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Knowledge, Attitudes, and Practices Towards Exercise Therapy Among Patients with Stage 5 Chronic Kidney Disease on Regular Hemodialysis

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Background: Exercise therapy could improve physical and psychological health in patients with chronic kidney disease (CKD). This study aimed to investigate knowledge, attitudes and practices (KAP) towards exercise therapy among patients with CKD stage 5 on regular hemodialysis.

Methods: The cross-sectional study was conducted between August 1st and 30th, 2023; KAP and demographic characteristics of CKD-5 patients were assessed with self-distributed questionnaire and analyzed using logistic regression and structural equation modeling (SEM). A higher score represented better knowledge, more positive attitude, and more proactive practice.

Results: In 513 collected questionnaires, mean scores for knowledge, attitudes, and practices were 9.5 ± 4.1 (possible range: 0–13), 31.9 ± 5.0 (possible range: 9–45), and 21.7 ± 9.3 (possible range: 9–45). Multivariate logistic regression analysis showed that education (OR = 1.8, 95% CI: 1.1–3.0, P = 0.02), income (OR = 1.7, 95% CI: 1.1–2.6, P = 0.02), and family support (OR = 3.8, 95% CI: 2.0–7.1, P < 0.001) were independently associated with higher knowledge scores. Knowledge score (OR = 5.1, 95% CI: 1.7–15.1, P < 0.001) and attitude score (OR = 7.3, 95% CI: 3.7–14.2, P < 0.001) were independently associated with higher practice scores. According to SEM, knowledge directly influenced attitude (β=1.3, P < 0.001), while attitude influenced practice (β=0.8, P < 0.001).

Conclusion: Patients with CKD-5 who underwent regular hemodialysis demonstrated insufficient knowledge, passive attitude and inactive practices towards exercise therapy. Improving knowledge and attitude through educational interventions might result in better practice.

Keywords: renal insufficiency, chronic, renal dialysis, exercise therapy, health knowledge, attitudes, practice, surveys and questionnaires

Introduction

Chronic kidney disease (CKD) is a progressive non-infectious condition characterized by a significant decline in glomerular filtration rate and/or proteinuria, resulting in the gradual deterioration of kidney structure and function.[1,2] The Global Burden of Disease (GBD) 2019 study highlights the substantial challenges posed by CKD to healthcare systems in China and globally.[3,4] Importantly, inadequate physical activity significantly impairs the quality of life for patients while also compromising their psychological wellbeing, particularly in those with advanced stages of CKD.[5,6] Patients' cooperation and understanding of CKD management are vital components in enhancing self-care, clinic attendance, compliance, and ultimately, prognosis.[7]

The physical activity level of patients with CKD who underwent regular dialysis is frequently lower than that of the healthy peer group, due to fatigue, muscle weakness, and other symptoms associated with their condition, resulting in significant complications, disease progression, notable impact on cardiovascular health, and diminished quality of life.[8] Exercise therapy including supervised resistance and aerobic exercises, strength training, cycling, and novel approaches

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to physical therapy[9,10] primarily enhances aerobic and walking capacity, along with improving health-related quality of life.[11] This approach has demonstrated efficacy in enhancing physical performance, blood pressure control, symptom relief, as well as improving both physical and psychological health in CKD.[10–12] Nevertheless, it is seldom considered as a therapeutic option among the present CKD population, likely due to existing accessibility issues, higher costs and perceived lack of time, as well as insufficient knowledge of indications and limitations among patients and healthcare providers.[13,14] The prescription of exercise therapy is often provided by healthcare professionals, but its implementation relies heavily on the commitment of both the patient and their support network. Therefore, a study on the knowledge, attitudes, and practices (KAP) of patients is crucial to understanding and improving CKD management adherence.

A few previous studies have discussed KAP towards different treatment aspects among CKD patients and their healthcare providers,[7,15,16] reporting mainly sufficient results, but noting the lacking understanding of lifestyle changes, medication adherence, and dietary restrictions necessary to slow disease progression. However, to the best of our knowledge, no studies have examined the KAP toward exercise therapy in CKD-5 patients. Analysis of KAP might help to identify barriers to compliance and ways to overcome it for effective usage of therapeutic exercises,[17] as well as identify vulnerable groups needing increased uptake of exercise therapy. Therefore, this study aimed to assess the knowledge, attitudes, and practices of CKD-5 patients who underwent regular hemodialysis towards exercise therapy.

Materials and Methods

Study Design and Participants

This cross-sectional study was conducted between August 1st and August 30th, 2023, in the Blood Purification Center of Shanghai General Hospital among patients diagnosed with CKD-5 on regular hemodialysis. The study included individuals who met the following criteria: 1) age older than 18 years, and 2) previous diagnosis of CKD based on the classification criteria of the Kidney Disease: Improving Global Outcomes (KDIGO)[18] and national CKD criteria. The exclusion criteria: 1) patients who were immobile or unable to exercise due to other comorbid conditions (those able to do static/strengthening exercises were not excluded), 2) those who refused to complete online questionnaires, and 3) questionnaires with incomplete answers or missing information.

This study was ethically approved by the Medical Ethics Committee of Shanghai General Hospital, and informed consent was obtained from the participants. Study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting cross-sectional studies.

