Original Research

Psychological Factors and Post-Traumatic Stress Disorder (PTSD) Risk in Stroke Survivors: A Cross-Sectional Study

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Introduction

As of 2023, stroke is the second leading cause of death and the third leading cause of death and disability globally, with an expected rise by 2030. While traditional risk factors like demographics, smoking, inactivity, diabetes, and hypertension are well-known, post-traumatic stress disorder (PTSD) remains under-studied despite its 13% incidence rate and link to stroke risk.

Methods

This cross-sectional study, conducted from 1st November, 2023 to 30th January, 2024 in Doanhung, Phutho Province, involved stroke patients over 18 years old diagnosed within the past year. A 56-question questionnaire assessed demographics, clinical characteristics, the Barthel Index, and the PTSD Checklist for DSM-5 (PCL-5). Multivariable logistic regression using Stepwise AIC identified optimal models related to PTSD.

Results

A cohort of 397 participants, with a mean age of 67.98 years and 54.9% female, had a PTSD prevalence of 10.8%. Significant PTSD predictors included regular alcohol consumption (OR=11.43, 95% CI: 1.30–99.15, p=0.027), slight memory decrease (OR=3.59, 95% CI: 1.28–10.62, p=0.017), female gender (OR=3.15, 95% CI: 1.08–10.44, p=0.045), extroverted personality (OR=4.36, 95% CI: 1.73–11.86, p=0.003), and Barthel Index scores (OR=0.85, 95% CI: 0.80–0.90, p<0.001). However, age showed marginally significant association with PTSD (OR=0.97, 95% CI: 0.94–1.00, p=0.067), and unconsciousness during stroke (yes) had an OR of 2.43 (95% CI: 0.96–6.04, p=0.056).

Conclusion

This study highlights the complex interplay of demographic, lifestyle, and clinical factors influencing PTSD risk in stroke survivors. Addressing these factors in interventions is crucial to reduce the psychological burden and improve rehabilitation outcomes.

I. INTRODUCTION

Stroke persists as the second leading cause of death globally and the third leading cause of death and disability combined as of 2023, with projections foreseeing a further increase in its prevalence by 2030.[1,2] Traditional risk factors include demographic differences, behaviors like smoking and physical inactivity, and clinical conditions such as diabetes and hypertension.[3,4] However, psychological risk factors like depression and PTSD are less studied despite evidence linking them to stroke risk.[5-8]

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Post-traumatic stress disorder (PTSD) represents a significant psychological sequelae following stroke, with an incidence rate of 13%,[9] driven by a complex interplay of risk factors.[10,11] Studies underscore the bidirectional relationship between stroke and PTSD, wherein stroke survivors are not only at heightened risk of developing PTSD due to the traumatic nature of the event and subsequent neurological consequences but also face differential susceptibility based on demographic, clinical, and psychosocial variables.[12]

Research has identified several key predictors contributing to PTSD prevalence among stroke patients. Age, for instance, demonstrates a nuanced association, with some evidence suggesting that older age may mitigate PTSD risk, albeit inconsistently across studies.[9,10] Gender disparities are stark, with females exhibiting a notably higher propensity for developing PTSD post-stroke, attributed to diverse coping mechanisms and hormonal influences.[13,14]

Furthermore, lifestyle factors such as alcohol consumption patterns significantly heighten PTSD vulnerability, exacerbating both physiological and psychological impacts.[9] Cognitive impairments, particularly memory deficits resulting from stroke-related brain damage, further augment PTSD risk by impeding the processing of traumatic experiences.[9,15]

Personality traits also emerge as critical determinants, with introversion potentially conferring a protective effect against PTSD compared to extroversion.[16] Functional impairment post-stroke, assessed by measures like the Barthel Index, correlates inversely with PTSD prevalence, underscoring the role of disability in exacerbating psychological distress.[17]

Moreover, the acute experience of unconsciousness during stroke significantly heightens PTSD risk, emphasizing the profound impact of traumatic events and neurological severity on subsequent psychological outcomes.[12,18]

Understanding these diverse influences is crucial for crafting effective interventions to alleviate the burden of PTSD in stroke survivors. This study utilizes a logistic regression model with multiple predictors to clarify the intricate relationship between these factors and the prevalence of PTSD following stroke. Its significance is underscored by its relevance to Phu Tho Province, which mirrors numerous other agricultural provinces and cities across Vietnam. The insights gained here can guide the development of targeted intervention strategies applicable to more than 60 similar regions throughout Vietnam.

