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Correlation analysis of anxiety, depression, and sleep quality in end-stage renal disease patients undergoing maintenance hemodialysis

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Abstract

End-stage renal disease (ESRD) patients undergoing maintenance hemodialysis (MHD) often experience significant psychological distress and sleep disturbances, with anxiety and depression being particularly prevalent. These conditions may negatively affect sleep quality. However, comprehensive studies examining the interplay between anxiety, depression, and sleep quality in ESRD patients are limited. Understanding these relationships is crucial for improving patient care. This study aimed to evaluate the prevalence and severity of anxiety, depression, and sleep disorders in ESRD patients on MHD and identify the independent effects of anxiety, depression, and other factors on sleep quality. Data from 65 ESRD patients on MHD between January 2020 and December 2023 were retrospectively analyzed. Inclusion criteria were age ≥ 18 years, MHD for ≥ 3 months, and complete clinical and psychological data. Exclusion criteria included a history of diagnosed psychiatric disorders or significant recent life events. Anxiety, depression, and sleep quality were assessed using the GAD-7, PHQ-9, and PSQI scales. Statistical analyses included *t*-tests, ANOVA, chi-square tests, Pearson correlation, and multiple linear regression to identify independent predictors of sleep quality, adjusting for potential confounders. Anxiety symptoms were present in 55.38% of patients, depressive symptoms in 50.77%, and sleep disturbances in 72.30%. Significant positive correlations were found between anxiety and depression with poor sleep quality, with depression showing a stronger association. Multivariate regression identified anxiety and depression as independent predictors of sleep quality. Disease-related factors such as longer chronic kidney disease duration, increased dialysis frequency, and elevated serum creatinine levels were associated with poorer sleep quality, while higher household income correlated with better sleep quality. Anxiety, depression, and sleep disorders are highly prevalent among ESRD patients on MHD. Anxiety and depression independently impair sleep quality, with additional contributing factors including disease duration, dialysis frequency, serum creatinine levels, and socioeconomic status. Comprehensive care should address psychological well-being alongside disease management, emphasizing psychological interventions, social support, and targeted strategies for at-risk groups to improve sleep and quality of life.

Abbreviations: ESRD = end-stage renal disease, MHD = maintenance hemodialysis.

Keywords: anxiety, depression, end-stage renal disease, maintenance hemodialysis, sleep quality

1. Introduction

End-stage renal disease (ESRD) is a significant global public health concern, posing a serious threat to individuals and societies alike.[1–3] The aging population and rising prevalence of chronic diseases have contributed to a steady increase in ESRD incidence worldwide.[4,5] According to the World Health Organization, more than 8.5 million people are affected by ESRD globally, with approximately 1 million new cases diagnosed annually. The condition's persistently high mortality rate places considerable economic and psychological strain on patients, families, and healthcare systems.[6,7]

Maintenance hemodialysis (MHD) is a cornerstone treatment for ESRD, designed to replace lost kidney function by eliminating metabolic waste and maintaining fluid and electrolyte balance.[8,9] Despite its benefits, prolonged dependence on hemodialysis imposes substantial challenges. Patients often endure frequent treatment sessions, profound lifestyle disruptions, and numerous complications, all of which significantly impact their mental health and overall quality of life.[10,11]

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In recent years, increasing attention has been given to the psychological health of ESRD patients undergoing MHD, particularly the high prevalence of mood disorders such as anxiety and depression.[12,13] Studies indicate that anxiety and depression are significantly more common among ESRD patients than in the general population. These psychological issues not only affect emotional well-being and cognitive function but also negatively impact treatment adherence and clinical outcomes.[14,15] Additionally, sleep disturbances – a critical component of quality of life – are notably more severe in this population. Poor sleep quality not only disrupts daily functioning and work capacity but also exacerbates anxiety and depression, creating a self-perpetuating cycle.[16,17]

While prior research has explored the relationship between anxiety, depression, and sleep quality, studies focusing specifically on ESRD patients undergoing MHD remain limited.[18] Therefore, this retrospective cohort study aims to systematically evaluate the prevalence of anxiety, depression, and sleep disturbances in this patient population by analyzing medical records. Furthermore, it seeks to investigate the mechanisms through which anxiety, depression, and other potential factors influence sleep quality.

