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ORIGINAL RESEARCH

A Pathway Analysis of Factors Affecting Quality of Life in Peritoneal Dialysis Patients: A Cross-Sectional Study Based on Individual and Family Self-Management Theory

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Purpose: This study aimed to explore factors affecting the quality of life in peritoneal dialysis (PD) patients. Furthermore, based on the Individual and Family Self-management Theory, this study constructed a path analysis to explore the relationship between psychological distress, social support, patient activation, and quality of life.

Participants and Methods: This study was a cross-sectional study. It included 211 PD patients from a peritoneal dialysis center in China. The questionnaire survey employed convenience sampling, with data collection conducted between March and June 2025. The survey tools included a general information questionnaire, the perceived social support scale, the Kessler psychological distress scale, the patient activation measure-13 item and the short-form 12-item health survey. Correlation analysis and linear regression were used to explore the factors affecting the quality of life of PD patients. Path analysis was performed using structural equation modelling, and the bootstrap program was employed to further test the mediating effect.

Results: In this study, quality of life was assessed in two dimensions, physical component summary (PCS) and mental component summary (MCS). MCS was positively correlated with social support ($r = 0.55$, $P < 0.01$) and patient activation ($r = 0.51$, $P < 0.01$), and negatively correlated with psychological distress ($r = -0.65$, $P < 0.01$). PCS was also positively related with social support ($r = 0.23$, $P < 0.01$) and patient activation ($r = 0.21$, $P < 0.01$), and negatively related with psychological distress ($r = -0.25$, $P < 0.01$). Complications, psychological distress, social support, and patient activation explained 48% of MCS. Age, monthly household income, psychological distress, social support, and patient activation explained 12% of PCS. The structural equation modelling exhibited a good fit (CMIN/df = 1.380, P = 0.252, GFI = 0.995, AGFI = 0.961, NFI = 0.993, IFI = 0.998, TLI = 0.990, CFI = 0.998, RMSEA=0.043). Path analysis revealed that social support ($\beta = 0.17$, $P < 0.05$), psychological distress ($\beta = -0.47$, $P < 0.001$), and patient activation ($\beta = 0.18$, $P < 0.01$) directly influenced MCS; only psychological distress ($\beta = -0.29$, $P < 0.01$) directly influenced PCS. Furthermore, patient activation mediated the relationship between social support and MCS ($\beta = 0.10$, 95% confidence interval [CI]: 0.02–0.18, $P < 0.01$), and also mediated the relationship between psychological distress and MCS ($\beta = -0.04$, 95% CI: −0.09 - −0.01, $P < 0.01$).

Conclusion: The results indicated that psychological distress, social support, patient activation, and quality of life were closely related in PD patients. These findings emphasize the importance of implementing comprehensive care strategies for PD patients that address their physical, psychological, and social needs. Interventions should be implemented to alleviate psychological distress and strengthen social support. Concurrently, educational programs should be implemented to actively guide PD patients in participating in their own dialysis care, thereby enhancing engagement and improving their overall quality of life.

Keywords: peritoneal dialysis, patient activation, quality of life, social support, psychological distress

Introduction

End-stage renal disease is the fifth stage of chronic kidney disease (CKD), which is incurable. Patients require renal replacement therapy or kidney transplantation to sustain life.[1] Peritoneal dialysis (PD), as an effective renal replacement

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therapy, is widely used because it is easy to perform and can be performed by patients at home.[2] However, the success of PD depends not only on medical technology, but also on the patient's self-management ability.[3] Self-management in PD patients involves mastering dialysis operations, dietary and fluid control, prevention and management of complications.[3] Whether patients can effectively carry out these behaviors, one important influencing factor is the patient activation.[4,5] Patient activation refers to an individual's knowledge, skills and confidence in health management and was introduced by Dr Hibbard in 2004.[6] Highly activated patients not only better understand and implement self-management measures, but also proactively seek help and support when encountering difficulties.[4–6] Research indicates that psychological and social support are significant factors influencing patient activation.[7,8] It is worth noting that regional healthcare systems, cultural factors, or differences in PD implementation may also have influenced the findings.

Social support refers to the material, emotional, informational, and other forms of assistance individuals receive through their social networks.[9] It emphasizes interpersonal interaction and resource exchange, helping individuals cope with stress and improve quality of life.[9] Psychological distress refers to negative emotions experienced by individuals when facing stress, primarily manifested as depression and anxiety.[10] CKD patients experience high levels of psychological distress, which is associated with higher mortality and poor health outcomes.[11]

