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Exploring Health-Related Quality of Life and Its Psychosocial, Sociodemographic, and Clinical Predictors Among Family Caregivers of Patients Undergoing Hemodialysis in Pakistan

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Abstract

Background

Caregivers of individuals undergoing hemodialysis for kidney failure face a gradual decline in their physical and emotional well-being, derived from the implications of treatment and the sustained responsibility of providing long-term care.

Objectives

This study aims to evaluate the quality of life of caregivers of patients undergoing hemodialysis in Pakistan. It also explores the determinants of health-related quality of life (HRQoL) and its association with clinical and sociodemographic factors, to inform the development of healthcare policies and interventions that enhance caregivers' quality of life and support systems.

Methodology:

A cross-sectional study was conducted among caregivers of patients undergoing hemodialysis in Pakistan. Participants were recruited from hemodialysis centers using convenience sampling. Data on caregivers' HRQoL were collected using the Five-level EuroQol five-dimensional questionnaire (EQ-5D-5L). Additional information on clinical and sociodemographic factors was obtained through a structured pro forma. Data were analyzed using descriptive statistics, non-parametric tests, and a general linear model to assess associations and predictors of quality of life.

Results

362 caregivers of hemodialysis patients were analyzed, primarily young adults aged 21–40 (59.9%), with a female majority (52.8%). Sociodemographic data revealed a cohort with limited education (42.8%), high unemployment (51.7%), and low household income (40.3%). Despite economic strain, familial support was evident: 81.8% were married, and 92.3% lived with family. EQ-5D-5L revealed minimal self-care issues (82.0% unaffected) but challenges in daily activities (39.5% mild impairment) and mental health. Upon regression analysis, higher depression scores were strongly associated with lower HRQoL ($\beta = -0.46$, 95% CI −0.31 to −0.14, $p < 0.001$), while better self-rated health on the VAS predicted higher HRQoL ($\beta = 0.27$, 95% CI 0.0015 to 0.0052, $p = 0.002$). Among sociodemographic factors, age ($\eta^2p = 0.155$, $p < 0.001$) and marital status ($\eta^2p = 0.092$, $p < 0.001$) showed the largest effects. No evidence of multicollinearity was detected (all VIFs < 2.5).

Conclusions

Sociodemographic factors, caregiving burden, and psychological health strongly influence the HRQoL of caregivers of hemodialysis patients. While the cross-sectional design and convenience sampling limit causal inference and generalizability, these findings highlight the need for family-centered renal care that includes psychological support, respite services, and financial assistance, particularly in resource-limited settings. Recognizing and supporting caregivers as integral partners is essential for improving outcomes in renal care.

INTRODUCTION

Chronic kidney disease (CKD) is a growing global health burden. Millions progress to end-stage renal disease and need maintenance hemodialysis (1). Dialysis sustains life but has major physical, emotional, and financial impacts on patients and their family caregivers. In low- and middle-income countries such as Pakistan, limited formal care means that unpaid relatives provide most of it. Caregivers coordinate treatments, manage finances, handle dietary needs, and offer emotional support, all at significant personal cost (2),(3),(4),(5). International evidence shows caregivers of hemodialysis patients face higher rates of depression, anxiety, and lower quality of life. Psychological distress and caregiving demands feed into each other; declining mental health worsens well-being. Yet data from resource-limited settings remain scarce(6–8).

In Pakistan, research on caregiver well-being is evolving. The literature is limited, with studies using single-site designs and reporting data without a systematic evaluation of psychological factors using validated screening tools. Thus, key gaps remain. This study addresses them with a multicenter assessment of caregivers of hemodialysis patients across Punjab, Pakistan. We use the EQ-5D-5L and validated Urdu versions of the PHQ-9 and GAD-7 to assess HRQoL and psychosocial and sociodemographic predictors of impaired well-being. By integrating psychological, socioeconomic, and caregiving-related factors into one analytical model, we provide a more complete view of caregiver vulnerability. Our findings aim to inform culturally sensitive, family-oriented renal care strategies and guide policies to integrate mental health screening and support into dialysis services in Pakistan.

METHODS

Study Design and Participants

This multicenter, cross-sectional study was conducted from June to October 2024 at five Hemodialysis centers and nephrology departments in Punjab, Pakistan. Centers were selected based on accessibility and willingness to participate; although they serve a diverse patient population, they may not fully

reflect the demographic and clinical diversity of the national hemodialysis population. The study aimed to estimate the quality of life among caregivers of hemodialysis patients. The sample size was calculated to be 362 caregivers using Raosoft, with a response distribution of 50%, a 0.05 α (alpha) error, and a 95% confidence interval. Caregivers were recruited using convenience (non-probability) sampling, enrolling those present and willing at the selected centers during the study period.

Eligible participants were caregivers aged 18 or older who had provided primary care for over 3 months and signed a consent form. Caregivers under 18 were excluded because: 1. They cannot legally give consent, and our process did not allow for parental consent. 2. The questionnaires used are for adults and may not work for teens. 3. Young and adult caregivers face different challenges, so studying minors would require a separate study.

Caregivers with a diagnosed psychiatric illness prior to assuming the caregiving role and those who were paid or professional caregivers were excluded. A total of nine caregivers were excluded based on a self-reported history of a physician-diagnosed psychiatric disorder occurring before the initiation of caregiving. Psychiatric history and timing of diagnosis relative to caregiving onset were assessed through a structured screening process. Trained interviewers asked participants whether they had ever received a physician-confirmed psychiatric diagnosis, the approximate timing of that diagnosis in relation to the start of caregiving, and current or prior use of psychiatric medications. When available and with participant consent, self-reported information was corroborated using medical records or medication history. Caregivers who reported psychiatric diagnoses occurring after they had assumed the caregiving role, or who reported psychological symptoms without a prior formal diagnosis, were included. These conditions may represent consequences of the caregiving experience rather than pre-existing morbidity.

