Journal of
Physical and Rehabilitation Medicine

J Phys Rehabil Med. 2026;4(1):01-11.
doi.org/10.1007/jprm.2026002

Research Article

The Chain Mediating Role of Patient Activation and Self-Efficacy in the Relationship Between Pain Intensity and Exercise Adherence Among Military Personnel with Meniscus Injury

Qianqian Wang[1,2], Qiaoli Zhao[2], Shaoyun Hong[2], Chao Zhang[2] and Yan Hua[1*]

[1]Department of Nursing, Air Force Medical University, Xi'an, Shaanxi Province, China.

[2]The 32268 Unit of the People's Liberation Army of China, Dali, Yunnan Province, China

Correspondence to: Yan Hua, Department of Nursing, Air Force Medical University, Xi'an, Shaanxi Province, China. E-mail: huayan1112@126.com

Received: May 10, 2026; **Accepted**: July 09, 2026

Citation: Wang Q, Zhao Q, Hong S, Zhang C, Hua Y. The Chain Mediating Role of Patient Activation and Self-Efficacy in the Relationship Between Pain Intensity and Exercise Adherence Among Military Personnel with Meniscus Injury. J Phys Rehabil Med. 2026;4(1):01-11.

ABSTRACT

Objective: To analyze the chain mediating role of patient activation and self-efficacy in the relationship between pain intensity and exercise adherence among military personnel with meniscus injury, thereby providing a theoretical basis for developing targeted rehabilitation programs for this population.

Methods: A convenience sample of 330 military personnel with meniscus injury was recruited from an army unit from September to December 2025. Data were collected using a general information questionnaire, the Exercise Adherence Rating Scale (EARS), the Exercise Self-Efficacy Scale, the Patient Activation Measure (PAM-13), and the Visual Analog Scale (VAS). Correlation analyses and chain mediation analyses were conducted.

Results: The exercise adherence of the study subjects was at a moderate level. Pain intensity was significantly negatively correlated with patient activation, self-efficacy, and exercise adherence (all $P < 0.001$). Patient activation was significantly positively correlated with self-efficacy and exercise adherence (all $P < 0.001$). The total indirect effect of patient activation and self-efficacy accounted for 46% of the total effect.

Conclusion: Exercise adherence among military personnel with meniscus injury requires improvement. Pain indirectly influences exercise adherence through the multiple mediating effects of patient activation and self-efficacy.

Keywords: Meniscus Injury; Exercise Adherence; Patient Activation; Self-Efficacy; Pain Intensity; Military Personnel.

INTRUDUCTION

Meniscus injury refers to structural damage or dysfunction of the meniscus caused by external forces or long-term wear and tear, which commonly affects military personnel, athletes and the elderly. Its main clinical manifestations include knee joint pain, swelling and limited movement, and severe cases may even lead to joint dysfunction or permanent disability [1-3]. With the in-depth advancement of the combat-oriented training concept, military training in the armed forces is increasingly featured by high intensity, high difficulty and prolonged duration. Military personnel are often required to perform high-speed, high-load lower limb movements under dynamic balance conditions or conduct sustained long-hour operations, which subject the knee joints to repeated loading and longitudinal impacts, thereby rendering them highly susceptible to meniscus injuries. Studies have demonstrated that the incidence of meniscus injuries in the military population is significantly higher than that in the general population, making it one of the common causes for military personnel to be disabled and discharged from military service [4-8]. Such injuries not only severely impair military personnel's daily training and combat mission execution, but also easily result in non-combat attrition of troops, thereby undermining the overall combat effectiveness. Rehabilitation exercises are an important approach to promote the recovery of meniscus injuries, which can effectively relieve pain, improve knee joint function and enhance muscle strength, thereby accelerating the rehabilitation process [9-11]. Exercise adherence refers to the degree to which patients follow the guidance and suggestions of medical staff and persist in participating in rehabilitation exercises, and it is a key process indicator for evaluating rehabilitation effects [12]. However, both clinical practice and previous studies have shown that exercise adherence is generally low among patients with meniscus injuries, and insufficient adherence may prolong the treatment cycle and reduce the overall rehabilitation effect [12, 13]. Therefore, exploring the influencing factors and their internal mechanisms of exercise adherence in patients with meniscus injuries in depth is of great practical and theoretical importance.

The relationship between pain and exercise Adherence

Pain refers to an unpleasant sensory and emotional experience associated with actual or potential tissue damage [14]. In patients with meniscus injuries, pain is the most common clinical symptom, which often worsens during activity and is generally recognized as one of the main barriers preventing patients from adhering to rehabilitation programs [15]. Studies have shown that patients often interrupt exercises due to pain or increased pain, and pain relief is a key factor in improving exercise adherence [16]. Based on this, this study proposes Hypothesis H1: Pain intensity is negatively correlated with exercise adherence.

