Effect of Health Education Based on Transtheoretical Model on Frailty and Self-Management in Patients with Diabetic Nephropathy

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Abstract: *Background:* In the past 30 years, the prevalence and mortality of chronic kidney disease in China have increased significantly, the Transtheoretical Model and health coaching technology are widely used in the self-management process of patients with chronic diseases, and have achieved good application results. However, there is no research to explore the effect of this model on the frailty and self-management ability of non-dialysis patients with diabetic nephropathy. *Objective:* To investigate the effect of health education based on Transtheoretical model of change on frailty and self-management in patients with diabetic nephropathy. *Methods:* In this study, a randomized controlled trial was adopted. from December 2022 to February 2023,80 patients with non-dialysis diabetic nephropathy in the Department of Nephrology of a tertiary hospital in Sichuan Province from December 2022 to February 2023 were selected by convenient sampling method. According to the random number table method, they were randomly divided into control group (n = 40) and experimental group (n = 40). The control group was treated with routine nursing program, and the experimental group was treated with the Transtheoretical model combined with health coaching technology on the basis of the control group, and evaluated by self-management behavior scale and frailty scale. *Results:* After 6 months of intervention, the self-management score of the experimental group was higher than that of the control group, The frailty score of the experimental group was lower than that of the control group, and the difference was statistically significant ($P<0.05$). *Conclusion:* This project improves the level of self-management behavior of non-dialysis patients with diabetic nephropathy and reduces the frailty state, which is worthy of further promotion.

Keywords: Diabetic Nephropathy, Self-Management, Health Coaching Techniques, Transtheoretical Model, Frailty

1. Introduction

Chronic kidney disease (CKD) is caused by genetic or environmental and other reasons of renal dysfunction, proteinuria or glomerular filtration rate (GFR) <60 ml/min /1.73m^2>three months, According to the glomerular filtration rate, it can be divided into 1 ~ 5 stages, and the fifth stage is called end-stage renal disease (ESRD). Globally, nearly 500 million adults had CKD in 2010, with more than 75% of them living in low- and middle-income countries [1]. According to 2023 data from the Kidney Disease Improving Global Outcomes, CKD currently has more than 850 million people worldwide. In developed countries, CKD is most often attributed to diabetes and hypertension, but less than 5% of early CKD patients have reported their disease awareness. Chronic kidney disease has become a major global public health problem [2, 3]. It is reported that the prevalence of CKD in adults in the United States is 11.5%, and it is as high as 40% in people over 70 years old [4], by 2030, the number of patients with end-stage renal disease is expected to exceed 1 million [5]. the prevalence of CKD in the UK is about 5% -7% [6], the prevalence of CKD in Japanese adults is about 12.5% [7]. The prevalence of CKD in China increased from 10.8% in 2012 to 13.4% in 2017 [8]. In the past 30 years, the prevalence

and mortality of chronic kidney disease in China have increased significantly. CKD has led to 196,726 deaths (13.8 deaths per 100,000 people), ranking 16th in China [9, 10]. The prevalence of chronic kidney disease in adults is expected to increase by 16.7% by 2030 [11]. Global epidemiological data show that 1.2 million people died of CKD in 2017. From 1990 to 2017, the mortality rate increased by 41.5%. Such a high prevalence and mortality rate may be due to insufficient disease management and population aging [12]. However, most patients with reduced renal function never progress to ESRD, but their health is significantly worse and the burden of symptoms is high [13]. The latest ' Global Diabetes Map (10th Edition) ' shows that in 2021, there will be about 537 million adults aged 20 to 79 in the world with diabetes. It is expected that by 2030 and 2045, this number will increase to 580 million and 700 million cases, respectively [14]. In the United States, > 40% of the more than 29 million patients with type 2 diabetes have diabetic nephropathy [15]. The Chinese guidelines for the prevention and treatment of type 2 diabetes point out that about 20% -40% of diabetic patients in China are accompanied by diabetic nephropathy; at present, the incidence of diabetic nephropathy in China is increasing year by year [16].

