

FACTORS ASSOCIATED WITH TREATMENT ADHERENCE AND SYMPTOM BURDEN AMONG PATIENTS RECEIVING MAINTENANCE HEMODIALYSIS IN PAKISTAN: A CROSS-SECTIONAL STUDY

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ABSTRACT

OBJECTIVES

This study aimed to assess treatment adherence, symptom burden, and factors associated with adherence among adults receiving maintenance hemodialysis in Pakistan.

METHODOLOGY

A cross-sectional study was conducted from January to July 2026 in the Dialysis Unit of District Headquarters Hospital, Kohat, Pakistan. A total of 141 adults receiving maintenance hemodialysis were recruited consecutively. Data were collected using a structured questionnaire, the End-Stage Renal Disease Adherence Questionnaire (ESRD-AQ), and the Dialysis Symptom Index (DSI). Descriptive statistics were used to summarise participant characteristics and adherence-related behaviours.

RESULTS

The mean age was 44.01 ± 14.40 years, and 55.3% of participants were male. Self-rated overall treatment compliance was excellent in 69.5%, very good in 21.3%, and good in 9.2%. No dialysis session was missed by 74.5% of participants during the reported period. Difficulties were reported with medication-taking (44.0%), fluid restriction (68.8%), and dietary recommendations (58.9%).

CONCLUSION

Most participants reported high overall treatment compliance; however, clinically relevant difficulties with medication use, fluid restriction, and dietary adherence remained common. Structured education, individualised counselling, and practical support for treatment barriers should be integrated into routine dialysis care. Validated DSI results and appropriately reanalysed association models are required before conclusions regarding symptom burden and independent predictors can be finalised.

KEYWORDS: Renal Dialysis, Kidney Failure, Medication Adherence, Treatment Adherence, Hemodialysis, Pakistan

INTRODUCTION

Chronic kidney disease (CKD) is a major global public health problem associated with substantial morbidity, mortality, disability, and healthcare expenditure. Global analyses show a continuing increase in CKD burden, particularly in low- and middle-income countries.^{1,2} Progressive CKD may culminate in kidney failure requiring kidney replacement therapy or comprehensive conservative kidney management, depending on clinical circumstances and patient preferences.^{3,4} Maintenance hemodialysis remains the most widely available form of kidney replacement therapy in many resource-constrained settings, where access to transplantation is limited.⁴ Hemodialysis can correct major metabolic disturbances and reduce uremic manifestations, but its effectiveness depends not only on dialysis delivery itself but also on sustained engagement with the broader treatment regimen, including session attendance,

medication use, dietary recommendations, and fluid restriction.^{5,6,7} Non-adherence to one or more components of the hemodialysis regimen is common and is associated with fluid overload, electrolyte disturbances, hospitalisation, and poorer clinical outcomes.^{7,8} At the same time, patients receiving long-term hemodialysis frequently experience a high burden of physical and psychological symptoms, including fatigue, pruritus, sleep disturbance, pain, muscle cramps, gastrointestinal symptoms, anxiety, and depressive symptoms.⁹ Symptom burden can interfere with daily functioning and self-management and may coexist with negative medication beliefs and non-adherence.¹⁰ Adherence is multidimensional. Patient-related factors, health literacy, treatment complexity, transportation, affordability, family support, and the quality of communication with healthcare professionals may all influence adherence behaviours.^{8,10,11} These barriers are particularly relevant in settings where

patients travel long distances for dialysis, have limited household resources, and have restricted access to multi-disciplinary renal services.^{11,12,13} South Asian populations also experience substantial cardiometabolic risk and may develop CKD at comparatively younger ages, increasing the long-term treatment burden.¹⁴ Pakistan faces a substantial and growing CKD burden, while access to nephrology services, transplantation, and long-term dialysis remains uneven.¹² Local evidence describing adherence behaviours and the practical challenges faced by patients on maintenance hemodialysis is therefore important for service planning. Previous regional studies have reported variable adherence across dialysis attendance, medication, diet, and fluid restriction, but locally contextualised data remain limited.^{7,15} The present study was designed to assess treatment adherence and symptom burden among adults receiving maintenance hemodialysis at a public-sector dialysis unit in Kohat, Pakistan, and to examine factors associated with treatment adherence. The objectives were to: describe treatment adherence among adults receiving maintenance hemodialysis; quantify symptom burden using the Dialysis Symptom Index; and examine demographic, clinical, dialysis-related, and self-management factors associated with treatment adherence.

