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The relationship between psychological distress and frailty in stroke patients: the mediating effect of depression

Ying Li[1*], Xiaoan Chen[1], Di Hu[2], Xu Peng[1] and Jinguo Wang[1]

Abstract

Background Frailty is a significant factor affecting the quality of life of stroke patients. psychological distress is an essential factor affecting depression in stroke patients. However, the mediating role of depression between psychological distress and debilitation has not been explored.

Methods In this study, 315 stroke patients in Shandong and Liaoning provinces were investigated by convenience sampling method from May 2024 to October 2024. Questionnaires included Frailty Scale and Psychological Distress and Depression scale.

Results In this study, psychological distress scores (4.16 ± 2.29), depression scores (8.81 ± 4.55) and frailty scores (8.92 ± 4.09) were obtained. There was a significant positive correlation between depression and psychological distress in stroke patients ($r = 0.483$, $P < 0.001$), depression and frailty ($r = 0.575$, $P < 0.001$). There was a significant positive correlation between psychological distress and frailty in stroke patients ($r = 0.391$, $P < 0.001$). The direct effect of psychological distress in stroke patients was 0.264. The direct mediating effect of depression on psychological distress and frailty was 0.435.

Conclusion This study provides further insights into the psychological mechanism of psychological distress and frailty in stroke patients. Clinicians and nurses can actively help stroke patients reduce psychological distress, reduce the depression of stroke patients, so as to reduce the occurrence of frailty and improve the quality of life of patients.

Keywords Psychological distress, Frailty, Depression, Stroke patient

Introduction

Stroke is a common disease caused by sudden cerebrovascular injury, which is mainly divided into hemorrhagic stroke and ischemic stroke [1]. Hemorrhagic stroke is defined as an acute neurologic injury occurring as a result of bleeding into the head [2]. Ischemic stroke occurs when a blood clotor other particles blocks the blood vessels that supply oxygen-rich blood to the brain [3]. China has one of the highest age-standardized incidence rates of stroke in the world [4–5]. The disability of stroke patients leads to the limitation of autonomous activities, which significantly impair rehabilitation efforts and overall quality of life. Frailty is a multi-dimensional syndrome characterized by decreased physiological reserve and function of multiple systems, which tends to reduce the patient's ability to respond to everyday or acute stressors [6–7]. A large number of studies have pointed out that frailty is a significant risk factor for

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stroke, and the prevalence rate of stroke combined with frailty is 2.2%~54.0% [8–9]. Interestingly, both ischemic and hemorrhagic strokes can lead to debilitating events [9]. It is independently correlated with a series of adverse post-stroke outcomes such as prolonged hospital stay, disability and death [8].

Psychological distress is an unpleasant emotional experience caused by a variety of factors, including psychological, social and spiritual changes [10]. Studies have found that both ischemic stroke and hemorrhagic stroke are associated with psychological distress [11]. After stroke, patients' decreased attention, poor memory, irritability, irritability and other emotions will reduce their cooperation in treatment, and long-term negative emotions are not conducive to the rehabilitation of the disease, and more seriously, it will increase patients' sense of self-rejection, causing patients' psychological distress [12–13]. Serious or persistent psychological distress often affects the enthusiasm of patients for treatment and rehabilitation, the quality of life continues to decline, and it can also lead to serious psychological problems such as anxiety, depression, and personality change [14–15].

Poststroke depression include low mood, loss of interest, sleep disturbances, and physical symptoms [16–17]. About 1/3 of stroke patients have depressive symptoms at different periods after stroke, and the cumulative incidence within five years is 39-52% [18–19]. Studies have shown that compared with stroke patients without depression, post-stroke depressed patients have more severe deficits in activities of daily living, worse prognosis for functional rehabilitation, more serious cognitive deficits, and higher disability, recurrence and mortality rates [20–21]. Studies have found a positive correlation between Post-stroke depression and psychological distress [22]. To the best of our knowledge, the mediating role of post-stroke depression between psychological distress and frailty in stroke patients has not been explored. This study will help us understand the mechanisms by which psychological distress leads to depression and develop effective interventions.

After stroke, patients often have varying degrees of nerve or limb function damage, resulting in changes in the physiological structure of patients, negative development of psychological conditions that are also worsened, and then psychological distress [23].

