



Factors Influencing Adherence to Physical Exercise Rehabilitation during the First Three Months Post-Stroke among Adults with First-Onset Stroke

Yinan Wu¹, Panicha Ponpinij², Pornpat Hengdomsub³

¹Master's Student, Faculty of Nursing, Burapha University, Chonburi, Thailand

²Assistant Professor, Faculty of Nursing, Burapha University, Chonburi, Thailand

³Associate Professor, Faculty of Nursing, Burapha University, Chonburi, Thailand

Received: July 9, 2025

Revised: October 3, 2025

Accepted: October 13, 2025

Corresponding author:

Panicha Ponpinij

Faculty of Nursing, Burapha University, 169 Longhard Bangsaen Road, Saen Suk, Chon Buri 20131, Thailand.

Tel: +66-89-8360884

Fax: +66-38-393-476

E-mail: ponpanicha@nurse.buu.ac.th

Purpose: This study aimed to identify key predictive factors influencing adherence to physical exercise rehabilitation among adults during the first three months following a first-onset ischemic stroke in China. **Methods:** A cross-sectional descriptive study was conducted among 137 adults who attended clinical follow-up appointments within the first three months after experiencing a first-onset ischemic stroke. Predictors included family support, coping with role transition, depression, self-efficacy, and body image. Hierarchical multiple regression analysis was performed. **Results:** The mean adherence score for physical exercise rehabilitation was 39.58 (standard deviation = 6.71), indicating a moderate adherence level (70.6%). In model 1, male sex ($\beta = .20, p = .017$) and post-stroke duration of 2 months ($\beta = .31, p = .015$) and 3 months ($\beta = .39, p = .002$) were significant predictors of adherence to physical exercise rehabilitation. Adding main predictors in model 2 resulted in a significant increase in explained variance ($\Delta R^2 = .418, p < .001$), accounting for 51.5% of the total variance ($R^2 = .515$, adjusted $R^2 = .484$). Male sex ($\beta = .15, p = .017$), family support ($\beta = .43, p < .001$), self-efficacy ($\beta = .26, p < .001$), depression ($\beta = -.24, p = .001$), and coping with role transition ($\beta = .16, p = .033$) were significant predictors. Body image and post-stroke duration were not significant after adjustment. **Conclusion:** Efforts to promote adherence to physical exercise rehabilitation should prioritize family support, depressive symptoms, self-efficacy, and coping with role transition. Furthermore, body image may warrant attention when developing sex-specific intervention strategies.

Key Words: Exercise therapy; Patient compliance; Self concept; Social support; Stroke

INTRODUCTION

Stroke remains a major global public health concern, contributing substantially to mortality and long-term disability [1]. In China, stroke is both a leading cause of death and the primary contributor to adult disability [2]. Epidemiological data from 2020 highlight the substantial burden of stroke, with 17.8 million survivors, including 3.4 million

first-onset cases, and 2.3 million deaths [2]. Among survivors, 12.5% experience stroke-related disabilities (modified Rankin Scale > 1), representing approximately 2.2 million individuals [2]. Additionally, there is an increasing trend of stroke incidence among younger adults [3]. Data from the national Stroke Risk Population Screening and Intervention Program (2012–2016) showed that individuals aged 18 to 64 years accounted for more than 66.6% of first-ever

stroke cases [4]. Therefore, stroke prevention and management are critical priorities in adult populations.

The impact of stroke extends beyond the acute phase, imposing significant burdens on individuals across physiological, psychological, and social dimensions [3]. Approximately 60% to 80% of adult stroke survivors experience residual disabilities that substantially limit daily functioning and impede social reintegration, while also facing heightened psychological distress and elevated recovery expectations [5]. Therefore, optimizing rehabilitation outcomes for adult stroke survivors is essential to improve quality of life and support successful societal reintegration. Adherence to physical exercise rehabilitation is widely recognized as a cornerstone of ischemic stroke recovery [6]. It is defined as the consistent and systematic engagement of post-stroke individuals in prescribed exercise regimens aimed at restoring motor function and resuming daily activities [7]. Importantly, the first three months following a stroke represent a period of heightened neuroplasticity, characterized by rapid spontaneous neurological recovery facilitated by synaptic reorganization and axonal sprouting in peri-infarct regions [8]. This critical window offers a unique opportunity in which early and sustained participation in structured exercise programs can significantly enhance recovery processes and prevent functional decline [9].

Despite its well-documented benefits, adherence to physical exercise rehabilitation remains low among stroke survivors. Previous studies using the Exercise Adherence Questionnaire (EAQ) have revealed concerning low adherence rates. For example, Zhao and Bai [10] reported that only 7.4% of stroke patients demonstrated high adherence, while most exhibited moderate (41.1%) or low (51.5%) adherence. Similarly, Cao et al. [11] found that 82.2% of participants had low adherence. These findings highlight a substantial gap between recommended rehabilitation practices and actual patient behavior.

Given the critical role of physical exercise rehabilitation in functional recovery, it is essential to investigate the determinants influencing adherence during the early post-stroke period. A clearer understanding of these factors can inform the development of targeted, evidence-based interventions to enhance rehabilitation outcomes and improve long-term quality of life for this population.

The Roy adaptation model (RAM) provided the conceptual foundation for this study [12], supported by an extensive review of the literature to deepen understanding of

adaptive processes in adults with first-onset ischemic stroke, particularly in relation to adherence to physical exercise rehabilitation. Stroke often results in lasting disabilities and functional limitations [3], requiring survivors to adapt rapidly to maintain independence and well-being. Stroke survivors are expected to engage in a multidimensional adjustment process in response to new physical, psychological, and social realities. According to RAM, adherence to physical exercise rehabilitation can be explained through four adaptive modes: physiological, self-concept, role function, and interdependence [12]. In this study, the relationships between these adaptive modes and the selected variables were examined to establish a theoretical foundation for understanding rehabilitation adherence. Following a first-onset stroke—particularly during the critical first three months—survivors may face challenges in adjusting to altered physical abilities, evolving self-perceptions, changing roles, and shifts in social support networks [5]. Therefore, the RAM offers a comprehensive framework for interpreting adherence behaviors, encompassing not only physical recovery but also psychological and social adaptation.

