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A cross-sectional study on post-stroke depression and the quality of life

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Abstract

Background Post-stroke depression (PSD) is a common mood disorder associated with stroke. By investigating the differences in life quality factors among stroke survivors, the results of this study offer insights into how to better prevent and manage the onset and progression of depression.

Methods This study is a cross-sectional study that selected patients receiving treatment in the Department of Rehabilitation Medicine at Hebei University Affiliated Hospital from September 1 to November 30, 2023. The inclusion criteria for this study were as follows: 1. Age ≥ 18 years; 2. Diagnosis of hemorrhagic or ischemic stroke confirmed by imaging examination. The exclusion criteria included: 1. A history of psychiatric disorders such as depression or anxiety prior to the onset of the illness; 2. History of psychiatric medication use before the onset; 3. Functional impairments, such as speech, cognitive, or consciousness disorders, that hinder cooperation with the survey questionnaire. Ultimately, a total of 131 patients were included in the study. Based on the results of the Patient Health Questionnaire-9 (PHQ-9), patients were divided into the PSD group and the non-PSD group. The primary evaluation metrics included the General Self-Efficacy Scale (GSES), Visual Analogue Scale (VAS), modified Rankin Scale (mRS), and Fatigue Assessment Scale (FAS), allowing for a comparison of demographic, clinical data, and evaluation metrics between the two groups. Statistical analysis was performed using SPSS version 25.0, and GraphPad Prism version 9.0 was used for graphical representations.

Results The morbidity rate of PSD in this study was 48%, which was slightly higher than the global statistical data. The demographic data did not show any statistical differences in terms of age, sex, history of smoking and drinking, or occupation, but they did show a significant difference in terms of education level ($p < 0.05$), which was primarily related to low education level in the PSD group. In contrast, the clinical data did not show any differences in terms of stroke type, pathogenic site, or medical history ($p > 0.05$).

Conclusion In this study, statistical results indicated no significant difference in the mRS between the two groups. However, the GSES, VAS, and FAS showed significant differences. This suggests a strong correlation between GSES, VAS, and FAS with the occurrence of PSD, indicating that these factors may serve as predictors for PSD. In medical practice, focusing on patients' self-efficacy, pain, and fatigue levels could facilitate recovery. When developing rehabilitation plans, it is crucial to minimize patients' feelings of self-defeat, enhance their self-efficacy, and manage fatigue

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effectively. Furthermore, reinforcing pain management throughout the rehabilitation process may promote more effective patient recovery.

Keywords General self-Efficacy score, Quality of life, Post-stroke depression, Post-stroke fatigue, Fatigue severity scale

Introduction

Cerebral stroke, an acute cerebrovascular disease, encompasses a spectrum of brain injuries resulting from the sudden occlusion or rupture of blood vessels in the brain, leading to impaired blood flow to cerebral tissue. Cerebral stroke, characterized by high morbidity, disability, and mortality rate, is an increasingly serious global public health problem and the second leading cause of death in the world. In 2019, approximately 101 million stroke cases were reported globally [1], with 6.55 million resulting in death. According to data from the epidemiological survey, there are approximately 610,000 newly diagnosed cases of stroke and 185,000 recurrent cases of stroke in the United States annually [2]. In China, an estimated 2 million new cases of stroke emerge annually, with approximately 70–80% of affected individuals experiencing disability, making them unable to living independently [3]. Stroke can lead to various sequelae, with motor and speech impairments as the most evident. Other complications, such as cognitive disorders, epilepsy, depression, fatigue, tremors, and dysphagia, receive comparatively less attention. These complications can significantly impact patients' functional abilities, emotional well-being, and cognitive functioning [4]. Post-stroke depression (PSD) is a common post-stroke mood disorder. PSD has a strong correlation with increased mortality and negatively correlates with patients' functional recovery [5, 6]. PSD can reduce the patients' personal life quality, slow down the patients' recovery speed, and further increase the burden on families and communities. Previous studies on quality of life declines in PSD patients have mainly focused on sleep or fatigue [7], with limited research on pain and self-efficacy. This study evaluates patients' daily quality of life across four dimensions, integrating general and clinical data to explore whether there are differences between PSD and non-PSD patients in these areas, and whether these factors may serve as potential risk factors for PSD. The findings aim to provide a basis for the prevention, diagnosis, and treatment of PSD. The purpose of this study is to provide the foundation for the prevention, diagnosis, and treatment of PSD by examining the life quality of these patients.