The study protocol received ethical approval from the Rahmah Health Foundation Institutional Review Board (Ref: RHF-05-2024).

Data Collection Procedures

Trained healthcare workers collected data through face-to-face interviews using standardized instruments:

Demographic and Clinical Characteristics:

Sociodemographic factors included gender, age, city of residence, and education, categorized as follows: no education, elementary school, middle school, secondary school, university, and postgraduate. Working status was examined under the following categories: unemployed, employed, disabled, and retired. Household income, marital status, relationship with the patient, and living situation were also included in the interview questions.

Validated Questionnaires:

EQ-5D-5L

Caregivers' quality of life was assessed using the Urdu EuroQol 5-Dimensions 5-Level (EQ-5D-5L) instrument (9), which measures health-related quality of life through descriptive profiles and a single index value suitable for statistical modeling and health economics. This makes it appropriate for our study objectives. The study used previously validated Urdu versions of the EQ-5D-5L to assess general health status, the PHQ-9 to screen for depressive symptoms, and the GAD-7 to screen for anxiety symptoms. These instruments were translated and culturally adapted for Pakistani populations following rigorous forward–backward translation, expert review, and cognitive debriefing protocols. Their psychometric validity and reliability have been established in prior studies. References to these validation studies are included.

The permission to use the EQ-5D-5L index calculation was obtained through formal registration with the EuroQol Research Foundation (Registration ID: RAHMAH HEALTH FOUNDATION | 64201). The registration document and standard validated tool can be found in the supplementary files.

PHQ-9: Depressive symptoms were assessed using the validated Urdu version of the Patient Health Questionnaire-9 (PHQ-9) (Ahmad et al., 2018). This translation demonstrated excellent reliability, with internal consistency (Cronbach's α) = 0.91 and split-half reliability (r) = 0.77. Exploratory factor analysis supported a unidimensional structure for the scale, as evidenced by an eigenvalue of 5.64, which explained 56.4% of the total variance, and all item loadings were at least 0.63. Convergent validity was established through strong correlations: negative affect scores correlated positively with the PHQ-9 ($r = 0.68–0.78$, $p < 0.01$), whereas positive affect and life satisfaction showed significant negative correlations ($p < 0.01$). The scale was rigorously adapted through forward-backward translation, expert review, and cognitive debriefing and validated in primary care settings across Punjab, Sindh, and Gilgit-Baltistan. Its short length and cultural fit make it especially suitable for caregivers in low-resource environments (10).

GAD-7

We assessed anxiety symptoms using the validated Urdu version of the Generalized Anxiety Disorder-7 (GAD-7) scale (Ahmad et al., 2017). This translation demonstrated excellent reliability (Cronbach's $\alpha = 0.92$; split-half reliability = 0.82) and strong construct validity in Pakistani populations, with a unidimensional structure matching that of the original English version (eigenvalue = 5.18, explaining 64.8% of the variance). The scale showed good convergent validity through significant correlations with well-being measures ($r = -0.44$ to 0.63, $p < 0.001$) and passed rigorous translation protocols, including forward-backward translation, expert committee review, and cognitive debriefing. Developed specifically for primary care settings in Pakistan, this version has shown clinical utility across diverse regions, including Punjab, where our study was conducted (11).

Statistical Analysis

All statistical analyses were performed using JAMOVI (Version 2.3). Continuous variables were assessed for normality using Shapiro-Wilk tests and visual inspection of Q-Q plots. Descriptive statistics for normally distributed variables are presented as mean ± standard deviation, while non-normally distributed variables are reported as median (interquartile range). Categorical variables are summarized as frequencies and percentages.

Missing data were limited to employment status (18/362; 4.97%). All other variables included in the regression analyses were complete. Given the low proportion of missingness (< 5%) and its restriction to a single descriptive variable, no imputation procedures were undertaken. Frequencies were calculated using the total sample size, with missing cases retained in the dataset.

The association between sociodemographic factors and EQ-5D index scores was evaluated using linear regression models with robust standard errors (HC3 estimator) to account for heteroscedasticity. We employed bootstrap resampling (5,000 iterations) to generate bias-corrected 95% confidence intervals for all regression coefficients. Effect sizes were reported using standardized beta coefficients (β) and partial eta-squared (η^2p) values. Model assumptions were verified by examining residual plots and variance inflation factors (all < 5), indicating no substantial multicollinearity.

Post-hoc pairwise comparisons were conducted using Tukey's HSD test, with effect sizes reported as Cohen's d using the pooled standard deviation for categorical predictors with significant overall effects in the regression models. All statistical tests were two-tailed, with p-values < 0.05 considered statistically significant.

Multivariable regression models were specified using a theory-driven approach, with covariates selected a priori based on prior evidence and conceptual relevance to caregiver psychological distress and health-related quality of life. All selected variables were retained regardless of statistical significance to account for potential confounding and to provide adjusted estimates for key predictors. Alternative data-driven model specifications were explored and yielded comparable results; however, the theoretically informed full model was retained for the primary analyses to enhance transparency and comparability with existing literature.

EQ-5D-5L Index Calculation

The EQ-5D-5L index scores were calculated using the Indian value set (Jyani et al., 20222), which assigns culturally relevant weights to health states based on population preferences (12). While developed for India, this value set is the closest available approximation for Pakistan. This is due to the shared sociocultural, economic, and demographic features of urban populations in both countries. They also face similar challenges in accessing care and in out-of-pocket expenditures. Additionally, both have shared linguistic roots, family structures, and illness perception patterns. GDP per capita and health spending as a percentage of GDP are also comparable.

Raw responses for each dimension (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) were converted to dimension-specific disutilities using published Indian weights (see Supplementary Material for SPSS syntax). The index was calculated as:

EQ index = 1−(disutmo+disutsc+disutua+disutpd+disutad) EQ index = 1−(disutmo+disutsc+disutua+disutpd+disutad)

Disutility values range from 0 (no problems) to 0.5843 (extreme problems, e.g., pain). Scores theoretically range from − 0.565 to 1.0, with negative values indicating health states worse than death.