II. METHODS

STUDY DESIGN

The research is a descriptive cross-sectional study carried out between 1st November, 2023 and 30th January, 2024 in Doanhung, Phutho Province. The participants are patients over the age of 18 who were diagnosed with a cerebral stroke within the year preceding their involvement in the study.

QUESTIONNAIRE DESIGN

The self-administered questionnaire consists of 56 questions, divided into six distinct sections. The initial section comprises 15 questions aimed at gathering demographic information and details about lifestyle habits. This is followed by 11 questions focusing on clinical characteristics, such as underlying health conditions and specific details related to stroke incidents. The Barthel Index section, which includes 10 questions, assesses activities of daily living (ADL) and functional independence, covering tasks such as feeding, grooming, and mobility.[17] Additionally, the PTSD Checklist for DSM-5 (PCL-5) contains 20 items rated on a 5-point Likert scale ranging from 0 (“Not at all”) to 4 (“Extremely”). A screening threshold for PTSD is set at 31 points, with patients scoring below 31 classified as non-PTSD and those scoring 31 or above classified as having PTSD.[19]

STATISTICS ANALYSIS

Descriptive statistics were utilized to compare differences between groups with and without PTSD, employing t-tests for continuous variables and the Chi-Square test for categorical variables with expected cell counts exceeding 5; otherwise, the Fisher exact test was applied. The main analysis involved multivariable logistic regression to establish an optimal model using Stepwise AIC in the MASS package, utilizing forward and backward stepwise methods to minimize AIC and maximize AUC criteria.[20] This analysis considered all variables, including demographics, lifestyle habits, underlying health conditions, and details related to stroke events. All statistical tests were two-tailed, with a significance level set at $p < 0.05$. R language version 3.6.2 was employed for all statistical analyses.[21]

ETHICAL CONSIDERATION

All study procedures were ethically approved by the Phutho Provincial General Hospital Ethics Committee (Approval No. 2155/QD-BV dated 02/10/2023). Prior to participation, patients were provided with comprehensive explanations regarding the study’s potential benefits and risks, following which they provided informed consent.

III. RESULTS

A cohort of 397 patients enrolled in the study, yielding a response rate of 35.9% (397 out of 1105 invited). The mean age of participants was 67.98 years (SD = 12.66), with females comprising 54.9% of the sample. The prevalence of PTSD among the participants was recorded at 10.8% (43 out of 397).

Table 1 provides an insightful overview of the characteristics of stroke patients categorized by PTSD status, with a focus on statistically significant variables.

Regarding demographic factors, there were no significant differences observed in age ($p = 0.845$) or gender ($p = 0.493$) between non-PTSD and PTSD groups. However, significant distinctions were found in education ($p = 0.028$)

