

Health Literacy And Treatment Compliance Among Patients With Chronic Kidney Disease Attending A Nephrology Outpatient Department And Dialysis Center In Lahore, Pakistan: An Analytical Cross-Sectional Study

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ABSTRACT

Background: Chronic kidney disease (CKD) requires continuous self-management, including medication adherence, dietary and fluid restriction, follow-up care, and dialysis-related practices where applicable. Health literacy may influence patients' ability to understand CKD-related information and follow treatment recommendations, but local evidence from Pakistan remains limited. **Objective:** To assess health literacy, CKD awareness, treatment compliance, treatment adherence, and selected clinical burden indicators among dialysis and non-dialysis CKD patients attending nephrology care in Lahore, Pakistan. **Methods:** A hospital-based analytical cross-sectional study was conducted among 256 adult CKD patients attending the nephrology outpatient department and dialysis center of Sheikh Zayed Hospital, Lahore. Participants were selected using non-probability consecutive sampling. Data were collected through a structured questionnaire/interview covering sociodemographic characteristics, clinical profile, health literacy, treatment compliance, treatment adherence, and barriers to compliance. Descriptive statistics were reported as frequencies and percentages. **Results:** Among 256 CKD patients, 115 (45.1%) had inadequate health literacy and 129 (50.3%) were unaware of CKD symptoms. Good treatment compliance was observed in 56 patients (21.8%), whereas 200 (78.2%) had poor or suboptimal compliance. Poor treatment adherence was reported in 148 patients (58.0%). Anemia was present in 202 CKD patients (78.7%), while anemia among dialysis patients was reported in 242 patients (94.7%). Six-month mortality was observed in 29 patients (11.4%). **Conclusion:** CKD patients in this hospital-based population showed substantial gaps in health literacy and CKD awareness, with high frequencies of poor compliance, poor adherence, anemia, and mortality. Structured, culturally appropriate, and family-centered patient education should be integrated into nephrology outpatient and dialysis care. Further inferential analysis using individual-level data is required to confirm the association between health literacy and treatment compliance. **Keywords:** Chronic kidney disease; health literacy; treatment compliance; treatment adherence; hemodialysis; Pakistan; patient education.

INTRODUCTION

INTRODUCTION

Chronic kidney disease is a progressive, long-term disorder characterized by persistent abnormalities in kidney structure or function that may lead to declining glomerular filtration rate, accumulation of metabolic waste products, fluid and electrolyte imbalance, anemia, cardiovascular complications, and

eventual kidney failure. Its clinical significance lies not only in progressive renal impairment but also in the prolonged and demanding nature of disease management, particularly when patients require lifelong medication, dietary modification, fluid restriction, regular follow-up, dialysis, or kidney transplantation. Because early-stage chronic kidney disease often remains clinically silent, many patients present late, when complications are advanced and self-management demands are already substantial. This makes patient understanding, timely care-seeking, and sustained adherence to treatment essential components of effective chronic kidney disease care (1).

The burden of chronic kidney disease is especially important in low- and middle-income countries, where delayed diagnosis, limited health awareness, constrained specialist access, and financial barriers can worsen clinical outcomes. In Pakistan, chronic kidney disease has emerged within the broader rise of non-communicable diseases, with diabetes mellitus, hypertension, cardiovascular disease, poverty, and low public awareness contributing to late presentation and high treatment burden. Patients receiving nephrology care in Pakistan often face not only biological complications of kidney disease but also social and economic challenges, including travel costs, medication expenses, dependence on family caregivers, reduced earning capacity, and difficulty maintaining recommended dietary and dialysis schedules. These challenges are particularly relevant in hospital-based nephrology outpatient departments and dialysis centers, where patients at different stages of disease require repeated counseling, monitoring, and treatment adjustment (2).

Health literacy is increasingly recognized as a key determinant of chronic disease self-management. It refers to the ability to access, understand, evaluate, communicate, and apply health information for informed decision-making and self-care. In chronic kidney disease, health literacy extends beyond the ability to read written instructions; it includes understanding laboratory results, medication timing, dietary restrictions, dialysis-related advice, warning symptoms, follow-up requirements, and the long-term implications of disease progression. Limited health literacy may reduce a patient's capacity to recognize complications, avoid nephrotoxic medicines, follow renal dietary guidance, interpret clinical instructions, and participate meaningfully in shared decision-making. This is particularly important in nephrology practice, where patients frequently encounter complex terminology, multiple medications, numerical laboratory values, and treatment plans that require continuous adjustment (3).

The relationship between health literacy and treatment behavior is highly relevant among patients with chronic kidney disease because the treatment regimen is complex, continuous, and often burdensome. Non-dialysis patients may be required to control blood pressure, manage diabetes, restrict salt intake, avoid nephrotoxic drugs, attend scheduled nephrology visits, and monitor disease progression. Patients receiving maintenance hemodialysis face additional demands, including adherence to dialysis sessions, fluid restriction, renal dietary recommendations, phosphate binders, antihypertensive therapy, anemia management, vascular access care, and recognition of urgent symptoms. These behaviors require sustained comprehension, motivation, family support, and interaction with healthcare providers, making health literacy a clinically meaningful exposure when evaluating treatment compliance among chronic kidney disease patients (4).

