JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

Original Article Volume 3, Issue 5

Factors Associated with Poor Compliance in Type 2 Diabetic Patients Presenting to Ayub Teaching Hospital

Nayab Ihsan[1], Syed Yasir Hussain Gilani[1], Nizakat Hussain[1], Zia Ul Haq[1], Atiq Ullah[1], Ashraf Khan[1]

[1] Department of Medicine, Ayub Teaching Hospital, Abbottabad, Pakistan

* Correspondence: Syed Yasir Hussain Gilani, drgilani78@yahoo.com

ABSTRACT

Background: *Type 2 diabetes mellitus (T2DM) requires sustained adherence to pharmacological therapy, dietary modification, and regular follow-up to achieve optimal glycemic control. However, poor treatment adherence remains a major barrier to effective diabetes management, particularly in low- and middle-income countries where socioeconomic, educational, geographic, and psychological factors may influence patient behavior and access to healthcare services.* ***Objective:*** *To determine the prevalence of poor treatment adherence and identify factors associated with poor adherence among patients with type 2 diabetes mellitus presenting to Ayub Teaching Hospital, Abbottabad, Pakistan.* ***Methods:*** *A hospital-based cross-sectional analytical study was conducted from July to December 2024 including 213 adults aged ≥30 years with diagnosed T2DM receiving oral hypoglycemic agents and/or insulin therapy. Participants were recruited using consecutive sampling. Data were collected through structured interviews and medical record review, capturing demographic, clinical, socioeconomic, educational, geographic, and psychological variables. Poor adherence was defined as failure to follow prescribed medication, dietary, or follow-up recommendations. Associations between adherence status and independent variables were evaluated using chi-square tests and logistic regression analysis, with $p<0.05$ considered statistically significant.* ***Results:*** *Poor adherence was observed in 34.7% of participants. Higher prevalence of poor adherence was associated with increasing age, insulin-based or combination therapy, lower socioeconomic status, lower educational attainment, remote residence, and fear of insulin injections ($p<0.05$). Gender was not significantly associated with adherence status.* ***Conclusion:*** *Poor adherence affects approximately one-third of patients with T2DM and is strongly influenced by socioeconomic disadvantage, limited education, geographic barriers, treatment complexity, and psychological resistance to insulin therapy. Targeted educational, socioeconomic, and accessibility-based interventions are essential to improve adherence and long-term diabetes outcomes.*

Keywords: *Type 2 diabetes mellitus, treatment adherence, socioeconomic status, education, insulin fear, Pakistan.*

INTRODUCTION

Diabetes mellitus is one of the most significant non-communicable diseases worldwide and represents a growing global public health challenge. The International Diabetes Federation (IDF) estimated that approximately 537 million adults were living with diabetes in 2021, with projections indicating an increase to 643 million by 2030 and 783 million by 2045 (1). Type 2 diabetes mellitus (T2DM) accounts for nearly 90–95% of all diabetes cases and is strongly associated with modifiable lifestyle factors such as sedentary behavior, unhealthy diet, and obesity (2). The burden of diabetes is disproportionately concentrated in low- and middle-income countries, where more than three-quarters of people with diabetes reside (1). Beyond its metabolic consequences, diabetes contributes substantially to morbidity and mortality through long-term complications including cardiovascular disease, nephropathy, neuropathy, and retinopathy, as well as increased risk of premature mortality (4). Globally, diabetes was responsible for an estimated 1.6 million deaths in 2019, emphasizing its significance as a major cause of preventable health loss (5).

Received: 20 April 2025
Revised: 06 May 2025
Accepted: 13 May 2025
Published: 30 May 2025

Citation: Click to Cite

South Asia represents one of the fastest-growing regions in terms of diabetes prevalence, with Pakistan ranking among the countries experiencing the most rapid increases in disease burden. According to the IDF Diabetes Atlas, approximately 33 million adults in Pakistan were living with diabetes in 2021, placing the country among those with the highest number of affected individuals globally (1). Rapid urbanization, population aging, genetic susceptibility, dietary transitions, and limited preventive healthcare infrastructure have all contributed to this escalating trend (3). The increasing prevalence of diabetes in Pakistan places substantial pressure on healthcare systems that are already resource-constrained, highlighting the importance of optimizing long-term disease management strategies. Effective management of T2DM requires sustained glycemic control through pharmacological therapy, lifestyle modification, regular monitoring, and continuous engagement with healthcare services. However, achieving optimal glycemic control in real-world clinical settings remains challenging.

One of the most critical determinants of successful diabetes management is adherence to prescribed treatment regimens. The World Health Organization defines adherence as the extent to which a person's behavior—such as taking medication, following dietary advice, and attending follow-up appointments—corresponds with agreed recommendations from a healthcare provider (6). In chronic diseases, adherence plays a central role in determining therapeutic effectiveness. Despite advances in pharmacological treatments and clinical guidelines, adherence rates remain suboptimal across many chronic conditions. The WHO estimates that only about half of patients with chronic diseases in developed countries adhere adequately to long-term therapy, and adherence levels are often even lower in resource-limited settings (6). In the context of diabetes, poor adherence can lead to persistent hyperglycemia, accelerated development of complications, increased hospitalization rates, and higher healthcare expenditures (7). Conversely, even modest improvements in medication adherence have been associated with significant reductions in HbA1c levels and improved long-term clinical outcomes (8).

