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Mediating Effects of Knowledge, Attitudes, and Practice of Rehabilitation on the Relationship between Fatigue and Kinesiophobia in Patients with Coronary Heart Disease

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Abstract: This study aimed to investigate the mediating role of knowledge, attitude, and practice (KAP) in the relationship between fatigue and kinesiophobia in 200 coronary heart disease patients from three Chinese tertiary hospitals. Using validated scales (MFSI-SF, TSK-SV Heart, and the Rehabilitation Exercise Knowledge-Attitude-Practice Scale for Patients), data analysis via SPSS 25.0 and AMOS 24.0 structural equation modeling identified a significant KAP-mediated pathway (total indirect effect = 0.377). KAP of rehabilitation was significantly negatively correlated with fatigue ($r = -0.51$, $p < 0.01$) and kinesiophobia ($r = -0.60$, $p < 0.01$), whereas fatigue was significantly positively correlated with kinesiophobia ($r = 0.678$, $p < 0.01$). Results indicate that fatigue amplifies kinesiophobia by compromising KAP of rehabilitation. A significant mediating effect of KAP of rehabilitation on the relationship between fatigue and kinesiophobia was found. Improving patient fatigue and the knowledge, attitudes, and practices of rehabilitation can help reduce kinesiophobia.

Keywords: Coronary heart disease; Fatigue; Kinesiophobia; KAP of rehabilitation

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1. Introduction

Coronary heart disease (CHD) is a global health challenge characterized by high morbidity, mortality, and long-term complications, significantly impairing patients' quality of life. Coronary heart disease affects 197 million people worldwide, with the number of deaths increasing to 9.1 million [1]. Therefore, coronary heart disease is an important challenge that needs to be solved in the world's public health. Exercise-based cardiac rehabilitation is recognized as a key component of comprehensive CHD management. Previous studies have demonstrated that participation in exercise-based cardiac rehabilitation can reduce cardiovascular disease mortality and hospitalization rates, modify risk factors, and improve quality of life [2,3].

Although the guidelines recommend cardiac rehabilitation for patients with cardiovascular disease, according to the available literature, the implementation of cardiac rehabilitation is not good worldwide. The enrollment rate for a cardiac rehabilitation program following STEMI is approximately 25–35% in Western countries and only 15% in Italy [4]. Many centers experienced challenges with long-term adherence, as 58% of patients discontinued participation in an exercise program within 8 to 9 months [5].

Studies have shown that kinesiophobia is the main factor affecting patients' cardiac rehabilitation, which has a negative impact on the outcome of rehabilitation in CHD patients [6]. Kinesiophobia is defined as a patient's excessive, irrational fear or avoidance state toward exercise due to the fear of injury to the body [7]. Kinesiophobia is frequently observed in individuals diagnosed with CHD. More than 70% of CHD patients have different degrees of kinesiophobia [8]. Kinesiophobia can lead to negative emotions and reduced quality of life [9]. According to the fear-avoidance model, patients avoid exercise and reduce physical activity, which decreases muscle strength and other conditions to further aggravate kinesiophobia [10].

The knowledge, attitude, and practice (KAP) of rehabilitation is used to assess the status quo of knowledge, attitudes and practices related to rehabilitation exercise among patients with CHD. The level of engagement in exercise-based cardiac rehabilitation in patients with CHD is generally closely related to patients' knowledge, attitudes and practices [11].

The greater the level of KAP of rehabilitation, the lower the level of kinesiophobia [12]. Fatigue, a common symptom in patients with CHD, is a persistent and subjective feeling of tiredness accompanied by a decrease in physical strength and cannot be relieved by rest [13]. Fatigue is one of the causes of sudden cardiac death, which leads to increased mortality and affects patients' cognitive ability and quality of life [14,15]. Studies have shown that the occurrence of moderate to severe fatigue in patients with CHD reaches 39% during cardiac rehabilitation and remains as high as 28% after 1 year [16].

A study of 263 patients with heart failure revealed that fatigue was a significant factor in kinesiophobia, and patients with more intense fatigue were found to have higher levels of kinesiophobia [17]. When patients experience physical or mental fatigue, they often choose to avoid exercise.