Table 1. Characteristics of stroke patients by PTSD status

Characteristics	Non-PTSD *N=354*	PTSD *N=43*	Total *N=397*	P-value
Age (years)	67.94 (12.64)	68.35 (12.93)	67.98 (12.66)	0.845
Gender				0.493
Male	197 (55.65%)	21 (48.84%)	218 (54.91%)	
Female	157 (44.35%)	22 (51.16%)	179 (45.09%)	
BMI (kg/m^2)	21.81 (2.45)	21.17 (2.84)	21.74 (2.50)	0.165
BMI classification				0.250
Underweight	18 (5.08%)	6 (13.95%)	24 (6.05%)	
Normal	232 (65.54%)	27 (62.79%)	259 (65.24%)	
At-risk of Obesity	76 (21.47%)	7 (16.28%)	83 (20.91%)	
Obese I	27 (7.63%)	3 (6.98%)	30 (7.56%)	
Obese II	1 (0.28%)	0 (0.00%)	1 (0.25%)	
Comorbidity				0.100
No	132 (37.29%)	10 (23.26%)	142 (35.77%)	
Yes	222 (62.71%)	33 (76.74%)	255 (64.23%)	
Hypertension				0.083
No	202 (57.06%)	18 (41.86%)	220 (55.42%)	
Yes	152 (42.94%)	25 (58.14%)	177 (44.58%)	
Diabetes				0.267
No	248 (70.06%)	26 (60.47%)	274 (69.02%)	
Yes	106 (29.94%)	17 (39.53%)	123 (30.98%)	
Religion				0.280
No religion	272 (76.84%)	39 (90.70%)	311 (78.34%)	
Buddhism	59 (16.67%)	3 (6.98%)	62 (15.62%)	
Christianity	18 (5.08%)	1 (2.33%)	19 (4.79%)	
Other	5 (1.41%)	0 (0.00%)	5 (1.26%)	
Education				0.028
University or Postgraduate Degree	11 (3.11%)	1 (2.33%)	12 (3.02%)	
Associate Degree	66 (18.64%)	2 (4.65%)	68 (17.13%)	
General Education Degree	269 (75.99%)	37 (86.05%)	306 (77.08%)	
Others	8 (2.26%)	3 (6.98%)	11 (2.77%)	
Marital status				0.604
Married	347 (98.02%)	42 (97.67%)	389 (97.98%)	
Divorced/ Separated/ Widowed	7 (1.98%)	1 (2.33%)	8 (2.02%)	
Accommodation				1.000
Living alone	9 (2.54%)	1 (2.33%)	10 (2.52%)	
Living with family	345 (97.46%)	42 (97.67%)	387 (97.48%)	
Profession				0.233
Farmer	81 (22.88%)	17 (39.53%)	98 (24.69%)	
Freelancer	111 (31.36%)	10 (23.26%)	121 (30.48%)	
Manual Laborer	18 (5.08%)	1 (2.33%)	19 (4.79%)	
Office Worker	5 (1.41%)	0 (0.00%)	5 (1.26%)	
Retired	139 (39.27%)	15 (34.88%)	154 (38.79%)	
Income (USD)	190.39 (139.28)	133.56 (95.18)	184.58 (136.39)	0.007
Alcohol drinking habits*				0.137
Infrequent drinker	240 (67.80%)	27 (62.79%)	267 (67.25%)	

Characteristics	Non-PTSD *N=354*	PTSD *N=43*	Total *N=397*	P-value
Former regular drinker	103 (29.10%)	12 (27.91%)	115 (28.97%)	
Regular drinker	11 (3.11%)	4 (9.30%)	15 (3.78%)	
Smoking habits				0.183
Infrequent smoker	230 (64.97%)	28 (65.12%)	258 (64.99%)	
Former regular smoker	111 (31.36%)	11 (25.58%)	122 (30.73%)	
Regular smoker	13 (3.67%)	4 (9.30%)	17 (4.28%)	
Exercise habits				0.331
No	190 (53.67%)	27 (62.79%)	217 (54.66%)	
Yes	164 (46.33%)	16 (37.21%)	180 (45.34%)	
Unconsciousness during stroke				<0.001
No	295 (88.32%)	28 (65.12%)	323 (85.68%)	
Yes	39 (11.68%)	15 (34.88%)	54 (14.32%)	
The most severe stroke condition				0.002
Complete hemiplegia	53 (14.97%)	17 (39.53%)	70 (17.63%)	
Hemiparesis, cannot sit independently	40 (11.30%)	5 (11.63%)	45 (11.34%)	
Hemiparesis, can sit independently	48 (13.56%)	5 (11.63%)	53 (13.35%)	
Hemiparesis, can still walk	213 (60.17%)	16 (37.21%)	229 (57.68%)	
Time of stroke (months)	6.44 (3.06)	7.33 (2.94)	6.54 (3.06)	0.068
Fastidious				<0.001
No	250 (70.62%)	15 (34.88%)	265 (66.75%)	
Yes	104 (29.38%)	28 (65.12%)	132 (33.25%)	
Current hemiplegia status				<0.001
No	206 (58.19%)	9 (20.93%)	215 (54.16%)	
Yes	148 (41.81%)	34 (79.07%)	182 (45.84%)	
Speech ability				<0.001
Normal	243 (69.23%)	16 (37.21%)	259 (65.74%)	
Speech difficult	102 (29.06%)	21 (48.84%)	123 (31.22%)	
Unable to communicate	6 (1.71%)	6 (13.95%)	12 (3.05%)	
Memory capacity				<0.001
Normal	197 (55.65%)	9 (20.93%)	206 (51.89%)	
Slightly decrease	55 (15.54%)	20 (46.51%)	75 (18.89%)	
Significant decrease	102 (28.81%)	14 (32.56%)	116 (29.22%)	
Receiving psychological counseling				<0.001
No	328 (92.66%)	30 (69.77%)	358 (90.18%)	
Yes	26 (7.34%)	13 (30.23%)	39 (9.82%)	
Personality Types				<0.001
Introverted	210 (59.32%)	10 (23.26%)	220 (55.42%)	
Extroverted	96 (27.12%)	25 (58.14%)	121 (30.48%)	
Neutral	48 (13.56%)	8 (18.60%)	56 (14.11%)	
Barthel index (scores)	25.52 (6.35)	16.72 (6.56)	24.57 (6.93)	<0.001
Barthel classification				<0.001
Severe dependency	268 (75.71%)	11 (25.58%)	279 (70.28%)	
Total dependency	86 (24.29%)	32 (74.42%)	118 (29.72%)	
Percentage of mobility self-assessment post-stroke (%)	33.35 (36.86)	75.76 (37.30)	38.00 (39.17)	<0.001