To assess the robustness of the findings to the choice of health-related quality-of-life measurement, a sensitivity analysis was conducted using the EQ-5D visual analogue scale (EQ-VAS) as the outcome variable. EQ-VAS is a valuation-independent measure of self-rated health ranging from 0 to 100. The same multivariable linear regression model used in the primary analysis was repeated, this time with EQ-VAS scores, including depressive symptoms (PHQ-9), anxiety (GAD-7), and relevant sociodemographic and caregiving-related covariates.

RESULTS

The study included 362 caregivers of patients undergoing hemodialysis, highlighting diverse socio-demographic characteristics as shown in Table 1. The sample was predominantly female (191, 52.76%), with 217 (59.9%) caregivers aged 21–40 years. In terms of education, 104 (28.7%) had secondary or higher education, while 51 (14.1%) reported no formal education. Over half of the caregivers, 187 (51.7%), were unemployed, with a significant portion earning less than 30,000 rupees per month, 111 (30.7%). A majority, 296 (81.8%), were married, and 334 (92.3%) lived with the patients they cared for, indicating strong familial support structures. Geographically,264 (72.9%) resided in urban areas. Caregiving varied, with 169 (46.7%) providing moderate care and 149 (41.2%) engaged in very long-term caregiving.

Table 1
Socio-demographic characteristics of caregivers of hemodialysis patients (N = 362)

Variables		N	%
Gender	male	171	47.24
	female	191	52.76
Age	< 20	10	2.8
	21–40	217	59.9
	41–60	132	36.5

	> 60	3	0.8
Education	None	51	14.1
	Elementary school	43	11.9
	Middle school	76	21
	Secondary school	104	28.7
	University	76	21
	Postgraduate	12	3.3
Working status	Unemployed	187	51.7
	Employed	151	41.7
	Disabled	1	0.3
	Retired	5	1.4
	Missing	18	5
Household income	< 30k	111	30.7
(Rupees)	30-50k	146	40.3
	51-75k	105	29
Marital status	Single	58	16
	Divorced	3	0.8
	Married	296	81.8
	Widowed	5	1.4
Relationship with the patient	Children	82	22.7
	Extended family (e.g., uncle, aunt, etc.)	11	3
	Others	9	2.5
	Spouse/Partner	148	40.9
	Parents	70	19.3
	Siblings	42	11.6
Living situation	Live separately from the patient	28	7.7
	Live with a patient	334	92.3
Residence	Rural area	98	27.1
	Urban area	264	72.9
Daily hours of caregiving	Low intensity (≤ 2)	60	16.6
	Moderate intensity (≤ 5)	169	46.7
	High intensity (≤ 10)	50	13.8
	Very high intensity (≤ 16)	36	9.9
	Extreme intensity (> 16)	47	13
Duration of caregiving in months	Short-term (≤ 6)	84	23.3
	Moderate term (≤ 12)	53	14.6
	Long-term (≤ 36)	76	21
	Very long-term (> 36)	149	41.2

The analysis of quality of life (QOL) dimensions using the EQ-5D scale revealed the following distribution of reported problems among caregivers, as shown in Table 2. Most participants reported no problems with self-care (n = 297), followed by mobility(n = 235) and pain or discomfort (n = 145). Slight problems were often reported in usual activities (n = 143) and anxiety/depression (n = 139). Moderate issues were reported by 101 caregivers in the dimension of anxiety/depression, followed by pain/discomfort by 53, and usual activities by 39 caregivers. Severe problems were infrequently reported, particularly in everyday activities (n = 35) and self-care (n = 24). Remarkably, no caregivers reported extreme issues in mobility, while 13 caregivers had extreme difficulties in the anxiety/depression dimension. These results demonstrate that the caregivers face challenges to varying degrees in differing

QOL dimensions, with a considerably more significant emphasis on anxiety and depression than on any other dimension. To further explore the specific areas of difficulty experienced by caregivers, the distribution of reported problems across each EQ-5D dimension is summarized in Table 2:

Table 2
Distribution of Caregivers by Level of Problems Reported in Each EQ-5D Dimension (%)

EQ-5D Dimension	No problem	Slight problem	Moderate problem	Severe problem	Extreme problem
Mobility	64.92	25.14	6.08	3.87	0
Usual activities	46.69	39.52	10.77	2.49	0.55
Self-care	82.04	11.60	3.31	2.9	0.55
Pain/Discomfort	40.06	39.50	14.64	5.52	0.28
Anxiety/Depression	19.61	38.40	27.90	10.50	3.59

EQ Index varies significantly across several factors, including age, marital status, education, household income, caregiving intensity, duration of caregiving, and occupation. Older individuals and those with lower socioeconomic status reported a lower quality of life. Higher levels of education and higher household income were associated with a better quality of life. Moreover, individuals who provided more daily and long-term caregiving hours exhibited lower EQ Index scores. Unemployed individuals also reported significantly lower quality of life than their employed counterparts. These findings underscore the impact of demographic and socioeconomic factors on health-related quality of life. The Kruskal-Wallis test was conducted to identify the factors significantly associated with EQ-5D index scores among caregivers, and the results are summarized in Table 3.

