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Contents

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REVIEW

973 Risk factors, preventive interventions, overlapping symptoms, and clinical measures of delirium in elderly patients

Mei X, Liu YH, Han YQ, Zheng CY

ORIGINAL ARTICLE

Case Control Study

985 Diagnostic and prognostic implications of non-high-density lipoprotein cholesterol and homocysteine levels for cognitive impairment in thalamic infarction

Zhu SY, Ge W, Zhang H

995 Brain-derived neurotrophic factor, sex hormones and cognitive decline in male patients with schizophrenia receiving continuous antipsychotic therapy

Li J, Xiao WH, Ye F, Tang XW, Jia QF, Zhang XB

1005 Haplotype analysis of long-chain non-coding RNA NONHSAT102891 promoter polymorphisms and depression in Chinese individuals: A case-control association study

Li Y, Wang YX, Tang XM, Liang P, Chen JJ, Jiang F, Yang Q, Liang YD

Retrospective Study

1016 Efficacy and risk factors for anxiety and depression after mini-incision hip arthroplasty for femoral head osteonecrosis

Yu WX, Hao YQ, Lu C, Li H, Cai YZ

1027 Efficacy of enhanced extracorporeal counterpulsation combined with atorvastatin in the treatment of cognitive impairment after stroke

Duan Y, Tang HX

1037 Value of Chuanjin Qinggan decoction in improving the depressive state of patients with herpes zoster combined with depression

Wang YN, Shi MM, Zhang JM

1046 Impact of an emergency department nursing intervention on continuity of care, self-care, and psychological symptoms

Xu S, Gu YF, Dong AH

1053 Effect of cognitive behavior therapy training and psychological nursing on the midwifery process in the delivery room

Shi Q, Wang J, Zhao D, Gu LY

1061 Meteorological factors, ambient air pollution, and daily hospital admissions for depressive disorder in Harbin: A time-series study

Hu T, Xu ZY, Wang J, Su Y, Guo BB

1079 Analysis of influencing factors and the construction of predictive models for postpartum depression in older pregnant women

Chen L, Shi Y

Observational Study

1087 Relationship between nightmare distress and depressive symptoms in Chinese emergency department nurses: A cross-sectional study

Gan QW, Yu R, Lian ZR, Yuan YL, Li YP, Zheng LL

1096 Mediating role of physical activity in the relationship between psychological distress and intimate relationships among stroke patients

Luo CY, Jiao P, Tu SM, Shen L, Sun YM

1106 Surviving the shift: College student satisfaction with emergency online learning during COVID-19 pandemic

Zhai XY, Lei DC, Zhao Y, Jing P, Zhang K, Han JT, Ni AH, Wang XY

1121 Influence of physical education on anxiety, depression, and self-esteem among college students

Fu HY, Wang J, Hu JX

1133 Influence of childhood trauma on adolescent internet addiction: The mediating roles of loneliness and negative coping styles

Dong WL, Li YY, Zhang YM, Peng QW, Lu GL, Chen CR

Contents

ABOUT COVER

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ORIGINAL ARTICLE

Observational Study

Mediating role of physical activity in the relationship between psychological distress and intimate relationships among stroke patients

Chang-Yue Luo, Peng Jiao, Shu-Min Tu, Lin Shen, Yong-Mei Sun

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Abstract

BACKGROUND

Stroke patients often experience psychological distress, which can impact their intimate relationships with spouses, subsequently influencing their treatment and recovery. Physical activity is considered a key rehabilitation method for stroke patients. This paper aims to analyze whether psychological distress affects intimate relationship between spouses through physical activity.

AIM

To explore the mediating effect of physical activity between psychological distress and intimate relationship in stroke patients.

METHODS

A total of 256 stroke patients who underwent treatment at the First People's Hospital of Shangqiu between July 2021 and July 2022 were enrolled in this study. The participants completed questionnaires, including the Kessler Psychological Distress Scale (K10), the Quality of Relationship Index (QRI), International Physical Activity Questionnaire, and a general information questionnaire. Data analysis were performed using SPSS 23.0. The Harman test was employed to detect common method deviations, and Spearman correlation was used for correlation analysis. The mediating effect was assessed using Process 3.4.1, with significance testing of the regression coefficients conducted using the bias-corrected percentile Bootstrap method (5000 iterations, 95% confidence interval). Statistical significance was set at $P < 0.05$.