Treatment compliance, also referred to as treatment adherence, describes the extent to which a patient's medication use, diet, lifestyle practices, dialysis attendance, follow-up behavior, and self-care activities correspond with recommendations agreed upon with healthcare providers. Poor adherence to long-term therapy remains a major barrier to effective chronic disease management and may lead to preventable complications. In chronic kidney disease, poor compliance can contribute to missed dialysis sessions, uncontrolled blood pressure, poor glycemic control, fluid overload, electrolyte disturbance, worsening anemia, hospitalization, faster renal deterioration, and increased mortality risk. For this reason, treatment compliance is an important outcome for evaluating quality of chronic kidney disease care, particularly in settings where health system limitations and patient-level barriers coexist (5).

Although adequate health literacy is expected to improve treatment compliance, the association is not necessarily direct or uniform. A patient may understand clinical advice yet remain unable to follow it because of medication cost, food insecurity, limited transportation, distance from the hospital, psychological distress, treatment fatigue, low family support, or competing domestic and occupational responsibilities. Conversely, some patients with limited formal education may achieve good adherence through repeated counseling, strong caregiver involvement, trust in healthcare providers, and frequent contact with dialysis staff. This complexity is highly relevant in Pakistan, where many patients depend on family members for transport, financial support, medical decision-making, interpretation of health information, and continuity of care (6).

Previous nephrology literature has shown that health literacy varies substantially across predialysis, in-center hemodialysis, and home dialysis populations, suggesting that literacy-related needs may differ according to treatment stage, clinical exposure, and frequency of interaction with healthcare services (7). Studies from different settings have also linked health literacy, illness perception, self-efficacy, and treatment adherence among patients with end-stage renal disease and hemodialysis, indicating that adherence behavior is shaped by both cognitive understanding and psychosocial factors (8). Evidence from crisis-affected and resource-constrained settings further suggests that healthcare navigation, patient education, and treatment affordability influence the extent to which patients can translate knowledge into sustained adherence (9). In addition, shared treatment decision-making in kidney failure may be compromised when patients have limited health literacy, reducing their ability to understand therapeutic options and participate actively in care planning (10).

In Pakistan, existing studies have examined treatment adherence, knowledge, attitudes, perceptions, clinical burden, anemia, dialysis outcomes, and the economic consequences of chronic kidney disease, but fewer have directly assessed how health literacy relates to treatment compliance among patients receiving nephrology care (11). Studies from Pakistani dialysis and nephrology populations have reported gaps in knowledge, adherence, disease awareness, and treatment practices, highlighting the need for locally grounded patient education strategies (12). Work on dialysis decision-making and patient experience in Pakistan also emphasizes the importance of contextual factors, including family involvement, financial constraints, and patient-provider communication, in shaping treatment choices and ongoing care behavior (13). These findings support the need to examine health literacy and treatment compliance together in a clinical population that includes both dialysis and non-dialysis chronic kidney disease patients.

The present study is therefore justified by an important local evidence gap. While chronic kidney disease care requires sustained self-management, there remains limited hospital-based evidence from Pakistan on whether patients' health literacy is associated with their level of treatment compliance across nephrology outpatient and dialysis center settings. Assessing this relationship in both dialysis and non-dialysis patients can help identify whether educational needs and adherence barriers differ according to treatment burden, disease stage, and frequency of healthcare contact. Such evidence may guide practical interventions, including simplified counseling, Urdu-language educational materials, medication charts, dietary counseling, family-centered teaching, reminder systems, and structured dialysis-unit education sessions tailored to the needs of patients with limited health literacy (14).

Using a PICO framework, the population of interest comprises adult patients with chronic kidney disease attending the nephrology outpatient department and dialysis center of Sheikh Zayed Hospital, Lahore; the primary exposure is health literacy status; the comparison is between patients with adequate and inadequate health literacy; and the principal outcome is treatment compliance. This study aimed to assess the level of health literacy, estimate treatment compliance, and examine the association between health literacy and treatment compliance among dialysis and non-dialysis patients with chronic kidney disease in Pakistan. The study was guided by the hypothesis that inadequate health literacy is associated

with poorer treatment compliance among patients with chronic kidney disease receiving nephrology care (15).

MATERIAL AND METHODS

A hospital-based analytical cross-sectional study was conducted to assess health literacy and treatment compliance among adult patients with chronic kidney disease attending the nephrology outpatient department and dialysis center of Sheikh Zayed Hospital, Lahore, Pakistan. The analytical cross-sectional design was selected because it allowed simultaneous assessment of health literacy status, treatment compliance, and their association within a defined clinical population receiving nephrology care. The study included both dialysis-dependent and non-dialysis chronic kidney disease patients to capture differences in disease stage, treatment burden, healthcare exposure, and self-management requirements across the spectrum of nephrology practice. The total study duration was six months and included participant recruitment, data collection, questionnaire checking, data entry, data cleaning, and statistical analysis.

The study population comprised adult patients with an established diagnosis of chronic kidney disease who were receiving care at Sheikh Zayed Hospital, Lahore. Patients were eligible for inclusion if they were 18 years of age or above, had a confirmed diagnosis of chronic kidney disease documented in the medical record or confirmed by the treating nephrology team, were either receiving maintenance hemodialysis or being managed as non-dialysis chronic kidney disease patients through nephrology outpatient care, and were willing to provide informed consent. Patients were excluded if they had acute kidney injury without established chronic kidney disease, severe cognitive impairment, acute medical instability, inability to communicate adequately for interview-based data collection, severe psychiatric illness interfering with participation, or refusal to participate. These eligibility criteria were applied to ensure that participants represented the target chronic kidney disease population while reducing misclassification and minimizing unreliable responses due to severe impairment or acute illness.