Table 3
Kruskal-Wallis Test Summary: Associations Between Caregiver Characteristics and EQ-5D Index Scores, Including Effect Sizes and Significant Pairwise Comparisons

Factor	χ^2	df	p-value	Effect Size (ε^2)	Significant Pairwise Comparisons ($p < 0.05$)
Age	56.0	3	< 0.001	0.155	Under 20 vs. 41–60 (p = 0.003); 21–40 vs. 41–60 (p < 0.001)
Marital Status	33.3	3	< 0.001	0.092	Single vs. Divorced (p < 0.001); Single vs. Widowed (p = 0.002); Divorced vs. Widowed (p = 0.011)
Education	39.8	5	< 0.001	0.110	None vs. Secondary (p = 0.036); None vs. University (p < 0.001); Elementary vs. University (p < 0.001); Middle vs. University (p < 0.001)
Household Income	19.2	2	< 0.001	0.053	Less than 30K vs. 30-50K (p < 0.001); Less than 30K vs. 51-75K (p < 0.001)
Daily Caregiving Hours	24.5	4	< 0.001	0.068	Low vs. High (p = 0.021); Low vs. Extreme (p = 0.021); Moderate vs. High (p = 0.024); Moderate vs. Extreme (p = 0.008); High vs. Very High (p = 0.026); Very High vs. Extreme (p = 0.020)
Employment status	32.1	4	< 0.001	0.089	Unemployed vs. Employed (p < 0.001); Unemployed vs. Missing (p = 0.026); Employed vs. Retired (p = 0.018); Retired vs. Missing (p = 0.011)

The analysis of the health visual analog score revealed significant differences based on age, education level, household income, daily caregiving hours, and caregiving duration. Specifically, younger individuals (under 20) had higher scores than older adults (over 60), with significant group differences ($p < .001$). The education level showed a considerable improvement in scores for those with higher education (p = 0.035). Household income also correlated with perceived health; lower-income groups reported significantly lower scores (p = 0.006). Additionally, higher caregiving intensity was associated with worse health visual analog scores ($p < .001$), and those in very long-term caregiving reported significantly lower health scores than short-term caregivers ($p < .001$). These findings suggest that demographic factors and caregiving intensity are crucial in assessing perceived health. Analysis of variance (ANOVA) was performed to assess the association between baseline caregiver factors and their overall perceived health as measured by the VAS score, with results detailed in Table 4.

Table 4
Associations Between Baseline Factors and Overall Perceived Health (VAS Score): ANOVA Results with Post-hoc Comparisons

Factor	F(df)	p-value	Levene's p-value	Significant Group Differences
Age Categories	**F (3,358) = 19.5**	**< .001**	**0.448**	**41–60 vs. Greater than 60 (p = 0.030)** **21–40 vs. 41–60 (p<.001)**
Marital Status	**F (3,358) = 10.0**	**< .001**	**0.203**	**Single vs. Widowed (p<.001)** **Married vs. Widowed (p<.001)**
Education Level	**F (5,356) = 3.37**	**0.035**	**0.005**	**None vs. Secondary (p<.001)** **None vs. University (p<.001)**
Household Income	**F (2,359) = 3.29**	**0.006**	**< .001**	**Less than 30K vs. 51-75K (p = 0.027)**
Daily Caregiving Hours	**F (4,357) = 14.4**	**< .001**	**< .001**	**Low vs. High Intensity (p<.001)** **Moderate vs. Extreme (p<.001)**
Caregiving Duration	**F (3,358) = 5.62**	**< .001**	**0.703**	**Short-term vs. Very Long-term (p<.001)**

The linear regression analysis assessed predictors of the EQ index among 362 caregivers (Table 5). Significant relationships appeared between certain psychological and health-related factors. The model's intercept was statistically significant ($\beta = 0.0097$, $p < 0.001$). Higher depression scores (Total PHQ-9) were linked to a lower EQ index ($\beta = -0.4656$, $p < 0.001$), showing a negative impact of depression on caregivers' quality of life. Self-rated health, measured by the health VAS score, showed a positive correlation with the EQ index ($\beta = 0.2656$, $p = 0.002$). This suggests that better self-assessed health is linked to improved quality of life. Other variables, such as total GAD score, household income, daily caregiving hours, duration of caregiving, gender, and education level, were not significant predictors of the EQ index. That said, trends in educational attainment, especially between middle school and no formal education, nearly reached significance. These findings underscore the importance of psychological well-being and perceived health for caregivers' quality of life.

Depressive symptom severity was independently and substantially associated with lower health-related quality of life. The standardized regression coefficient ($\beta = -0.46$) indicates a robust inverse relationship between depressive symptoms and EQ-5D index scores (an EQ-5D score is a standardized measure of general health status). Although the absolute change per unit increase in PHQ-9 score (the Patient Health Questionnaire-9, a measure of depressive symptoms) was modest, the cumulative impact across increasing levels of depressive symptom burden is likely to be clinically meaningful. In contrast, self-rated health demonstrated a moderate positive association ($\beta = 0.27$), reinforcing the importance of subjective health perception as an indicator of overall quality of life.

Effect sizes were interpreted according to conventional benchmarks for partial eta squared (η^2p), where approximately 0.01 is considered small, 0.06 medium, and 0.14 large, as described by Jacob Cohen. Based on these benchmarks, age ($\eta^2p = 0.155$) had a large effect, marital status ($\eta^2p = 0.092$) and education ($\eta^2p = 0.110$) had medium effects, and household income ($\eta^2p = 0.053$) had a small effect. Taken together, these findings highlight the multidimensional nature of caregiver vulnerability, particularly among younger caregivers and those with limited socioeconomic and social support resources.