RESULTS

The results showed that patients scored an average of 21.61 ± 6.44 points on the K10, 32.40 ± 6.19 points on the QRI; the median physical activity level according to the International Physical Activity Questionnaire was 1861 (566, 2846)

MET·min/w. The level of physical activity (the physical activity intensity of the patients reflected by the International Physical Activity Questionnaire-Long Form scale) negatively correlated with psychological distress and intimacy ($P < 0.05$), and positively correlated with each other ($P < 0.05$), with the correlation stronger at lower physical activity levels compared to higher ones. The mediating effect of physical activity between psychological distress and intimate relationship was calculated to be 40.23%. Bootstrap analysis further validated the results. The mediating effect of psychological distress on intimate relationships through physical activity level was -0.284, with a confidence interval of -0.409 to -0.163, excluding 0, confirming a significant mediating effect of psychological distress on intimate relationships.

CONCLUSION

Physical activity significantly affects relationship between psychological distress and intimate relationships among stroke patients. Addressing the role of physical activity may have implications for improving patient outcomes and rehabilitation strategies.

Key Words: Stroke; Cross-sectional study; Psychological distress; Intimate relationship; Mediating effect; Physical activity level

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Core Tip: Psychological distress is prevalent among stroke patients and can significantly impact their intimate relationships with spouses. Physical activity plays a crucial role in stroke prevention and rehabilitation. This study successfully identified a mediating effect of physical activity on psychological distress and intimate relationships, among stroke patients, confirmed through the Bootstrap test. These findings provide a robust foundation for promoting stroke patient rehabilitation and addressing relationship challenges between spouses.

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INTRODUCTION

Stroke is not simply a singular disease; rather, it encompasses a group of conditions resulting from impaired brain function caused by cerebrovascular disease[1]. With its high incidence, disability, mortality and recurrence rate, stroke has become a global health concern, leading to numerous disabilities and deaths in China[2]. During the post-stroke treatment and rehabilitation process, patients often face stigma and significant psychological distress due to disabilities and disruptions in their self-image[3]. Intimate relationships, characterized by communication that fosters intimacy and cooperation within an interdependent framework, play a crucial role in the lives of stroke patients and their spouses[4]. Spouses of stroke patients endure long-term care and economic burdens and experience multiple psychological pressures from family and society, which can negatively impact their relationship and mutual happiness[5]. Research indicates that regular physical activity is a vital preventive measure against stroke, attributed to its potential to improve vascular function and reduce stroke-related risk factors[6]. Therefore, physical activity can potentially aid patient rehabilitation, delay deterioration of their condition, alleviate psychological distress, and mitigate the adverse effects of negative emotions on the relationship between stroke patients and their spouses. However, there is a lack of research on the interplay among physical activity level, psychological distress, and intimacy in the context of stroke patients, both domestically and globally. Therefore, this study aimed to investigate whether the level of physical activity acts as a mediating factor between psychological distress and intimacy in stroke patients. By exploring this relationship, the study seeks to provide novel insights into alleviating the strains within the spousal relationships among stroke patients.

MATERIALS AND METHODS

Patient characteristics

This cross-sectional survey involved 256 patients who received stroke-related treatment at the First People's Hospital of Shangqiu between July 2021 and July 2022. Inclusion criteria were as follows: (1) Patients meeting the diagnostic criteria of stroke and diagnosed with stroke through head computed tomography or magnetic resonance imaging; (2) Age under 80 years; (3) Married and cohabitating with a spouse; and (4) Stable condition, clear consciousness, and no obvious language comprehension and expression disorders. Exclusion criteria included: Severe heart, liver or kidney dysfunction, respiratory failure and malignant tumors. The study received ethical approval from the First People's Hospital of

Shangqiu (2021-125-29), and all participants provided informed consent voluntarily.