METHODOLOGY

A hospital-based cross-sectional observational study was conducted from January to July 2026 in the Dialysis Unit of District Headquarters (DHQ) Hospital, Kohat, Khyber Pakhtunkhwa, Pakistan. The unit provides maintenance hemodialysis services to patients from Kohat and surrounding districts. Eligible patients attending the outpatient dialysis unit during the study period were approached consecutively and invited to participate after written informed consent. Adults aged 18-70 years with kidney failure who had been receiving maintenance hemodialysis for at least three months were eligible if they could communicate in Urdu and/or English and were able to provide written informed consent. Patients who were critically ill, had cognitive or communication impairment that prevented completion of the questionnaires, or declined participation were excluded. The supplied study record states that the minimum sample size was calculated using OpenEpi with a 95% confidence level and 5% margin of error, and that the target was increased to 141 participants to allow for approximately 10% nonresponse or incomplete questionnaires. Consecutive

non-probability sampling was used until the target sample was reached. A structured questionnaire captured sociodemographic, clinical, dialysis-related, and treatment-related information. Treatment adherence was assessed using the 46-item End-Stage Renal Disease Adherence Questionnaire (ESRD-AQ), which evaluates hemodialysis attendance, medication use, fluid restriction, and dietary recommendations.¹⁶ Symptom burden was assessed using the Dialysis Symptom Index (DSI), a 30-item patient-reported instrument developed for people receiving chronic hemodialysis; higher scores indicate greater symptom burden.¹⁷ Trained investigators administered the questionnaires face-to-face before or after participants' scheduled dialysis sessions. The purpose of the study was explained, and written informed consent was obtained before data collection. Clinical and dialysis-related information was verified from medical records when required. Completed questionnaires were checked immediately for completeness and internal consistency to minimise missing data. Ethical approval was obtained from the Institutional Ethics Committee of DHQ Hospital, Kohat. All participants provided written informed consent. Participation was voluntary, withdrawal did not affect clinical care, and study information was handled confidentially in accordance with the principles of the Declaration of Helsinki. Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). A two-sided p -value < 0.05 should be considered statistically significant.

RESULTS

A total of 141 patients receiving maintenance hemodialysis were included. The mean age was 44.01 ± 14.40 years, and the mean body weight was 56.86 ± 11.20 kg. Males comprised 55.3% ($n=78$) of the sample. Most participants were married (73.0%), had no formal education (60.3%), lived in rural areas (57.4%), were unemployed (52.5%), belonged to joint families (84.4%), and lived with family members (84.4%). Hypertension was the most frequently reported comorbidity (54.6%), followed by diabetes mellitus (32.6%) and kidney stone disease (12.8%). All participants had an arteriovenous fistula, and none reported previous peritoneal dialysis or kidney transplantation. Most participants used personal transport to reach dialysis (59.6%). A total of 83.7% received two or fewer dialysis sessions per week, and 90.1% considered their dialysis schedule convenient.

Table: Baseline Sociodemographic, Clinical, and Dialysis Characteristics of Hemodialysis Patients (n = 141)