Questionnaire

The questionnaire for this study was developed based on the Expert Consensus on exercise therapy in Chinese Adults with Chronic Kidney Disease and relevant literature on exercise training in severe CKD,[10,11,19] and was further modified with input from 2 senior experts. The pilot study conducted within the study population yielded a Cronbach's α coefficient value of 0.905, indicating strong internal consistency.

The final questionnaire (Supplementary Material) was in Chinese and contained four dimensions: demographic information, knowledge, attitude, and practice. The demographic information consisted of 13 items, while the knowledge, attitude, and practice dimensions comprised 13, 9, and 9 items, respectively. Demographic information section included age, residence, education, monthly income, type of medical insurance, support from family members, duration and frequency of dialysis. Questionnaire included self-reported participation in healthcare interventions related to the CKD management, such as health education in hospital (any educational intervention on the topic of CKD implemented by healthcare professionals), instructions on specific medications, dietary and exercise interventions. Each knowledge item was scored 1 point for a correct answer and 0 points for incorrect answers, resulting in a possible score range of 0–13. The attitude and practice items were scored on a Likert scale ranging from very positive (5 points) to very negative (1 point), based on the degree of positivity.[20] The possible score range for both attitude and practice dimensions were 9–45. A Bloom's cut-off ≥80% of the maximal possible score[21] was considered as a good knowledge (≥10.4 points), positive attitude (≥36 points), and proactive practice (≥36 points).

Patients from hemodialysis centers in various hospitals in Shanghai were recruited through convenience sampling, with the help of local medical staff. Data collection was conducted through an online questionnaire hosted on the Sojump platform (http://www.sojump.com). Researchers distributed questionnaires by sending survey links to the participants through WeChat social messenger using the platform. The informed consent form was placed on the first page of the electronic questionnaire, and participants were required to sign it before completing the questionnaire.

Sample Size

Sample size was calculated according to the formula for cross-sectional surveys: $n = (Z_{1-\alpha/2} / \delta)^2 * p * (1 - p)$, were "n" represented the sample size for each group, "α" represented the type I error, typically set at 0.05, $Z_{1-\alpha/2} = 1.96$, "δ" represented the allowable error, typically set at 0.05, and "p" was set at 0.5 to maximize the value and ensure a sufficient sample size. The resulted minimal sample size was 384. Considering an estimated questionnaire response rate of 80%, the final plan was to collect at least 480 valid questionnaires.

Statistical Analysis

STATA 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis. The continuous variables were expressed as Mean ± SD, and the categorical variables were expressed as n (%). The continuous variables conformed to the normal distribution were tested by the *t*-test or ANOVA. Logistic regression analysis was performed to uncover factors associated with good knowledge, positive attitude, and proactive practice (>80% of maximal score), and results of univariate analysis with $P < 0.05$ were included in multivariate logistic regression analysis. Structural equation modeling (SEM) was used to evaluate the hypothesis that knowledge might directly affect attitude and practice, as well as indirectly influence practice through attitude. Root mean square error of approximation (RMSEA), standardized root mean squared residual (SRMR), comparative fit index (CFI), and Tucker-Lewis index (TLI) were calculated to ensure the performance of the SEM model. All statistical analyses were performed using two-sided test and two-sided $P < 0.05$ was considered statistically significant.

Results

A total of 513 valid questionnaires were collected. Among the participants, 257 (50.1%) were male and 148 (28.9%) were older than 60 years old. The duration of hemodialysis varied, with 42 (8.2%) receiving dialysis for ≤1 year, 174 (33.9%) for 1–5 years, 153 (29.8%) for 6–10 years, and 144 (28.1%) for more than 10 years. The majority of participants (91.2%) underwent dialysis three times a week for four hours each time. Additionally, over 80% of participants had already received health education in the hospital, while 35.7% of them underwent exercise interventions (Table 1).

The mean score in the knowledge dimension was 9.5 ± 4.1 (possible range: 0–13) (Table 1). The questions with the highest positive rate pertained to "stopping exercises upon feeling uncomfortable" (K10), with a correct rate of 85.4%, and "monitoring heart rate changes" (K11), with a correct rate of 85.0%. The questions that had the lowest accuracy were related to the nature of exercise therapy (38.0% of incorrect answers) (K12) and the desirable duration of exercises (38.8% of incorrect answers) (K1) (Table 2).

The mean score in the attitude dimension was 31.9 ± 5.0 (possible range: 9–45) (Table 1). The majority of participants exhibited a neutral attitude towards all questions, particularly regarding the initiative to develop a treatment plan for exercise therapy or the negative impact of the exercises (A4 and A8). Participants' responses that expressed a predominantly positive attitude were related to seeking additional knowledge or paying more attention to the physical assessment and other preparatory measures before exercising (A2 and A7). There were no instances of a predominant negative attitude; however, some participants approached the general about the necessity of exercises in the recovery with caution (A1, A2, and A7) (Figure 1).