Research tools

Figure 1 illustrates the study process. The following research tools were utilized: (1) General information questionnaire: A self-designed questionnaire capturing demographic data (*e.g.*, age, gender) and disease-related information (*e.g.*, stroke attack, stroke course); (2) The Kessler Psychological Distress Scale (K10)[7]: Used to assess the mental health status of individuals, comprising ten items scored on a five-level scale (score range: 10-50). Higher scores indicate poorer mental health status (Cronbach's α = 0.896); (3) The Quality of Relationship Index (QRI)[8]: Evaluates satisfaction with intimate relationships using six items rated on a 7-level scale (score range: 6-42). Higher scores indicate higher satisfaction with intimate relationships (Cronbach's α = 0.943); and (4) International Physical Activity Questionnaire-Long Form (IPAQL)[9]: Measures patients' health-related physical activity over the past week and calculates metabolic equivalents. The questionnaire covers physical activities (work-related, transportation, daily life, sports, and leisure), sedentary behavior, and sleep. Among them, four types of physical activities were evaluated for walking, moderate and severe physical activities, with a total of 27 items. The total metabolic equivalent was used to evaluate the overall physical activity level. Higher scores indicate better physical activity levels (Cronbach α = 0.827). For analysis, the total metabolic equivalent scores were sorted from small to large, and the first 50% and the last 50% were divided into two groups: Lower activity group and higher activity group.

Quality control

A sample size of 256 patients was deemed sufficient, meeting the requirement of seven times the number of research variables (based on the largest number of items in the International Physical Activity Questionnaire, 27 items) with a consideration of a 20% missing rate. The investigators, designated by the hospital, distributed and collected the questionnaires on-site with unified guidance. If respondents were unable to complete the questionnaire themselves, investigators assisted them in filling it out based on the their inputs. Missing items were addressed promptly to ensure complete and accurate information was obtained. Double entry and verification of data were conducted to ensure the validity, accuracy and integrity of data entry.

Statistical analysis

Data processing was performed using SPSS 23.0 (IBM Corp., Armonk, N.Y., United States). Normally distributed measurement data are presented as mean ± SD, while skewed distribution data are expressed as median (M) and quartile (P_{25}, P_{75}). Count data are expressed as cases (%). The Harman single factor test was used to test for common method bias. Spearman correlation analysis was used for correlation analysis. The mediating effect was tested by Process 3.4.1 (Designed by Andrew F. Hayes based on SPSS), and the significance of regression coefficients was assessed using the bias-corrected percentile Bootstrap method (5000 iterations, 95% confidence interval). Statistical significance was set at $P < 0.05$.

RESULTS

Clinical characteristics

A total of 260 questionnaires were distributed, and 256 valid questionnaires were collected, yielding an effective response rate of 98.46%. Among the participants, 195 were male (76.17%) and 61 were female (23.83%). The age distribution was as follows: 28 patients (10.94%) were younger than 45 years, 132 patients (51.56%) were between 45 and 60 years, and 96 patients (37.50%) were older than 60 years. The proportion of patients with junior high school education was the largest (40.23%), and the college or higher had the lowest proportion (14.84%). More than ninety percent of the patients had a year of marriage of more than 20 years (92.19%), and only 7.81% (20/256) of the patients had less than 20 years. There are 71.88% (184/256) of the patients were a first-ever stroke. The type of stroke in 3.52% (9/256) of patients were hemorrhagic, 94.14% (241/256) were ischemic, and 2.34% (6/256) were hybrid. About 7 percent of the patients had self-care ability and did not need to rely on others for activities, 65.24 % of the patients had mild dependence, and 27.73 % of the patients had moderate and heavy dependence (Table 1).

Common method bias

To address potential common method bias, quality control measures were implemented during the investigation. Factor analysis of the questionnaires was conducted, and the Harman test showed that the eigenvalue of two factors exceeded 1, accounting for a maximum of 34.59% (< 40%), indicating no significant common method deviation.