Variable	Category	n (%) / Mean $\pm$ SD
Age (years)	Mean $\pm$ SD	44.01 $\pm$ 14.40
Weight (kg)	Mean $\pm$ SD	56.86 $\pm$ 11.20
Gender	Male	78 (55.3)
	Female	63 (44.7)
Marital status	Single	29 (20.6)
	Married	103 (73.0)
	Widow	9 (6.4)
Education level	No formal education	85 (60.3)
	Primary	14 (9.9)
	Secondary	34 (24.1)
	Graduate	8 (5.7)
Residence	Rural	81 (57.4)
	Urban	60 (42.6)
Occupation	Unemployed	74 (52.5)
	Employed	17 (12.1)
	Housewife	50 (35.5)
Monthly family income (PKR)	10,001–20,000	83 (58.9)
	20,001–50,000	58 (41.1)
Type of family	Nuclear	22 (15.6)
	Joint	119 (84.4)
Living arrangement	Alone	22 (15.6)
	With family	119 (84.4)
Duration on hemodialysis (years)	1.0	37 (26.2)
	1.2	9 (6.4)
	1.5	9 (6.4)
	2.5	26 (18.4)
	4.0	13 (9.2)
	5.0	33 (23.4)
	6.8	14 (9.9)
Comorbidity	Hypertension	77 (54.6)
	Diabetes mellitus	46 (32.6)
	Kidney stone disease	18 (12.8)
Vascular access	A V fistula	141 (100.0)
Previous peritoneal dialysis	No	141 (100.0)
Previous kidney transplant	No	141 (100.0)
Transportation	Personal transport	84 (59.6)
	Taxi	44 (31.2)
	Bus	13 (9.2)
Accompanying person	Self	8 (5.7)
	Spouse	36 (25.5)
	Parent	13 (9.2)
	Child	36 (25.5)
	Friend	48 (34.0)
Dialysis sessions/week	≤ 2 days	118 (83.7)
	3 days	23 (16.3)
Dialysis duration/session	2.5 hours	14 (9.9)
	3.5 hours	49 (34.8)
	4 hours	36 (25.5)
	>4 hours	42 (29.8)
Dialysis schedule convenient	Yes	127 (90.1)
	No	14 (9.9)

Table 3: Treatment Adherence, Self-management Behaviours, and Patient Education Characteristics of Hemodialysis Patients (n = 141)

Variable	Category	n (%age)
Prescribed medications	Yes	141 (100.0)
Treatment initiated at diagnosis	Yes	141 (100.0)
Overall treatment compliance	Good	13 (9.2)
	Very good	30 (21.3)
	Excellent	98 (69.5)
Last education by staff	Never	16 (11.3)
	This week	17 (12.1)
	One month ago	46 (32.6)
	>1 month ago	62 (44.0)
Frequency of staff education	Never	26 (18.4)
	Rarely	14 (9.9)
	Every dialysis treatment	101 (71.6)
Importance of dialysis schedule	Highly important	141 (100.0)
Reason for following schedule	Understand kidney disease	83 (58.9)
	Keeps body healthy	58 (41.1)
Difficulty during dialysis	None	82 (58.2)
	A little	10 (7.1)
	Moderate	23 (16.3)
	A lot	26 (18.4)
Missed dialysis treatments	None	105 (74.5)
	One	26 (18.4)
	≥ 4	10 (7.1)
Reason for missed dialysis	None	105 (74.5)
	Transportation	26 (18.4)
	Family/Financial	10 (7.1)
Minutes shortened	Not applicable	89 (63.1)
	21–30 minutes	39 (27.7)
	≥ 31 minutes	13 (9.2)
Medication adherence	Very seldom	33 (23.4)
	Sometimes	26 (18.4)
	Most of the time	40 (28.4)
	All of the time	42 (29.8)
Reason for medication adherence	Understand kidney disease	106 (75.2)
	Previous hospitalisation	26 (18.4)
	Previous illness	9 (6.4)
Difficulty taking medicines	No	79 (56.0)
	Yes	62 (44.0)
Level of difficulty	None	79 (56.0)
	Mild	23 (16.3)
	Moderate	13 (9.2)
	Severe	26 (18.4)
Missed medicines (past week)	None	89 (63.1)
	One dose	26 (18.4)
	Two doses	26 (18.4)
Reason for missed medicines	Not applicable	89 (63.1)

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	Medication cost	26 (18.4)
	Hospitalisation	13 (9.2)
Medication side effects	Side effects	13 (9.2)
	None	99 (70.2)
	Headache	29 (20.6)
Fluid restriction adherence	Gastrointestinal symptoms	13 (9.2)
	At initiation of dialysis	72 (51.1)
	About half of the time	40 (28.4)
Reason for limiting fluids	Most of the time	29 (20.6)
	Understand kidney disease	76 (53.9)
	Medical advice	30 (21.3)
Difficulty limiting fluid intake	Became sick	26 (18.4)
	Keeps body healthy	9 (6.4)
	No	44 (31.2)
Level of difficulty	Yes	97 (68.8)
	None	35 (24.8)
	Mild	35 (24.8)
Weight monitoring at home	Moderate	71 (50.4)
	Never	40 (28.4)
	Once	49 (34.8)
Importance of daily weight monitoring	Twice	19 (13.5)
	Three times	16 (11.3)
	>4 times	17 (12.1)
Reason for dietary adherence	Moderate	46 (32.6)
	High	95 (67.4)
	Understand kidney disease	106 (75.2)
Difficulty following dietary recommendations	Medical advice	26 (18.4)
	Keeps body healthy	9 (6.4)
	No	58 (41.1)
	Yes	83 (58.9)

Table 4: ANOVA of sociodemographic, clinical, and dialysis variables versus overall treatment compliance.

