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ORIGINAL RESEARCH

Family Function and Self-Management of Patients With Early Chronic Kidney Disease: The Mediating Roles of Self-Perceived Burden and Ego Depletion

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Background: Effective self-management in the early stage of chronic kidney disease (CKD) is key to delaying disease progression. However, no studies have confirmed that the combined support of internal individual factors and external family environmental factors may play an important role in the self-management of patients with early CKD.

Purpose: This current study aims to explore the effect of family function on the self-management of patients with early CKD and examine the mediating roles of self-perceived burden and ego depletion.

Patients and Methods: Three hundred and sixty patients with stage 1–3 CKD participated in the cross-sectional survey and completed structured questionnaires, including the family APGAR index, self-perceived burden scale, self-regulatory fatigue scale and chronic kidney disease self-management instrument. Mplus 8.3 was used to establish a structural equation model.

Results: Family function had a positive predictive effect on self-management ($\beta = 0.231$, $P < 0.001$). Self-perceived burden and ego depletion were not only single mediating variables between family function and self-management but also played a chain-mediating role. The total indirect effect was 0.304 (95% CI: 0.234 to 0.388, $P < 0.001$), accounting for 56.82% of the total effect ($\beta = 0.535$, 95% CI: 0.420 to 0.651, $P < 0.001$).

Conclusion: This study highlights the importance of self-management for patients and their families and provides new important theoretical guidance for multiple interventions of improving family function, reducing self-perceived burden and ego depletion to improve self-management, which is of great value in delaying the progression of renal disease.

Keywords: chronic kidney disease, family function, self-management, self-perceived burden, ego depletion

Introduction

Chronic kidney disease (CKD) is a comprehensive kidney disease involving the progressive deterioration of renal function and multisystem lesions.[1] According to the internationally recognized Kidney Disease Outcome Quality Initiative (K/DOQI) guidelines, CKD is divided into stages 1–5, and stages 1 to 3 are usually referred to as early CKD.[2] The incidence of CKD is increasing annually, and patients are being diagnosed at younger ages. At present, there are 697.5 million patients with CKD worldwide, accounting for 9.1% of the global population, of which 97.8% are in stages 1–3.[3] The prevalence of CKD in China is as high as 10.8%; with 132.3 million patients, China has the largest number of patients with CKD worldwide.[4] As a chronic noninfectious disease with high morbidity and

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mortality, CKD has become a global public health problem that seriously threatens human health. Patients' quality of life declines significantly with disease progression, and individuals and families also bear substantial economic and psychological burdens caused by long-term treatment.[5] Due to the long course of CKD and its irreversible development, most patients require home management. Effective self-management in the early stage is key to delaying disease progression and preventing patients from developing uremia to the greatest extent possible.[6] According to Bandura's social cognitive theory, the combined support of internal individual factors and external family environmental factors may play an important role in patients' self-management.[7] Therefore, further exploration to improve the self-management of patients with early CKD is worthwhile from the perspective of external and internal strengths.

Patients' Self-Management and Family Function

The self-management of CKD refers to patients taking the initiative to perform preventive health care activities with the assistance of health care professionals.[8] The most widely used chronic disease management model, the American Chronic Care Model (CCM), emphasizes that as an important part of the chronic disease prevention and control system, patients should increase their enthusiasm and actively participate in medical service, decision-making and disease management processes.[9] In the early stage of CKD, effective self-management can significantly delay further damage to renal function, improve patient's quality of life and save medical resources.[10]

Family function is considered a key factor in the health of an individual's social environment, which can meet physical and emotional needs. According to family system theory, family members have natural interaction functions, and one member can have a multidimensional influence on the cognition, emotion and behavior of other members.[11] CKD is a lifelong disease, in addition to scientific treatment and medication, a clear division of family roles, a harmonious communication environment, good family emotional regulation and the companionship and support of family members can also arouse patients' awareness of their family responsibility, thereby improving their confidence to fight and actively manage the disease.[12] Studies have shown that good family function can promote patients' self-management.[13] On the one hand, encouragement and care from family members can alleviate patients' anxiety and fear, improve their confidence and help them adopt a more positive coping style to face the disease. On the other hand, family members can obtain disease-related knowledge through the internet or books, which can help correct patients' poor behavioral habits in daily life and improve their self-management.[14] Our previous study has also revealed a close relationship between "growth" in family function and "seeking social support" in self-management, which provides a certain basis for this study.[15] Hence, we proposed Hypothesis 1: Family function is positively related to the self-management of patients with early CKD.