* Maintaining a continuous consumption of more than 2 units of alcohol per day.
# The statistical analyses employed encompassed t-tests, Chi-square tests, and Fisher's exact test.

and income (p = 0.029). Specifically, individuals with a general education degree were more prevalent in the PTSD group, indicating a potential association between lower education levels and PTSD risk. Additionally, patients with PTSD had significantly lower incomes compared to those without PTSD.

Clinical factors such as comorbidity (p = 0.100), hypertension (p = 0.083), and diabetes (p = 0.267) did not show statistically significant differences between the two groups. However, there was a significant association between unconsciousness during stroke and PTSD status (p < 0.001). Patients who experienced unconsciousness during stroke were more likely to develop PTSD.

Moreover, significant differences were observed in memory capacity (p < 0.001), with individuals experiencing slight or significant decreases in memory capacity showing higher prevalence of PTSD. Similarly, receiving psychological counseling was significantly associated with PTSD status (p < 0.001), indicating a potential role of counseling in managing PTSD post-stroke.

The Barthel index scores (p < 0.001) and percentage of mobility self-assessment post-stroke (p < 0.001) were significantly lower in the PTSD group, suggesting a greater degree of dependency and reduced mobility among individuals with PTSD.

Figure 1A and Figure 1C display density plots of the Barthel index scores and PCL-5 scores, respectively. Within these plots, the density of individuals classified as "fastidious" is notably higher in the group with Barthel index scores of 28 and above, while PCL-5 scores predominantly fall within the group with scores lower than 10. Meanwhile, figure 1B illustrates the inverse correlation between PCL-5 scores and Barthel index scores, where individuals with a fastidious status of "yes" exhibit significantly higher scores compared to the "no" group. This distinction persists consistently across all levels of the Barthel index.

Table 2 illustrates the outcomes of a comprehensive multivariable regression examination aimed at discerning the correlation between PTSD status and several prognostic factors subsequent to a stroke incident. The analysis encompasses a range of predictors including age, gender, alcohol consumption patterns, memory capacity, personality traits, consciousness levels during the stroke event, and Barthel index scores. Overall, the model demonstrated satisfactory discriminative ability, as evidenced by an AUC of 0.8782.

In the negative predictors category, advanced age exhibited a marginally significant association with a reduced risk of PTSD (OR = 0.97, 95% CI: 0.94 – 1.00, p = 0.067). Regular alcohol consumption emerged as a significant risk factor, with regular drinkers displaying notably heightened odds of PTSD compared to infrequent drinkers (OR = 11.43, 95% CI: 1.30 – 99.15, p = 0.027). Additionally, individuals with slightly decreased memory capacity were significantly more susceptible to PTSD compared to those with normal memory (OR = 3.59, 95% CI: 1.28 – 10.62, p = 0.017).

In contrast, the positive predictors revealed distinctive trends. Females exhibited a significantly elevated risk of PTSD compared to males (OR = 3.15, 95% CI: 1.08 – 10.44, p = 0.045). Extroverted (OR = 4.36, 95% CI: 1.73 – 11.86, p = 0.003) and neutral (OR = 4.83, 95% CI: 1.32 – 17.71, p = 0.016) personality types were associated with heightened odds of PTSD compared to introverted individuals. Moreover, higher Barthel index scores were significantly linked to a reduced risk of PTSD (OR = 0.85, 95% CI: 0.80 – 0.90, p < 0.001).