Prior research has identified multiple psychosocial and behavioral factors that influence treatment adherence in both stroke and other chronic illnesses [13]. Among these, in the context of community-dwelling stroke survivors, self-efficacy has consistently shown a positive correlation with rehabilitation adherence [13]. A stronger belief in one's ability to perform specific actions predicts greater engagement in prescribed exercise regimens and improved long-term functional outcomes [13]. Similarly, depression—a common post-stroke condition—impairs cognitive function, reduces motivation, and diminishes engagement in rehabilitation. Several studies have linked depressive symptoms to lower adherence to physical exercise rehabilitation among stroke survivors [5,14]. Furthermore, family support has emerged as a critical determinant of rehabilitation engagement. Supportive family environments have been shown to enhance patient confidence and encourage adherence, whereas the absence of such support is often associated with poor treatment compliance [5]. Another salient factor, particularly within the context of chronic illness, is coping with role transition, which encompasses cognitive and behavioral strategies such as confronting, avoiding, or yielding to challenges. Evidence suggests that individuals who employ a proactive, “facing” approach to adaptation are more likely to maintain higher adherence

levels [15]. In addition, body image—defined as one's perceptions and attitudes toward physical appearance—has been associated with adherence behaviors among individuals with chronic illness. Studies indicate that patients with negative body image perceptions tend to exhibit poorer adherence to treatment [16]. Collectively, these factors highlight the multidimensional nature of adherence behaviors and provide a foundation for examining their influence on post-stroke rehabilitation.

Previous studies have demonstrated that self-efficacy, family support, depression, coping with role transition, and body image influence treatment adherence in stroke and other chronic illnesses [5,13-16]. However, their specific roles during the first one to three months after a first-onset stroke—a period critical for adaptation and recovery—remain underexplored, particularly among adult survivors aged 18 to 60 years, who represent more than two-thirds of stroke cases in China (66.6%) and possess distinct rehabilitation needs compared with older adults [4]. This study addresses this gap by examining these factors in relation to adherence to physical exercise rehabilitation during early recovery, guided by the RAM. Within this framework, the variables correspond to the four adaptive modes: self-efficacy and body image align with the self-concept mode; coping with role transition corresponds to the role function mode; depression represents an emotional manifestation within the physiological mode; and family support reflects the interdependence mode. The findings from this study will provide evidence-based insights to inform the development of targeted, patient-centered rehabilitation strategies and promote sustained functional recovery among stroke survivors.

METHODS

1. Study Design

This cross-sectional descriptive study was conducted at the Neurology Outpatient Clinic of the First Affiliated Hospital of Wenzhou Medical University (FAH of WMU) in China from July to October 2024.

2. Setting and Samples

The target population consisted of adult patients diagnosed with a first-onset ischemic stroke who received treatment at the Department of Neurology, FAH of WMU.

Participants were recruited based on the following inclusion criteria: (1) attendance at a clinical follow-up between 1–3 months after discharge; (2) age between 18 and 60 years; (3) ability to read and communicate in Chinese; (4) full consciousness and good cooperation; and (5) an Activities of Daily Living (ADL) score between 21 and 90. The exclusion criteria were: (1) disability due to other causes; (2) severe cardiopulmonary dysfunction or a history of craniocerebral trauma; and (3) serious auditory or visual impairment that prevented cooperation with the study. Participants did not receive any monetary or non-monetary compensation for their participation.

In the absence of a directly comparable prior study, the sample size was determined a priori using G*Power software (version 3.1). The calculation was based on a planned multiple regression analysis with nine predictors, an alpha level of .05, statistical power of .85, and a medium effect size (0.15), as recommended for nursing research [17]. This resulted in a required sample size of 126 participants. To account for a potential 10% attrition rate, the target was increased to 138 participants. The final analytic sample included 137 participants (one case was excluded due to excessive Cook's distance), yielding an achieved post hoc power of approximately .92, indicating adequate statistical power for the final model.

3. Instruments

1) General demographic questionnaire

The general demographic questionnaire consisted of eight items covering sex, age, date of first onset, length of hospital stay, post-stroke duration, date of follow-up visit, ADL score, and site of limb function loss.

The ADL scale is a commonly used instrument for evaluating patients' self-care ability in daily life. It assesses multiple dimensions of functional capacity on a scale ranging from 0 to 100. The scoring criteria are as follows: a score of 0–20 indicates complete dependence on others for daily living; 21–40 suggests a significant need for assistance; 41–60 indicates a moderate need for help; 61–90 signifies that the patient has basic self-care abilities; and a score of 91–100 indicates that the patient is largely independent in performing daily living activities.

2) Physical exercise rehabilitation adherence

Physical exercise rehabilitation adherence was defined as the extent to which stroke patients performed prescribed

exercises systematically and scientifically to restore limb function and daily activities according to professional guidance. Adherence was measured using the EAQ developed by Lin et al. [7]. The EAQ includes 14 items across three dimensions: adherence to rehabilitation exercises, exercise monitoring, and advice seeking. Each item is rated on a 4-point Likert scale ranging from 1 (“not do it at all”) to 4 (“do it completely”), yielding a total score range of 14–56. Higher scores indicate stronger adherence. Adherence levels were categorized as high ($\geq 75\%$), moderate (50.0%–74.9%), and low ($\leq 50\%$), using the formula: adherence level = actual adherence score/possibility total adherence score (56 points) $\times 100\%$. Cronbach’s α was .92 in Lin’s study [7]; in this study, it was .90.

3) Self-efficacy

Self-efficacy—defined as an individual’s confidence in executing specific behaviors to achieve desired outcomes—was assessed using the General Self-Efficacy Scale (GSES) developed by Schwarzer and Jerusalem and translated into Chinese by Zhang and Schwarzer [18]. The GSES consists of 10 items rated on a 4-point Likert scale from 1 (“not at all true”) to 4 (“exactly true”), with a total score range of 10–40. Higher scores indicate greater self-efficacy. Cronbach’s α in this study was .72.