Studies have shown that fatigue and KAP of rehabilitation are important factors in kinesiophobia [12,17]. The fear-avoidance model refers to a change in physical conditions (pain, discomfort, fatigue, etc.) so that the patient stimulates the body to experience kinesiophobia through psychological factors, individual coping strategies and other variables [18]. This model of cognitive behavior is often used to explain kinesiophobia.

According to the fear-avoidance model, kinesiophobia is the behavior of avoiding exercise on the basis of psychological cognitive changes. Therefore, through a literature review, this study aims to explore whether the KPA of rehabilitation plays a mediating role in the relationship between fatigue and kinesiophobia to provide a theoretical basis for formulating targeted intervention strategies to improve patients' participation in cardiac rehabilitation and quality of life. On the basis of the fear-avoidance model, this study proposed the following hypothesis

(1) KAP of rehabilitation in CHD patients is significantly negatively correlated with kinesiophobia, and fatigue is significantly positively correlated with kinesiophobia.

(2) Fatigue can directly affect kinesiophobia and can also indirectly affect kinesiophobia by affecting KAP of rehabilitation.

2. Methods

2.1. Design and sample

A multicenter cross-sectional questionnaire survey was carried out in the cardiology departments of three tertiary hospitals located in Shiyan City, Hubei Province, from October 1 to November 31, 2024. Convenience sampling was chosen because of feasibility constraints in clinical settings. Patients were included if they

(a) Had a confirmed clinical diagnosis of CHD

(b) Were aged ≥ 18 years

(c) Were able to understand and speak Chinese

(d) Had a heart function classification of no more than Grade III

Patients were excluded if they had

(a) Cognitive dysfunction resulting in an inability to answer the questionnaires

(b) Organic lesions of important organs

(c) Limb motor dysfunction caused by various factors and not fully recovering to normal

Data collection was conducted face-to-face by trained researchers. For participants with limited literacy, questionnaires were administered verbally, and responses were recorded by the researchers. Each interview lasted approximately 30–40 minutes.

2.2. Instruments

This study utilized a self-designed questionnaire to gather sociodemographic information from participants, such as their gender, age, marital status, level of education, monthly household income, occupation, etc.

The level of fatigue in patients was evaluated via the Multidimensional Fatigue Inventory developed by Smets et al [19]. The scale comprises a total of 20 items organized into five distinct dimensions: general fatigue, physical fatigue, mental fatigue, reduced motivation and reduced activity. Using the 5-point Likert scale, the scale's total score ranges from 20--100, with higher scores indicating higher levels of fatigue. The scale has demonstrated strong reliability and validity, with a Cronbach's α of 0.84 [19]. For this sample, the Cronbach's α for the scale was 0.915.

The Tampa Scale for Kinesiophobia Heart Compiled by Bäck et al [20]. In 2019, Chinese scholar Mengjie Lei revised it into a Chinese version of the Tampa Scale for Kinesiophobia Heart. The Cronbach's α coefficient of the revised scale was 0.859. The scale comprises a total of 20 items organized into four distinct dimensions: perceived danger for heart problems, avoidance of exercise, fear of injury and dysfunctional self. The total score ranges from 17 to 68 points. The higher the score is, the greater the level of kinesiophobia. For this sample, the Cronbach's α for the scale was 0.827.

The rehabilitation exercise knowledge-attitude-practice scale for patients with CHD was developed by Mengli Zhao [21]. There are 3 dimensions and 23 items, including knowledge, attitudes and practices. The higher the score is, the greater the level of knowledge of rehabilitation exercise, the more positive the attitude toward rehabilitation exercise, and the greater the level of rehabilitation exercise behavior. This scale showed good reliability, with a Cronbach's α of 0.833. For this sample, the Cronbach's α for the scale was 0.924.

2.3. Ethical considerations

The research received approval from the Non-Invasive Ethics Committee of Hubei University of Medicine (Approval No: 2024-RE-027). The purpose and significance of the study were explained to the participants before the questionnaire survey. After providing written informed consent, the participants in the study were invited to

fill out the questionnaire anonymously. The participants' personal information and completed questionnaires were sealed to ensure their privacy.