IV. DISCUSSION

PTSD and stroke have a complex relationship, where PTSD can increase the risk of stroke due to chronic stress and physiological changes, and experiencing a stroke can subsequently lead to the development of PTSD due to the traumatic nature of the event and its aftermath. A cross-sectional study of 397 patients using Stepwise AIC was conducted to determine the optimal logistic regression model related to the occurrence of PTSD. The optimal model encompasses 7 predictors including age, gender, alcohol consumption patterns, memory capacity, personality traits, consciousness levels during the stroke event, and Barthel index scores. Overall, the model demonstrated satisfactory discriminative ability, as evidenced by an AUC of 87.82%.

The relationship between advanced age and the risk of PTSD in stroke patients is sophisticated, with some studies suggesting that older age may be associated with a reduced risk of PTSD following a stroke, although this association is not always statistically significant.[9,22] A meta-analysis found that the prevalence of PTSD after a stroke is approximately 13%, with considerable variability across different studies.[9] Age is one of the factors influencing PTSD prevalence, and while older adults might experience lower rates of PTSD, the evidence remains mixed and not consistently definitive.[9,22] Our study's findings are consistent with these observations, indicating that each additional year of age is associated with a 3% reduction in the rate of PTSD, a marginally significant association with a reduced risk of PTSD.

Gender differences in the prevalence and manifestation of post-traumatic stress disorder (PTSD) following ischemic stroke have been extensively studied. Research consistently shows that female stroke survivors are significantly more likely to develop PTSD compared to males, with rates up to three times higher in the female patient group. Several studies have identified a strong correlation between female gender and increased incidence of PTSD symptoms post-stroke.[10,11,14] This heightened vulnerability among women may be attributed to differences in coping mechanisms, social support networks, and hormonal influences. Furthermore, Smith and colleagues (2020) highlighted the impact of social factors on PTSD prevalence, emphasizing that women often encounter unique challenges in navigating recovery after stroke, which can exacerbate psychological distress.[23] Additionally, hormonal fluctuations following stroke may contribute to increased emotional reactivity and susceptibility to PTSD among female patients.[14,24]

Regular alcohol consumption has emerged as a significant risk factor for developing PTSD in stroke patients. Studies indicate that individuals who regularly consume alcohol are more susceptible to PTSD following a stroke. This