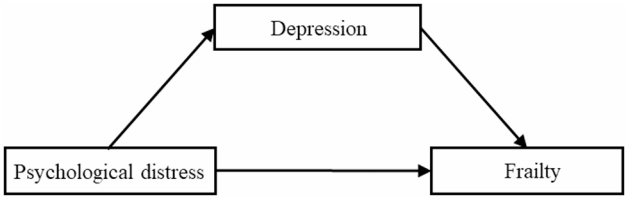

Fig. 1 Hypothesized a mediation model

YE [24] and SCHNITTGER [25] found a significant positive correlation between psychological distress and frailty. The existence of long-term psychological distress may cause patients to lose confidence and sense of meaning in overcoming the disease, leading to fatigue in disease management and emotional regulation, and exacerbating the occurrence of frailty. Psychological distress is correlated with the occurrence of depression. The occurrence of psychological distress affects the average social ability of patients, reduces the quality of life of patients, seriously reduces the autonomy of patients in disease treatment, aggravates the negative emotions of patients, and leads to depression [26–27]. Yan [28] analyzed the correlation between frailty and depression, and found that the incidence of depression also increased significantly with the aggravation of frailty, and the two were positively correlated ($r = 0.34$, $P < 0.05$). In addition, a growing body of evidence supports chronic inflammation as a causative mechanism for depression and frailty [29]. Several studies have shown that the inflammatory factor interleukin-6 (IL-6) is positively associated with frailties and depression [30–34].In addition, studies have shown that age [35–37], chronic inflammatory response [38] and residential conditions [39] have potential effects on frailty and psychological distress, and their potential effects should also be considered in exploring the correlation between frailty, depression and psychological distress.

Based on the above studies, we hypothesize that psychological distress after stroke can not only directly affect frailty, but also indirectly through depression (see Fig. 1). However, the current lack of available evidence has not clearly tested the validity of the above mediation model. Therefore, this study took stroke patients as human participants.

to explore the mediating role of depression between psychological distress and frailty.

Materials and methods

Participants

To clarify the depression, psychological distress and frailty of stroke patients, convenience sampling was used to select medically diagnosed stroke patients in the neurology departments of two hospitals in Shandong Province and Liaoning Province from May 2024 to October 2024 as the study objects. In the process of investigation, the investigator administered paper questionnaires to introduce the investigation purpose, research content and questionnaire filling method to the patients. After obtaining the consent of the patient, the questionnaire is issued, which is filled out by the patient and withdrawn on the spot. Patients (physical limitations, illiterate, hearing impairments) are unable to fill out the questionnaire due to special reasons, and the investigators read the

questions aloud to ensure clarity. A total of 330 questionnaires were sent out in this study. After excluding invalid questionnaires, including those with missing answers and consistent answers to all items, 315 valid questionnaires were finally included, with an effective recovery rate of 95.45%.

Inclusion criteria meeting the diagnostic criteria for stroke, with newly diagnosed ischemic or hemorrhagic stroke confirmed by CT and/or MRI; age ≥ 18 years; clear awareness; volunteer for the study.

Exclusion criteria those with serious comorbid conditions affecting the heart, brain, kidneys, other organ systems; those with speech or cognitive impairments; those with mental illness or intellectual disabilities.

Measures

Geriatric depression scale (GDS-15)

In this study, GDS was used to assess the degree of depression in stroke patients. The scale included 15 items, the total score was the sum of items. The GDS-15 score is ≥ 8 for depressive symptoms [40]. GDS-15 was assessed within the last week, and the participants answered "yes" or "no" with 1 point for each "yes" and 0 point for each "no". The higher the score, the more obvious the depressive symptoms were. In this study, the Cronbach's α for the sample was 0.912.

Distress thermometer(DT)

DT was used to screen for psychological distress. DT was developed by Roth et al. [41]. in 1998. The Chinese version of DT was revised by Zhang Yining et al. and used to assess the psychological distress level of patients in the past week, from "no distress " to "extreme distress " 0 ~ 10 points, DT ≥ 4 points is a positive result, indicating that patients have obvious psychological distress [42]. DT has been widely used to assess psychological distress in patients with chronic diseases [43–46]. In this study, the Cronbach's α for the sample was 0.805.

Tilburg frailty indicator(TFI)

The TFI scale was developed by Gobbens et al. in 2010 based on the FadH integration model framework. The scale includes three dimensions of physical weakness, psychological weakness and social weakness [47]. Scores range from 0 to 15, with scores greater than 5 indicating frailty [47]. In this study, the Cronbach's α for the sample was 0.885.