The Mediating Role of Self-Perceived Burden

Self-perceived burden refers to the fear of adverse effects on caregivers due to an individual's disease and nursing needs, which causes patients to experience negative emotional reactions such as depression, self-blame and the loss of dignity.[16] Self-perceived burden is described in two main ways: 1) a patient's sense of dependence on the caregiver, frustration and guilt; and 2) a patient's worry that their care needs will place physical, psychological, and economic burdens on their caregivers. Studies have shown that social support, especially family support, is an effective measure to prevent the self-perceived burden of patients with CKD.[17] Good family function can improve patients' adaptability, ease the pressure caused by disease and reduce self-perceived burden. Self-perceived burden is also closely related to the level of self-management.[18] Patients with a heavy self-perceived burden have a high level of pessimism, which may affect their implementation of health behaviors.[19] Patients with low self-perceived burden are more likely to actively cope with the disease and have a higher sense of self-efficacy, so they are more inclined to adopt positive coping behaviors and have a higher level of self-management.[20] Thus, we proposed Hypothesis 2: Self-perceived burden is a potential mediating factor in the relationship between family function and self-management.

The Mediating Role of Ego Depletion

Ego depletion refers to a state in which limited and internal resources are reduced as a result of individual self-control. The theory of limited self-control resources holds that psychological resources are indispensable to the executive function of the self (including self-control, decision-making and active behavior); the process of self-control consumes psychological resources, which are limited within a certain period; and self-control consumes the psychological resources needed for subsequent tasks, resulting in the failure of subsequent self-control efforts.[21] Psychological resources are internal cognitive resources that the self depends on to perform executive function. Supplementing or reducing the depletion of this resource can reduce ego depletion. The self-management of CKD is an arduous and long process, and long-term demanding management will quickly deplete patients' self-control resources.[22] In the state of ego depletion, patients' cognition, decision-making and behavioral control abilities will decline, leading to self-management failure.[23] However, in this process, family function can supplement patients' psychological resources. Previous studies have reported that good family adaptation can induce positive emotions in patients, help them tap into their own potential and value, and effectively promote the supplementation of their self-control resources.[24] Thus, we proposed Hypothesis 3: Ego depletion is a potential mediating factor in the relationship between family function and self-management.

The Chain-Mediating Role of Self-Perceived Burden and Ego Depletion

Self-management behavior is based on the most important ternary interaction determinant in social cognitive theory; that is, behavior, human internal factors and the environment are interrelated and mutually determined.[25] In this study, both self-perceived burden and ego depletion were included as internal patient factors. Self-perceived burden can lead to negative emotions, and the expression of these negative emotions will lead to the consumption of psychological resources, causing ego depletion, and some irrational behaviors.[26] Studies have shown that patients with chronic diseases have a higher degree of ego depletion. They are extremely vulnerable psychologically, and their ego depletion intensifies, resulting in unhealthy behaviors.[27] Thus, we proposed Hypothesis 4: Self-perceived burden and ego depletion play a chain-mediating role in the relationship between family function and self-management.

In summary, on the basis of social cognitive theory, external environmental factors, including family function, and internal factors, including self-perceived burden and ego depletion, may play important roles in self-management. It has been established that family function influences self-management of patients with early CKD; however, there has been no studies to confirm how an individual's self-perceived burden and ego-depletion play a role in this process. Therefore, we proposed the theoretical model and hypothesis for this study, which is shown in Figure 1. We aimed to explore the effect of family function on self-management and examine the mediating roles of self-perceived burden and ego depletion to provide scientific guidance for improving patients' self-management and delaying CKD progression.