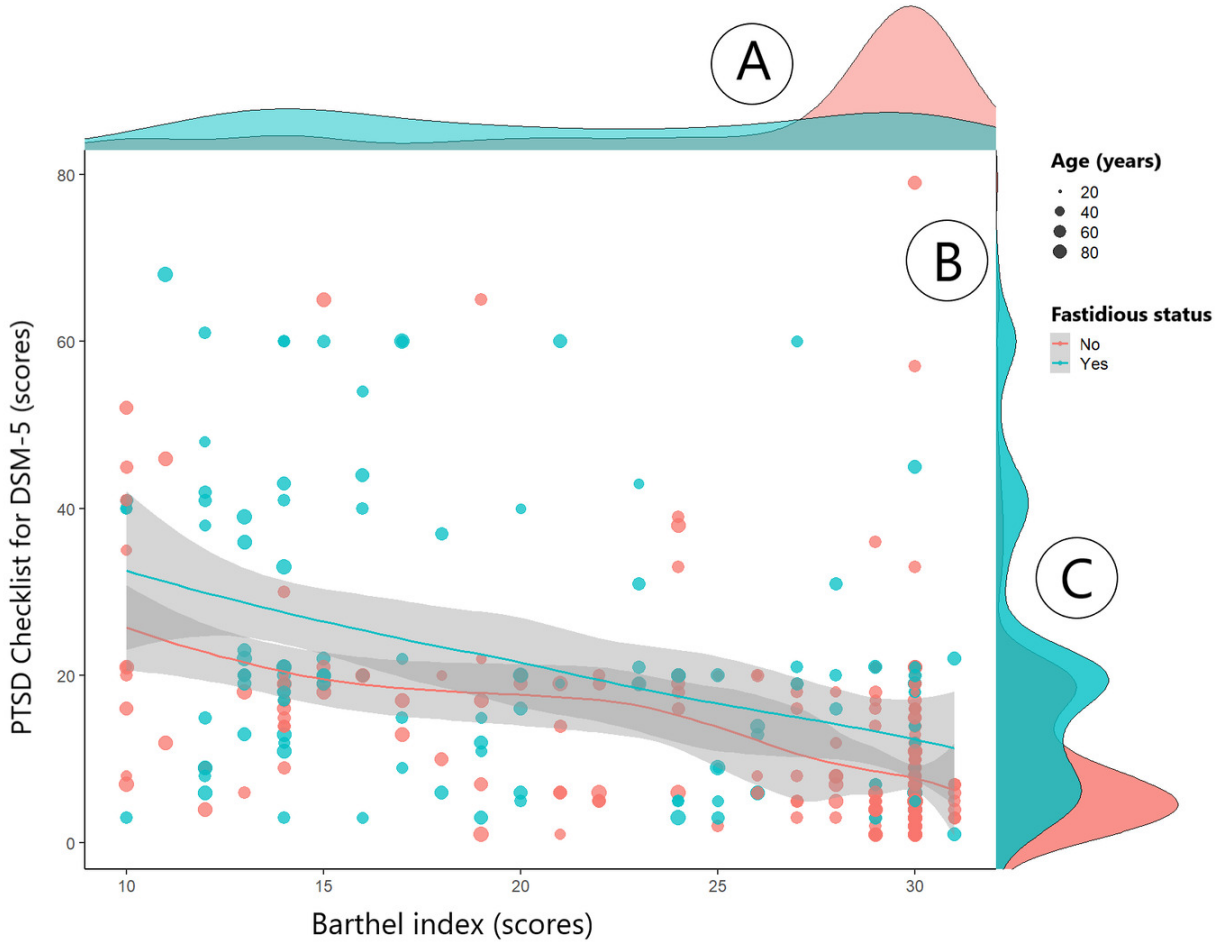

Figure 1. Correlation between Barthel index scores and PTSD Checklist for DSM-5 scores

Figure 1A and figure 1C present density plots of the Barthel index scores and PCL-5 scores, respectively. In figure 1B, the inverse correlation between PCL-5 scores and Barthel index scores is depicted, segmented by fastidious status.

may be due to alcohol's detrimental effects on the brain's stress response system, which can exacerbate both the psychological and physiological impacts of traumatic events like a stroke.[9] Additionally, alcohol can impair cognitive function and emotional regulation, making it more difficult for stroke survivors to cope with the aftermath, thereby increasing their vulnerability to PTSD.[22,25] Moreover, alcohol abuse is associated with poorer stroke outcomes and higher rates of post-stroke depression, which are both linked to an elevated risk of PTSD.[26] These findings are consistent with our study, which shows that patients who regularly consume alcohol are 11 times more likely to develop PTSD. Although patients who have quit drinking still have a twice as high likelihood of developing PTSD, this difference is not statistically significant. However, this group has a fivefold lower risk compared to those who continue to drink regularly. Our study highlights the importance of controlling alcohol consumption after a stroke because 29.1% of patients had maintained regular alcohol use before their stroke, and 3.1% continued to drink daily afterward.

Memory decline following a stroke is closely linked to an increased risk of developing PTSD. Common cognitive impairments post-stroke, affecting about one-third of survivors, hinder the processing of traumatic experiences.[27-29] Damage to the hippocampus, crucial for memory formation, exacerbates memory deficits in stroke patients.[15,30,31] This impairs the ability to process and integrate traumatic events, potentially leading to persistent, intrusive memories characteristic of PTSD.[15,32] Cognitive dysfunctions further undermine effective coping strategies, increasing emotional distress and susceptibility to PTSD.[32-34] Interventions aimed at improving memory and cognitive function in stroke rehabilitation are critical for mitigating the risk of PTSD.[35,36]

Research on personality traits and PTSD in stroke patients reveals that introverted traits are associated with a significantly lower likelihood of developing PTSD compared to extroverted and neutral traits. The results contradict Xiangzhi Jing's study on flood-resilient populations, which showed that introversion and PTSD were the primary risk factors for post-disaster depression, anxiety, and stress.[16] This difference could arise because post-stroke patients often face isolation due to their prolonged need for family support and acceptance of a more sedentary lifestyle.[37-39] Therefore, introverted individuals may experience fewer psychological issues as a result.