Quality of life is a multidimensional concept, and its definition varies depending on the researcher, field of study, and cultural context. The World Health Organization (WHO) defines quality of life as an individual's perception of their life within cultural and personal contexts, considering physical and psychological well-being, social connections, and environmental factors.[12,13] Care must be provided in the physical, social, psychological, and spiritual dimensions. Some studies have shown that PD patients have lower scores on the physical functioning, role-physical, vitality, and emotional well-being.[14,15] These findings reflect the numerous challenges PD patients face in their daily lives and mental health. Low physical functioning scores in PD patients indicate overall physical limitations and impaired activities of daily living; reduced role-physical hinders fulfillment of family/social responsibilities; low vitality reflects insufficient energy and susceptibility to fatigue; poor emotional health reflects poor psychological state and increased vulnerability to anxiety and depression. Being married, under 60 years of age, having strong family support, and having a body mass index of less than 30 kg/m^2 were associated with higher quality of life scores in PD patients.[16] Social support not only enhances patients' social adaptation abilities but also effectively mitigates the adverse effects of stressors.[17–20] In addition, studies have shown that the greater the psychological distress, the lower quality of life for PD patient.[21] Patient compliance, self-efficacy, and self-management abilities are also closely related to patients' quality of life.[22]

According to the Individual and Family Self-management Theory (IFSMT),[23] self-management is a complex and dynamic process that includes environment, process, and endings. The environment consists of physical and social settings, as well as individual and family factors. The process of self-management is a combination of knowledge and beliefs, self-regulation skills and abilities, and social facilitation. Endings are divided into two categories: proximal outcomes focus on the immediate impact of self-management behaviour on healthcare spending; distal outcomes cover health status, quality of life, and cost of health. In IFSMT, risk and protective factors in the environment (psychological distress and social support) affect self-management (patient activation) and health outcomes (quality of life). Promoting individual and family participation in self-management processes contributes to improved short-term and long-term health outcomes. Consequently, we assumed that there might be a relationship between psychological distress, social support, patient activation and quality of life in PD patients. Existing evidence also suggests that there may be a correlation between these four variables;[17–21] however, the underlying mechanisms of these associations have not been clearly clarified, nor have they been tested using structural equation modeling. In this study, quality of life is categorized into physical component summary (PCS) and mental component summary (MCS) according to the previous studies.[24,25]

Based on IFSMT (Figure 1), we hypothesize that (1) social support, psychological distress, and patient activation influence the quality of life of PD patients; (2) patient activation may mediate the relationship between social support and quality of life, as well as between psychological distress and quality of life. Therefore, this study aims to explore: (1) the current status of quality of life among Chinese PD patients; (2) the correlations among social support, psychological distress, patient activation, and quality of life in PD patients; and (3) a path analysis of social support, psychological distress and patient activation to quality of life in PD patients. This study will provide guidance for developing more effective patient education programs and interventions, thereby enhancing the overall quality of life for PD patients.

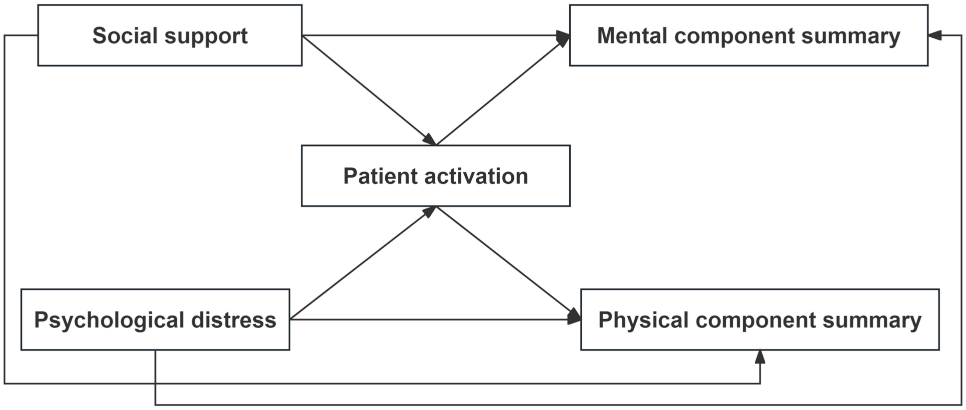

Figure 1 The initial hypothesized model.

Materials and Methods

Study Design and Participants

This study was a cross-sectional study. From March to June 2025, PD patients were recruited via convenience sampling from the Peritoneal Dialysis Center at Tongji Hospital in Wuhan, Hubei Province, China.

The following inclusion criteria were used for the study population: 1) patients receiving PD treatment, including dialysis patients with newly placed tubes; 2) patients who signed the informed consent and participated voluntarily. The exclusion criteria for the study were as follows: 1) patients who received both HD and PD treatment; 2) patients with the combination of acute cardiovascular and cerebrovascular diseases, malignant tumors, immunodeficiencies, hematological diseases; 3) patients with cognitive impairment or inability to co-operate.

Researchers then guided patients who met the inclusion criteria to complete the questionnaire. For patients who have difficulty reading or completing, the researchers read aloud each question and option in neutral language. Researchers reviewed the records together with patients to confirm they accurately reflected the patients' intentions. After the questionnaire was completed, the researchers would check the completeness of the questionnaire and enter the data into the database.

