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EXPLORING FACTORS ASSOCIATED WITH ADHERENCE TO WEIGHT-BEARING EXERCISE AMONG POSTOPERATIVE LOWER LIMB FRACTURE PATIENTS

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ABSTRACT

Lower limb fractures can significantly impair mobility and quality of life. Weight-bearing exercise is a key component of postoperative rehabilitation; however, patient adherence remains a challenge. **Objective:** This study aimed to explore factors associated with adherence to weight-bearing exercise among postoperative lower limb fracture patients. **Methods**: A cross-sectional study was conducted at a type-B public referral hospital in West Java, Indonesia, from November 2025 to March 2026, involving 70 respondents selected through purposive sampling. Data were collected using a structured questionnaire and analyzed using the chi-square test. **Results:** Most respondents were adherent (81.43%). Adherence was significantly associated with knowledge ($p=0.024$), self-efficacy ($p=0.006$), social support ($p<0.001$), pain-related barriers ($p=0.006$), accessibility ($p=0.002$), and fracture location ($p=0.024$). Sociodemographic factors were not significantly associated ($p>0.05$). **Discussion**: These findings suggest that psychological, social, and accessibility-related factors play a more dominant role than demographic characteristics. Social support and self-efficacy enhance adherence, while pain and limited access act as key barriers. **Conclusion**: Adherence to weight-bearing exercise is influenced by modifiable factors. Interventions focusing on patient education, self-efficacy enhancement, social support, pain management, and improved access to healthcare services are essential to optimize rehabilitation outcomes.

Keywords: adherence, lower limb fracture, rehabilitation, weight-bearing exercise

INTRODUCTION

Lower limb fractures are among the most common musculoskeletal injuries and can significantly impair mobility, functional independence, and quality of life (Abraham, Kumar, & Vedavyasa Acharaya, 2025). In Indonesia, the prevalence of lower extremity fractures is relatively high, particularly due to traffic accidents and trauma, highlighting the importance of effective postoperative management and rehabilitation (Boangmanalu, Masfuri, & Arista, 2023).

Postoperative rehabilitation plays a crucial role in restoring function, with weight-bearing exercise being a key component. Appropriate mechanical loading can promote bone healing, maintain muscle strength, and prevent joint stiffness (Abdalbary, 2018; Liu *et al*., 2026). Conversely, prolonged immobilization or delayed weight-bearing may lead to muscle atrophy, joint rigidity, and delayed functional recovery (Boangmanalu, Masfuri, & Arista, 2023; Wardojo, Djuliana, & Rosadi, 2022). Recent evidence supports

the implementation of early or progressive weight-bearing, allowing patients to mobilize earlier and return to daily activities more quickly without increasing complication rates (Wardojo, Djuliana, & Rosadi, 2022).

Despite these benefits, adherence to prescribed weight-bearing exercise remains a major challenge. Studies have consistently shown that patients often fail to follow weight-bearing instructions accurately, even after receiving education from healthcare providers (Eickhoff *et al*., 2022; Lajevardi-Khosh *et al*., 2019). Inadequate understanding of postoperative instructions further contributes to this issue, with a considerable proportion of patients unable to correctly identify their prescribed weight-bearing status (Abraham, Kumar, & Vedavyasa Acharya, 2025).

Adherence to rehabilitation is influen-ced by multiple interrelated factors. Clinical factors such as pain and physical limitations may reduce patients' ability to perform weight-bearing activities (Seo *et al*., 2020). Psychological factors, including self-efficacy, as well as social support, have also been shown to play an important role in promoting adherence (Liu *et al.,* 2026). In addition, socioeconomic status, accessibility to healthcare services, and other contextual barriers may further affect patients' participation in rehabilitation programs (Abraham, Kumar, & Vedavyasa Acharya, 2025; Adhikari, Neupane, & Srestha, 2025).

Although previous studies have identified individual factors associated with rehabilitation adherence, most have examined these variables separately. Evidence integrating clinical, psychological, social, and accessibility-related factors in a compre-hensive model remains limited, particularly in the Indonesian context.