Table 5
General linear model for EQ index (N = 362)

Names	Effect	Estimate	Standard error	95% Confidence interval		β	df	t-Value	p-value
				Lower	upper				
Intercept	intercept	0.8072	0.0105	0.7869	0.8263	0.0097	344	77.0606	< .001
Total PHQ-9	Total PHQ-9	-0.0228	0.0045	-0.0309	-0.0144	-0.4656	344	-5.1072	< .001
Health VAS Score	Health VAS Score	0.0033	0.0010	0.0015	0.0052	0.2656	344	3.1625	0.002
Total GAD Score	Total GAD Score	-0.0043	0.0029	-0.0096	0.0011	-0.0801	344	-1.4732	0.142
Household income	Household income	0.0000	0.0000	0.0000	0.0000	0.0490	344	0.9512	0.342
Daily caregiving (hours)	Daily caregiving (hours)	-0.0025	0.0019	-0.0063	0.0011	-0.0729	344	-1.2750	0.203
Duration of caregiving (months)	Duration of caregiving (months)	-0.0002	0.0002	-0.0006	0.0002	-0.0473	344	-1.0192	0.309
Male	Female-male	0.0016	0.0216	-0.0414	0.0400	0.0067	344	0.0748	0.940
Elementary school	Elementary school-None	0.0202	0.0409	-0.0559	0.0980	0.0840	344	0.4943	0.621
Middle school	Middle school-None	0.0731	0.0404	-0.0024	0.1462	0.3036	344	1.8068	0.072
Secondary school	Secondary school-None	0.0543	0.0337	-0.0058	0.1174	0.2256	344	1.6105	0.108
University	University-None	0.0228	0.0352	-0.0407	0.0873	0.0948	344	0.6482	0.517
Postgraduate	Postgraduate-None	0.0868	0.0480	0.0008	0.1770	0.3606	344	1.8093	0.071
Male * Elementary school	(Female-male) vs (Elementary School-None)	-0.0559	0.0856	-0.2143	0.0990	-0.2323	344	-0.6531	0.514
Male * Middle school	(Female-male) vs (Middle School-None)	-0.1212	0.0842	-0.2791	0.0352	-0.5034	344	-1.4392	0.151
Male * Secondary school	(Female-male) vs (Secondary School-None)	-0.1034	0.0735	-0.2454	0.0309	-0.4294	344	-1.4065	0.160
Male * University	(Female-male) vs (University-None)	-0.1202	0.0751	-0.2609	0.0138	-0.4993	344	-1.5995	0.111
Male * Postgraduate	(Female-male) vs (Postgraduate-None)	-0.1378	0.0926	-0.3120	0.0228	-0.5727	344	-1.4882	0.138

A collinearity assessment (Table 6) confirmed that multicollinearity was not an issue since all the values of the variance inflation factor (VIF) were below 3.0 and tolerance values above 0.2, indicating acceptable collinearity among predictors.

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Table 6
Collinearity Assessment

Predictor	VIF	Tolerance
Total PHQ-9	2.537	0.3942
Health VAS Score	1.960	0.5102
Total GAD Score	1.982	0.5044
Household Income	1.274	0.7847
Daily hours of caregiving	1.323	0.7558
Duration of caregiving (months)	1.107	0.9035
Gender	1.908	0.5240
Education	1.924	0.5197
Gender * Education	2.267	0.4412

In sensitivity analyses using EQ-VAS scores, higher depressive symptom severity was strongly and independently associated with poorer health-related quality of life (β = −2.33 per one-point increase in PHQ-9; 95% CI: −2.75 to − 1.92; p < .001). This association remained robust after adjustment for anxiety symptoms and caregiving-related factors. The overall pattern and direction of associations were comparable to those observed in analyses using EQ-5D-

5L index scores, indicating consistency across valuation-dependent and valuation-independent HRQoL measures. The detailed sensitivity analysis is given in the supplementary file (Tables 1–3 of the supplementary file).

DISCUSSION

Our research highlights the major psychosocial issues faced by family caregivers of hemodialysis patients in Pakistan. These caregivers are often an overlooked group in the healthcare system. The study shows that a high burden of depressive symptoms is the strongest psychological factor affecting caregivers' health-related quality of life (HRQoL). Even after adjusting for sociodemographic and caregiving factors, depressive symptoms remained closely tied to lower EQ-5D index scores. Anxiety showed weaker and less consistent links with HRQoL measures. This suggests depressive symptoms have a broader and more disruptive impact on health status than anxiety.

Accumulated epidemiological and psychometric evidence suggests that depressive symptomatology exerts a more direct influence on health-related quality of life than anxiety(13, 14). Depression predominantly affects energy levels, motivation, physical functioning, and individuals' global perceptions of health domains explicitly represented in the EQ-5D descriptive system and reflected in EQ-VAS ratings. In contrast, anxiety symptoms are more closely related to cognitive and affective processes such as worry, anticipatory stress, and emotional hypervigilance, which are less comprehensively captured by generic preference-based HRQoL instruments. Accordingly, our study also showed that stronger and more consistent associations were observed between depressive symptoms and both EQ-5D index and EQ-VAS scores, whereas associations with anxiety measures appeared weaker or non-significant.

Psychological distress as a determinant of caregiver HRQoL has been consistently observed in dialysis populations, but our findings refine this understanding by quantifying the relative magnitude of depressive symptom burden within a South Asian context. A recent single-center study by Afzal et al (15). reported that caregivers of hemodialysis patients in Pakistan experienced overall moderate quality of life, with the social relationships domain scoring highest and the physical health domain lowest using the World Health Organization Quality of Life - brief version (WHOQOL-BREF) instrument. In their cohort (N = 164), no significant differences in WHOQOL-BREF domain scores were observed across gender, education, or marital status, and the analysis was largely descriptive. In contrast, our multicenter study extends these findings by employing the EQ-5D-5L, a preference-based measure of health-related quality of life, alongside validated assessments of depressive and anxiety symptoms (PHQ-9 and GAD-7). Moreover, through multivariable general linear modeling, we identified significant independent effects of psychological distress and age on HRQoL, demonstrating that depressive symptom severity and self-rated health were robust predictors of diminished quality of life. These methodological and analytical distinctions allow for a more comprehensive evaluation of caregiver vulnerability and help bridge important gaps left by earlier single-site investigations.

Prior literature has demonstrated that caregiving load and perceived social support are central determinants of diminished quality of life among family caregivers of hemodialysis patients (2, 16). Our results extend this literature by demonstrating that depressive symptoms remain independently associated with HRQoL even after accounting for socioeconomic and caregiving variables, depression not merely as a coexisting condition but as a central driver of diminished perceived health. In line with Avşar et al. (17), the substantial psychological burden observed in our cohort reinforces the need to integrate structured mental health screening within routine renal services, particularly in settings where caregiver support systems are informal and under-resourced.