Comparison of K10 and QRI scores

The study found that the average K10 score of the 256 patients was 21.61 ± 6.44 points, while the average QRI score was 32.40 ± 6.19 points. Significant differences in K10 and QRI scores were observed among patients with different physical activity levels ($P < 0.05$) (Figure 2).

Correlation analysis

Correlation analysis was performed among psychological distress (K10), intimate relationship (QRI), and metabolic equivalent (IPAQL) in patients with different physical activity levels. In the lower activity group, psychological distress

Table 1 General characteristics of the stroke patients

Clinical features	Cases	Constituent ratio (%)
Sex		
Male	195	76.17
Female	61	23.83
Age (yr)		
< 45	28	10.94
45-60	132	51.56
> 60	96	37.50
BMI (kg/m^2)		
< 18.5	6	2.34
18.5-23.9	71	27.73
24-27.9	84	32.81
≥ 28	95	37.12
Educational		
Primary school or below	73	28.52
Junior high school	103	40.23
Senior high school	42	16.41
College or higher	38	14.84
Personal monthly income (Yuan)		
< 1000	68	26.56
1000-3000	61	23.83
3001-5000	69	26.95
> 5000	58	22.66
Payment method		
Medical insurance	219	85.55
Private expense	37	14.45
Year of marriage (yr)		
< 10	9	3.51
10-20	11	4.30
> 20	236	92.19
Frequency		
First	184	71.88
Recurrence	72	28.12
Course (mo)		
< 6	193	75.39
6-12	5	1.95
13-36	12	4.69
> 36	46	17.97
Type		
Hemorrhagic	9	3.52
Ischemic	241	94.14
Hybrid	6	2.34

Staging		
Acute stage	215	83.98
Recovery stage	23	8.98
Sequelae stage	18	7.04
Dysfunction		
No	223	87.11
Yes	33	12.89
Long-term medication history		
No	121	47.27
Yes	135	52.73
Combined types of chronic diseases (type)		
0	89	34.77
1	117	45.70
2	43	16.80
≥ 3	7	2.73
Self-care ability		
Heavy dependence	5	1.95
Moderate dependence	66	25.78
Mild dependence	167	65.24
No need to rely on	18	7.03

exhibited negative correlations with intimacy and metabolic equivalent (r = -0.523, P < 0.001; r = -0.528, P < 0.001), while intimate relationship positively correlated with metabolic equivalent (r = 0.631, P < 0.001). In the higher activity group, psychological distress showed negative correlations with intimate relationship and metabolic equivalent (r = -0.481, P < 0.001; r = -0.265, P < 0.001), and a positive correlation between intimate relationship and metabolic equivalent (r = 0.476, P < 0.001) was observed (Figure 3).

Mesomeric effect

The mediating effect analysis revealed that psychological distress significantly influenced intimate relationships in the first step (b = -0.734, P < 0.001), indicating a total effect. In the second step, psychological distress had a significant effect on physical activity level (b = -0.650, P < 0.001). In the third step, both psychological distress and physical activity level significantly affected intimate relationships (b = -0.439, P < 0.001; b = 0.454, P < 0.001), establishing a partially mediated model through activity level (Table 2).

The results were further validated through Bootstrap analysis. It was found that: (1) The total effect of psychological distress on intimate relationships was -0.706, with a confidence interval of -0.786 to -0.625, indicating a significant total effect; (2) The direct effect of psychological distress on intimate relationships was -0.422, with a confidence interval of -0.514 to -0.330 also signifying a significant direct effect; and (3) The mediating effect of psychological distress on intimate relationships through physical activity level was -0.284, with a confidence interval of -0.409 to -0.163, excluding 0, confirming a significant mediating effect of psychological distress on intimate relationships (Table 3).

The level of physical activity was found to act as a mediating factor between psychological distress and intimacy, and the mediating model was established. The psychological distress-physical activity level-intimacy relationship exhibited a partial mediating effect, accounting for 40.23% of the total effect (Figure 4).