Materials and Methods

Study Design, Participants and Data Collection

A cross-sectional survey was conducted among patients with early CKD in three tertiary hospitals in Xi'an, China, from January to December 2022. The participants were selected by convenience sampling with the following inclusion criteria: 1) met the diagnostic criteria of CKD in the K/DOQI clinical practice guidelines; 2) had clinical stage 1–3 CKD; 3) aged ≥18 years; 4) had clear consciousness, normal communication skills and the ability to cooperate to

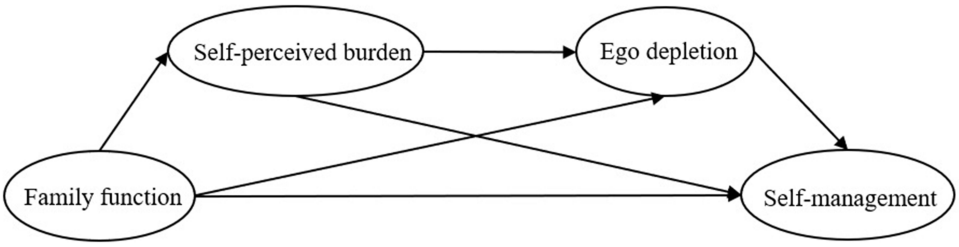

Figure 1 Theoretical model and hypothesis.

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complete the questionnaire; and 5) provided informed consent and volunteered to participate. Patients with severe cardiovascular, neurological, pulmonary or other systemic diseases, cognitive impairment or comorbid psychiatric conditions were excluded. Experienced researchers organized nurses in the department of nephrology to form an investigation team and conducted unified training on the acquisition methods, anonymity principle and questionnaire distribution in advance. Data collection was conducted in a separate ward through face-to-face interviews. Researchers and nurses used unified instructions to explain the aim of this study and points of attention when filling out questionnaires for patients. After obtaining informed consent, patients began to fill out the questionnaire, which took approximately 15 to 20 minutes. After completing the questionnaire, researchers checked questionnaires to avoid missing questions or misfiling (such as choosing the same answer for all questions).

The study was reviewed and approved by the ethics committee of the Second Affiliated Hospital of Air Force Medical University (Ethical Grant Number: 202206–02). Before the start of the survey, all participants were made aware of the aim of this study, chose to voluntarily participate and signed an informed consent form. Participants could withdraw at any time during the survey. Throughout the process, participants participated anonymously, and the information obtained from the survey was kept confidential and used only for scientific research.

Sample Size

A minimum sample size of 200 was calculated based on Kline's principle for structural equation model (SEM) analysis.[28] In addition, the sample size should be 10–20 times the number of observed variables in SEM analysis.[29] Given that there were 27 observed variables (12 variables in the sociodemographic and clinical questionnaire, 4 variables of self-management, 5 variables of family function, 3 variables of self-perceived burden and 3 variables of ego depletion) in this study, the required sample size was between 270 and 540. Ultimately, we distributed a total of 400 questionnaires and recovered 360 valid questionnaires, for an effective response rate of 90.00%, satisfying the sample size demand.

Measurement

The sociodemographic and clinical variables included age, gender, marital status, educational background, employment status, residence, living mode, payment of medical expenses, per capita monthly family income (RMB), course of disease, frequency of review, and stage of CKD.

The Chronic Kidney Disease Self-management Instrument (CKD-SM) was developed by Lin[30] and revised by Liu[31] to measure self-management behavior in patients with early CKD (stage 1–3); the instrument consists of 4 dimensions (self-integration, problem solving, seeking social support and adherence to recommended regimen) and 29 items. A 4-point Likert scale ranging from 1 ("never") to 4 ("always") is used for scoring. The higher the total score is, the stronger the self-management ability. A score rate <60% is considered as low level, 60%–80% as moderate level, and ≥80% as high level. This scale has been widely used worldwide and has good reliability and validity. In this study, the Cronbach's α of CKD-SM was 0.803.