Socioeconomic gradients in HRQoL were also evident. Lower education and reduced household income were associated with poorer outcomes. In resource-constrained environments such as Pakistan, chronic kidney disease imposes significant out-of-pocket expenditures, employment disruption, and cumulative financial strain on families. These structural stressors likely compound the psychological impact of caregiving responsibilities. Furthermore, the observed association between longer caregiving duration and lower HRQoL aligns with evidence suggesting a dose–response relationship between caregiving intensity and deterioration in well-being (18). Together, these findings support a stress accumulation framework, in which prolonged exposure to caregiving demands interacts with socioeconomic disadvantage to amplify vulnerability.

Our study also showed a culturally nuanced observation regarding the caregiver's relationship to the patient. Spousal and extended-family caregivers demonstrated higher EQ-5D index scores than adult child caregivers. While Western literature often reports greater spousal burden, this divergence may reflect the collectivist family structure prevalent in Pakistan, where caregiving responsibilities are frequently distributed across extended kinship networks. Shared caregiving norms and culturally embedded expectations may mitigate perceived strain in certain relational contexts. Similar associations between family relationships and caregiver outcomes have been noted by Shah et al. (19), although the directionality and magnitude appear context-dependent. These findings highlight the importance of culturally grounded interpretations when examining caregiver burden across health systems.

Implications for Policy and Practice

While our findings support the value of tailored psychological support, respite care, and financial assistance for caregivers, key recommendations for implementation in Pakistan include: (1) Subsidizing psychological, respite, and financial support through integration into existing insurance schemes like the Sehat Sahulat Program; (2) Leveraging community health initiatives and strengthening primary care for basic psychological support; (3) Engaging family and social networks to reduce stigma and improve help-seeking; (4) Training non-specialist health workers to deliver psychosocial support; and (5) Linking these efforts with social protection programs to enhance access and sustainability. These recommendations directly address the challenges of limited mental health resources, societal stigma, and financial barriers described above, and require multi-level policy support for effective implementation.

Limitations

1. A cross-sectional design does not allow us to establish causal relationships; longitudinal research is required to examine both temporal aspects and transformations over time.
2. Convenience sampling can introduce selection bias, limiting the generalizability of our results to other cultural settings. Participants were selected from dialysis centers accessible to the research team, as no national caregiver registry exists in Pakistan, rendering random sampling unfeasible. To partially address this limitation, we recruited from multiple centers in both urban and rural areas. Response rates exceeded 90%, reducing the chance of systematic non-response bias. Nevertheless, findings should be interpreted with caution, and future studies using probability-based sampling across provinces are warranted. These findings are most applicable to caregivers attending tertiary-care dialysis centers in Punjab and should be extrapolated to the national context with caution
3. Self-reported outcomes are prone to recall and social desirability bias.
4. The EQ-5D index was calculated using an Indian value set. India was chosen as the closest cultural and socioeconomic comparator, but it may not reflect the health-state preferences of the Pakistani population. Unfortunately, alternative regional value sets (e.g., Thai, Chinese, or UK) are less culturally and economically comparable to Pakistan than the Indian set. Thus, they were not applied.
5. Although formal collinearity diagnostics (VIF < 3.0, tolerance > 0.2) indicated no major multicollinearity, we note the conceptual overlap between depressive and anxiety symptoms. We did not run additional sensitivity analyses that excluded a single symptom scale. The collinearity diagnostics and the pattern of results (PHQ-9 significant, GAD-7 non-significant) suggested that such analyses were unlikely to alter the study's main conclusions.
6. Our analysis did not employ imputation methods or sensitivity analyses for missing data patterns. However, since missing data was minimal (5% for employment status), we anticipate a limited impact on the findings.
7. Lastly, our analysis failed to quantify likely unmeasured confounders, including the caregiver's physical health or social support networks, which have been found to affect quality of life, and did not compare the experiences of various renal replacement therapies.
8. Excluding caregivers with pre-existing psychiatric diagnoses may underestimate the overall psychological burden, as such individuals are present in real-world settings.
9. Although efforts were made to verify psychiatric history through medical records when available, some information on the timing of diagnoses relied on participant recall. This may be subject to misclassification, particularly for conditions with insidious onset. These factors may limit external validity. Findings should be interpreted as reflecting depressive symptom burden among caregivers without documented pre-caregiving psychiatric illness.

Future Research

Although caregiver well-being is usually conceptualized within a dyadic framework, the present analyses were limited to caregiver-level data, as patient-level variables required for formal dyadic modeling were not available. As a result, bidirectional influences between patient and caregiver outcomes could not be empirically examined. Future studies should employ dyadic analytical approaches, such as actor–partner interdependence models, to better capture reciprocal effects within patient–caregiver dyads in chronic kidney disease. A longitudinal study is necessary to track the caregiver's HRQoL over time. To develop evidence-based support solutions, intervention studies assessing the efficacy of personalized psychosocial and educational interventions are required. A comparative analysis of caregiver experiences across various renal replacement therapies, including hemodialysis and transplantation, may identify therapy-related challenges as reported by Vovlianou S et al.(20). Also, qualitative and mixed-methods research may provide a deeper understanding of caregivers' lived experience.

CONCLUSION

The health-related quality of life among caregivers of hemodialysis patients in Pakistan is significantly influenced by psychological distress, caregiving intensity, and socioeconomic factors. Depressive symptom severity and self-rated health emerged as strong independent predictors of diminished HRQoL, while age and socioeconomic indicators contributed meaningfully to caregiver vulnerability. These findings highlight the multidimensional burden caregivers face in resource-constrained settings.

