Received: 18 April 2025 | Revised: 25 June 2025 | Accepted: 29 June 2025

DOI: 10.1002/pcn5.70160

PCN Reports
Psychiatry and Clinical Neurosciences
Open Access

ORIGINAL ARTICLE

Post-stroke depression prevalence and associated factors at Hawassa University Hospital, Ethiopia: A prospective cross-sectional study

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Funding information
None

Abstract

Background: Post-stroke depression (PSD) is the most common neuropsychiatric complication following stroke. Although its prevalence varies across studies and meta-analyses, it is estimated to affect over 25% of stroke survivors. Despite its significant negative impact on recovery and quality of life, PSD is frequently underdiagnosed, misinterpreted as a stroke-related symptom, and often left untreated. Although multiple studies have been conducted in high-income countries, research on PSD remains limited in Ethiopia, especially in the southern region.

Methods: An institution-based prospective cross-sectional study was conducted from June to December 2024 on 216 stroke patients attending follow-up at the neurology clinic. Data were collected using a standardized questionnaire and review of patient records, facilitated by Kobo Toolbox. The data were then cleaned and analyzed using SPSS Version 27. Binary logistic regression was employed to identify factors associated with PSD. A p-value < 0.05 with a 95% confidence interval (CI) was considered statistically significant.

Results: In the bivariable analysis, age, marital status, duration since stroke, physical disability, diabetes mellitus, renal failure, cardiac illness, presence of multiple co-morbidities, and khat *(Catha edulis)* chewing were associated with PSD (p < 0.25). In the multivariable analysis, 6–12 months post-stroke (adjusted odds ration [AOR]: 0.07; 95% CI: 0.02–0.21), more than 12 months post-stroke (AOR: 0.02; 95% CI: 0.01–0.08), presence of physical disability (AOR: 5.27; 95% CI: 1.85–15.0), and cardiac illness (AOR: 5.05; 95% CI: 1.36–18.7) were significantly associated with PSD (p < 0.05).

Conclusion: This study identified physical disability, cardiac illness, and shorter duration since stroke as significant predictors of PSD. Approximately one in three stroke survivors were affected by PSD. The findings underscore the need for early detection, routine screening, and integration of mental health care into stroke rehabilitation programs. Identifying and addressing modifiable risk factors is crucial in reducing the burden of PSD and improving patient outcomes.

KEYWORDS
Ethiopia, post-stroke depression, prevalence, risk factors, stroke

BACKGROUND

"Stroke" is defined as a rapid neurological deficit attributed to a localized vascular origin. Thus, the diagnosis of stroke should be made clinically and supported by investigations, including brain imaging. Due to the intricate structure of the brain and its vasculature, the clinical signs and symptoms of stroke vary greatly.[1] About 85% of strokes are caused by ischemic occlusion, while intracerebral hemorrhage (ICH) accounts for the remaining cases.[2] Stroke prevalence represents a major public health concern. In 2021, studies showed that ICH was responsible for 3,308,367 (45.6%) of the estimated 7,252,678 stroke-related deaths, although it only accounted for 28.3% of stroke cases. Since 1990, the age-standardized incidence of ICH has shown an overall decline.[3]

The global burden of stroke has shifted from industrialized nations to developing countries, influenced by changing lifestyles, increased life expectancy, and other contributing factors. However, stroke in these regions often results in greater disability and mortality compared to developed nations. The burden of disease is believed to be transitioning to low- and middle-income countries, making stroke a growing public health concern in these settings.[4] ICHs, which were defined as acute extravasation of blood causing damage to brain parenchyma, account for about 10% of the 795,000 annual stroke cases in the USA.[5]

Stroke can present in several clinical forms, including ischemic stroke, hemorrhagic stroke, cerebral venous thrombosis, subarachnoid hemorrhage, and undifferentiated stroke.[6] Although global stroke incidence has increased, it is declining in wealthier countries while rising in areas with limited access to medical care.[1] Over the past three decades, stroke burden has increased significantly in developing countries while declining in high-income nations, largely due to better risk-factor management. In the same period, both the number of stroke cases and stroke-related deaths has continued to rise.[7]

Among the many neuropsychiatric conditions that follow a stroke, post-stroke depression (PSD) is the most common.[8] Approximately one-third of stroke survivors develop PSD at some point after the event. Though the precise pathophysiology is not fully understood, PSD is believed to result from a complex interaction of biological and psychosocial factors that may vary depending on the timing post-stroke. Understanding PSD's pathogenesis is essential for effective management. For example, pharmacologic therapy may be more appropriate for PSD driven by biological mechanisms, while psychotherapy and social support might better address PSD from psychosocial origins. PSD in stroke survivors is associated with worse recovery, recurrent vascular events, poorer quality of life (QoL), and increased mortality.[9]

Despite its clinical significance, PSD is often underdiagnosed and overlooked in clinical settings, making it critical to assess the neuropsychiatric status of post-stroke individuals.[10] While the global average prevalence of major depressive disorder is about 8.8%,[11] higher rates are seen in vulnerable groups. A cross-sectional study in northern India among 800 participants over the age of 60 years found that 76 (9.5%) were depressed. Factors associated with depression included lower income, smoking, recent stressful life events, multiple chronic diseases, and a pessimistic outlook.[12]