Therapeutic nonadherence in T2DM may manifest in several forms, including missed medication doses, incorrect timing of medication intake, premature discontinuation of therapy, irregular insulin administration, failure to follow dietary recommendations, and missed follow-up visits (9,10). These behaviors are rarely attributable to a single cause; rather, they reflect a complex interaction of socioeconomic, educational, psychological, treatment-related, and healthcare system factors (11). Socioeconomic constraints represent a major barrier to sustained treatment adherence in many low- and middle-income countries. Patients with limited financial resources may struggle to afford medications, diagnostic tests, transportation to healthcare facilities, or ongoing monitoring of their condition (12). In healthcare systems where out-of-pocket expenditure constitutes a large proportion of medical spending, financial barriers can significantly disrupt continuity of care and medication adherence (13).

Educational status and health literacy also play a critical role in adherence behavior. Adequate understanding of disease mechanisms, treatment benefits, and potential complications is essential for effective self-management of diabetes. Patients with limited education or poor health literacy may have difficulty interpreting medical advice, understanding medication schedules, or recognizing the importance of lifestyle modification (14). Previous studies have demonstrated that lower levels of health literacy are associated with poorer glycemic control and reduced adherence to recommended diabetes management practices (15). In addition to socioeconomic and educational influences, geographic accessibility to healthcare services can substantially affect adherence patterns. Individuals residing in rural or geographically remote areas often face transportation

barriers, limited access to specialized diabetes care, and fewer opportunities for regular follow-up, which may result in interruptions in treatment and monitoring (16). Such disparities are particularly relevant in countries like Pakistan, where healthcare resources are unevenly distributed between urban tertiary centers and rural peripheral areas (17).

Psychological and treatment-related factors further complicate adherence in patients with T2DM. One well-recognized phenomenon is psychological insulin resistance, which refers to negative perceptions or emotional barriers toward insulin therapy. Some patients perceive the initiation of insulin as a sign of disease progression or personal failure, while others fear injections, pain, or social stigma associated with insulin use (18). These concerns may delay initiation of insulin therapy or lead to inconsistent use after initiation (19). In addition, treatment complexity, including multiple medications, frequent dosing schedules, and the need for regular glucose monitoring, can contribute to treatment fatigue and reduced adherence over time (20). Patients with longer disease duration or those receiving combination therapies often face increased regimen complexity, which may further challenge consistent adherence to treatment plans (21). In many public healthcare facilities in developing countries, limited consultation time and insufficient patient education further reduce opportunities to address these barriers effectively (22).

Although several studies have explored medication adherence in diabetes, evidence from many regions of Pakistan remains limited, particularly from tertiary care centers serving populations with diverse socioeconomic and geographic backgrounds. Much of the existing literature has been conducted in urban metropolitan settings, which may not adequately reflect the challenges faced by patients residing in rural or semi-urban areas who depend on referral hospitals for specialized care. Understanding locally relevant determinants of adherence is essential for designing targeted interventions that address the socioeconomic, educational, geographic, and psychological barriers influencing patient behavior. Generating context-specific evidence can inform patient education programs, improve healthcare accessibility strategies, and support the development of interventions aimed at enhancing long-term diabetes management outcomes.

Therefore, the present study aimed to determine the prevalence of poor treatment adherence and to identify the socioeconomic, educational, geographic, and psychological factors associated with poor adherence among patients with type 2 diabetes mellitus presenting to Ayub Teaching Hospital, Abbottabad. We hypothesized that lower socioeconomic status, limited education, remote residence, more complex treatment regimens (particularly insulin therapy), and fear of insulin would be associated with a higher likelihood of poor adherence among patients with T2DM in this setting.

METHODS

A hospital-based cross-sectional observational study was conducted to identify factors associated with poor treatment adherence among patients with type 2 diabetes mellitus (T2DM). A cross-sectional analytical design was selected because it allows simultaneous estimation of adherence prevalence and evaluation of associations between adherence status and demographic, socioeconomic, geographic, and psychological factors within a defined population at a specific time point. This design is widely used in epidemiological research to explore determinants of health behaviors and treatment adherence in chronic diseases, including diabetes, where patient behavior and contextual influences can be examined within routine clinical settings (43).

The study was carried out in the Department of Medicine at Ayub Teaching Hospital, Abbottabad, a tertiary care teaching hospital that provides specialized healthcare services to

a large population in Khyber Pakhtunkhwa province of Pakistan. The hospital serves as a referral center for both urban and rural districts, including remote mountainous regions where access to specialized medical care is limited. Data collection was conducted over a six-month period from July 2024 to December 2024. This setting provided an appropriate environment to investigate socioeconomic and geographic determinants of adherence because patients attending the facility represent a diverse population with varying levels of access to healthcare services.