Variable	F-value	p-value
Gender	29.193	<0.001
Age (years)	24.622	<0.001
Weight (kg)	103.159	<0.001
Marital status	30.031	<0.001
Education level	14.876	<0.001
Residence	9.557	<0.001
Occupation	9.557	<0.001
Monthly family income	8.604	<0.001
Type of family	2.706	0.070
Living arrangement	2.706	0.070
Duration on hemodialysis	25.513	<0.001
Comorbidity	12.640	<0.001
Transportation	77.741	<0.001
Accompanying person	14.349	<0.001
Dialysis sessions/week	3.575	0.031
Dialysis duration/session	29.079	<0.001
Dialysis schedule convenience	3.507	0.033
Last education by staff	5.109	0.007
Frequency of staff education	14.339	<0.001

Table 5: ANOVA of adherence and self-management variables versus overall treatment compliance.

Variable	F-value	p-value
Difficulty during dialysis	25.236	<0.001
Missed dialysis treatments	1.858	0.160
Reason for missed dialysis	12.287	<0.001
Minutes shortened	45.646	<0.001
Medication adherence	5.462	0.005
Difficulty taking medicines	28.832	<0.001
Level of difficulty taking medicines	12.713	<0.001
Missed medicines (past week)	2.534	0.083
Medication side effects	26.875	<0.001
Fluid restriction adherence	31.528	<0.001
Difficulty limiting fluid intake	3.521	0.032
Level of difficulty limiting fluid intake	16.355	<0.001
Weight monitoring at home	22.260	<0.001
Importance of daily weight monitoring	34.039	<0.001
Difficulty following dietary recommendations	7.487	0.001

Table 6: Correlation between Overall Treatment Compliance and Selected Sociodemographic, Clinical, Dialysis, and Self-management Variables among Hemodialysis Patients (n = 141)

Variable	Pearson's correlation (r)	p-value
Gender	-0.021	0.801
Age (years)	0.386	<0.001
Weight (kg)	0.144	0.088
Marital status	0.394	<0.001
Education level	-0.045	0.598
Residence	0.349	<0.001
Occupation	0.348	<0.001
Monthly family income	0.333	<0.001
Type of family	-0.022	0.794
Living arrangement	-0.022	0.794
Duration on hemodialysis (years)	0.197	0.019
Comorbidity	0.024	0.776
Transportation	-0.549	<0.001
Accompanying person	0.350	<0.001
Dialysis sessions/week	0.004	0.963
Dialysis duration/session	-0.540	<0.001
Dialysis schedule convenience	-0.203	0.016
Last education by dialysis staff	-0.212	0.012
Frequency of staff education	-0.382	<0.001
Difficulty during dialysis	0.477	<0.001
Missed dialysis treatments	-0.133	0.116
Reason for missed dialysis	-0.376	<0.001
Minutes shortened	-0.561	<0.001
Medication adherence	0.121	0.153
Difficulty taking medicines	-0.030	0.722
Level of difficulty taking medicines	0.063	0.459
Missed medicines (past week)	-0.111	0.189
Medication side effects	-0.506	<0.001
Fluid restriction adherence	-0.058	0.496
Difficulty limiting fluid intake	-0.199	0.018
Level of difficulty limiting fluid intake	-0.430	<0.001
Weight monitoring at home	-0.216	0.010
Importance of daily weight monitoring	0.575	<0.001
Difficulty following dietary recommendations	-0.311	<0.001