Study participants and method

In this cross-sectional study, using simple random sampling methods, patients with stroke were selected from the Department of Rehabilitation Medicine at the Hebei University Affiliated Hospital between September 1 and November 30, 2023. This study was approved by the Ethics Committee of the Affiliated Hospital of Hebei University (No. HDFYLL-KY-2023-138). Written informed consent was obtained from all participants. The inclusion criteria for this study were as follows: (1) Must be ≥ 18 years old; (2) Must have an imaging-confirmed hemorrhagic or ischemic stroke. The exclusion criteria were: (1) A history of mental illness diagnosis and treatment, such as anxiety and depression, before the onset of cerebral stroke; (2) A history of using psychotropic medications before the onset; (3) Individuals with speech and cognitive impairments, consciousness disturbance, and other functional barriers, who are unable to complete the questionnaires. To ensure the accuracy and reliability of the assessment findings, three nurses who had received training in the use of questionnaires and screened the cases collected the data. The sample size was estimated using the formula $n = \left(\frac{Z_{1-\alpha/2} \times \sqrt{\bar{p}(1-\bar{p})}}{E}\right)^2$, with a 95% confidence interval. Studies indicate that approximately one-third of stroke survivors experience PSD, [8, 9] leading to an incidence rate of 33%. A Southeast Asian study referenced a relative precision of 10% [7]. To account for potential incomplete responses or participant dropouts, an additional 10% was added to the estimated sample size, resulting in a total of 131 patients included in the study. All participants were hospitalized patients, and assessments were conducted on the second day after admission, before rehabilitation training commenced to control for patient fatigue. All questionnaires were completed with medical staff assistance within 20 min to minimize the impact of leading questions from healthcare providers on the questionnaire results. A total of 131 patients were included in the study.

Demographic data: Detailed demographic data, including age, gender (male/female), body mass index (BMI), smoking history, drinking history, education level, and occupation, were collected from all patients included in the study. Smoking history was categorized as never smoked, quit (referring to those who quit over a year

ago), and current smokers. Drinking history was divided into never drank, abstinence, and drinks, in which abstinence refers to the people who had a drinking history but had abstained from drinking for more than a year. Education level was divided into primary education, secondary education, and higher education. Primary education includes primary school and junior high school; secondary education includes senior high school, vocational high school, and technical secondary school; and higher education includes junior college, undergraduate university, master's and doctoral degree programs, and postdoctoral research. Occupation was categorized as employed (individuals with stable income), retired (those receiving government pensions), and unemployed (those without stable income).

Clinical data: Clinical data of cerebral stroke includes stroke type, lesion site, and medical history. Cerebral stroke types include hemorrhagic stroke and ischemic stroke, as determined by medical records. Based on the imageological data, lesion sites are classified into brain lobes (which include the frontal lobe, temporal lobe, parietal lobe, occipital lobe, and insular lobe), basal ganglia (which include the thalamus, internal capsule, and related nucleus masses), and other parts (which include the cerebellum, brain stem, external capsule, and other brain regions except the first two). Medical history covers hypertension, diabetes, and coronary heart disease. It also includes cases of two or more of the aforementioned diseases as well as other related diseases like hyperlipidemia, gout, and stroke. Additionally, it includes cases where the participants are physically healthy and have no medical history, as determined by data and medical records.

Screening of those with post-stroke depression symptoms: The Patient Health Questionaire-9 (PHQ-9) is a short self-management questionnaire with 9 items [10]. It is a validated tool for screening post-stroke depression. It can be used to understand the depression status of stroke patients and measure the severity of depression symptoms. The questionnaire uses a scale of "0" (none) to "3" (almost every day) to score the nine items that are widely accepted as depression criteria. In a recent meta-analysis on patients with stroke, the sensitivity and specificity of PHQ-9 screening to PSD were found to be 86% and 79%, respectively, suggesting the tool's superiority over alternative screening methods [11]. Based on research on the validity, reliability, and clinical efficacy of PHQ-9, the optimum cutoff score for PHQ-9 when screening for major depressive disorder is 10 [12]. As a result, PHQ-9 was employed in this study as an indicator to assess the post-stroke symptoms of depression, with 10 serving as the critical point. Patients were then classified into two groups: the PSD group (PHQ-9 > 10) and the non-PSD group (PHQ-9 < 10). There were 63 members in the PSD group and 68 members in the non-PSD group.

The General Self-Efficacy Scale (GSES), the Visual Analogue Scale (VAS), the Fatigue Assessment Scale (FAS), and the modified Rankin Scale (mRS) were the primary observation indicators.