Patients with chronic kidney disease can lead to frailty due to a series of problems such as limited nutritional intake, protein loss, low vitamin D level, renal anemia, comorbidity, and multiple medications. Previous studies on frailty in patients with chronic kidney disease mainly focused on maintenance hemodialysis, peritoneal dialysis, and kidney transplant recipients. These patients are all patients with renal replacement therapy and only represent a small number of special populations with CKD progression to end-stage. Patients with non-renal replacement therapy are the most widely used and most interventional in patients with chronic kidney disease. The improvement of quality of life and the reduction of social burden after intervention are of great significance. Early attention to the frailty of this population can move the intervention threshold forward, reduce medical costs and improve the prognosis of the disease [17]. The concept of self-management was first proposed in 1976 [18], and was later widely used by scholars at home and abroad in the management of chronic diseases such as hypertension, diabetes and kidney disease [19]. Through the multidisciplinary cooperation of self-management behavior intervention, the self-management ability of patients with diabetic nephropathy can be effectively improved, and the renal function status and blood glucose control level can be improved [20]. By improving the self-management ability of diabetic nephropathy patients, the occurrence of adverse outcomes can be effectively reduced. Frailty refers to a clinical syndrome in which the physiological function of the body declines and (or) the health is constantly deficient, resulting in the weakening of the anti-stress ability of the body. Frailty was a predictor of negative outcomes of diabetic nephropathy, including all-cause mortality, all-cause hospitalization, and falls. Therefore, frailty of diabetic nephropathy should be routinely assessed and interventions implemented to prevent poor prognosis, reduce

mortality, and provide evidence for future targeted interventions. However, due to limited information in the current literature, more prospective intervention studies are needed to explore the effects of frailty in patients with diabetic nephropathy [21].

The Transtheoretical model of change (TTM) was proposed by Prochaska in 1983 and was originally developed by observing smokers who plan or attempt to quit smoking. It is often used to systematically describe and understand a wide range of health behaviors and their changes. Health coaching was first developed from the motivational interview technology of American scholar MILLER et al [22]. Health coaching technology emphasizes the focus of discussion in interaction. Through well-designed equipment combined with appropriate applications, it helps to effectively improve the degree of coach-client interaction and effectively improve the effectiveness of health education. The Transtheoretical model and health coaching technology are widely used in the self-management process of patients with chronic diseases, and have achieved good application results. However, there is no research to explore the effect of this model on frailty and self-management ability of non-dialysis patients with diabetic nephropathy.

2. Patients and Methods

2.1. Study Design

This study is a randomized controlled trial. The convenience sampling method was used to select patients with non-dialysis diabetic nephropathy from December 2022 to February 2023 in the Department of Nephrology of a tertiary hospital in Sichuan Province as the research object. Before the start of this study, it was examined and approved by the Ethics Committee of Deyang People 's Hospital, and the ethics number was (2022-04-030-K01).

2.2. Study Population

(1) Inclusion criteria: 1 In accordance with the guidelines for patients with diabetes mellitus complicated with chronic kidney disease and the diagnostic criteria of chronic kidney disease; 2 age $\geq$ 18 years old; 3: clear consciousness, communication barrier-free; 4: voluntarily participate in and sign the informed consent. (2) Exclusion criteria: 1 previous mental / mental disorders; 2 combined with other serious chronic diseases; 3: Patients with poor cognitive ability and inability to express themselves. (3) Sample size calculation: According to the sample size calculation formula of group design, the self-management score was taken as the outcome variable. According to the pre-test results, considering the 10% loss of follow-up, a total of 80 subjects were finally included. They were divided into observation group and control group by random number table method, with 40 cases in each group.

2.3. Measurement

(1) General Information Questionnaire

They were designed by the researchers, mainly including age, gender, marital status, education level, years of diagnosis.

(2) Frailty phenotype assessment tool

Five indicators of unexplained weight loss, fatigue, decreased grip strength, decreased physical activity, and decreased walking speed were included. The positive score of each index was 1 point, and the total score was 0-5 points. 0 was no frailty, 1-2 was pre-frailty, and 3-5 was frailty [23].