A non-probability consecutive sampling technique was used. Eligible patients attending the nephrology outpatient department or dialysis center during the study period were approached consecutively until the required sample size was achieved. The purpose of the study was explained to each potential participant in understandable language, and written informed consent was obtained before data collection. For patients receiving maintenance hemodialysis, interviews were conducted at a suitable time during their dialysis visit when clinically stable and comfortable. For non-dialysis patients, interviews were conducted during outpatient nephrology visits after routine clinical processes were completed. Data were collected in a private or semi-private clinical area to protect confidentiality and reduce response bias.

The sample size was calculated using the single-population proportion formula, $n = Z^2pq/d^2$, using a 95% confidence level, Z value of 1.96, expected prevalence of inadequate health literacy of 45.1%, complementary proportion of 54.9%, and margin of error of 6.1%. Substituting these values produced $n = (1.96)^2 \times 0.451 \times 0.549 / (0.061)^2 = 255.6$, which was rounded to 256. Therefore, the final sample size was 256 chronic kidney disease patients. The prevalence estimate was selected from relevant nephrology health-literacy literature and was used to provide an adequate sample for estimating inadequate health literacy and examining its association with treatment compliance in the study population (16).

Data were collected using a structured questionnaire developed after review of relevant literature on chronic kidney disease, health literacy, treatment adherence, dialysis self-management, and barriers to compliance in nephrology populations (17–20). The questionnaire included sections on sociodemographic characteristics, clinical profile, health literacy, treatment compliance, and barriers to compliance. Sociodemographic variables included age, gender, marital status, education, occupation, monthly income, residence, and socioeconomic indicators. Clinical variables included chronic kidney disease stage where available, dialysis status, duration of chronic kidney disease, duration of dialysis

among hemodialysis patients, comorbidities such as diabetes mellitus and hypertension, medication use, missed appointments, missed dialysis sessions where applicable, and history of CKD-related complications. Support-related variables included family support, transportation access, cost-related barriers, and patient-provider communication.

Health literacy was operationalized as the patient's ability to understand and use chronic kidney disease-related information for self-care, including understanding of disease status, medication instructions, dietary advice, fluid restriction, dialysis-related information, follow-up requirements, warning symptoms, and communication with healthcare providers. Treatment compliance was operationalized as adherence to prescribed medication, dietary restriction, fluid restriction, dialysis schedule where applicable, follow-up visits, and medical advice provided by the nephrology team. Dialysis patients were defined as chronic kidney disease patients receiving maintenance hemodialysis at the dialysis center, while non-dialysis patients were defined as chronic kidney disease patients managed through nephrology outpatient care without current dialysis treatment. Chronic kidney disease was defined as an established diagnosis of chronic impairment of kidney function documented in the patient's medical record or confirmed by the treating nephrology team.

The questionnaire was prepared in English and translated into Urdu where required to improve participant comprehension. For participants unable to read, the questionnaire was administered through face-to-face interview by the researcher using the same structured wording to maintain consistency. Clinical information, including dialysis status, duration of disease, comorbidities, medication history, and relevant treatment details, was verified from medical records where available. Each completed questionnaire was reviewed at the time of data collection to identify missing or inconsistent responses. Ambiguous or incomplete responses were clarified immediately with the participant when appropriate, without influencing the participant's answer.

Several procedures were used to strengthen data quality and reduce bias. The questionnaire was reviewed for clarity, relevance, and appropriateness before final data collection. A pilot assessment was conducted among chronic kidney disease patients who were not included in the final analysis, and unclear questions were revised before the main study. Consecutive recruitment was used to reduce selection bias within the constraints of a hospital-based non-probability sampling design. The use of a structured questionnaire reduced interviewer variability, while verification of clinical variables from medical records reduced recall error. Confidential interviewing was used to minimize social desirability bias, particularly for questions related to missed medication, missed appointments, dietary restriction, fluid restriction, and dialysis attendance. Potential confounding was addressed analytically by collecting information on sociodemographic, clinical, and support-related variables that could influence treatment compliance, including education, income, residence, dialysis status, duration of disease, comorbidities, family support, transportation access, and patient-provider communication.

Data were entered and analyzed using SPSS version 25. Categorical variables were summarized as frequencies and percentages. Continuous variables were assessed for distributional normality and summarized as mean $\pm$ standard deviation for normally distributed variables or median and interquartile range for non-normally distributed variables. Health literacy and treatment compliance were categorized according to the predefined scoring criteria of the study questionnaire. The association between health literacy category and treatment compliance category was assessed using the chi-square test. Correlation between health literacy score and treatment compliance score was assessed using Pearson correlation for normally distributed continuous scores or Spearman rank correlation for ordinal or non-normally distributed scores. Independent-samples t-test was used to compare mean compliance scores between two-group variables, including gender, residence, dialysis status, and transportation access, when assumptions were met. One-way analysis of variance was used to compare mean compliance scores across variables with more than two categories, including education level, income group, and chronic kidney disease stage, with appropriate post hoc comparisons when indicated.

Regression analysis was planned to identify independent predictors of treatment compliance. Multiple linear regression was used when treatment compliance was analyzed as a continuous score, and binary logistic regression was used when poor compliance was analyzed as a categorical dependent variable. Clinically relevant variables and variables showing association in bivariate analysis were considered for entry into regression models. Candidate predictors included age, gender, education, income, residence, dialysis status, duration of chronic kidney disease, comorbidity status, family support, transportation access, and health literacy status. Regression findings were planned to be reported using regression coefficients, standard errors, standardized beta values where applicable, odds ratios for logistic models, 95% confidence intervals, and p-values. A p-value of less than 0.05 was considered statistically significant.