Ethical considerations

This study was conducted after the Ethics Committee of Jishou University approved the exemption review (JSDX-2024-0084). The study's objectives were explained for the participants' ethical reasons, and they were informed that the results could only be used for research purposes. Participants provided written informed consent before completing the study questionnaire. Patients' data is anonymized in the study to ensure that it is used only for research purposes and is not disclosed to third parties.

Statistical analyses

All analyses were performed using IBM SPSS Statistics Version 26.0. The mean and standard deviation of continuous variables were used to calculate psychological distress, frailty, and depression scores. Independent sample t test or one-way analysis of variance were used to compare the scores of three variables with different demographic characteristics. In order to provide the basis for selecting the appropriate mediating variables, we carried out partial correlation analysis to determine the correlation between the variables. PROCESS macros implemented in SPSS software (IBM Corporation, Armonk, NY, USA) [48]were used to analyze the mediation model. The PROCESS macro plugin uses 5000 bootstrap resampling iterations to evaluate model tests and 95% confidence interval estimates. If 95% CI does not include 0, the relationship is significant. The statistical significance was considered as $p < 0.05$.

Results

Results Harman's single factor test and normality test

Harman's single-factor test was used to examine the impact of common method bias. The analysis results showed that there were two factors with eigenvalues greater than 1. The first factor could explain 42.59% of the variability in the data, which was less than the critical threshold of 50%, indicating that there was no serious common method bias [49–50]. By inference, the relationship between variables was little affected by common method bias in this study.

The variable scores for participants

The mean and standard deviation (M ± SD) of psychological distress, depression and frailty were 4.16 ± 2.29, 8.81 ± 4.55 and 8.92 ± 4.09, respectively. The depression scores of stroke patients aged > 60 years were significantly higher than those ≤ 60 years (t = -3.32, $p < 0.001$). See Table 1 for details.

Correlation analysis

The inter-correlations of our study variables are presented in Table 2. There was a significant positive correlation between depression and psychological distress in stroke patients ($r = 0.483$, $P < 0.001$), depression and frailty ($r = 0.575$, $P < 0.001$). There was a significant positive correlation between psychological distress and frailty in stroke patients ($r = 0.391$, $P < 0.001$).

Table 1 Psychological distress, depression and frailty by participants' characteristics

	N (%)	Psychological distress	t/F (*p*)	Frailty	t/F(*p*)	Depression	t/F(*p*)
Gender			-1.27(0.21)		-0.17(0.86)		-1.58(0.12)
Female	174	4.01 ± 2.16		8.89 ± 3.87		8.44 ± 4.64	
Male	141	4.34 ± 2.43		8.96 ± 4.25		9.26 ± 4.41	
Age							
≤ 60	81	3.78 ± 2.34	-1.744(0.08)	8.27 ± 4.15	-1.67(0.09)	7.38 ± 4.57	-3.32(0.001) **
>60	234	4.29 ± 2.26		9.15 ± 4.06		9.30 ± 4.45	
Place of Residence			-0.62(0.54)		-3.05(0.003) **		-2.70(0.007) **
Urban	114	4.05 ± 2.18		8.00 ± 4.38		7.89 ± 4.72	
Rural	201	4.22 ± 2.35		9.44 ± 3.84		9.32 ± 4.38	
Living style			-1.39(0.163)		-0.61(0.55)		0.68(0.49)
Live alone	48	4.08 ± 2.35		8.86 ± 4.07		4.66 ± 0.29	
Live with family	267	4.58 ± 1.91		9.25 ± 4.21		3.89 ± 0.56	
Smoking history			0.72(0.47)		1.01(0.31)		1.75(0.08)
yes	106	4.22 ± 2.35		9.09 ± 4.14		9.12 ± 4.46	
no	209	4.03 ± 2.16		8.59 ± 3.98		8.18 ± 4.67	
Drinking history			1.65(0.10)		0.61(0.54)		1.41(0.16)
yes	88	3.82 ± 2.37		9.01 ± 4.12		9.03 ± 4.45	
no	227	4.29 ± 2.25		8.69 ± 4.03		8.23 ± 4.78	

*$p<0.05$,**$p<0.001$

Table 2 Inter-correlations among measures ($n = 315$)

	Depression	Psychological distress	Frailty
Depression	—	—	—
Psychological distress	0.483**	—	—
Frailty	0.575**	0.391**	—