The Family APGAR Index (APGAR) is a measurement tool that can quickly assess a family member's evaluation of family function and reflects their subjective satisfaction with family function. The scale was developed by Smilkstein[32] and translated into the Chinese version by Lv;[33] this version has good reliability and validity in various patients. The tool comprises five items—adaptation, partnership, growth, affection and resolve—with scores ranging from 0 ("hardly ever") to 2 ("almost always"). A higher total score indicates a higher level of family function; scores of 0–3 indicate severe family dysfunction, scores of 4–6 indicate moderate family dysfunction, and scores of 7–10 indicate good family function. In this study, the Cronbach's α of APGAR was 0.929.

The Self-perceived Burden Scale (SPBS) is mainly used to measure the level of self-perceived burden of patients with chronic diseases. The scale was developed by Cousineau,[34] translated into Chinese and verified by Wu.[35] It is widely used worldwide and has good reliability and validity. The scale consists of 3 dimensions (economic, emotional and physical burden), with a total of 10 items. A 5-point Likert scale ranging from 1 ("never") to 5 ("always") is used for scoring; the higher the score is, the heavier the patient's self-perceived burden is. The total score is divided into no obvious burden (<20 points), mild burden (20–30 points), moderate burden (30–40 points) and severe burden (≥40 points). In this study, the Cronbach's α of SPBS was 0.784.

The Self-regulatory Fatigue Scale (SRF-S) is an effective tool to measure the degree of individual self-regulation fatigue, which is used to reflect the state of individual-specific ego depletion. The scale was developed by Nes[36] and translated into Chinese by Wang.[37] It consists of 3 dimensions (cognition, emotion and behavior), with a total of 16 items. Each item is scored on a 5-point scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The higher the score is, the more serious the ego depletion is. In this study, the Cronbach's α of SRF-S was 0.772.

Statistical Analysis

The data were analysed by SPSS software version 26.0 and Mplus software version 8.3. Skewness and kurtosis tests and the Kolmogorov–Smirnov (K-S) test were used to test normality, and all the variables showed a normal distribution. Descriptive statistics are used to describe the sociodemographic and clinical characteristics of the participants and their family function, self-perceived burden, ego depletion and self-management scores. The independent *t*-test or one-way ANOVA was used to perform the comparison of self-management among different sociodemographic and clinical characteristics subgroups. The Pearson correlation coefficient (*r*) was used to investigate the correlation among the study variables. The significance level was set at 0.05 for all analyses ($P < 0.05$). Then, we used Mplus 8.3 to establish the SEM and used the maximum likelihood method to estimate the measurement model. Finally, the mediating effects were tested and validated by 5000 bootstraps bias-corrected 95% confidence intervals (95% CIs). If the 95% CI for the estimate of indirect effects did not contain zero, the indirect effects were considered significant.

Results

Sociodemographic and Clinical Characteristics and Comparison of Self-Management Among the Participants

A total of 360 patients with early CKD participated in our study, of whom 220 (61.11%) were male and 140 (38.89%) were female. The mean age of the patients was 46.33 years (SD = 16.54, ranging from 18 to 90 years). A total of 204 (56.67%) patients had stage 1 CKD, 81 (22.50%) had stage 2 CKD and 75 (20.83%) had stage 3 CKD. For self-management, there were significant differences in age, marital status, educational background, employment status, residence, per capita monthly family income, course of disease, and frequency of review. The sociodemographic and clinical characteristics and comparison of self-management among the participants are shown in Table 1.

Table 1 Sociodemographic and Clinical Characteristics and Comparison of Self-Management Among the Participants (N = 360)

Variables	Category	N	%	Mean (SD)	*t/F*	*P*
Age					13.672	<0.001**
	18–35 years old	103	28.61	91.17(15.44)		
	36–45 years old	79	21.94	93.95(19.36)		
	46–60 years old	101	28.06	82.92(20.37)		
	>60 years old	77	21.39	76.87(21.68)		
Gender					−1.580	0.115
	Male	220	61.11	85.07(20.00)		
	Female	140	38.89	88.51(20.29)		
Marital status					−2.439	0.015*
	Married	278	77.22	85.01(21.25)		
	Unmarried/divorced/widowed	82	22.78	91.15(15.05)		

(*Continued*)

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Table 1 (Continued).