Studies have also demonstrated a link between PSD and cognitive or functional impairment after stroke, suggesting that depression may be a psychological response to such deficits.[13] In a German stroke inpatient facility, 31.1% of patients exhibited major depression during recovery. Anxiety disorders were also prevalent at 20.4%, with generalized anxiety disorder (GAD) being the most common (4.8%), followed by phobias, panic disorder, and obsessive–compulsive disorder.[14] Diagnosing PSD remains a challenge due to overlapping symptoms, and non-psychiatric physicians miss 50%–80% of cases.[15] Multiple lines of evidence suggest that PSD is not merely a psychological reaction to disability or a life-threatening event, but may have underlying biological mechanisms. These include disruption of the hypothalamic–pituitary–adrenal axis, elevated cortisol levels, increased oxidative stress, inflammatory markers, monoamine imbalance, and genetic predisposition.[16]

To investigate whether stroke causes specific emotional disturbances, one study compared neuropsychiatric profiles in orthopedic versus stroke patients using the Mini-Mental State Examination, the Visual Analogue Mood Scale, and the Hamilton Rating Scale. Stroke patients, particularly those with right hemisphere lesions, had a significantly higher depression rate (45%) compared to orthopedic patients (10%).[17] A study conducted in Lagos, Nigeria, found that PSD was more common in individuals with low education, unemployment, comorbidities, and functional disability.[18]

Furthermore, varying depression rates have been reported in patients with other chronic medical conditions: hypertension (21.3%), chronic kidney disease (20.3%), heart failure (19.3%), cancer (16.3%), type 1 and type 2 diabetes (13.6% and 10.9%, respectively), and chronic obstructive pulmonary disease (27.6%).[19]

There is a well-established link between functional impairment and the severity of PSD.[20] A recent systematic review and meta-analysis based on seven studies emphasized the impact of early PSD on survival. It estimated that individuals with early depressive symptoms were nearly 1.5 times more likely to die compared to non-depressed stroke patients, in both short- and long-term contexts.[21] In Ghana, more than 25% of stroke patients died within 5 years of their initial event. Depression and treatment-resistant hypertension were identified as modifiable therapeutic targets to improve outcomes.[22]

A screening using the Patient Health Questionnaire-9 (PHQ-9) showed that around 20% of acute stroke patients had moderate depression. Notably, patients from Middle Eastern and African backgrounds were nearly twice as likely to have depression, possibly due to higher stress levels or pre-existing trauma. PSD was also strongly associated with dysarthria.[23] Poor functional status

post-stroke is frequently linked to PSD and is associated with reduced QoL. Although no comprehensive meta-analysis exists on this topic, multiple studies have reported a strong correlation between PSD and decreased post-stroke QoL.[9] Functional impairment may increase the risk of PSD, which in turn leads to greater disability, fewer social interactions, slower recovery, inability to return to work, longer hospital stays, and diminished overall QoL.[24]

A cross-sectional study from Addis Ababa, Ethiopia, concluded that many stroke patients experience depressive symptoms post-stroke, consistent with international data. Early diagnosis and management of PSD may improve recovery. Female gender and aphasia were associated with higher PSD screening positivity, emphasizing the need for validated screening tools in clinical settings.[25]

Although numerous studies have been conducted in high-income countries, research on PSD remains limited in Ethiopia, particularly in the southern region. This study aims to assess the prevalence of PSD and its associated factors among stroke patients attending follow-up care at Hawassa University Comprehensive Specialized Hospital. The findings will help identify high-risk groups and improve early detection and referral from neurology to psychiatry clinics for timely intervention.

Additionally, the results will be relevant for clinicians, researchers, and health system planners by providing evidence to guide policy-making, enhance screening practices, allocate resources effectively, and potentially inform national PSD management guidelines. Given the similar demographic and socioeconomic characteristics, these insights could also benefit other low- and middle-income countries facing comparable challenges.

METHODS

Study area and period

This study was conducted at the Hawassa University Comprehensive Specialized Hospital (HUCSH), a tertiary teaching hospital located in Hawassa, Sidama Region, approximately 270 km southeast of Addis Ababa, Ethiopia. HUCSH serves as a referral hospital for a catchment population of over 18 million people. It is also a teaching hospital for the College of Medicine and Health Sciences at Hawassa University. The study was conducted from June to December 2024.

Study design

The study was an institution-based prospective cross-sectional study.

Source and study population

The source population for this study consisted of all patients with a documented history of stroke who were on follow-up at the HUCSH outpatient neurology clinic. On average, approximately 40 stroke patients visit the neurology clinic each month, with a total of 480 registered clients.

Inclusion and exclusion criteria

The inclusion criteria were as follows:

1. All adult stroke patients on follow-up at the neurology clinic with documented brain imaging in their respective medical charts.
2. Patients who provided informed consent.

The exclusion criteria were as follows:

1. Patients with incomplete medical records.
2. Patients with a history of major depressive disorder.
3. Patients with post-stroke duration of less than 2 weeks.
4. Patients with severe aphasia or low glasgow coma scale,[3–14] as patients were required to be conscious and fully oriented.

Sample size determination and procedure

The sample size was calculated using a single population proportion formula, based on a previous study conducted at Zewditu Hospital, Addis Ababa, which reported a PSD prevalence of 27.5%. The assumptions used were: 95% confidence level ($Z = 1.96$), 5% margin of error ($d = 0.05$), and an estimated population of 480 stroke patients registered at the Neurology – Medical Referral Clinic.

$$n = (Z^2 \times p(1 - p))/d^2 = (1.96)^2 \times 0.275(1 - 0.275)/(0.05)^2 = 307$$

since the total stroke population was 480, a finite population correction was applied, yielding a corrected sample size of 187. Adding a 10% non-response rate resulted in a final sample size of 206.