Study Size

When the power is 0.80, the significance level is 0.05, the effect size is moderate, and there are 12 predictor variables, the required sample size is 127.[26] To address potential issues of invalid samples (such as incorrect responses or logical inconsistencies) during questionnaire collection, this study increased the initial sample size by 10%.[27] Therefore, it was determined that at least 140 PD patients were required to participate. Finally, 219 PD patients participated in this study.

Data Collection

Demographic and Clinical Variables

The personal information form was created by the researchers, and included questions about age, gender, educational level, living status, marital status, employment status, monthly household income (RMB), complications, and dialysis duration of PD.

The Kessler Psychological Distress Scale (K10)

PD patient' psychological distress was measured by the Chinese version of the K10,[28] which was translated from the original K10 developed by Kessler in the United States.[29] K10 comprises two dimensions, namely anxiety and depression. Each item is rated on a scale from 1 to 5, representing "almost never" to "all the time", respectively. The scale consists of 10 items, and the total score is calculated by summing all items. The total score ranges from 10 to 50, with higher scores indicating more severe psychological distress. In this study, the Cronbach's alpha reliability coefficient was calculated as 0.90.

The Perceived Social Support Scale (PSSS)

PSSS was developed in 1988[30] and translated into Chinese in 2001.[31] PSSS involves three dimensions, namely, family support, friend support, and other support. A 7-point Likert scale was used, with scores ranging from 1 to 7, from "very poorly" to "very well". The sum of the scores for each item is the total score of the scale, which ranges from 12 to 84. Higher scores indicate higher levels of perceived social support. The Cronbach's alpha reliability coefficient in this study was 0.74.

Patient Activation Measure-13 Item (PAM-13)

The scale was developed by Hibbard in 2004 and consists of 22 items,[6] and was then revised to a 13-item scale in 2005.[32] The PAM-13 used in this study is the Chinese version provided by the authors, which has been validated and applied in Chinese CKD populations.[33] The PAM-13 includes four dimensions: (1) the belief that active role is important; (2) the level of confidence and knowledge to take action; (3) the ability to take action, and (4) the ability to stay the course under stress. The scale is rated on a 4-point scale: 1 for "strongly disagree"; 2 for "disagree"; 3 for "agree"; 4 for "strongly agree"; and 0 for "not applicable". The score of the 13 items was the raw score, which was then converted to a percentage score using the PAM scoring sheet provided by the original author. Based on the final score, activation was divided into four activation stages: ≤ 47.0 was classified as stage 1 (lowest activation), 47.1 to 55.1 as stage 2, 55.2 to 67.0 as stage 3, and ≥ 67.1 as stage 4 (highest activation). In this study, the Cronbach's alpha reliability coefficient was calculated as 0.92.

The Short-Form 12-Item Health Survey (SF-12)

In this study, SF-12 was applied to assess quality of life.[25] The scale has 12 items and 8 dimensions. PCS includes 4 dimensions of general health, physical functioning, role physical and bodily pain; MCS includes 4 dimensions of mental health, vitality, social functioning and role emotional. The score of the 12 items was the raw score. Raw scores are first converted into percentage scores, then transformed into standard scores for each dimension using the US norm. At the same time, PCS and MCS are calculated. A higher score indicates a higher quality of life. SF-12 has been validated and applied in the Chinese population.[24,34] The Cronbach's alpha reliability coefficient was tested to be 0.83.

Statistical Analysis

All data were double-entered using Excel software. Statistical analysis was conducted using SPSS 27.0 and Amos 18.0 software (IBM Corp., Armonk, NY, USA). Count data were described by frequency (n) and constituent ratio (%). Normality testing was conducted for measurement data. Data that conformed to a normal distribution were expressed using the mean ± standard deviation (SD), and data that did not conform to a normal distribution were expressed using the median (P25, P75).

The correlation between variables was then expressed using the Spearman correlation coefficient. Univariate analysis and multiple linear regression analysis were used to identify factors associated with quality of life. The variance inflation factor (VIF) was used to detect the presence of multicollinearity. It is generally considered acceptable for $VIF \leq 5$. Path analysis was conducted by constructing structural equation models and employing the maximum likelihood method. Even when the multivariate normality assumption is not satisfied, the estimated parameters remain reliable. The model fit was assessed using the CMIN/df, Goodness of Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Tucker-Lewis index (TLI), Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA). Goodness-of-fit was evaluated using the following indices: CMIN/df (<3), GFI (>0.90), AGFI (>0.90), NFI (>0.90), IFI (>0.90), TLI (>0.90), CFI (>0.90), and for RMSEA, <0.08 means acceptable fit while <0.05 means excellent fit. Since all indices meet the recommended thresholds, it indicates excellent model fit. On the basis of good model fit, the bootstrap program was employed to further test the mediating effect (bootstrap samples = 5000). Significance tests were two-tailed, with a level of 0.05.