4) Coping with role transition

Coping with role transition was assessed using the Post-Discharge Coping Difficulty Scale (PDCDS) developed by Fitzgerald, Piacentine and translated into Chinese by Zhao et al. [19]. The Chinese version of the scale consists of two primary dimensions: the life management dimension, which includes emotional self-regulation, self-care capacity, self-medication management ability, and challenges faced by family caregivers; and the emotional needs dimension, which comprises life stress and rehabilitation-related difficulties [19]. The PDCDS contains seven items rated on a 10-point Likert scale from 0 (“no difficulty”) to 10 (“very difficult”), with total scores ranging from 0 to 70. Lower scores indicate more effective coping with post-discharge difficulties [19]. Cronbach’s α was .89 in Zhao et al.’s study [19] and .91 in this study.

5) Body image

Body image is defined as an individual’s beliefs and attitudes toward their physical appearance, encompassing perceptions of physical form, body size and shape, weight,

and attractiveness. Body image was assessed using the Body Image States Scale (BISS), developed by Cash et al. and translated into Chinese by Wang [20]. The scale consists of six items rated on a nine-point Likert scale. Three items—body shape, weight, and degree of self-perception—are positively scored from 1 (extremely dissatisfied) to 9 (extremely satisfied), while the remaining three items—body size, self-attractiveness, and comparison with others—are negatively scored from 9 (extremely satisfied) to 1 (extremely dissatisfied) [20]. The total score ranges from 6 to 54, with lower scores indicating a more positive perception of body image. The Cronbach’s α for the Chinese version was .71 in Wang’s research [20] and .76 in this study.

6) Depression

Depression is a class of mood disorders characterized by significant and persistent disturbances in mood, cognition, and behavior, manifesting as depressed mood, slowed thinking, impaired cognitive functioning, diminished volitional activity, and somatic symptoms. Depression was assessed using the Patient Health Questionnaire (PHQ-9), developed by Spitzer et al. and translated into Chinese by Bian et al. [21]. The PHQ-9 consists of nine symptom items and one overall functional assessment. The symptom items measure reduced interest, depressed mood, sleep disturbance, fatigue, changes in appetite, low self-esteem, concentration difficulties, psychomotor retardation, and suicidal ideation. Each item is rated on a four-point scale ranging from 0 (“not at all”) to 3 (“nearly every day”), with higher scores indicating greater depressive severity. The total score ranges from 0 to 27. Depression severity is classified as follows: 0–4, no depressive symptoms; 5–9, mild; 10–14, moderate; and ≥ 15 , severe [21]. Cronbach’s α for the Chinese version was .84, and it was .86 in the present study.

7) Family support

Family support refers to the degree to which family members provide emotional, informational, and instrumental assistance to meet patients’ needs during recovery. Family support was measured using the Perceived Social Support from Family Scale (PSS-Fa), developed by Procidano and Heller and translated into Chinese by Chen [22]. The PSS-Fa consists of 20 items rated on a 5-point Likert scale ranging from 1 (“totally disagree”) to 5 (“totally agree”), with higher scores indicating greater perceived family support. The Cronbach’s α in Procidano’s study was .90 [23] and for this study was .87.

4. Data Collection

Rigorous standardized procedures were employed for participant selection and data collection. Using a simple random sampling method, eligible patients were identified through a multi-step process. After obtaining approval from the Institutional Review Boards (IRBs) of Burapha University and the First Affiliated Hospital of Wenzhou Medical University, researchers accessed daily outpatient lists (Monday to Sunday) to identify first-onset stroke patients within one to three months post-discharge. Each eligible patient was assigned a unique identification number written on uniformly sized pieces of paper, which were placed in an opaque box, thoroughly mixed, and randomly drawn at a 50% selection rate by an independent staff member.

During the data collection process, all selected patients were informed both orally and in writing about the study's purpose, procedures, confidentiality assurances, and voluntary nature. They were clearly informed that participation was voluntary and that refusal or withdrawal at any stage would not affect their access to medical care. Written informed consent was obtained from all participants prior to data collection.

Questionnaires were administered under standardized conditions. After obtaining permission to meet the patient, the researcher met participants in a designated visitor area adjacent to the neurology office. Each participant was provided with a paper-based questionnaire packet, including the General Demographic Questionnaire, EAQ, PSS-Fa, PDCDS, PHQ-9, BISS, and GSES, which took approximately 30 minutes to complete. For participants with motor impairments, researchers assisted by scribing responses under direct supervision, ensuring accuracy and confidentiality. All questionnaires were reviewed for completeness while respecting the participants' right to skip questions. Upon confirmation of completion, all data were securely uploaded to the study's software system and stored in a password-protected database.

5. Ethical Considerations

This study was reviewed and approved by the Institution Review Board (IRB) of Burapha University, Thailand (2024/July/16th, G-HS052/2567) and the First Affiliated Hospital of Wenzhou Medical University, China (2024/July/14th, KY2024-151).

All participants were provided with a comprehensive explanation of the study objectives, procedures, data handling, and participant rights. The researchers ensured that all participants fully understood the information provided and voluntarily signed informed consent forms prior to participation.

6. Data Analysis

All data analyses were performed using IBM SPSS ver. 27.0 (IBM Corp., Armonk, NY, USA), with the level of statistical significance set at $p < .05$. Descriptive statistics, including frequencies, percentages, means, and standard deviations (SDs), were used to describe participant characteristics and study variables. The independent t-test and one-way analysis of variance (ANOVA) were applied to examine differences in adherence to physical exercise rehabilitation across participant characteristics. For any significant effects found in the ANOVA, post hoc comparisons were performed using Tukey's honestly significant difference test. Hierarchical multiple regression analysis was conducted to identify predictors of adherence to physical exercise rehabilitation.

The assumptions of multiple regression were verified before analysis. Scatterplots of the dependent variable against each independent variable demonstrated approximately linear relationships. The Durbin-Watson statistic was 1.631 for Model 1 and 1.83 for Model 2, indicating no autocorrelation. Normality was confirmed using histograms and Q-Q plots, and homoscedasticity was supported by the residuals plotted against predicted values. Variance inflation factor values ranged from 1.11 to 1.34, confirming the absence of multicollinearity. Cook's distance values were below 1, and standardized residuals indicated no influential outliers. No missing data were observed.