The mediating role of patient activation

Patient activation refers to the level of knowledge, skills, and confidence that patients possess to maintain their own health, which is specifically reflected in their understanding of health conditions, degree of active participation in treatment decisions, and ability to implement self-management behaviour's [17,18]. In pain management, a bidirectional interaction exists among patients' cognition, emotions, and pain experience: cognitive and emotional factors can modulate an individual's perception of pain, while chronic pain may in turn trigger or exacerbate negative emotions [19]. These dynamics may further diminish patient's initiative and engagement in treatment. Studies have demonstrated that improving patient activation contributes to alleviating pain levels in patients with osteoarthritis [20], and pain intensity is negatively correlated with patient activation. Furthermore, patient activation positively predicts exercise adherence; patients with higher activation are more likely to persist in rehabilitation exercises [21]. Based on this, this study proposes Hypothesis H2: Patient activation plays a mediating role between pain intensity and exercise adherence.

The mediating role of self-efficacy

Self-efficacy, introduced by psychologist Bandura within the social cognitive theory, refers to an individual's belief and confidence in their ability to execute and persist in a specific course of action [22]. In the field of health behaviors, self-efficacy is frequently regarded as a key psychological factor influencing an individual's adoption and maintenance of health behaviors (such as regular exercise and adherence to doctor-advised rehabilitation) [23-26]. Studies have shown that pain intensity is negatively correlated with self-efficacy, and high-intensity pain often impairs patient's confidence in completing rehabilitation exercise [27,28]. In the context of rehabilitation exercises, self-efficacy is positively correlated with rehabilitation exercise adherence; patients with high self-efficacy typically exhibit greater psychological resilience and hold higher confidence in physical function recovery, which helps sustain exercise motivation, facilitate the completion of rehabilitation programs, and thereby improve exercise adherence [29,30]. Based on this, this study proposes Hypothesis H3: Self-efficacy plays a mediating role between patient activation and exercise adherence.

The chain mediating role of patient activation and self-efficacy

Studies have shown that there is a significant positive correlation between patient activation and self-efficacy. Patients with higher self-efficacy levels hold stronger confidence in disease rehabilitation, are more proactive in acquiring disease-related knowledge and self-management skills and can consciously and persistently practice good self-management behaviors [31]. Based on the social cognitive theory, an individual's psychological cognitive process plays a key mediating role between the environment and behavior [32]. Pain may first weaken patient activation, then reduce their confidence in their ability to perform rehabilitation behaviors, impair self-efficacy—and finally exert a negative impact on rehabilitation exercise adherence. Studies have confirmed that self-efficacy beliefs can partially mediate the relationship between pain intensity and pain interference, indicating that a higher level of self-efficacy helps alleviate the negative impact of pain on functional activities [32]. Based on this, this study proposes Hypothesis H4: Patient activation and self-efficacy play a chain mediating role between pain intensity and exercise adherence.

Due to their distinct organizational culture, stringent disciplinary requirements, and unique occupational characteristics, the psychological and behavioural mechanisms underlying rehabilitation in military personnel may differ significantly from those observed in the general population. However, relevant research is still lacking at present. Therefore, based on the social cognitive theory and the health behaviour model as the theoretical basis, this study explores the influence mechanism of pain intensity on exercise adherence in military personnel with meniscus injuries, and verifies the chain mediating role of patient activation and self-efficacy.

MATERIALS AND METHODS

Study subjects

This study adopted a convenience sampling method to select military personnel with meniscus injuries from an army unit from September to December 2025. The inclusion criteria were: 1. active-duty military personnel; 2. clear diagnosis of meniscus injury by MRI; 3. injury caused by military training; 4. age ≤ 35 years old; 5. informed consent and voluntary participation in this survey. The exclusion criteria were as follows: 1. questionnaires with missing answers; 2. questionnaires with duplicate IP addresses. Prior to the survey commencement, all investigators received standardized training to ensure they provided participants with explanations using standardized instructions. The questionnaires were developed and converted into QR codes via the Wenjuanxing platform, printed as hard copies, distributed to participants on-site, and completed online by scanning the corresponding QR codes. A total of 330 valid questionnaires were collected in the study. In view of the chain mediating effect analysis between multiple variables in this study, this method usually requires a sample size of at least 100-200 cases [33]. The 330 samples included in this study met this requirement. This study was approved by the Tangdu Hospital, Fourth Military Medical Ethics Committee (approval number K202509-64).

Study instruments

General Information Questionnaire

Disease-related information: Smoking history, meniscus injury grading (the grading standard of meniscus injury is mainly based on MRI results, which is usually divided into Grade 0 to Grade III; the higher the grade, the more severe the injury [34]), and whether they have received guidance on rehabilitation exercises.

Exercise Adherence Rating Scale (EARS)

The Exercise Adherence Rating Scale (EARS), originally developed by Beinart et al. (2016) for patients with chronic low back pain, has been widely used to assess exercise adherence in individuals with chronic conditions [35]. In 2024, a Chinese version of the scale was culturally adapted and validated [36]. The Chinese version of the EARS consists of 16 items divided into two sections: the first section measures exercise adherence (6 items), and the second section assesses factors influencing exercise adherence (10 items). Each item is rated on a 5-point Likert scale, with "completely agree" scored as 0 and "completely disagree" as 4; higher total scores indicate greater exercise adherence. The correlation coefficients between the scores of each item in the exercise adherence section and the total score ranged from 0.833 to 0.908; the item-level content validity index (I-CVI) of the scale was 0.8 to 1.0, and the average scale-level content validity index (S-CVI/Ave) was 0.95. The Cronbach's α coefficient of the exercise adherence measurement section was 0.939, the test-retest reliability was 0.873, and the split-half reliability was 0.937, indicating good reliability and validity. This scale can accurately reflect patients' exercise adherence behaviour's and the relevant reasons for adherence/non-adherence.