The "GSES" consists of 10 items, aimed at evaluating an individual's perceived capacity to cope with difficult situations and obstacles. It was developed by Schwarzer and his colleagues in 1981 and introduced to China in 2001 by Professor Wang Caikang from South China Normal University, who conducted reliability and validity studies on the Chinese version, yielding good results [13]. The "VAS" is used to evaluate the intensity of pain. It has been widely used in China since 2002, typically using a VAS card supervised by the Pain Society of the Chinese Medical Association [14]. The basic method is to use a vernier caliper that is about 10 cm long and has 10 grades marked on one side, with "0" denoting no pain and "10" denoting the most severe pain at both ends. The participants need to only identify the number between 0 and 10 by looking at the "pain ruler". Another self-reporting tool used in stroke research is called "FAS". This scale was originally used to assess patients with sarcoidosis and has recently been adopted as a self-reporting tool in clinical stroke research [15, 16]. It consists of 10 items that are scored on a scale of 1 to 5 for the degree of fatigue; the higher the FAS score, the higher the fatigue degree. The patient's degree of disability was assessed using the "mRS" scale, which ranges from none (0), no significant disability despite symptoms (1), slight disability (2), moderate disability (3), moderately severe disability (4), severe disability (5), death (6). The Rankin scale was first proposed by Scottish physician John Rankin and was modified in 1988. The modified Rankin scale has since become the widely accepted standard version, frequently used in modern clinical stroke research to assess pre-stroke function and assist in selecting study subjects or as an outcome efficacy judgment index. It has also been extensively applied in stroke clinical research in China [17].

Statistical methods: (1) Descriptive statistics: The Kolmogorov–Smirnov Test was used to determine whether the measurement data was normally distributed. The data was described using the mean and standard deviation; for the counting data, frequency and percentage were used; and for the grading data, the medians (25th and 75th percentiles) were utilized. (2) Comparison between groups: For measurement data, the differences between the two groups of variables were compared using the independent sample t-test; for counting data, the differences between the two groups of variables were compared using the chi-squared test; and for grading data, the differences between the two groups of variables were tested

using the non-parametric Mann–Whitney U test. Test for statistical significance: if the p-value was less than or equal to 0.05, statistical significance was established. The statistical software utilized was SPSS 25.0, and the statistical plotting was done with GraphPad Prism 9.0.

Results

Demography

Demographic measurement data

The variables included were age and BMI. The result was indicated through age: both groups were composed of mainly middle-aged and elderly people, with most of them being over 50 years old. Using BMI, it could be seen that both groups were overweight (BMI > 25). Age and BMI differences between the two groups were not statistically significant. See Table 1 for specific data.

Demographic counting data

The variables considered were: gender (male or female), drinking history (never smoked, quit smoking, smokes), education level (primary, secondary, higher), and occupation (employed, retired, unemployed). Depending on whether there were depressive symptoms, a classification was made. In the group of 131 patients with stroke, the overall PSD morbidity rate was 48%, and there was no discernible difference between the two groups in terms of gender distribution, smoking and drinking histories, or occupations. Primary education made up the majority of educational experience in both groups. However, compared to the non-PSD group, the PSD group's primary education accounted for a higher proportion. The comparison of the educational levels between the two groups indicated that there was a statistically significant difference in the distribution of education levels ($p = 0.022$, < 0.05), suggesting that education may be related to the occurrence of PSD. See Table 2 for specific data.

Table 1 Social and demographic characteristics of patients classified according to symptoms of Post-stroke Depression (measurement data)

Demographic Measurement Data Variable	Symptoms of Post-Stroke Depression (PHQ-9, critical point = 10)		*P* Value
	PSD Group ($n = 63$) Mean Value ± Standard Deviation	Non-PSD Group ($n = 68$) Mean Value ± Standard Deviation	
Age	57.05 ± 11.97	55.24 ± 10.39	0.356
BMI	26.484 ± 3.28	25.674 ± 2.89	0.135

The data were continuous variables. A Kolmogorov-Smirnov test was used to assess normality, and the results indicated a normal distribution. Therefore, the mean and standard deviation were usedto describe the data. An independent samples t-test was employed to compare the differences between the two groups

PSD Post stroke depression, *BMI* Body Mass Index, *PHQ-9* Patient Health Questionnaire-9

Comparison of clinical data

The variables included were stroke type, medical history, and lesion site. According to the results, the most common type of lesion, accounting for 83.2% of cases, was cerebral infarction. The most common background disease, accounting for 30.5% of cases, was hypertension. The majority of the lesion sites were found in the basal ganglia (68.7%). There was no statistical significance in the medical history, stroke type, and lesion site between the two groups ($p > 0.05$). See Table 3 for specific data.

Comparison of Observation indicators

The GSES score of the PSD group was generally lower than that of the non-PSD group, however, the VAS and FAS scores of the PSD group were higher than that of the non-PSD group. There were notable variations in all three indicators between the two groups, indicating that the patients in the PSD group experienced more severe pain and exhaustion as well as lower perceived self-efficacy. However, the medians in the mRS scores, which were both 2 points, suggested that there was no discernible variation in the functional disability between the two groups. See Table 4 for specific data. See Figs. 1, 2, 3 and 4 for the characteristics of data distribution.