Our results spotlight the importance of systematically assessing caregiver mental health and sociodemographic risk factors within dialysis services. Although this study did not evaluate specific interventions, the strong association between psychological symptoms and impaired HRQoL suggests that integrating routine mental health screening into renal care pathways may be warranted. Recognizing caregivers as essential contributors to the dialysis care continuum is critical to developing evidence-informed policies and future interventional research to improve caregiver well-being in Pakistan and similar settings. These findings should be interpreted with caution, given the cross-sectional design, convenience sampling, potential recall bias, and residual confounding.

Abbreviations

ANOVA
Analysis of Variance
β
Standardized Regression Coefficient
B
Unstandardized Regression Coefficient
CFI
Comparative Fit Index
CI

Confidence Interval
CKD
chronic kidney disease
CFA
Confirmatory Factor Analysis
COPD
Chronic Obstructive Pulmonary Disease
df
Degrees of Freedom
EFA
Exploratory Factor Analysis
EQ
5D–5L–EuroQol 5–Dimension 5–Level Questionnaire
EQ VAS
EuroQol Visual Analogue Scale
ESRD
End–Stage Renal Disease
F
F–statistic
GAD
7–Generalized Anxiety Disorder–7
GLM
General Linear Model
HRQoL
Health–Related Quality of Life
IQR
Interquartile Range
KMO
Kaiser–Meyer–Olkin Measure of Sampling Adequacy
LMICs
Low–and Middle–Income Countries
M
Mean
MID
Minimally Important Difference
n
Subsample Size
N
Total Sample Size
OR
Odds Ratio
p
Probability Value
PHQ
9–Patient Health Questionnaire–9
QOL
Quality of Life
RMSEA
Root Mean Square Error of Approximation
SD
Standard Deviation
SE
Standard Error
VAS
Visual Analogue Scale
WHO
World Health Organization
WHOQOL
BREF–World Health Organization Quality of Life–BREF

χ^2
Chi–Square

Declarations

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Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the **Declaration of Helsinki.** Ethical approval was obtained from the Institutional Review Board of Rahmah Health Foundation, Islamabad, Pakistan (Approval No. RHF-04-2024). Written informed consent was obtained from all participants prior to inclusion in the study.

Clinical trial number

Not applicable.

Consent for publication

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before inclusion in the study.

Data availability

The data supporting this study's findings are available from the corresponding author upon reasonable request.

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References

1. Jager KJ, Kovesdy C, Langham R, Rosenberg M, Jha V, Zoccali C. A single number for advocacy and communication-worldwide more than 850 million individuals have kidney diseases. Kidney Int. 2019 Nov;96(5):1048–50. doi:10.1016/j.kint.2019.07.012 PubMed PMID: 31582227.
2. Sajadi SA, Ebadi A, Moradian ST. Quality of Life among Family Caregivers of Patients on Hemodialysis and its Relevant Factors: A Systematic Review. Int J Community Based Nurs Midwifery. 2017 Jul;5(3):206–18. PubMed PMID: 28670583; PubMed Central PMCID: PMC5478741.
3. Gerogianni G, Polikandrioti M, Babatsikou F, Zyga S, Alikari V, Vasilopoulos G, et al. Anxiety-Depression of Dialysis Patients and Their Caregivers. Medicina (Mex). 2019 May 20;55(5):168. doi:10.3390/medicina55050168 PubMed PMID: 31137563; PubMed Central PMCID: PMC6572629.
4. Caputo J, Pavalko EK, Hardy MA. The Long-Term Effects of Caregiving on Women's Health and Mortality. J Marriage Fam. 2016 Oct;78(5):1382–98. doi:10.1111/jomf.12332 PubMed PMID: 27795579; PubMed Central PMCID: PMC5079527.
5. Shukri M, Mustofai MA, Md Yasin MAS, Tuan Hadi TS. Burden, quality of life, anxiety, and depressive symptoms among caregivers of hemodialysis patients: The role of social support. Int J Psychiatry Med. 2020 Nov;55(6):397–407. doi:10.1177/0091217420913388 PubMed PMID: 32216495.
6. Pio TMT, Prihanto JB, Jahan Y, Hirose N, Kazawa K, Moriyama M. Assessing Burden, Anxiety, Depression, and Quality of Life among Caregivers of Hemodialysis Patients in Indonesia: A Cross-Sectional Study. Int J Environ Res Public Health. 2022 Apr 9;19(8):4544. doi:10.3390/ijerph19084544

PubMed PMID: 35457412; PubMed Central PMCID: PMC9032362.