(3) (Summary of Diabetes Self Care Activities, SDSCA)

SDSCA was developed by Toobert [24], Wan Qiaoqin translated it into Chinese, with a total of 11 items in 5 dimensions, including diet, blood glucose monitoring, exercise, foot care and drug treatment. The highest score of each item was 7 points, the lowest was 0 points, and the score range was 0-77 points. The higher the total score, the higher the level of self-management behavior, and the overall Cronbach 's α was 0.84. This scale is currently widely used to evaluate the level of self-management behavior in patients with diabetic nephropathy [25].

2.4. Intervention

The control group program: mainly using conventional nursing methods, including drugs, diet, blood glucose and blood pressure management, lifestyle management, regular follow-up schedule (telephone follow-up, outpatient follow-up, family follow-up), and distribution of relevant publicity materials.

Experimental group program: The intervention group was given TTM health education intervention measures on the basis of routine care in the control group. When entering the group, the contents and methods of this project were introduced in detail to the patients and their families, and the patients were included in this study after obtaining the consent of the patients. The intervention lasted for 8 weeks, 2 times a week, and each intervention lasted for 15-30 minutes. Including two stages of hospitalization and discharge follow-up. The intervention methods during hospitalization included health education, peer education, health guidance, etc. The intervention methods after discharge include telephone follow-up and WeChat communication. Before each intervention, the behavior stage scale was used to evaluate the behavior stage of the patient, and the corresponding health education measures were given according to the stage of the patient. The details are as follows.

1) Pre-intention stage: Face-to-face contact was started after admission, patient information files were established, and trust relationship was established.
2) Intention stage: Patients and their families were encouraged to express the difficulties encountered in the implementation of health plans in the form of private letters or face-to-face, and the initiative to raise health needs was encouraged.
3) Preparation stage: Develop targeted nutrition, exercise, medication and other individualized plans, and invite patients or family members to participate in the development of detailed recipes; encourage patients to talk about their feelings and actively interact with patients.
4) Action stage: Use WeChat to connect patients to observe various operations, point out existing problems, such as incorrect monitoring methods and incorrect diet matching, and educate them again in the wrong places.
5) Maintenance stage: For patients who have completed health goals, give positive encouragement and praise online, enhance life confidence, and introduce health goals into daily life.

2.5. Statistical Analysis

Data analysis was performed using SPSS 22.0 (IBM, Armonk, NY, USA), Counting data is expressed as n (%); measurement data is described with means ± standard divisions (SD). Two independent samples t test was used for comparison between groups.

3. Results

3.1. General Information (Table 1)

Table 1. General Information.

Variables	Experimental group (n = 40)	control group (n=40)	t/x^2	P
Age	59.83±12.43	59.75 ±14.52	0.025	0.980
Gender			0.802	0.370
Male	21	17		
Women	19	23		
Educational level			1.528	0.446
Junior high school	20	24		
High school	14	9		
College degree or above	6	7		
Marital status			1.727	0.422
Married	23	27		
Divorce	12	7		
Unmarried	5	6		
Years of illness	5.08±2.57	5.53±2.76	-0.755	0.453

3.2. Comparison of Two Groups of Frailty

There was no significant difference in the frailty scores between the two groups before the intervention. After 6 months of intervention, the frailty score of the intervention group was 2.00 (2.00,2.75), and the frailty score of the control group was 3.00 (2.00,3.00). The difference was statistically significant (P < 0.001).

Table 2. Comparison of self-management scores between the two groups before and after intervention.

