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Original Article

Medication Adherence in Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Background: Type 2 diabetes mellitus requires long-term treatment, regular follow-up, and active patient participation. Even when effective medicines are prescribed, poor medication adherence can reduce glycaemic control and increase the risk of microvascular and macrovascular complications. In routine clinical practice, patients often miss medicines because of forgetfulness, financial burden, lack of symptoms, side effects, multiple drug schedules, or inadequate understanding of the disease. The present study was conducted to assess the level of medication adherence among patients with type 2 diabetes mellitus and to identify the common factors contributing to poor adherence.

Materials and Methods: This observational study was carried out among 150 patients with type 2 diabetes mellitus attending the outpatient department. Patients aged above 18 years, diagnosed with type 2 diabetes mellitus, and receiving oral antidiabetic drugs or insulin for at least six months were included. Socio-demographic details, duration of diabetes, treatment pattern, comorbidities, number of prescribed medicines, follow-up history, and recent glycaemic parameters were recorded. Medication adherence was assessed using a structured adherence questionnaire. Based on the adherence score, patients were grouped into good, moderate, and poor adherence categories. The reasons for missed doses and their association with glycaemic control were analysed.

Results: Among the 150 patients, 84 were males (56.0%) and 66 were females (44.0%). The mean age of the study population was 54.6 ± 9.8 years, and the mean duration of diabetes was 7.2 ± 4.1 years. Good medication adherence was observed in 58 patients (38.7%), moderate adherence in 54 patients (36.0%), and poor adherence in 38 patients (25.3%). Overall, 92 patients (61.3%) had either moderate or poor adherence. The most common reason for missing medication was forgetfulness, reported by 64 patients (42.7%), followed by financial difficulty in 39 patients (26.0%), lack of symptoms or feeling well in 34 patients (22.7%), fear of adverse effects in 28 patients (18.7%), and complex drug schedules in 25 patients (16.7%). Poor adherence was more frequent among patients taking three or more medicines daily (34.8%), those with diabetes duration above five years (31.5%), and those with irregular follow-up (40.6%). Patients with good adherence had better glycaemic control, with a mean HbA1c of 7.2 ± 0.8%, compared with 8.1 ± 1.0% in the moderate adherence group and 9.0 ± 1.2% in the poor adherence group.

Conclusion: Medication adherence was unsatisfactory in a considerable proportion of patients with type 2 diabetes mellitus. Forgetfulness, cost of treatment, absence of symptoms, fear of side effects, multiple medicines, and irregular follow-up were the major barriers to regular drug intake. Patients with better adherence showed lower HbA1c levels, indicating the importance of consistent medication use in achieving glycaemic control. Regular counselling, simplified prescriptions, reminder-based strategies, family support, and affordable access to medicines may help improve adherence and reduce diabetes-related complications.

Keywords: Type 2 diabetes mellitus; medication adherence; glycaemic control;

HbA1c; antidiabetic drugs; treatment compliance; diabetes care; patient education.

INTRODUCTION

Type 2 diabetes mellitus is a chronic metabolic disorder characterised by persistent hyperglycaemia resulting from insulin resistance, progressive beta-cell dysfunction, and inadequate insulin action. It has become one of the most important public health problems worldwide because of its rising prevalence, long duration of treatment, and close association with cardiovascular, renal, neurological, and ocular complications. The International Diabetes Federation estimated that 537 million adults were living with diabetes in 2021, and this number is expected to increase to 643 million by 2030 and 783 million by 2045 [1]. India carries a particularly high burden of diabetes. The ICMR-INDIAB study reported that nearly 101 million people in India were living with diabetes, along with a large population having prediabetes, indicating a major future burden on health services [2].

The management of type 2 diabetes mellitus depends not only on prescribing appropriate medicines but also on the patient's ability and willingness to take them regularly. Antidiabetic drugs, dietary regulation, physical activity, periodic monitoring, and follow-up are all necessary for maintaining glycaemic control. However, in day-to-day practice, treatment success is often limited by poor medication adherence. Adherence refers to the extent to which a patient's medication-taking behaviour corresponds with the agreed recommendations of the healthcare provider [3]. In diabetes, this includes taking medicines at the correct dose, at the correct time, and for the prescribed duration, even when symptoms are absent.

Good medication adherence is clinically important because sustained hyperglycaemia is strongly associated with microvascular and macrovascular complications. The UK Prospective Diabetes Study showed that better glycaemic control reduces diabetes-related complications, and each reduction in HbA1c is associated with meaningful improvement in long-term outcomes [4,5]. On the other hand, missed doses, irregular intake of medicines, and early discontinuation of treatment can lead to poor glycaemic control, increased risk of hospitalization, higher treatment cost, and avoidable disease progression [6,7]. Therefore, medication adherence is now considered a key component of diabetes care, similar in importance to drug selection and dose adjustment.

Despite the availability of effective oral antidiabetic drugs and insulin therapy, non-adherence remains common among patients with type 2 diabetes mellitus. Earlier systematic reviews have shown wide variation in adherence levels, mainly because of differences in study design, adherence measurement methods, healthcare settings, and patient populations [8,9]. Cramer reported that many patients prescribed medications for diabetes did not take them as recommended, and adherence was lower when treatment regimens were complex [8]. Krass et al. also observed that adherence to antidiabetic medication continues to be a persistent challenge and is influenced by patient-related, therapy-related, and healthcare-system-related factors [9]. These findings suggest that non-adherence is not merely a patient fault but a multifactorial problem requiring structured assessment.