The mean score for the practice dimension was 21.7 ± 9.3 (possible range: 9–45) (Table 1). The practices with the highest positive rate included seeking knowledge related to exercise therapy through various sources and paying attention to cardiopulmonary function and muscle atrophy (P1 and P5). However, approximately half of the participants did not actively contact the doctor to develop an exercise program, nor did they participate in in-hospital education on exercise therapy, or request the doctor or rehabilitation therapist to assess their physical condition before and after exercising (P2,

Table 1 Demographic Characteristic and KAP Score

Variables	N (%)	Knowledge Score		Attitude Score		Practice Score	
		Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Total	513	9.5 ± 4.1		31.87 ± 4.98		21.65 ± 9.3	
Gender			0.599		0.946		0.038
Male	257 (50.1)	9.3 ± 4.3		31.9 ± 5.1		22.5 ± 9.5	
Female	256 (49.9)	9.7 ± 4.0		31.9 ± 4.9		20.8 ± 9.1	
Age			0.820		< 0.001		0.006
Less than 40 years old	118 (23.0)	9.5 ± 4.2		32.3 ± 4.4		21.8 ± 10.4	
41–50 years old	131 (25.5)	9.6 ± 4.1		33.1 ± 5.4		22.4 ± 9.7	
51–60 years old	116 (22.6)	9.5 ± 4.2		31.9 ± 5.5		23.3 ± 8.7	
More than 60 years old	148 (28.9)	9.4 ± 4.1		30.4 ± 4.2		19.5 ± 8.2	
Body mass index			0.013		0.393		0.017
<18.5 (light)	130 (25.3)	9.0 ± 4.5		31.4 ± 4.9		20.00 ± 9.2	
18.5–23.9 (normal)	261 (50.9)	10.0± 3.9		32.2 ± 5.2		22.5 ± 9.3	
≥24 (overweight/obese)	122 (23.8)	9.0 ± 4.1		31.6 ± 4.6		21.6 ± 9.5	
Residence			0.005		0.002		0.003
Rural	87 (17.0)	8.5 ± 4.4		30.2 ± 4.0		18.9 ± 8.1	
Urban	426 (83.0)	9.7 ± 4.1		32.2 ± 5.1		22.2 ± 9.5	
Education			< 0.001		< 0.001		< 0.001
Middle School and below	139 (27.1)	8.7 ± 4.2		29.5 ± 3.4		19.2 ± 7.5	
High School and Technical secondary school	187 (36.5)	9.6 ± 4.1		32.0 ± 5.5		21.3 ± 9.6	
Junior college and above	187 (36.5)	10.0 ± 4.1		33.5 ± 4.7		23.8 ± 9.8	
Monthly per capita income (CNY)			< 0.001		0.002		< 0.001
< 5000	240 (46.8)	8.9 ± 4.2		31.0 ± 4.2		19.9 ± 8.8	
5000–10,000	179 (34.9)	10.2 ± 3.9		32.5 ± 5.9		23.1 ± 9.4	
>10,000	94 (18.3)	9.87 ± 4.1		32.9 ± 4.6		23.5 ± 9.7	
Medical insurance (multiple choice)			–		–		–
Basic medical insurance for urban employees	296 (57.7)	10.0 ± 3.8		32.4 ± 5.0		21.7 ± 9.0	
New Cooperative Medical insurance	57 (11.1)	7.7 ± 4.6		30.1 ± 3.9		17.5 ± 9.4	
Basic medical insurance for urban residents	162 (31.6)	9.5 ± 4.3		31.7 ± 5.1		23.4 ± 9.6	
Medical insurance for retired	4 (0.8)	9.8 ± 6.5		30.8 ± 3.9		20.3 ± 4.3	
Commercial insurance	30 (5.9)	11.7 ± 3.3		35.37 ± 7.0		27.0 ± 11.5	
No insurance	12 (2.3)	7.3 ± 4.5		29.75 ± 2.4		17.2 ± 5.9	
Support from family members			< 0.001		< 0.001		0.022
Yes	459 (89.5)	9.8 ± 3.9		32.2 ± 5.0		22.0 ± 9.4	
No	54 (10.5)	6.5 ± 4.7		28.9 ± 3.5		18.9 ± 8.3	
Duration of dialysis			0.121		0.118		0.689
≤ 1 year	42 (8.2)	10.7 ± 3.4		32.5 ± 4.2		23.1 ± 10.0	
1–5 years (including 5 full years)	174 (33.9)	9.3 ± 4.0		32.1 ± 4.6		21.3 ± 9.4	
6–10 years (including 10 full years)	153 (29.8)	9.7 ± 4.1		32.1 ± 5.5		21.9 ± 9.2	
More than 10 years	144 (28.1)	9.1 ± 4.4		31.3 ± 5.2		21.3 ± 9.3	
Dialysis frequency			0.090		0.442		< 0.001
Once a day for 4 hours	10 (2.0)	11.1 ± 4.0		32.8 ± 3.9		31.8 ± 9.6	
Once every other day for 5 hours	10 (2.0)	9.4 ± 4.4		31.6 ± 3.5		27.3 ± 7.2	
Twice a week for 5 hours each time	9 (1.8)	7.8 ± 5.4		30.8 ± 3.4		17.5 ± 7.4	
3 times a week for 4 hours each time	468 (91.2)	9.5 ± 4.1		31.9 ± 5.1		21.6 ± 9.3	
Other	16 (3.1)	8.0 ± 3.7		29.88 ± 4.4		14.75 ± 6.3	
Healthcare interventions (multiple choice)			–		–		–
Health education in hospital	430 (83.8)	10.0 ± 3.8		32.1 ± 5.0		22.1 ± 9.5	
Medication instruction	402 (78.4)	9.9 ± 3.9		32.2 ± 5.2		22.2 ± 9.5	
Dietary interventions	392 (76.4)	10.0 ± 3.8		32.3 ± 5.2		22.4 ± 9.5	
Exercise interventions	183 (35.7)	10.7 ± 3.7		33.2 ± 5.9		26.3 ± 10.3	
Did not receive any of the above	41 (8.0)	7.9 ± 4.7		31.6 ± 5.0		18.0 ± 9.2	

