ORIGINAL RESEARCH

Trajectories and Interactions of Dyadic Coping and Depression in Patients After Thrombolysis for Acute Ischemic stroke: A Longitudinal Study in China

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Objective: To explore the developmental trajectory of dyadic coping and depression in stroke patients and the predictive relationship between the two and to provide a theoretical basis for improving depression in stroke patients.

Design: A longitudinal study.

Methods: Two hundred and forty-two stroke patients who underwent thrombolysis in the emergency department of our hospital from January 2023 to March 2024 were selected as the study subjects, and their dyadic coping and depression were tracked and investigated in T1 (after thrombolysis), T2 (3 months after the disease), and T3 (6 months after the disease), and the data were analyzed using a cross-lagged model and latent variable growth model.

Results: Two hundred and twelve valid serial questionnaires were recovered at the completion of the three time points. Stroke patients showed an increasing trend in dyadic coping and a decreasing trend in depression. Pearson correlation showed that the correlation between the two was significant at all 3 time nodes ($P<0.05$). Cross-lagged modeling showed that dyadic coping levels on average significantly and positively predicted depression at the next node, whereas depression did not significantly predict dyadic coping longitudinally at the next node. The latent variable growth model showed that dyadic coping (S=3.215, $P<0.001$) tended to increase and depression (S=−0.292, $P<0.001$) tended to decrease from T1 to T3 in stroke patients; at the initial level, dyadic coping was negatively correlated with depression (r=−0.356, P=0.002), initial levels of dyadic coping were able to positively predict itself (β=0.355, P=0.007) and the rate of development of depression (β=0.515, P=0.002), and the rate of development of dyadic coping was able to positively predict the rate of development of depression (β=0.584, $P<0.001$).

Conclusion: Dyadic coping was negatively associated with post-stroke depression, suggesting that higher levels of dyadic coping may serve as a protective factor against depressive symptoms in stroke survivors. This relationship underscores the potential therapeutic value of fostering mutual support and adaptive problem-solving strategies within patient-caregiver dyads, highlighting the clinical importance of integrating dyadic coping interventions into post-stroke mental health care.

Keywords: stroke, thrombolysis, dyadic coping, depression, trajectory, interaction relationship, longitudinal study, correlation

Introduction

In recent years, stroke has become the leading cause of death and disability in the world[1] and, as a major chronic non-communicable disease, poses a major threat to national health.[2] As a major chronic non-communicable disease, it poses a major threat to national health. According to the results of China's Stroke Screening and Intervention for High-Risk Populations report, 17.8 million adults in China will have experienced a stroke in 2020[3] The number of adults who have experienced a stroke in China in 2020 is 17.8 million. With the popularization of emergency thrombolysis, the mortality rate of stroke has been greatly reduced, but the disability rate is still at a high level.[4] However, after thrombolysis, patients often suffer from hemiparesis and aphasia, and the dysregulation of the hypothalamic–pituitary–adrenal axis, the increase of inflammatory factors, and the decrease of monoamine levels are the direct cause of patients' depression.[5,6]

Studies have indicated that the incidence of post-stroke depression is as high as 33%.[7] The emergence of depression puts patients in long-term psychological pain, which in turn induces a series of chain reactions such as anorexia, self-injury and suicide.[8] The presence of depression puts patients in long-term psychological distress, which in turn induces a series of chain reactions such as anorexia, self-injury and suicide. However, the relevant psychological nursing practices and interventions regarding depressive symptoms in stroke patients in our country are still at the primary stage. Therefore, it is important to understand the occurrence of depression in post-stroke patients and to provide timely psychological counseling and active intervention for patients at high risk of depression, in order to protect the life safety of patients and improve their prognosis.