7. Adejumo OA, Okaka EI, Akinbodewa AA, Iyawe OI, Edeki IR, Abolarin OS. Self-perceived Burden on Caregivers, Anxiety and Depression among Chronic Kidney Disease Patients in Southern Nigeria. West Afr J Med. 2021 Apr 23;38(4):335–41. PubMed PMID: 33900716.
8. Askaryzadeh Mahani M, Ghasemi M, Arab M, Baniasadi Z, Omidi A, Irani PS. The correlation between caregiver burden with depression and quality of life among informal caregivers of hemodialysis and thalassemia patients during the COVID-19 pandemic: a cross-sectional study. BMC Nurs. 2023 May 29;22:183. - Google Search [Internet]. [cited 2026 Mar 1]. Available from: https://www.google.com/search?q=Askaryzadeh+Mahani+M%2C+Ghasemi+M%2C+Arab+M%2C+Baniasadi+Z%2C+Omidi+A%2C+Irani+PS.+The+correlation+between+caregiver+burden+with+depression+and+quality+of+life+among+informal+caregivers+of+hemodialysis+and+thalassemia+patients+during+the+COVID-19+pandemic%3A+a+cross-sectional+study.+BMC+Nurs.+2023+May+29%3B22%3A183.&sca_esv=7b0a4ded6b34ffb0&sxsrf=ANbL-n6QB-5Vpb4GOO2tV8qFa0pX626-Qw%3A1772411643663&ei=-9qkaYiWKOiChbIPwInqQQ&ved=0ahUKEwjl_6nz-_-SAxVoQUEAHcCEOggQ4dUDCBE&uact=5&oq=Askaryzadeh+Mahani+M%2C+Ghasemi+M%2C+Arab+M%2C+Baniasadi+Z%2C+Omidi+A%2C+Irani+PS.+The+correlation+between+caregiver+burden+with+depression+and+quality+of+life+among+informal+caregivers+of+hemodialysis+and+thalassemia+patients+during+the+COVID-19+pandemic%3A+a+cross-sectional+study.+BMC+Nurs.+2023+May+29%3B22%3A183.&gs_lp=Egxnd3Mtd2l6LXNlcnAirQJBc2thcnI6YWRlaCBNYWhhbmkgTSwgR2hhc2VtaSBNLCBBcmFiIE0sIEJhbmlhc2FkaSBaLCBPbWlkaSBBLCBJcmFuaSBQUy4gVGhlIGNvcnJlbGF0aW9uIGJldHdlZW4gY2FyZWdpdmVyIGJ1cmRlbiB3aXRoIGRlcHJlc3Npb24gYW5kIHF1YWxpdHkgb2YgbGlmZSBhbW9uZyBhbmZvcm1hbCBjYXJlZ2l2ZXJzIG9mIGhlbW9kaWFseXNpcyBhbmQgdGhhbGFzc2VtaWEgcGF0aWVudHMgZHVyaW5nIHRoZSBDT1ZJRC0xOSBwYW5kZW1pYzogYSBjcm9zcy1zZWN0aW9uYWwgc3R1ZHkuIEJNQyBOdXJzLiAyMDIzIE1heSAyOTsyMjoxODMuSABQAFgAcAB4AJABAJgBAKABAKoBALgBA8gBAPgBAvgBAZgCAKACAJgDAJIHAKAHALIHALgHAMIHAMgHAIAIAA&sclient=gws-wiz-serp
9. EQ-5D-5L. EuroQol [Internet]. [cited 2026 Mar 1]. Available from: https://euroqol.org/information-and-support/euroqol-instruments/eq-5d-5l/
10. Ahmad S, Hussain S, Akhtar F, Shah FS. Urdu translation and validation of PHQ-9, a reliable identification, severity and treatment outcome tool for depression. JPMA J Pak Med Assoc. 2018 Aug 1;68(8):1166–70. PubMed PMID: 30108380.
11. Ahmad S, Hussain S, Shah FS, Akhtar F. Urdu translation and validation of GAD-7: A screening and rating tool for anxiety symptoms in primary health care. JPMA J Pak Med Assoc. 2017 Oct;67(10):1536–40. PubMed PMID: 28955070.
12. Jyani G, Sharma A, Prinja S, Kar SS, Trivedi M, Patro BK, et al. Development of an EQ-5D Value Set for India Using an Extended Design (DEVINE) Study: The Indian 5-Level Version EQ-5D Value Set. Value Health J Int Soc Pharmacoeconomics Outcomes Res. 2022 Jul;25(7):1218–26. doi:10.1016/j.jval.2021.11.1370 PubMed PMID: 35779943.
13. Hays RD, Fayers PM. Overlap of Depressive Symptoms with Health-Related Quality-of-Life Measures. PharmacoEconomics. 2021 Jun;39(6):627–30. doi:10.1007/s40273-020-00972-w PubMed PMID: 33135149; PubMed Central PMCID: PMC8088445.
14. Kim C, Ko H. Network Analysis of Depressive Symptoms and Meaning in Life and Their Association with Health-Related Quality of Life Among South Korean Older Adults. Healthcare. 2025 Jan;13(18):2281. doi:10.3390/healthcare13182281
15. Afzal A, Rahman HS, Rauf MA, Rafique Z, Gulzar A, Rasheed W, et al. Quality of Life Among Attendants/Caregivers of Dialysis Patients. Cureus. 2025 May;17(5):e83989. doi:10.7759/cureus.83989 PubMed PMID: 40519448; PubMed Central PMCID: PMC12162365.
16. Vovlianou S, Koutlas V, Papoulidou F, Tatsis V, Milionis H, Skapinakis P, et al. Burden, depression and anxiety effects on family caregivers of patients with chronic kidney disease in Greece: a comparative study between dialysis modalities and kidney transplantation. Int Urol Nephrol. 2023 Jun;55(6):1619–28. doi:10.1007/s11255-023-03482-8 PubMed PMID: 36720745.
17. Avşar U, Avşar UZ, Cansever Z, Yucel A, Cankaya E, Certez H, et al. Caregiver Burden, Anxiety, Depression, and Sleep Quality Differences in Caregivers of Hemodialysis Patients Compared With Renal Transplant Patients. Transplant Proc. 2015 Jun;47(5):1388–91. doi:10.1016/j.transproceed.2015.04.054 PubMed PMID: 26093725.
18. Rioux JP, Narayanan R, Chan CT. Caregiver burden among nocturnal home hemodialysis patients. Hemodial Int Int Symp Home Hemodial. 2012 Apr;16(2):214–9. doi:10.1111/j.1542-4758.2011.00657.x PubMed PMID: 22304491.
19. Shah KK, Murtagh FEM, McGeechan K, Crail SM, Burns A, Morton RL. Quality of life among caregivers of people with end-stage kidney disease managed with dialysis or comprehensive conservative care. BMC Nephrol. 2020 May 4;21(1):160. doi:10.1186/s12882-020-01830-9 PubMed PMID: 32366220; PubMed Central PMCID: PMC7199363.
20. Vovlianou S, Koutlas V, Papoulidou F, Tatsis V, Milionis H, Skapinakis P, et al. Burden, depression and anxiety effects on family caregivers of patients with chronic kidney disease in Greece: a comparative study between dialysis modalities and kidney transplantation. Int Urol Nephrol. 2023 Jun;55(6):1619–28. doi:10.1007/s11255-023-03482-8 PubMed PMID: 36720745.

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