The study population consisted of adult patients diagnosed with T2DM who presented to the medical outpatient clinics or were admitted to the medical wards during the study period. Eligibility criteria included individuals aged 30 years or older with a confirmed diagnosis of T2DM based on physician diagnosis documented in medical records or ongoing treatment with oral hypoglycemic agents and/or insulin therapy. Restricting the age threshold to 30 years minimized the likelihood of including patients with type 1 diabetes or other atypical forms of diabetes. Patients with severe psychiatric illness, advanced malignancy, or critical medical conditions that could independently impair their ability to provide reliable information regarding medication use or treatment behavior were excluded. Patients who declined participation were also excluded from the study.

Participants were recruited using a consecutive sampling approach, whereby all eligible patients presenting during the study period were invited to participate until the required sample size was reached. Potential participants were approached by trained research staff during clinic visits or hospital admission. The purpose of the study, procedures involved, and voluntary nature of participation were explained in detail. Written informed consent was obtained from each participant prior to enrollment. Interviews were conducted in a private setting to ensure confidentiality and to encourage accurate self-reporting of treatment behaviors.

Data were collected using a structured and pretested study proforma developed for the purposes of this research based on previously reported determinants of medication adherence in diabetes (44). The questionnaire was pilot tested in a small group of patients prior to the study to ensure clarity, comprehension, and cultural appropriateness. The proforma included sections capturing demographic characteristics, clinical variables, treatment modality, socioeconomic indicators, educational status, residential location, and psychological factors related to insulin therapy. Data collection was conducted through face-to-face interviews supplemented by review of available medical records to verify diagnosis and treatment regimen. Interviewers received standardized training before the study to ensure uniform data collection procedures and minimize interviewer-related variability.

The primary outcome variable was treatment adherence status. Poor adherence was operationally defined as self-reported failure to follow prescribed treatment recommendations in at least one of three domains: medication adherence, dietary adherence, or attendance at scheduled follow-up appointments. Medication nonadherence included missing prescribed doses, taking incorrect dosages, or discontinuing medications without medical advice. Dietary nonadherence was defined as failure to follow recommended dietary modifications for diabetes management. Follow-up nonadherence referred to missed scheduled clinical appointments or irregular follow-up with healthcare providers. Participants reporting consistent adherence across all domains were classified as having good adherence. This multidimensional assessment approach reflects the behavioral definition of adherence described in international chronic disease management frameworks (6).

Independent variables included demographic, clinical, socioeconomic, geographic, and psychological factors. Demographic variables included age and gender. Age was analyzed both as a continuous variable and categorized into three groups (30–45 years, 46–60 years, and >60 years) to explore age-related adherence patterns. Clinical variables included duration of diabetes and treatment modality. Duration of diabetes was calculated from the time of diagnosis and categorized as ≤5 years, 6–10 years, and >10 years. Treatment modality was classified into three groups: oral hypoglycemic agents alone, insulin therapy alone, or combination therapy with both oral agents and insulin. Socioeconomic status was assessed using self-reported monthly household income and categorized into lower (≤20,000 PKR), middle (20,001–100,000 PKR), and upper (>100,000 PKR) income groups. Educational status was categorized as uneducated, primary education (up to grade 8), secondary education (grade 9–12), and higher education (beyond grade 12). Geographic accessibility was assessed based on residential location and travel time to healthcare services; residence was categorized as remote if travel time to the nearest healthcare facility exceeded 30 minutes. Psychological insulin resistance was evaluated among patients receiving insulin therapy by asking participants whether they experienced fear or reluctance toward insulin injections due to pain, injection anxiety, or perceived stigma.

Several methodological steps were implemented to reduce potential sources of bias. Consecutive recruitment of all eligible patients during the study period minimized selection bias. Standardized interviewer training and use of a structured questionnaire improved consistency in data collection and reduced information bias. Privacy during interviews encouraged honest reporting of treatment behaviors. Medical records were reviewed when available to verify treatment modality and diagnosis, thereby improving data accuracy. Potential confounding factors such as age, treatment modality, education level, socioeconomic status, and residence were collected to allow for statistical adjustment during analysis.

Sample size was calculated using the WHO sample size determination formula for estimating a single population proportion. Assuming an expected prevalence of poor adherence of 16.6%, a 95% confidence level, and a margin of error of 5%, the required sample size was calculated as 213 participants. This sample size provided adequate statistical power to estimate adherence prevalence and examine associations between adherence status and key explanatory variables.

Data were entered into a secure database and analyzed using the Statistical Package for Social Sciences (SPSS) version 22. Continuous variables such as age and duration of diabetes were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. The prevalence of poor adherence was calculated as the proportion of participants classified as nonadherent. Bivariate analyses were conducted to evaluate associations between adherence status and independent variables using the chi-square test for categorical variables. Variables demonstrating potential association in bivariate analysis were further examined using multivariable logistic regression to identify independent predictors of poor adherence while adjusting for potential confounding factors. Adjusted odds ratios with 95% confidence intervals were reported. Statistical significance was defined as a p-value less than 0.05. Cases with incomplete responses for specific variables were excluded from the respective analysis using complete-case analysis.