2.4. Statistical analysis

For the data analysis in this study, SPSS 25.0 and Amos 24.0 statistical software were used. The demographic variables are displayed as the means and standard deviations, whereas count data are reported as frequencies and percentages.

Pearson's coefficient was used to assess the correlation between the KAP of rehabilitation, kinesiophobia and fatigue. The Harman single-factor test was used to assess common method bias, with a critical value of 40%. The mediating effect of KAP of rehabilitation was examined via Amos 24.0. In the mediation model, fatigue was the independent variable, kinesiophobia was the dependent variable, and KAP of rehabilitation was the mediator. The mediation analyses were tested with 2000 bootstrapping samples and 95% confidence intervals (95% CI). The level of statistical significance was set at $p < 0.05$.

3. Results

3.1. Common method bias test

The data in this study were obtained via self-reports, which could potentially introduce common method bias.

To improve the rigor of the study, all items of the questionnaire in this study were included in the analysis via Harman's single factor test. The findings indicated that 14 factors had a value greater than 1 (**Table 1**), and the first common factor explained 26.73% of the total variance, which fell below the threshold of 40%. Therefore, there was no significant common method bias in the data of this study.

Table 1. Common factors with eigenvalues greater than 1 (N = 200)

Components	Total	Percent variance of the initial eigenvalues	Cumulation %	Total	Extract the load squared sum variance percentage	Cumulation %
1	16.037	26.728	26.728	16.037	26.728	26.728
2	4.93	8.217	34.945	4.93	8.217	34.945
3	2.546	4.243	39.188	2.546	4.243	39.188
4	2.392	3.987	43.174	2.392	3.987	43.174
5	2.117	3.528	46.702	2.117	3.528	46.702
6	1.88	3.133	49.835	1.88	3.133	49.835
7	1.679	2.799	52.634	1.679	2.799	52.634
8	1.668	2.78	55.413	1.668	2.78	55.413
9	1.435	2.392	57.805	1.435	2.392	57.805
10	1.355	2.258	60.064	1.355	2.258	60.064
11	1.19	1.983	62.047	1.19	1.983	62.047
12	1.16	1.933	63.98	1.16	1.933	63.98
13	1.091	1.819	65.799	1.091	1.819	65.799
14	1.055	1.758	67.558	1.055	1.758	67.558

3.2. Sample characteristics

The study included a total of 200 patients who were diagnosed with CHD. The sociodemographic characteristics are shown in **Table 2**. Notably, 97.5% of the patients were over 45 years old, and 53% of the patients were men. A total of 48.5% of the patients had a primary or lower education and were married (92%). In this study, the KAP for the rehabilitation of patients with CHD was 44.61 ± 12.10. The fatigue score was 57.91 ± 11.53. The kinesiophobia score was 43.12 ± 5.13.

Table 2. Demographic and clinical characteristics (N = 200)

Variable		N (%)
Gender		
	Male	106(53)
	Female	94(47)
Age		
	18–45	5(2.5)
	46–59	45(22.5)
	60–75	101(50.5)
	＞ 75	49(24.5)
Education level		
	Uneducated	35(17.5)
	Primary School	62(31)
	Junior High School	56(28)
	High School	27(13.5)
	College and above	20(10)
Marital status		
	Married	184(92)
	Unmarried, Divorced or Widowed	16(8)
Place of residence		
	Villages	59(29.5)
	Towns, Counties or Cities	141(70.5)
Average monthly income (RMB, yuan)		
	＜ 5000	46(23)
	5000–10000	141(70.5)
	＞ 10000	13(6.5)

3.3. Correlation analysis

Pearson correlations were used to examine the associations among the three variables of the KAP of rehabilitation, fatigue, and kinesiophobia, and the correlations of various variables are shown in **Table 3**. KAP of rehabilitation was significantly and negatively correlated with fatigue ($r = -0.51$, $p < 0.01$) and kinesiophobia ($r = -0.60$, $p < 0.01$), whereas fatigue was significantly and positively correlated with kinesiophobia ($r = 0.678$, $p < 0.01$).