RESULTS

1. Characteristics of Participants

Data from 137 adults with first-onset ischemic stroke were analyzed. The majority of participants were male (68.6%), and most were aged between 51 and 60 years (66.4%), with a mean age of 52.20 years (SD = 6.76). Most participants demonstrated moderate dependency, as indicated by ADL scores ranging from 61 to 90 (92.7%, mean = 83.69, SD = 11.70). Regarding post-stroke duration, 11.7% were as-

sessed at one month, 24.1% at two months, and 64.2% at three months post-stroke (mean = 2.53, SD = 0.70). Detailed demographic and clinical characteristics are presented in [Table 1](#).

2. Descriptive Information of Study Variables

[Table 2](#) summarizes the overall adherence to physical exercise rehabilitation, with a mean score of 39.58 (SD = 6.71), representing a moderate level of adherence (70.6%). Among the three dimensions, adherence to rehabilitation exercise demonstrated a high level (mean = 24.49, SD = 4.17; 76.5%), while exercise monitoring (mean = 7.80, SD = 1.56; 64.9%) and advice seeking (mean = 7.30, SD = 2.07; 60.8%) showed moderate levels. The mean scores were 28.72 (SD = 4.69) for self-efficacy, 25.74 (SD = 12.13) for coping with role transition, 32.55 (SD = 5.28) for body image, 0.66 (SD = 1.54) for depression, and 66.97 (SD = 10.65) for family support, as shown in [Table 3](#).

3. Differences in Adherence to Physical Exercise Rehabilitation across Demographic and Clinical Characteristics

Significant differences in adherence to physical exercise rehabilitation were observed according to sex and post-

stroke duration. Male participants exhibited significantly greater adherence than female participants ($t = 2.06$, $p = .041$). With respect to clinical factors, adherence also differed significantly among the three post-stroke duration groups ($F = 4.08$, $p = .019$). Post-hoc comparisons revealed that participants at three months post-stroke demonstrated significantly higher adherence than those at one month. Conversely, no significant differences were identified in adherence across age groups ($t = 0.43$, $p = .666$) or ADL levels ($t = -0.21$, $p = .403$), as presented in [Table 1](#).

4. Correlations among Key Study Variables

Pearson correlation analyses revealed significant positive correlations between rehabilitation adherence and both self-efficacy ($r = .50$, $p < .001$) and family support ($r = .56$, $p < .001$). In contrast, depression ($r = -.36$, $p < .001$) and body image ($r = -.17$, $p = .022$) were significantly negatively correlated with adherence. No significant associations were identified for coping with role transition ($r = -.06$, $p = .257$). Detailed correlation coefficients are presented in [Table 4](#).

Table 1. Characteristics of Participants ($N = 137$)

Variables	Categories	Adherence to physical exercise rehabilitation			
		n (%)	M ± SD	t or F	<i>p</i> (Tukey's HSD)
Sex	Male	94 (68.6)	40.37 ± 6.29	2.06	.041
	Female	43 (31.4)	37.86 ± 7.32		
Age (year)	18–45	18 (13.1)	40.22 ± 5.70	0.43	.666
	46–60	119 (86.9)	39.49 ± 6.86		
Post-stroke duration (month)	1 ^a	16 (11.7)	35.35 ± 8.37	4.08	.019 (<i>c</i> > <i>a</i>)
	2 ^b	33 (24.1)	39.67 ± 6.28		
	3 ^c	88 (64.2)	40.34 ± 6.30		
ADL score	21–60	10 (7.3)	39.80 ± 3.58	-0.21	.403
	61–90	127 (92.7)	39.57 ± 6.90		

ADL = activities of daily living; HSD = honestly significant difference; M = mean; SD = standard deviation.

Table 2. Descriptive Statistics for Adherence to Physical Exercise Rehabilitation ($N = 137$)

Variables	Possible score (range)	Actual score (range)	M ± SD	Adherence level (%)
Total adherence to physical exercise rehabilitation	14–56	17–55	39.58 ± 6.71	Moderate (70.6)
Adherence to rehabilitation exercise	8–32	9–32	24.49 ± 4.17	High (76.5)
Exercise monitoring	4–12	4–12	7.80 ± 1.56	Moderate (64.9)
Advice seeking	3–12	3–12	7.30 ± 2.07	Moderate (60.8)

M = mean; SD = standard deviation.

Table 3. Description of Factors Related to Rehabilitation Exercise ($N=137$)

Variables	Possible score (range)	Actual score (range)	M \pm SD
Family support	20–100	19–93	66.97 \pm 10.65
Coping with role transition	0–70	3–58	25.74 \pm 12.13
Depression	0–27	0–13	0.66 \pm 1.54
Self-efficacy	10–40	15–40	28.72 \pm 4.69
Body image	6–54	16–48	32.55 \pm 5.28

M = mean; SD = standard deviation.

Table 4. Correlation between Predictors and Adherence to Physical Exercise Rehabilitation ($N=137$)

Variables	Adherence for physical exercise rehabilitation					
	Family support	Coping with role transition	Depression	Self-efficacy	Body image	
	r or t (p)					
Adherence to physical exercise rehabilitation	1					
Sex	.17 (.021)					
Post-stroke duration of 2 months	.01 (.468)					
Post-stroke duration of 3 months	.15 (.038)					
Family support	.56 (<.001)					
Coping with role transition	-.07 (.216)					
Depression	-.36 (<.001)					
Self-efficacy	.50 (<.001)					
Body image	-.17 (.022)					

5. Predictive Factors of Adherence to Physical Exercise Rehabilitation

Preliminary analyses indicated that adherence to physical exercise rehabilitation differed significantly by sex ($t=2.06$, $p=.041$) and post-stroke duration ($F=4.08$, $p=.019$), while no significant differences were observed for age or ADL (Table 1). Therefore, sex and post-stroke duration were retained as covariates in subsequent regression analyses.

