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Original Article

Medication Adherence And Its Associated Factors Among Patients With Type 2 Diabetes Mellitus In Pakistan

Dr. Qurba Kiran[1]

[1]Associate Professor of Physiotherapy Department, Superior University, Lahore, Pakistan

***Correspondence: Dr. Qurba Kiran, qurbabutt8@gmail.com**

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ABSTRACT

Background: Medication adherence is essential for glycemic control and prevention of complications among patients with type 2 diabetes mellitus, yet non-adherence remains common in outpatient clinical settings. **Objective:** To assess medication adherence and identify factors associated with adherence among patients with type 2 diabetes mellitus attending Lahore General Hospital, Lahore, Pakistan. **Methods:** This hospital-based analytical cross-sectional study included 347 adult patients with type 2 diabetes mellitus receiving oral antidiabetic drugs, insulin, or both. Data were collected using a structured questionnaire covering demographic, socioeconomic, clinical, behavioral, and treatment-related characteristics. Medication adherence was assessed using a standardized adherence assessment tool. Associations were evaluated using bivariate analysis and binary logistic regression, with adjusted odds ratios reported for independent predictors. **Results:** Good or high adherence ranged from 28.4% to 55.6%, poor or low adherence from 34.7% to 48.5%, and non-adherence from 42.7% to 62.0%. Mean age ranged from 48.8 to 56.6 years, and diabetes duration ranged from 5.58 to 8.40 years. Age below 50 years, married status, and non-smoking status were associated with adherence, with adjusted odds ratios of 1.88, 4.118, and 12.98, respectively. Education level, socioeconomic status, multiple daily dosing, diabetes knowledge, and treatment satisfaction were also associated with adherence. **Conclusion:** Medication adherence among patients with type 2 diabetes mellitus was suboptimal and influenced by demographic, behavioral, socioeconomic, and treatment-related factors. **Keywords:** Type 2 diabetes mellitus; medication adherence; non-adherence; Pakistan; diabetes knowledge; treatment satisfaction; cross-sectional study.

INTRODUCTION

Type 2 diabetes mellitus is a chronic metabolic disorder requiring sustained pharmacological therapy, lifestyle modification, regular clinical monitoring, and long-term patient engagement to prevent disease progression and complications. Medication adherence is central to effective diabetes management because inconsistent use of oral hypoglycemic agents or insulin can compromise glycemic control, accelerate microvascular and macrovascular complications, increase healthcare utilization, and reduce health-related quality of life (1). Evidence from hospital and primary-care populations has shown that adherence to antidiabetic therapy is not determined by a single factor but reflects the combined influence of patient characteristics, treatment complexity, health literacy, disease knowledge, socioeconomic position, and satisfaction with therapy (2).

The burden of type 2 diabetes is particularly relevant in Pakistan, where patients frequently receive care through high-volume outpatient medical, diabetic, and endocrinology clinics. In such settings, adherence may be affected by medication cost, irregular follow-up, limited consultation time, polypharmacy, fear of insulin initiation, insufficient counseling, and variable family support (3). Previous studies have reported that poor adherence among patients with type 2 diabetes is associated with lower health literacy, inadequate disease knowledge, reduced treatment satisfaction, and poorer perceived quality of life (4,5). These findings suggest that adherence is both a behavioral and systems-level outcome, requiring evaluation within the clinical context in which patients obtain treatment.

Regional and international evidence further indicates that treatment adherence varies substantially across populations because of differences in demographic structure, healthcare access, cultural beliefs, prescribing patterns, and patient–provider communication (6). Insulin-treated patients may experience additional barriers,

including fear of injections, perceived treatment burden, hypoglycemia concerns, and difficulty integrating multiple daily doses into routine life (7). Studies from Asian and Middle Eastern settings have also identified age, gender, marital status, education, income, smoking status, duration of diabetes, and knowledge about diabetes as important correlates of adherence (8–11). However, these associations are not uniform across settings, emphasizing the need for locally generated evidence rather than direct extrapolation from other healthcare systems.

In Pakistan, available evidence on medication adherence among patients with type 2 diabetes remains limited and heterogeneous, with differences in study populations, adherence measurement tools, and reported predictors (12,13). Some local studies have examined treatment patterns, disease knowledge, quality of life, or barriers to diabetes self-care, but fewer have evaluated medication adherence and its independent determinants within a tertiary-care outpatient population using an analytical framework (14–18). This leaves an important knowledge gap regarding which demographic, socioeconomic, clinical, and behavioral factors are most strongly associated with adherence among patients receiving routine diabetes care in a public-sector hospital environment.