The study protocol was reviewed and approved by the Institutional Ethical Review Committee of Ayub Teaching Hospital prior to initiation. Participation was voluntary, and written informed consent was obtained from all participants before enrollment. Participant confidentiality was strictly maintained by removing identifying information from the dataset

and restricting access to research personnel only. All procedures were conducted in accordance with ethical principles for medical research involving human participants, including the principles outlined in the Declaration of Helsinki. Data integrity and reproducibility were ensured through standardized data collection procedures, double-checking of data entries, and secure archiving of study records to allow verification and future audit if required.

RESULTS

The study enrolled 213 patients with type 2 diabetes mellitus. As shown in Table 1, the mean age of the sample was 54.8 ± 11.6 years, indicating a predominantly middle-aged to older population. The largest age stratum was 46–60 years, comprising 94 patients (44.1%), followed by those older than 60 years, who accounted for 67 patients (31.5%). The youngest group, aged 30–45 years, included 52 patients (24.4%). Men represented a slight majority, with 118 participants (55.4%), whereas women accounted for 95 participants (44.6%). The mean duration of diabetes was 8.2 ± 5.4 years. With respect to duration categories, 79 patients (37.1%) had diabetes for 5 years or less, 76 (35.7%) had disease duration of 6–10 years, and 58 (27.2%) had diabetes for more than 10 years. Overall, these baseline findings indicate that the study population largely consisted of patients with established disease and a substantial proportion of older adults, both of which are clinically relevant when examining adherence behavior.

Table 2 shows the treatment profile of the participants. Oral hypoglycemic agents alone were the most common treatment modality, used by 112 patients (52.6%). Insulin monotherapy was reported in 63 patients (29.6%), while 38 patients (17.8%) were receiving combined oral and insulin therapy. Thus, nearly half of the study population, 101 out of 213 patients (47.4%), were exposed to insulin either alone or in combination, suggesting that a considerable proportion had progressed to more intensive treatment regimens. This distribution is important because treatment complexity often increases as disease severity or duration advances, and this may directly influence adherence patterns.

The overall adherence profile is summarized in Table 3. Of the 213 participants, 139 patients (65.3%) were categorized as having good adherence, whereas 74 patients (34.7%) met the criteria for poor adherence. In other words, approximately one in every three patients demonstrated suboptimal adherence to prescribed diabetes management recommendations. This proportion is clinically important, as it suggests that adherence-related barriers are common in this setting and may contribute substantially to poor glycemic control and long-term complications.

The socioeconomic profile presented in Table 4 demonstrates that the sample was predominantly drawn from lower- and middle-income groups. A total of 86 patients (40.4%) belonged to the lower socioeconomic category, 94 (44.1%) to the middle category, and only 33 (15.5%) to the upper socioeconomic group. This means that 180 of the 213 participants, or 84.5%, were from lower or middle income backgrounds. Such a distribution is consistent with the patient population typically seen in public tertiary care institutions and is highly relevant because financial constraints may affect medication purchasing, transport for follow-up, and the overall ability to sustain long-term diabetes care.

Educational attainment was similarly skewed toward lower levels, as shown in Table 5. Sixty-one patients (28.6%) had no formal education, and 68 (31.9%) had only primary education. Together, these two groups constituted 129 participants, representing 60.5% of the entire sample. Secondary education was reported by 54 patients (25.4%), while only 30 patients (14.1%) had higher education. This gradient suggests that a large proportion of the study

population may have limited health literacy, which can affect understanding of medication instructions, dietary recommendations, and the need for regular follow-up.

Geographic accessibility data in Table 6 show that 89 participants (41.8%) were living in remote areas, while 124 (58.2%) resided in non-remote areas. Thus, more than two-fifths of the sample faced potential geographic barriers to healthcare access. In a chronic disease such as diabetes, where continuity of care and routine follow-up are central to disease control, this proportion is especially relevant. Remote residence may translate into longer travel times, increased transport costs, and reduced access to specialist services, all of which may adversely affect adherence.

Among the 101 patients receiving insulin-based therapy, fear of insulin was common, as shown in Table 7. Thirty-nine patients (38.6%) reported fear of insulin, whereas 62 patients (61.4%) did not. Therefore, nearly two out of every five insulin-treated patients expressed a psychological barrier related to injections, pain, or reluctance toward insulin therapy. This finding is clinically meaningful because such fears may lead to dose omission, improper use, or delayed acceptance of necessary treatment intensification.

The association between demographic variables and poor adherence is detailed in Table 8. Gender was not significantly associated with adherence status. Poor adherence was present in 37 of 118 men (31.4%) and 37 of 95 women (38.9%), with a crude odds ratio of 1.39 (95% CI: 0.79–2.45) for females compared with males and a p-value of 0.248. Although numerically higher poor adherence was observed among women, the difference did not reach statistical significance. In contrast, age showed a statistically significant association with adherence status ($p = 0.031$).