Missing or incomplete questionnaire responses were checked during data collection and data entry. Questionnaires with substantial incompleteness affecting the main exposure or outcome variables were excluded from relevant analyses, while available complete responses were used for descriptive summaries where appropriate. Data were entered carefully, checked for range errors, reviewed for internal consistency, and cleaned before final analysis. The final dataset was stored securely and was accessible only to the research team. Reproducibility was supported by applying predefined eligibility criteria, standardized data collection procedures, uniform operational definitions, documented scoring categories, and a prespecified statistical analysis plan.

Ethical approval was obtained from the relevant institutional review committee before commencement of the study. Permission was also obtained from the hospital administration and the nephrology department. Participation was voluntary, and written informed consent was obtained from all participants before enrollment. Participants were informed that refusal to participate would not affect their treatment or relationship with healthcare providers. Confidentiality and anonymity were maintained throughout the study by avoiding personal identifiers in the final dataset and reporting only aggregated results. All collected data were used solely for research purposes and stored securely.

RESULTS

A total of 256 patients with chronic kidney disease were included in the final analysis. The study population comprised patients receiving nephrology care through the outpatient department and dialysis center. The available results describe health literacy, chronic kidney disease awareness, treatment compliance, treatment adherence, selected clinical burden indicators, and six-month mortality. Inferential analyses examining the association between health literacy and treatment compliance were planned but could not be reported from the available aggregated data because cross-tabulated and individual-level data were not supplied.

Table 1. Health Literacy and Chronic Kidney Disease Awareness Among Study Participants

Indicator	Category	n	%
Health literacy	Adequate	141	54.9
Health literacy	Inadequate	115	45.1
CKD symptom awareness	Aware	127	49.7
CKD symptom awareness	Unaware	129	50.3

CKD, chronic kidney disease.

Among the 256 patients included in the study, 141 participants had adequate health literacy, representing 54.9% of the sample, while 115 participants had inadequate health literacy, representing 45.1%. Awareness of CKD symptoms was almost evenly distributed, with 127 patients aware of CKD symptoms and 129 unaware. These findings indicate that nearly half of the study population had inadequate health literacy and slightly more than half lacked awareness of CKD symptoms.

Table 2. Treatment Compliance and Treatment Adherence Among Study Participants

Indicator	Category	n	%
Treatment compliance	Good compliance	56	21.8
Treatment compliance	Poor/suboptimal compliance	200	78.2
Treatment adherence	Good/moderate adherence	108	42.0
Treatment adherence	Poor adherence	148	58.0

Treatment-related outcomes showed a high burden of poor treatment behavior. Good treatment compliance was reported in 56 patients, accounting for 21.8% of the study population, whereas 200 patients, or 78.2%, had poor or suboptimal compliance. When treatment adherence was categorized separately, 108 patients had good or moderate adherence and 148 had poor adherence. The difference between the compliance and adherence distributions suggests that these constructs require clearer operational distinction in the manuscript, particularly because good compliance was lower than good/moderate adherence.

Table 3. Clinical Burden and Mortality Indicators Among Study Participants

Clinical indicator	Category	n	%
Anemia among CKD patients	Present	202	78.7
Anemia among CKD patients	Absent	54	21.3
Anemia among dialysis patients	Present	242	94.7
Anemia among dialysis patients	Absent	14	5.3
Six-month mortality	Death	29	11.4
Six-month mortality	Survived	227	88.6

CKD, chronic kidney disease.

Clinical burden indicators showed that anemia was present in 202 patients with CKD, corresponding to 78.7% of the total sample. Anemia among dialysis patients was reported in 242 patients, corresponding to 94.7%, while 14 patients were reported as not having anemia. Six-month mortality was reported in 29 patients, representing 11.4% of the study population, while 227 patients survived. The dialysis-specific anemia result requires denominator verification because the reported values total 256, although the study population was described as including both dialysis and non-dialysis patients.

Table 4. Summary of Key Study Outcomes

Outcome domain	Key outcome	n	%
Health literacy	Inadequate health literacy	115	45.1
CKD awareness	Unaware of CKD symptoms	129	50.3
Treatment compliance	Good compliance	56	21.8
Treatment adherence	Poor adherence	148	58.0
Clinical burden	Anemia among CKD patients	202	78.7
Clinical burden	Anemia among dialysis patients	242	94.7
Clinical outcome	Six-month mortality	29	11.4

CKD, chronic kidney disease.

The key findings demonstrate a clinically important burden of inadequate health literacy, poor disease awareness, poor treatment behavior, and CKD-related complications. Inadequate health literacy was observed in 115 patients, while 129 patients were unaware of CKD symptoms. Only 56 patients had good compliance, whereas poor adherence was reported in 148 patients. Anemia was common among CKD patients and was even more frequent when reported among dialysis patients. Six-month mortality affected 29 patients.