A convenient sampling technique was used due to the limited number of stroke patients seen monthly (less than 40). Participants were enrolled during follow-up visits or contacted by phone. Ultimately, 216 participants were included and their medical charts were reviewed for the required data.

Study variables

Dependent variable

Prevalence of PSD was the dependent variable.

Independent variables

Independent variables consisted of the following:

- Sociodemographic factors
  - Age
  - Gender
  - Residence (urban/rural)
  - Employment status
  - Marital status
  - Educational level

- Stroke-related factors
  - Stroke type (ischemic or hemorrhagic)
  - Location of stroke
  - Duration since stroke onset
  - Degree of physical disability

- Comorbid medical conditions
  - Diabetes mellitus
  - Hypertension
  - Chronic kidney disease (renal failure)
  - Ischemic heart disease and other cardiac illnesses
  - Malignancy
  - Chronic obstructive pulmonary disease

- Psychosocial and behavioral factors
  - Family history of depression
  - Substance use:
    - Alcohol
    - Khat (*Catha edulis*)
    - Cigarette smoking.

Operational definitions

The study used the following operational definitions:

- Stroke: A sudden onset of neurological deficit due to a focal vascular cause confirmed by imaging and interpreted by a radiologist.
- Depression: Diagnosed based on the PHQ-9 criteria for depression.
- PSD: A new onset of depression occurring after the stroke event.
- Significant physical disability: Inability to perform daily activities without assistance from others.
- Comorbidities: Presence of other medical conditions requiring regular follow-up and ongoing management.

Data-collection tools and procedures

A validated screening tool, originally prepared in English, was translated into Amharic and other languages understood by the participants to ensure clarity and comprehension. Data collection was carried out by five trained resident physicians under the supervision of a senior physician who oversaw the process and addressed any issues encountered during data collection. A standardized and pretested questionnaire, based on the PHQ-9, was administered to eligible participants. The PHQ-9 includes 10 core items designed to screen for depression, along with additional questions to capture relevant variables. After translation, modifications were made to the questionnaire to better suit the study context and population. Medical chart reviews were also conducted to assess imaging results and evaluate comorbid medical conditions.

The PHQ-9, a self-administered tool for diagnosing common mental disorders, assigns a score from 0 to 3 for each of its nine items. The total score determines the severity of depression, categorized as follows: no depression for scores less than 10, minor depression for scores between 10 and 14, moderately severe depression for scores between 15 and 19, and severe depression for scores of 20 or more. A PHQ-9 score of 10 or above was used as the diagnostic cutoff for depression, which is supported by evidence indicating 88% sensitivity and 88% specificity for this threshold.

Substance use was also assessed. Cigarette smoking was initially planned to be classified using the World Health Organization guidelines as light (<11 cigarettes/day), moderate (11–19 cigarettes/day), and heavy (>20 cigarettes/day) smoking. However, in this study, all smokers were found to be light smokers. Alcohol consumption was evaluated using the DSM-5 criteria for alcohol use disorder (AUD), which includes 11 diagnostic parameters. A minimum of two positive responses is required for diagnosis, with severity classified as mild (2–3 criteria), moderate (4–5 criteria), or severe (more than 6 criteria).

A pretest of the questionnaire was conducted on 10 patients, representing 5% of the final sample size. Feedback and challenges identified during this pretest led to appropriate adjustments and refinements in the questionnaire. Additional data on patient demographics, stroke type, stroke location, duration since the stroke event, degree of physical disability, comorbidities, and any history of depression prior to the stroke were collected through patient chart reviews.

Data quality assurance

Medical residents and certified nurses working in the outpatient clinics were informed and involved in the data-collection process. They received clear instructions on how to fill out the questionnaire and extract relevant information from patient charts. To ensure proper adherence to the study protocol, an internal medical resident was assigned to supervise and oversee the entire data-collection process.

Data processing and analysis

Data collected using the Kobo Toolbox were directly exported to SPSS Version 27 for analysis. The dataset was carefully checked, cleaned, and then analyzed. Descriptive analysis was performed using basic proportions and frequencies, and the findings were

presented using tables, bar graphs, and pie charts. To evaluate the association between PSD and various factors, including sociodemographic characteristics, stroke-related variables, comorbidities, and psychosocial factors, a binary logistic regression analysis was conducted. Furthermore, to control for potential confounding variables, a multivariable logistic regression was performed on all statistically significant variables. A p-value of <0.05 was considered statistically significant, and adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported to quantify the strength of associations.

RESULTS

Sociodemographic characteristics of study participants

A total of 216 patients were enrolled in the study. Of these, more than half were male, accounting for 57.4% of the participants. The age of respondents ranged from 16 to 90 years, with a mean age of 57.44 years (±13.382 years). The majority of participants were married, representing 86.1% of the study population. Regarding socioeconomic status, nearly half of the respondents (48.1%) reported a very low monthly income (less than 3500 Ethiopian birrs ~$60 at the time of the study). Additionally, more than half of the participants (51.9%) were illiterate (Table 1).

TABLE 1 Sociodemographic characteristics of stroke patients who visited Hawassa University Comprehensive Specialized Hospital from June to December 2024.