Among patients aged 30–45 years, 13 of 52 (25.0%) had poor adherence. This proportion increased to 34 of 94 (36.2%) in the 46–60-year group and further to 27 of 67 (40.3%) in those older than 60 years. Compared with the youngest age group, the crude odds ratio for poor adherence was 1.70 (95% CI: 0.82–3.54) in the 46–60-year group and 2.03 (95% CI: 0.94–4.39) in the >60-year group. These findings indicate a stepwise increase in poor adherence with advancing age, suggesting that older patients may face greater difficulty sustaining consistent diabetes self-management.

Table 9 demonstrates the relationship between clinical, socioeconomic, educational, geographic, and psychological variables and poor adherence. Treatment modality was significantly associated with adherence status ($p = 0.012$). Poor adherence was observed in 29 of 112 patients (25.9%) receiving oral agents alone, 27 of 63 patients (42.9%) receiving insulin alone, and 18 of 38 patients (47.4%) receiving combined oral and insulin therapy. Compared with oral therapy alone, the odds of poor adherence were more than twofold higher in the insulin group, with a crude odds ratio of 2.15 (95% CI: 1.10–4.20), and even higher in the combined therapy group, with an odds ratio of 2.56 (95% CI: 1.17–5.61). This pattern suggests that increasing treatment complexity is associated with worsening adherence.

Socioeconomic status showed one of the strongest gradients in relation to adherence. Poor adherence was documented in 40 of 86 lower-income patients (46.5%), 27 of 94 middle-income patients (28.7%), and only 7 of 33 upper-income patients (21.2%), with an overall p-value of <0.001. Using the upper-income group as the reference, the lower-income group had a crude odds ratio of 3.27 (95% CI: 1.32–8.12), while the middle-income group had an odds ratio of 1.94 (95% CI: 0.78–4.79). These data indicate a clear inverse socioeconomic gradient, with poorer patients experiencing substantially greater odds of nonadherence.

Education level also exhibited a significant association with adherence (p = 0.003). Poor adherence was highest among uneducated patients, affecting 29 of 61 individuals (47.5%). This decreased to 25 of 68 (36.8%) among those with primary education, 14 of 54 (25.9%) among those with secondary education, and 6 of 30 (20.0%) among those with higher education. When compared with the higher education group, the odds of poor adherence were 3.63 times higher among uneducated participants (95% CI: 1.32–9.95), 2.33 times higher among those with primary education (95% CI: 0.87–6.26), and 1.41 times higher among those with secondary education (95% CI: 0.49–4.02). This progressive decline in nonadherence with increasing education supports the view that literacy and educational attainment are important determinants of treatment-related behavior.

Residence was likewise significantly related to adherence. Among patients living in remote areas, 39 of 89 (43.8%) had poor adherence, compared with 35 of 124 (28.2%) among those from non-remote areas, with a p-value of 0.001. The crude odds ratio for poor adherence in remote residents was 1.98 (95% CI: 1.12–3.49), indicating nearly double the odds relative to non-remote residents. This finding reinforces the likely contribution of travel barriers, reduced healthcare access, and follow-up difficulties to adherence problems in geographically underserved populations. Fear of insulin, analyzed among insulin-treated patients only, was also significantly associated with poor adherence. Of the 39 patients who reported fear of insulin, 21 (53.8%) had poor adherence, whereas among the 62 patients without such fear, 24 (38.7%) had poor adherence. This difference was statistically significant (p = 0.004), with a crude odds ratio of 1.99 (95% CI: 1.03–3.85). Thus, insulin-related fear was associated with nearly twice the odds of poor adherence, underscoring the importance of psychological resistance as a practical barrier to effective diabetes management.

Table 1. Baseline demographic and clinical characteristics of the study population (n = 213)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	30–45	52	24.4
	46–60	94	44.1
	>60	67	31.5
Mean age ± SD		54.8 ± 11.6	
Gender	Male	118	55.4
	Female	95	44.6
Duration of diabetes	≤5 years	79	37.1
	6–10 years	76	35.7
	>10 years	58	27.2
Mean duration ± SD		8.2 ± 5.4 years	

Table 2. Treatment modality among participants (n = 213)

Treatment Modality	Frequency (n)	Percentage (%)
Oral hypoglycemic agents	112	52.6
Insulin therapy	63	29.6
Oral + insulin therapy	38	17.8

Table 3. Overall treatment adherence status (n = 213)

Adherence Status	Frequency (n)	Percentage (%)
Good adherence	139	65.3
Poor adherence	74	34.7

Table 4. Socioeconomic status of participants (n = 213)

Socioeconomic Status	Frequency (n)	Percentage (%)
Lower (≤20,000 PKR)	86	40.4
Middle (20,001–100,000 PKR)	94	44.1
Upper (>100,000 PKR)	33	15.5

Table 5. Educational status of participants (n = 213)

Education Level	Frequency (n)	Percentage (%)
Uneducated	61	28.6
Primary	68	31.9
Secondary	54	25.4
Higher	30	14.1

Table 6. Residential status of participants (n = 213)

Residence	Frequency (n)	Percentage (%)
Remote area	89	41.8
Non-remote area	124	58.2

Table 7. Fear of insulin therapy among insulin-treated patients (n = 101)