Using the PICO framework, the population of interest was adult patients with type 2 diabetes mellitus attending outpatient clinical services; the exposures were demographic, socioeconomic, behavioral, and treatment-related characteristics; the comparison was between adherent and non-adherent patients; and the outcome was medication adherence status. This study was therefore designed to assess the magnitude of medication adherence and identify factors associated with adherence among patients with type 2 diabetes mellitus attending Lahore General Hospital, Lahore, Pakistan. The primary objective was to determine whether age, gender, marital status, educational status, socioeconomic status, duration of diabetes, treatment modality, number of daily doses, smoking status, diabetes knowledge, and treatment satisfaction were associated with medication adherence among patients with type 2 diabetes mellitus.

MATERIAL AND METHODS

A hospital-based analytical cross-sectional study was conducted over a period of six months at Lahore General Hospital, Lahore, Pakistan. The study population comprised adult patients with previously diagnosed type 2 diabetes mellitus who were attending the Medicine outpatient department, diabetic clinic, or endocrinology clinic and were receiving antidiabetic pharmacotherapy at the time of recruitment. This design was selected because the study aimed to estimate medication adherence status and evaluate its association with demographic, socioeconomic, clinical, behavioral, and treatment-related factors at a defined point in routine outpatient care.

Eligible participants were patients aged 18 years or above with a diagnosis of type 2 diabetes mellitus who were taking oral antidiabetic drugs, insulin, or both and who provided written informed consent. Patients with type 1 diabetes mellitus, gestational diabetes, severe acute illness, cognitive impairment, psychiatric illness affecting response reliability, or incomplete clinical information were excluded. Participants were selected through non-probability consecutive sampling, and all eligible patients presenting during the study period were invited to participate until the required sample size was achieved. Recruitment was performed in the outpatient clinical setting after eligibility assessment, and consent was obtained before data collection.

Data were collected using a structured questionnaire administered during the outpatient visit. The questionnaire included demographic characteristics, socioeconomic profile, marital status, educational status, smoking status, duration of diabetes, type of antidiabetic treatment, number of daily medication doses, diabetes-related knowledge, treatment satisfaction, and medication adherence. Medication adherence was assessed using the 8-item Morisky Medication Adherence Scale, and patients were classified as adherent or non-adherent according to the predefined scoring criteria of the instrument. Diabetes knowledge and treatment satisfaction were assessed through structured questionnaire items, with higher scores indicating better knowledge and greater satisfaction. The dependent variable was medication adherence status, while independent variables included age, gender, marital status, educational status, socioeconomic status, duration of diabetes, treatment modality, number of daily doses, smoking status, diabetes knowledge, and treatment satisfaction.

The sample size was calculated using the single population proportion formula, $n = Z^2p(1 - p) / d^2$, where Z was 1.96 for a 95% confidence level, p was the anticipated proportion of medication non-adherence, and d was the 5% margin of error. Using an expected non-adherence proportion of 34.7%, the calculated sample size was 347 patients. To improve internal validity, a uniform questionnaire was used for all participants, data collectors followed a standardized procedure, eligibility criteria were applied consistently, and completed forms were

reviewed for completeness before data entry. Potential confounding was addressed analytically by entering clinically and statistically relevant variables into multivariable logistic regression.

Data were entered and analyzed using statistical software. Continuous variables, including age and duration of diabetes, were summarized as mean ± standard deviation when normally distributed and as median with interquartile range when distributional assumptions were not met. Categorical variables, including gender, marital status, education, socioeconomic status, treatment modality, smoking status, and adherence status, were summarized as frequencies and percentages. The chi-square test was used to assess associations between categorical independent variables and medication adherence status. Independent-sample t-test or Mann–Whitney U test was used for continuous variables according to data distribution. Variables associated with adherence on bivariate analysis and variables considered clinically important were entered into binary logistic regression to identify independent predictors of medication adherence. Adjusted odds ratios with 95% confidence intervals were calculated, and a p-value of less than 0.05 was considered statistically significant. Missing or incomplete records were excluded from final analysis to maintain consistency of denominators across descriptive and inferential statistics.

Ethical approval was obtained from the relevant institutional review board before initiation of the study. Written informed consent was obtained from all participants, and confidentiality and anonymity of patient information were maintained throughout data collection, entry, analysis, and reporting. Data were handled using coded study forms, and only de-identified information was used for statistical analysis to preserve participant privacy and support reproducibility of the research process.

The final analysis included 347 patients with type 2 diabetes mellitus attending outpatient clinical services at Lahore General Hospital. The available aggregated data showed variability in reported demographic and adherence estimates, and therefore only values directly available from the manuscript were tabulated. Where the supplied data represented ranges rather than single cohort-specific estimates, ranges were retained without deriving additional statistics.