In the covariate-only model (Model 1), male sex ($\beta=.20$, $p=.017$) and post-stroke duration of two months ($\beta=.31$, $p=.015$) and three months ($\beta=.39$, $p=.002$) were significant predictors of physical exercise rehabilitation adherence. Model 1 accounted for 9.7% of the variance in adherence ($R^2=.097$, adjusted $R^2=.076$, $F(3, 133)=4.76$, $p=.004$). When the main predictors (family support, coping with role transition, depression, self-efficacy, and body image) were added in model 2, the explained variance significantly increased by 41.8% ($\Delta R^2=.418$, $F(5, 128)=22.03$, $p<.001$), resulting in a total explained variance of 51.5% ($R^2=.515$, adjusted $R^2=.484$). In this adjusted model, male sex remained significant but decreased in magnitude ($\beta=.15$,

$p=.017$), while post-stroke duration at two and three months was no longer significant. Among the main predictors, family support ($\beta=.43$, $p<.001$), self-efficacy ($\beta=.26$, $p<.001$), depression ($\beta=-.24$, $p=.001$), and coping with role transition ($\beta=.16$, $p=.033$) emerged as significant predictors of adherence. Body image was not a significant predictor ($\beta=-.13$, $p=.050$), suggesting that its apparent effects in unadjusted models may be partly attributable to sex differences. Full regression results are summarized in Table 5.

DISCUSSION

This cross-sectional descriptive study examined adherence to physical exercise rehabilitation and identified its key predictive factors among adults during the first three months following a first-onset ischemic stroke in China. The findings revealed that family support and self-efficacy were the strongest predictors of adherence, while depression, sex, and coping with role transition showed secondary predictive effects after controlling for sex and post-stroke duration. Body image and post-stroke duration were not statistically significant.

Initial bivariate analyses found no significant association

Table 5. Hierarchical Multiple Regression Analysis of Factors Influencing Adherence to Physical Exercise Rehabilitation ($N=137$)

Variables	Categories	Model 1					Model 2				
		B	SE	β	t	p	B	SE	β	t	p
Constant		32.92	1.88		17.51	<.001	11.83	4.74		2.49	.014
Sex	Female (ref.)										
	Male	2.87	1.20	.20	2.41	.017	2.18	0.90	.15	2.42	.017
Post-stroke duration (month)	1 (ref.)										
	2	4.84	1.97	.31	2.45	.015	1.71	1.53	.11	1.12	.27
	3	5.50	1.76	.39	3.13	.002	1.45	1.42	.11	1.03	.31
Family support							0.27	0.04	.43	6.56	<.001
Coping with role transition							0.08	0.04	.16	2.15	.033
Depression							-1.06	0.31	-.24	-3.30	.001
Self-efficacy							0.38	0.10	.26	3.70	<.001
Body image							-0.17	0.09	-.13	-1.98	.050
Adjusted R ²				.076					.484		
R ²				.097					.515		
Change of R ²				.097					.418		
df				3					5		
F (p)				4.76 (.004)					22.03 (<.001)		
Durbin-Watson				1.631					1.83		

df= degrees of freedom; SE=standard error.

between rehabilitation adherence and coping with role transition. However, this variable was retained in the hierarchical regression model based on two key considerations. First, previous research has established its theoretical importance as a determinant of long-term rehabilitation engagement [15]. Second, according to the RAM, effective adaptation to role transitions represents a critical psychosocial process in post-stroke recovery, influencing health behaviors such as rehabilitation adherence [12]. The selective inclusion of this variable ensured that the final model maintained an appropriate balance between statistical rigor and clinical relevance.

The hierarchical regression analysis emphasized that modifiable psychosocial factors—particularly strong family support and high self-efficacy—were the most robust predictors of greater adherence to physical exercise rehabilitation. Lower depression levels and more positive perceptions of coping with role transitions also contributed significantly, though to a lesser extent. Conversely, the effects of non-modifiable factors, such as stroke duration, diminished once psychosocial variables were accounted for. Although male sex was associated with higher adherence, this finding highlights the importance of developing sex-tailored intervention strategies rather than suggesting an inherently causal relationship. The regression model explained 51.5% of the variance in adherence, indicating a

substantial influence of psychosocial and demographic factors. Nevertheless, 48.5% of the variance remained unexplained, suggesting that additional variables, such as environmental, cognitive, or healthcare system-related factors, should be examined in future research to further clarify adherence mechanisms.

Adherence to rehabilitation exercises in the early post-stroke period is critical for optimizing functional recovery and preventing secondary complications. Consistent engagement in exercise rehabilitation during this period significantly enhances motor outcomes and reduces the risk of long-term disability. In this study, the mean adherence score was 39.58 (SD=6.71), corresponding to a moderate level of adherence (70.6%). Dimensional analysis showed relatively high adherence to rehabilitation exercise itself (76.5%), while adherence to exercise monitoring (64.9%) and advice-seeking behaviors (60.8%) remained at moderate levels. This result was slightly lower than that reported by Zhang et al. [24], who found an adherence rate of 77.1%. Although this moderate level of engagement suggests a reasonable degree of participation, it remains suboptimal for maximizing rehabilitation benefits. These findings emphasize the necessity of identifying key determinants of adherence and implementing targeted nursing interventions to improve adherence and support recovery.

The moderate adherence levels observed in this study

may partly reflect the influence of sex composition and post-stroke duration. Regression analyses identified male sex as a significant predictor of greater rehabilitation adherence, consistent with the findings of Zhang et al. [24], who reported superior adherence among male stroke patients. Several factors may explain this pattern. Physiologically, males generally exhibit higher baseline physical fitness and more favorable hormonal profiles, both of which may enhance recovery potential [25]. Additionally, male often carry greater social and familial responsibilities, leading to stronger motivation and expectations to maintain functional independence through rehabilitation [26]. According to the RAM, individuals with greater physiological and psychological adaptive capacity are better equipped to adjust to post-stroke changes and engage actively in rehabilitation exercises [12,25]. This highlights the need to explore and develop sex-specific intervention strategies.

In the initial regression model (model 1), post-stroke duration at two and three months, compared with one month, was a significant predictor of adherence. However, this effect was no longer significant once behavioral variables were introduced in model 2. This finding suggests that time since stroke does not exert a direct influence on adherence; rather, its apparent effect becomes non-significant once psychosocial factors such as family support and self-efficacy are considered. According to the RAM, individuals gradually make adaptive adjustments to environmental and physiological changes over time. A longer post-stroke duration allows patients more opportunities for both physical and psychological adaptation, facilitating progressive engagement in rehabilitation activities and enhancing willingness and confidence to participate in exercise programs [27].