Discussion

In this study, the incidence of PSD was 48%, which is slightly higher than global statistics. There were no statistically significant differences in demographic data regarding age, gender, smoking and alcohol history, or occupation. There was a significant difference in education level ($p < 0.05$), likely due to a higher proportion of individuals with lower education in the PSD group. Clinical data showed no differences in stroke type, lesion location, or medical history ($p > 0.05$). Among the observed indicators, there were no significant differences in mRS scores between the two groups, but significant differences were found in GSES, VAS, and FAS. This suggests that GSES, VAS, and FAS are highly correlated with the occurrence of PSD and may serve as predictive factors. In medical practice, paying attention to patients' self-efficacy, pain, and fatigue may help improve recovery.

Morbidity rate

PSD usually refers to a depressive state after the onset of cerebral stroke. About one-third of stroke survivors suffer from PSD [8, 9]. It is reported in a meta-analysis of 61 studies that the combined frequency of depressive

Table 2 Social and demographic characteristics of patients classified according to symptoms of Post-stroke Depression (counting data)

Demographic Counting Data Variable	Symptoms of Post-Stroke Depression (PHQ-9, critical point = 10)						*P* Value
	PSD Group (*n* = 63) Mean Value ± Standard Deviation		Non-PSD Group (*n* = 68) Mean Value ± Standard Deviation		Total (*n* = 131)		
	n	%	*n*	%	*n*	%	
Total	63	48	68	52	131	100%	
Gender							
Male	44	69.8	52	76.5	96	73.3	
Female	19	30.2	16	23.5	35	26.7	0.392
Smoking History							
Never Smoke	36	57.1	31	45.6	67	51.1	
Quit Smoking	8	12.7	15	22.1	23	17.6	
Smoking	18	30.2	22	32.4	41	31.3	0.281
Drinking History							
Never Drinking	33	52.4	37	54.4	70	53.4	
Abstinence	15	23.8	15	22.1	30	22.9	
Drinking	15	23.8	16	23.5	31	23.7	0.966
Educational Level							
Primary	39	61.9	33	48.5	72	55.0	
Secondary	17	27.0	14	20.6	31	23.7	
Higher	7	11.1	21	30.9	28	21.4	0.022
Occupation							
Employed	13	20.6	20	29.4	33	25.2	
Retired	11	17.5	11	16.2	22	16.8	
Unemployed	39	61.9	37	54.4	76	58.0	0.510

The data are categorical variables and described using frequency and percentage. A chi-square test was used to compare the differences between the two groups
PSD Post stroke depression, *PHQ-9* Patient Health Questionnaire-9

Table 3 Characteristics of clinical data of patients classified according to symptoms of post-stroke depression

Clinical Data Variable	Symptoms of Post-Stroke Depression (PHQ-9, critical point = 10)						*P* Value
	PSD Group (*n* = 63)		Non-PSD Group (*n* = 68)		Total (*n* = 131)		
	n	%	*n*	%	*n*	%	
Total	63	48	68	52	131	100%	
Stroke Type							
Cerebral Infarction	54	85.7	55	80.9	109	83.2	
Encephalorrhagia	9	14.3	13	19.1	22	16.8	0.460
Medical History							
Hypertension	22	34.9	18	26.5	40	30.5	
Coronary Heart Disease	7	11.1	8	11.8	15	11.5	
Diabetes	8	12.7	7	10.3	15	11.5	
Exceeding Two Diseases	18	28.6	21	30.9	39	29.8	
None	8	12.7	14	20.6	22	16.8	0.697
Lesion Site							
Brain Lobe	7	11.1	6	8.8	13	9.9	
Basal Ganglia	46	73.0	44	64.7	90	68.7	
Other Sites	10	15.9	18	26.5	28	21.4	0.330

The data are categorical variables and described using frequency and percentage. A chi-square test was used to compare the differences between the two groups
PSD Post stroke depression, *PHQ-9* Patient Health Questionnaire-9

Table 4 Characteristics of quality of life data of patients classified according to symptoms of post-stroke depression

Quality of Life Data Variable	Symptoms of Post-Stroke Depression (PHQ-9, critical point = 10)										*P* Value
	PSD Group ($n = 63$)					Non-PSD Group ($n = 68$)					
	Mean Value ± Standard Deviation	Quartile			Mean Rank	Mean Value ± Standard Deviation	Quartile			Mean Rank	
		The 25th	The 50th (median)	The 75th			The 25th	The 50th (median)	The 75th		
GSES	25.57±6.037	22	25	30	55.19	28.60±5.409	25	28	32	76.01	0.002
VAS	2.56±1.563	1	2	4	84.38	1.12±1.000	0	1	2	28.91	0.000
FAS	26.87±4.133	24	26	29	82.83	23.46±2.975	21.25	23	25	50.41	0.000
mRS	1.86±0.859	1	2	2	72.17	1.60±0.813	1	2	2	60.29	0.056