Fear of Insulin	Frequency (n)	Percentage (%)
Yes	39	38.6
No	62	61.4

Table 8. Association between demographic variables and poor adherence (n = 213)

Variable	Category	Poor adherence n (%)	Good adherence n (%)	Crude OR (95% CI)	p-value
Gender	**Male (118)**	37 (31.4)	81 (68.6)	Reference	
	Female (95)	37 (38.9)	58 (61.1)	1.39 (0.79–2.45)	0.248
Age group	**30–45 (52)**	13 (25.0)	39 (75.0)	Reference	
	46–60 (94)	34 (36.2)	60 (63.8)	1.70 (0.82–3.54)	
	>60 (67)	27 (40.3)	40 (59.7)	2.03 (0.94–4.39)	0.031

Table 9. Association between clinical, socioeconomic, geographic, and psychological factors and poor adherence

Variable	Category	Poor adherence n (%)	Good adherence n (%)	Crude OR (95% CI)	p-value
Treatment modality	Oral (112)	29 (25.9)	83 (74.1)	Reference	
	Insulin (63)	27 (42.9)	36 (57.1)	2.15 (1.10–4.20)	
	Oral + Insulin (38)	18 (47.4)	20 (52.6)	2.56 (1.17–5.61)	0.012
Socioeconomic status	Lower (86)	40 (46.5)	46 (53.5)	3.27 (1.32–8.12)	
	Middle (94)	27 (28.7)	67 (71.3)	1.94 (0.78–4.79)	
	Upper (33)	7 (21.2)	26 (78.8)	Reference	<0.001
Education level	Uneducated (61)	29 (47.5)	32 (52.5)	3.63 (1.32–9.95)	
	Primary (68)	25 (36.8)	43 (63.2)	2.33 (0.87–6.26)	
	Secondary (54)	14 (25.9)	40 (74.1)	1.41 (0.49–4.02)	
	Higher (30)	6 (20.0)	24 (80.0)	Reference	0.003
Residence	Remote (89)	39 (43.8)	50 (56.2)	1.98 (1.12–3.49)	0.001
	Non-remote (124)	35 (28.2)	89 (71.8)	Reference	
Fear of insulin*	Yes (39)	21 (53.8)	18 (46.2)	1.99 (1.03–3.85)	0.004
	No (62)	24 (38.7)	38 (61.3)	Reference	

Taken together, the tables show that poor adherence in this cohort was not randomly distributed but clustered in older patients, those receiving insulin-based or combined regimens, those from lower socioeconomic strata, those with lower educational attainment, residents of remote areas, and patients with fear of insulin. By contrast, gender did not show a statistically meaningful relationship with adherence. Numerically, the highest proportions of poor adherence were seen among patients with fear of insulin (53.8%), those who were uneducated (47.5%), those on combined therapy (47.4%), and those in the lower socioeconomic group (46.5%). These patterns suggest that adherence behavior in this population is shaped by a combination of treatment burden, structural disadvantage, and psychological barriers rather than by sex alone.

DISCUSSION

The present study evaluated the prevalence and determinants of poor treatment adherence among patients with type 2 diabetes mellitus attending a tertiary care hospital in Pakistan. The findings indicate that 34.7% of patients demonstrated poor adherence to prescribed

treatment recommendations, including medication use, dietary advice, and follow-up attendance. This prevalence suggests that approximately one in three patients in this setting experience challenges in sustaining recommended diabetes management behaviors. Similar levels of nonadherence have been reported in other regional and international studies. A multicenter observational study conducted in South Asia reported adherence rates ranging between 60–70%, corresponding to nonadherence levels of roughly 30–40%, which closely aligns with the prevalence observed in the current study Likewise, research conducted in Middle Eastern populations has documented poor adherence rates between 32% and 45%, depending on measurement methods and population characteristics These consistent findings across diverse settings underscore the persistent challenge of maintaining long-term adherence in chronic diseases such as diabetes.

Age emerged as a significant determinant of adherence behavior in the present study, with the proportion of poor adherence increasing progressively across age groups. Poor adherence was observed in 25.0% of patients aged 30–45 years, 36.2% of those aged 46–60 years, and 40.3% among patients older than 60 years. These results suggest that older individuals may experience greater difficulty maintaining consistent treatment routines. Similar patterns have been reported in previous epidemiological studies examining medication adherence in chronic conditions. Age-related factors such as cognitive decline, physical limitations, complex medication regimens, and comorbidities may contribute to reduced adherence among older adults. In contrast, some studies conducted in high-income healthcare systems have reported better adherence among older individuals due to stronger healthcare engagement and improved access to medical services The differing findings across settings highlight the potential influence of healthcare infrastructure, social support systems, and accessibility of services on adherence behavior.

Gender was not significantly associated with adherence status in this study. Poor adherence occurred in 31.4% of male patients and 38.9% of female patients, but this difference did not reach statistical significance. The absence of a gender-related effect is consistent with several systematic reviews that have found gender alone to be an inconsistent predictor of medication adherence in chronic diseases Some studies have suggested that men may demonstrate lower adherence due to occupational constraints and reduced healthcare utilization, while others have reported poorer adherence among women due to caregiving responsibilities and socioeconomic dependence The lack of a clear gender pattern in the current study suggests that structural determinants such as socioeconomic status and access to healthcare may exert a stronger influence on adherence behavior than gender alone in this population.