By comprehensively examining the mental health and sleep quality of ESRD patients undergoing MHD, this study provides valuable insights for clinical practice. The findings will contribute to optimizing patient management strategies, improving quality of life, and guiding the development of targeted psychological interventions. These results aim to enhance both the physical and mental well-being of ESRD patients while promoting better treatment outcomes.

2. Methods

2.1. Study design

This study was approved by the Ethics Committee of the Central Hospital of Enshi Tujia and Miao Autonomous Prefecture. This retrospective cohort study aimed to evaluate the prevalence of anxiety, depression, and sleep disturbances in patients with ESRD undergoing MHD by analyzing existing medical records. Additionally, the study sought to explore the impact of anxiety, depression, and other potential factors on patients' sleep quality. As a retrospective analysis, all data were obtained from de-identified and anonymized medical records. Since the study involved no interventions and was conducted solely for academic purposes, the Ethics Committee granted a waiver of informed consent. This decision ensured compliance with ethical standards while safeguarding patient confidentiality.

2.2. Study population

Data were collected from the hospital's electronic medical record system for patients with ESRD who underwent MHD in the hospital's dialysis unit between January 2020 and December 2023. A total of 65 patients were included. Information on anxiety, depression, and sleep quality was extracted from prior patient questionnaire records, while laboratory data were obtained from monthly predialysis test results.

Inclusion criteria: Age ≥ 18 years. Diagnosis of ESRD with MHD treatment for ≥ 3 months. No record of missed or untimely dialysis in the preceding 3 months. At least 1 assessment of GAD-7, PHQ-9, and PSQI within the data collection timeframe. Absence of clinically significant complications (e.g., dialysis-associated infections, acute decompensated heart failure) that could disrupt regular dialysis schedules. Availability of complete electronic health records, including predialysis laboratory data, demographic details, and relevant medical history.

Exclusion criteria: Documented diagnosis of anxiety or depression that could confound GAD-7 or PHQ-9 scores. Major life events (e.g., loss of a close family member, divorce) within 3 months of assessment that might significantly influence psychological status or sleep quality. Long-standing or uncontrolled medical conditions affecting sleep (e.g., sleep apnea syndrome, severe insomnia).

Comorbid severe mental disorders (e.g., bipolar disorder, schizophrenia) or significant cognitive impairment. Other terminal illnesses (e.g., advanced cancer, uncontrolled thyroid dysfunction) that could interfere with psychological assessments. Incomplete records or missing key indicators.

2.3. Assessment indicators

Assessment was conducted 1 month after patients had completed at least 3 months of dialysis. Anxiety, depression, and sleep quality were assessed by trained clinical psychologists or nursing staff using standardized scales (GAD-7, PHQ-9, PSQI). All assessments were carried out by the same group of evaluators to ensure consistency and uniformity in the evaluation process. The assessments were performed within the same time frame for each patient to minimize potential time-related discrepancies in results. Anxiety levels were measured using the GAD-7 scale, with classification based on total scores: no anxiety (0–4 points), mild anxiety (5–9 points), moderate anxiety (10–14 points), and severe anxiety (15–21 points). Depression levels were evaluated using the PHQ-9 scale, categorized as follows: no depression (0–4 points), mild depression (5–9 points), moderate depression (10–14 points), and severe depression (15–27 points). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which evaluates 7 components: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of hypnotic medication, and daytime dysfunction. Each component is scored from 0 to 3, with a total score ranging from 0 to 21. Sleep quality was classified as follows: good (0–5), moderate (6–10), poor (11–15), and very poor (16–21).

2.4. Sample size estimation

The sample size of 65 patients was determined based on a power calculation, aiming for a statistical power of 80% to detect a medium effect size (Cohen d = 0.5) at an alpha level of 0.05. The power calculation was conducted using G*Power software (version 3.1), with the assumption that anxiety, depression, and sleep quality scores would show moderate correlations. This sample size was sufficient to achieve reliable results in the correlation and regression analyses while accounting for potential confounders and loss of data. The chosen sample size also meets the standard recommendation for retrospective cohort studies in similar research.