Exercise Self-Efficacy Scale

Self-efficacy was evaluated using a scale originally developed by Resnick et al. (2000) [37]. The Cronbach's α coefficient of the original scale was 0.92, and the factor loading of each item was greater than 0.50. This study used the 9-item Chinese version cross-culturally adapted by Lee et al. [38], using a 0–10 scoring scale where higher scores indicate greater confidence in adhering to exercise. This Chinese version of the scale has been applied in various patient populations and has demonstrated good reliability and validity [39-41].

Patient Activation Measure-13 (PAM-13)

The Patient Activation Measure-13 (PAM-13) was originally developed by Hibbard et al. (2005) [42]. This study used the culturally adapted Chinese version, which consists of 13 items rated on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree, 5 = not applicable). Higher scores indicate greater patient activation. The scale demonstrated good reliability and validity [43], with a Cronbach's α coefficient of 0.82 and a content validity index of 0.87.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) was used to assess the degree of knee joint pain in patients. As one of the commonly used scales for evaluating pain intensity in clinical practice [44], the VAS is a ruler approximately 10 cm in length, with 10 scales representing scores from 0 to 10. The scoring criteria were as follows: 0 = no pain; 1-3 = mild pain; 4-6 = moderate pain; 7-9 = severe pain; 10 = intense pain.

Statistical analysis

Data were analyzed using SPSS version 23.0, including common method bias test and correlation analysis. The SPSS plugin Process 4.1 developed by Hayes was used for mediating effect test, with bootstrap resampling (5,000 samples) to estimate the 95% confidence intervals for the significance level of the indirect effect. A p-value of < 0.05 was considered statistically significant.

Findings

Common Method Bias Test

This study collected data using a questionnaire survey, which may have potential common method bias. Therefore, Harman's single-factor test was conducted for analysis. An unrotated principal component analysis was performed on the scale items, and the results showed that the variance explanation rate of the first factor was 35.214%, which was lower than the critical standard of 40%. This indicated that there was no serious common method bias in this study.

Descriptive Statistics and Correlation Analysis of Variables

The results of the general information on the study subjects are shown in Table 1. The results of the correlation analysis between variables are shown in Table 2. The data indicated that the four variables—pain intensity, patient activation, self-efficacy, and exercise adherence—were pairwise correlated ($P < 0.001$).

Mediation effect test

This study established a path model based on the chain mediating effect theory, with pain intensity as the independent variable, patient activation and self-efficacy as the mediating variables, and exercise adherence as the dependent variable (Figure 1). Statistical analysis was performed using the PROCESS macro-Version 4.1 (Model 6) developed by Hayes. Three hierarchical regression analyses were conducted to verify the mechanism among variables, with detailed results presented in Tables 3 and 4.

In Model 1, where patient activation served as the dependent variable, pain intensity (the independent variable) showed a significant predictive effect on patient activation ($\beta = -0.271$, $p < 0.001$). The standardized regression coefficient indicated that pain intensity negatively predicted patient activation.

Regression analysis for Model 2, with self-efficacy as the dependent variable, revealed that pain intensity had a significant negative effect on self-efficacy ($\beta = -0.192$, $p < 0.001$), whereas patient activation exerted a significant positive effect on self-efficacy ($\beta = 0.291$, $p < 0.001$).

Path analysis for Model 3, in which exercise adherence was the dependent variable, showed that after controlling for the mediating variables, pain intensity retained a significant negative predictive effect on exercise adherence ($\beta = -0.145$, $p = 0.006$). Meanwhile, both patient activation and self-efficacy had significant positive effects on exercise adherence ($\beta = 0.253$, $p < 0.001$; $\beta = 0.213$, $p < 0.001$, respectively).

Further bootstrap analysis (with 5,000 re-samples) was conducted to test the significance of the mediating effects, revealing that all three indirect pathways were statistically significant (Table 4). The indirect effect of pain intensity on exercise adherence via patient activation was −0.069 (95% CI [−0.111, −0.031]); via self-efficacy was −0.041 (95% CI [−0.076, −0.015]);

and via the chain mediation of patient activation and self-efficacy was −0.017 (95% CI [−0.032, −0.006]). The total indirect effect was −0.126, accounting for 46% of the total effect, indicating that patient activation and self-efficacy played a chain mediating role in the relationship between pain intensity and exercise adherence. These empirical findings confirm the hypothesized chain mediation mechanism: the independent variable (pain intensity) not only directly inhibits exercise adherence by reducing patient activation but also decreases self-efficacy through the reduction of patient activation, thereby exerting a negative indirect impact on exercise adherence.