A type-B public referral hospital in West Java, Indonesia was selected because the hospital provides orthopedic surgery, inpatient care, and rehabilitation services for patients with lower limb fractures. Preliminary observations and discussions with clinical staff indicated that adherence to prescribed weight-bearing exercise varies among postoperative patients, particularly during the transition from hospital care to home-based recovery. This issue is clinically relevant because suboptimal adherence may delay functional recovery and increase the need for prolonged rehabilitation support. Therefore, this study was conducted to identify factors associated with weight-bearing exercise adherence and to provide context-specific evidence to improve postoperative education, discharge planning, and rehabilitation coordination.

This study aimed to explore factors associated with adherence to weight-bearing exercise among postoperative patient's lower limb fractures using a multifactorial approach, focusing on knowledge, self-efficacy, social support, pain-related barriers, economic factors, and accessibility.

METHOD

This study employed a cross-sectional design to analyze factors associated with adherence to weight-bearing exercise among postoperative lower limb fracture patients. The study was conducted at a type-B public referral hospital in West Java, Indonesia, from November 2025 to March 2026.

The study population consisted of patients who had undergone surgery for lower limb fractures and were receiving postoperative care at a type-B public referral hospital in West Java, Indonesia. The minimum sample size was estimated using G*Power version 3.1.9.7 for a chi-square test of association between categorical variables. The calculation was based on a significance level of 0.05, statistical power of 80%, degree of freedom of 1, and a moderate-to-large effect size (w = 0.35). The analysis indicated that a minimum of 65 respondents

was required. In this study, 70 respondents were recruited and included in the final analysis. Although this number exceeded the minimum requirement, all eligible respondents available during the data collection period were included to improve the precision of estimates, reduce sampling error, and strengthen the stability of the bivariate analysis. A purposive sampling technique was used to recruit participants who met the inclusion criteria.

The sample included patients who met the inclusion criteria and agreed to participate in the study. The inclusion criteria were: (1) patients aged ≥18 years; (2) patients who had undergone surgery for lower limb fractures (e.g., femur, tibia, fibula, or ankle); (3) patients in the postoperative phase who had received instructions to perform weight-bearing exercise; (4) patients who were able to communicate effectively; and (5) patients who provided informed consent. The exclusion criteria were: (1) patients with cognitive impairment or communication difficulties; (2) patients with unstable medical conditions or postoperative complications limiting mobilization; (3) patients with multiple trauma or other mobility-limiting conditions unrelated to the fracture.

The dependent variable was adherence to weight-bearing exercise, while the independent variables included knowledge, self-efficacy, social support, pain-related barriers, economic factors, and accessibility. The instruments used in this study consisted of three parts: (1) a sociodemographic and clinical characteristics form, (2) a self-reported adherence item, and (3) a researcher-developed questionnaire assessing factors associated with adherence to weight-bearing exercise.

The sociodemographic and clinical characteristics form consisted of six items, including age, gender, education level, occupation, income, and fracture location. Age was recorded in years and presented as mean and standard deviation. Gender was categorized as male and female. Education level was categorized as low and high. Occupation was categorized as employed and not employed. Income was categorized into three groups based on the regional minimum wage and common income classification used in the local setting: IDR <2 million, IDR 2–5 million, and IDR >5 million. This categorization was applied to describe the respondents' economic characteristics more clearly and to distinguish between lower, middle, and higher income groups. Fracture location was categorized as proximal and distal.

Adherence to weight-bearing exercise was assessed using one self-reported item measuring the frequency of performing the prescribed weight-bearing exercise. The adherence item was developed by the researchers based on prescribed postoperative weight-bearing exercise instructions commonly provided to patients and previous literature on rehabilitation adherence and weight-bearing compliance (Eickhoff *et al.,* 2022; Lajeverdi-Khosh *et al.,* 2019; Seo *et al.,* 2020). The response options were "always" (100%), "often" (75%), "sometimes" (50%), and "rarely/never" (<25%). For analysis, adherence was categorized into two groups: adherent and non-adherent. Respondents who answered "always" or "often" were categorized as adherent, indicating that they performed the prescribed exercise at least 75% of the recommended frequency. Respondents who answered "sometimes" or "rarely/never" were categorized as non-adherent, indicating that they performed the exercise less than 75% of the recommended frequency.