Variable		Frequency (*n*)	Percent (%)
Age (years)	<45	35	16.2
	45–60	89	41.2
	>60	92	42.6
Gender	Female	92	42.6
	Male	124	57.4
Marital status	Married	186	86.1
	Single	8	3.7
	Widowed	17	7.9
	Divorced	5	2.3
Residence	Rural	112	51.9
	Urban	104	48.1
Religion	Muslim	31	14.4
	Orthodox	63	29.2
	Protestant	120	55.6
	Others	2	0.9
Level of education	Did not attend formal education	125	**57.9**
	Primary school	32	14.8
	Secondary school	30	13.9
	Diploma	4	1.9
	Bachelor's degree	23	10.6
	Master's and above	2	0.9

Behavioral and clinical characteristics of study participants

Among the participants, nearly half had experienced an ischemic stroke (50.5%), followed closely by hemorrhagic stroke (48.6%). In terms of stroke location, the majority of cases were subcortical, accounting for 58.3% of the total. Hypertension was the most commonly reported comorbidity, present in 69% of the patients. Regarding the duration since stroke onset, the majority (44.9%) had experienced a stroke more than 12 months prior to data collection. Additionally, a significant proportion of the participants (63.4%) were found to have notable physical disabilities following their stroke (Table 2).

The prevalence of PSD

The prevalence of PSD in this study was found to be 29.2% (63 out of 216 patients), with a 95% CI of 23.1% to 35.2%. Of the total 216 participants, 153 (70.83%) were not diagnosed with depression. Among the patients who reported PSD, 30 (13.89%) experienced moderate depression, while 28 (12.96%) had mild depression. The remaining 2.31% of 5 participants reported experiencing severe depression (Figure 1).

Factors associated with PSD

In the bivariable logistic regression analysis, several factors were found to have a potential association with PSD, with a p-value of <0.25. These included age, marital status, post-stroke duration, current physical disability, diabetes mellitus, renal failure, cardiac illness, presence of multiple comorbidities, and chewing khat (*Catha edulis*). However, when adjusted for confounding variables in the multivariable binary logistic regression analysis, only three factors were found to be significantly associated with PSD. These factors included the post-stroke duration: patients with a post-stroke duration of 6–12 months had an AOR of 0.07 (95% CI: 0.02–0.21), while those with a post-stroke duration of more than 12 months had an AOR of 0.02 (95% CI: 0.01–0.08). Additionally, current physical disability was strongly associated with PSD, with an AOR of 5.27 (95% CI: 1.85–15.0), and cardiac illness was also significantly associated, with an AOR of 5.05 (95% CI: 1.36–18.7) (Table 3).

TABLE 2 Behavioral and clinical characteristics of stroke patients of stroke patients who visited Hawassa University Comprehensive Specialized Hospital from June to December 2024.

Variable		Frequency (*n*)	Percent (%)
Type of stroke	Ischemic stroke	109	50.5
	Hemorrhage stroke	105	48.6
	Subarachnoid hemorrhage	2	0.9
Site of stroke	Sub cortical	126	58.3
	Left cortical	43	19.9
	Right cortical	42	19.4
	Brain stem	5	2.3
Duration since stroke	<6 months	74	34.3
	6–12 month	45	20.8
	>12 months	97	44.9
Hypertension	No	67	31.0
	Yes	149	69.0
Diabetes Mellitus	No	177	81.9
	Yes	39	18.1
Renal failure	No	206	95.4
	Yes	10	4.6
Cardiac illness	No	183	84.7
	Yes	33	15.3
Alcohol consumption	No	208	96.3
	Yes	8	3.7
Smoking	No	207	95.8
	Yes	9	4.2

DISCUSSION

The present study found a PSD prevalence of 29.2% (95% CI: 23.1%–35.2%) among patients attending follow-up care at HUCSH. This finding aligns with the global estimated PSD prevalence range of 20%–50% reported in various studies.[14,25–27] Our results show particular consistency with studies from Germany (31.1%),[14] Uganda (31.5%),[26] and another Ethiopian study at Zewditu Hospital (32.2%).[25] However, some African studies have reported higher prevalence rates of 40%–50%,[28,29] while Bangladesh reported an exceptionally high rate of 70%.[30] A 2021 institutional-based survey in Ethiopia further highlighted regional variability, reporting a PSD prevalence of 43.3%,[31] underscoring the influence of healthcare access and rehabilitation strategies on outcomes.

The observed variations in PSD prevalence across different regions may be attributed to several factors. Differences in neurological care quality for post-stroke patients likely play a significant role.[14,25] Sociocultural and religious factors that influence stress thresholds and coping mechanisms may also contribute to these disparities.[28,32] For instance, a Nigerian study identified lack of spousal support and female gender as key social determinants of PSD,[32] emphasizing the role of psychosocial context. Importantly, studies that included patients with pre-existing depression history tended to report higher prevalence rates, given the 60–90% recurrence risk in this population.[9] A recent meta-analysis found remarkably similar PSD prevalence between developed (27%) and developing (28%) countries,[33] suggesting that both biological and psychosocial mechanisms of PSD may be universal across different healthcare settings.