Name	Options	Frequency	Percentage(%)
Gender	male	330	100
Age	18-23 years old	146	44.2
	24-29 years old	151	45.8
	30-35 years old	33	10
Educational level	High School	78	23.6
	Junior College	201	60.9
	Bachelor’s degree	51	15.5
Marital status	Unmarried	267	80.9
	Married	63	19.1
Years of working	≤5 years	224	67.9
	6-10 years	68	20.6
	≥11 years	38	11.5
Smoking history	Yes	182	55.2
	No	148	44.9
Degree of meniscus injury	I°	238	72.1
	II°	51	15.4
	III°	41	12.4
Exercise guidance	Yes	285	86.3
	No	45	13.6

Table 1 : General information of the research subjects

Variable	$\bar{x} \pm s$	**Pain intensity**	**Patient Activation**	**Self-Efficacy**	**Exercise adherence**
Pain intensity	2.161±2.110	1			
Patient Activation	42.620±9.584	-0.271***	1		
Self-Efficacy	64.250±22.140	-0.271***	0.343***	1	
Exercise adherence	17.424±4.297	-0.271***	0.366***	0.339***	1

Note: *** represents P<0.001

Table 2 Correlation analysis of the variable

Regression		**Coefficient**			**Fitting index**		
Outcome variable	**Predictor variable**	***β***	***t***	***P***	***R***	***c***	***F***
Patient Activation	Pain intensity	-0.271		<0.001	0.271	0.073	25.961***
Self-Efficacy	Pain intensity	-0.192		<0.001	0.390	0.152	29.367***
	Patient Activation	0.291	5.509	<0.001			
Exercise adherence	Pain intensity	-0.145		0.006	0.452	0.204	27.899***
	Patient Activation	0.253	4.725	<0.001			
	Self-Efficacy	0.213	3.966	<0.001			

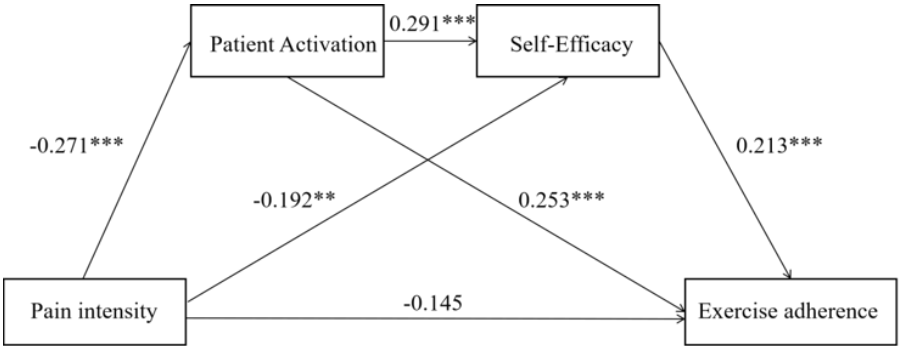
Note: *** represents P<0.001

Table 3 : The regression equation of chain mediation

Path	**Effect**	***SE***	**Relative mediation effect**	**95%CI**
Indirect effect 1	-0.069	0.020	25%	-0.111~-0.031
Indirect effect 2	-0.041	0.016	15%	-0.076~-0.015
Indirect effect 3	-0.017	0.007	6%	-0.032~-0.006
Total indirect effect	-0.126	0.025	46%	-0.179~-0.079
Direct effect	-0.145	0.107	54%	-0.505~-0.086
Total effect	-0.271	0.108	100%	-0.766~-0.340

Note: Ind1: Pain intensity - Patient Activation - Exercise adherence. Ind 2: Pain intensity - Self - Efficacy - Exercise adherence. Ind 3: Pain intensity - Patient Activation- Self-Efficacy - Exercise adherence.

Table 4: Bootstrap analysis of the mediation effect test



Note: *** represents P<0.001

DISCUSSION

Current status of exercise adherence among military personnel with meniscus injury

The results of this study indicated that the exercise adherence score of military personnel with meniscus injury was (17.424 ± 4.297), falling within the moderate range and higher than that reported among cancer patients [36]. This suggests that exercise adherence in this military cohort is relatively favorable, although considerable room for improvement remains in the execution of rehabilitation exercises. The following factors may account for these findings: 1. The dual facilitative and restrictive role of the military environment. Military discipline and a sense of collective honor constitute the basic motivation for rehabilitation; however, the suddenness and high intensity of military tasks often lead to the interruption of rehabilitation training [45], which becomes a significant external barrier. 2. Insufficient knowledge and support. Some personnel lack adequate awareness of rehabilitation importance and specific methods [46]. Additionally, a general shortage of professional rehabilitation instructors at the grassroots level hinders the systematization and scientific implementation of rehabilitation exercises.3. Psychosocial factors. Fear of exacerbated pain or re-injury, along with injury-related negative emotions, may subtly undermine exercise adherence. Accordingly, military health departments are recommended to strengthen professional rehabilitation guidance and psychological support to enhance rehabilitation exercise adherence, thereby promoting functional recovery and safeguarding combat readiness.