Results

Demographic Characteristics

A total of 223 questionnaires were distributed, of which 219 PD patients agreed to participate. 8 questionnaires were excluded due to poor quality (such as incorrect responses or logical inconsistencies), resulting in 211 questionnaires.

The characteristics of the participants are shown in Table 1. The average age of PD patients was 46.02 ± 17.92, with males accounting for 62.56% (n=132). The majority of PD patients had middle school and below (n = 107, 50.71%). A smaller proportion of PD patients lived alone (n = 25, 11.85%), with the majority residing with their spouse (n = 122,

Table 1 Sample Characteristics

	N (%)	Score
Age (year)		
< 18	2 (0.95)	46.02 ± 17.92
18–44	110 (52.13)	
45–59	68 (32.23)	
60–74	29 (13.74)	
≥ 75	2 (0.95)	
Gender		
Male	79 (37.44)	
Female	132 (62.56)	
Educational level		
Middle school and below	107 (50.71)	
High school	60 (28.44)	
Junior College	24 (11.37)	
Undergraduate and above	20 (9.48)	
Living status		
Alone	25 (11.85)	
With spouse	122 (57.82)	
With family	64 (30.33)	
Marital status		
Single	30 (14.22)	
Married	166 (78.67)	
Divorced	15 (7.11)	
Employment status		
Not working	146 (69.19)	
Working	31 (14.69)	
Retirement	34 (16.11)	
Monthly household income (RMB)		
< 1000	66 (31.28)	
1000–5000	94 (44.55)	
5000–10000	45 (21.33)	
> 10000	6 (2.84)	
Complications		
Yes	97 (45.97)	
No	114 (54.03)	
Dialysis duration (months)		
< 6	54 (25.59)	
6–36	98 (46.45)	
37–59	32 (15.17)	
≥ 60	27 (12.8)	
Social support (PSSS)		61.88 ± 11.66
Psychological distress (K10)		19.00 (14.00, 24.00)

(*Continued*)

Table 1 (Continued).

	N (%)	Score
Patient activation (PAM-13)		58.10 (51.00, 75.00)
Quality of life (SF-12)		
PCS		41.53 (36.75, 45.24)
MCS		45.83 ± 8.56

Abbreviations: PSSS, perceived social support scale; K10, Kessler Psychological Distress Scale; PAM-13, Patient Activation Measure-13 Item Version; SF-12, 12-items Short Form Health Survey; PCS, physical component summary; MCS, mental component summary.

57.82%) or other family members (n = 64, 30.33%). Over half of the PD patients were married (n = 166, 78.67%), and the majority were unemployed (n = 146, 69.19%).

The largest proportion of PD patients had a monthly income of between 1,000 and 5,000 RMB (n = 94, 44.55%). 54.03% (n = 114) of PD patients had no complications. Regarding dialysis duration, among PD patients, those with less than 6 months of dialysis (n=54, 25.59%) and those with 6–36 months (n=98, 46.45%) constituted the predominant groups. The mean score of PSSS was 61.88 ± 11.66. The median for K10 was 19.00 (14.00, 24.00), and the median for PAM-13 was 58.10 (51.00, 75.00). The mean score for MCS was 45.83 ± 8.56 and the median for PCS was 41.53 (36.75, 45.24).

In the demographic factors, only complications were significantly different in MCS. Age and monthly income were significantly different in PCS. Details could be seen in Table 2.

Table 2 Associations Between Demographic Factors and SF-12 Scores

	MCS			PCS		
	Score	*t/F*	*P*	Score	*Z/H*	*P*
Age (year)						
< 18	46.56 ± 8.36	0.33	0.86	41.97 (37.3, 46.6)	10.54	0.03
18–44	46.37 ± 8.03			41.82 (37.1, 45.5)		
45 - 59	45.32 ± 9.41			42.97 (38.0, 45.2)		
60 - 74	44.77 ± 8.61			39.49 (32.2, 43.4)		
≥ 75	48.36 ± 13.93			28.08 (22.1, 34.0)		
Gender						
Male	45.07 ± 8.61	−1.00	0.32	42.19 (37.1, 45.4)	−0.69	0.49
Female	46.29 ± 8.53			41.42 (36.3, 45.2)		
Educational level						
Middle school and below	45.35 ± 8.76	0.84	0.47	42.02 (36.9, 45.5)	4.51	0.21
High school	45.91 ± 8.99			40.85 (36.5, 43.7)		
Junior College	48.35 ± 8.16			40.95 (35.5, 45.0)		
Undergraduate and above	45.19 ± 6.31			43.87 (37.9, 47.4)		
Living status						
Alone	44.92 ± 11.65	0.41	0.67	37.97 (30.9, 44.4)	5.65	0.06
With spouse	46.28 ± 8.08			42.42 (36.9, 45.3)		
With family	45.35 ± 8.14			42.04 (37.2, 45.3)		
Marital status						
Single	45.70 ± 9.52	0.01	0.10	40.22 (35.4, 45.8)	0.95	0.62
Married	45.85 ± 8.41			42.11 (36.9, 45.3)		
Divorced	45.95 ± 8.82			41.26 (34.8, 44.6)		

(*Continued*)

Table 2 (Continued).