Dyadic coping (DC) refers to the joint decision-making behavior of spouses in the face of a common stressor.[9] Given that many stroke survivors rely heavily on their spouses for emotional and practical support, exploring how couples jointly manage stress – known as dyadic coping – becomes essential in understanding and mitigating post-stroke depression. Good dyadic coping can alleviate patients' adverse emotions, improve patients' motivation for treatment, enhance quality of life, and improve prognosis.[10] For stroke patients, positive dyadic coping can help them adjust and adapt to the impact of the disease, reduce their negative emotions, alleviate depressive symptoms, and promote their mental health, etc. Understanding the trajectory of depression in stroke patients after thrombolysis and its interaction with dyadic coping, and actively intervening in patients through the interaction of dyadic coping for the time period of high incidence of depression are conducive to the reduction of their depression and improvement of their prognosis.

However, domestic and international studies have been limited to cross-sectional studies, and the developmental trajectories of dyadic coping and depression and their dynamic interrelationships in post-thrombolysis patients after stroke have not been clarified. In this study, we used a longitudinal design, cross-lagged modeling and latent variable growth modeling to explore the trajectories of dyadic coping and depression and their mutual predictive relationships in post-thrombolysis patients with stroke, in order to provide a theoretical basis for clinical staff to reduce patients' depression.

Subjects and Methods of Study
Research Target
Two hundred and forty-two stroke patients who underwent thrombolytic therapy in the emergency department of our hospital from January 2023 to March 2024 were selected as the study subjects by convenience sampling method. Inclusion criteria: (1) patients met the clinical diagnostic criteria for stroke and were confirmed by imaging and/or pathology in our hospital and had their first attack; (2) aged 18 years and above; (3) with basic understanding and communication ability, all signed the informed consent form. Exclusion criteria: (1) previous history of mental and psychological illness; (2) undergoing medication, psychotherapy, etc. Exclusion criteria: patients died in the middle of the study or withdrew for other reasons. This study was conducted as a clinical research after approval by the Ethics Committee of our hospital. This study adhered to the principles outlined in the Declaration of Helsinki and was finally approved by the Ethics Committee of The First Affiliated Hospital of Soochow University (ID: 2022120035). All participants provided informed consent prior to participation, and confidentiality was maintained throughout the study.

Research Methodology
Sample Size Calculation
According to the sample size requirement of the latent variable growth model, at least 200 stroke patients were needed, and considering the possible high dropout rate of 3 measurements, the dropout rate was set at 15%, so the minimum sample size for this study was set at n=200/(1–15%)=235 cases.

Survey Instruments
1) A self-administered questionnaire was used for the basic information, which contained general demographic information (including age, gender, marital status, income level, education level, and occupation of the stroke patients).

2) The dyadic coping Inventory (DCI), originally developed by Bodenmann et al, was translated, culturally adapted, and validated in Chinese by Xu et al.[11] DCI included 6 dimensions with 37 entries. A Likert 5-point scale was used, with a total score of 37–175, with <111 indicating below average; 111–145 indicating in the normal range; and >145 indicating above average, with higher scores indicating more positive dyadic coping in couples. The Cronbach's alpha coefficient for this scale in this study was 0.846.

3) The 9-item Patient Health Questionnaire (PHQ-9), originally developed by Kroenke et al,[12] was translated, culturally adapted, and validated in Chinese by Bian Cuidong et al,[13] "Not at all" scored 0 points, "several days" scored 1 point, "more than half of the days" scored 2 points, "almost every day" were scored as 3, and the total score ranged from 0 to 27. The sum of PHQ-9 scores <5 indicated no depression, 5–9 was mild depression, 10–14 was moderate depression, and >15 was severe depression. The Cronbach's alpha coefficient for this scale in this study was 0.810.

Data Recovery Methods and Quality Control

After the questionnaire survey of this study was approved by the hospital ethics committee (ID: 2022120035), all patients signed the informed consent form, and the face-to-face investigation was conducted after the patients' conditions were stable. The general information questionnaire was obtained after the patient's first diagnosis of stroke thrombolysis.

Varner et al[14] noted that dyadic coping is divided into supportive and unsupportive behaviors and that patients' supportive behaviors are relatively stable over 12 months after illness, and unsupportive behaviors change significantly over 6 months. Therefore, the dyadic coping Scale and the depression Questionnaire were acquired at T1 (after thrombolysis), T2 (3 months after illness), and T3 (6 months after illness).