Among all predictors, family support emerged as the most significant determinant of rehabilitation exercise adherence, consistent with previous evidence [5,10]. Within the framework of the RAM, interdependence is identified as one of the four primary adaptive modes, highlighting the central role of social support systems in health recovery [12]. For stroke survivors, family support serves as a critical adaptive resource that strengthens the ability to cope with physical and psychosocial stressors associated with stroke, thereby promoting greater adaptive capacity and sustained rehabilitation engagement [28]. These findings underscore the need for healthcare professionals to provide targeted health education to families, emphasizing the essential role of family involvement, particularly during the first three

months post-stroke, to optimize recovery outcomes.

Self-efficacy was identified as the second most influential predictor of adherence to physical exercise rehabilitation, even after controlling for sex and post-stroke duration. This finding reinforces the importance of psychological resources in facilitating adherence during the early recovery phase. Consistent with prior empirical studies, self-efficacy has been recognized as a pivotal determinant of exercise adherence among stroke survivors [13]. Self-efficacy represents an individual's belief in their capacity to manage challenges and execute specific behaviors effectively. In the context of RAM, health maintenance is achieved through adaptive responses to environmental stimuli [12]. Stroke survivors with higher levels of self-efficacy often demonstrate stronger self-identity and greater self-esteem [29], enabling them to approach rehabilitation with confidence and perseverance. During the critical window of neuroplasticity, enhanced self-efficacy enables patients to take full advantage of recovery opportunities, establish sustainable exercise routines, and improve adherence to rehabilitation regimens [30]. Clinically, healthcare providers should promote self-efficacy by setting achievable short-term goals, offering structured guidance to reframe challenges as opportunities for mastery, and providing timely positive feedback to reinforce patients' confidence in their rehabilitation progress.

Depression was also found to be a significant predictor of adherence to physical exercise rehabilitation. This finding aligns with previous research demonstrating that post-stroke depression significantly impairs exercise adherence [31]. In this study, only 2.9% of participants exhibited mild depressive symptoms, a prevalence notably lower than that reported in prior studies [32]. Within the RAM, depression reflects a maladaptive response within the self-concept mode [12], representing difficulties in psychological adjustment following stroke. Depressive symptoms can compromise post-stroke rehabilitation adherence by impairing physiological regulation, role adaptation, and stimulus processing capacity. Among adult stroke patients, psychosocial stressors may reduce both energy and motivation for rehabilitation participation [33]. Moreover, fatigue associated with depression often further limits participation in therapy, hindering neurofunctional recovery [14]. These findings emphasize the importance of standardized early depression screening and timely psychological interventions—such as counseling or behavioral therapy—to optimize rehabilitation adherence and improve long-term

functional outcomes.

Coping with role transition also emerged as a significant predictor of adherence to physical exercise rehabilitation. Notably, while the bivariate analysis did not identify a significant correlation between coping with role transition and adherence, its significance became apparent in the multiple regression model after controlling for sex and post-stroke duration. This suggests that the relationship between coping with role transition and adherence may be mediated or moderated by other psychosocial factors. Within RAM, coping reflects a patient's ability to adjust to changes in role function following stroke. For individuals experiencing their first stroke, the abrupt shift in identity can lead to challenges in role adaptation and maladaptive coping responses, which in turn affect health behaviors such as treatment adherence [34]. Maladaptive coping often diminishes motivation for rehabilitation, resulting in poor adherence to prescribed exercise regimens. Working-age stroke survivors, in particular, frequently face significant psychosocial adjustments as they transition from "breadwinner" to "care recipient" or from "professional" to "patient." Successful adaptation to these role changes can reduce frustration and depressive symptoms while increasing engagement in rehabilitation. The first three months after stroke represent a critical window for both neurological recovery and psychological adaptation; poor adjustment during this period may establish negative behavioral patterns that compromise long-term adherence. Prior evidence in chronic illness populations also supports the positive relationship between effective coping and treatment adherence [15]. These findings reinforce the importance of enhancing role transition coping to improve rehabilitation engagement. Nurses can play a pivotal role in implementing role-restructuring interventions that help patients identify pre-morbid social roles, recognize roles that remain sustainable, and modify those requiring functional adaptation.

Contrary to the initial hypothesis, although correlation analysis revealed a weak negative association between body image and adherence to physical exercise rehabilitation, this relationship was not significant in the hierarchical multiple regression model after adjustment. Similarly, Schwieger et al. [35] reported that body image did not significantly influence brace-wearing adherence among females with adolescent idiopathic scoliosis. One possible explanation is that body image primarily reflects satisfaction with physical appearance and does not directly trans-

late to health behavior. Furthermore, patients with similar levels of body image satisfaction may adopt markedly different coping mechanisms. For example, individuals with low body image but high self-efficacy may channel dissatisfaction into motivation to exercise, thereby enhancing adherence [16]. In contrast, patients who experience both low body image and poor self-identity are more likely to disengage from rehabilitation activities [33]. Such individual variability limits the predictive utility of body image as a uniform indicator of rehabilitation adherence. Therefore, healthcare providers should emphasize personalized strategies that integrate self-efficacy enhancement and adaptive coping support to optimize rehabilitation outcomes.

The findings from this study provide meaningful contributions to both clinical nursing practice and nursing research, offering theoretical innovation by addressing key gaps in the existing literature. First, with respect to the study population, this research specifically targeted adult stroke patients aged 18 to 60 years, a demographic that has been underrepresented in prior studies. Second, in terms of the temporal dimension, this study uniquely focused on the first three months following the initial onset of ischemic stroke—a critical window for neurorehabilitation and behavioral adaptation. By systematically investigating adherence to physical exercise rehabilitation during this period and identifying key predictive factors among adult stroke survivors, this study provides empirical evidence to guide early, individualized intervention strategies. The findings also advocate the implementation of evidence-based approaches to enhance adherence, with the broader goal of helping patients attain optimal physical, cognitive, emotional, and social recovery. Moreover, these results can assist healthcare professionals in delivering personalized, patient-centered guidance that facilitates a smoother transition from hospital-based rehabilitation to community or home-based continuing care. However, several limitations should be acknowledged. First, as a single-center study, the generalizability of findings to broader populations may be limited. Second, the reliance on self-reported measures of adherence introduces potential recall and social desirability biases. Future studies could strengthen methodological rigor by incorporating objective assessment tools, such as direct observation or digital monitoring systems. Finally, the cross-sectional design limits the ability to infer causal relationships or track behavioral changes over time. Future longitudinal or mixed-method designs are recommended to capture the

dynamic nature of post-stroke adaptation and explore the motivational mechanisms that underlie adherence behaviors.