Table 5. Required Inferential Analyses for Association Between Health Literacy and Treatment Compliance

Analysis objective	Variables	Statistical test	Required output
Association between health literacy category and compliance category	Health literacy × compliance category	Chi-square test	χ^2 , df, p-value
Association between health literacy score and compliance score	Health literacy score × compliance score	Pearson or Spearman correlation	r or ρ , p-value
Mean compliance difference by two-category variables	Compliance score × gender, residence, transport access, or dialysis status	Independent-samples t-test	Mean ± SD, t, df, p-value

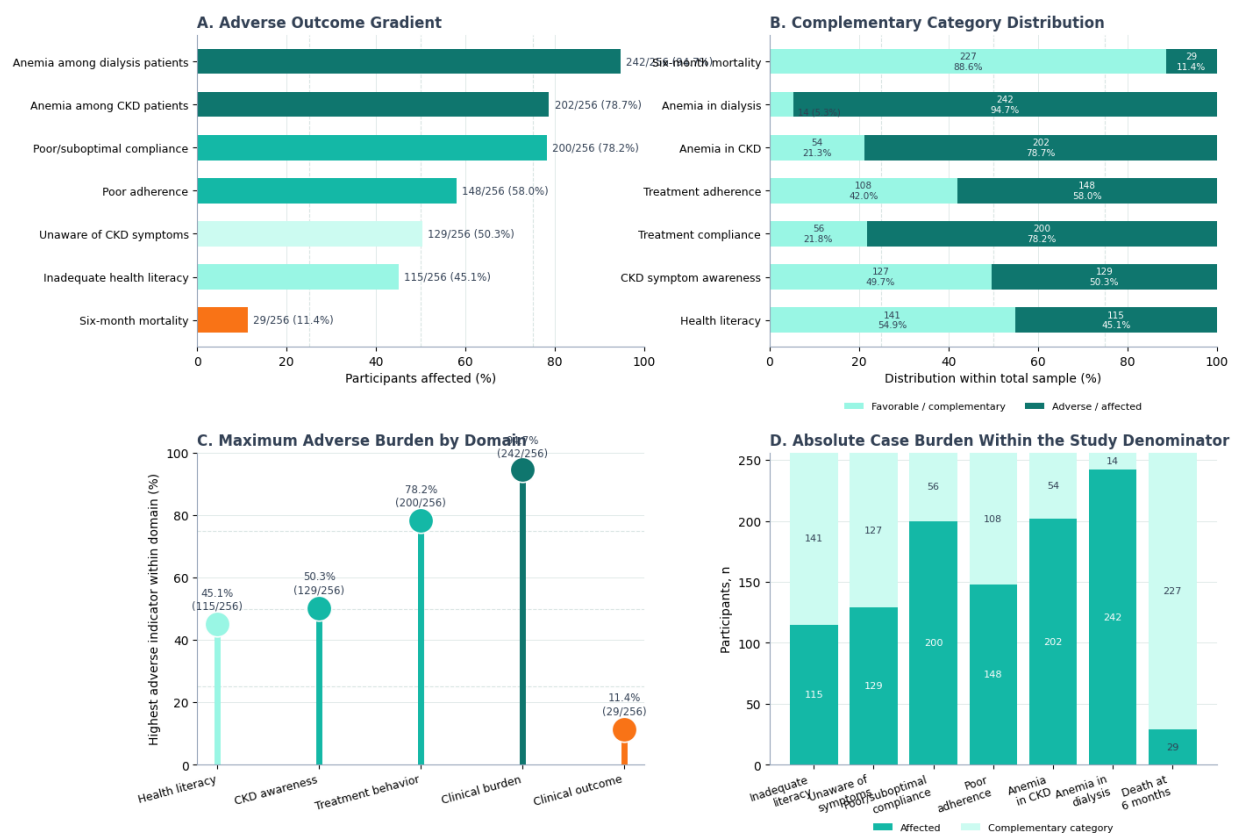
Analysis objective	Variables	Statistical test	Required output
Mean compliance difference across multiple-category variables	Compliance score × education, income, or CKD stage	One-way ANOVA	Mean ± SD, F, df, p-value
Predictors of compliance score	Compliance score as dependent variable	Multiple linear regression	B, SE, β , t, p-value, 95% CI
Predictors of poor compliance	Poor compliance as dependent variable	Binary logistic regression	B, SE, Wald χ^2 , OR, p-value, 95% CI

ANOVA, analysis of variance; CI, confidence interval; df, degrees of freedom; OR, odds ratio; SD, standard deviation; SE, standard error.

The planned inferential analyses are necessary to address the primary analytical objective of the study. However, the available aggregated results do not include the cross-tabulated distribution of health literacy by treatment compliance, continuous health literacy scores, continuous compliance scores, or individual-level covariates. Therefore, chi-square statistics, correlation coefficients, mean differences, ANOVA results, and regression estimates cannot be validly calculated from the supplied information. These analyses should be performed using the final individual-level dataset before submission.

Overall, the descriptive results indicate that nearly half of the CKD patients had inadequate health literacy and more than three-quarters had poor or suboptimal treatment compliance. The coexistence of inadequate health literacy, limited CKD symptom awareness, poor adherence behavior, anemia, and mortality suggests a clinically vulnerable nephrology population requiring structured education and adherence-support interventions. However, the manuscript's main research question—whether health literacy is associated with treatment compliance—cannot be answered from the currently supplied aggregate results alone. A complete analytical Results section should include cross-tabulation of health literacy by compliance category, subgroup comparisons by dialysis status and sociodemographic variables, and multivariable regression to determine whether health literacy independently predicts poor compliance after adjustment for relevant confounders.