Although our study was conducted in a low-resource setting with limited access to specialized neurological care, the PSD prevalence we found (29.2%) is comparable to that reported in many high-income countries, such as Germany.[14] This similarity may reflect the shared impact of biological mechanisms (e.g., post-stroke neurochemical changes), universal psychosocial stressors, and the widespread use of similar screening instruments, such as the PHQ-9.[9,33] It is possible that even in settings with less access to rehabilitation services; the intrinsic risk of PSD remains consistent due to the nature of stroke-related brain injury itself. However, healthcare infrastructure and cultural differences might still influence long-term outcomes, severity, and recognition of PSD.[31,32]

Our study identified several key factors associated with PSD. Stroke duration emerged as a significant predictor, with higher PSD risk observed in the first 6 months post-stroke.[26,27,34,35] This temporal pattern aligns with existing literature demonstrating that depression risk is highest in the acute post-stroke phase.[9,14] The natural history of PSD shows peak incidence in the first month (33%), declining to 27% at 1–5 months, 22% at 6–12 months, and 29% beyond one year.[33] This trajectory likely reflects both the neurobiological effects of acute stroke and the psychological adjustment to new disabilities.[9,16] Our finding of lower PSD prevalence after 12 months supports this pattern, suggesting that natural recovery processes and adaptation may reduce depression risk over time.[26,27,35]

The degree of physical disability showed a strong association with PSD in our study, corroborating previous research findings.[9,20,24,28,29] The American Stroke Association has emphasized this relationship in their scientific statement on PSD.[9,29] The mechanisms underlying this association may involve both biological and psychological pathways. More severe physical disability often reflects greater neuronal injury, which has been postulated as a pathophysiological contributor to PSD.[16] Additionally, sudden and significant disability can cause psychological trauma, impair QoL, and limit social participation, all of which may precipitate depression.[9,24] This bidirectional relationship between disability and depression creates a vicious cycle, as depression itself can hinder rehabilitation efforts and functional recovery.[20]

Comorbid medical conditions, particularly cardiac illness, were significantly associated with PSD in our population.[36–39] Cardiac and renal diseases may increase PSD risk through multiple pathways,

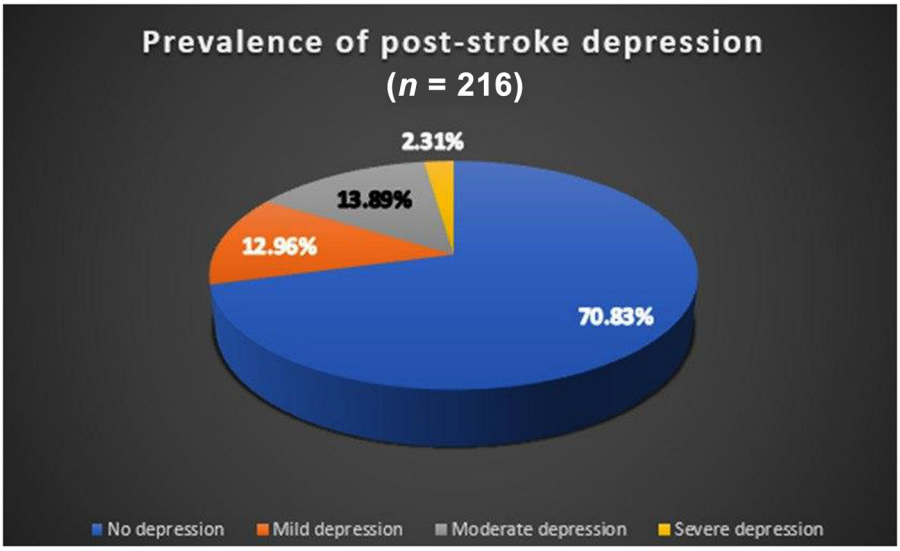

FIGURE 1 The prevalence of post-stroke depression among stroke patients who visited Hawassa University Comprehensive Specialized Hospital from June to December 2024.

including systemic inflammation, oxidative stress, and neurotransmitter dysregulation.[36,40] A study conducted in Gondar, Ethiopia identified ischemic heart disease as a significant predictor of PSD,[37,39] which supports our findings. These comorbidities may exacerbate functional limitations and reduce QoL, further predisposing stroke survivors to depression.[38] Renal dysfunction has been specifically identified as a strong predictor of poor outcomes in post-stroke patients,[41] likely contributing to increased depression risk through both physiological and psychological mechanisms.

Geographic variations in PSD prevalence reveal important patterns. While our Ethiopian findings are consistent with many international reports, some regions show markedly different rates. Bangladesh's reported 70% prevalence[30] may reflect differences in population demographics, lifestyle factors, or assessment methods. An Egyptian hospital-based study found 36.9% PSD prevalence compared to 12% in controls,[42] identifying low education, socioeconomic status, smoking, and functional impairment as significant risk factors. These findings highlight how socioeconomic determinants can exacerbate PSD risk in resource-limited settings.[31,32] In high-income countries, such as Germany, despite similar overall prevalence (31.1%),[14] better healthcare access may lead to earlier detection and management.

The clinical implications of these findings are substantial. Underdiagnosis remains a major challenge, with non-psychiatric physicians missing 50–80% of PSD cases.[15] This diagnostic gap underscores the need for routine screening using validated tools, such as the PHQ-9.[23,43] A Pakistani study emphasized that systematic screening combined with family support, rehabilitation, and prompt psychiatric referral could significantly improve outcomes.[32,38] The DSM-IV-TR criteria for PSD (mood disorder directly caused by stroke)[15] provide a framework for diagnosis, but clinical implementation requires greater awareness of risk factors, including pre-stroke history, physical disability, and cognitive impairment.[9,44]

CONCLUSION, RECOMMENDATIONS, AND LIMITATIONS

This study underscores the significant burden of PSD, revealing that nearly one-third (29.2%) of stroke patients develop depression following their stroke event. This finding is consistent with both local and global studies, reinforcing the notion that PSD is a prevalent and serious complication of stroke. The study identifies critical risk factors, such as early post-stroke period, physical disability, and cardiac comorbidities, that significantly increase the likelihood of developing PSD. These associations offer valuable insights into the risk profile of stroke survivors and emphasize the importance of early, targeted interventions.