Variables	Category	N	%	Mean (SD)	*t/F*	*P*
Educational background					11.074	<0.001**
	Junior high school and below	182	50.56	82.62(20.74)		
	Senior high school	110	30.56	86.93(19.84)		
	Bachelor degree and above	68	18.88	95.71(15.72)		
Employment status					2.847	0.005*
	Be on the job	267	74.17	88.18(19.17)		
	Jobless	93	25.83	81.33(22.09)		
Residence					2.933	0.004*
	Urban	208	57.78	89.06(19.55)		
	Rural	152	42.22	82.78(20.46)		
Living mode					−1.601	0.110
	Living with family	308	85.56	85.71(21.03)		
	Living alone	52	14.44	90.54(13.32)		
Payment of medical expenses					−1.645	0.101
	Medical insurance	324	90.00	85.83(20.57)		
	Self-paying	36	10.00	91.64(15.19)		
Per capita monthly family income (CNY)					3.717	0.025*
	≤2000	99	27.50	84.80(19.26)		
	2000–5000	189	52.50	85.06(20.74)		
	≥5000	72	20.00	92.15(18.99)		
Course of disease					3.179	0.002*
	≤12 months	91	25.28	92.14(17.33)		
	>12 months	269	74.72	84.47(20.70)		
Frequency of review					8.018	<0.001**
	≤1 month	118	32.78	90.81(17.09)		
	1–3 months	116	32.22	87.84(18.70)		
	≥3 months	126	35.00	80.96(22.84)		
Stage of CKD					1.073	0.343
	1	204	56.67	87.76(20.40)		
	2	81	22.50	84.38(20.08)		
	3	75	20.83	84.92(19.54)		

Abbreviations: SD, standard deviation; CNY, Chinese Yuan. *P<0.05, **P<0.01.

Descriptive Statistics and Correlation Analysis of Key Study Variables

The early CKD patients' mean family function, self-perceived burden, ego depletion and self-management scores were 6.91 (SD = 3.03), 30.97 (SD = 9.46), 43.16 (SD = 8.56), and 86.41 (SD = 20.16), respectively. A total of 54.17% of the patients had moderate or low self-management levels, 42.22% had moderate or severe family dysfunction, 58.61% had moderate or severe self-perceived burden, and 85.28% had moderate or high ego depletion levels.

The Pearson correlation analysis revealed that self-management was significantly positively correlated with family function ($r = 0.510$, $P < 0.001$), and negatively correlated with self-perceived burden ($r = -0.577$, $P < 0.001$) and ego depletion ($r = -0.482$, $P < 0.001$). Family function was significantly negatively correlated with self-perceived burden ($r = -0.546$, $P < 0.001$) and ego depletion ($r = -0.382$, $P < 0.001$). There was also a positive association between self-perceived burden and ego depletion ($r = 0.462$, $P < 0.001$).

Path Model

We established an SEM to analyse the relationships among family function, self-perceived burden, ego depletion and self-management. First, we used confirmatory factor analysis to estimate the parameters of the model. The model fit indices were as follows: Chi-Square Test (χ^2) = 241.577, degree of freedom (df) = 84, $\chi^2/df = 2.88 < 4.0$, comparative fit index (CFI) = 0.957 > 0.9, Tucker-Lewis index (TLI) = 0.947 > 0.9, root mean square error of approximation (RMSEA) = 0.072 < 0.08, and standard root mean square residual (SRMR) = 0.051 < 0.08, suggesting a good model fit with satisfactory indices.[38]

Table 2 shows the path coefficients of the SEM. Family function negatively predicted self-perceived burden ($\beta = -0.589$, $P < 0.001$) and ego depletion ($\beta = -0.175$, $P = 0.012$), and positively predicted self-management ($\beta = 0.231$, $P < 0.001$). Self-perceived burden positively predicted ego depletion ($\beta = 0.369$, $P < 0.001$) and negatively predicted self-management ($\beta = -0.351$, $P < 0.001$). Ego depletion negatively predicted self-management ($\beta = -0.248$, $P < 0.001$).