The data are ordinal variables. A higher score on the GSES indicates a stronger sense of self-efficacy, while a higher VAS score indicates a greater level of pain. Similarly, a higher FAS score reflects increased fatigue, and a higher mRS score indicates a lower degree of disability, requiring less nursing intervention. The data were described using the median (25th percentile; 75th percentile). The Mann-Whitney U test was utilized to assess the differences between the two groups for these ordinal variables

PSD Post stroke depression, *PHQ-9* Patient Health Questionnaire-9, *GSES* General Self-Efficacy Scale, *VAS* Visual Analogue Scale, *FAS* Fatigue Assessment Scale, *mRS* Modified Rankin scale

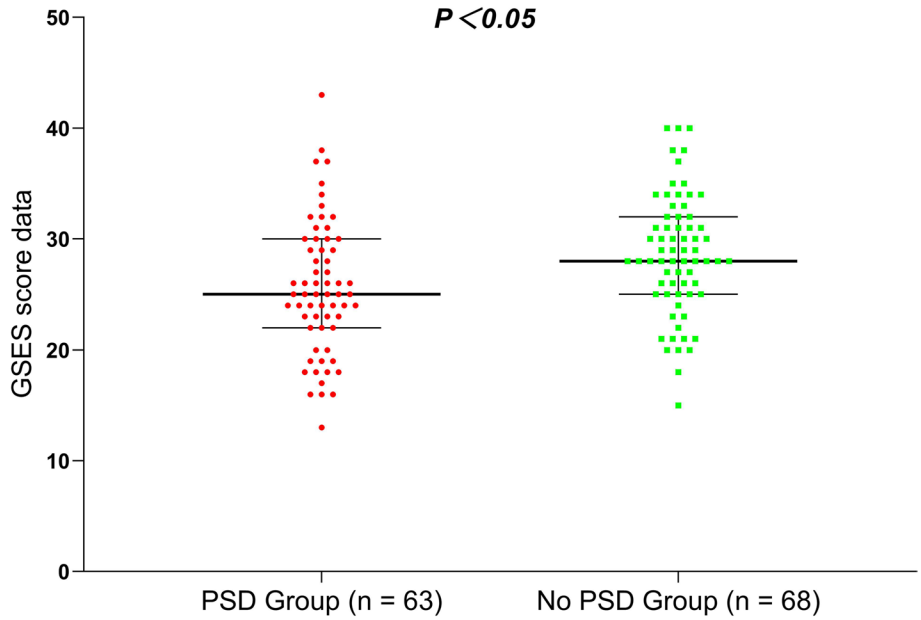

Fig. 1 Distribution characteristics of GSES score results for two sets of data, including median and quartile, with *P* <0.05

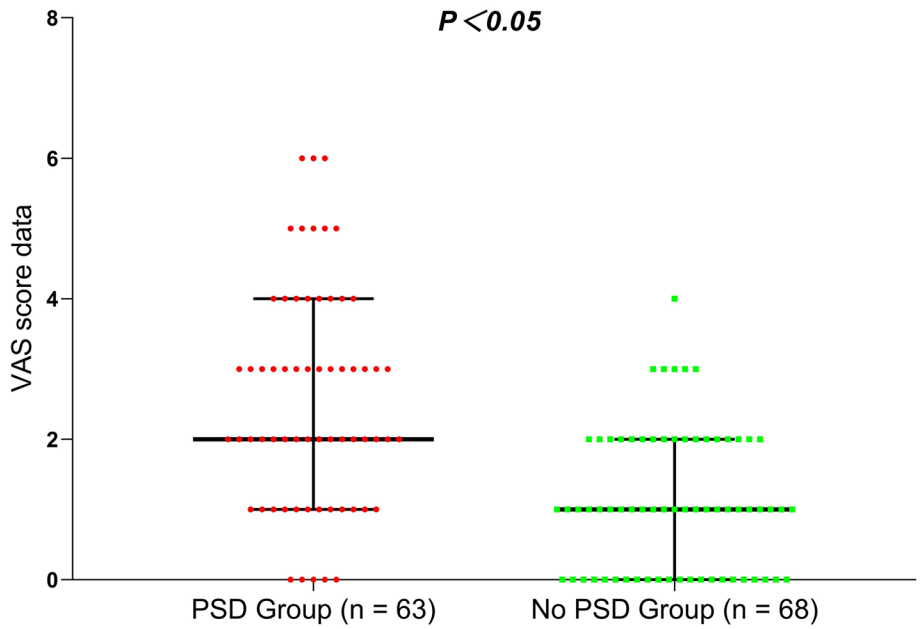

Fig. 2 Distribution characteristics of VAS score results for two sets of data, including median and quartile, with *P* <0.05

disorder was 31% [18]. According to the comprehensive statistics of 13 global studies from 1982 to 2020, the morbidity rate of PSD was 11–41% [6]. The main factors contributing to differences in morbidity rate include varying diagnostic criteria, sample size, affected area, racial disparities, and differences in primary diseases. A cross-sectional study involving 112 people showed that the morbidity rate of PSD was 42.9% [19], while another 11-year study involving 157,243 patients showed that the morbidity rate of PSD was 25.4% [20]. A study on American Mexicans and non-Hispanic whites in the United States showed that the morbidity rate of PSD in American Mexicans was higher than that in non-Hispanic whites in the US within 90 days [21]. A total of 113