Table 3. Correlation analysis of KAP of rehabilitation, fatigue, and kinesiophobia (n = 200)

Variable	M ± SD	The KAP of rehabilitation	Fatigue	Kinesiophobia
The KAP of rehabilitation	44.61 ± 12.10	1		
Fatigue	57.91 ± 11.53	-.512**	1	
Kinesiophobia	43.12 ± 5.13	-.600**	.678**	1

M: mean; SD: standard deviation. **$p < 0.01$.

The study established a structural equation model, with fatigue as the independent variable, kinesiophobia as the dependent variable, the KAP of rehabilitation as the mediating variables, and all variables were standardized. The mediation model is shown in **Figure 1**. Structural equation model fitting index: CMIN/DF = 2.508, GFI = 0.916, AGFI = 0.865, RMSEA = 0.087, NFI = 0.911, NNFI=0.924, indicating that the model fits well. The model effect size results are shown in **Table 4**, fatigue had direct predicted of kinesiophobia (β = 0.27, p = 0.001). In addition, kinesiophobia can be predicted indirectly through the KAP of rehabilitation (β = 0.106, p = 0.001). All the 95%CI for the effect sizes of all paths did not include 0, indicating that all paths were statistically significant. The KAP of rehabilitation has a partial mediating effect between fatigue and kinesiophobia.

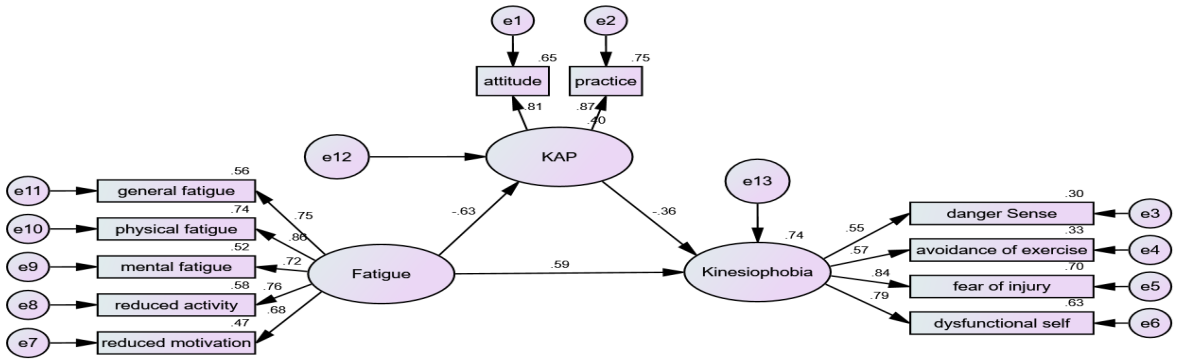

Figure 1. The mediation model.

Table 4. The mediating effects of fatigue on the relationships among knowledge, attitudes, practice of rehabilitation and kinesiophobia

Effect	Item	β	p	95% CI
Direct effect	Fatigue → Kinesiophobia	0.27	0.001	0.168–0.415
Indirect effect	Fatigue → The KAP of Rehabilitation → Kinesiophobia	0.106	0.001	0.054–0.184
Total effect	Fatigue → Kinesiophobia	0.377	0.001	0.267–0.503

β: standardized beta; CI: confidence interval

4. Discussion

In this study, the score of kinesiophobia in patients with CHD was 43.12 ± 5.13, and the fatigue score was 57.91 ± 11.53, which was moderate. This finding is consistent with previous findings on fatigue and kinesiophobia in CHD patients [16,22]. CHD patients avoid exercise because they are afraid of disease recurrence, death, or increased heart rate during exercise. Patients with coronary heart disease are affected by disease factors such as dyspnea and chest pain, which can lead to anxiety, depression and other negative emotions and are more likely to experience physical and mental decline, leading to fatigue [23]. In this study, the KAP score for rehabilitation in patients with CHD was 44.61 ± 12.10, which was lower than that reported by Feng Qingjing et al. [12]. The reason may be that the proportion of patients over 60 years old in this study was as high as 75%. Owing to the decline in memory and cognitive function, the level of KAP associated with rehabilitation in patients is not high.