Panelled Profile of Health Literacy, Treatment Behavior, Clinical Burden, and Mortality Among CKD Patients



CKD, chronic kidney disease; n = 256. All panel A values are only the supplied aggregate data. The reported dialysis-specific anemia value uses the full sample denominator and should be verified against the actual dialysis subgroup size.
HL, Inadequate literacy; Awareness: Unaware of symptoms;
Behavior: Poor/suboptimal compliance; Burden: Anemia in dialysis; Outcome: Mortality

The panelled figure summarizes the distribution and gradient of health literacy, CKD awareness, treatment behavior, clinical burden, and mortality among 256 patients with chronic kidney disease. The highest adverse burden was anemia among dialysis patients, reported in 242 participants (94.7%), followed by anemia among CKD patients overall in 202 participants (78.7%) and poor/suboptimal treatment compliance in 200 participants (78.2%). Poor adherence was present in 148 participants (58.0%), while 129 participants (50.3%) were unaware of CKD symptoms and 115 participants (45.1%) had inadequate health literacy. Six-month mortality was reported in 29 participants (11.4%). Across panels, the data show that treatment-related and clinical morbidity indicators were substantially more frequent than inadequate health literacy alone, suggesting that poor compliance in this CKD population may reflect a broader interaction of literacy, disease burden, dialysis demands, affordability, transport access, family support, and patient-provider communication rather than knowledge deficits alone.

DISCUSSION

The present hospital-based study assessed health literacy, CKD awareness, treatment compliance, treatment adherence, and selected clinical burden indicators among 256 patients with chronic kidney disease attending nephrology outpatient and dialysis center settings in Lahore, Pakistan. The findings show a substantial burden of limited patient understanding and poor treatment behavior in this clinical population. Inadequate health literacy was observed in 115 patients, accounting for 45.1% of the sample, while 129 patients, or 50.3%, were unaware of CKD symptoms. These findings are clinically important because CKD management requires patients to understand complex information related to disease progression, medication use, laboratory monitoring, dietary restriction, fluid control, dialysis schedules, warning symptoms, and follow-up care. The nearly equal distribution between adequate and inadequate health literacy suggests that a large proportion of patients receiving nephrology care may remain insufficiently prepared for the self-management demands imposed by CKD, particularly in a setting where educational, financial, and healthcare-access barriers may influence treatment behavior.

The high frequency of poor/suboptimal treatment compliance was one of the most important findings of the study. Only 56 patients, representing 21.8% of the sample, demonstrated good compliance, whereas 200 patients, or 78.2%, had poor or suboptimal compliance. Similarly, poor treatment adherence was reported in 148 patients, corresponding to 58.0% of the study population. These results indicate that difficulty following treatment recommendations is common among CKD patients and may involve multiple components of care, including medication-taking, diet, fluid restriction, attendance at dialysis sessions where applicable, and follow-up visits. The finding is consistent with the broader chronic disease literature, which recognizes adherence to long-term therapy as a persistent challenge, particularly when treatment is lifelong, expensive, behaviorally demanding, and dependent on repeated healthcare contact (5). In CKD, poor adherence is especially concerning because it may contribute to uncontrolled blood pressure, poor glycemic control, fluid overload, electrolyte imbalance, missed dialysis, hospitalization, accelerated disease progression, and increased mortality risk.

Although health literacy is often considered a modifiable determinant of adherence, the descriptive pattern observed in this study suggests that treatment behavior may be influenced by factors beyond knowledge alone. Inadequate health literacy was present in 45.1% of patients, but poor/suboptimal compliance was present in 78.2%, indicating that non-compliance was more frequent than inadequate health literacy. This does not exclude a relationship between literacy and compliance, but it suggests that literacy may be only one component of a wider adherence pathway. Patients may understand medical advice but remain unable to follow it because of medication cost, transportation difficulty, food insecurity, dialysis fatigue, distance from hospital, employment constraints, family responsibilities, psychological distress, or limited caregiver support. Conversely, some patients with limited formal education may remain adherent because of repeated counseling, strong family involvement, trust in healthcare providers, or close supervision by dialysis staff. This interpretation is consistent with literature emphasizing that adherence among CKD and hemodialysis patients is shaped by illness perception, self-efficacy, patient-provider communication, healthcare navigation, and contextual barriers, not health literacy alone (2, 3, 8, 10).

The findings also highlight an important gap in CKD symptom awareness. More than half of the participants were unaware of CKD symptoms, despite receiving care in specialist nephrology settings. This has implications for early recognition of complications and timely care-seeking. Limited symptom awareness may delay reporting of warning signs such as reduced urine output, edema, breathlessness, fatigue, uncontrolled blood pressure, access-site problems, or features of fluid overload. In CKD, where early disease may remain asymptomatic and advanced disease may produce non-specific symptoms, patient education must address not only general disease knowledge but also practical symptom recognition and action plans. Previous Pakistani studies have identified gaps in CKD knowledge, awareness of medication and laboratory investigations, and patient understanding of disease-related

practices, supporting the need for structured and locally appropriate educational interventions (13, 18, 20).

The clinical burden indicators further emphasize the vulnerability of the study population. Anemia was reported among 202 CKD patients, representing 78.7% of the total sample. Anemia is a common complication of CKD and is associated with fatigue, reduced functional capacity, impaired quality of life, cardiovascular burden, and greater treatment complexity. The reported frequency of anemia among dialysis patients was even higher at 94.7%, although this result requires careful denominator verification because the reported value uses 256 as the denominator despite the study including both dialysis and non-dialysis patients. If confirmed among the dialysis subgroup, this finding would reflect the heavy hematologic burden commonly observed in advanced CKD and dialysis-dependent populations. Evidence from Pakistan has similarly emphasized the high prevalence and management burden of anemia among CKD and dialysis patients and its potential effect on health-related quality of life (17). From a clinical perspective, the coexistence of anemia, poor compliance, poor adherence, and limited disease awareness may compound morbidity and increase the need for integrated nephrology care that combines medical treatment with patient education and adherence support.