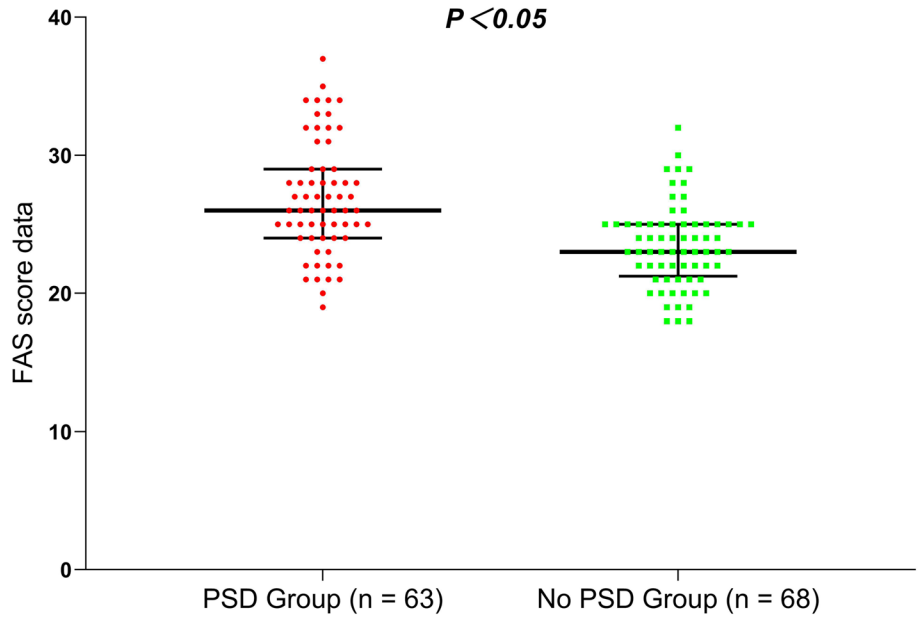

Fig. 3 Distribution characteristics of the scoring results of two sets of FAS data, including median and quartile, with $P < 0.05$

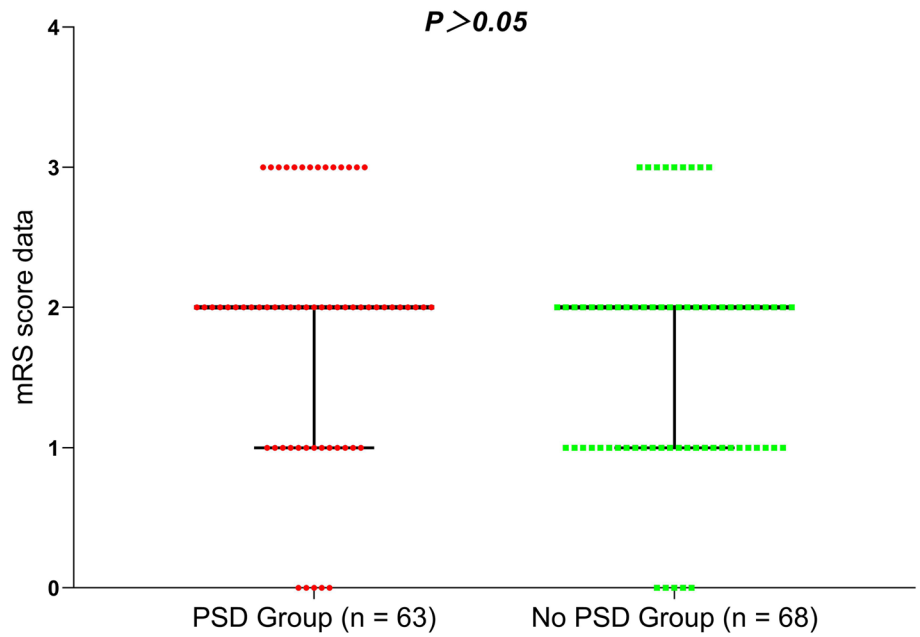

Fig. 4 Distribution characteristics of two sets of mRS data scoring results, including median and quartile, with $P > 0.05$

patients were included in this study, including 53 patients with PSD and 58 patients without PSD, and the onset time varied from 2 weeks to one year, and the morbidity was 46.9%. The morbidity rate was higher than that in the global statistics. This study was conducted in China, and the inclusion criteria included hemorrhagic and ischemic strokes. Therefore, the difference in morbidity rate is mainly related to the sample size and the choice of PSD diagnostic criteria. A follow-up study will involve further screening and diagnosis by increasing the sample size, standardizing the diagnostic criteria, adopting subjective and objective scales for comprehensive analysis, and introducing a way to schedule psychiatrists to conduct psychiatric interviews.