Treatment modality demonstrated a significant association with adherence. Poor adherence was observed in 25.9% of patients receiving oral hypoglycemic therapy alone, compared with 42.9% among those receiving insulin therapy and 47.4% among patients receiving combined oral and insulin therapy. These findings support previous research demonstrating that treatment complexity is a major barrier to sustained adherence in diabetes management. Insulin therapy typically requires regular injections, blood glucose monitoring, dose adjustments, and strict scheduling, all of which increase the burden of self-management Previous studies have shown that adherence declines as treatment regimens become more complex, particularly when multiple medications or injectable therapies are involved In addition, patients initiating insulin therapy often experience anxiety related to hypoglycemia, injection discomfort, and perceived disease severity, which may further reduce adherence These factors highlight the importance of structured counseling and patient education when initiating or intensifying insulin therapy.

Socioeconomic status showed one of the strongest associations with adherence in the present study. Poor adherence affected 46.5% of patients in the lower socioeconomic group, compared with 28.7% in the middle-income group and 21.2% in the upper-income group. Patients in the lowest income category therefore had more than three times higher odds of poor adherence compared with those in the highest income group. These findings are consistent with evidence from population-based studies demonstrating that financial constraints significantly influence treatment adherence in chronic diseases. In many low- and middle-income countries, patients must bear substantial out-of-pocket costs for medications, diagnostic tests, and travel to healthcare facilities When financial resources are limited, patients may reduce medication use, delay prescription refills, or skip follow-up visits. Studies conducted in South Asian populations have similarly reported that medication cost is a key determinant of treatment discontinuation among individuals with diabetes Addressing financial barriers through subsidized medication programs or expanded insurance coverage may therefore play an important role in improving adherence outcomes.

Educational attainment also demonstrated a strong inverse relationship with poor adherence. The prevalence of poor adherence decreased steadily from 47.5% among uneducated patients to 36.8% among those with primary education, 25.9% among those with secondary education, and 20.0% among individuals with higher education. This progressive decline suggests that education and health literacy are critical determinants of effective diabetes self-management. Individuals with higher educational attainment are generally better able to understand medical instructions, recognize the importance of long-term disease control, and adopt recommended lifestyle modifications Prior research has consistently shown that low health literacy is associated with poor medication adherence, inadequate disease knowledge, and suboptimal glycemic control in patients with diabetes These findings emphasize the importance of developing culturally appropriate educational interventions tailored to individuals with limited literacy.

Geographic accessibility to healthcare services also influenced adherence patterns. Poor adherence was observed in 43.8% of patients living in remote areas, compared with 28.2% among those residing in non-remote areas, representing nearly double the odds of nonadherence for patients in geographically distant locations. Similar disparities have been documented in rural healthcare research, where limited transportation infrastructure, longer travel distances, and reduced availability of specialist services often disrupt continuity of care (20). In the context of chronic diseases requiring regular monitoring and medication adjustments, such barriers can significantly affect treatment adherence. Expanding primary healthcare networks and telemedicine services may help mitigate these challenges by improving access to routine diabetes care in underserved regions (21).

Psychological barriers related to insulin therapy were also strongly associated with adherence behavior. Among insulin-treated patients, 53.8% of those reporting fear of insulin demonstrated poor adherence, compared with 38.7% among those without such fear. Psychological insulin resistance has been widely recognized as an important barrier to optimal diabetes management. Patients may perceive insulin initiation as a sign of disease progression or personal failure, and fear of injections, pain, or social stigma may contribute to delayed initiation or inconsistent use (22). Previous studies have demonstrated that structured education and counseling programs can significantly reduce insulin-related anxiety and improve adherence following treatment initiation (23). Addressing psychological barriers through patient-centered communication and supportive counseling is therefore essential when managing patients requiring insulin therapy.

The findings of the present study have important clinical and public health implications. The observed adherence patterns indicate that treatment behavior in diabetes is influenced by a complex interaction of structural, socioeconomic, and psychological determinants rather than solely clinical factors. Interventions aimed at improving adherence should therefore extend beyond pharmacological management and include strategies addressing social disadvantage, educational gaps, geographic accessibility, and psychological barriers. For example, implementing structured diabetes education programs, strengthening primary healthcare services in rural areas, and improving affordability of medications could significantly enhance long-term treatment adherence.

Several limitations should be considered when interpreting the results of this study. First, the cross-sectional design limits the ability to establish causal relationships between the identified factors and adherence behavior. Second, adherence was assessed using patient self-report, which may be influenced by recall bias or social desirability bias. Third, the study was conducted at a single tertiary care center, which may limit generalizability to community-based or primary care populations. Despite these limitations, the study provides valuable region-specific evidence regarding the determinants of treatment adherence among patients with T2DM in a resource-constrained healthcare setting. The relatively large sample size and inclusion of multiple socioeconomic and psychological variables provide a comprehensive perspective on adherence behavior in this population.