Several factors may contribute to poor medication adherence in patients with type 2 diabetes mellitus. Forgetfulness is one of the most frequently reported causes, especially among elderly patients and those taking multiple medicines. Other common barriers include cost of treatment, fear of side effects, lack of visible symptoms, poor understanding of diabetes, low health literacy, irregular follow-up, depression, social constraints, and lack of family support [10,11]. Patients with type 2 diabetes often have hypertension, dyslipidaemia, obesity, renal disease, or cardiovascular disease, which increases pill burden and complicates daily treatment schedules [12]. Polypharmacy may reduce adherence by making treatment difficult to remember and sustain over a long period [13].

The relationship between medication adherence and glycaemic control has been demonstrated in several studies. Patients who take their antidiabetic medicines regularly are more likely to have lower HbA1c levels than those with poor adherence [14,15]. Kirkman et al. observed that adherence to diabetes medication was associated with better glycaemic outcomes in adults with type 2 diabetes [16]. Similarly, García-Pérez et al. reported that non-adherence to diabetes therapy is linked with poorer metabolic control and increased clinical burden [17]. These findings highlight the need to routinely evaluate adherence in diabetic patients, particularly among those with uncontrolled blood glucose despite prescribed therapy.

Assessment of medication adherence can be done by direct and indirect methods. Direct methods include drug level estimation or direct observation of therapy, but these are often costly and impractical in routine outpatient practice. Indirect methods such as patient interviews, pill counts, pharmacy refill records, and validated questionnaires are more commonly used [18]. The Morisky Medication Adherence Scale and its modified versions have been widely used in chronic diseases, including diabetes, because they are simple, inexpensive, and suitable for clinical and research settings [19,20]. Such tools help identify patients who may require counselling, simplified prescriptions, reminder strategies, or closer follow-up.

In the Indian setting, adherence assessment is especially relevant because patients differ widely in education, income, access to medicines, awareness regarding diabetes, and family support. Many patients continue treatment only when symptoms are present or when blood glucose levels are markedly abnormal. Some discontinue medicines once they feel better, while others miss doses because of financial limitations or fear of lifelong drug dependency. These patterns can remain unnoticed during routine consultations unless adherence is specifically assessed. Therefore, studying medication adherence among patients with type 2 diabetes mellitus can provide useful information for improving diabetes care at the outpatient level.

The present study was undertaken to assess medication adherence among patients with type 2 diabetes mellitus and to identify the common factors associated with poor adherence. The study also aims to examine the relationship between adherence status and glycaemic control. Understanding these factors may help clinicians design simple, patient-centred interventions such as counselling, dose simplification, reminder methods, family involvement, and affordable access to medicines.

MATERIALS AND METHODS

Study Design

This was a hospital-based observational study conducted to assess medication adherence among patients with type 2 diabetes mellitus. The study was designed to evaluate how regularly patients were taking their prescribed antidiabetic medicines and to identify the common reasons for missed or irregular drug intake. Since the intention of the study was to observe existing treatment behaviour without introducing any intervention, an observational design was considered appropriate. The study also attempted to examine whether medication adherence was related to glycaemic control among the participants.

Place of Study

The study was conducted at **Mahavir Institute of Medical Sciences, Vikarabad, Telangana**. Patients were recruited from the outpatient services of the Department of General Medicine and diabetes follow-up clinics attached to the institution. The hospital caters to patients from Vikarabad and surrounding rural and semi-urban areas, providing a suitable setting to assess medication adherence among patients from different socioeconomic and educational backgrounds.

Study Duration

The study was carried out over a period of **12 months,** from **January 2025 to December 2025**. During this period, eligi**b**le patients attending the outpatient department for diabetes-related consultation or routine follow-up were screened and enrolled after obtaining informed consent. The extended study duration allowed adequate recruitment of patients and helped include individuals with varying duration of diabetes and different patterns of treatment follow-up.

Study Population

The study population consisted of adult patients previously diagnosed with type 2 diabetes mellitus and receiving antidiabetic treatment. Patients using oral antidiabetic drugs, insulin, or a combination of oral drugs and insulin were considered for inclusion. Both newly attending follow-up patients and known diabetic patients already registered at the institution were screened. The study mainly focused on patients who had been on treatment for a sufficient period to meaningfully assess medication-taking behaviour.

Sample Size

The sample size for the present study was calculated using the standard formula for estimating a single proportion. Since the reported prevalence of medication adherence among patients with type 2 diabetes mellitus varies across different regions and healthcare settings, an expected adherence proportion of 50% was considered. This value was chosen because it provides the maximum required sample size when the exact prevalence is uncertain. At a 95% confidence level, the standard normal value was taken as 1.96, with an allowable error of 8%. The sample size was calculated using the formula $\mathbf{n = Z^2pq/d^2}$, where **n** is the required sample size, **Z** is 1.96, **p** is the expected proportion of adherence, **q** is 1 − p, and **d** is the allowable error. Substituting the values, $\mathbf{n = (1.96)^2 \times 0.50 \times 0.50 / (0.08)^2}$, which gives a sample size of approximately **150**. Therefore, a total of **150 patients with type 2 diabetes mellitus** were included in the study.

Sampling Method

A consecutive sampling technique was followed for patient recruitment. All patients with type 2 diabetes mellitus attending the outpatient department during the study period were screened for eligibility. Those who fulfilled the inclusion criteria and agreed to participate were enrolled until the required sample size was achieved. This method was selected because it was practical in a hospital-based outpatient setting and allowed the inclusion of patients presenting during routine clinical care.

Inclusion Criteria
Patients aged **18 years and above** with a confirmed diagnosis of type 2 diabetes mellitus were included in the study. Only those who had been receiving antidiabetic medication for at least **six months** were considered, as this duration was necessary to assess treatment adherence in a meaningful way. Patients attending the outpatient department or diabetes follow-up clinic at Mahavir Institute of Medical Sciences, Vikarabad, Telangana, and willing to provide informed consent were included. Both patients on oral antidiabetic drugs and those receiving insulin, either alone or in combination with oral drugs, were eligible for participation.