DISCUSSION

The present study aimed to thoroughly assess treatment adherence and symptom burden among patients on maintenance hemodialysis at a tertiary care hospital in Pakistan. The overall average of the participants showed good adherence behaviours, with 69.5% reporting excellent compliance with treatment, and relatively few participants reported poor adherence. Also, the majority of patients were regular at the set appointments for dialysis, took medications as ordered, and understood the importance of restricting their food and fluid intake. However, many remained with symptoms and treatment-related challenges, highlighting the importance of optimising adherence, but not necessarily being able to eliminate the symptom burden for patients receiving long-term hemodialysis. Most of the study population was middle-aged (44.0 ± 14.4 years) and male. Hypertension (54.6%) and diabetes (32.6%) were the most common comorbid conditions. These results are similar to the Global Burden of Disease analyses, which showed that hypertension and diabetes were the top contributors to CKD and ESRD around the world.^{16,17} The relatively low age of patients versus European and North American studies may be due to the fact that CKD occurs earlier in South Asian populations, as diabetes, uncontrolled hypertension and poor access to preventive nephrology services are early drivers of disease progression. The findings were encouraging, as almost 70% of the patients reported excellent overall treatment compliance, whereas 90.1% of patients thought their dialysis schedule was convenient and 83.7% attended dialysis at least two times per week. These findings are similar to previous studies which reported that the adherence of maintenance hemodialysis patients in India in general was satisfactory with the ESRD-AQ and varied in each treatment domain.¹⁹ In a similar study, it was found that structured dialysis programs, regular counselling, and family support were significant factors for better adherence to treatment in patients with chronic hemodialysis.²⁰ A relatively high adherence was found in the present study, which might be associated with the frequent education of the patient by the health care staff involved in dialysis, because 71.6% of the participants indicated that they received patient education every time they went for dialysis. Despite favourable adherence, symptom burden remained substantial. Approximately 42% of participants experienced varying degrees of difficulty during dialysis, while 44% reported difficulty taking prescribed medications, and 58.9% experienced difficulty following dietary recommendations. Similar observations were reported in the previous research study, which demonstrated that fatigue, pain, sleep disturbances, and gastrointestinal

symptoms remain highly prevalent among CKD patients despite ongoing dialysis treatment.¹¹ A previous research study reported that greater symptom burden was associated with poorer medication adherence and negative treatment beliefs among maintenance hemodialysis patients.²¹ These findings emphasise that symptom management should accompany adherence-promoting interventions to optimise patient outcomes. In the current study, medication adherence was generally good, with 63.1% of participants indicating that they had not missed any medications over the past week; however, 44% had some difficulties when taking their medications, mainly because of the cost of the medications and hospitalisation. The results are similar to earlier studies showing that adherence to medications is one of the most difficult aspects of ESRD management due to complicated drug regimens and pill burden.²² Additionally, Hamza et al. (2025) found that financial constraints, lack of health literacy, and patient education were found to always have a negative impact on adherence to medication among patients on long-term hemodialysis.²¹ Likely, the same barriers play a role in medication problems seen with Pakistani patients. Other challenges included fluid and dietary adherence. While all the participants recognised the need for fluid restriction and dietary advice, 68.8% and 58.9% reported challenges with limiting fluids and following dietary advice, respectively. These findings corroborate those of the previous study, which found that fluid and dietary restrictions were among the most challenging symptoms of lifelong hemodialysis management due to cultural dietary habits, poor nutritional education and psychological stress.²⁰ The multivariable analysis showed that there were several demographic and treatment factors that independently influenced adherence to treatment. Higher age, education, dialysis duration, number of staff education, medication adherence and regular self-care behaviours were positively correlated with medication adherence, while transportation challenges, medication side effects and higher symptom burden were negatively correlated with adherence. They are congruent with earlier research, which has shown that adherence to treatment is a multifaceted phenomenon that is influenced by a combination of socioeconomic, behavioural, psychological, and health care factors rather than one factor.²² This means continued patient education and supportive communication from the healthcare provider continues to be a vital part of dialysis care. A correlation analysis also found that adherence to treatment was significantly related to various patient factors. Regular attendance at dialysis, staff education, taking medications, and awareness of the disease were positively associated with adherence, while burden of symptoms, transportation problems, medication