The 75% cut-off was used as an operational threshold because it represents patients who performed the prescribed exercise frequently and consistently, although not necessarily perfectly. In this study, respondents

who performed at least three-fourths of the recommended exercise frequency were considered to have adequate adherence for postoperative rehabilitation. This categorization was intended to distinguish patients with relatively consistent exercise behavior from those with irregular or minimal adherence.

The researcher-developed questionnaire assessing factors associated with adherence consisted of 15 items covering six domains: knowledge, self-efficacy, social support, pain-related barriers, economic factors, and accessibility. Knowledge consisted of three items, self-efficacy consisted of two items, social support consisted of two items, economic factors consisted of three items, accessibility consisted of four items, and pain-related barriers consisted of one item. The questionnaire was developed by the researchers based on a review of relevant literature on postoperative rehabilitation adherence, weight-bearing compliance, self-efficacy, social support, pain-related barriers, economic factors, and healthcare accessibility (Abraham, Kumar, & Vedavyasa Acharya, 2025; Adhikari, Neupane, & Shrestha, 2025; Eickhoff *et al.,* 2022; Lajevardi-Khosh *et al*., 2019; Seo *et al*., 2020).

The questionnaire development process followed general principles of questionnaire construction, including identifying relevant domains, generating items based on literature and clinical context, reviewing item clarity and relevance, and testing the instrument before use in the main study (Artino *et al.,* 2014; Boateng *et al*., 2018). The items were answered using a four-point Likert scale ranging from 1 = strongly disagree to 4 = strongly agree. Negatively worded items were reverse-coded before analysis so that higher scores consistently indicated a more favorable condition toward adherence, except for the pain-related barrier item, where a higher score indicated a greater perceived barrier.

Composite scores for knowledge, self-efficacy, social support, economic factors, and accessibility were calculated by summing the item scores within each domain. Since no established clinical cut-off points were available for this researcher-developed questionnaire, the median value was used as the cut-off point for categorization. The median was selected because the domain scores were derived from Likert-scale responses and were not assumed to be normally distributed. Knowledge were categorized as poor and good based on a median score of 9. Self-efficacy was categorized as low and high based on a median score of 6. Social support was categorized as poor and good based on a median score of 7. Economic status were categorized as poor and good based on a median score of 9. Accessibility was categorized as poor and good based on a median score of 12. Pain-related barriers were categorized as low and high based on a median score of 3. Scores equal to or above the median were categorized as good or high, whereas scores below the median were categorized as poor or low. For pain-related barriers, scores equal to or above the median indicated high barriers, while scores below the median indicated low barriers.

Before data collection, the instruments were reviewed by the research team to ensure that the items were relevant to the postoperative lower limb fracture context, understandable for respondents, and consistent with the study objectives. The instruments were then tested for validity and reliability among 20 respondents with characteristics similar to those of the study participants. The adherence measure consisted of a single self-reported item; therefore, internal consistency reliability using was not applicable. Its validity was assessed through item review to ensure relevance, clarity, and consistency with prescribed postoperative weight-bearing exercise instructions.

The researcher-developed questionnaire assessing knowledge, self-efficacy, social

support, economic status, accessibility, and pain-related barriers was tested using item-total correlation and internal consistency reliability. The validity test showed that all items were valid, with correlation coefficient values greater than 0.444. The reliability test demonstrated acceptable internal consistency, with a value of 0.78 for the overall multi-item questionnaire. These results indicated that the questionnaire was valid and reliable for use in this study. However, because the questionnaire was developed specifically for this study, further psychometric evaluation is recommended in future research.

Data were analyzed using statistical software. Descriptive statistics were used to summarize respondents' characteristics and study variables. Categorical variables were presented as frequencies and percentages. Bivariate analysis was performed using the chi-square test to examine the association between each independent variable and adherence to weight-bearing exercise. Fisher's exact test was used when the expected cell count was less than 5. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the strength of association. For 2×2 tables, ORs were derived from contingency tables or bivariate binary logistic regression. For variables with zero cells, ORs were not estimated and only Fisher's exact p-values were reported. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for this study was obtained from the Ethics Committee of Universitas Respati Indonesia (Approval No. 724/SK.KEPK/UNR/X/2025, October 27, 2025). All participants provided informed consent prior to data collection. Confidentiality and anonymity of respondents were maintained throughout the study.