	MCS			PCS		
	Score	***t*/*F***	***P***	**Score**	***Z*/*H***	***P***
Employment status						
Not working	45.20 ± 8.63	1.60	0.20	41.56 (36.9, 45.2)	3.79	0.15
Working	48.09 ± 7.49			43.61 (38.6, 45.5)		
Retirement	46.51 ± 9.01			40.75 (33.3, 44.5)		
Monthly household income (RMB)						
< 1000	44.33 ± 9.74	1.73	0.16	40.49 (35.3, 44.3)	12.74	0.005
1000–5000	46.16 ± 7.99			43.18 (39.0, 45.5)		
5000–10000	46.61 ± 7.77			39.73 (34.6, 44.8)		
> 10000	51.44 ± 7.17			45.80 (43.8, 47.7)		
Complications		−2.63	0.01			
Yes	44.18 ± 8.21			41.26 (34.9, 44.7)	−1.16	0.25
No	47.24 ± 8.63			42.20 (37.8, 45.4)		
Dialysis duration (months)						
< 6	47.61 ± 8.50	1.30	0.28	42.57 (37.1, 44.9)	3.64	0.30
6–36	45.64 ± 7.91			42.10 (37.2, 45.5)		
37–59	44.86 ± 8.91			40.04 (34.0, 45.1)		
≥ 60	44.11 ± 10.27			40.26 (35.4, 44.1)		

Notes: *t*, independent samples *t*-test; *F*, One-Way ANOVA; *Z*, Mann–Whitney *U*-test; *H*, the Kruskal–Wallis *H*-test.
Abbreviations: PCS, physical component summary; MCS, mental component summary.

Association between psychological distress, social support, patient activation, quality of life among PD patients

Table 3 shows the correlations between the psychological distress, social support and quality of life. Different dimensions of each scale were also included in the analysis. PCS was significantly positively correlated with patient activation ($r = 0.21$, $P < 0.01$) and social support ($r = 0.23$, $P < 0.01$). MCS was significantly positively correlated with patient activation ($r = 0.51$, $P < 0.01$) and social support ($r = 0.55$, $P < 0.01$). Psychological distress showed significant

Table 3 Correlation Between Social Support, Patient Activation, and Psychological Distress, PCS and MCS

	I	II	III	IV	V	VI	VII	VIII	IX
I. Social support - family	1								
II. Social support -friend	0.55**	1							
III. Social support -others	0.67**	0.73**	1						
IV. Social support	0.79**	0.89**	0.91**	1					
V. Psychologicaldistress - anxiety	−0.044**	−0.35**	−0.34**	−0.44**	1				
VI. Psychological distress - depression	−0.50**	−0.58**	−0.52**	−0.63**	0.76**	1			
VII. Psychological distress	−0.51**	−0.52**	−0.48**	−0.59**	0.90**	0.96**	1		
VIII. Patient activation	0.54**	0.65**	0.58**	0.68**	−0.42**	−0.57**	−0.54**	1	
IX. PCS	0.18**	0.21**	0.21**	0.23**	−0.22**	−0.24**	−0.25**	0.21**	1
X. MCS	0.47**	0.48**	0.48**	0.55**	−0.58**	−0.63**	−0.65**	0.51**	0.04

Note: Spearman's rank correlation coefficient. ***P* < 0.01.
Abbreviations: PCS, physical component summary; MCS, mental component summary.

negative correlation with MCS ($r = -0.65$, $P < 0.01$), PCS ($r = -0.25$, $P < 0.01$), social support ($r = -0.59$, $P < 0.01$) and patient activation ($r = -0.54$, $P < 0.01$). Patient activation had a positive relationship with social support ($r = 0.68$, $P < 0.01$).

Multivariate stepwise linear regression analysis was conducted with MCS and PCS as the respective dependent variables. Demographic variables that were statistically significant in univariate analyses were included in multivariate linear regression analyses. With MCS as the dependent variable, the included predictor variables encompassed complications, social support, patient engagement, and psychological distress. The results revealed that only three factors - social support ($\beta = 0.15$, $P = 0.032$), patient activation ($\beta = 0.18$, $P = 0.01$), psychological distress ($\beta = -0.49$, $P < 0.001$) - were significantly associated with MCS among PD patients (Table 4). The four variables explained 48% of the variance in MCS ($R^2 = 0.49$, adjusted $R^2 = 0.48$, F = 49.62, $P < 0.001$). Age, monthly household income, psychological distress, social support, and patient activation were included in the regression analysis with PCS as the dependent variable. In model 4, only age ($\beta = -0.19$, $P < 0.001$) and psychological distress ($\beta = -0.21$, $P = 0.01$) were associated with PCS in PD patients (Table 5). These five variables explained 12% of the variance in PCS ($R^2 = 0.14$, adjusted $R^2 = 0.12$, F = 6.51, $P < 0.01$).