*$P<0.05$, **$P<0.001$

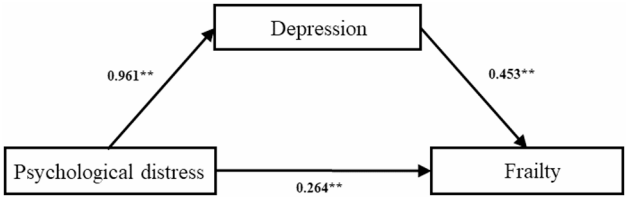

Fig. 2 The pathway of Psychological distress on frailty symptoms in stroke patients

Table 3 Significance test for mediating effects of depression, psychological distress and frailty

	Effect	SE	LLCL	ULCL	Percentage of Total Effect
Total effect	0.699	0.093	0.517	0.882	100%
Direct effect	0.264	0.093	0.081	0.448	37.77%
Indirect effect	0.435	0.061	0.323	0.561	62.23%

LLCI, the lower limit of B in 95% confidential interval; ULCI, the upper limit of B in 95% confidential interval. Bootstrap 95% CI excluding zero indicates a statistical difference

Test of the mediating effect of depression

There was a direct relationship between psychological distress and frailty in stroke patients (β = 0.264 (95%CI: 0.081~-0.448), and depression plays a significant mediating role in the relationship between psychological distress and frailty (β = 0.435, 95%CI: 0.323 ~ 0.561), as shown in Fig. 2; Table 3.

Discussion

This study investigated the relationship between psychological distress, frailty and depression in stroke patients. The results of the study showed that psychological distress in stroke patients was positively correlated with frailty and depression, which were statistically significant. After controlling for demographic variables, we found that depression mediates between psychological distress and frailty in stroke patients, confirming our initial hypothesis.

The frailty detection rate of stroke patients in this study was 79.37%, which was higher than that of MUNTHE [51]. This may be due to differences in disease severity, sample size, and assessment tools. In our study, the frailty score was 8.92 ± 4.09, and the stroke patients investigated in this study were in a frailty state. After stroke, patients are often accompanied by functional changes of multiple systems. In terms of motor system, due to damage to functional areas of the brain, muscle function, motor coordination and muscle control ability are prone to decline [52–54]. In terms of nervous system, due to autonomic nervous dysfunction, patients have an increased risk of myocardial injury, unstable blood pressure, and gastrointestinal dysfunction [55–56]. Immune imbalance may occur in the immune system, and the immune response ability of patients to infection is decreased, which increases the risk of infection and chronic inflammatory diseases [57]. The interaction of multiple systems

increases the individual's vulnerability to internal and external stressors, while limiting the ability to recover, making the patient's physical condition easy to develop into frailty. However, the occurrence of frailty will lead to the decline of physiological functions of the body, aggravate the condition and increase the risk of stroke recurrence [58]. Studies have found that although there is no direct correlation between pre-stroke frailty and short-term functional outcomes of stroke patients, the relationship between the two is mediated by disease severity and progression [59], and pre-stroke frailty is significantly correlated with stroke severity [60].Therefore, we should pay attention to the prevention and management of stroke patients' frailty, improve the frailty state of stroke patients, reduce the occurrence of adverse outcomes, and improve the quality of life.

In addition, our study found that stroke patients living in rural areas had higher frailty and depression scores. The reason may be that compared with urban patients, rural patients have no fixed economic income such as wages and pensions, cannot work after illness, loss of economic sources, low economic income, medical insurance reimbursement ratio is lower than urban workers and other practical difficulties, resulting in heavier economic burden than urban workers, more prone to guilt and depression [61]. In addition, it should not be ignored that social support plays a role in depression and frailty, and stroke patients living in rural areas have lower social support [62]. The study found that the higher the level of social support, the lower the frailty [63]. The results of LUGE's study show that active social support interventions can help solve the frailty problems of elderly people at home [64]. For stroke patients in rural areas the government should actively establish a preventive health care service system and increase attention to stroke patients in rural areas. The government should give full play to the central role of social support, increase the efforts to help stroke patients in economically tricky rural areas, reduce the economic pressure on patients, and improve the depression of stroke patients in rural areas. At the same time, we should actively guide families and communities to give more care and support to stroke patients and provide relationships and support to stroke patients in various aspects to avoid the occurrence of weakness and depression and improve the quality of life of patients with brain stroke. The results of this study showed a positive correlation between depression and frailty. The results of this study are consistent with those of previous studies. Poststroke depression reduces patients' enthusiasm for active rehabilitation [65], affects their participation in rehabilitation [66], reduces the effect of neurological rehabilitation, and increases the risk of disability of patients [20]. The occurrence of depression may lead to a decrease in interpersonal communication, a reduction of social participation and the lack of physical exercise in patients, and an increase in the levels of pro-inflammatory cytokines IL-6, TNF-α and non-specific acute protein CRP in the body [67]. High levels of pro-inflammatory cytokines act on skeletal muscle, reducing muscle density, weakening muscle strength and reducing muscle content. Cause the occurrence of sarcopenia. Inflammatory processes can also adversely affect the central nervous system - especially dopaminergic function in the basal ganglia, leading to fatigue, slow movement, frailty, and cognitive impairment, ultimately leading to frailty in patients [68].