(*Continued*)

Table 1 (Continued).

Variables	N (%)	Knowledge Score		Attitude Score		Practice Score	
		Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Suffering diseases (multiple choice)			–		–		–
Hypertension	355 (69.2)	9.6 ± 4.0		31.9 ± 4.9		21.1 ± 9.0	
Diabetes mellitus	119 (23.2)	9.8 ± 3.9		31.7 ± 5.1		23.8 ± 9.1	
Chronic nephritis	222 (43.3)	9.80 ± 4.0		32.9 ± 5.8		23.1 ± 10.1	
Polycystic kidney	70 (13.7)	9.40 ± 4.2		32.2 ± 5.3		20.3 ± 8.9	
Other	84 (16.4)	11.1 ± 2.9		33.2 ± 6.0		21.6 ± 10.2	
None of the above	33 (6.4)	8.9 ± 4.3		30.3 ± 3.5		20.1 ± 10.5	
Received medication (multiple choice)			–		–		–
Antihypertensive drugs	376 (73.3)	9.5 ± 4.1		31.7 ± 4.9		21.8 ± 8.9	
Chinese patent drug for proteinuria	111 (21.6)	10.6 ± 3.4		34.2 ± 6.6		28.3 ± 10.9	
Diuretics	55 (10.7)	10.4 ± 3.7		36.8 ± 7.0		29.4 ± 11.8	
Creatinine-lowering drugs	111 (21.6)	10.2 ± 3.7		34.6 ± 6.7		27.8 ± 11.1	
None of above	94 (18.3)	9.3 ± 4.2		31.4 ± 4.1		18.9 ± 9.2	

Table 2 Responses to the Questionnaire on Knowledge

Knowledge	Correct Rate N (%)
K1. Exercise therapy is one of the adjunctive methods in the treatment of end-stage chronic kidney disease.	318 (612.0)
K2. The patient's quality of life will be seriously affected by the decline in renal function and cardiopulmonary function as well as muscle atrophy.	422 (82.3)
K3. Exercise therapy can improve the cardiopulmonary endurance of patients with CKD.	361 (70.4)
K4. Exercise therapy can reduce the risk of cardiovascular disease in patients to some extent.	360 (70.2)
K5. Exercise therapy can help to maintain the body's muscle mass and reduce the decomposition of muscle protein.	325 (63.4)
K6. Before performing moderate or high-intensity exercise, an exercise load test should be performed under the supervision of a professional medical staff to control the intensity of exercise.	380 (74.1)
K7. Physical condition should be assessed regularly and the treatment plan of exercise therapy should be adjusted in a timely manner.	401 (78.2)
K8. Flexibility exercises such as neck joint and hip joint, aerobic exercises such as jogging and bicycling, resistance exercise such as resistance band training, supine leg lifting and etc. are all types of exercise therapy.	330 (64.3)
K9. Appropriate stretching and warm-up exercises should be done before carrying out exercise therapy.	403 (78.6)
K10. You need to stop immediately if you feel uncomfortable during exercise (such as burning pain in the chest, arms, etc., sense of narrowing, sense of chest tightness, weakness, etc).	438 (85.4)
K11. You need to pay attention to heart rate changes during exercise to prevent cardiovascular adverse events.	436 (85.0)
K12. The more hours you spent exercising, the better is the effect.	314 (61.2)
K13. It is generally recommended to start with low intensity exercise training and gradually reach a moderate level of exercise.	380 (74.1)

P3, and P8). Approximately, one-third of the participants occasionally engaged in exercise therapy and shared their experience and opinions with other patients (P4 and P6) (Figure 2).

Multivariate logistic regression analysis showed that college or higher (OR = 1.8, 95% CI: 1.1–3.0, P = 0.02), income of 5000–10000 CNY (OR = 1.7, 95% CI: 1.1–2.6, P = 0.02), and family support (OR = 3.8, 95% CI: 2.0–7.1, P < 0.001) were independently associated with knowledge (Figure 3A). Knowledge score (OR = 9.4, 95% CI: 4.3–20.4, P < 0.001), college or higher (OR = 6.4, 95% CI: 2.3–17.9, P < 0.001), and technical secondary and high school (OR = 3.7, 95% CI: 1.3–10.2, P = 0.01) were independently associated with attitude (Figure 3B). Knowledge score (OR = 5.1, 95% CI: 1.7–15.1, P < 0.001) and attitude score (OR = 7.3, 95% CI: 3.7–14.2, P < 0.001) were independently associated with practice (Figure 3C).