2.5. Statistical analysis

All data were analyzed using SPSS statistical software (version 25.0, IBM SPSS Statistics, Armonk). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons of continuous variables were performed using the *t*-test or one-way ANOVA, and categorical variables were compared using the chi-square test. Correlations between anxiety, depression, and sleep quality were assessed using Pearson or Spearman correlation coefficients. Multiple linear regression was employed to evaluate the independent effects of anxiety and depression on sleep quality, with adjustments for potential confounders such as age, gender, and dialysis frequency. A *P*-value of <.05 was considered statistically significant.

3. Results

3.1. General demographic and clinical disease characteristics

This study included 65 patients with ESRD undergoing MHD. Of the participants, 32 (49.23%) were male, and 33 (50.77%) were female. The age distribution was as follows: 9 patients (13.85%) aged ≤ 40 years, 31 (47.69%) aged 40–60 years, and 25 (38.46%) aged ≥ 61 years. The majority of patients were married (66.15%), and educational levels were evenly divided, with 49.23% having a high school education or below and 50.77% holding a college degree or higher. Regarding lifestyle factors, 20 patients (30.77%) had a history of smoking, and 15 (23.08%) reported alcohol consumption. Monthly household income was distributed as follows: ≤5000 CNY (38.46%), 5000–10,000 CNY (47.69%), and ≥ 10,000 CNY (13.85%). The average duration of chronic kidney disease (CKD) was 8.75 ± 5.32 years, with a mean dialysis duration of 56.04 ± 38.52 months and an average dialysis frequency of 3.22 ± 0.53 times per week. The majority of patients (70.77%) underwent hemodialysis, while the remainder were on peritoneal dialysis. Comorbid conditions included hypertension in 87.69%, diabetes mellitus in 66.15%, and heart disease in 30.77% of patients. Further details are provided in Table 1.

3.2. Current status of anxiety, depression, and sleep quality

Anxiety, depression, and sleep disorders were prevalent among the 65 patients with ESRD undergoing MHD, with varying degrees of severity (Table 2, Fig. 1). The mean anxiety score (GAD-7) was 7.35 ± 4.58, with 55.38% of patients exhibiting anxiety symptoms and 16.92% experiencing severe anxiety. The mean depression score (PHQ-9) was 8.26 ± 4.29, with depressive symptoms observed in 50.77% of patients, including 20.00% with severe depression. The mean sleep quality score (PSQI) was 10.12 ± 4.32, indicating that 72.30% of patients experienced sleep disorders, of which 15.38% were classified as severe (Table 2, Fig. 1). These findings highlight the high prevalence of mental health issues and sleep disturbances in this patient population, underscoring the need for targeted interventions to address these critical concerns.

Table 1

General data of sociodemographic and clinical disease characteristics of study subjects (n = 65, x ± s, n/%).

Variable	Item	Proportion or specific value
Age (yr)	≤40	9 (13.85%)
	40–60	31 (47.69%)
	≥61	25 (38.46%)
Gender	Male	32 (49.23%)
	Female	33 (50.77%)
Marital status	Married	43 (66.15%)
	Single/other	22 (33.85%)
Education level	High school or below	32 (49.23%)
	College or above	33 (50.77%)
Smoking history	Yes	20 (30.77%)
	No	45 (69.23%)
Alcohol history	Yes	15 (23.08%)
	No	50 (76.92%)
Household income (Monthly)	≤5000 CNY/mo	25 (38.46%)
	5000–10,000 CNY/mo	31 (47.69%)
	≥10,000 CNY/mo	9 (13.85%)
Chronic kidney disease duration (yr)		8.75 ± 5.32
Dialysis duration (mo)		56.04 ± 38.52
Dialysis frequency (times/wk)		3.22 ± 0.53
Dialysis type	Hemodialysis	46 (70.77%)
	Peritoneal dialysis	19 (29.23%)
Comorbidities	Hypertension	57 (87.69%)
	Diabetes	43 (66.15%)
	Heart disease	20 (30.77%)
Laboratory indicators	Serum Creatinine (Cr, μmol/L)	478.42 ± 56.18
	Hemoglobin (Hb, g/L)	101.54 ± 16.02
	Albumin (Alb, g/L)	32.13 ± 5.64
	Serum Calcium (Ca, mmol/L)	2.34 ± 0.42
	Serum Phosphorus (P, mmol/L)	1.67 ± 0.59