The impact of pain intensity on exercise adherence

This study confirms that pain intensity exerts a direct negative effect on exercise adherence, with higher pain intensity associated with poorer exercise adherence. This finding aligns with domestic and international research conclusions on chronic pain and rehabilitation behaviors [16, 47, 48]. As an aversive somatic signal, pain instinctively triggers behavioral avoidance [49]. In rehabilitation, this manifests as military personnel discontinuing or reducing training due to discomfort from intensified pain. Furthermore, per the fear-avoidance model, fear of pain can become a more powerful behavioral inhibitor than pain itself [50]. Military personnel may interrupt rehabilitation exercises for fear of exacerbating pain. Additionally, pain-induced frustration directly undermines recovery confidence. Therefore, pain management is not merely aimed at symptom relief but is a critical component in ensuring successful rehabilitation program implementation. It is recommended that rehabilitation protocols for military personnel with meniscus injury integrate pain physiological assessment and psychological interventions to alleviate pain and reduce pain-related fear, thereby enhancing exercise adherence.

The mediating role of patient activation

The findings of this study indicate that patient activation mediates the relationship between pain intensity and exercise adherence. This aligns with the theoretical framework linking patient activation to chronic disease management in existing literature [51]. Specifically, pain not only undermines adherence behavior directly but also leads to reduced adherence indirectly through the psychological mechanism of diminished patient activation. Patient activation reflects an individual's comprehensive capacity—encompassing knowledge, skills, and confidence—to actively engage in managing their own health [51]. This construct has been widely applied in research on the management of various chronic conditions. The impact of pain on patient activation is mainly reflected in several aspects: First, persistent or severe pain requires individuals to invest substantial cognitive and emotional resources to cope, resulting in significant consumption of psychological energy, which is consistent with the research finding that chronic pain patients have limited cognitive resources [52]. Second, pain is often accompanied by a sense of loss of physical control, making patients feel that the rehabilitation process depends more on the progression of the injury itself rather than personal effort, thereby adopting a more passive and dependent coping attitude. This change in cognitive pattern is closely associated with the formation of pain catastrophizing and fear of movement [53, 54]. When patient activation is reduced due to pain, patients often lack the psychological motivation to overcome difficulties and the intrinsic motivation to integrate rehabilitation activities into daily life. This mechanism explains why simple external supervision or pain reduction strategies often fail to achieve ideal improvements in adherence [52,55]. Therefore, intervention strategies to improve exercise adherence should focus on effectively stimulating and maintaining patient activation even in the presence of pain. This includes enhancing their recognition of the value of rehabilitation through health education, strengthening their sense of participation through goal setting, and reinforcing their role in autonomous decision-making through empowering communication.

The mediating role of self-efficacy

This study confirmed the mediating role of self-efficacy in the relationship between pain intensity and exercise adherence, consistent with existing research indicating that pain experiences significantly undermine individual’s confidence in successfully completing rehabilitation tasks, and insufficient self-efficacy directly reduces adherence to rehabilitation behaviors [32,56]. Drawing upon Bandura's social cognitive theory, self-efficacy serves as a core cognitive factor influencing behavioral choice, effort expenditure, and persistence, playing a pivotal role in the rehabilitation process [32]. The emergence or intensification of pain symptoms during exercise diminishes individuals' sense of efficacy; moreover, based on prior pain experiences, patients may anticipate pain recurrence, further eroding their confidence in coping with rehabilitation challenges [57]. Studies have confirmed that patients with low self-efficacy are prone to negative responses such as catastrophizing thinking, emotional anxiety, and behavioral avoidance when facing rehabilitation exercises [56,58]. Such patients often give up efforts prematurely at the onset of mild discomfort or are unwilling to attempt necessary but challenging rehabilitation training. Improvements in self-efficacy are significantly associated with functional recovery, and self-efficacy plays an important role in the rehabilitation of patients with chronic pain. Therefore, rehabilitation interventions should include self-efficacy cultivation, including approaches such as setting progressive goals, providing successful experiences, vicarious learning, social persuasion, and regulation of physiological and emotional states. The provision of targeted psychological interventions not only enhances adherence to rehabilitation exercises but also contributes to optimizing overall rehabilitation outcomes, thereby establishing a psychological foundation for patients' functional recovery.

The chain mediating role of patient activation and self-efficacy

This study identified that patient activation and self-efficacy not only serve as independent mediators but also form a significant chain mediation pathway: pain intensity → patient activation → self-efficacy → exercise adherence. As an initial stressor, pain first diminishes patient activation, manifested as reduced engagement motivation and heightened negative emotions. When patients are in a state of low activation, their cognitive appraisal systems tend to overestimate the difficulty and risks associated with tasks, thereby undermining self-efficacy. In the field of pain management, studies have shown that pain catastrophizing affects physical activity participation through the chain mediation of fear of movement and self-efficacy [59]. The impact of pain on activity limitation in patients with hip osteoarthritis is also achieved through the full mediation of self-efficacy [60]. For military personnel with meniscus injury, the particularity of the military environment requires that rehabilitation interventions must take into account the characteristics of their psychological resilience. Effective self-management behaviors can improve disease control, while high disease activity may reduce self-efficacy in chronic disease management, forming a vicious cycle. Therefore, it is crucial to break this negative cycle and establish a positive feedback mechanism [61]. Studies have shown that patient groups with higher activation perform better in exercise rehabilitation adherence [61]. Therefore, rehabilitation interventions should first activate patient activation through pain management, empathetic communication, and goal-oriented education; then construct self-efficacy using immediate feedback and peer modeling and finally integrate the military rehabilitation management system, establish a long-term follow-up mechanism, cultivate patient's self-regulation abilities, and achieve sustainable improvement in rehabilitation adherence. .