Exclusion Criteria
Patients with type 1 diabetes mellitus and gestational diabetes mellitus were excluded, as the treatment pattern and adherence behaviour in these groups differ from type 2 diabetes mellitus. Newly diagnosed patients who had been on treatment for less than six months were also excluded because their medication-taking behaviour may not reflect long-term adherence. Critically ill patients, patients requiring emergency care, and those admitted for acute complications were not included. Patients with severe cognitive impairment, major psychiatric illness, or communication difficulty that prevented reliable responses were excluded. Patients who were unwilling to participate or whose clinical and laboratory records were incomplete were also excluded from the study.

Ethical Considerations
The study was conducted after obtaining approval from the Institutional Ethics Committee of **Mahavir Institute of Medical Sciences, Vikarabad, Telangana**. Before enrolment, each participant was informed about the purpose of the study, the type of information to be collected, and the voluntary nature of participation. Written informed consent was obtained from all participants. The study did not involve any alteration in the treatment prescribed by the treating physician. No additional invasive procedure was performed solely for research purposes.

Confidentiality of patient information was strictly maintained. Personal identifiers were not used during analysis or reporting. Each participant was assigned a study code, and the collected data were used only for academic and research purposes. Patients who refused to participate continued to receive routine medical care without any difference in treatment or follow-up.

Data Collection Procedure
Data were collected using a predesigned structured proforma. Eligible patients were interviewed during their outpatient visit after obtaining consent. Information was obtained through direct patient interview and by reviewing available outpatient records, prescriptions, and laboratory reports. Care was taken to collect information in a simple and patient-friendly manner so that participants could clearly explain their medication-taking practices.

The proforma included details regarding age, sex, residence, educational status, occupation, socioeconomic background, duration of diabetes, type of treatment, number of medicines prescribed, use of insulin, and presence of associated comorbidities such as hypertension, dyslipidaemia, chronic kidney disease, obesity, or cardiovascular disease. Details of follow-up regularity, history of missed doses, reasons for irregular medication intake, and awareness regarding diabetes complications were also recorded. Recent fasting blood glucose, postprandial blood glucose, and HbA1c values were noted wherever available.

Assessment of Medication Adherence
Medication adherence was assessed using a structured medication adherence questionnaire administered to each participant. The questionnaire included questions related to regular intake of prescribed medicines, missed doses, forgetfulness, stopping medicines when symptoms improved, discontinuing drugs because of side effects, difficulty in following the prescribed schedule, and attending follow-up visits. The responses were recorded carefully without blaming or judging the patient, as non-adherence is often influenced by several practical, social, and economic factors.
Based on the adherence score, patients were grouped into **good adherence, moderate adherence**, and **poor adherence** categories. Patients who took their medicines regularly as prescribed and rarely missed doses were considered to have good adherence. Patients who missed medicines occasionally but continued treatment most of the time were classified as having moderate adherence. Patients who frequently missed doses, stopped medicines without medical advice, or followed treatment irregularly were placed in the poor adherence group. These categories were later used to compare clinical characteristics and glycaemic control.

Assessment of Reasons for Non-Adherence
Patients who reported missing medicines or taking them irregularly were further asked about the possible reasons for non-adherence. Since more than one factor may contribute to irregular drug intake, multiple responses were allowed. Commonly assessed reasons included forgetfulness, financial difficulty, absence of symptoms, fear of adverse effects, actual side effects, multiple medicines, complex dosing schedule, irregular follow-up, lack of family support, poor knowledge about diabetes, and use of alternative systems of medicine.

The purpose of assessing these reasons was to understand the practical barriers faced by patients in their daily life. For example, some patients missed doses because they felt well and believed that medicines were no longer required, while others skipped treatment due to cost or difficulty in remembering multiple doses. Identifying these factors was important because many of them can be addressed through counselling, treatment simplification, reminder methods, and family involvement.

Assessment of Glycaemic Control

Glycaemic control was assessed using available laboratory parameters. The most recent HbA1c value recorded within the previous three months was considered for analysis whenever available. HbA1c was preferred because it reflects average blood glucose levels over the preceding two to three months and is a reliable marker for long-term glycaemic control. Fasting blood glucose and postprandial blood glucose values were also recorded from patient records when available.

For the purpose of analysis, patients with HbA1c less than **7.0%** were considered to have controlled diabetes, while those with HbA1c **7.0% or above** were considered to have uncontrolled diabetes. In patients without recent HbA1c reports, available fasting and postprandial blood glucose values were documented, but HbA1c was used as the principal indicator wherever possible. The glycaemic status was then compared across different adherence groups.

Study Variables

The primary study variable was medication adherence status among patients with type 2 diabetes mellitus. Adherence was classified as good, moderate, or poor based on the structured questionnaire score. The secondary outcome variable was glycaemic control, assessed mainly through HbA1c values.

The independent variables included age, sex, place of residence, educational level, occupation, socioeconomic status, duration of diabetes, type of antidiabetic treatment, number of medicines used per day, insulin use, presence of comorbidities, regularity of follow-up, and patient awareness regarding diabetes. These variables were selected because they may influence treatment adherence either directly or indirectly.

Operational Definitions

For this study, type 2 diabetes mellitus was defined as a previously diagnosed condition for which the patient was receiving oral antidiabetic drugs, insulin, or both. Medication adherence was defined as the regular intake of prescribed antidiabetic medicines according to the advice of the treating physician. Non-adherence was defined as missing doses, taking medicines irregularly, reducing or stopping medicines without medical advice, or failing to follow the prescribed treatment schedule.

Polypharmacy was defined as the use of three or more medicines per day for diabetes and associated comorbid conditions. Regular follow-up was defined as attending outpatient review as advised by the treating physician. Irregular follow-up was defined as missing scheduled visits or attending the hospital only when symptoms worsened. Good glycaemic control was defined as HbA1c less than 7.0%, while HbA1c of 7.0% or above was considered uncontrolled diabetes.