DISCUSSION

Stroke patients often experience language impairment and motor dysfunction, leading to reduced self-care ability and social adaptability, which can result in psychological distress for both the patients and their partners[10]. As the main caregivers in the family, partners' attitudes and caregiving abilities directly influence the patient's mood and rehabilitation progress[11]. Importantly, alleviating psychological distress can enhance the relationship between patients and partners, foster open communication, and improve marital happiness and overall quality of life for spouses[12]. Previous studies have identified hypertension, diabetes, dyslipidemia, and obesity as risk factors associated with stroke, and physical activity can have a positive impact on these risk factors[13,14]. Physical activity can positively impact these risk factors by improving vasodilation, reducing diabetes, hypertension, dyslipidemia, obesity, and depression risk, thus

Table 2 Process method to test the mediating effect

Procedure	Dependent variable	Independent variable	R^2	β	*F* value	*t* value	*P* value
Step one	Intimate relationship	Psychological distress	0.536	-0.734	296.150	-17.209	< 0.001
Step two	Physical activity	Psychological distress	0.420	-0.650	185.574	-13.623	< 0.001
Step three	Intimate relationship	Psychological distress	0.655	-0.439	242.710	-9.063	< 0.001
		Physical activity		0.454		9.377	< 0.001

Table 3 Bootstrap analysis of the mediating effect

Index	Effect	SE	*t* value	*P* value	95%CI
Direct effect	-0.422	0.047	-9.062	< 0.001	-0.514 to -0.330
Indirect effect	-0.284	0.064	-	-	-0.409 to -0.163
Total effect	-0.706	0.041	-17.209	< 0.001	-0.786 to -0.625

CI: Confidence interval.