The first survey was conducted face-to-face in a conference room/independent ward, and the surveys at the T2 and T3 time points were obtained by telephone follow-up. In order to ensure the privacy of the patients, the surveys were conducted in a confidential environment and the patients were promised that the questionnaires would only be used for the purpose of the present study and that the questionnaires would be conducted in an anonymous manner, with no disclosure of personal information or exploration of individual factors alone. Patients with low literacy and dyslexia were asked to repeat the scale entries by the investigator, and the patients made independent choices.

The consistency test of the questionnaire used the method of setting lie detector questions, placing four questions with the same stem and different option order in different positions of the questionnaire, eliminating the invalid questionnaire with different options to ensure the reliability of the questionnaire, and ensuring that each questionnaire can express the true will of the patients. In order to ensure the enthusiasm of the patients to participate in the clinical research, the questionnaires ended with a small gift worth 10 yuan.

A total of 242 questionnaires were initially distributed, and 212 valid consecutive questionnaires were recovered at the completion of the three time points, with an effective recovery rate of 87.60%. Sensitivity analysis showed that the results of lost follow-up data were robust after multiple interpolation (fluctuation of path coefficient < 10%).

Statistical Methods

SPSS26.0 and Mplus 8.0 software were used for correlation statistical analysis. Count data and measurement data were expressed as cases/percentage and mean ± standard deviation, respectively, and Pearson correlation analysis was used for correlation test. Latent Growth Modeling (LGM) was used to explore the changes in dyadic coping in stroke patients, with the intercept indicating the initial level of their dyadic coping and the slope indicating the changes in dyadic coping, and a parallel latent growth model was constructed. Cross-lagged models were used to analyze the interactions between dyadic coping and changes in depression over time. A robust Maximum Likelihood Robust Estimator (MLR) was used to evaluate the model.

Results

General Demographic Information

A total of 212 valid questionnaires were collected in this study, of which 118 (55.66%) were male and 94 (44.34%) were female, Table 1.

Table 1 General Information of Respondents (n=212)

Items	Categories	N	%	Items	Categories	N	%
Age (years)	< 60	137	64.62	Marital status	Unmarried	5	2.36
	≥60	75	35.38		Married	183	86.32
Gender	Male	118	55.66		Divorce	15	7.08
	Female	94	44.34		Widowed	9	4.24
Level of education	Junior high school and below	140	66.04	Residence	City	76	35.85
	High school	44	20.75		Township	58	27.36
	College and above	28	13.21		Rural	78	36.79
Way of living	Living alone	33	15.57	Hypertension	Yes	71	33.49
	Family residence	179	84.43		No	141	66.51
Monthly household income (yuan)	< 4000	59	27.83	Coronary heart disease	Yes	69	32.55
	4000 ~ 6000	86	40.57		No	143	67.45
	6001 ~ 10,000	48	22.64	Diabetes	Yes	49	23.11
	> 10,000	19	8.96		No	163	76.89

Common Method Bias Test

The Harman's one-factor test was used to test the common method bias of the three data separately, and the results showed that the amount of variance explained by the 1st factor in the three measurements was 19.33%, 23.52%, and 25.36%, which were less than the critical value of 40%, so there was no significant common method bias in this study.

Dyadic Coping and Depression Scores and Correlation Analysis at 3 Time Points in Stroke Patients

Pearson correlation analysis was used to analyze the dyadic coping and depression at the three time points, and the results showed that the correlation between the two was significant at all three time points ($P < 0.05$), which fulfilled the prerequisites for doing cross-lagged models and parallel latent variable models, and the matrix relationships are shown in Table 2.

Cross-Lagged Model of Dyadic Coping and Depression in Stroke Patients

A cross-lagged model was developed to examine the reciprocal predictive relationship between dyadic coping and depression. The model fit well, $\chi^2/df = 0.422$, GFI = 0.990, TLI = 0.957, and RMSEA < 0.001. As shown in Figure 1: dyadic coping levels on average significantly and positively predicted depression at the next node, whereas depression was not significant in longitudinally predicting dyadic coping at the next node, and the specific paths are shown in Figure 1.