3.3. Correlation analysis

Correlation analyses revealed significant associations between anxiety (GAD-7 score), depression (PHQ-9 score), and sleep quality (PSQI score). Depression showed a stronger correlation with sleep quality ($R = 0.63$, $P < .01$) compared to anxiety ($R = 0.56$, $P < .01$) (Table 3). Additionally, disease-specific factors, including CKD duration ($R = 0.45$, $P < .05$), dialysis frequency ($R = 0.38$, $P < .05$), and serum creatinine levels ($R = 0.34$, $P < .05$), were positively correlated with sleep quality scores (Table 4). These findings highlight the critical role of psychological factors, particularly anxiety and depression, in influencing sleep quality. Moreover, the impact of disease-specific factors such as CKD duration, dialysis frequency, and serum creatinine levels underscores the need for a comprehensive approach to managing sleep problems that addresses both mental health and underlying disease conditions.

3.4. Univariate analysis

Univariate analysis identified age and monthly household income as significant factors influencing sleep quality in patients with ESRD (Table 5). Patients aged ≥ 61 years had significantly higher PSQI scores compared to younger age groups ($F = 5.326$, $P = .008$), indicating that older patients are more likely to experience severe sleep disturbances. Similarly, patients with lower monthly household income (≤5000 CNY) exhibited significantly higher PSQI scores than those with higher income levels ($F = 6.158$, $P = .004$), suggesting a negative impact of economic status on sleep quality. No statistically significant associations were observed for gender, marital status, education level, smoking or drinking history, dialysis type, or comorbidities ($P > .05$).

3.5. Multivariate linear regression analysis

The independent effects of anxiety and depression on sleep quality were analyzed using multiple linear regression, with the PSQI score as the dependent variable and potential confounders (e.g., age, gender, dialysis frequency) controlled. Variable assignments are detailed in Table 6. The results (Table 7) indicated that anxiety ($\beta = 1.253$, $P < .001$) and depression ($\beta = 1.125$, $P < .001$) were significant psychological factors influencing sleep quality, both positively associated with poorer sleep outcomes. While a weak correlation between anxiety and depression was observed, the variance inflation factor for these variables was 1.478, below the threshold of 2, confirming no significant multicollinearity issues. Disease-specific factors, including CKD duration ($\beta = 0.654$, $P = .002$), dialysis frequency ($\beta = 0.805$, $P = .002$), and serum creatinine levels ($\beta = 0.550$, $P = .002$), were also significantly associated with poorer sleep quality. Conversely, monthly household income showed a negative correlation with sleep quality scores ($\beta = -1.521$, $P < .001$), suggesting that patients with higher income levels experience fewer sleep disturbances. Age, however, did not have a significant effect on sleep quality ($P = .190$).

Table 2

Anxiety, depression, and sleep quality scores and distribution characteristics of study subjects (x ± s, n/%).

Scale	Mean score	Distribution characteristics			
		No	Mild	Moderate	Severe
Anxiety (GAD-7)	7.35 ± 4.58	12 (18.46%)	24 (36.92%)	18 (27.69%)	11 (16.92%)
Depression (PHQ-9)	8.26 ± 4.29	10 (15.38%)	22 (33.85%)	20 (30.77%)	13 (20.00%)
Sleep quality (PSQI)	10.12 ± 4.32	8 (12.31%)	23 (35.38%)	24 (36.92%)	10 (15.38%)