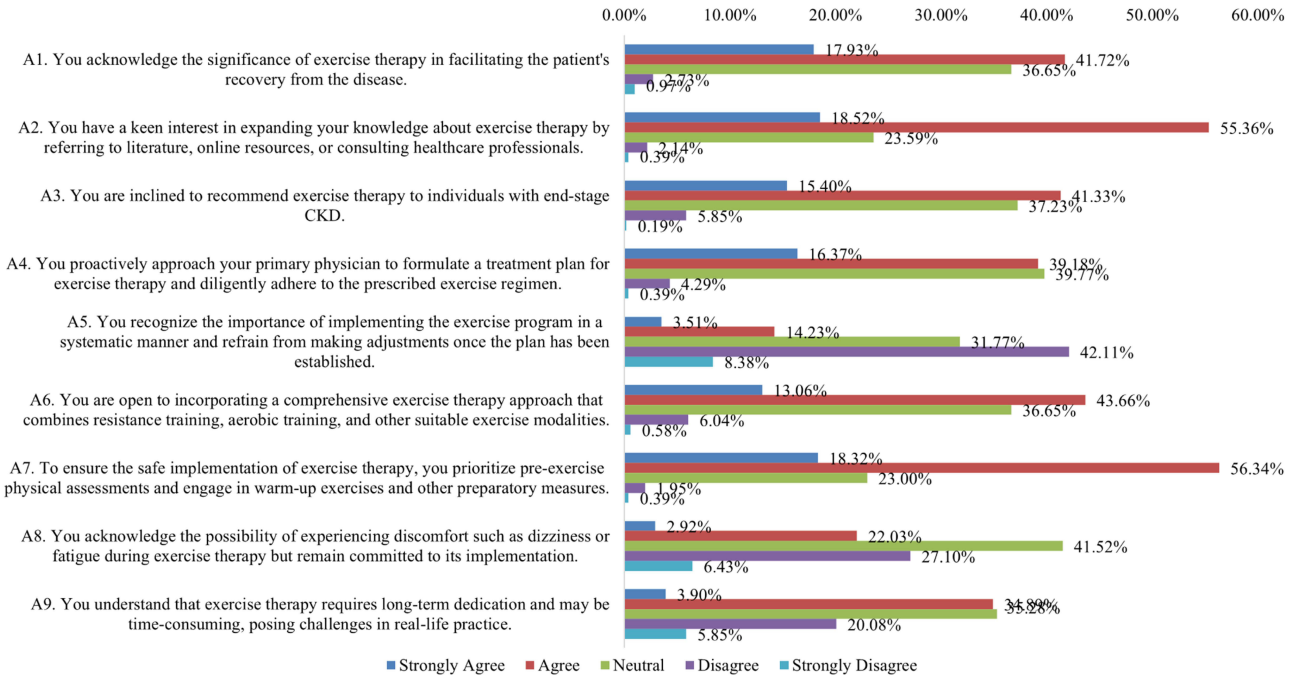

Figure 1 Summary of questions and responses of attitudes.

Notes: The categorization of frequency is based on the practice within the last 2 months. The term "Always" refers to individuals who have practiced more than 6 times during this period. "Often" is used for individuals who have practiced 5 to 6 times within the last 2 months. "Sometimes" is assigned to individuals with a practice frequency of 3 to 4 times during this period. "Occasionally" is used for individuals who have practiced 1 to 2 times within the last 2 months. Finally, "Never" indicates individuals who have not engaged in any practice within the last 2 months.

