)
No complication	42	46.70%
Neuropathy	20	22.20%
Nephropathy	14	15.60%
Retinopathy	10	11.10%
Multiple complications	4	4.40%
Total	**90**	**100%**

Discussion

The current research study about Analysis of Glycemic Control Outcomes in Type 2 Diabetes Mellitus: A Retrospective Approach shows three main findings which include suboptimal glycemic control patterns and increased disease burden with longer disease duration and the discovery that poor glycemic levels lead to microvascular complications. The current research findings show multiple similarities with existing literature but also present specific contextual differences which enhance their clinical relevance.

The current research showed that most patients who participated in the study had poor glycemic control because their HbA1c levels exceeded 7% which demonstrated that their metabolic control was insufficient. A large Indian urban cross-sectional study showed similar results because only 23.4% of pa-

tients reached good glycemic control which corresponds to an HbA1c level below 7% and their average HbA1c level was 7.7%±1.09 (Unnikrishnan et al., 2018) [8]. The population-based registry which studied 26 Indian states found that only 23.4% of diabetics controlled their condition according to their report (Anjana et al., 2017) [9]. The research findings from this study demonstrate that poor glycemic control represents a common problem which affects all Indian patients who have Type 2 diabetes. The ICMR-INDIAB study reported better control rates which reached 31% while Kerala showed control rates of 28.3% which suggests that different regions experienced varying treatment outcomes through their healthcare access and patient knowledge and treatment compliance (Kumar & Sandhya, 2018) [10]. The studies show consistent results because all research experiments discovered that people with diabetes fail to reach their optimal HbA1c targets in real-life situations.

The present study discovered that extended diabetes duration serves as a primary component which results in negative diabetes management results. The findings from this research study in China match the results found in a retrospective research study which showed that diabetes duration exceeding four years raised the chances of diabetes poor glycemic control by 5.98 times (Li et al., 2018) [11]. Indian research studies demonstrate that a gradual decline in blood sugar control occurs throughout the entire disease period because of both beta cell damage and difficulties in advancing treatment (Joshi, 2015) [12]. The similarity between these findings demonstrates that Type 2 diabetes progresses inexorably from its initial metabolic decline to create long-term treatment difficulties for patients.

The study found that most patients needed two or more diabetes medications which continued to rise as their condition progressed. This finding shows that diabetes patients who have had the condition for a long time need combination treatment according to worldwide research evidence (Cahn & Cefalu, 2016) [13]. Indian healthcare systems show a pattern of treating patients who need urgent therapy after a long period of uncontrolled blood sugar levels. The concept of clinical inertia exists as a major barrier which prevents doctors from achieving blood sugar control targets during their everyday work.

Neuropathy emerged as the most prevalent microvascular complication in this research study while nephropathy and retinopathy followed as the second and third most common microvascular complications. The pattern of results from this study shows the same outcomes as the Chennai Urban Rural Epidemiology Study which discovered a 25.7% prevalence of neuropathy and a 5.1% prevalence of nephropathy and a 17.5% prevalence of retinopathy (Pradeepa et al., 2010) [14]. DiabCare India found that diabetic patients experienced neuropathy as their most common health problem which was followed by retinopathy and nephropathy (Mohan et al., 2014) [15]. The evidence shows that peripheral nerve damage becomes more common and starts earlier than other microvascular complications throughout the progression of the disease.

The present study demonstrates that existing evidence supports the link between inadequate blood sugar management and microvascular health problems. The UKPDS follow-up study demonstrated that sustained hyperglycemia significantly increases the risk of microvascular complications (Stratton et al., 2000) [16]. The meta-analysis of randomized controlled trials showed that intensive blood sugar management can lower the chance of kidney and eye problems by 20% and 13% respectively (Zoungas et al., 2017) [17]. The study results show that strict blood sugar control remains essential for diabetes management according to the findings of the current research study.

The research study confirms previous studies which found that extended disease duration and additional health issues and intricate medical treatments lead to poor glycemic management. Indian and international research studies showed a similar pattern which demonstrated that obesity and hypertension and treatment intensity directly affected glycemic control results (Babu et al., 2018; Li et al., 2018) [18]. The research demonstrates that metabolic syndrome elements significantly contribute to the deterioration of diabetes management and diabetes results.

The existing literature shows complete agreement with the current study findings which match research results from both Indian and international studies. The population and healthcare system differences between two groups result in different control rates and complication rates yet both groups show identical overall patterns. The present findings, therefore, reinforce the urgent need for early diagnosis, timely therapeutic intensification, improved patient adherence, and structured follow-up strategies to achieve better glycemic outcomes and reduce long-term complications in Type 2 Diabetes Mellitus.

Conclusion

The present retrospective study highlights that glycemic control among patients with Type 2 Diabetes Mellitus remains suboptimal in a significant proportion of cases, with 60% of patients showing HbA1c levels ≥7%. The findings demonstrate a higher prevalence of diabetes in middle-aged and older individuals, with a slight male predominance. A progressive increase in disease burden was observed with longer duration of diabetes, indicating worsening metabolic control over time. Microvascular complications were present in a considerable number of patients, with neuropathy being the most common, fol-

lowed by nephropathy and retinopathy. Importantly, nearly half of the patients were still free from complications, suggesting potential benefits of early detection and management. Overall, the study emphasizes the need for improved treatment adherence, timely intensification of therapy, and regular monitoring to achieve target glycemic levels. Strengthening diabetes care strategies is essential to reduce complications and improve long-term patient outcomes.

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