Table 2 Matrix of Dyadic Coping and Depression Scores and Correlation Coefficients at 3 Time Points in Stroke Patients (r, n=162)

Sports event	Avg.	SD	①	②	③	④	⑤	⑥
① dyadic coping T1	105.26	21.25	1					
② depression T1	9.25	2.09	−0.356***	1				
③ dyadic coping T2	116.62	20.38	0.552**	−0.213*	1			
④ depression T2	8.02	1.93	−0.310**	0.377**	−0.413***	1		
⑤ dyadic coping T3	122.57	23.21	0.443**	−0.196*	0.502**	−0.197**	1	
⑥ depression T3	6.72	1.38	−0.268**	0.295**	−0.322**	0.431**	−0.493***	1

Note: *Indicates $P < 0.05$, **Indicates $P < 0.01$ and ***Indicates $P < 0.001$.
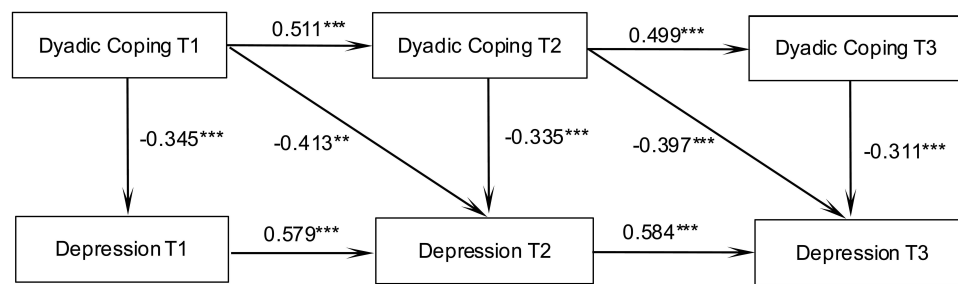
Figure 1 Pathways of dyadic coping and predicted role of depression in stroke patients at 3 time points.
Note: ***Indicates P < 0.001, **Indicates P < 0.01.

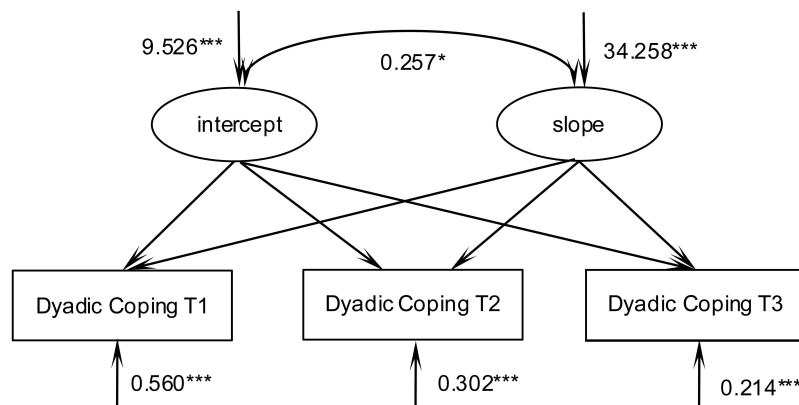## Parallel Latent Variables of Dyadic Coping and Depression in Stroke Patients

Because the interval between all three measurements was 3 months, the slope factor loadings for the three measurements were set at 0, 1, and 2, with the intercept indicating the initial level and the slope indicating the rate of development.