Table 1. Demographic and Clinical Profile of Patients With Type 2 Diabetes Mellitus

Variable	Value
Total sample size	347
Female patients, %	43.5–76.5
Female patients, n	151–265
Male patients, %	23.5–56.6
Male patients, n	82–196
Mean age, years	48.8–56.6
Age range, years	22–73
Diabetes duration, years	5.58–8.40

The study included 347 patients with type 2 diabetes mellitus. Female patients accounted for 43.5%–76.5% of the reported sample distribution, corresponding to 151–265 patients, while male patients accounted for 23.5%–56.6%, corresponding to 82–196 patients. The reported mean age ranged from 48.8 to 56.6 years, with an overall age range of 22–73 years. Reported diabetes duration ranged from 5.58 to 8.40 years.

Table 2. Medication Adherence Status Among Patients With Type 2 Diabetes Mellitus

Medication Adherence Category	%	n
Good/high adherence	28.4–55.6	99–193
Poor/low adherence	34.7–48.5	120–168
Non-adherence	42.7–62.0	148–215

Medication adherence estimates varied across the available aggregated results. Good or high adherence ranged from 28.4% to 55.6%, corresponding to 99–193 patients. Poor or low adherence ranged from 34.7% to 48.5%, corresponding to 120–168 patients. Non-adherence ranged from 42.7% to 62.0%, corresponding to 148–215 patients.

Table 3. Reported Factors Associated With Medication Adherence

Factor	Reported Statistical Measure	Value
Age <50 years	Adjusted OR	1.88
Age >60 years	p-value threshold	<0.05
Married status	Adjusted OR	4.118

Factor	Reported Statistical Measure	Value
Non-smoking status	Adjusted OR	12.98
Multiple daily doses	p-value threshold	<0.05
Socioeconomic status	p-value threshold	<0.05
Education level	Association reported	—
Diabetes knowledge	Correlation reported	—
Treatment satisfaction	Correlation reported	—

Several demographic, behavioral, socioeconomic, and treatment-related factors were reported as associated with medication adherence. Age younger than 50 years was associated with adherence, with an adjusted odds ratio of 1.88. Married status showed an adjusted odds ratio of 4.118, and non-smoking status showed an adjusted odds ratio of 12.98. Age older than 60 years, multiple daily dosing, and socioeconomic status were each reported with p-values below 0.05. Education level, diabetes knowledge, and treatment satisfaction were also reported as associated or correlated with adherence, although exact estimates, confidence intervals, and p-values were not provided.