Table 4 Multivariate Stepwise Linear Regression Analysis on MCS of PD Patients

Model	Variables	Unstandardized Coefficients		Standardized Coefficients	*t*	*P*	VIF	R^2	Adjusted R^2	F
		B	SE	β						
1	Complications	3.06	1.17	0.18	2.63	0.009	1.00	0.03	0.03	6.90
2	Complications	1.28	1.02	0.07	1.25	0.214	1.04	0.29	0.28	41.96
	Social support	0.38	0.04	0.52	8.64	< 0.001	1.04			
3	Complications	0.93	0.99	0.05	0.94	0.35	1.05	0.34	0.33	35.52
	Social support	0.23	0.06	0.32	4.18	< 0.001	1.80			
	Patient activation	0.15	0.04	0.31	4.05	< 0.001	1.80			
4	Complications	−0.52	0.89	−0.03	−0.58	0.56	1.10	0.49	0.48	49.62
	Social support	0.11	0.05	0.15	2.16	0.032	1.98			
	Patient activation	0.09	0.03	0.18	2.62	0.01	1.90			
	Psychological distress	−0.61	0.08	−0.49	−7.81	< 0.001	1.59			

Abbreviations: MCS, dependent variable; B, unstandardized coefficient; SE, standard error; β, standardized coefficient; VIF, variance inflation factor.

Table 5 Multivariate Stepwise Linear Regression Analysis on PCS of PD Patients

Model	Variables	Unstandardized Coefficients		Standardized Coefficients	*t*	*P*	VIF	R^2	Adjusted R^2	F
		B	SE	β						
1	Age	−0.07	0.03	−0.18	2.62	0.01	1.01	0.04	0.03	4.36
	Income	0.89	0.57	0.11	1.55	0.12	1.01			
2	Age	−0.08	0.03	−0.20	−3.04	0.003	1.01	0.11	0.09	8.18
	Income	0.59	0.56	0.07	1.06	0.29	1.02			
	Social support	0.15	0.04	0.26	3.91	< 0.001	1.03			
3	Age	−0.08	0.03	−0.20	−3.01	< 0.001	1.01	0.11	0.09	6.25

(*Continued*)

Table 5 (Continued).

Model	Variables	Unstandardized Coefficients		Standardized Coefficients	t	P	VIF	R^2	Adjusted R^2	F
		B	SE	β						
	Income	0.53	0.57	0.06	0.93	0.36	1.05			
	Social support	0.13	0.05	0.22	2.48	0.01	1.80			
	Patient activation	0.03	0.03	0.06	0.72	0.47	1.83			
4	Age	−0.07	0.03	−0.19	−2.97	< 0.001	1.02	0.14	0.12	6.51
	Income	0.48	0.56	0.06	0.85	0.40	1.05			
	Social support	0.08	0.05	0.14	1.56	0.12	2.00			
	Patient activation	0.00	0.04	0.01	0.08	0.94	1.94			
	Psychological distress	−0.20	0.08	−0.21	−2.62	0.01	1.52			

Abbreviations: PCS, dependent variable; B, unstandardized coefficient; SE, standard error; β, standardized coefficient; VIF, variance inflation factor.

Testing of the Hypothesized Model

In the suitability test of the research model on the relationship between social support, psychological distress, patient activation, and quality of life (MCS and PCS), the initial theoretical model appeared saturated. Therefore, we considered modifying the model. When evaluating model fit by removing insignificant paths, the optimal approach was to eliminate the path from patient activation and social support to PCS. The final model was presented in Figure 2. The model exhibited a good fit (CMIN/df = 1.380, p = 0.252, GFI = 0.995, AGFI = 0.961, NFI = 0.993, IFI = 0.998, TLI = 0.990, CFI = 0.998, RMSEA=0.043). This model explained 49% of the variance in MCS and 9% of the variance in PCS.

The standardized coefficients (β) and 95% confidence interval (CI) of all the direct and indirect relationship in this model could be found in Table 6. More severe psychological distress was directly associated with lower patient activation ($\beta = -0.22$, $P < 0.001$). Better social support was directly associated with higher levels of patient activation ($\beta = 0.54$, $P = 0.001$). There was a direct relationship between MCS and psychological distress ($\beta = -0.47$, $P < 0.001$), social support ($\beta = 0.17$, $P = 0.01$) and patient activation ($\beta = 0.18$, $P = 0.007$). In addition, psychological distress has a direct effect on PCS ($\beta = -0.29$, $P = 0.001$). There exists a mediating effect of patient activation between social support and MCS ($\beta = 0.10$, $P = 0.006$), with a relative effect size of 36.8%. Patient activation also mediated the relationship between psychological distress and MCS ($\beta = -0.04$, $P = 0.003$), with a relative effect size of 7.9%.