The Trajectory of Dyadic Coping in People with Stroke

According to the unconditional latent variable linear growth model of dyadic coping in stroke patients, the fit indices were as follows: χ^2/df = 2.456, GFI = 0.989, TLI = 0.9457, RMSEA = 0.062, and SRMR = 0.035, which is a good fit. The model intercept, ie, the initial value of dyadic coping, 105.26, showed an increasing trend in the subsequent three measurements (S = 3.215, P < 0.001), and the differences in intercept (σ^2 = 9.526, P < 0.001) and slope (σ^2 = 34.258, P < 0.001) variances were significant, suggesting that there are individual differences. There was a significant correlation between intercept and slope (r = 0.257, P = 0.021), suggesting that the higher the initial level of dyadic coping in stroke patients, the faster the rate of increase in the later stages of the process, as shown in Figure 2.
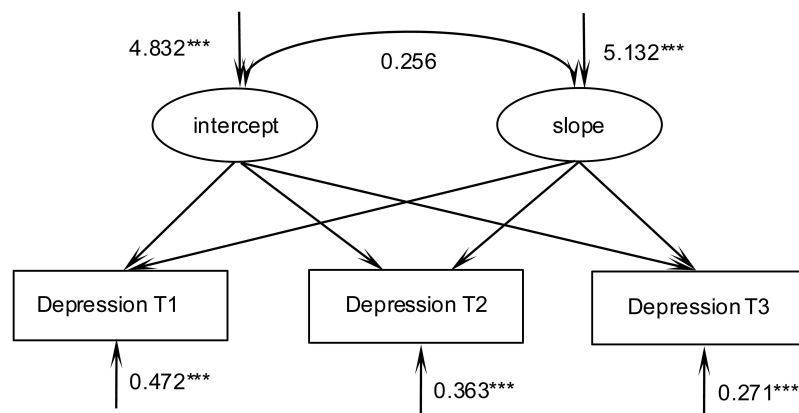
Trajectories of Depression in Stroke Patients

According to the unconditional latent variable linear growth model of depression in stroke patients, the fit indicators were as follows: χ^2/df = 2.493, GFI = 0.993, TLI = 0.968, RMSEA = 0.086, and SRMR = 0.024, which is a good fit. The model intercept, ie, the initial value of depression of 10.25, showed a decreasing trend in the subsequent three measurements (S = −0.292, P < 0.001), and the differences in the variances of the intercept (σ^2 = 4.832, P < 0.001) and the slope (σ^2 = 5.132, P < 0.001) were significant, suggesting that there are individual differences in the initial level and developmental rate of depression in stroke patients. There was no significant correlation between intercept and slope (r = −0.195, P = 0.112), suggesting that there is no significant correlation between the initial state of depression and the rate of development in stroke patients, as shown in Figure 3.

Figure 2 Model of dyadic coping in stroke patients.
Note: ***Indicates P < 0.001, *Indicates P < 0.05.

Figure 3 Model of depression in stroke patients.
Note: ***Indicates P < 0.001.

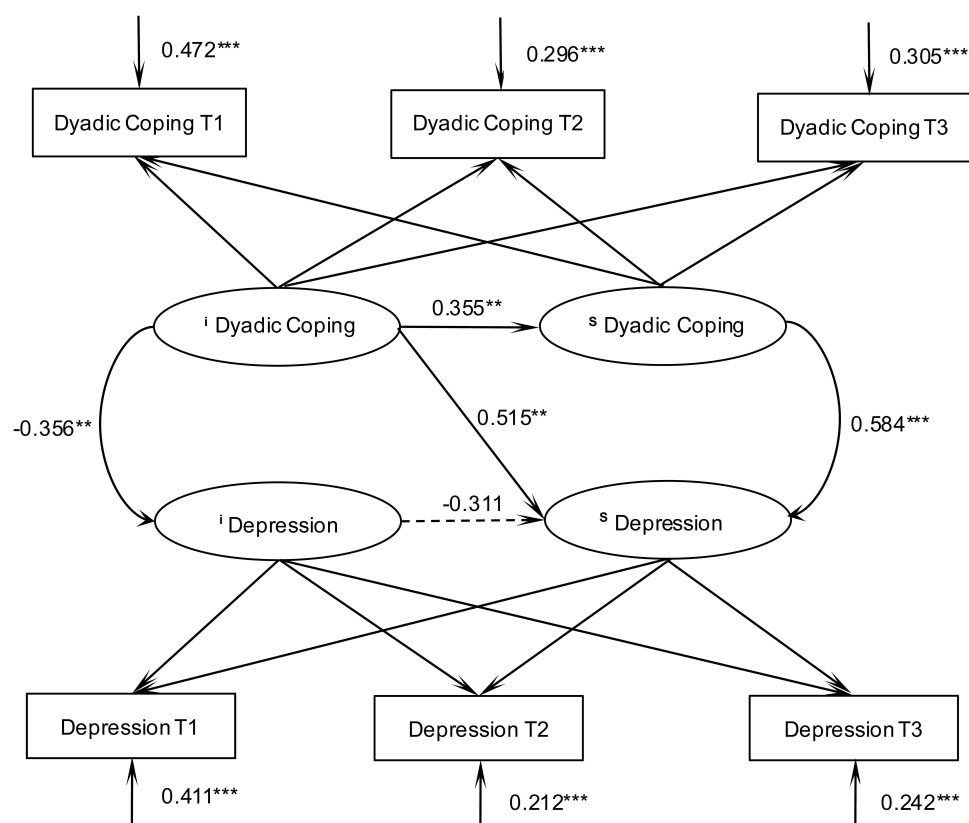## Dynamics of Dyadic Coping and Depression in Stroke Patients