Data Management

All collected data were checked for completeness before entry. The information was entered into a Microsoft Excel spreadsheet using study identification numbers instead of patient names. After entry, the data were reviewed for missing values, duplicate entries, and inconsistencies. Any unclear information was cross-checked with the original proforma or available medical record. Confidentiality was maintained throughout the process, and only authorised investigators had access to the study data.

Statistical Analysis

The collected data were analysed using appropriate statistical methods. Continuous variables such as age, duration of diabetes, fasting blood glucose, postprandial blood glucose, and HbA1c were expressed as mean and standard deviation. Categorical variables such as sex, education, treatment type, adherence category, comorbidities, follow-up status, and reasons for non-adherence were presented as frequency and percentage.

The chi-square test was used to assess the association between medication adherence and categorical variables. Mean HbA1c levels were compared between adherence groups using appropriate tests such as independent t-test or analysis of variance, depending on the number of groups being compared. A **p-value less than 0.05** was considered statistically significant. The findings were presented in tables and figures wherever suitable to improve clarity and interpretation.

Methodological Flow of the Study

Patients with type 2 diabetes mellitus attending the outpatient department of Mahavir Institute of Medical Sciences, Vikarabad, Telangana, were screened according to the eligibility criteria. Those who satisfied the inclusion criteria and

provided written informed consent were enrolled in the study. Demographic details, clinical history, treatment details, comorbidities, and laboratory values were collected using a structured proforma.

Medication adherence was then assessed through a structured questionnaire, and patients were classified into good, moderate, or poor adherence groups. The reasons for missed or irregular medication intake were recorded. Glycaemic control was assessed mainly using HbA1c values. Finally, the adherence pattern was analysed in relation to demographic factors, treatment-related factors, follow-up behaviour, and glycaemic control.

RESULTS

Baseline Characteristics of the Study Population

A total of **150 patients with type 2 diabetes mellitus** were included in the study. Among them, **84 patients were males (56.0%)** and **66 were females (44.0%).** The mean age of the study population was **54.6 ± 9.8 years**. Most patients were in the middle and older age groups, with **58 patients (38.7%)** belonging to the 50 to 59 years age group, followed by **50 patients (33.3%)** below 50 years and **42 patients (28.0%)** aged 60 years and above.

The mean duration of diabetes was **7.2 ± 4.1 years**. Overall, **82 patients (54.7%)** had diabetes for more than five years, while **68 patients (45.3%)** had diabetes for five years or less. Comorbid illnesses were present in **69 patients (46.0%)**, with hypertension and dyslipidaemia being the most common associated conditions (Table 1).

Table 1: Baseline Characteristics of Patients with Type 2 Diabetes Mellitus

Variable	Category	Number of Patients	Percentage
Age group	<50 years	50	33.3
	50 to 59 years	58	38.7
	≥60 years	42	28.0
Sex	Male	84	56.0
	Female	66	44.0
Duration of diabetes	≤5 years	68	45.3
	>5 years	82	54.7
Comorbidities	Present	69	46.0
	Absent	81	54.0
Type of treatment	Oral antidiabetic drugs only	108	72.0
	Insulin with/without oral drugs	42	28.0
Number of medicines per day	<3 medicines	86	57.3
	≥3 medicines	64	42.7

Values are expressed as frequency and percentage. Comorbidities included hypertension, dyslipidaemia, chronic kidney disease, and cardiovascular disease.

Medication Adherence Pattern

Out of 150 patients, **58 patients (38.7%)** had good medication adherence, **54 patients (36.0%)** had moderate adherence, and **38 patients (25.3%)** had poor adherence. Thus, **92 patients (61.3%)** had either moderate or poor adherence, indicating that irregular medication intake was common among patients with type 2 diabetes mellitus (Table 2; Figure 1).

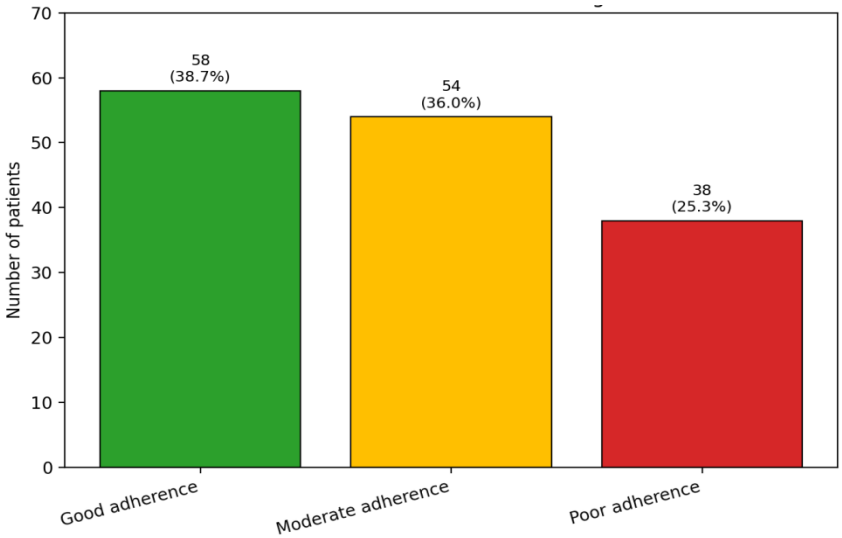

Figure 1: Adherence distribution among T2DM Patients

Table 2: Distribution of Medication Adherence among Study Participants

Medication Adherence Category	Number of Patients	Percentage
Good adherence	58	38.7
Moderate adherence	54	36.0
Poor adherence	38	25.3
Total	**150**	**100.0**

Medication adherence was classified based on responses to a structured adherence questionnaire.