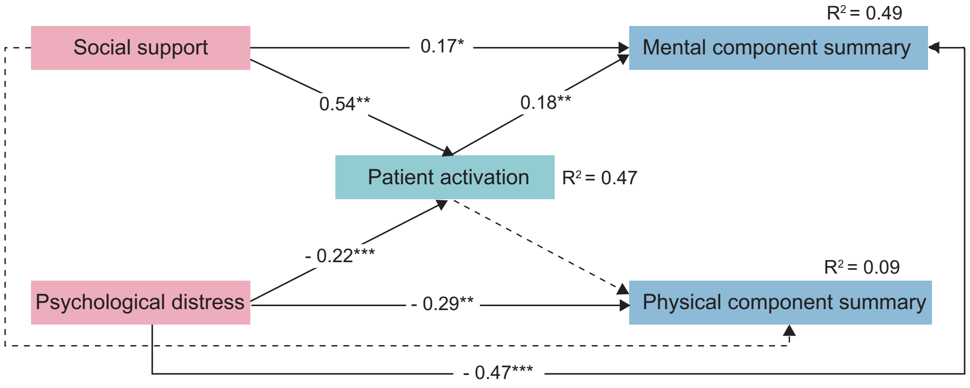

Figure 2 The final model of quality of life. →standardized regression coefficients, significant. *P < 0.05; **P < 0.01; ***P < 0.001.

Table 6 Bootstrap Confidence Intervals for the Total, Direct, and Indirect Effects

Structural Paths	***β***	**95% CI**		***P***
		Lower	**Upper**	
Direct path				
Patient activation				
Psychological distress → Patient activation	−0.22	−0.32	−0.12	< 0.001
Social support → Patient activation	0.54	0.44	0.63	0.001
MCS				
Psychological distress → MCS	−0.47	−0.58	−0.34	< 0.001
Social support → MCS	0.17	0.04	0.30	0.01
Patient activation → MCS	0.18	0.04	0.32	0.007
PCS				
Psychological distress → PCS	−0.29	−0.42	−0.16	0.001
Indirect path				
Psychological distress → Patient activation → MCS	−0.04	−0.09	−0.01	0.003
Social support → Patient activation → MCS	0.10	0.02	0.18	0.006

Note: β is the standardized coefficients. CI is confidence interval.
Abbreviations: MCS, mental component summary; PCS, physical component summary.

Discussion

This study aimed to explore the association between psychological distress, social support, patient activation, and quality of life in PD patients. The results showed that psychological distress, social support, patient activation, and quality of life were significantly correlated. Psychological distress and social support not only directly affected MCS but also indirectly affected MCS through patient activation. These findings may provide clear evidence for developing targeted, comprehensive interventions to improve the quality of life for PD patients.

Patients with stage 5 CKD not receiving dialysis treatment exhibited lower activation levels, primarily remaining in stage 2.[35] According to data from a multicenter cross-sectional study, 32% of PD patients were classified as having low activation status (stage 1–2).[36] In this study, PD patients' activation were at stage 3, indicating that PD patients actively managed their disease but lacked confidence in disease management. In our peritoneal dialysis centers, all PD patients receive theoretical and practical training before starting PD, and nurses assess PD patients until they meet the standards. Additionally, an application is used for long-term remote management of patients. These may explain the relatively high activation levels observed in PD patients in this study.

In this study, the PSSS score for PD patients was 61.88 ± 11.66, indicating that PD patients perceived a moderate or high level of overall social support. Compared with hemodialysis patients, PD patients have larger networks, more types of relationships, and receive more social support.[37] This may be related to the greater flexibility in scheduling for PD patients. PD patients can maintain some work or social activities, making it easier for them to gain understanding and help from external groups such as colleagues and friends. In addition, PD usually needs to be done at home. Family members often need to be involved in the care process, which objectively promotes support and cooperation within the family. The psychological distress score for PD patients was 19.00 (14.00, 24.00), indicating that PD patients experienced fewer negative emotions in this study, which may be related to the fact that patients receive more social support. Numerous studies have confirmed that the higher the level of social support patients receive, the fewer negative emotions they experience.[18,38,39]

Alaoui conducted a survey on the quality of life of patients undergoing hemodialysis and PD.[40] The results showed that PD patients had an MCS score of 47.7 (41.6, 50.9) and a PCS score of 33.2 (30.0, 42.8).[40] This is similar to the results of this study, where PD patients had an MCS score of 45.83 ± 8.56 and a PCS score of 41.53 (36.75, 45.24), with the MCS score being higher than the PCS score. In subgroup analyses, complications affected PD patients' MCS but had no significant impact on PCS. Complications likely did not significantly affect core physiological functions (such as pain and mobility), which are primary dimensions of PCS assessment. However, complications exacerbate patients' disease-related concerns and increase treatment burdens, thereby indirectly affecting mental health.[41] Therefore, nurses should enhance their focus on the mental health of PD patients and provide timely intervention. Additionally, subgroup analysis revealed that different ages and income levels influenced PCS. As age increases, organ function gradually declines, thereby affecting patients' physical functioning.[42] Income indirectly impacts PCS through social resources, lifestyle, and other factors.[43] Therefore, nurses need to prioritize the physical health of elderly populations. Simultaneously, for low-income groups, efforts should focus on improving healthcare accessibility (such as expanding health insurance coverage) and promoting lifestyle (such as providing health education).