CONCLUSION

The exercise adherence of military personnel with meniscus injury was found to be at a moderate level. Patient activation and self-efficacy exerted a chain mediating effect in the pathway through which pain intensity influences exercise adherence, indicating that pain first diminishes patient's engagement motivation, subsequently undermines their sense of self-efficacy, and ultimately leads to reduced adherence. Therefore, clinical rehabilitation should integrate pain management, activation enhancement, and self-efficacy cultivation into a systematic rehabilitation promotion strategy, thereby effectively improving both the level of exercise adherence and the overall quality of rehabilitation in this population. This study has the following limitations: 1. This study is a single-center study, which has certain limitations; 2. All subjects are male, lacking research on female military personnel; 3. in terms of research variables, this study focuses on psychology-related factors and fails to cover all potential important influencing factors; 4. the change trajectory of military personnel's exercise adherence was not observed.

Authors' contributions

Conceived and designed the research: Yan Hua; Wrote the paper: Qianqian Wang; Data collection: Qianqian Wang, Qiaoli Zhao, Shaoyun Hong, Chao Zhang; Analyze date: Qianqian Wang, Qiaoli Zhao, Shaoyun Hong, Chao Zhang; Revised the pape:Yan Hua, Qianqian Wang, Qiaoli Zhao, Shaoyun Hong, Chao Zhang. All authors reviewed the manuscript.

REFERENCES

1. Abram SGF, Beard DJ, Price AJ. BASK Meniscal Working Group. National consensus on the definition, investigation, and classification of meniscal lesions of the knee. Knee. 2018; 25(5):834-840.
2. Gee SM, Posner M. Meniscus Anatomy and Basic Science. Sports Med Arthrosc Rev. 2021; 29(3):e18-e23.
3. Adams BG, Houston MN, Cameron KL. The Epidemiology of Meniscus Injury. Sports Med Arthrosc Rev.2021; 29(3):e24-e33.
4. Donohue MA, Zhou L, Haley CA. Meniscus Injuries in the Military Athlete. J Knee Surg. 2019; 32(2):123-126.
5. YANG Sen, XIA Lei, Zhenzhen MA, et al. A retrospective analysis in military training injuries in recent 5 years in a group army. Acad J Chin PLA Med Sch. 2021; 42(10):1030-1034.
6. Galvin JW, Dukes CA, Grassbaugh JA, et al. Return to Duty Rates Following Meniscal Repair Surgery in an Active Duty Military Population. Mil Med. 2016; 181(11):e1661-e1665.
7. Adams BG, Taylor KM, Cameron KL, et al. Predicting Postoperative Injury and Military Discharge Status After Knee Surgery in the US Army. Am J Sports Med. 2023 Sep; 51(11):2945-2953.
8. Ximei J, Xingzhu W, Dengzhi M, et al. Analysis of the Situation of Disabled Personnel in a Certain Naval Vessel Unit from 2015 to 2021. Journal of Navy Medicine. 2024; 45(4):436-439.
9. Mao S, Xiao K, Xu H, et al. Clinical Outcomes of Exercise Rehabilitation for Degenerative Tibial Meniscal Tears: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Pain Res. 2024 24; 17: 3431-3448.
10. Cavanaugh JT. Rehabilitation of meniscal injury and surgery. J Knee Surg. 2014; 27(6): 459-478.
11. Argent R, Daly A, Caulfield B. Patient Involvement with Home-Based Exercise Programs: Can Connected Health Interventions Influence Adherence? JMIR Mhealth Uhealth. 2018; 6(3):e47.
12. Tuakli-Wosornu YA, Selzer F, Losina E, Katz JN. Predictors of Exercise Adherence in Patients With Meniscal Tear and Osteoarthritis. Arch Phys Med Rehabil. 2016 97 (11):1945-1952.
13. Merskey H, Bogduk N. Classification of Chronic Pain: Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms, 2nd Edition. Seattle, Washington: International Association for the Study of Pain (IASP) Press; 1994.
14. de Amorim H, de Noronha M, Hunter J, Barrett S, Kingsley M. Barriers and facilitators to exercise-based rehabilitation in people with musculoskeletal conditions: A systematic review. Musculoskelet Sci Pract. 2025; 77: 103279.
15. Gilanyi YL, Shah B, Cashin AG, Gibbs MT, Bellamy J, Day R, et al. Barriers and enablers to exercise adherence in people with nonspecific chronic low back pain: a systematic review of qualitative evidence. Pain. 2024; 165(10): 2200-2214.
16. Hibbard JH, Stockard J, Mahoney ER, Tusler M. Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. Health Serv Res. 2004; 39(4 Pt 1):1005-1026.
17. MaRui, WangJunxia, Zhang Ruixing, et al. Concept analysis of patient activation. Journal of Nursing Science. 2024; 39(16):77-82.
18. Crofford LJ. Chronic Pain: Where the Body Meets the Brain. Trans Am Clin Climatol Assoc. 2015; 126:167-183.
19. Ahn YH, Ham OK. Evaluation of the Interaction Model of Client Health Behavior-based multifaceted intervention on patient activation and osteoarthritis symptoms. Jpn J Nurs Sci. 2020; 17(2):e12306.
20. Shuang F, Zhen L, Yixin W, et al. The chain mediating effect of behavioral decision-making and positivity degree between the perception of recurrence risk and the compliance behaviour of rehabilitation exercise in young and middle-aged patients with first-onset ischemic stroke. Nurse Continuing Education Journal. 2025; 40(13):1361-1367.
21. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977; 84(2):191-215.
22. Huang J, Ding S, Xiong S, et al. Medication Adherence and Associated Factors in Patients with Type 2 Diabetes: A Structural Equation Model. Front Public Health. 2021;9: 730845.
23. Zhang Q, Huang F, Zhang L, et al. The effect of high blood pressure-health literacy, self-management behavior, self-efficacy and social support on the health-related quality of life of Kazakh hypertension patients in a low-income rural area of China: a structural equation model. BMC Public Health. 2021;21(1):1114.
24. Salarvand S, Ghazvineh S, Mousivand F, et al. Health literacy and its related factors as predictors for the breastfeeding self-efficacy in a western province in Iran. BMC Public Health. 2023;23(1):593.
25. Salmanpour N, Salehi A, Nemati S, et al. The effect of self-care, self-efficacy, and health literacy on health-related quality of life in patients with hypertension: a cross-sectional study. BMC Public Health. 2025; 25(1):2630.
26. Jackson T, Wang Y, Wang Y, et al. Self-efficacy and chronic pain outcomes: a meta-analytic review. J Pain. 2014; 15(8):800-814.
27. Martinez-Calderon J PT, MSc, Meeus M PT, et al. The role of