Mediation Analysis

We used 5000 bootstraps bias-corrected 95% CIs to test the mediating effects. Table 3 shows the direct and indirect effects of family function on self-management, and Figure 2 depicts the final SEM. The results revealed that the total, direct, indirect and total indirect effects were all statistically significant. The total indirect effect was 0.304 (95% CI: 0.234 to 0.388, $P < 0.001$), accounting for 56.82% of the total effect ($\beta = 0.535$, 95% CI: 0.420 to 0.651, $P < 0.001$). Specifically, the mediating effect was generated by three pathways. First, the indirect effect of self-perceived burden on the relationship between family function and self-management was 0.207 (95% CI: 0.140 to 0.286, $P < 0.001$). Second, the indirect effect of ego depletion on the relationship between family function and self-management was 0.043 (95% CI:

Table 2 Path Coefficients of the SEM

Paths	Std. β	SE	P	95% CI	
				LB	UB
FF → SPB	−0.589	0.040	<0.001	−0.663	−0.506
FF → ED	−0.175	0.070	0.012	−0.313	−0.039
FF → SM	0.231	0.061	<0.001	0.110	0.349
SPB → ED	0.369	0.078	<0.001	0.218	0.524
SPB → SM	−0.351	0.059	<0.001	−0.468	−0.237
ED → SM	−0.248	0.052	<0.001	−0.352	−0.147

Abbreviations: FF, family function; SPB, self-perceived burden; ED, ego depletion; SM, self-management; Std. β, standardized estimate; SE, standard error; CI, confidence interval; LB, lower bound; UB, upper bound.

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Table 3 Direct and Indirect Effects of Family Function on Self-Management

Paths	Effects	Std. β	*SE*	*P*	95% CI	
					LB	UB
FF → SM	Total effect	0.535	0.799	<0.001	0.420	0.651
	Direct effect	0.231	0.061	<0.001	0.110	0.349
FF → SPB → SM	Indirect effect	0.207	0.507	<0.001	0.140	0.286
FF → ED → SM		0.043	0.280	0.037	0.010	0.093
FF → SPB → ED → SM		0.054	0.241	0.003	0.027	0.010
	Total indirect effect	0.304	0.525	<0.001	0.234	0.388

Abbreviations: FF, family function; SPB, self-perceived burden; ED, ego depletion; SM, self-management; Total effect = direct effect + total indirect effect; Std. β, standardized estimate; *SE*, standard error; CI, confidence interval; LB, lower bound; UB, upper bound.

0.010 to 0.093, $P = 0.037$). Third, the indirect effect of self-perceived burden and ego depletion on the relationship between family function and self-management was 0.054 (95% CI: 0.027 to 0.101, $P = 0.003$).

Discussion

To the best of our knowledge, this is the first study based on social cognitive theory to explore the relationship between family function and self-management among patients with early CKD and to further evaluate the single mediating role and chain-mediating role of self-perceived burden and ego depletion. The results of this study draw the attention of patients and their family members to the importance of self-management and provide new important theoretical guidance and a scientific basis for multiple interventions to improve self-management and delay the progression of CKD.

The Status Quo of Self-Management, Family Function, Self-Perceived Burden and Ego Depletion

The current study revealed that the self-management, family function, self-perceived burden and ego depletion scores of patients with early CKD are not ideal and need to be further improved, which is consistent with the results of previous studies of patients with chronic diseases.[39] Due to the low awareness rate and lack of obvious symptoms in the early stage, most patients do not pay enough attention to CKD, thus neglecting self-management. This finding also suggests