In addition, inflammatory factors may influence frailty either directly by promoting protein degradation or indirectly by affecting important metabolic signaling pathways [69]. Therefore, it is necessary to pay attention to the mental health problems of stroke patients, prevent the occurrence of depression, dynamically assess the psychological status of patients in the process of rehabilitation, continue to pay attention to the emotional changes of patients, be alert to the occurrence of abnormal emotions, provide targeted psychological counselling, reduce the occurrence of adverse events, pay attention to the factors that may cause the emotional changes of patients, and intervene in time. Reduce the debilitating effects of depression.

The results of the mediating effect test showed that depression played a partial mediating role in psychological distress and frailty in stroke patients. On the one hand,

psychological distress has a positive predictive effect on stroke frailty. A longer course of disease will cause patients to suffer from different degrees of psychological distress, resulting in reduced emotional support and understanding for stroke patients, leading to the occurrence of frailty. On the other hand, the psychological distress of stroke indirectly affects the occurrence of frailty through depression. Our findings support the conceptual model of social relationships proposed by Berkman [70], which posits that social relationships influence health through a series of causal processes that begin at the macro-social level (upstream factors). On micropsychological biological processes (downstream factors). In the social network framework, psychological factors such as self-efficacy, self-esteem, depression, psychological distress, and well-being represent some "downstream" pathways linking social relationships to health [63]. In our study, we found that depression can seriously affect the health of stroke patients, further leading to the frailty of patients. Gonzalez et al. [71]conducted a study on depression and psychological distress and believed that there were some overlaps in symptoms of depression and psychological distress. It can lead to an imbalance of the patient's physical function state and increase the risk of

faltering [72–73]. The accumulated negative emotions can also interfere with the patient's management of their disease, leading to debilitating events.

There are some limitations to this study. First, the cross-sectional studies used in this study failed to prove a true cause-and-effect relationship. Cross-sectional studies are affected by a variety of confounding factors, and can only show the correlation between variables, but cannot determine which variable appears first. Therefore, longitudinal studies or empirical studies are needed to further clarify the relationship between stroke depression, psychological distress and frailty. Second, the results of this study took stroke patients as the research object, but did not divide the onset time of stroke patients, which will affect the results of this study to a certain extent. Future studies should collect relevant data of stroke patients with different disease courses to expand the applicability of the study results. Finally, the sample representation of our study may be insufficient, which will lead to selectivity bias. It is suggested to increase the sample size in the future to further verify the results of this study.

Conclusion

This study shows that depression has a positive correlation with psychological distress and frailty, and depression plays an intermediary role between psychological distress and frailty in stroke patients. The occurrence of psychological distress and frailty will not only reduce the patient's cooperation with treatment, but also be detrimental to the recovery of the disease and the recovery of daily living ability [74]. Reducing the psychological distress of stroke patients is very important to improve depression and relieve the frailty of patients. Therefore, in future studies, the psychological distress of stroke patients should be assessed as early as possible to actively reduce the psychological distress of stroke patients and improve the level of depression in patients to prevent the occurrence of frailty.

Author contributions

Li Ying12345, Xiaoan Chen124, Di Hu234, Xu peng13, Jinguo Wang13
1.Conceptualization; 2.Methodology; 3.Data curation; 4.Writing - Original Draft; 5.Writing - Review & Editing;

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Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval and consent to participate

Studies involving human subjects were reviewed and approved by the Research Ethics Committee of Jishou University (JSDX-2024-0084). Patients/participants provided written informed consent to participate in the study. We confirm that all the experiment is in accordance with the relevant guidelines and regulations such as the declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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