Six-month mortality was reported in 29 patients, representing 11.4% of the sample. This finding suggests a clinically serious outcome burden; however, it must be interpreted cautiously because the stated study design is cross-sectional. Mortality assessment over six months implies longitudinal follow-up or retrospective outcome ascertainment, which should be clearly explained in the methods. Without clarification of follow-up procedures, mortality ascertainment source, completeness of follow-up, dialysis status, baseline severity, comorbidities, and timing, this outcome should not be interpreted as a causal consequence of health literacy or treatment compliance. If mortality was collected through medical records after baseline recruitment, the design description should be revised to indicate a cross-sectional analytical study with six-month outcome follow-up or retrospective mortality ascertainment. This clarification is essential for accurate interpretation and for avoiding overstatement of temporal relationships.

The study has several clinically relevant implications. First, nephrology outpatient departments and dialysis centers should not assume that repeated contact with healthcare services automatically results in adequate understanding of CKD. Nearly half of the patients had inadequate health literacy, and more than half were unaware of CKD symptoms, indicating the need for repeated, structured, and language-appropriate counseling. Second, education should be practical rather than purely informational. Patients may benefit from simplified Urdu or Punjabi educational materials, medication charts, pictorial dietary guidance, fluid-intake tools, dialysis attendance reminders, warning-symptom checklists, and family-centered counseling. Third, adherence interventions should address social and economic barriers alongside literacy. Screening for medication affordability, transport difficulty, family support, and communication problems may help clinicians identify patients at higher risk of poor compliance. Fourth, dialysis-unit staff, nurses, dietitians, and nephrologists should work collaboratively because dialysis patients often require continuous reinforcement regarding fluid restriction, phosphate binder timing, vascular access care, anemia treatment, and missed-session risks.

The findings should also be interpreted in light of important methodological limitations. The hospital-based design limits generalizability to CKD patients who do not attend tertiary care facilities, patients managed in primary care, and patients unable to access nephrology services. Consecutive non-probability sampling may introduce selection bias, although it is practical in clinical settings. The use of a structured questionnaire may be subject to recall bias and social desirability bias, especially for self-reported medication use, dietary restriction, fluid control, and missed appointments. The manuscript should also provide detailed scoring criteria for health literacy and treatment compliance, including item structure, score range, cutoff values, and reliability testing, because the validity of the main exposure and outcome depends on the measurement tool. In addition, the current aggregated results do

not include the cross-tabulation of health literacy by treatment compliance, continuous literacy and compliance scores, or multivariable regression outputs. Therefore, the main analytical question—whether health literacy is independently associated with treatment compliance—cannot be fully answered until inferential analyses are reported.

Despite these limitations, the study addresses an important and underexplored issue in CKD care in Pakistan. Its inclusion of both dialysis and non-dialysis patients is a strength because it reflects different stages of disease burden and varying levels of healthcare exposure. The findings suggest that inadequate health literacy, poor symptom awareness, poor treatment compliance, poor adherence, anemia, and mortality coexist in a clinically vulnerable CKD population. However, the descriptive results also suggest that poor compliance is more widespread than inadequate health literacy alone, reinforcing the need to evaluate adherence as a multidimensional outcome influenced by knowledge, socioeconomic resources, access to care, treatment burden, and support systems. Future analyses should examine the association between health literacy and compliance using chi-square testing, correlation analysis, and multivariable regression adjusted for education, income, dialysis status, CKD duration, comorbidities, family support, transport access, and patient-provider communication. Such analysis would clarify whether health literacy is an independent predictor of poor compliance or whether its effect is modified by social and clinical barriers.

Overall, the findings support the need for patient-centered educational and adherence-support interventions in nephrology care. Improving health literacy remains important, but education alone may be insufficient if structural barriers such as cost, travel, treatment fatigue, and limited caregiver support are not addressed. A practical model for CKD care in Pakistan should combine simplified communication, culturally and linguistically appropriate counseling, family involvement, routine adherence screening, and targeted support for high-risk patients. By integrating health literacy assessment into routine nephrology OPD and dialysis center practice, healthcare teams may be better able to identify patients who require additional counseling, improve treatment engagement, and reduce preventable complications among patients with chronic kidney disease.

CONCLUSION

This hospital-based study found a substantial burden of inadequate health literacy, limited CKD symptom awareness, poor treatment compliance, poor treatment adherence, anemia, and six-month mortality among patients with chronic kidney disease attending nephrology outpatient and dialysis center settings in Lahore, Pakistan. Inadequate health literacy was present in 45.1% of participants, while 50.3% were unaware of CKD symptoms, indicating important gaps in patient understanding despite ongoing nephrology care. Treatment-related challenges were more frequent, with only 21.8% of patients demonstrating good compliance and 58.0% showing poor adherence, suggesting that difficulty following medication, dietary, fluid, dialysis-related, and follow-up recommendations remains a major clinical concern in this population. Anemia was common among CKD patients overall and was especially frequent in the reported dialysis group, reflecting the high complication burden associated with advanced kidney disease, while six-month mortality further highlights the vulnerability of this clinical population. These findings support the need for structured, culturally appropriate, and family-centered patient education strategies integrated into routine nephrology OPD and dialysis care. However, because the currently available results are descriptive, the relationship between health literacy and treatment compliance should be confirmed through ap

propriate inferential analysis using cross-tabulated or individual-level data, including adjustment for relevant socioeconomic, clinical, and healthcare-access factors. Overall, improving health literacy should be considered an important but not exclusive strategy for strengthening treatment adherence, reducing preventable complications, and improving patient-centered CKD care in Pakistan.