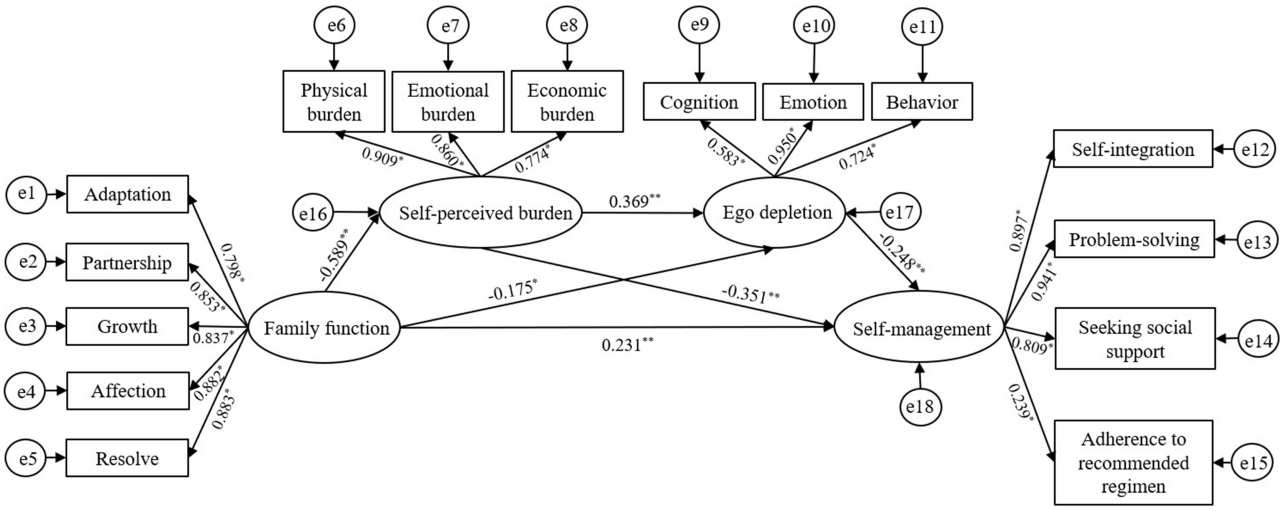

Figure 2 The final structural equation model. * *P*<0.05, ** *P*<0.01.

that we should strengthen the popularization of CKD knowledge, attempt to achieve early diagnosis, prevention and treatment, and improve patients' early self-management ability. In terms of family function, family members need to provide help and support for patients in many aspects. However, because family members bear other social responsibilities, few can fully care for patients, which leads some patients to believe that their family function is impaired.[14] It is suggested that nurses carry out family-centered health education to enhance family support for patients and urge patients and their family members to manage the disease together. Regarding self-perceived burden, renal function defects can easily cause symptoms such as anemia and malnutrition, resulting in physical burden; CKD cannot be cured and the progression of the disease can only be delayed. High treatment costs not only cause an economic burden but also easily lead to emotional burdens. We should therefore pay attention to the role of psychological nursing and integrate psychological counselling into clinical nursing, including respiratory relaxation training, attention diversions and other psychological support methods, to reduce patients' negative emotions and sense of burden. Patient cognition and behavior will consume their individual psychological resources and energy, resulting in ego depletion. Moreover, studies have confirmed that people with chronic diseases show higher ego depletion and that the impact is more profound and long-lasting.[27] Therefore, we can use mindfulness therapy and positive psychological interventions to improve patients' psychological resources reserves and reduce ego depletion.

Mediating Role of Self-Perceived Burden

Family function not only had a direct positive predictive effect on self-management but also used self-perceived as a partial mediating variable to have an indirect effect on self-management, which is similar to the results for patients with diabetes, cancer and so on.[40] Differences in family function will directly affect the mental state and cognition of patients with CKD. When patients' family members take the initiative to provide full support, patients' emotional states are better regulated, and they develop hope for life; this also helps patients master correct and scientific methods to improve their self-management. More importantly, family function is conducive to improving patients' adaptability, enhancing their confidence and reducing their self-perceived burden. After their self-perceived burden is reduced, patients feel less psychological pressure caused by stress and are more inclined to actively cope with the disease.[41] This suggests that we should promote family function by inviting family members to participate in health education and family activities, improve the enthusiasm of family members and encourage them to provide more support to patients, and alleviate patients' self-perceived burden, ultimately improving patients' self-management.