Despite significant advances in medical technology that have improved survival rates among stroke patients, maintaining adherence to physical exercise rehabilitation remains a persistent challenge. Within this context, nurses play a pivotal role in fostering and sustaining engagement in rehabilitation activities. To address this challenge effectively, a multifaceted and patient-centered approach is essential. During the early post-stroke phase, strengthening family support through structured education for both patients and caregivers can foster a collaborative and empowering environment. Enhancing patients' confidence by employing motivational interviewing, structured goal-setting, and positive reinforcement can further improve adherence. Routine screening for depressive symptoms and the timely provision of psychological support are critical for reducing emotional barriers that impede participation. Additionally, assisting patients in adapting to new roles through counseling and coping strategy training can promote emotional adjustment and resilience. Addressing body image concerns through validated assessment tools and reframing focus from appearance toward functional improvement may further support engagement. Collectively, these targeted, nurse-led interventions can significantly improve rehabilitation adherence, thereby enhancing long-term recovery and quality of life among stroke survivors.

CONCLUSION

This study identified the factors associated with adherence to physical exercise rehabilitation among adults experiencing a first-onset ischemic stroke. Stronger family support and higher self-efficacy emerged as the most powerful and consistent predictors of adherence, while lower levels of depression also contributed substantially. Positive perceptions of coping with role transition demonstrated additional, though smaller, predictive value. The observed association between male sex and higher adherence underscores the importance of developing sex-tailored interventions rather than implying inherent behavioral differences. These findings provide actionable insights for clinical practice. Healthcare professionals should emphasize family education, motivational goal-setting, regular depression screening, and role adaptation counseling to strengthen adherence during the early post-stroke period.

Future research should expand sample sizes and incorporate multicenter designs to enhance representativeness, while longitudinal methods are recommended to track adherence trajectories over time. The inclusion of objective adherence measures, such as digital monitoring or direct observation, would also improve the accuracy of outcome evaluation. Through these methodological and clinical advancements, future work can more effectively address post-stroke adaptation challenges, promote consistent rehabilitation adherence, and ultimately improve the overall quality of life of stroke survivors.

ORCID

Yinan Wu, <https://orcid.org/0009-0007-3327-3717>

Panicha Ponpinij, <https://orcid.org/0009-0007-8253-1145>

Pornpat Hengudomsab, <https://orcid.org/0000-0002-7078-4037>

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - YW, PH, and PP; acquisition of data - YW; analysis - YW, PH, and PP; interpretation of the data - YW, PH, and PP; and drafting or critical revision of the manuscript for important intellectual content - YW, PH, and PP.

FUNDING

None.

ACKNOWLEDGEMENT

This article is a condensed form of the Yinan Wu's master's thesis from Burapha University.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

REFERENCES

1. World Health Organization (WHO). The top 10 causes of death [Internet]. Geneva: WHO; 2024 [cited 2024 October 5]. Available from: <https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death>
2. Tu WJ, Wang LD. China stroke surveillance report 2021. *Mil Med Res*. 2023;10(1):33. <https://doi.org/10.1186/s40779-023-00463-x>
3. Ping Q, Jia JJ, Que HY. Relationship between hope level and compliance of functional exercise in young and middle-aged stroke patients. *Nurs Pract Res*. 2022;19(5):646-50. <https://doi.org/10.3969/j.issn.1672-9676.2022.05.004>
4. Stroke Prevention and Treatment in China Writing Group. Brief report on stroke prevention and treatment in China, 2021. *Chin J Cerebrovasc Dis*. 2023;20(11):783-93.
5. Zhang Y, Qiu X, Jin Q, Ji C, Yuan P, Cui M, et al. Influencing factors of home exercise adherence in elderly patients with stroke: a multiperspective qualitative study. *Front Psychiatry*. 2023;14:1157106. <https://doi.org/10.3389/fpsy.2023.1157106>
6. Winstein CJ, Stein J, Arena R, Bates B, Chorney LR, Cramer SC, et al. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2016;47(6):e98-169. <https://doi.org/doi:10.1161/STR.0000000000000098>
7. Lin BL, Zhang ZH, Sun YM, Mei YX, Xie JF, Zhang YQ. Development and reliability test of functional exercise adherence scale for community stroke patients. *Chin J Rehabil Med*. 2013;6:574-8. <https://doi.org/10.3969/j.issn.1001-1242.2013.06.018>
8. Murphy TH, Corbett D. Plasticity during stroke recovery: from synapse to behaviour. *Nat Rev Neurosci*. 2009;10(12):861-72. <https://doi.org/10.1038/nrn2735>
9. Dromerick AW, Geed S, Barth J, Brady K, Giannetti ML, Mitchell A, et al. Critical Period After Stroke Study (CPASS): a phase II clinical trial testing an optimal time for motor recovery after stroke in humans. *Proc Natl Acad Sci U S A*. 2021;118(39):e2026676118. <https://doi.org/10.1073/pnas.2026676118>
10. Zhao DD, Bai YJ. An investigation of exercise adherence among stroke rehabilitation patients and analysis of influencing factors. *Clin Med Res Pract*. 2023;8(22):45-8. <https://doi.org/10.19347/j.cnki.2096-1413.202322011>
11. Cao Y, Zhang ZX, Lin BL, Zhang CH, Mei YX, Chen SY, et al. The status of rehabilitation exercise adherence among rural stroke survivors and countermeasures in Henan province. *Chin J Pract Neurol Dis*. 2020;23(7):625-30.
12. Roy C, Whetsell MV, Frederickson K. The Roy adaptation model and research. *Nurs Sci Q*. 2009;22(3):209-11. <https://doi.org/10.1177/0894318409338692>
13. Lin B, Zhang Z, Mei Y, Liu L, Ping Z. The influential factors of adherence to physical activity and exercise among community-dwelling stroke survivors: a path analysis. *J Clin Nurs*. 2022;31(17-18):2632-43. <https://doi.org/10.1111/jocn.16091>
14. Xu YH, Ying DD, Yang J. Functional exercise compliance among young and middle-aged stroke patients. *Chin Prev Med J*. 2023;35(2):171-5. <https://doi.org/10.19485/j.cnki.issn2096-5087.2023.02.020>
15. Xu LL, Luo M, Den L, Liao M, Liu S. Effect of personality characteristics, coping styles and protection motivation on medication adherence of elderly patients with benign prostatic hyperplasia. *J North Sichuan Med Coll*. 2023;38(1):137-40. <https://doi.org/10.3969/j.issn.1005-3697.2023.01.033>
16. Lee E, Jang MH. The influence of body image, insight, and mental health confidence on medication adherence in young adult women with mental disorders. *Int J Environ Res Public Health*. 2021;18(8):3866. <https://doi.org/10.3390/ijerph18083866>
17. Kang H. Sample size determination and power analysis using the G*Power software. *J Educ Eval Health Prof*. 2021;18:17. <https://doi.org/10.3352/jeehp.2021.18.17>
18. Zhang JX, Schwarzer R. Measuring optimistic self-beliefs: a Chinese adaptation of the General Self-Efficacy Scale. *Psychologia*. 1995;38(3):174-81.
19. Zhao XQ, Shi YL, Wang J, Xiang XX, Xiong SS. The reliability and structural validity of the Chinese version of the coping ability scale after discharge. *Nurs Sci*. 2021;10(1):27-35. <https://doi.org/10.12677/ns.2021.101005>
20. Wang J. The examination of the body image state scale [master's thesis]. Wuhan: Wuhan Institute of Physical Education; 2012.
21. Bian CD, He SY, Qian J, Wu WY, Li CB. The reliability and validity of a modified patient health questionnaire for screening depressive syndrome in general hospital outpatients. *J Tongji Univ*. 2009;30(5):136-40.
22. Chen CM. The study of resilience and life adaptation among adolescent survivors of brain tumors in Taiwan