This study revealed that kinesiophobia was positively correlated with fatigue ($r = 0.678$, $p < 0.01$). According to the fear-avoidance model, when individuals face pain, discomfort and other stimuli, they experience kinesiophobia and actively avoid physical activity [18]. Patients with coronary heart disease are affected by physical fatigue and psychological fatigue, resulting in kinesiophobia. The greater the degree of fatigue is, the greater the level of kinesiophobia. These results are consistent with those of previous studies [24,25]. Previous studies on fatigue-related exercise fear in 236 patients with heart failure have shown that severe fatigue may lead to increased levels of kinesiophobia [17]. Fatigue easily causes patients to have negative emotions [26]. The greater the level of negative emotions is, the more patients avoid exercise [27]. In addition, the KAP score of rehabilitation in patients with CHD was negatively correlated with kinesiophobia ($r = -0.600$, $p < 0.01$). These results are consistent with those of previous studies [12]. Patients' exercise rehabilitation behavior is generally closely related to patients' knowledge, attitudes and behavior [11,28]. The more patients know about rehabilitation exercise, the more positive their attitude toward it, the greater their likelihood of performing rehabilitation exercise, and the lower their level of kinesiophobia.

The mediating effect model tested via the bootstrap method revealed that the KAP score of rehabilitation partially mediated the relationship between fatigue and kinesiophobia in patients with CHD. Fatigue had a direct predictive effect on kinesiophobia in patients with CHD, and it could also indirectly predict kinesiophobia through KAP of rehabilitation; the mediating effect was 28.12%. The fear-avoidance model posits that maladaptive cognitive responses to somatic sensations (e.g., fatigue) amplify avoidance behaviors. In CHD patients, this may manifest as kinesiophobia due to misinterpretation of exercise-related symptoms as threatening. Reducing the fatigue level of patients with coronary heart disease is beneficial for enhancing patients' confidence in rehabilitation exercise and reducing kinesiophobia. Fatigue is a multidimensional subjective feeling of fatigue, including physiological, psychological and cognitive aspects [19]. The disease restricts patients' daily activities, resulting in physical fatigue. Coronary heart disease has a long course and a heavy disease burden. Patients may experience negative emotions, exacerbating their psychological fatigue. Physical fatigue can affect the speed and endurance of patients during exercise, resulting in slow movement and affecting their exercise ability [29]. Studies have shown that patients are more likely to perform rehabilitation exercises when they are in good physical condition [30]. In addition, patients often choose negative coping styles such as avoidance when they have a bad psychological state [31]. Patients with coronary heart disease affected by psychological fatigue have a negative attitude toward rehabilitation. A higher level of fatigue may reduce patients' desire to actively seek learning knowledge, resulting in a low level of rehabilitation exercise knowledge. Therefore, medical staff can reduce the fatigue level of patients through psychological intervention to improve their KAP level of rehabilitation.

When patients with CHD have a greater KAP level of rehabilitation, they have a deeper understanding of disease knowledge to be better able to experience the benefits of exercise, have a more positive attitude, have greater exercise compliance, and have less kinesiophobia. Therefore, medical staff should strengthen their knowledge education, emphasize the important role of exercise in the secondary prevention of CHD, help patients establish exercise beliefs, reduce fatigue and kinesiophobia, and increase their enthusiasm for exercise rehabilitation.

5. Limitations

The study used convenience sampling, the sample size was small, and the representativeness of the sample was limited, which could not better represent the overall level. Moreover, this study was a multicenter cross-sectional study at a single time point, and it could not longitudinally track the relationship between the changes in each variable over time. Moreover, considering fatigue as a partial mediator, future research can employ multicenter stratified sampling with a large sample size to investigate the impact of other variables.

6. Conclusion

This multicenter cross-sectional study explored the relationships among KAP of rehabilitation, fatigue, and kinesiophobia. The results of this study confirmed that KAP of rehabilitation partially mediated the relationship between fatigue and kinesiophobia in patients with CHD. These findings provide a reference for the development of effective intervention measures for kinesiophobia. Medical staff should pay attention to patients' disease-related knowledge support and improve patients' KAP toward rehabilitation to reduce patients' fatigue and kinesiophobia.

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Disclosure statement

The authors declare no conflict of interest.

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