self-efficacy in pain intensity, function, psychological factors, health behaviors, and quality of life in people with rheumatoid arthritis: A systematic review. Physiother Theory Pract. 2020;36(1):21-37.

28. Min M, Fanfan W, Shasha W. Analysis of the Chain Mediating Effect of Kinesiophobia and Rehabilitation Self-efficacy Between Pain Catastrophizing and Exercise Compliance in Patients Undergoing Total Knee Arthroplasty. Shanghai Nursing. 2025; 25(6):43-48.
29. Martinez-Calderon J, Zamora-Campos C, Navarro-Ledesma S, et al The Role of Self-Efficacy on the Prognosis of Chronic Musculoskeletal Pain: A Systematic Review. J Pain. 2018; 19(1):10-34.
30. Masterson Creber R, Chen T, Wei C, et al. Brief Report: Patient Activation Among Urban Hospitalized Patients With Heart Failure. J Card Fail. 2017; 23(11):817-820.
31. Pedrero-Martin Y, Falla D, Martinez-Calderon J, et al. Self-efficacy beliefs mediate the association between pain intensity and pain interference in acute/subacute whiplash-associated disorders. Eur Spine J. 2021; 30(6):1689-1698.
32. MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. Annu Rev Psychol. 2007; 58: 593-614.
33. Stoller DW, Martin C, Crues JV 3rd, et al. Meniscal tears: pathologic correlation with MR imaging. Radiology. 1987; 163(3):731-735.
34. Newman-Beinart NA, Norton S, Dowling D, et al. The development and initial psychometric evaluation of a measure assessing adherence to prescribed exercise: the Exercise Adherence Rating Scale (EARS). Physiotherapy. 2017;103(2):180-185.
35. Yuxuan W, Xinyuan Y, Xinchu L, et al. Translation of the Exercise Adherence Rating Scale and its reliability and validity test in cancer patients. Chinese Nursing Research. 2024; 38(21):3799-3805.
36. Resnick B, Jenkins LS. Testing the reliability and validity of the Self-Efficacy for Exercise scale. Nurs Res. 2000; 49(3):154-159.
37. Lee LL, Perng SJ, Ho CC, et al. A preliminary reliability and validity study of the Chinese version of the self-efficacy for exercise scale for older adults. Int J Nurs Stud. 2009;46(2):230-238.
38. Naixin K, Ruiqin Z, Yanyan L, et al. Impact of perceived social support, exercise self-efficacy, and depression on the benefit finding of breast cancer patient in convalescence. China Journal of Health Psychology. 2019; 27(11):1714-1717.
39. Zhiying Z, Cuiping C, Yanyan L, et al. The exercise self-efficacy scale was used to verify its reliability and validity in stoke patients. Nurse Education in Practice. 2016; 31(9):836-838.
40. Tianxi Y, Guozhen S, Min G, et al. Mediation effect of self-efficacy for exercise on the relationship between kinesiophobia and exercise rehabilitation adherence in patients with heart failure. Modern Preventive Medicine.2022; 49(22): 4163-4168.
41. Hibbard JH, Mahoney ER, Stockard J, et al. Development and testing of a short form of the patient activation measure. Health Serv Res. 2005; 40(6 Pt 1):1918-1930.
42. Shiqiao C, Peixia C, Zhenxiang L, et al. Reliability and validity analysis for the Chinese version of patient activation measure for patients with chronic heart failure. Nurse Education in Practice. 2020; 35(3):198-203.
43. Thong, Ivan S. K., Jensen, et al. The validity of pain intensity measures: what do the NRS, VAS, VRS, and FPS-R measure? Scandinavian Journal of Pain. 2018; 18(1): 99-107.
44. Zhi W, Bing W, Zhengqiang L. Investigation and preventive measures of meniscus injury in a border troops. J Trauma Surg. 2022; 24(7):490-493.
45. Lihua Z, Gege H, Ning X, et al. Qualitative Study on the Cognition and Demand of Meniscus Injury of Soldiers. Mil Med J S Chin. 2020; 34(3):196-198.