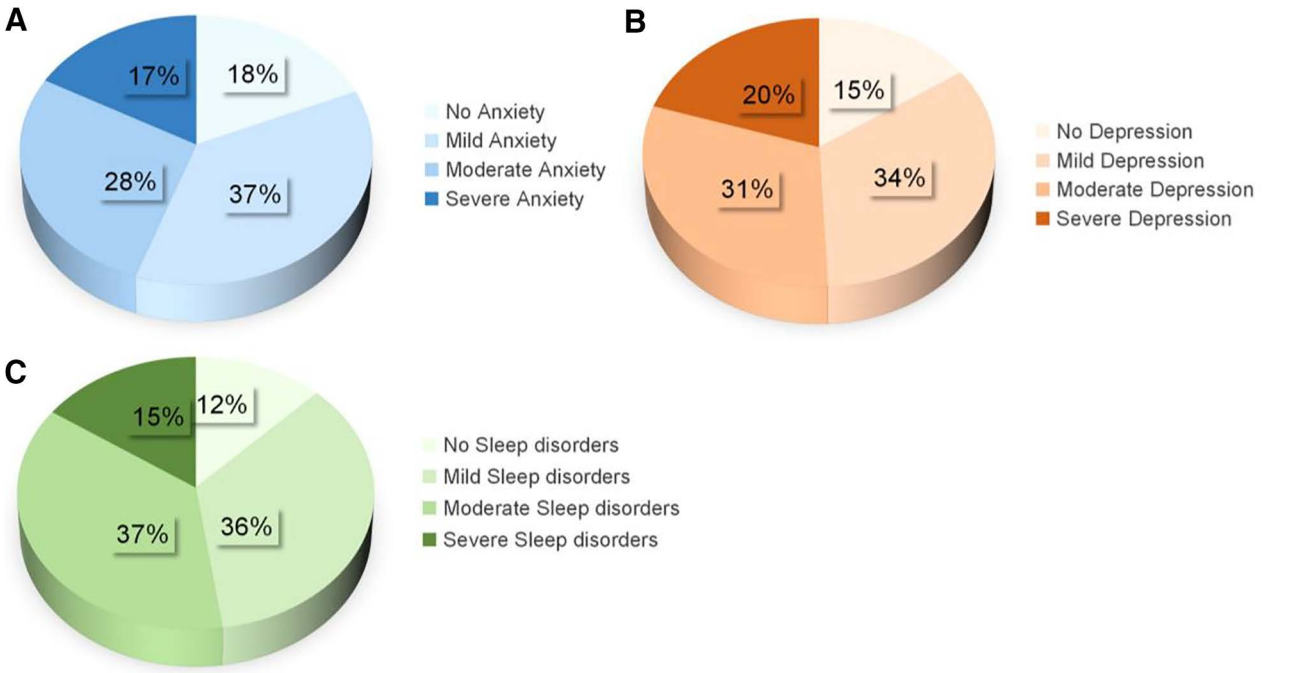

Figure 1. Distribution characteristics of anxiety, depression, and sleep quality in the study population. (A) Anxiety. (B) Depression. (C) Sleep quality.

Table 3

Correlation analysis of anxiety, depression, and sleep quality.

Variable	GAD-7 (anxiety)	PHQ-9 (depression)	PSQI (sleep quality)
GAD-7 (anxiety)	1.00	0.21*	0.56**
PHQ-9 (depression)		1.00	0.63**
PSQI (sleep quality)			1.00

Correlation analysis was conducted using Pearson analysis.

*$P < .05$.

**$P < .01$.

4. Discussion

This study utilized a retrospective cohort design to analyze the demographic and disease characteristics, as well as the anxiety, depression, and sleep quality status, of 65 ESRD patients undergoing MHD. Relevant factors influencing sleep quality were also explored, providing valuable insights for addressing mental health challenges in this patient population.

The findings revealed a high prevalence of anxiety (55.38%) and depression (50.77%) among ESRD patients, with an even higher proportion (72.30%) experiencing sleep disorders. Multiple regression analysis identified anxiety and depression as independent psychological factors significantly impacting sleep quality. Additionally, disease-related factors such as CKD duration, dialysis frequency, serum creatinine levels, and monthly household income were found to significantly influence sleep quality. These results highlight the interplay between psychological and disease-specific factors in shaping sleep outcomes for ESRD patients.