Demographic characteristics of PSD

In past studies, it has not been determined whether gender is a risk factor for PSD incidence, and the most controversial issue has been whether women are more likely to suffer from PSD. In a systematic evaluation research, 7 studies found a relationship between PSD and female sex, while 13 studies found no correlation between PSD and gender [6]. The average BMI for both groups was more than 25, which is considered overweight, and it is confirmed in many studies that being overweight is related to cardiovascular and cerebrovascular diseases. Previous studies have shown that being overweight increases the risk of depressive disorders, potentially due to factors such as the hypothalamus-pituitary-adrenal axis, immune inflammation, and neuroendocrine regulation [22]. Therefore, overweight patients have a higher risk of PSD occurrence during stroke. There have only been a few prior studies on the relationship between PSD and alcohol and tobacco use histories. A meta-analysis evaluating the risk factors for post-stroke depression found correlations with alcohol and tobacco consumption. The results indicated that there is a fixed effect model correlation between alcohol and tobacco consumption and PSD [23]. The study on the correlation between cerebrovascular stenosis and depression after three months of ischemic stroke shows that the drinking history of patients with PSD at the time of discharge from the hospital is lower than that of patients without PSD, indicating that moderate drinking is a protective factor of PSD [24]. In the comparison of occupations, the majority in both groups were unemployed. Individuals with low incomes typically do not have health insurance, do not get a check-up as often, and ignore health issues like chronic fatigue. Individuals with low incomes are three times more likely than average people to suffer from anxiety and depression [25]. Regarding education, the proportion of individuals with only primary education in the PSD group was higher; a meta-analysis also revealed that a low education level (≤ 8 years) is associated with mild to moderate post-stroke depression [26]. This finding is also supported by a study on the morbidity rate of PSD among American Mexicans and non-Hispanic whites in the United States [21].

Clinical characteristics of PSD

Substantial evidence shows that PSD is closely correlated to the lesion site. The study on the correlation between stroke lesion sites in specific brain regions and PSD can be traced back to the early 20th century. Advances in stroke imaging and a better understanding of the brain network involved in the pathophysiology of depression have led to more precise research on the lesion sites of cerebral stroke associated with depression. A higher degree of right-sided infarction can be used to diagnose the primary depressive symptoms [27]. Among patients with ischemic stroke, patients with PSD have greater infarct numbers and larger infarct volumes, especially affecting the subcortical neural circuit of the left prefrontal lobe [28]. It was found in a recent study from Cologne, Germany that the severity of overall depression is mainly related to the lesions in the dorsolateral prefrontal cortex and inferior frontal gyrus of the right hemisphere, no matter what the individual symptoms are [29]. In terms of stroke types, those with infarction account for the majority of the patients with stroke, which is consistent with previous studies. In terms of medical history, individuals with hypertension continue to account for the largest percentage of patients with stroke, exceeding 30%. Hypertension is the most important risk factor for cerebral stroke. An investigation on older adults revealed a correlation between clinically significant depressive disorder and hypertension, with a significant increase in the likelihood of hypertension occurrence among patients with severe depressive disorder [30]. More research is required to determine whether lowering blood pressure can lower the morbidity rate associated with PSD.

Selection of screening tools for PSD

PHQ-9 was selected as the screening tool for this study. Additionally, the more sensitive Beck Depression Inventory (BDI) and Hamilton Depression Scale (HAMD) are also frequently used screening tools. Compared with the latter two, PHQ-9 is more practical in the initial screening of PSD because of its simplicity and expediency. Furthermore, a multitude of studies have validated the efficacy of PHQ-9 in identifying major depressive disorders [31]. However, the clear diagnosis of PSD should be based on the clinical standards of psychiatric and psychological professionals, who can apply the diagnosis criteria related to DSM-5 (The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) or ICD-10 (The International Statistical Classification of Diseases and Related Health Problems, 10th Revision) while conducting psychiatric interviews to prevent omissions or false positives.

What do the observation indicators reveal

The perceived self-efficacy in the PSD group was significantly lower than that in the non-PSD group, suggesting that the lack of self-efficacy should be a risk factor for PSD occurrence. Perceived self-efficacy refers to individuals' speculation and assessment of their ability to perform a certain action. Numerous studies have substantiated the role of perceived self-efficacy as a psychological mechanism for adjustment, particularly in the context of rehabilitation for various diseases, notably

chronic ailments. High self-efficacy can indeed enhance the patients' confidence and reduce negative emotions such as fear and dejection. Patients possessing a high degree of self-efficacy are frequently able to attain superior results when compared to those with limited functions or ongoing rehabilitation needs. Self-efficacy is an intervening variable for improving professional ability, especially for patients under the age of 60 who need to return to their workplaces [32].