REFERENCES

1. Rahmawati B, Rochmawati E. Health literacy in patients undergoing hemodialysis: literature review. *Bali Med J*. 2022;11(3). doi:10.15562/bmj.v11i3.3754.
2. Hamza MA, Ullah S, Ahsan H, Ali W, Masud M, Ahmed A. Health literacy, illness perception, and their association with medication adherence in end-stage renal disease. *Int Urol Nephrol*. 2025. doi:10.1007/s11255-025-04472-8.
3. Afzal F, Rafique R. Mediating role of self-efficacy between illness perception, health literacy, and treatment adherence among patients undergoing hemodialysis. *J Psychol Health Soc Chall*. 2026. doi:10.63075/7rqarn67.
4. Boyer A, Bégin Y, Dupont J, Rousseau-Gagnon M, Fernandez N, Demian M, et al. Health literacy level in a various nephrology population from Québec: predialysis clinic, in-centre hemodialysis and home dialysis; a transversal monocentric observational study. *BMC Nephrol*. 2021;22. doi:10.1186/s12882-021-02464-1.
5. Pasari A, Tolani P, Bhawane A, Balwani M. Management of nephrology practice in the environment of poor health literacy: the challenge. *J Nephrol Soc*. 2022. doi:10.4103/jtns.jtns_11_22.
6. Zainab R, Arif S, Saddique H, Tasneem S. The assessment of treatment adherence among dialysis patients. *Biol Clin Sci Res J*. 2024. doi:10.54112/bcsrj.v2024i1.1257.
7. Bégin Y, Boyer A, Dupont J, Rousseau-Gagnon M, Fernandez N, Demian M, et al. Health literacy level in a various nephrology population: predialysis clinic, in-centre hemodialysis and home dialysis. 2021. doi:10.21203/RS.3.RS-135442/V1.
8. Boueri M, Abdelkhalik M, Maaz FA, Chehade H, Bouclaous C. Navigating health care in crises: health literacy and treatment adherence among hemodialysis patients in Lebanon. *Kidney Med*. 2025. doi:10.1016/j.xkme.2025.101081.
9. Toapanta N, Salas-Gama K, Pantoja PE, Soler MJ. The role of low health literacy in shared treatment decision-making in patients with kidney failure. *Clin Kidney J*. 2023. doi:10.1093/ckj/sfad061.
10. Afzal F, Rafique R. A qualitative study on illness perception, health literacy, self-efficacy, and treatment adherence among patients undergoing hemodialysis. *J Psychol Health Soc Chall*. 2026. doi:10.63075/1fyqah15.
11. Zahra B, Sagheer M, Ikhtiar R, Attiq S, Lashari A, Shaheen A, et al. Management of patients with dialysis-dependent chronic kidney disease: a prospective observational study at Allama Iqbal Teaching Hospital, Dera Ghazi Khan, Pakistan. *J Med Health Sci Rev*. 2026. doi:10.65035/g84z0t16.
12. Butt MN, Zafar U, Ansar F, Butt SN, Basit A, Abrar M, et al. Economic burden and clinical epidemiology of dialysis: a cross-sectional analysis of chronic kidney disease patients. *Cureus*. 2025. doi:10.7759/cureus.93372.
13. Kazmi SMK, Rabab UE, Dawood T, Arif S, Azam SM, Bokhari SMNA, et al. Assessment of knowledge, attitudes, and practices associated with chronic kidney disease in Pakistan. *Eur J Health Sci*. 2023. doi:10.47672/ejhs.1696.
14. Rizzolo K, Al-Rousan T, Cervantes L. Dialysis decision making and the patient experience: lessons from Pakistan. *Kidney Med*. 2022;4(11):100556. doi:10.1016/j.xkme.2022.100556.

15. Dhania B, Kumar A, Kalal N, Bajpai NK. Burden and treatment seeking behaviour in chronic kidney disease patients: a cross-sectional descriptive study. *Int J Community Med Public Health*. 2021;8(10):4976. doi:10.18203/2394-6040.ijcmph20213805.
16. Billany R, Thopte A, Adenwalla SF, March D, Burton J, Graham-Brown M. Associations of health literacy with self-management behaviours and health outcomes in chronic kidney disease: a systematic review. *J Nephrol*. 2023. doi:10.1007/s40620-022-01537-0.
17. Khan A, Hussain SG, Mushtaq S, Abbas S, Dong Y, Feng W, et al. Prevalence and management of anemia and impact of treatment burden on health-related quality of life in chronic kidney disease and dialysis patients. *J Pharm Policy Pract*. 2024. doi:10.1080/20523211.2024.2427779.
18. Ahmed J, Azhar S, Haq NU, Hussain S, Stájer A, Urbán E, et al. Awareness of chronic kidney disease, medication, and laboratory investigation among nephrology and urology patients of Quetta, Pakistan. *Int J Environ Res Public Health*. 2022;19(9):5015. doi:10.3390/ijerph19095015.
19. Ahmad W. Retrospective evaluation of a large nephrology out-patient cohort. *Pak J Kidney Dis*. 2025;9(1):54-57. doi:10.53778/pjkd91294.
20. Hussain F, Ashraf S, Arshad M, Rehman MAU, Khan F, Ahmad MA, et al. Knowledge, adherence, and perception of patients on maintenance hemodialysis to treatment regimens at a tertiary care hospital in Pakistan. *Cureus*. 2023. doi:10.7759/cureus.51341.