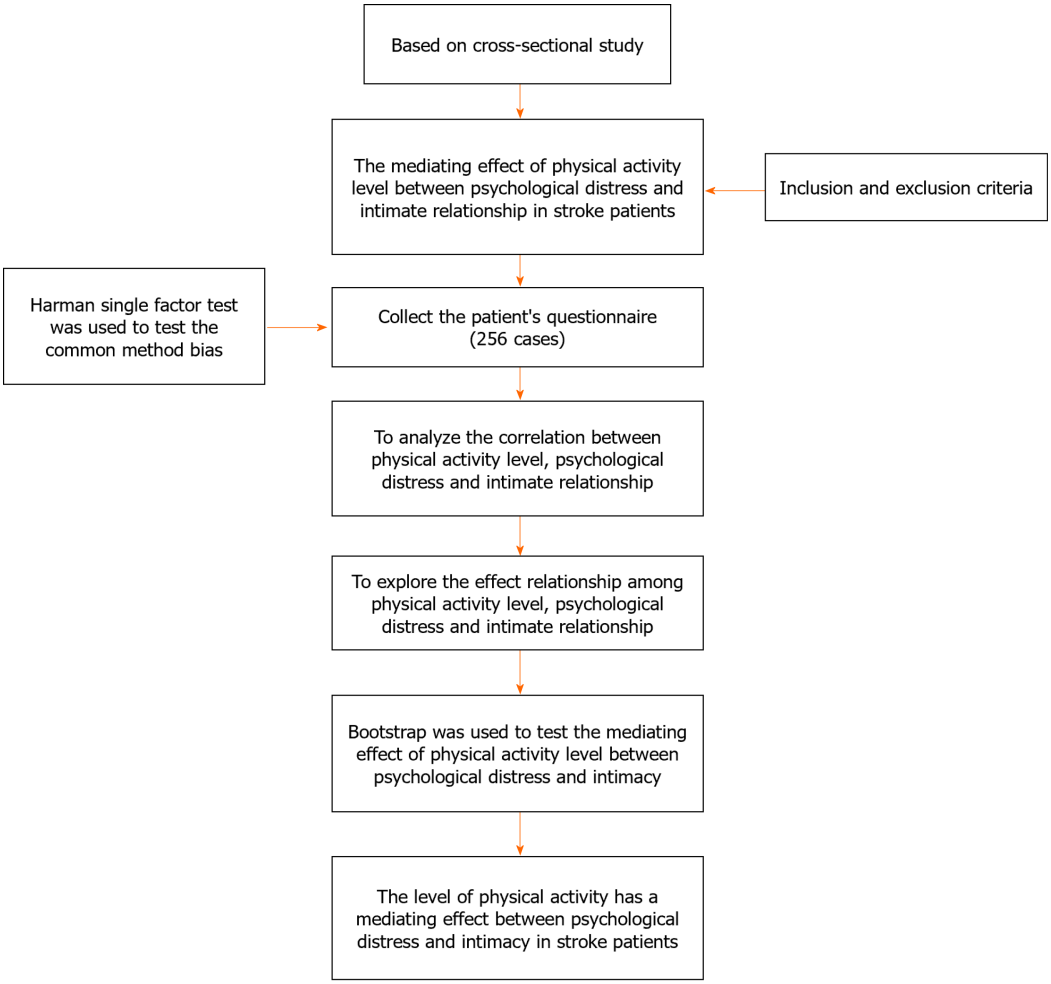

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Figure 1 Flowchart providing the steps and approach of this study.

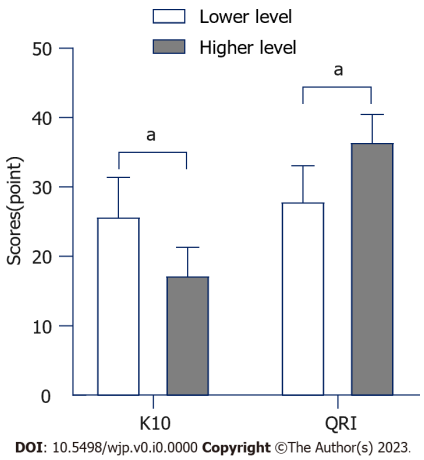

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Figure 2 The Kessler Psychological Distress Scale and Quality of Relationship Index scores of stroke patients based on physical activity level. $^{a}P < 0.05$. QRI: The Quality of Relationship Index; K10: The Kessler Psychological Distress Scale.