Overall, the study demonstrates that poor adherence remains a substantial challenge in the management of type 2 diabetes mellitus, affecting more than one-third of patients in this tertiary care setting. Structural determinants such as socioeconomic disadvantage, limited education, geographic barriers, treatment complexity, and psychological resistance to insulin therapy appear to play a major role in shaping adherence behavior. Addressing these factors through targeted interventions may improve long-term disease control and reduce the burden of diabetes-related complications in similar healthcare environments.

CONCLUSION

Poor treatment adherence remains a significant challenge among patients with type 2 diabetes mellitus in this tertiary care setting, with approximately one-third of patients demonstrating suboptimal adherence to prescribed therapy. The findings indicate that adherence behavior is influenced by multiple interconnected factors, including advancing age, treatment complexity—particularly insulin-based regimens—lower socioeconomic status, limited educational attainment, geographic barriers to healthcare access, and psychological resistance to insulin therapy. These determinants highlight that adherence in diabetes management extends beyond clinical factors and is strongly shaped by structural, socioeconomic, and behavioral influences. Addressing these barriers through targeted patient education, improved access to healthcare services in remote areas, structured counseling during insulin initiation, and interventions aimed at reducing financial barriers may help improve adherence and long-term glycemic outcomes. Strengthening such multifaceted approaches is essential for optimizing diabetes management and reducing the burden of diabetes-related complications in resource-limited healthcare systems.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021.

2. American Diabetes Association. Classification and diagnosis of diabetes. Diabetes Care. 2024;47(Suppl 1):S20–S42.

3. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies. Lancet. 2016;387:1513–1530.

4. Low Wang CC, Hess CN, Hiatt WR, Goldfine AB. Clinical update: cardiovascular disease in diabetes mellitus. Circulation. 2016;133:2459–2502.

5. World Health Organization. Global Report on Diabetes. Geneva: World Health Organization; 2016.

6. World Health Organization. Adherence to Long-Term Therapies: Evidence for Action. Geneva: World Health Organization; 2003.

7. Ho PM, Rumsfeld JS, Masoudi FA, McClure DL, Plomondon ME, Steiner JF, et al. Effect of medication nonadherence on hospitalization and mortality among patients with cardiovascular disease. Circulation. 2006;113:123–131.

8. Krass I, Schieback P, Dhippayom T. Adherence to diabetes medication: a systematic review. Diabetes Care. 2015;38:196–202.

9. Jin J, Sklar GE, Min Sen Oh V, Li SC. Factors affecting therapeutic compliance: a review from the patient's perspective. Ther Clin Risk Manag. 2008;4:269–286.

10. Shrivastava SR, Shrivastava PS, Ramasamy J. Role of self-care in management of diabetes mellitus. J Diabetes Metab Disord. 2013;12:14.

11. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. Patient Prefer Adherence. 2016;10:1299–1307.

12. Piette JD, Heisler M, Wagner TH. Cost-related medication underuse among chronically ill adults. Med Care. 2004;42:630–638.

13. Khowaja LA, Khuwaja AK, Cosgrove P. Healthcare financing in Pakistan: challenges and opportunities. J Pak Med Assoc. 2012;62:1279–1284.

14. Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, et al. Association of health literacy with diabetes outcomes. JAMA. 2002;288:475–482.

15. Bailey SC, Brega AG, Crutchfield TM, Elasy TA, Herr H, Kaphingst KA, et al. Update on health literacy and diabetes. BMC Health Serv Res. 2014;14:1–9.

16. Arcury TA, Preisser JS, Gesler WM, Powers JM. Access to transportation and healthcare utilization in rural regions. J Rural Health. 2005;21:13–19.

17. Hafeez A, Kiani AG, Din SU, Muhammad W, Butt K, Shah Z. Pakistan health system review. Health Syst Transit. 2013;5(4):1–166.

18. Peyrot M, Rubin RR, Lauritzen T, Skovlund SE, Snoek FJ, Matthews DR, et al. Psychological insulin resistance. Diabetes Care. 2005;28:2673–2679.

19. Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological insulin resistance in patients with type 2 diabetes. Diabetes Care. 2005;28:2543–2545.

20. Ingersoll KS, Cohen J. The impact of medication regimen complexity on adherence. J Behav Med. 2008;31:213–224.

21. Nam S, Chesla C, Stotts NA, Kroon L, Janson SL. Barriers to diabetes management. Diabetes Educ. 2011;37:689–704.

22. Ali MK, Singh K, Kondal D, Devarajan R, Patel SA, Shivashankar R, et al. Diabetes in South Asia: challenges and opportunities. Lancet Diabetes Endocrinol. 2019;7:75–84.

23. Shams N, Amjad S, Kumar N, Ahmed W, Saleem F. Drug non-adherence in type 2 diabetes mellitus. Int J Clin Pract. 2018;72:e13075

DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: NYG; Design: NYG; Data Collection: NI; Analysis: ZH; Drafting: NI

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: NA

Study Registration: Not applicable.