Pain is a common post-stroke symptom, but at present its full diagnosis and treatment have not been achieved. In a 2018 study investigating the correlation between functional status, physical pain, and post-stroke depression among patients in Chinese urban and rural settings, the incidence of physical pain among patients with stroke was found to be 14.0%. Depressive symptoms were linked to lower functional status and increasing physical pain, particularly among females, and this correlation was greater in urban areas than in rural areas [33]. Further research is required to determine whether pain management can stop, slow down, or even reverse the progression of symptoms in PSD patients.

According to earlier research, patients with PSD frequently experience fatigue as a concomitant symptom. Post-stroke fatigue can also affect the mobility of patients and further interact with depressive symptoms. Post-stroke fatigue is related to the activity of the lower limbs, while post-stroke depressive symptoms are related to cognitive ability. According to the mediation analysis, poor cognitive performance of patients during depressive episodes is correlated with fatigue. Likewise, in cases where patients exhibit fatigue, depressive symptoms are associated with low mobility [16].

There is a strong negative correlation between PSD occurrence and the decline in the ability to perform activities of daily living (ADL) caused by post-stroke dysfunction. This suggests that a patient's ability to significantly strengthen their ADL ability is correlated with a rapid improvement in their depressive symptoms [34]. After a stroke, a patient's ability to carry out daily tasks may decline, which may increase their dependence on others and worsen their mood or even result in depression. It has been established that PSD causes the deterioration of everyday living skills and living standards [35].

In clinical practice, this study demonstrates that there are differences in self-efficacy, pain, and fatigue between patients with PSD and those without. Paying attention to patients' self-efficacy, pain, and fatigue may aid in their recovery. When developing rehabilitation plans, it is important to focus on reducing patients' feelings of self-defeat, enhancing their sense of self-efficacy, and minimizing fatigue. Pain, being a common complication of stroke, requires significant attention; therefore, pain management should be integrated into the entire rehabilitation process and reflected in the rehabilitation plans. Strengthening pain management during the rehabilitation journey can more effectively promote patient recovery. Currently, research on the relationship between self-efficacy and PSD is limited. This study is cross-sectional and did not include follow-up; therefore, the next step will include follow-up studies to explore the association between self-efficacy and post-stroke depression, as well as fatigue and pain management in stroke patients, to inform the development of related studies.

Conclusion

The morbidity rate of PSD in this study is 48%, which is slightly higher than the global average. There were no statistically significant differences in age, sex, history of drinking and smoking, or occupation; however, education level did show a significant difference, primarily due to the high proportion of related patients with low levels of education in the PSD group. This result is consistent with earlier research. On the other hand, variations in stroke type, pathogenic site, and medical history have not been observed in the clinical data. There were no significant difference in mRS scores between the two groups, but there are significant differences in GSES, VAS, and FAS. The findings suggest that GSES, VAS, and FAS are strongly correlated with the occurrence of PSD and may serve as predictive factors. In clinical practice, attention to patients' self-efficacy, pain, and fatigue may enhance recovery. When formulating rehabilitation plans, it is essential to focus on reducing patients' feelings of self-defeat, enhancing their self-efficacy, and minimizing their fatigue. Additionally, strengthening pain management throughout the rehabilitation process will promote more effective patient recovery. Future investigations should focus on increasing sample size, extending follow-up duration, modifying observational indicators, and refining statistical methodologies.

Abbreviations

PSD	post stroke depression
BMI	Body mass index
PHQ-9	Patient health questionaire-9
GSES	General self-efficacy scale
VAS	Visual analogue scale
FAS	Fatigue assessment scale
mRS	modified rankin scale
BDI	Beck depression inventory
HAMD	Hamilton depression scale
DSM-5	The diagnostic and statistical manual of mental disorders, fifth edition
ICD-10	The international statistical classification of diseases and related health problems
ADL	Activities of daily living

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
Qian-Ying Hu: Conceptualization, Formal Analysis, Funding acquisition, Writing – original draft, Writing – review & editing. Ya-Jing Chen: Formal Analysis, Software, Writing – original draft. Juan Liu: Conceptualization, Data curation, Resources. Xue-Ping Zhao: Writing – original draft, Writing – review & editing. Wen-Ya Feng: Data curation, Formal Analysis. Jian-Bin Tian: Data curation, Formal Analysis. Su-Juan Sun: Data curation, Formal Analysis, Software. Zi-Ning Li: Data curation, Formal Analysis, Software. All authors read and approved the final draft.

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Data availability
The relevant supporting data are available from the author upon request.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of the Affiliated Hospital of Hebei University (No. HDFYLL-KY-2023-138). Written informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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