problems, and dietary problems were negatively associated with adherence. These findings are in line with the findings of the previous research study, in which the authors found that symptom burden and medication beliefs were significant factors affecting adherence among maintenance hemodialysis patients.²¹ Put together, these findings support the multidimensionality of adherence and indicate that interventions targeting a single factor may be less effective. In Pakistan, the present study offers much-needed local evidence on adherence behaviours of maintenance hemodialysis patients. The burden of CKD keeps on increasing in Pakistan, with a shortage of dialysis infrastructure, nephrology services, financial support, and patient education. While the majority showed good compliance, transportation issues, cost of medications, symptom burden and problems with fluid and dietary restrictions were still significant barriers. The results highlight the need for a multi-disciplinary approach with nephrologists, dialysis nurses, dietitians, the pharmacist, and members of the family to enhance patient education and self-management and to improve long-term clinical outcomes.

LIMITATIONS

The single-centre cross-sectional design limits generalizability and prevents causal inference. Adherence measures were self-reported and are susceptible to recall and social-desirability bias. Objective indicators such as interdialytic weight gain, serum phosphate or potassium, dialysis adequacy (Kt/V), and prescription-refill data were not reported. Depression, anxiety, health-related quality of life, and formal social-support measures were also not assessed in the supplied results. In addition, the sample-size basis, ESRD-AQ scoring, DSI results, and inferential statistical analyses require clarification or reanalysis before submission.

CONCLUSIONS

Participants generally reported high overall treatment compliance and regular dialysis attendance, but substantial difficulties remained with medication-taking, fluid restriction, and dietary recommendations. These findings support routine, repeated education combined with individualised counselling and practical support for treatment barriers. Conclusions regarding symptom burden and independent predictors of adherence should be finalised only after the DSI data and statistically appropriate multivariable analyses are incorporated.

CONFLICT OF INTEREST: None

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REFERENCES

- Francis A, Harhay MN, Ong ACM, Tummalapalli SL, Ortiz A, Fogo AB, et al. Chronic kidney disease and the global public health agenda: an international consensus. *Nat Rev Nephrol.* 2024;20(7):473-485. doi:10.1038/s41581-024-00820-6. PMID:38570631.
- Ke C, Liang J, Liu M, Liu S, Wang C. Burden of chronic kidney disease and its risk-attributable burden in 137 low- and middle-income countries, 1990-2019: results from the Global Burden of Disease Study 2019. *BMC Nephrol.* 2022;23(1):17. doi:10.1186/s12882-021-02597-3. PMID:34986789.
- Maringhini S, Zoccali C. Chronic kidney disease progression -a challenge. *Biomedicine.* 2024;12(10):2203. doi:10.3390/biomedicine12102203. PMID:39457516.
- Thurlow JS, Joshi M, Yan G, Norris KC, Agodoa LY, Yuan CM, et al. Global epidemiology of end-stage kidney disease and disparities in kidney replacement therapy. *Am J Nephrol.* 2021;52(2):98-107. doi:10.1159/000514550. PMID:33752206.
- Combe C, Alencar de Pinho N, Guedes M, Frimat L, Fouque D, Liabeuf S, et al. Optimal patient care in advanced chronic kidney disease progressing to kidney failure. *Nat Rev Nephrol.* 2026;22(6):406-421. doi:10.1038/s41581-026-01056-2. PMID:41667648.
- Kalantar-Zadeh K, Li PKT, Tantisattamo E, Kumaraswami L, Liakopoulos V, Lui SF, et al. Living well with kidney disease by patient and care-partner empowerment: Kidney Health for Everyone Everywhere. *J Nephrol.* 2021;34(2):381-388. doi:10.1007/s40620-021-01000-6. PMID:33675529.
- Belhmer FS, Al Amad MA, Albitahi MH, Babattah FK. Adherence to treatment regimens among end-stage renal disease patients: a cross-sectional study. *Int J Nephrol Renovasc Dis.* 2025;18:143-150. doi:10.2147/IJNRD.S511221. PMID:40491665.
- Win KCM, Zhou H, Patton V, Steen M, Della P. Factors contributing to non-adherence to treatment among adult patients with long-term haemodialysis: an integrative review. *Nurs Rep.* 2025;15(9):314. doi:10.3390/nursrep15090314. PMID:41003269.
- Kalantar-Zadeh K, Lockwood MB, Rhee CM, Tantisattamo E, Andreoli S, Balducci A, et al. Patient-centred approaches for the management of unpleasant symptoms in kidney disease. *Nat Rev Nephrol.* 2022;18(3):185-198. doi:10.1038/s41581-021-00518-z. PMID:34980890.
- Mechta Nielsen T, Marott T, Hornum M, Feldt-Rasmussen B, Kallemose T, Thomsen T. Non-adherence, medication beliefs and symptom burden among patients receiving hemodialysis-a cross-sectional study. *BMC Nephrol.* 2023;24(1):321. doi:10.1186/s12882-023-03371-3. PMID:37891566.
- Nee R, Yuan CM, Narva AS, Yan G, Norris KC. Overcoming barriers to implementing new guideline-directed therapies for chronic kidney disease. *Nephrol Dial Transplant.* 2023;38(3):532-541. doi:10.1093/ndt/gfac283. PMID:36264305.
- Imtiaz S, Alam A. Epidemiology and demography of chronic kidney disease in Pakistan-a review of Pakistani literature. *Pak J Kidney Dis.* 2023;7(1):2-7. doi:10.53778/pjkd71209. PMID: not indexed.
- Scholes-Robertson N, Gutman T, Howell M, Craig JC, Chalmers R, Tong A. Patients' perspectives on access to dialysis and kidney transplantation in rural communities in Australia. *Kidney Int Rep.* 2022;7(3):591-600. doi:10.1016/j.ekir.2021.11.010. PMID:35257071.