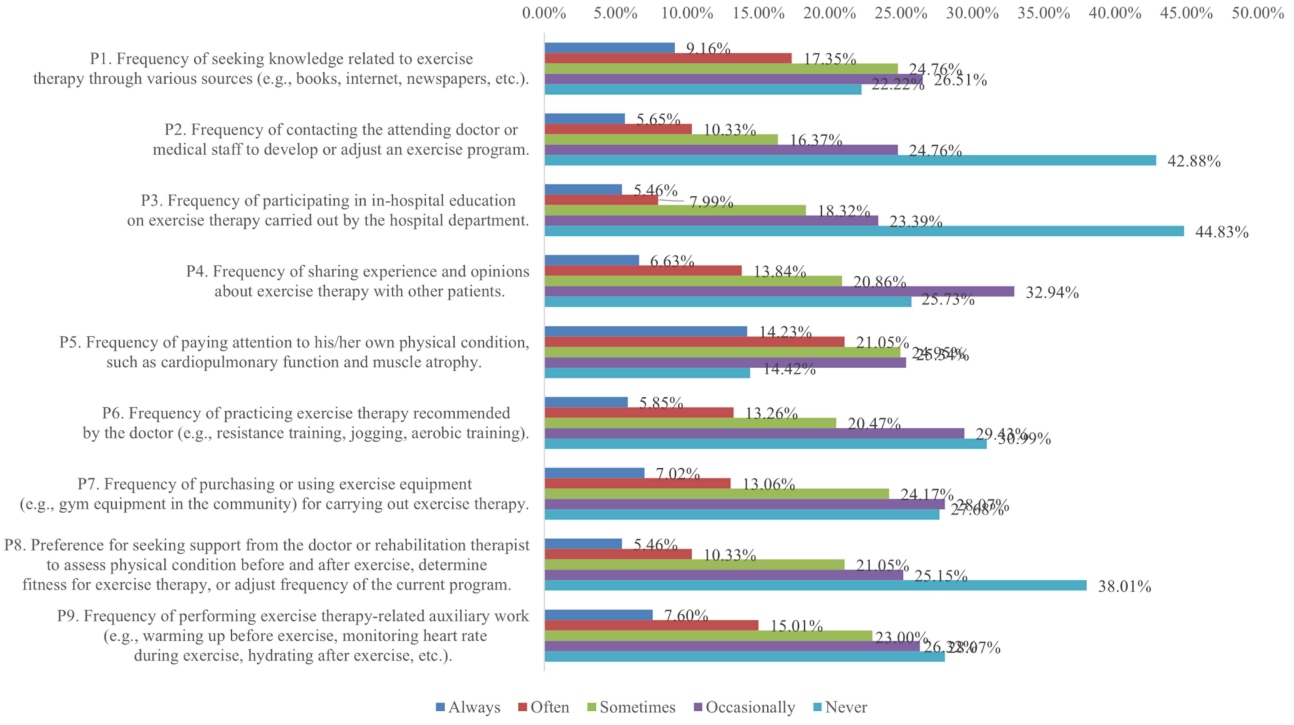

Figure 2 Summary of questions and responses to practices.

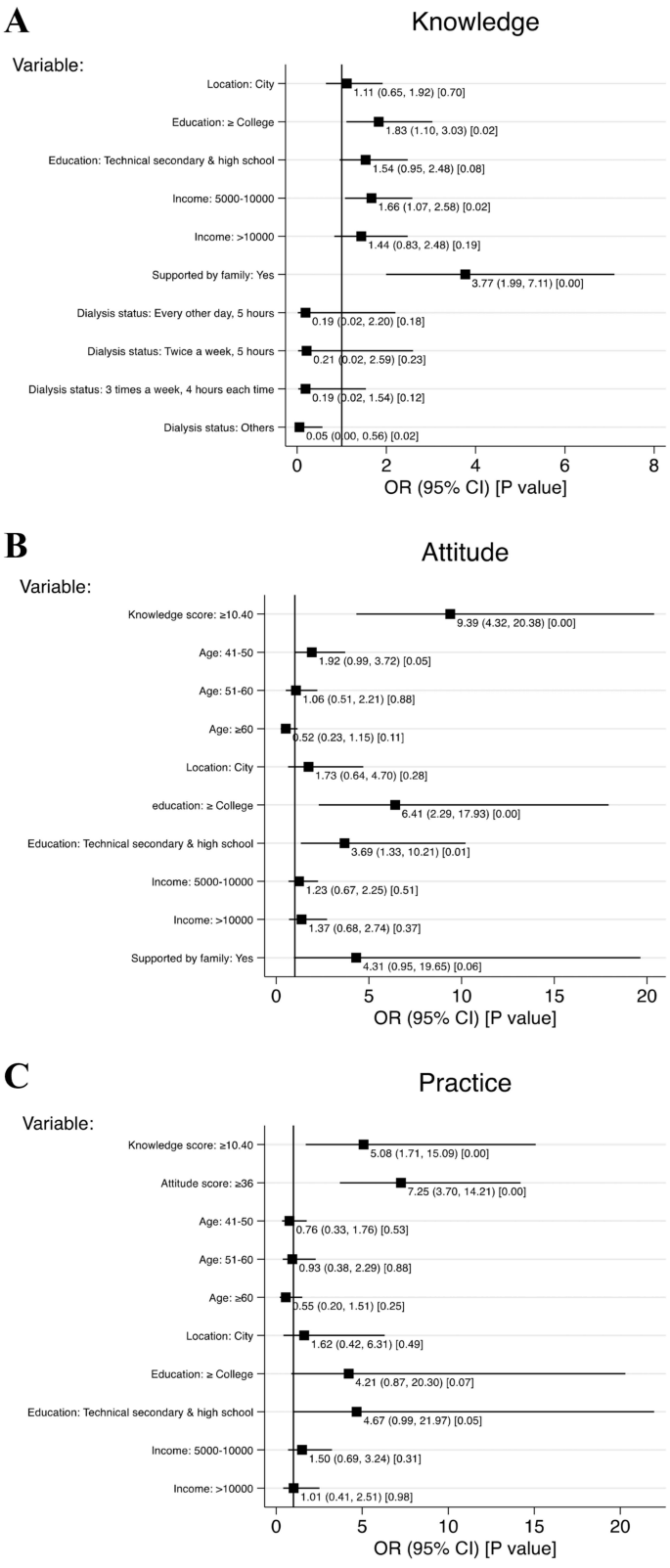

Figure 3 Forest plot of multivariate analysis for knowledge (**A**), attitude (**B**) and practice (**C**).