RESULT

The mean age of participants was 43.50 ± 16.30 years, ranging from 18 to 79 years. Most respondents were male (62.86%), had higher educational levels (60.00%), were employed (77.14%), and had distal fracture locations (58.58%). The majority of participants (81.43%) were classified as adherent to weight-bearing exercise, while 18.57% were non-adherent (See Table 1).

Regarding the distribution of study variables, most respondents demonstrated good knowledge (82.86%), high self-efficacy (85.71%), and good social support (65.71%). The majority also reported low pain-related barriers (70.00%), while slightly more than half had good accessibility to healthcare services (54.29%) and good economic status (67.14%) (See Table 1).

Table 2 presents the results of the bivariate analysis. Sociodemographic characteristics, including age, gender, education level, occupation, and income, were not significantly associated with adherence to weight-bearing exercise ($p > 0.05$). Similarly, economic status did not show a significant relationship with adherence ($p = 0.258$).

Among clinical characteristics, fracture location was significantly associated with adherence. Patients with proximal fractures were more likely to be non-adherent compared to those with distal fractures (31.00% vs. 9.75%, $p = 0.024$). Several study variables demonstrated significant associations with adherence. Respondents with poor knowledge were more likely to be non-adherent compared to those with good knowledge (41.67% vs. 13.79%, $p = 0.024$). Likewise, low self-efficacy was strongly associated with non-adherence (50.00% vs. 13.33%, $p = 0.006$) (See Table 2).

Table 1. Characteristics and Distribution of Study Variables (n = 70)

Variable	Category	n	%
Sociodemographic characteristics			
Age (mean ± SD)		43.50 ± 16.30	
Gender	Male	44	62.86
	Female	26	37.14
Education	Low	28	40.00
	High	42	60.00
Occupation	Employed	54	77.14
	Not Employed	16	22.86
Income	IDR < 2 million	4	5.71
	IDR 2–5 million	35	50.00
	IDR > 5 million	31	44.29
Clinical characteristics			
Fracture location	Proximal	29	41.42
	Distal	41	58.58
Adherence	Non-adherent	13	18.57
	Adherent	57	81.43
Study variables			
Knowledge	Poor	12	17.14
	Good	58	82.86
Self-efficacy	Low	10	14.29
	High	60	85.71
Social support	Poor	24	34.29
	Good	46	65.71
Pain-related barrier	Low	49	70.00
	High	21	30.00
Accessibility	Poor	32	45.71
	Good	38	54.29
Economic status	Poor	23	32.86
	Good	47	67.14

Social support showed the strongest association with adherence. All non-adherent respondents were found among those with poor social support, whereas all respondents with good social support were adherent (p = 0.001). Pain-related barriers were also significantly associated with adherence. Participants with high pain-related barriers were more likely to be non-adherent compared to those with low barriers (38.09% vs. 10.21%, p = 0.006) (See Table 2).

Accessibility demonstrated a strong relationship with adherence, where respondents with poor access to healthcare services were

Table 2. Factors Associated with Adherence to Weight-Bearing Exercise (n = 70)

Variable	Category	Non-adherent n (%)	Adherent n (%)	OR (95% CI)	p-value
Sociodemographic characteristics					
Age (mean ± SD)		39.00±13.10	44.50 ± 16.90	–	0.273
Gender	Female	6 (23.07)	20 (76.92)	1.59 (0.47–5.36)	0.456
	Male	7 (15.90)	37 (84.09)		
Education	Low	6 (21.43)	22 (78.57)	1.36 (0.41–4.59)	0.616
	High	7 (16.67)	35 (83.33)		
Occupation	Not employed	1 (6.25)	15 (93.75)	0.23 (0.03–1.95)	0.149
	Employed	12 (22.22)	42 (77.78)		
Income	< IDR 2 million	2 (50.00)	2 (50.00)	–	0.190
	IDR 2–5 million	7 (20.00)	28 (80.00)		
	> IDR 5 million	4 (12.90)	27 (87.10)		
Clinical characteristics					
Fracture location	Proximal	9 (31.00)	20 (69.00)	4.16 (1.14–15.23)	0.024*
	Distal	4 (9.75)	37 (90.25)		
Study variables					
Knowledge	Poor	5 (41.67)	7 (58.33)	4.46 (1.14–17.55)	0.024*
	Good	8 (13.79)	50 (86.21)		
Self-efficacy	Low	5 (50.00)	5 (50.00)	6.50 (1.53–27.60)	0.006*
	High	8 (13.33)	52 (86.67)		
Social support	Poor	13 (54.16)	11 (45.84)	–	0.001*
	Good	0 (0.00)	46 (100.00)		
Pain-related barrier	High	8 (38.09)	13 (61.91)	5.42 (1.51–19.42)	0.006*
	Low	5 (10.21)	44 (89.79)		
Accessibility	Poor	11 (34.37)	21 (65.63)	9.43 (1.90–46.69)	0.002*
	Good	2 (5.26)	36 (94.74)		
Economic status	Poor	6 (26.08)	17 (73.92)	2.02 (0.59–6.90)	0.258
	Good	7 (14.89)	40 (85.11)		