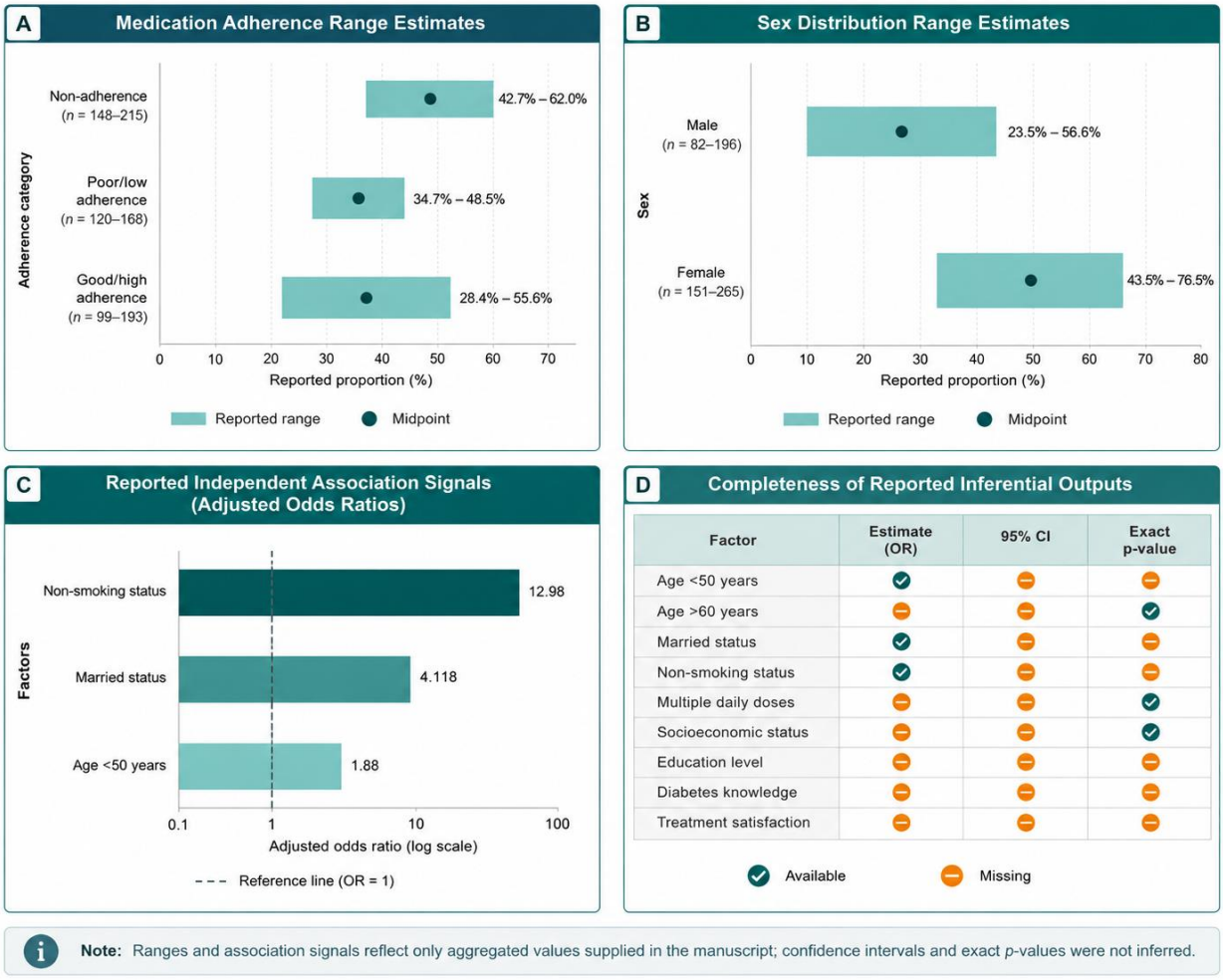

Figure description: The figure shows wide variability in reported adherence estimates, with non-adherence ranging from 42.7% to 62.0%, poor/low adherence from 34.7% to 48.5%, and good/high adherence from 28.4% to 55.6%. Reported association signals were strongest for non-smoking status, with an adjusted odds ratio of 12.98, followed by married status at 4.118 and age below 50 years at 1.88. The completeness panel highlights that confidence intervals and exact p-values are largely missing, limiting full inferential interpretation

DISCUSSION

The present study assessed medication adherence and its associated factors among patients with type 2 diabetes mellitus attending outpatient clinical services at Lahore General Hospital. The findings indicate that medication adherence remains suboptimal, with good or high adherence reported between 28.4% and 55.6%, poor or low adherence between 34.7% and 48.5%, and non-adherence between 42.7% and 62.0%. These findings are clinically

important because long-term adherence to antidiabetic therapy is central to glycemic control, prevention of diabetes-related complications, and reduction of avoidable healthcare utilization. Similar adherence challenges have been reported in other hospital-based populations with type 2 diabetes mellitus, supporting the view that non-adherence is a persistent and clinically relevant barrier to effective diabetes care (1).

The adherence pattern observed in this study is broadly consistent with previous Pakistani evidence. Hassan-Gillani et al. reported 28.4% high adherence and 48.5% low adherence among diabetic patients in Punjab, which falls within the adherence range observed in the present Lahore cohort (2). Ihsan et al. also reported poor compliance in 34.7% of patients with type 2 diabetes mellitus presenting to a tertiary-care hospital in Abbottabad, again aligning with the lower bound of poor adherence identified in the present analysis (3). This consistency across geographically distinct Pakistani settings suggests that medication non-adherence is not merely a local clinic-level problem but may reflect broader health-system, socioeconomic, and patient-level barriers affecting diabetes management across the country.

The demographic profile of the present study also overlaps with prior regional findings. The reported mean age range of 48.8–56.6 years is comparable with the mean age reported by Hassan-Gillani et al. and with other studies focusing on middle-aged and older adults with type 2 diabetes mellitus (2,6). Female representation ranged from 43.5% to 76.5%, while male representation ranged from 23.5% to 56.6%, indicating variability in clinic attendance patterns. Such variation may reflect differences in healthcare-seeking behavior, referral patterns, household decision-making, and access to chronic disease care. Previous studies have shown that sociodemographic characteristics may influence adherence through mechanisms related to health literacy, financial access, social support, and perceived treatment necessity (4,9).