The parallel latent variable growth model of dyadic coping and depression in stroke patients was constructed with the following fitting indexes: χ^2/df=2.091, GFI=0.990, TLI=0.970, RMSEA=0.065, and SRMR=0.036, which was a good fit. At the initial level, dyadic coping was negatively correlated with depression (r=−0.356, P=0.002), ie, the higher the patient's level of dyadic coping, the lower his or her level of depression. The initial level of dyadic coping was able to positively predict its developmental speed (β=0.355, P=0.007), ie, the higher the initial level of dyadic coping, the faster the level of its rise; the initial level of dyadic coping was able to positively predict the developmental speed of the depression (β=0.515, P=0.002), ie, the higher the initial level of dyadic coping, the faster the speed of the decline in the depression of the patients. The rate of development of dyadic coping positively predicted the rate of development of depression (β = 0.584, P < 0.001), ie, the faster the rise of dyadic coping, the faster the rate of decline of depression, and the pathways of action are shown in Figure 4.

Discussion

Trajectories of Dyadic Coping and Depression in Stroke Patients

In this study, a longitudinal investigation revealed an upward trend in dyadic coping and a downward trend in depression in stroke patients within 6 months after the onset of the disease. The study[15] pointed out that the ability of spouses to communicate about their illness gradually increased after the illness of stroke patients, which also confirms the results of this study. As patients and spouses communicate with each other about their own feelings and illnesses, spouses give some psychological support to patients, which to a certain extent alleviates patients' negative emotions, including worry, anxiety, and depression; Therefore, patients' dyadic coping levels show an increasing trend and depression show a decreasing trend after the illness. Most of the previous longitudinal investigations on dyadic coping have been limited to malignant tumors, and the trend of change in dyadic coping is controversial. Vaske et al[16] noted that dyadic coping levels showed an increasing and then decreasing trend over a three-year period, and Ernst et al[17] showed that patients' dyadic coping levels did not change significantly within six months of their illness. Svensson et al[18] supported that dyadic coping levels also increased and then decreased in post-stroke patients. The trend in dyadic coping levels was correlated with the type of disease, patient demographics, and measurement tools used in the included population. The longitudinal selection time of this study was relatively short, the patients had more negative emotions in the early stage of the disease, and the depression was at a high level.[19,20] Spouses faced a sudden increase in the caregiving burden of the patient's sudden illness, with dyadic coping at a low level. With the treatment and recovery of the disease, the spouse through effective communication with the patient, the negative emotions have been effectively cathartic, dyadic coping showed a rising trend, depression showed a downward trend. As clinical staff, we could actively communicate with spouses of stroke patients to improve the coping ability of the patient's spouse. At the same time, we could encourage patients to vent their bad emotions, which is conducive to the alleviation of depression.

Figure 4 Parallel latent variable model of dyadic coping and depression in stroke patients.
Note: ***Indicates P < 0.001, **Indicates P < 0.01.