The prevalence of anxiety and depression observed in this study aligns with previous findings, which attribute these conditions to the chronic burden of disease, demanding treatment regimens, and reduced quality of life in patients with CKD.[19,20] Similarly, the high incidence of sleep disorders in dialysis patients has been extensively documented.[21] This study further confirmed the independent effects of anxiety and depression on sleep quality through correlation and regression analyses, emphasizing the critical role of psychological well-being in managing chronic illnesses. Notably, this study highlighted the significant impact of monthly household income on sleep quality, a factor less commonly addressed in earlier research. The findings suggest that socioeconomic status may play a crucial role in the mental health and sleep quality of ESRD patients, underscoring

Table 4

Correlation analysis between chronic kidney disease duration, dialysis frequency, serum creatinine, and sleep quality.

Variable	Chronic kidney disease duration (yr)	Dialysis frequency (times/wk)	Serum creatinine (Cr, μmol/L)	PSQI (sleep quality)
Chronic kidney disease duration (yr)	1.00	0.20	0.25	0.45*
Dialysis frequency (times/wk)		1.00	0.18	0.38*
Serum creatinine (Cr, μmol/L)			1.00	0.34*
PSQI (sleep quality)				1.00

Correlation analysis was conducted using Pearson analysis.*$P < .05$.

Table 5

Univariate analysis of differences in sleep quality scores based on baseline categorical variables (x ± s).

Variable	Item	PSQI (sleep quality)	*F*/*t*	*P* value
Age (yr)	≤40	8.01 ± 2.53	5.326	**.008**
	40–60	10.52 ± 4.04		
	≥61	12.01 ± 3.82		
Gender	Male	10.07 ± 3.51	0.217	.652
	Female	10.26 ± 4.17		
Marital status	Married	10.18 ± 3.92	0.343	.567
	Single/Other	10.31 ± 4.23		
Education level	High school or below	10.48 ± 3.84	0.156	.881
	College or above	10.07 ± 4.07		
Smoking history	Yes	10.54 ± 3.91	0.227	.813
	No	10.16 ± 4.03		
Alcohol history	Yes	10.22 ± 4.10	0.182	.724
	No	10.03 ± 3.84		
Household income (monthly)	≤5000 CNY/mo	12.07 ± 4.07	6.158	**.004**
	5000–10,000 CNY/mo	9.56 ± 3.52		
	≥10,000 CNY/mo	8.82 ± 2.83		
Dialysis type	Hemodialysis	10.41 ± 3.91	0.094	.916
	Peritoneal dialysis	10.04 ± 4.23		
Comorbidities	Hypertension	10.35 ± 3.84	0.255	.782
	Diabetes	10.13 ± 4.05		
	Heart disease	10.51 ± 4.16		

Bold values indicate statistically significant.

Table 6

Variable assignment table.

Variable	Definition	Assignment explanation
X1	Age (years)	≤40 = 1, 40–60 = 2, ≥61 = 3
X2	Household income (monthly)	≤5000 CNY/mo = 1, 5000–10,000 CNY/mo = 2, ≥10,000 CNY/mo = 3
X3	Chronic kidney disease duration (yr)	Specific value
X4	Dialysis frequency (times/wk)	Specific value
X5	Serum creatinine (Cr, μmol/L)	Specific value
X6	Anxiety	Specific value
X7	Depression	Specific value

the importance of considering economic factors in comprehensive patient care.[22]

Anxiety and depression can influence sleep quality through various mechanisms. Psychological stress and negative emotions activate the sympathetic nervous system and elevate cortisol levels, disrupting the normal sleep–wake cycle.[23] Additionally, the prolonged course of CKD, frequent dialysis, and elevated serum creatinine levels – markers of disease severity – can cause discomfort, pain, and fatigue, further aggravating sleep disturbances.[24] Chronic inflammation and oxidative stress, common in ESRD patients, may also impair central nervous system function, contributing to sleep dysregulation.[25] Moreover, physiological stress and fluid-electrolyte imbalances during dialysis can directly affect sleep quality.[26] These complex interactions between psychological and physiological factors make sleep disorders in ESRD patients particularly challenging to manage.[27]

The primary strength of this study lies in its systematic retrospective cohort design, incorporating a broad range of clinical and psychological assessment parameters. This approach enabled a comprehensive evaluation of the mental health and sleep quality of ESRD patients. Confounding factors, such as age, gender, and dialysis frequency, were effectively controlled through multiple regression analysis, enhancing the reliability of the findings. Standardized assessment tools (GAD-7, PHQ-9, PSQI) were employed to ensure the validity and consistency of the data.