In the correlation analysis (Table 3), psychological distress, social support, and patient activation were strongly correlated with MCS ($r > 0.5$, $P < 0.01$), while PCS was weakly correlated ($r > 0.2$, $P < 0.01$). These factors exert a more pronounced effect on PD patients' MCS, consistent with findings from previous studies.[18,20,37] Psychosocial factors directly influence MCS, thus exhibiting strong correlations. PCS focuses on the physiological functions of PD patients (such as pain, fatigue, and physical activity). PCS is primarily influenced by disease progression (such as declining residual renal function in PD patients) and treatment interventions (such as dialysis adequacy, medication efficacy). In Lin's study, psychological distress can affect patients' physical strength by impacting their sleep.[44] This further corroborates that psychosocial factors exert an indirect, long-term influence on PCS.

Tommel conducted a regression analysis of MCS, which showed that gender and Charlson comorbidity index were not significantly correlated with MCS (but together explained a significant 7.3% of the variance), while helplessness and worry, as well as lower social support, were significantly correlated with poorer MCS.[45] In this study, patients with complications had significantly lower MCS scores than those without complications. Patients without comorbidities are able to cope more actively with their own illnesses due to their lower symptom burden.[39,46,47] This state enhances their confidence, enabling them to pay attention to changes in their own health and take measures to prevent further deterioration.[39,46,47] However, in regression analysis of this study (Table 4), comorbidities also had no significant effect on MCS in PD patients. This may be because other factors have a more significant impact on MCS, thereby masking the effect of comorbidities. In path analysis of this study (Figure 2), psychological distress, social support, and patient activation explained a significant 49% of MCS. Psychological distress also directly influenced PCS. Long-term psychological stress can activate the hypothalamic-pituitary-adrenal axis, leading to elevated cortisol levels and exacerbating inflammatory responses.[48] In addition, the more severe the psychological distress experienced by PD patients, the lower their treatment compliance, self-management, and social participation, ultimately leading to a decline in quality of life.[39,49] Social support influences the patient self-management process through three mechanisms: network navigation (identifying and connecting existing resources), negotiation within networks (adjusting relationships, roles, and communication among members), and collective efficacy (enhancing the ability to collaboratively achieve goals through shared efforts and beliefs).[50] PD patients can obtain emotional, financial, and informational support from family, friends, and colleagues.[51,52] Sharing disease management experiences among wardmates directly enhances treatment adherence and self-management capabilities.[52,53] Kim's research further confirms that social support indirectly improves quality of life by self-efficacy and self-management.[54] This study also found that patient activation mediated the relationship among psychological distress, social support, and MCS in PD patients. The mediating role of patient activation and its direct impact on quality of life have been demonstrated in other diseases.[55–57] These findings also underscore the need to enhance PD patients' activation levels through educational programs and motivational interviewing, aiming to strengthen their cognitive abilities, beliefs, and theoretical and practical knowledge.

Limitation

This study has some limitations. First, cross-sectional studies measure variables at the same point in time, making it impossible to determine the temporal sequence between them and thus precluding causal inference. Second, this study employed a single-center design, and the applicability of its findings to other centers and cultural contexts may be limited. Then, all data were obtained through self-report questionnaire, which may lead to inaccuracies due to recall bias or social desirability bias. The convenience sampling may introduce selection bias (high willingness to participate). Therefore, future research will require more large-scale, multi-center, and longitudinal studies for further validation.

Conclusion

This study, based on IFSMT, deepened the understanding of the relationship between social support, psychological distress, patient activation, and quality of life by constructing a highly fit structural equation model. Pathway analysis revealed that psychological distress and social support significantly influenced the quality of life of PD patients. Patient activation mediated the relationship between psychological distress, social support, and MCS. This study provides direction for nurses in caring for PD patients and offers valuable insights and practical guidance for developing intervention protocols. Nurses should prioritize enhancing the activation level of PD patients by implementing educational programs to strengthen their beliefs, knowledge, skills, and cognitive abilities. Additionally, intervention should incorporate psychological support (such as cognitive behavioral therapy) and social support networks (such as establishing family support groups) to improve the quality of life for PD patients.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author (Qin Xu) upon reasonable request.

Ethics Approval and Informed Consent

Each participant was informed of the purpose of the study and signed an informed consent form before completing the questionnaire. The privacy of the participant was fully respected and protected. The study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the Tongji hospital (Approval number: TJ-IRB202506009).

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Disclosure

The authors declare that there is no conflict of interest.

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