Interrelationships Between Dyadic Coping and Depression in Stroke Patients

By constructing a cross-lagged model, the present study found that dyadic coping levels on average significantly and positively predicted depression at the next node, whereas depression did not significantly predict dyadic coping longitudinally at the next node. Previous research[19,21] showed that the prevalence of depression in poststroke patients ranged from 18% to 41% and that poststroke depression can lead to a variety of poor prognostic outcomes in patients, with differences in prevalence associated with differences in the severity of post-stroke condition and the tools used for measurement in the included patients. Good dyadic coping reduces depression in patients in the next stage, probably because patients with higher levels of dyadic coping tend to receive more psychological support and care from their spouses after illness, and the negative emotions generated after illness can be effectively exported and released.[22] As the spouse is the first caregiver, effective communication could alleviate the negative emotions generated by the patient so that the patient can maintain a more stable state of mind; therefore, the level of dyadic coping can predict the level of depression in the next stage. Patients with higher levels of depression were not able to regulate their spouses through effective feedback, and therefore their depression was not able to longitudinally predict the level of dyadic coping in the next stage. As clinical staff, we should pay attention to the assessment of dyadic coping level of stroke patients, actively carry out psychological counseling or intervention for people with dyadic coping disorders, provide necessary life care, and communicate with spouses of patients, so as to reduce the quality of life of patients due to the disease, and improve the dyadic coping level of patients, which will have a positive effect on the reduction of depression in the later stages of the disease.

Relationship Between Dyadic Coping and Depression Dynamics in Stroke Patients

The results of the parallel latent variable growth model showed that dyadic coping was negatively associated with depression in stroke patients at the initial level, ie, the higher the patient's level of dyadic coping, the lower their level of depression, which has been confirmed in previous studies.[23,24] This has been confirmed in previous studies. At the beginning of the

illness, the higher the level of support that the patient receives from his or her spouse, the lower the output of dysphoria and the lower the likelihood of depression. The initial level of dyadic coping can positively predict the speed of its development. Patients who are able to communicate effectively in the early stage of the disease are better able to express their inner needs in the recovery period, and the anxiety and depression arising from the disease can be relieved through the psychological support given by the spouse.[25] The higher the initial level of dyadic coping, the faster the increase in the level of dyadic coping. The initial level of dyadic coping can positively predict the speed of development of depression. Even if patients with higher levels of dyadic coping in the early stage of the disease develop anxiety and depression after the disease, they can be quickly relieved through the spouse's care and effective communication, so the higher the initial level of dyadic coping is, the faster the decline of their depression. The developmental speed of dyadic coping can positively predict the developmental speed of depression, ie, the faster the rise of dyadic coping, the faster the decline of depression. The more significant the rise of dyadic coping, the higher the psychological support received by the patients, the more obvious the alleviation of negative emotions, and therefore the faster the decline of depression. This suggests that clinical staff should pay attention to the assessment of the initial level and rising trend of dyadic coping in patients, which is conducive to the rapid reduction of patients' depression and the maintenance of their physical and mental health.

Shortcomings and Prospects

This study adopted a longitudinal design to investigate the development trajectories of dyadic coping and depression in 212 stroke patients within 6 months after acute thrombolysis, providing a basis for clinical dynamic research. However, the longitudinal time node selection is relatively short, and this study is a single-center survey with a long survey period and a small number of respondents, which may reduce the statistical validity to a certain extent. Furthermore, when collecting and analyzing patient data, there may be omissions of some factors, such as the risk of stroke for patients. Subsequently, on the one hand, the longitudinal investigation period for stroke patients will be extended; on the other hand, the influencing factors of patients' depressive symptoms will be explored to better investigate the interrelationship between dyadic coping and depressive symptoms. The focus will also be on the intervention of depression to minimize the incidence of post-stroke depression and its adverse consequences.

Conclusion

Stroke patients' dyadic coping showed an increasing trend and depression showed a decreasing trend, and dyadic coping had a negative predictive effect on depression, indicating that dyadic coping is an important influence on stroke patients' depression. The initial level of dyadic coping can positively predict the development of depression symptoms, and the development of dyadic coping can positively predict the development of depression symptoms. Paying attention to the dyadic coping of stroke patients in different periods, and actively providing guidance and intervention for people with lower levels of dyadic coping are conducive to lowering the depression symptoms of stroke patients, which will in turn reduce the psychological burden and improve the prognosis.

Disclosure

The authors report no conflicts of interest in this work.

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