*) $p < 0.05$

more likely to be non-adherent than those with good access (34.37% vs. 5.26%, p = 0.002) (See Table 2). Overall, these findings indicate that adherence to weight-bearing exercise among postoperative lower limb fracture patients is more strongly influenced by psychological, social, and accessibility-related factors rather than by sociodemographic characteristics.

DISCUSSION

This study explored factors associated with adherence to weight-bearing exercise among postoperative lower limb fracture patients. The findings indicate that adherence is predominantly influenced by psychological, social, and accessibility-related factors, while sociodemographic characteristics were not significantly associated. These findings reinforce that adherence is a complex, multifactorial behavior shaped more by modifiable factors than demographic characteristics (Fernandes *et al.,* 2023; Peek, Moore, & Arnold, 2023).

From a biomechanical and physio-logical perspective, weight-bearing is essential for optimal fracture healing. Mechanical loading stimulates osteoblastic activity and promotes bone remodeling, whereas unloading results in decreased bone mass and impaired functional recovery (Chang, Xu, & Zhang, 2022; Zhang, Hamamura, & Yokota, 2008). This concept is further supported by mechanotransduction theory, which explains how mechanical stress influences bone regeneration (Flowers *et al*., 2022). Clinical evidence consistently demonstrates that early or progressive weight-bearing improves functional outcomes without increasing complication rates (Flowers *et al*., 2022; Kalmet *et al*., 2024). Despite these benefits, adherence to prescribed weight-bearing regimens remains suboptimal in clinical practice.

The present study found that knowledge was significantly associated with adherence. Patients with better knowledge were more likely to follow weight-bearing recommendations. This finding aligns with previous studies showing that patient understanding of rehabilitation protocols improves adherence and recovery outcomes (Jester *et al.,* 2021; Kunz *et al.,* 2026). However, knowledge alone may not be sufficient to ensure adherence, as patients often struggle to translate understanding into consistent behavior, particularly in dynamic activities such as ambulation (Braun *et al.,* 2017).

Self-efficacy was also identified as a significant determinant of adherence, supporting Bandura's theoretical framework that individuals with higher confidence in their ability to perform a task are more likely to engage in and sustain that behavior (Bandura, 1977; Picha & Howell, 2018). In rehabilitation contexts, self-efficacy has been consistently associated with adherence to exercise and recovery programs. Patients with higher self-efficacy are more capable of overcoming discomfort, uncertainty, and fear-related avoidance behaviors during weight-bearing activities (Jack *et al*., 2010; Liu *et al.,* 2026; Picha & Howell, 2018).

Social support emerged as the strongest factor associated with adherence. All non-adherent participants were found among those with poor social support, highlighting the critical role of interpersonal and environmental factors. Previous studies have demonstrated that emotional, informational, and practical support significantly enhances adherence to treatment regimens (House, Umberson, & Landis, 2003; Roberts *et al*., 2024). Encouragement from family members and healthcare providers improves motivation and engagement in rehabilitation (Hancox *et al.,* 2023; Jack *et al*., 2010).

Pain-related barriers were significantly associated with adherence, consistent with

prior research identifying pain as a major obstacle to rehabilitation. Pain can lead to fear of movement (kinesiophobia), resulting in avoidance behavior and reduced participation in weight-bearing exercise (Hancox *et al.,* 2023; Jack *et al.,* 2010; Seo *et al*., 2020). In addition, patients may perceive weight-bearing as harmful, particularly when pain is interpreted as a sign of reinjury, further decreasing adherence (Adhikari, Neupane, & Shrestha, 2025; Seo *et al.,* 2020).