The relationship between post-stroke functional impairment, measured by the Barthel Index, and PTSD prevalence

Table 2. Multivariable regression model regarding PTSD status

Predictors	Univariable			Multivariable		
	OR	95%CI	P-value	OR	95%CI	P-value
(Intercept)	-	-	-	2.69	0.14 – 49.79	0.505
Age (years)	1.00	0.98 – 1.03	0.944	0.97	0.94 – 1.00	0.067
Gender						
Male		*Reference*			*Reference*	
Female	1.28	0.68 – 2.43	0.447	3.15	1.08 – 10.44	0.045
Alcohol drinking habits						
Infrequent drinker		*Reference*			*Reference*	
Former regular drinker	1.01	0.47 – 2.03	0.985	2.16	0.63 – 7.93	0.227
Regular drinker	2.99	0.79 – 9.45	0.077	11.43	1.30 – 99.15	0.027
Memory capacity						
Normal		*Reference*			*Reference*	
Slightly decrease	7.97	3.52 – 19.43	<0.001	3.59	1.28 – 10.62	0.017
Significant decrease	2.93	1.24 – 7.28	0.016	1.26	0.44 – 3.71	0.671
Personality Types						
Introverted		*Reference*			*Reference*	
Extroverted	5.44	2.58 – 12.32	<0.001	4.36	1.73 – 11.86	0.003
Neutral	3.77	1.37 – 10.14	0.008	4.83	1.32 – 17.71	0.016
Unconsciousness during stroke						
No		*Reference*			*Reference*	
Yes	4.01	1.94 – 8.10	<0.001	2.43	0.96 – 6.04	0.056
Barthel index (scores)	0.84	0.80 – 0.88	<0.001	0.85	0.80 – 0.90	<0.001
AUC		-			0.8782	
Observations		374			374	

is crucial in stroke rehabilitation. Our findings indicate a 15% lower likelihood of PTSD for every 1-point (equivalent to 1%) increase on the Barthel Index.[17] Lower Barthel scores correlate significantly with heightened PTSD symptoms, reflecting how impaired ADL capabilities contribute to psychological distres.[40-43]

Unconsciousness during a stroke significantly increases the risk of developing PTSD in survivors.[12] Unconsciousness during a stroke typically signifies severe neurological damage and a heightened life-threatening situation, exacerbating feelings of fear and helplessness upon regaining consciousness, core elements contributing to PTSD.[12,18] Early psychological intervention and ongoing monitoring for PTSD symptoms are crucial for enhancing recovery and improving the quality of life for stroke survivors who experienced unconsciousness.[44]

V. CONCLUSION

In conclusion, this study conducted in Doanhung, Phutho Province, provides crucial insights into PTSD prevalence and its predictors among stroke survivors. With a focus on factors such as alcohol consumption, memory decline, gender, personality traits, and functional independence, the study underscores the complexity of psychological vulnerability post-stroke.

These findings emphasize the need for tailored interventions to address these diverse risk factors effectively. Strategies aimed at reducing alcohol consumption, enhancing cognitive rehabilitation, providing gender-specific psychological support, and promoting functional recovery are pivotal in improving the quality of life and long-term outcomes for stroke survivors.

VI. LIMITATIONS

The study's geographical scope was limited to a small area in Doanhung, Phutho Province, which may not fully reflect the characteristics of stroke patients in other regions, as these may vary across different areas, thereby limiting the generalizability of the findings.

AUTHOR CONTRIBUTIONS

Ngoc Huy Nguyen: Data curation; Methodology; Formal analysis; Project administration; Writing – original draft; Writing – review & editing; **Cuong Cao Do:** Methodology; Data curation; Writing – original draft; Writing – review & editing; **Son Dinh Thanh Le:** Data curation; Methodology; Writing – original draft; **Ha Thi Thu Bui:** Data curation;

Writing – original draft; **Viet Quoc Hoang:** Data curation; Writing – original draft.

DATA AVAILABILITY STATEMENT

The data is not published per the decision of the ethics committee.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest. No funding was received for this study.

APPROVAL OF THE RESEARCH PROTOCOL

All study procedures were ethically approved by the Phu Tho Provincial General Hospital Ethics Committee (Approval No. 2155/QD-BV dated 02/10/2023).

INFORMED CONSENT

Prior to participation, patients were provided with comprehensive explanations regarding the study's potential benefits and risks, following which they provided informed consent.

REGISTRY AND THE REGISTRATION NO. OF THE STUDY/TRIAL

Not applicable.

ANIMAL STUDIES

Not applicable.

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