Despite being conducted in a low-resource setting, our findings were comparable to those from developed countries, highlighting that the core biological mechanisms and psychosocial stressors associated with PSD may transcend differences in healthcare infrastructure. This comparability suggests that universal factors, rather than health system strength alone, drive the risk of PSD. Nonetheless, differences in long-term management and rehabilitation access may influence chronic PSD outcomes.

The findings highlight the urgent need for integrated stroke care that includes routine mental health assessment and management, especially during the first 6 months post-stroke when the risk of depression is highest. Systematic screening using validated tools, such as the PHQ-9, combined with early rehabilitation, family support, and appropriate psychiatric referrals, can substantially improve patient outcomes. Educating stroke survivors and their families about PSD is also critical, as increased awareness may facilitate early detection and treatment.

To effectively address PSD, a comprehensive, multidisciplinary approach is recommended that brings together neurologists, psychiatrists, cardiologists, and rehabilitation specialists. Such collaboration ensures that both the physical and psychological needs of stroke patients are met, promoting more holistic and effective

TABLE 3 Factors associated with post-stroke depression among stroke patients who visited Hawassa University Comprehensive Specialized Hospital from June to December 2024 (after bi- and multivariate regression).

Variables	Categories	PSD		COR (95% CI)	*p*-value	AOR (95% CI)
		No	Yes			
Age (years)	<45	29 (82.9)	6 (17.1)	1		1
	45–60	70 (78.7)	19 (21.3)	1.31 (0.47, 3.61)	0.6	2.36 (0.56, 9.87)
	>60	54 (58.7)	38 (41.3)	3.40 (1.28, 8.99)	0.014	1.96 (0.48, 7.96)
Marital status	Married	135 (72.6)	51 (27.4)	1		1
	Currently unmarried[a]	18 (60.0)	12 (40.0)	1.76 (0.79, 3.92)	0.15	2.38 (0.67, 8.42)
Duration since stroke	<6 months	20 (28.6)	50 (71.4)	1		1
	6–12 months	40 (84.9)	8 (15.1)	0.07 (0.02, 0.17)	<0.001	0.07 (0.02, 0.21) **
	>12 months	88 (94.6)	5 (5.4)	0.02 (0.01, 0.06)	<0.001	0.02 (0.01, 0.08)**
Current physical disability	Yes	36 (45.6)	43 (54.4)	6.98 (3.65, 13.3)	<0.001	5.3 (1.85, 15.0)**
	No	117 (84.4)	20 (14.6)	1		1
Diabetes mellitus	Yes	21 (53.8)	18 (46.2)	2.51 (1.23, 5.13)	0.010	0.69 (0.14, 3.32)
	No	132 (74.6)	45 (25.4)	1		1
Renal failure	Yes	4 (40.0)	6 (60.0)	3.92 (1.06, 14.4)	0.028	1.61 (0.14, 18.19)
	No	149 (72.3)	57 (27.7)	1		1
Comorbidities	Yes	18 (45.0)	22 (55.0)	4.02 (1.97, 8.22)	<0.001	3.45 (0.68, 17.39)
	No	135 (76.7)	41 (23.3)	1		1
Cardiac illness	Yes	20 (60.6)	13 (39.4)	1.73 (0.80, 3.73)	0.160	5.05 (1.36, 18.7)*
	No	133 (72.7)	50 (27.3)	1		1
Chewing khat	Yes	6 (46.2)	7 (53.8)	3.06 (0.98, 9.50)	0.043	2.04 (0.45, 9.26)
	No	147 (72.4)	56 (27.6)	1		1

[a]Single, divorced, and widowed.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odd ratio; PSD, post-stroke depression.

*$p < 0.05$; **$p < 0.01$.

recovery. Moreover, adequate management of comorbidities, such as cardiac disease and the provision of continuous physiotherapy, may help mitigate the risk of PSD and enhance overall rehabilitation.

Despite its contributions, this study has limitations. Its cross-sectional design limits causal inference, and the single-center setting may affect generalizability. Moreover, the absence of data on pre-existing depression is an established risk factor for PSD and a notable gap. The reliance on self-reported data introduces the possibility of recall bias, particularly concerning depressive symptoms and medical history. Additionally, the use of a convenience sampling method may introduce selection bias and limit the applicability of findings to the broader stroke population. Nevertheless, the consistency of our findings with international literature strengthens their validity.

Future research should focus on longitudinal studies to better understand the causal pathways between stroke, comorbidities, and depression over time. Investigations into sociocultural and regional differences in PSD prevalence within Ethiopia are also warranted to tailor interventions to specific demographic groups. Importantly, the development and implementation of national guidelines for PSD screening and management would help standardize care across healthcare settings and improve long-term outcomes for stroke survivors.

In conclusion, PSD is a common and impactful complication of stroke in Ethiopia, particularly among those with recent strokes, severe disabilities, and cardiac illnesses. Integrating mental health services into stroke care through early screening, targeted intervention, and multidisciplinary collaboration can significantly enhance the QoL and rehabilitation outcomes for stroke survivors. Culturally adapted strategies and national policy frameworks are needed to guide the prevention, detection, and management of PSD in Ethiopia and similar low-resource settings.

Given the similarity in prevalence across diverse healthcare settings, future policies should recognize PSD as a global concern that warrants universal screening and intervention strategies, even in low-resource environments.