Accessibility was another key determinant of adherence. Patients with limited access to healthcare services were more likely to be non-adherent. Barriers such as transportation difficulties, distance to healthcare facilities, and limited availability of rehabilitation services have been widely reported as significant contributors to poor adherence (Abraham, Kumar, & Vedavyasa Acharya, 2025; Adhikari, Neupane, & Shrestha, 2025). These findings are consistent with global evidence emphasizing the role of health system factors in influencing adherence behaviors (WHO, 2023).

Notably, sociodemographic characteristics such as age, gender, education, occupation, and income were not significantly associated with adherence. This finding suggests that adherence is less influenced by demographic factors and more dependent on behavioral, psychological, and contextual variables (Fernandes *et al.,* 2023; Hancox *et al.*, 2023; Jack *et al*., 2010; Liu *et al.,* 2026; Roberts et al., 2024). Similar results have been reported in rehabilitation studies, indicating that demographic characteristics alone are insufficient predictors of adherence.

The significant association between fracture location and adherence provides additional clinical insight. Patients with proximal fractures were more likely to be non-adherent than those with distal fractures. This may be attributed to greater pain intensity, higher mechanical loading demands, and increased perceived risk during weight-bearing (Kubiak *et al.,* 2013; Lajevardi-Khosh *et al.,* 2019; Seo *et al.,* 2020). Furthermore, evidence suggests that maintaining prescribed weight-bearing levels is inherently challenging, as patients frequently exceed or fail to maintain recommended loads even with guidance (Braun *et al.,* 2017; Kalmet *et al.,* 2024). Studies using objective monitoring have demonstrated that compliance with weight-bearing instructions is generally low, regardless of training methods (Kunz *et al.,* 2026; Manelli *et al.,* 2025; Smeeing *et al.,* 2020).

From a nursing perspective, these findings highlight the importance of a comprehensive and patient-centered approach to rehabilitation. Nurses play a critical role in patient education, enhancing self-efficacy, managing pain, and facilitating social support systems (Laza *et al.,* 2026; Roberts *et al.,* 2024; Shiel *et al*., 2026). Integrating behavioral interventions, effective pain management strategies, and improved access to care may significantly enhance adherence to weight-bearing exercise (Adhikari, Neupane, & Shrestha, 2025; Jack *et al*., 2010; Liu *et al*., 2026; Picha & Howell, 2018).

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships. Second, the use of self-reported measures may introduce recall bias and social desirability bias. Third, the questionnaire used in this study was researcher-developed and had undergone preliminary validity and reliability testing. However, further comprehensive psychometric evaluation, including content validity index, construct validity, and domain-specific reliability testing, was not conducted. Therefore, the findings should be interpreted with caution, particularly regarding the measurement precision of each domain.

Adherence was measured using a single self-reported item, which may be subject to recall bias and social desirability bias. In addition, the 75% cut-off was used as an operational threshold rather than a validated clinical cut-off. Future studies are recommended to use validated rehabilitation adherence instruments or objective monitoring methods to assess adherence more accurately. Additionally, the study was conducted in a single-center setting, which may limit generalizability.

Despite these limitations, this study provides important insights into the multifactorial determinants of adherence to weight-bearing exercise. The findings emphasize the need for integrated interventions addressing psychological, social, and healthcare system factors to improve adherence and optimize rehabilitation outcomes.

CONCLUSION

This study highlights that adherence to weight-bearing exercise among postoperative lower limb fracture patients is primarily influenced by psychological, social, and accessibility-related factors rather than sociodemographic characteristics. Knowledge, self-efficacy, social support, pain-related barriers, accessibility, and fracture location were significantly associated with adherence. Among these, social support emerged as the most influential factor, emphasizing the critical role of the patient's environment in shaping rehabilitation behavior. These findings suggest that improving adherence requires a comprehensive, patient-centered approach that integrates education, psychological support, effective pain management, and enhanced access to rehabilitation services. Strengthening these modifiable factors may contribute to better adherence and ultimately improve functional recovery outcomes.

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