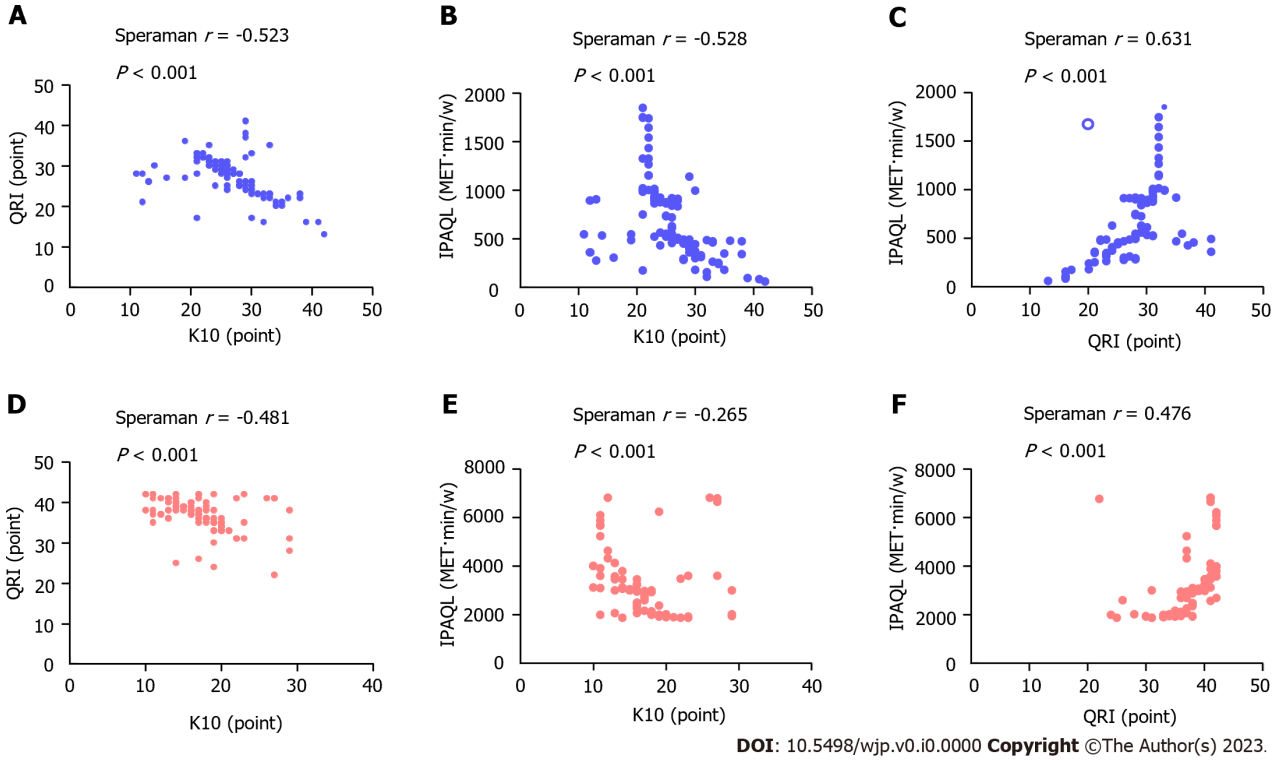

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Figure 3 Correlation analysis of patients' psychological distress, intimate relationship satisfaction, and physical activity level. A: Lower activity level group, the correlation between psychological distress [the Kessler Psychological Distress Scale (K10)] and intimate relationship satisfaction [the Quality of Relationship Index (QRI)]; B: Lower activity level group, the correlation between psychological distress (K10) and physical activity level [International Physical Activity Questionnaire-Long Form (IPAQL)]; C: Lower activity level group, the correlation between intimate relationship satisfaction (QRI) and physical activity level (IPAQL); D: Higher activity level group, the correlation between psychological distress (K10) and intimate relationship satisfaction (QRI); E: Higher activity level group, the correlation between psychological distress (K10) and physical activity level (IPAQL); F: Higher activity level group, the correlation between intimate relationship satisfaction (QRI) and physical activity level (IPAQL). K10: The Kessler Psychological Distress Scale; QRI: The Quality of Relationship Index; IPAQL: International Physical Activity Questionnaire-Long Form.

promoting stroke recovery and delaying deterioration. Therefore, moderate physical activity can aid stroke patients' recovery, reduce their psychological distress, and help restore and improve the relationship between patients and their partners.

The prevalence of psychological distress among stroke patients in China is high, with post-stroke depression and anxiety reported at 84.51% and 75.63%, respectively[15]. Psychological distress significantly hampers treatment, rehabilitation, long-term function, and quality of life for stroke patients, increasing the risk of stroke recurrence and mortality [16]. Physical activity refers to bodily movements that requires energy expenditure, primarily achieved through skeletal muscle contraction. It encompasses both structured and physical exercises as well as daily activity[17]. After illness,

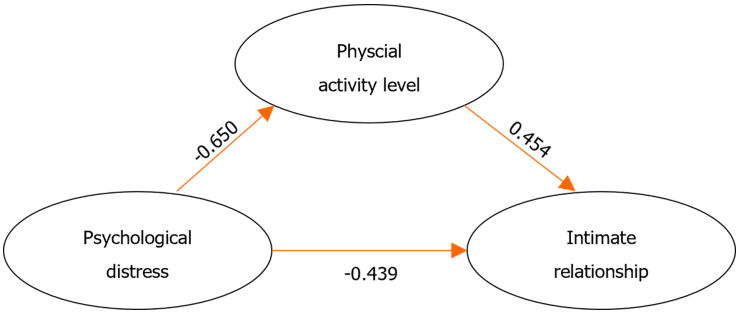

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Figure 4 Patient physical activity mediation model.