Additionally, one of the unique strengths of this study is its holistic approach, combining both psychological and clinical factors to assess the impact on sleep quality. Compared to other studies that often focus on either psychological factors or clinical variables in isolation, our study offers a more comprehensive understanding of how these factors interact to affect ESRD patients. This integration of clinical markers (such as dialysis frequency and serum creatinine levels) with psychological assessments (such as anxiety and depression) provides a more well-rounded perspective of the challenges faced by ESRD patients.

Table 7

Multiple linear regression analysis: effects of anxiety, depression, and other variables on sleep quality.

Variable	β	SE	*t*	*P* value
Constant	5.000	1.537	3.253	.002
Anxiety	1.253	0.351	3.570	<.001
Depression	1.125	0.325	3.462	<.001
Chronic kidney disease duration (yr)	0.654	0.211	3.100	.002
Dialysis frequency	0.805	0.250	3.220	.002
Serum creatinine	0.550	0.183	3.005	.002
Household income	−1.521	0.425	−3.579	<.001
Age	0.214	0.150	1.427	.190

Furthermore, the use of well-established, standardized assessment tools, such as GAD-7, PHQ-9, and PSQI, strengthens the reliability and comparability of our findings with other studies. Unlike smaller studies or those with less validated measures, our research provides a robust dataset that enhances the generalizability of the conclusions. In comparison to other studies, which may not account for confounding factors such as socioeconomic status or disease duration, our study utilized multiple regression analysis to control for these variables, offering a clearer picture of the independent effects of psychological factors on sleep quality.

Although this study provides valuable insights, it has several limitations. First, as a retrospective study, it is subject to selection and information biases, particularly due to reliance on the completeness and accuracy of medical records. Missing psychological assessments in some cases may have impacted the accuracy of the findings. Second, the relatively small sample size of 65 patients limits the generalizability of the results and reduces statistical power. Third, while anxiety and depression were assessed using self-reported scales (GAD-7 and PHQ-9), this may introduce screening bias, as some patients might have undiagnosed mental health issues. Additionally, the exclusion criterion of "no history of mental illness" may not fully account for patients with subclinical psychiatric conditions. Future studies could incorporate clinical interviews or diagnostic assessments to complement self-reported measures.

Our findings highlight the critical importance of addressing mental health and sleep quality in the management of ESRD patients. Strengthening psychological assessments in clinical practice can facilitate early identification and timely intervention for anxiety and depression, ultimately improving patients' quality of life. Given the high prevalence of anxiety, depression, and sleep disorders, specific interventions should be implemented in clinical settings. Cognitive behavioral therapy (CBT) or counseling services may be beneficial for patients experiencing mental health challenges. Tailored support for high-risk groups, such as older adults and individuals with lower socioeconomic status, may help mitigate sleep disturbances. On a public health level, enhancing mental health support systems for ESRD patients – through psychological counseling services and mental health education programs – can effectively reduce the prevalence of anxiety and depression, thereby improving sleep quality. Moreover, sleep hygiene practices and pharmacological interventions for sleep disorders should also be considered as part of the treatment plan. Comprehensive interventions should integrate psychotherapy (e.g., CBT), medication, and robust social support networks to promote holistic improvements in patient well-being.

5. Conclusions

This study underscores the high prevalence of anxiety, depression, and sleep disorders among ESRD patients undergoing MHD. Anxiety and depression were not only common but also significantly associated with poorer sleep quality. Additionally, disease-specific factors, such as the duration of CKD, dialysis frequency, serum creatinine levels, and monthly household income, were significant contributors to sleep quality. These findings suggest that clinical management should adopt a multifaceted approach, addressing both mental health and disease-related factors, to enhance the quality of life for ESRD patients. Furthermore, future intervention studies are recommended to evaluate the effectiveness of psychological interventions, such as CBT or counseling, in improving sleep quality and alleviating mental health symptoms in this patient population. Such studies could provide valuable insights into the potential benefits of addressing psychological well-being as part of comprehensive care for ESRD patients.

Author contributions

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