AUTHOR CONTRIBUTIONS

Awoke Seid: Conceptualization; writing—original draft; writing—reviewing and editing; formal analysis; methodology; validation. **Abera Kuma**: Writing—reviewing and editing; supervision. **Yegzeru Belete**: Writing—reviewing and editing; methodology; formal analysis; visualization. **Amanuel Anegagregn**: Writing—reviewing and editing; methodology; formal analysis; software; visualization; resources.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the administration of Hawassa University Comprehensive Specialized Hospital for their unwavering support throughout this study. We also extend our heartfelt appreciation to the data collectors for their dedicated efforts, professionalism, and collaboration during the data-collection process. Their hard work and commitment were integral to the success of this study.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data used in the current study are available from the corresponding author upon reasonable request.

ETHICAL APPROVAL STATEMENT

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of the Hawassa University College of Medicine and Health Sciences, under the reference number IRB/350/16. Prior to participation, the purpose and potential benefits of the study were thoroughly explained to all participants. Additionally, participants were informed of their right to withdraw from the study at any time without consequence. All data collected from patient charts and interviews were treated with the utmost confidentiality and were used exclusively for the objectives of this research.

PATIENT CONSENT STATEMENT

N/A.

CLINICAL TRIAL REGISTRATION

N/A.

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REFERENCES

1. Loscalzo Fauci, Kasper Hauser, Longo Jameson. Harrison's Principles of internal medicine. J Orthop Trauma. 1992;6(4):518.
2. Kuriakose D, Xiao Z. Pathophysiology and treatment of stroke: present status and future perspectives. Int J Mol Sci. 2020;21(20):7609.
3. Owolabi MO, Thrift AG, Martins S, Johnson W, Pandian J, Abd-Allah F, et al. The state of stroke services across the globe: report of World Stroke Organization–World Health Organization surveys. Int J Stroke. 2021;16(8):889–901.
4. Kalkonde YV, Alladi S, Kaul S, Hachinski V. Stroke prevention strategies in the developing world. Stroke. 2018;49(12):3092–7.
5. Greenberg SM, Ziai WC, Cordonnier C, Dowlatshahi D, Francis B, Goldstein JN, et al. 2022 guideline for the management of patients with spontaneous intracerebral hemorrhage: a guideline from the American Heart Association/American Stroke Association. Stroke. 2022;53:282–361.
6. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(7):2064–89.
7. Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol. 2021;20(10):795–820.
8. Mitchell AJ, Sheth B, Gill J, Yadegarfar M, Stubbs B, Yadegarfar M, et al. Prevalence and predictors of post-stroke mood disorders: a meta-analysis and meta-regression of depression, anxiety and adjustment disorder. Gen Hosp Psychistry. 2017;47:48–60.
9. Towfighi A, Ovbiagele B, El Husseini N, Hackett ML, Jorge RE, Kissela BM, et al. Poststroke depression: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2017;48(2):e30–43.
10. Pohjasvaara T, Leppävuori A, Siira I, Vataja R, Kaste M, Erkinjuntti T. Frequency and clinical determinants of poststroke depression. Stroke. 1998;29(11):2311–7.
11. Vilagut G, Forero CG, Barbaglia G, Alonso J. Screening for depression in the general population with the Center for Epidemiologic Studies Depression (CES-D): a systematic review with meta-analysis. PLoS One. 2016;11(5):e0155431.
12. Sharma K, Gupta A, Sharma R, Mahajan N, Mahajan A, Sharma D, et al. Prevalence and risk factors for depression in elderly North Indians. J Geriatr Ment Health. 2016;3(2):158.
13. Nys GMS, Van Zandvoort MJE, Van Der Worp HB, De Haan EHF, De Kort PLM, Kappelle LJ. Early depressive symptoms after stroke: neuropsychological correlates and lesion characteristics. J Neurol Sci. 2005;228(1):27–33.
14. Schöttke H, Giabbiconi CM. Post-stroke depression and post-stroke anxiety: prevalence and predictors. Int Psychogeriatr. 2015; 27(11):1805–12. https://doi.org/10.1017/S1041610215000988
15. Espárrago Llorca G, Castilla-Guerra L, Fernández Moreno MC, Ruiz Doblado S, Jiménez Hernández MD. Post-stroke depression: an update. Neurología (English Edition). 2015;30(1):23–31.
16. Levada OA, Troyan AS. Poststroke depression biomarkers: a narrative review. Front Neurol. 2018;9(JUL):1–18.
17. Folstein MF, Maiberger R, McHugh PR. Mood disorder as a specific complication of stroke. J Neurol Neurosurg Psychiatry. 1977;40:1018–20.
18. Ayasrah SM, Ahmad MM, Basheti IA. Post-stroke depression in Jordan: prevalence correlates and predictors. J Stroke Cerebrovasc Dis. 2018;27(5):1134–42.
19. Li Z, Li Y, Chen L, Chen P, Hu Y, Wang H. Prevalence of depression in patients with hypertension: a systematic review and meta-analysis. Medicine (Baltimore). 2015;94(31):e1317.
20. Astuti P, Kusnanto K, Dwi Novitasari F. Depression and functional disability in stroke patients. J Public Health Res. 2020;9(2):169–71.
21. Bartoli F, Di Brita C, Crocamo C, Clerici M, Carrà G. Early post-stroke depression and mortality: meta-analysis and meta-regression. Front Psychiatry. 2018;9(November):1–7.
22. Sarfo FS, Ovbiagele B. Key determinants of long-term post-stroke mortality in Ghana. J Neurol Sci. 2022;434:120123.