Association of Demographic and Clinical Factors with Medication Adherence

Medication adherence was analysed in relation to age, sex, education, duration of diabetes, number of medicines, comorbidities, and follow-up regularity. Poor adherence was more frequent among patients taking **three or more medicines per day**, those with **irregular follow-up**, and those with **longer duration of diabetes**.

The association between number of medicines and adherence was statistically significant ($\chi^2 = 9.25$, **p = 0.010**). Among patients taking three or more medicines daily, **23 patients (35.9%)** had poor adherence, compared with **15 patients (17.4%)** among those taking fewer than three medicines. Similarly, irregular follow-up showed a significant association with poor adherence ($\chi^2 = 12.45$, **p = 0.002**). Among patients with irregular follow-up, **22 patients (40.0%)** had poor adherence, while only **16 patients (16.8%)** with regular follow-up had poor adherence (Table 3).

Table 3: Association of Selected Factors with Medication Adherence

Variable	Category	Good Adherence n (%)	Moderate Adherence n (%)	Poor Adherence n (%)	Chi-square Value	p-value
Age group	<50 years	18 (36.0)	17 (34.0)	15 (30.0)	0.98	0.913
	50 to 59 years	24 (41.4)	21 (36.2)	13 (22.4)		
	≥60 years	16 (38.1)	16 (38.1)	10 (23.8)		
Sex	Male	34 (40.5)	28 (33.3)	22 (26.2)	0.59	0.743
	Female	24 (36.4)	26 (39.4)	16 (24.2)		
Educational status	Illiterate/Primary	14 (26.4)	20 (37.7)	19 (35.9)	9.00	0.061
	Secondary	22 (39.3)	21 (37.5)	13 (23.2)		
	Graduate and above	22 (53.7)	13 (31.7)	6 (14.6)		
Duration of diabetes	≤5 years	31 (45.6)	25 (36.8)	12 (17.6)	4.46	0.107
	>5 years	27 (32.9)	29 (35.4)	26 (31.7)		
Number of medicines/day	<3 medicines	41 (47.7)	30 (34.9)	15 (17.4)	9.25	0.010
	≥3 medicines	17 (26.6)	24 (37.5)	23 (35.9)		
Follow-up pattern	Regular	45 (47.4)	34 (35.8)	16 (16.8)	12.45	0.002
	Irregular	13 (23.6)	20 (36.4)	22 (40.0)		
Comorbidities	Present	21 (30.4)	25 (36.2)	23 (33.3)	5.47	0.065
	Absent	37 (45.7)	29 (35.8)	15 (18.5)		

Values are expressed as frequency and percentage. Chi-square test was applied. A p-value <0.05 was considered statistically significant.

Reasons for Non-Adherence

The most common reason for missing medication was **forgetfulness**, reported by **64 patients (42.7%).** Financial difficulty was reported by **39 patients (26.0%)**, while **34 patients (22.7%)** missed medicines because they felt well or had no symptoms (Table 4). Fear of adverse effects was reported by **28 patients (18.7%)**, and **25 patients (16.7%)** found the treatment schedule difficult because of multiple medicines or complex dosing times (Figure 2).

Some patients reported more than one reason for missing medication. This shows that non-adherence was not due to a single factor, but was influenced by personal, economic, treatment-related, and follow-up-related issues.

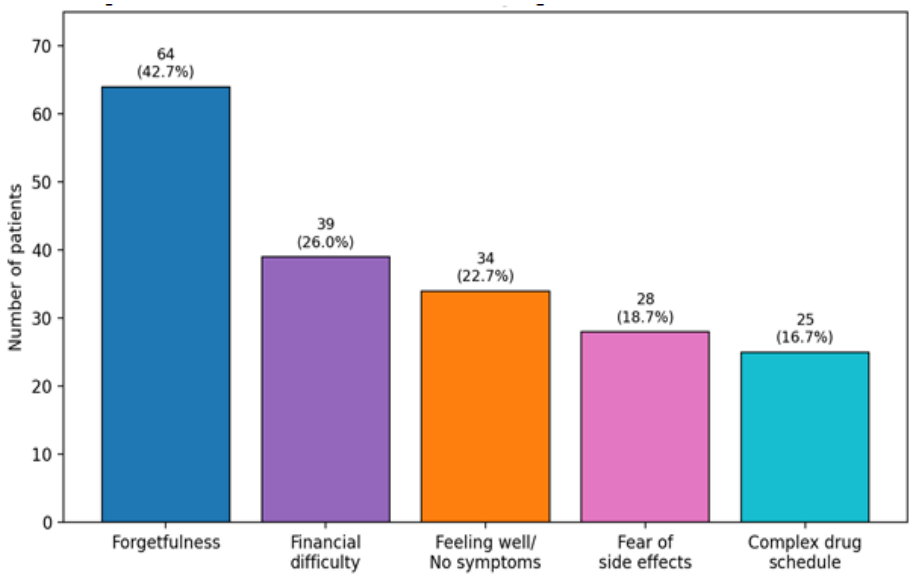

Figure 2: Common Reasons for Missing Antidiabetic Medication

Table 4: Common Reasons for Missing Antidiabetic Medication

Reason for Non-Adherence	Number of Patients	Percentage
Forgetfulness	64	42.7
Financial difficulty	39	26.0
Feeling well/lack of symptoms	34	22.7
Fear of adverse drug effects	28	18.7
Complex drug schedule/multiple medicines	25	16.7
Irregular follow-up	23	15.3
Lack of family support	17	11.3
Poor understanding of diabetes	15	10.0

Multiple responses were allowed; therefore, the total percentage exceeds 100%.