Mediating Role of Ego Depletion

We also found that family function can have an indirect effect on self-management through ego depletion, which is consistent with the study by Finkel.[42] Good family function is extremely helpful in forming a positive self-concept. Strengthening family stability and the sense of balance in the process of change can supplement individuals' psychological resources and energy. Family members and spouses of patients with early CKD are the best collaborators and supervisors of patients' actions. A cohesive functional family unit can help patients make medical decisions, obtain more disease knowledge and eliminate negative emotions to reduce the consumption of psychological resources. After ego depletion is compensated, patients with early CKD can have better control, mobilize positive coping strategies and adopt healthy management behaviors.[43] Self-control resources can be supplemented by rest and positive emotions. This study also suggests that we can reduce the ego depletion of patients with early CKD through short-term mediation and role model priming and strengthen social support to improve self-management.

Chain-Mediating Role of Self-Perceived Burden and Ego Depletion

Finally, we found that self-perceived burden and ego depletion play a significant chain-mediating role in the relationship between family function and self-management in patients with early CKD. Satisfactory family function can reduce self-perceived burden, further reduce ego depletion and improve self-management in patients, which is consistent with the results of previous studies. Self-perceived burden can cause a series of negative emotions and even suicidal ideation. The unbalanced emotional experience can reduce the input of self-resources and the control ability of behavioral decision-

making, leading to ego depletion. Ego depletion can weaken an individual's positive belief in their own ability and weaken their self-control ability. It can easily cause patients to engage in impulsive behaviors and develop poor living habits, reducing their self-efficacy in compliance and physical health behavior.[44] Therefore, we should consider patients and their families as a whole, pay attention to the family environment and patients' psychological problems while treating their physiological diseases, encourage and support patients and their families, create a positive living environment, and reduce patients' self-perceived burden. In addition, it is also necessary to help patients specify practical plans, stimulate their motivation for a healthy life, teach them a reasonable method of catharsis, supplement their psychological resources, reduce their ego depletion and promote their self-management.

Implication for Clinical Practice

The management of CKD is a dynamic, comprehensive and complex process that requires the cooperation of patients, their family members, clinical medical workers and mental health experts to maintain patients' satisfactory health function so that they can work and live independently and return to society. First, we should consider patients and their families as a whole. We can provide both patients and their families with health education and self-management skills training about CKD regularly through the formation of chronic disease management teams to increase their belief in overcoming the disease and difficulties. We should pay full attention to the importance of family care and support, actively cultivate patients' self-efficacy and effectively reduce their self-perceived burden. Second, psychological treatment should be actively provided through affirmation, increased motivation, example initiation, short-term meditation, mindfulness therapy and other psychological interventions to improve individual self-control willpower, enhance the efficiency in accessing self-resource utilization and reduce ego depletion. Finally, we should assist patients in establishing a self-management support system with the help of a clinical chronic disease management remote system and effectively encourage them to adopt positive self-management attitudes, uphold correct health beliefs and behaviors and constantly improve their self-management ability to obtain good CKD treatment outcomes.

Limitations

Despite these promising results, this study had some limitations. First, our subjects were from a single city in China, which may limit the generalizability of the results. In the future, more comprehensive multicenter studies of patients with early CKD should be conducted in different regions and compared with foreign datasets to ensure the generalizability of the results. Second, given that a cross-sectional study design cannot determine causality between study variables, the SEM can establish only a study hypothesis. Therefore, we should perform longitudinal and experimental studies to investigate the causal relationship between variables as a next step. Third, CKD is a progressive disease, and we should consider the impact of different stages on patients to develop more targeted measures to help patients cope with the disease effectively in the future.

Conclusion

The self-management of patients with early CKD should not be ignored. On the basis of the theory of social cognition, for the first time, this study established a chain-mediating effect model from the two perspectives of internal human factors and external environmental factors to explore the process and mechanism of family function on the self-management of patients with early CKD. We found that self-perceived burden and ego depletion play an important chain-mediating role in the relationship between family function and self-management, which provides an important theoretical basis for improving the self-management of patients in the future. We can have a positive impact on patients' self-management from the perspective of improving family function, reducing self-perceived burden, replenishing psychological resources and reducing ego depletion, which are of great value in delaying the progression of renal disease.

Data Sharing Statement

The datasets used during the study are available from the corresponding author on reasonable request.

Ethical Approval and Informed Consent

The study received approval from the ethics committee of the Second Affiliated Hospital of Air Force Medical University (202206-02) and obtained informed consent from all participants.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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