Table 3 Structural Equation Modeling (SEM) Building; Indices Demonstrate Acceptable Model Fit

Indicators	Reference	Results
RMSEA	<0.08 Good	0.072
SRMR	<0.08 Good	0.073
TLI	>0.8 Good	0.895
CFI	>0.8 Good	0.903

Abbreviations: RMSEA, root mean square error of approximation; SRMR, standardized root mean squared residual; CFI, comparative fit index; TLI, Tucker-Lewis index.

Method of structural equation modeling was used to further explore the influence of knowledge on practice, with model fit indices corresponding to the acceptable model fit (Table 3). As demonstrated on Figure 4, it was found that knowledge directly influenced attitude (β=1.3, P < 0.001), while attitude influenced practice (β=0.8, P < 0.001).

Discussion

This study found that patients with CKD-5 who underwent regular hemodialysis demonstrated insufficient knowledge, passive attitude and inactive practice towards exercise therapy, which emphasizing the pressing need to establish efficient physician-patient educational initiatives. Logistic regression and SEM methods confirmed significant links between knowledge, education, attitude and practice, suggesting that educational interventions focused on enhancing knowledge and changing attitudes might be an effective way for improving practice.

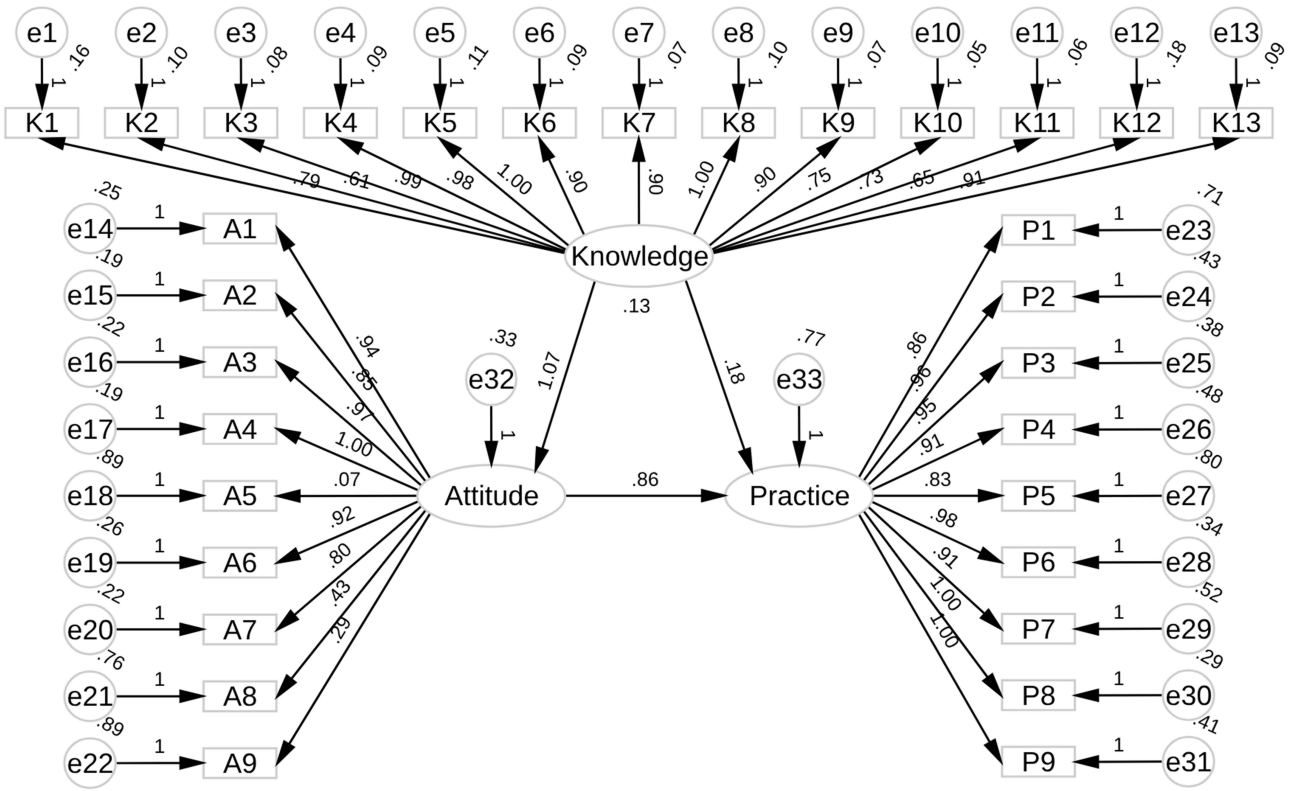

Figure 4 Results of Structural equation modeling (SEM) analysis, demonstrating influence of knowledge on practice, with the impact of each questionnaire item on final results. Single items are coded with the first letter of questionnaire directory (K1-12 for knowledge, A1-9 for attitude and P1-9 for practice).

Slightly different from the present study, a few previous studies conducted in the comparable population of late stage CKD patients on dialysis all reported sufficient levels of knowledge regarding therapeutic interventions.[15,16,22] In the present study, the knowledge scores of included CKD-5 patients did not meet the defined threshold for "sufficient knowledge" based on the study's cut-off value. However, absolute score still indicated a relatively high level of knowledge, explained by the fact that those patients frequently visit hospital and receive explanations regarding treatment.[15] At the same time, lower level of knowledge regarding the nature of exercise therapy and desirable duration of exercises was noted, suggesting that those areas were not covered enough by the hospital educational interventions. In addition, Zibran and Mohammadnezhad[16] reported that despite high level of knowledge, the practice of CKD patients was lacking, especially regarding clinic attendance and self-monitoring. Similarly, in the present study, the mean practice score was only 48.11% of total possible score, with only one-third of participants occasionally participating in exercises. This information should be considered by health care providers to improve management and treatment of CKD.