patients may have reduced self-care ability and fear of exercise, leading to low physical activity levels. In this study, patients with lower physical activity levels had higher scores for psychological distress (K10) and a lower scores for intimate relationship satisfaction (QRI), consistent with previous research findings[18-20]. Unimproved conditions, poor prognosis, and uncertainty about the illness cause psychological problems that lead to patient self-closure and reluctance to express thoughts and feelings to their partners, affecting the intimate relationship between them. Correlation analysis revealed significant associations among psychological distress (K10), intimate relationship satisfaction (QRI), and physical activity levels (IPAQL) in patients with different physical activity levels. Patients with lower physical activity levels showed stronger correlations, suggesting that lower physical activity levels were associated with more distress and reduced communication with spouses, leading to a greater impact on intimate relationships. Unpleasant emotional experiences can disrupt the maintenance of intimate relationships between spouses.

The mediating effect analysis indicated that physical activity levels significantly mediated the relationship between psychological distress and intimate relationship satisfaction, accounting for 40.23% of the total effect. This suggests that physical activity can alleviate the patients' psychological distress and indirectly influence the intimate relationship with their spouses. Several studies have highlighted the correlation between psychological distress and physical activity level [21]. Prolonged exposure to severe and complex stress, exceeding an individual's coping abilities, can not only affect the patient's emotional responding, but also impact their partner's well-being and marital satisfaction. Increasing physical activity, such as participating in sports, can help reduce the risk of adverse psychological states, anxiety and depression during such challenging times. In fact, stroke patients often use physical activity as part of their rehabilitation treatment. This approach can stimulate nerve and limb function recovery, regulate the sympathetic nervous system to alleviate anxiety and depression levels, enhance physical functionality, decrease disability rates, and improve daily living activities [22]. However, it is important to note that in this study, physical activity level represents only one of the mediating factors between psychological distress and intimate relationship satisfaction. This implies that physical activity plays a partial role in mediating these factors. To effectively address patients' psychological distress, a comprehensive consideration of other contributing factors is necessary. Medical professionals play a crucial role in supporting patients during their treatment journey. Encouraging patients to manage their illness correctly, guiding them and their spouses to adopt positive behaviors, and fostering effective coping strategies are essential steps to alleviate psychological distress. Furthermore, enhancing patient cooperation and strengthening the intimacy between spouses can help mitigate both the psychological and physical burdens faced by the couple.

CONCLUSION

In summary, patients' psychological distress significantly affects their intimate relationship with their spouses, and the level of physical activity serves as a crucial factor between psychological distress and intimate relationship satisfaction. Therefore, it is imperative to focus on improving patients' physical activity levels to reduce psychological distress pressure, enhance communication between spouses, and provide mutual support to foster a stronger sense of intimacy and well-being.

ARTICLE HIGHLIGHTS

Research background

The psychological distress experienced by stroke patients can significantly impact their intimate relationships with their partners.

Research motivation

The strain in spousal relationships can further exacerbate the psychological distress of stroke patients and imped their recovery process.

Research objectives
This study aims to investigate whether the level of physical activity in stroke patients influences their psychological distress and subsequently affects the quality of their intimate relationships with their spouses.

Research methods
Data was collected through questionnaires, and the presence of common method bias was verified using Harman test. The mediating effect analysis was conducted to explore the relationships between psychological distress, intimacy, and physical activity levels. The significance of the regression coefficient was verified using Bootstrap.

Research results
The findings indicate that the physical activity level of stroke patients has an impact on their psychological distress, which, in turn, influences the quality of their intimate relationships with their partners.

Research conclusions
This study has shed light on the interplay between psychological distress, intimate relationships, and physical activity levels among stroke patients, offering new insights to improve the bond between couples in such situations.

Research perspectives
As a single-center study, this research has certain limitations, and other factors may also influence the outcomes. To enhance the generalizability and validity of the findings, further expansion and external validation are warranted.

FOOTNOTES

Author contributions: Luo CY, Shen L, and Sun YM designed this study; Jiao P organized the literature; Luo CY wrote the manuscript; Tu SM reviewed the manuscript.

Institutional review board statement: The study procedures were approved by the First People's Hospital of Shangqiu (2021-125-29).

Informed consent statement: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

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