23. Wilkins SS, Akhtar N, Salam A, Bourke P, Joseph S, Santos M, et al. Acute post stroke depression at a primary stroke center in the Middle East. PLoS One. 2018;13(12):e0208708.
24. Khedr EM, Abdelrahman AA, Desoky T, Zaki AF, Gamea A. Post-stroke depression: frequency, risk factors, and impact on quality of life among 103 stroke patients—hospital-based study. Egypt J Neurol Psychiatr Neurosurg. 2020;56(1):66.
25. Tsehayneh F, Tafesse A. High prevalence of poststroke depression in ischemic stroke patients in Ethiopia. Neurol Res Int. 2020;2020: 1–6.
26. Tsao CW, Aday AW, Almarzooq ZI, Alonso A, Beaton AZ, Bittencourt MS, et al. Heart Disease and Stroke Statistics-2022 Update: a report from the American Heart Association. Circulation. 2022;145:E153–639.
27. Akinyemi RO, Ovbiagele B, Adeniji OA, Sarfo FS, Abd-Allah F, Adoukonou T, et al. Stroke in Africa: profile, progress, prospects and priorities. Nat Rev Neurol. 2021;17(10):634–56.
28. Erkabu SG, Agedie Y, Mihretu DD, Semere A, Alemu YM. Ischemic and hemorrhagic stroke in Bahir Dar, Ethiopia: a retrospective hospital-based study. J Stroke Cerebrovasc Dis. 2018;27(6): 1533–8.
29. Debebe EY, Biyadgie M, Chekol HA, Asmare L, Yigzaw ZA. Prevalence and associated factors of post-stroke depression among patients on follow-up at medical referral clinics of Bahir Dar city public specialized hospitals. BMC Neurol. 2024;24(1):470.
30. Robinson RG, Jorge RE. Post-stroke depression: a review. Am J Psychiatry. 2016;173(3):221–31.
31. Worku S, Tesfaye M, Deresse E, Agumasie M. Prevalence of depression and associated factors among post stroke patients at St Paul's Hospital Millennium Medical College, A.A, Ethiopia. SPHMMC. 2021:1–15. https://doi.org/10.21203/rs.3.rs-690619/v1
32. Gloria MU, Jonah OE, Olusanjo AC, Chiebuka OE, Nene JJ, Nwakego AU, et al. Post-stroke depression and suicidal ideations: relationship with gender and marital status: a cross sectional study. J Prim Care Community Health. 2024;15:21501319241233172.
33. Liu L, Xu M, Marshall IJ, Wolfe CD, Wang Y, O'Connell MD. Prevalence and natural history of depression after stroke: a systematic review and meta-analysis of observational studies. PLoS Med. 2023; 20(3):e1004200.
34. Ariful Islam M, Rahman A, Aleem MA, Islam SMS. Prevalence and associated factors of depression among post-stroke patients in Bangladesh. Int J Ment Health Addict. 2016;14(2):154–66.
35. Wubshet TY, Geberemichael SG, Adilo TM, Arusi TT, Gutulo MG, Assefa DZ, et al. Prevalence and associated factors of poststroke depression among outpatient stroke patients who have a follow-up at the Outpatient Neurology Clinic of Zewditu Memorial Hospital in Addis Ababa, Ethiopia. Depress Res Treat. 2022;2022:1–7.
36. Jeong YJ, Kim WC, Kim YS, Choi KW, Son SY, Jeong YG. The relationship between rehabilitation and changes in depression in stroke patients. J Phys Ther Sci. 2014;26(8):1263–6.
37. Bour A, Rasquin S, Aben I, Boreas A, Limburg M, Verhey F. A one-year follow-up study into the course of depression after stroke. J Nutr Health Aging. 2010;14:488–93. https://doi.org/10.1007/s12603-010-0033-x
38. Huo X, Zhang L, Bai X, He G, Li J, Miao F, et al. Impact of non-cardiac comorbidities on long-term clinical outcomes and health status after acute heart failure in China. Front Cardiovasc Med. 2022;9:883737.
39. Fantu E, Hailu W, Bekele N, Tsegaye T, Tadesse M, Asres MS. Determinants of post-stroke depression among stroke survivors at University of Gondar Hospital, Northwest Ethiopia: a case-control study. BMC Neurol. 2022;22(1):446.
40. Gyagenda JO, Ddumba E, Odokonyero R, Kaddumukasa M, Sajatovic M, Smyth K, et al. Post-stroke depression among stroke survivors attending two hospitals in Kampala Uganda. Afr Health Sci. 2016;15(4):1220–31.
41. Lin S, Luan X, He W, Ruan Y, Yuan C, Fan A, et al. Post-stroke depression and estimated glomerular filtration rate: a prospective stroke cohort. Neuropsychiatr Dis Treat. 2020;16:201–8.
42. Seetlani NK, Ali A, Haroon H, Shams N, Ali P, Sheikh T. Frequency of depression in patients with stroke. Med Channel. 2015;21(4):22–6.
43. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9. J Gen Intern Med. 2001;16(9):606–13.
44. Ayerbe L, Ayis S, Wolfe CDA, Rudd AG. Natural history, predictors and outcomes of depression after stroke: Systematic review and meta-analysis. Br J Psychiatry. 2013;202:14–21.

How to cite this article: Seid A, Kuma A, Belete Y, Anegagregn A. Post-stroke depression prevalence and associated factors at Hawassa University Hospital, Ethiopia: A prospective cross-sectional study. Psychiatry Clin Neurosci Rep. 2025;4:e70160. https://doi.org/10.1002/pcn5.70160