Glycaemic Control among the Study Participants

The mean HbA1c of the total study population was **7.98 ± 1.18%**. Patients with good medication adherence had a lower mean HbA1c of **7.2 ± 0.8%**, compared with **8.1 ± 1.0%** among patients with moderate adherence and **9.0 ± 1.2%** among patients with poor adherence (Figure 3). The difference in mean HbA1c across the three adherence groups was statistically significant (**F = 38.92, p < 0.001**) (Table 5).

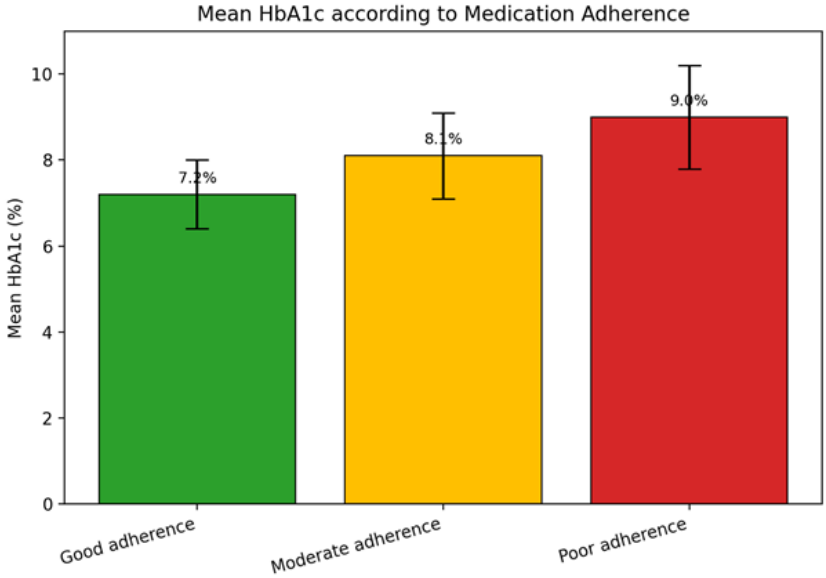

Figure 3: Mean HbA1C according to medication adharence

Table 5: Comparison of Glycaemic Parameters across Medication Adherence Groups

Parameter	Good Adherence Mean ± SD	Moderate Adherence Mean ± SD	Poor Adherence Mean ± SD	Test Value	p-value
Fasting blood glucose (mg/dL)	128.4 ± 24.6	151.2 ± 31.8	178.6 ± 38.5	F = 28.64	<0.001
Postprandial blood glucose (mg/dL)	186.5 ± 42.3	224.8 ± 51.6	268.2 ± 63.4	F = 31.72	<0.001
HbA1c (%)	7.2 ± 0.8	8.1 ± 1.0	9.0 ± 1.2	F = 38.92	<0.001

Values are expressed as mean ± standard deviation. One-way ANOVA was applied to compare means between adherence groups.

Association between Medication Adherence and Glycaemic Control

Among patients with good adherence, **39 patients (67.2%)** had controlled diabetes with HbA1c less than 7%, while **19 patients (32.8%)** had uncontrolled diabetes. In the moderate adherence group, **21 patients (38.9%)** had controlled diabetes and **33 patients (61.1%)** had uncontrolled diabetes. Among patients with poor adherence, only **7 patients (18.4%)** had controlled diabetes, while **31 patients (81.6%)** had uncontrolled diabetes (Table 6).

The association between medication adherence and glycaemic control was statistically significant ($\chi^2 = 23.28$, $p < 0.001$) (Figure 4). This indicates that patients with better adherence were more likely to have satisfactory glycaemic control.

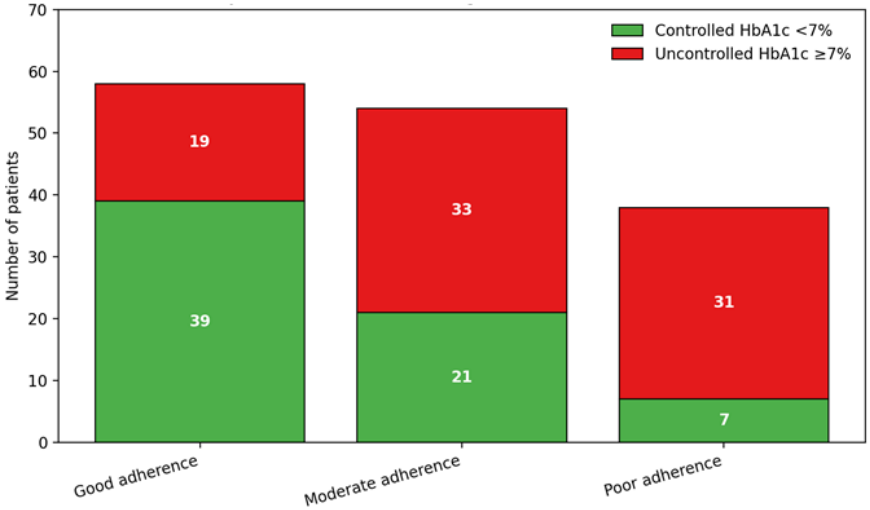

Figure 4: Glycaemic control according to medication adherence

Table 6: Association between Medication Adherence and Glycaemic Control

Glycaemic Control	Good Adherence n (%)	Moderate Adherence n (%)	Poor Adherence n (%)	Chi-square Value	p-value
Controlled, HbA1c <7%	39 (67.2)	21 (38.9)	7 (18.4)	23.28	<0.001
Uncontrolled, HbA1c ≥7%	19 (32.8)	33 (61.1)	31 (81.6)		
Total	**58 (100.0)**	**54 (100.0)**	**38 (100.0)**		

Values are expressed as frequency and percentage. Chi-square test was applied. HbA1c was used as the principal marker of glycaemic control.