46. Petrosyan H, Leonardi C, Thakral A, et al. Barriers and factors associated with adherence to a home exercise program of adults with musculoskeletal pain. J Back Musculoskelet Rehabil. 2024; 37(2):473-485.
47. Himler P, Lee GT, Rhon DI, Young JL, et al. Understanding barriers to adherence to home exercise programs in patients with musculoskeletal neck pain. Musculoskelet Sci Pract. 2023; 63:102722.
48. Meulders A. Fear in the context of pain: Lessons learned from 100 years of fear conditioning research. Behav Res Ther. 2020; 131: 103635.
49. Vlaeyen JWS, Linton SJ. Fear-avoidance model of chronic musculoskeletal pain: 12 years on. Pain. 2012; 153(6):1144-1147.
50. Michelle P S, Marianne S M, Crystal L S, et al. The Role of Patient Activation in Psychiatric Visits. Psychiatric Services. 2009; 60(11): 1535-1539.
51. Evy D, Jessica V O, Barbara C, et al. Predicting Treatment Adherence and Outcome to Outpatient Multimodal Rehabilitation in Chronic Low Back Pain. Journal of Back and Musculoskeletal Rehabilitation. 2020; 33(2): 277-293.
52. Pablo V, Jesus A, Dara M V, et al. The Importance of Mind-Body in Pilates Method in Patients with Chronic Non-Specific Low Back Pain-A Randomized Controlled Trial. Journal of clinical medicine. 2024; 13(16):4731-4731.
53. Varallo G, Cattivelli R, Giusti EM, et al. The efficacy of a brief

acceptance-based group intervention in a sample of female patients with fibromyalgia and comorbid obesity: a randomised controlled trial. Clin Exp Rheumatol. 2023;41(6):1332-1341.

54. Lenoir Dit Caron R, Rouzée M, Coquart J, et al. Compliance with a personalised home exercise programme in chronic low back pain patients after a multidisciplinary programme: A pilot randomised controlled trial. Front Rehabil Sci. 2022 17; 3:1050157.
55. Thompson DP, Antcliff D, Woby SR. The role of self-efficacy and catastrophizing in explaining improvements in disability, pain and fatigue among patients with chronic widespread pain treated with physiotherapy: an exploratory analysis. Physiotherapy. 2022; 114: 96-102.
56. Varkey E, Dahlbäck A, Thulin M, et al. Physical activity, self-efficacy and quality of life in patients with chronic pain, assessed during and 1 year after physiotherapy rehabilitation-a prospective follow-up study. Disabil Rehabil. 2022; 44(22):6730-6737.
57. Chester R, Khondoker M, Shepstone L, Lewis JS, Jerosch-Herold C. Self-efficacy and risk of persistent shoulder pain: results of a Classification and Regression Tree (CART) analysis. Br J Sports Med. 2019; 53(13):825-834.
58. Zhang W, Zhu T, Wang S, et al. Chain-mediating effects of kinesiophobia and self-efficacy on pain catastrophizing and physical activity in haemophilia patients. Haemophilia. 2024; 30(3):809-816.
59. Bieler T, Anderson T, Beyer N, et al. The Impact of Self-Efficacy on Activity Limitations in Patients with Hip Osteoarthritis: Results from a Cross-Sectional Study. ACR Open Rheumatol. 2020; 2(12):741-749.
60. Zhu Y, Liu K, Jiang J, et al. Structural equation modelling of the impact of disease activity on inflammatory bowel disease control: the mediating roles of self-efficacy and self-management behaviors. BMC Gastroenterol. 2025; 25(1):30.
61. Jie W, Guozhen S, Zhipeng B, et al. Development Trajectory and Predictors of Strength-duration Adherence to Home-based Exercise Rehabilitation among Patients with Atrial Fibrillation after Radiofrequency Catheter Ablation□a Longitudinal Study. Chinese General Practice. 2024; 27(2):168-176.