14. Vijayan M, Deshpande K, Anand S, Deshpande P. Risk amplifiers for vascular disease and CKD in South Asians: when intrinsic beta-cell dysfunction meets a high-carbohydrate diet. *Clin J Am Soc Nephrol.* 2023;18(5):681-688. doi:10.2215/CJN.0000000000000076. PMID:36758530.
15. Ankit L, Rathee G, Sharma R, Dahiya S, Vaibhav F, Kumar P. Treatment adherence and factors influencing it in end-stage renal disease patients on maintenance hemodialysis: a study from a tertiary care hospital in North India. *Cureus.* 2024;16(11):e73335. doi:10.7759/cureus.73335. PMID:39655099.
16. Kim Y, Evangelista LS, Phillips LR, Pavlish C, Kopple JD. The End-Stage Renal Disease Adherence Questionnaire (ESRD-AQ): testing the psychometric properties in patients receiving in-center hemodialysis. *Nephrol Nurs J.* 2010;37(4):377-393. PMID:20830945. DOI: not assigned.
17. Weisbord SD, Fried LF, Arnold RM, Rotondi AJ, Fine MJ, Levenson DJ, et al. Development of a symptom assessment instrument for chronic hemodialysis patients: the Dialysis Symptom Index. *J Pain Symptom Manage.* 2004;27(3):226-240. doi:10.1016/j.jpainsymman.2003.07.004. PMID:15010101.
18. Ying M, Shao X, Qin H, Yin P, Lin Y, Wu J, et al. Disease burden and epidemiological trends of chronic kidney disease at the global, regional, national levels from 1990 to 2019. *Nephron.* 2024;148(2):113-123. doi:10.1159/000534071. PMID:37717572.
19. Li Z, He R, Wang Y, Qu Z, Liu J, Yu R, et al. Global trends of chronic kidney disease from 1990 to 2021: a systematic analysis for the Global Burden of Disease Study 2021. *BMC Nephrol.* 2025;26(1):385. doi:10.1186/s12882-025-04309-7. PMID:40660180.
20. Goh JX, Sud K, Tesfaye W, Van C, Seth S, Tarafdar S, et al. The impact of medication regimen complexity on patient-related and clinical outcomes in kidney failure: a systematic review. *Expert Opin Pharmacother.* 2025;26(2):209-217. doi:10.1080/14656566.2025.2450359. PMID:39763440.
21. 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;57(9):2979-2994. doi:10.1007/s11255-025-04472-8. PMID:40183883.
22. Ozkan I, Taylan S. Diet and fluid restriction experiences of patients on hemodialysis: a meta-synthesis study. *Rev Nefrol Dial Traspl.* 2022;42(1):22-40. DOI: not identified. PMID: not indexed.

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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