Despite the increasing global number of patients who underwent maintenance dialysis,[23] physical activity and exercise training have a low priority of in the nephrology field.[11] In addition to objective physical, financial and healthcare-related obstacles, some barriers and positive influences for better practice regarding exercise therapy were identified in this study. It is most likely that practice was influenced by the neutral attitude expressed by the participants, especially towards taking initiative to develop a treatment plan for exercise therapy or perceived negative impact of the exercises. It is in line with previous KAP studies that reported significant correlation between patients' knowledge and practice with their self-care activities.[24,25] Another important point is the support from family members, which was associated with the better knowledge scores in this study. Besides health care professionals, care providers act as the source of knowledge and might support the better practice, as was confirmed by the results of the previous study.[7]

Population segmentation is an evolving field focused on personalizing treatment and rehabilitation approaches based on specific needs and barriers of patients.[26,27] In particular, patient vulnerability and uremic symptoms were previously identified as important barriers to CKD patient's involvement in clinical studies,[28] and might prevent the initiative in seeking a treatment plan for exercise therapy. Poor methodology was also reported as a barrier for translating the role of exercise or its adoption as a therapeutic option in CKD.[10] Among health care providers, it is not traditionally recommended because of the possible renal function impairment and increasing proteinuria.[13] Finally, older age might act as the psychological or logistic barrier to hamper exercise implementation.[29,30] In this study, although practice differed notably in all age groups, younger age was not linked to the better Practice according to the multivariate logistic regression analysis. At the same time, younger age (among other age-related factors) was independently associated with better attitude and might potentially influence practice patterns as such. It is important to note that in the majority of currently published trials the mean age of CKD patients on hemodialysis is comparatively old, still exercise therapy demonstrates promising results. In particular, in the study by Greenwood et al[31] the mean age of participants was 56.1 ± 12.4 and exercise based renal rehabilitation interventions notably reduced the risk of morbidity and mortality. Among options available for CKD patients in any age are interval training, virtual reality exercises, yoga, electrical myostimulation and blood flow restriction training.[10] At the same time, practical aspects and safety concerns of exercise therapy should be taken into consideration, as well as timing for implementation; therefore, population segmentation becomes a promising solution, while KAP methodology could be effectively utilized to identify important subgroups of patients to target and implement strategies for increased uptake of exercise therapy.

In this study, practice scores were closely associated with knowledge scores; moreover, according to SEM results, knowledge directly influenced practice and attitude, while attitude influenced practice, suggesting that increasing knowledge and amending attitude are necessary for changing practice habits. Whether or not patient education alone is enough to improve health and treatment adherence in CKD is still under discussion. It was previously noted that evidence is limited regarding the sufficiency of patients' knowledge processed in patient education.[32,33] Moreover, knowledge, attitude and perception might be notably influenced by a person's educational level and economic status,[34] as was also confirmed by the present study results. In these circumstances, other sources of knowledge and information should be made available for CKD patients and their family members. External sources of support, such as Peer Mentoring programs, also demonstrated promising results in CKD.[35] Pharmacist counseling might be effective in improving attitude toward therapy, providing

additional point of view, as described in the study by Ghimirey et al.[15] Finally, patients might benefit from the better explanation of exercise options available for elderly and education programs tailored to the requirements of older age.

This study has several limitations. First, the single-center cross-sectional design of the study may introduce unaccounted regional peculiarities and selection bias. Second, the answers were self-reported and may be influenced by social desirability bias, as participants may provide positive responses to unclear in order to appear more knowledgeable or educated. Third, minimal clinically important difference for the items within the questionnaire was not evaluated, which could have limited the clinical applicability of results to some degree. In addition, the decision to exclude patients who were unable to exercise due to physical condition and/or other comorbidities might further limit the generalizability of results. Moreover, a variety of other objective factors that influence the decision to partake in exercises were not studied. Fourth, other aspects of exercise therapy from the physician's perspective, including identifying suitable populations and exploring possible alternatives, were not examined and require further study. Nevertheless, this study provides a comprehensive reflection of the knowledge, attitudes, and practices among CKD-5 patients who are on regular hemodialysis who have the ability to participate in the exercise therapy. It also explores the deficiencies in these areas and offers valuable guidance for clinical practitioners.

Conclusion

Patients with CKD-5 who underwent regular hemodialysis demonstrated insufficient knowledge, passive attitude and inactive practice towards exercise therapy. Improving knowledge and attitude through educational interventions might result in better practice.

Data Sharing Statement

All data generated or analysed during this study are included in this published article.

Ethics Approval and Consent to Participate

The study was carried out after the protocol was approved by the Medical Ethics Committee of Shanghai General Hospital (2023-304). I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments, and informed consent was obtained 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 declare that they have no competing interests.

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