DISCUSSION

Medication adherence is one of the most important determinants of successful long-term management in type 2 diabetes mellitus. In the present study, medication adherence was assessed among 150 patients with type 2 diabetes mellitus attending Mahavir Institute of Medical Sciences, Vikarabad, Telangana. The study showed that only 58 patients, accounting for 38.7%, had good adherence to prescribed antidiabetic medication. Moderate adherence was observed in 54 patients, representing 36.0%, while 38 patients, representing 25.3%, had poor adherence. Overall, 61.3% of the study participants had either moderate or poor adherence. This finding indicates that irregular intake of antidiabetic medicines remains a major challenge in routine diabetes care.

The findings of the present study are consistent with earlier reports which have shown that non-adherence is common among patients with chronic diseases, particularly diabetes mellitus. Diabetes requires long-term and often lifelong

treatment, but many patients find it difficult to continue medicines regularly in the absence of symptoms. Cramer reported that adherence to diabetes medication is often suboptimal and varies widely across different patient groups and treatment settings [8]. Similarly, Krass et al. observed that adherence to antidiabetic drugs remains a persistent problem and is influenced by several patient-related, treatment-related, and health system-related factors [9]. The present study supports these observations, as more than half of the patients did not fall under the good adherence category.

In this study, the mean age of the participants was 54.6 ± 9.8 years, and the majority were in the middle-aged and elderly groups. However, age was not significantly associated with medication adherence. Poor adherence was observed across all age categories, suggesting that non-adherence is not restricted to elderly patients alone. Although older patients may miss medicines because of forgetfulness or multiple comorbidities, younger and middle-aged patients may also miss doses due to occupational commitments, travel, lack of symptoms, or poor disease perception. Earlier studies have also shown that the association between age and adherence is not always uniform and may vary depending on social support, education, comorbidities, and treatment complexity [10,18].

Sex was also not significantly associated with adherence in the present study. Good adherence was seen in 40.5% of males and 36.4% of females, while poor adherence was noted in 26.2% of males and 24.2% of females. This suggests that both male and female patients face similar difficulties in maintaining regular treatment. Although some studies have reported differences in adherence based on gender, such differences are often influenced by access to care, financial independence, family support, health awareness, and cultural practices. In the present hospital-based population, sex alone did not appear to be a major determinant of adherence.

Educational status showed a clinically relevant trend, although it did not reach statistical significance. Poor adherence was more common among patients with illiterate or primary-level education, while better adherence was observed among graduates and those with higher educational status. This finding suggests that education may influence patients' understanding of diabetes, the need for lifelong treatment, and the consequences of missed medication. Patients with better education may be more likely to understand prescription instructions, recognise the importance of regular medication, and attend follow-up visits. Previous literature has emphasised that low health literacy is an important barrier to proper medication use in diabetes [10,17]. Therefore, counselling should be delivered in simple language, irrespective of the educational background of the patient.

The duration of diabetes was another important clinical factor examined in this study. Patients with diabetes duration of more than five years had a higher proportion of poor adherence compared with those having a shorter duration of disease. Although the association was not statistically significant, the trend is clinically meaningful. Patients with longer disease duration may develop treatment fatigue, frustration with lifelong medication, or reduced motivation, especially when they require multiple drugs or insulin. Long-standing diabetes is also commonly associated with comorbidities and complications, which can increase pill burden and reduce treatment confidence. Similar observations have been reported in earlier studies, where longer duration of diabetes and treatment complexity were associated with reduced adherence [11,13].

A significant finding in the present study was the association between number of medicines and medication adherence. Patients taking three or more medicines per day had significantly poorer adherence compared with those taking fewer than three medicines. Poor adherence was observed in 35.9% of patients taking three or more medicines daily, compared with 17.4% among those taking fewer medicines. This association was statistically significant. The finding is expected because multiple medicines increase the difficulty of remembering doses, timing, and instructions. Patients with diabetes frequently receive medicines not only for blood glucose control but also for hypertension, dyslipidaemia, neuropathy, renal protection, and cardiovascular risk reduction. Grant et al. reported that polypharmacy is common in type 2 diabetes and can influence medication-taking behaviour [12]. Claxton et al. also showed that simpler dosing schedules are generally associated with better compliance [13]. Therefore, simplifying prescriptions wherever clinically possible may improve adherence.

Follow-up regularity was strongly associated with adherence in the present study. Patients with irregular follow-up had a much higher proportion of poor adherence compared with those attending regular follow-up. Among patients with irregular follow-up, 40.0% had poor adherence, while only 16.8% of those with regular follow-up had poor adherence. This association was statistically significant. Regular follow-up gives the treating physician an opportunity to reinforce the importance of medication, identify side effects, adjust treatment, address doubts, and monitor glycaemic status. Patients who miss follow-up visits may also be more likely to discontinue or irregularly take medicines. This finding highlights the importance of structured follow-up systems, appointment reminders, and patient tracking in diabetes clinics.

The most common reason for non-adherence in the present study was forgetfulness, reported by 42.7% of patients. This is a practical and frequently overlooked reason for poor adherence. Many patients do not intentionally avoid treatment

but miss doses because of daily routine changes, travel, work, or lack of reminder systems. Forgetfulness has been reported as one of the most common barriers to medication adherence in several chronic disease studies [10,19]. Simple interventions such as fixed medication timing, pill boxes, mobile phone alarms, family reminders, and linking medication intake with daily activities may be useful in such patients.

Financial difficulty was the second most common reason for non-adherence, reported by 26.0% of patients. This finding is particularly relevant in resource-limited settings, where out-of-pocket expenditure for chronic illness may affect treatment continuation. Diabetes care involves recurring costs for medicines, investigations, consultations, travel, and management of complications. Patients with limited income may skip medicines, reduce doses, or purchase medicines intermittently. This issue has been highlighted in earlier studies where cost of treatment was identified as an important contributor to non-adherence [10,14]. Ensuring affordable access to essential antidiabetic drugs, use of generic medicines, and strengthening public health supply systems may help reduce this barrier.