- [dissertation]. Taipei: National Taiwan University; 2007.
23. Procidano ME, Heller K. Measures of perceived social support from friends and from family: three validation studies. *Am J Community Psychol.* 1983;11(1):1-24. <https://doi.org/10.1007/bf00898416>
 24. Zhang YX, Chen L, Ji CL, Wang F, Yuan P, He ML. Influencing factors and pathway analysis of functional exercise compliance in young and middle-aged hemorrhagic stroke patients. *J Nurs.* 2022;29:6-10. <https://doi.org/10.16460/j.issn1008-9969.2022.20.006>
 25. Zhang J, Chen PJ, Xiao WH. Regulation of androgen on skeletal muscle protein metabolism and its mechanism. *Chin Bull Life Sci.* 2019;31(8):826-32. <https://doi.org/10.13376/j.cbbs/2019101>
 26. Ali PA, McGarry J, Maqsood A. Spousal role expectations and marital conflict: perspectives of men and women. *J Interpers Violence.* 2022;37(9-10):NP7082-108. <https://doi.org/10.1177/0886260520966667>
 27. Gunnes M, Langhammer B, Aamot IL, Lydersen S, Ihle-Hansen H, Indredavik B, et al. Adherence to a long-term physical activity and exercise program after stroke applied in a randomized controlled trial. *Phys Ther.* 2019;99(1):74-85. <https://doi.org/10.1093/ptj/pzy126>
 28. Cheiloudaki E, Alexopoulos EC. Adherence to treatment in stroke patients. *Int J Environ Res Public Health.* 2019;16(2):196. <https://doi.org/10.3390/ijerph16020196>
 29. Babazadeh T, Ranjbaran S, Pourrazavi S, Maleki Cholou K, Nadi A, Tazekand ES. Self-efficacy, self-esteem, and happiness in older adults: a cross-sectional study. *PLoS One.* 2025;20(3):e0319269. <https://doi.org/10.1371/journal.pone.0319269>
 30. Caetano LC, Pacheco BD, Samora GA, Teixeira-Salmela LF, Scianni AA. Self-efficacy to engage in physical exercise and walking ability best predicted exercise adherence after stroke. *Stroke Res Treat.* 2020;2020:2957623. <https://doi.org/10.1155/2020/2957623>
 31. Gnanaprakasam A, Solomon JM, Roy AK, Deshmukh AS, Karthikbabu S. Association between depression and adherence to upper limb exercises among community-dwelling stroke survivors: a cross-sectional study. *Health Sci Rep.* 2024;7(10):e70133. <https://doi.org/10.1002/hsr2.70133>
 32. Hu RD, Zhou HZ, Liu ZH, Hou JK, Liu YY, Bai XJ, et al. Correlation between stigma and post-stroke depression in initially diagnosed stroke patients. *Chin Gen Pract.* 2021;24(6):727-31. <https://doi.org/10.12114/j.issn.1007-9572.2020.00.616>
 33. Gong SH, Sun C, Yang H, Yi XP, Hu NN, Zhang A, et al. The real experience of stroke patients in young and middle-age adults: a qualitative meta-synthesis. *Chin J Nurs.* 2021;56(6):843-51.
 34. Chatoo A, Lee S. Association of coping strategies and medication adherence: a systematic review. *Innov Pharm.* 2022;13(3):10.24926/iip.v13i3.4991. <https://doi.org/10.24926/iip.v13i3.4991>
 35. Schwieger T, Campo S, Weinstein SL, Dolan LA, Ashida S, Steuber KR. Body image and quality of life and brace wear adherence in females with adolescent idiopathic scoliosis. *J Pediatr Orthop.* 2017;37(8):e519-23. <https://doi.org/10.1097/bpo.0000000000000734>