Groups	n	Diet	Exercise	Blood Glucose	Foot	Drug Care	Total Score
Before intervention							
Experimental group	40	13.75±1.65	5.85±1.37	2.38±0.77	3.10±0.78	4.18±0.68	29.25±2.54
Control group	40	13.68±1.33	5.40±1.15	2.28±0.75	2.95±1.01	4.15±0.77	28.45±2.28
		0.224	1.592	0.587	0.743	0.154	1.484
P		0.823	0.116	0.559	0.459	0.878	0.142
After intervention							
Experimental group	40	20.23±1.31	10.23±1.39	4.25±1.10	5.13±1.51	6.08±0.86	45.90±3.24
Control group	40	14.88±2.22	6.25±1.30	2.25±0.93	2.15±1.00	4.18±0.81	29.70±3.40
		13.121	13.246	8.777	10.407	10.161	21.819
P		<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**

**P<0.001

3.3. Comparison of Self-Management Scores Between the Two Groups Before Intervention

Before the intervention, the independent sample t test was used to statistically analyze the total score of self-management and the scores of each dimension between the two groups, and the difference was not statistically significant. After 6 months of intervention, the self-management scores of the two groups were different, *P* < 0.05, as detailed in table 2.

4. Discussion

In recent years, CKD self-management has become an emerging field, which may be related to the increasing recognition of the importance of including patients and their families in disease management to improve outcomes. The self-management behavior of CKD patients is affected by the interaction of individual factors and environmental factors. First of all, medical workers should make patients realize the significance and importance of self-management by understanding the basic needs of patients, and formulate a personalized education list to meet the patient 's disease knowledge needs and motivation for self-management from diet, psychology, exercise and medication. Identify and monitor risk factors (such as blood glucose and blood pressure) and self-adjust home care procedures, optimize the care strategies of CKD patients, use Internet and other technologies to improve the daily behavior management of CKD patients, and delay the progression to ESRD. So as to improve the survival rate and reduce the economic burden.

Multiple frailty interventions such as exercise combined with nutrition, exercise combined with cognition, exercise, nutrition and psychology can effectively improve the frailty of patients. [26]. The results of this study showed that after 6 months of intervention, the frailty score of the experimental group was lower than that of the control group (*P*< 0.05).

This was a health education based on the Transtheoretical model, which effectively improved the patient's eating habits and daily activities, and effectively reduced the patient's frailty. In order to implement self-management behavior and participate in health care decision-making, patients must understand their condition, and patient education is a key way to ensure that individuals can be taught to participate in self-management tasks. The treatment of diabetic nephropathy focuses on lowering blood pressure, lowering blood sugar, nutritional support, reducing urinary protein exudation, and improving renal function. The level of self-management ability is related to the key to the treatment effect of diabetic nephropathy patients. Health coaching technology is a human-centered, goal-oriented health behavior intervention technology that helps people establish and achieve health promotion goals, change unhealthy lifestyle behaviors, and improve self-management skills. At the same time, with the participation of medical staff and patients, patients ' sense of responsibility for their own health is the center, and patients need to adjust and control their behaviors, including beneficial behaviors, such as daily diet, physical exercise, mental health adjustment and disease treatment [27]. Medical staff can provide necessary support by emphasizing the importance of behavior and providing guidance and encouragement to patients involved in behavior. When patients are informed of the positive benefits of their actions, their compliance with dietary restrictions will be higher. Under the guidance of transtheoretical model, it can help patients make more effective decisions to reduce health risk behaviors and increase health behaviors [28]. This study provides support for patients from multiple dimensions such as family members (family support, family encouragement and companionship, etc.), patients (sharing disease resistance experience, mutual supervision, role model strength, etc.), and medical teams (empathy, psychological support, technical guidance, guidance and supervision, etc.), which meets the psychological needs of patients. Through the management of patients with diabetic nephropathy,

self-management behavior is improved and the occurrence of frailty is reduced.

5. Conclusion

This project improves the self-management behavior level of non-dialysis patients with diabetic nephropathy and reduces the debilitating state. Due to time and manpower constraints, this study is a 6-month single-center study. It is possible that there will be a certain deviation in the selection of samples, and there are certain limitations in the promotion. It is suggested that the subsequent research should extend the intervention time and conduct a multi-center large-sample study to further explore the application effect of this theory in nursing intervention.

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Conflicts of Interest

The authors declare no conflicts of interest.

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