Another important reason for missing medication was the absence of symptoms or feeling well, reported by 22.7% of patients. Diabetes is often asymptomatic in the early and intermediate stages, and patients may wrongly assume that medicines are not needed when they feel normal. This reflects inadequate understanding of the silent progression of diabetes and its complications. Many patients seek treatment only when symptoms appear or when blood glucose levels are markedly high. Patient education should therefore focus on explaining that diabetes requires regular treatment even in the absence of symptoms. The long-term benefits of glycaemic control in preventing microvascular and macrovascular complications have been clearly demonstrated in landmark studies such as UKPDS [4,5].

Fear of adverse effects was reported by 18.7% of patients, while complex drug schedules were reported by 16.7%. Some patients avoid or stop medicines because of fear of hypoglycaemia, weight gain, gastrointestinal intolerance, weakness, or kidney-related concerns. Others find it difficult to follow prescriptions involving multiple daily doses. These findings underline the need for clear communication between physician and patient. Patients should be informed about expected side effects, warning symptoms, and what to do if adverse effects occur. Treatment regimens should be individualised, and once-daily or fixed-dose combinations may be considered where suitable. Polonsky and Henry emphasised that non-adherence in type 2 diabetes is often driven by emotional, practical, and treatment-related barriers rather than simple unwillingness [10].

One of the most important observations of the present study was the relationship between medication adherence and glycaemic control. Patients with good adherence had a mean HbA1c of 7.2 ± 0.8%, while those with moderate adherence had a mean HbA1c of 8.1 ± 1.0%, and those with poor adherence had a mean HbA1c of 9.0 ± 1.2%. The difference was statistically significant. Similar trends were observed for fasting and postprandial blood glucose values. These findings clearly show that patients who took medicines more regularly had better glycaemic control. This is consistent with previous studies showing that adherence to antidiabetic medication is strongly associated with lower HbA1c and better metabolic outcomes [14-17].

The association between adherence category and controlled diabetes was also significant. Among patients with good adherence, 67.2% had HbA1c below 7%, whereas only 18.4% of patients with poor adherence achieved this level of control. In contrast, uncontrolled diabetes was seen in 81.6% of patients with poor adherence. This finding has direct clinical importance. It suggests that before escalating therapy in patients with uncontrolled diabetes, clinicians should carefully assess whether the patient is actually taking the prescribed medicines regularly. Increasing the dose or adding new drugs without addressing adherence may increase pill burden further and worsen adherence.

The present study also supports the concept that diabetes management should be patient-centred rather than prescription-centred. Many barriers identified in the study, such as forgetfulness, cost, lack of symptoms, fear of side effects, irregular follow-up, and poor understanding of diabetes, can be improved through simple clinical interventions. Regular counselling, written instructions, family participation, affordable medicines, fixed-dose combinations, and reminder-based strategies may improve adherence. The role of healthcare providers is not only to prescribe medicines but also to assess whether patients are able to follow the treatment plan in real life.

The findings also have implications for diabetes clinics in semi-urban and rural healthcare settings. Patients attending such institutions may have varying levels of literacy, financial capacity, and access to continuous care. A structured adherence assessment tool can be easily incorporated into routine outpatient visits. Even a brief discussion on missed doses can help identify patients at risk of poor control. Since adherence assessment is inexpensive and non-invasive, it can be used as a practical quality improvement measure in diabetes care.

The present study has some limitations. Medication adherence was assessed using patient self-report, which may be affected by recall bias or social desirability bias. Some patients may underreport missed doses because they feel embarrassed or fear criticism. Pharmacy refill records and pill counts were not used, which could have provided

additional objective information. The study was conducted in a single institution; therefore, the findings may not be generalisable to all populations. HbA1c values were taken from available clinical records, and lifestyle factors such as diet, physical activity, and stress were not analysed in detail. Despite these limitations, the study provides useful insight into medication adherence patterns and their relationship with glycaemic control among patients with type 2 diabetes mellitus in a tertiary care setting.

Overall, the present study shows that medication adherence among patients with type 2 diabetes mellitus is suboptimal, with nearly one-fourth of patients showing poor adherence and more than one-third showing moderate adherence. Forgetfulness, financial difficulty, absence of symptoms, fear of side effects, complex drug schedules, and irregular follow-up were the major contributors to missed medication. Better adherence was strongly associated with lower HbA1c and improved glycaemic control. These findings emphasise the need for routine adherence assessment, repeated patient education, simplified treatment regimens, affordable access to medicines, and stronger follow-up systems in diabetes care.

CONCLUSION

The present study showed that medication adherence among patients with type 2 diabetes mellitus was not satisfactory, as a considerable proportion of patients had moderate or poor adherence to prescribed antidiabetic treatment. Forgetfulness was the most common reason for missed medication, followed by financial difficulty, absence of symptoms, fear of adverse effects, complex drug schedules, and irregular follow-up. Poor adherence was more frequent among patients taking multiple medicines and among those who did not attend follow-up regularly.

The study also demonstrated a clear relationship between medication adherence and glycaemic control. Patients with good adherence had lower fasting blood glucose, postprandial blood glucose, and HbA1c values compared with patients having moderate or poor adherence. These findings suggest that assessment of medication-taking behaviour should be a routine part of diabetes care, particularly in patients with uncontrolled blood glucose despite prescribed therapy.

Improving adherence requires more than prescribing medicines. Regular counselling, simplified treatment regimens, affordable access to drugs, reminder-based strategies, family involvement, and periodic follow-up can help patients continue treatment more consistently. Early identification of adherence barriers may reduce poor glycaemic control and prevent long-term diabetes-related complications.

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Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

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