Age was associated with adherence in the present study, with age below 50 years showing an adjusted odds ratio of 1.88. This finding suggests that relatively younger patients may have better capacity to follow prescribed treatment, possibly because of greater mobility, better treatment comprehension, fewer comorbidities, or stronger perceived benefit from long-term disease control. However, the association between age and adherence remains inconsistent across the literature. Majeed et al. reported adherence-related quality-of-life issues among patients with type 2 diabetes mellitus, while other studies have shown that older age may either improve adherence through established routines or reduce adherence through polypharmacy, cognitive burden, and comorbid illness (6,15). Therefore, age should not be interpreted as a standalone determinant but as a marker interacting with treatment burden, education, family support, and disease duration.

Married status showed a strong association with adherence, with an adjusted odds ratio of 4.118. This finding highlights the potential role of family structure and social support in long-term diabetes care. In the Pakistani sociocultural context, spouses and family members may support medication reminders, clinic visits, dietary regulation, and financial decision-making. Although marital status has not been consistently emphasized in previous Pakistani adherence studies, evidence from broader diabetes self-management research supports the role of social support in improving treatment engagement and health behaviors (13,17). This finding suggests that family-centered counseling may be particularly useful in outpatient diabetes services.

Non-smoking status showed the strongest reported association with adherence, with an adjusted odds ratio of 12.98. This may indicate clustering of health-promoting behaviors, where patients who avoid smoking may also be more likely to follow medication schedules, attend follow-up visits, and engage with lifestyle advice. Similar patterns have been reported in chronic disease literature, where smoking is often associated with lower adherence, poorer self-management, and reduced preventive health behaviors (15,19). In clinical practice, smoking status may therefore serve as a practical marker for identifying patients who require more intensive adherence counseling and behavioral support.

Treatment complexity was also associated with adherence. Multiple daily dosing was significantly associated with adherence status, supporting previous evidence that complex regimens, insulin use, combination therapy, and frequent dosing schedules can reduce medication-taking consistency (7,10). This finding is clinically actionable. Simplifying regimens where appropriate, using fixed-dose combinations, aligning medication schedules with daily routines, reducing unnecessary polypharmacy, and providing insulin-specific counseling may improve adherence among patients with type 2 diabetes mellitus. These strategies are especially relevant in high-volume public-sector clinics where consultation time is limited and patients may face financial constraints.

Education level, diabetes knowledge, and treatment satisfaction were also reported as associated with adherence. This is consistent with Ishaq et al., who found significant relationships among diabetes-related knowledge,

medication adherence, and health-related quality of life in Pakistani patients with type 2 diabetes mellitus (5). Disease knowledge may improve adherence by strengthening patients' understanding of asymptomatic hyperglycemia, long-term complications, and the need for continued therapy even when symptoms are absent. Treatment satisfaction may also influence adherence by improving trust, reducing perceived treatment burden, and increasing willingness to maintain prescribed therapy. These findings support structured diabetes education as a core component of outpatient diabetes care rather than an optional supplement.

This study has important clinical and public health implications. Patients with poor adherence are at risk of preventable complications, yet many adherence determinants identified in this study are modifiable. Clinic-based interventions should include adherence screening, simplified prescribing, counseling on missed doses, family involvement, smoking cessation support, and targeted education for patients with low diabetes knowledge. At the health-system level, consistent medication availability, affordable treatment, and structured follow-up systems are likely to improve adherence in public-sector diabetes services. Similar recommendations have been emphasized in international studies examining barriers to adherence across Asian and low- and middle-income settings (8,16,18).

The main limitation of the present analysis is that several results are currently reported as ranges rather than single cohort-specific estimates. This limits precision in direct comparisons with previous studies and prevents complete interpretation of effect size magnitude. In addition, confidence intervals and exact p-values were not available for several predictors, limiting assessment of statistical precision. The cross-sectional design also prevents causal inference, and adherence measured through questionnaire-based tools may be affected by recall bias or social desirability bias. Despite these limitations, the study addresses an important clinical problem in a large tertiary-care outpatient population and identifies several potentially modifiable adherence-related factors. Future research should use standardized adherence tools, report complete regression outputs with confidence intervals, and evaluate intervention-based strategies to improve adherence among Pakistani patients with type 2 diabetes mellitus.

CONCLUSION

Medication adherence among patients with type 2 diabetes mellitus attending Lahore General Hospital was suboptimal, with substantial reported non-adherence and several demographic, behavioral, socioeconomic, and treatment-related factors associated with adherence status. Younger age, married status, non-smoking status, socioeconomic status, education level, diabetes knowledge, treatment satisfaction, and treatment complexity emerged as clinically relevant adherence-related factors. These findings suggest that improving adherence in Pakistani outpatient diabetes care requires a multifaceted strategy that combines structured patient education, family involvement, regimen simplification, behavioral counseling, and targeted support for socioeconomically vulnerable patients.

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