



Risk Factors and Outcomes of Young Stroke Patients: A Retrospective Analysis.

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Abstract

Background: Stroke among young adults is an important cause of premature mortality and long-term disability. The increasing prevalence of conventional vascular risk factors among younger individuals has contributed to a changing epidemiological profile of young stroke. **Objectives:** To evaluate the demographic characteristics, risk factors, stroke patterns, clinical outcomes, and predictors of unfavorable functional outcome among young stroke patients. **Materials and Methods:** This retrospective observational study included 180 patients aged 18–45 years with radiologically confirmed acute stroke admitted to a tertiary care hospital. Demographic characteristics, clinical presentation, vascular risk factors, stroke type, etiological characteristics, NIHSS severity, and functional outcome were recorded from medical records. Functional outcome at discharge was assessed using the modified Rankin Scale (mRS), with mRS 0–2 considered favorable and mRS 3–6 unfavorable. Factors associated with unfavorable outcome were evaluated using univariate and multivariable logistic regression analyses. A p-value <0.05 was considered statistically significant. **Results:** The mean age was 38.2 ± 5.6 years, and 64.4% of patients were males. Ischemic stroke accounted for 73.3% of cases and hemorrhagic stroke for 26.7%. Hypertension (50.6%) was the most common risk factor, followed by dyslipidemia (40.0%), smoking (37.8%), alcohol consumption (29.4%), and diabetes mellitus (23.9%). Motor weakness/hemiparesis (79.4%) was the predominant presentation. A favorable functional outcome was observed in 69.4%, while 30.6% had an unfavorable outcome and in-hospital mortality was 6.7%. Admission NIHSS >15 was the strongest independent predictor of unfavorable outcome (adjusted OR 6.18, 95% CI 2.72–14.05). Hemorrhagic stroke, altered sensorium, hypertension, and diabetes mellitus were also independently associated with unfavorable outcome. **Conclusion:** Young stroke was predominantly ischemic and was strongly associated with modifiable vascular risk factors. Although most patients achieved favorable functional outcomes, greater neurological severity, hemorrhagic stroke, altered sensorium, hypertension, and diabetes mellitus were associated with poor outcomes. Early identification and control of modifiable risk factors, prompt treatment, and appropriate rehabilitation are essential for reducing stroke-related disability among young adults.

Keywords: Young stroke; ischemic stroke; hemorrhagic stroke; risk factors; NIHSS; modified Rankin Scale; functional outcome.



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INTRODUCTION

Stroke is an important cause of mortality and long-term disability worldwide, and its occurrence among young adults has emerged as a growing clinical and public health concern. Although stroke is traditionally considered a disease of older individuals, recent evidence indicates a substantial burden among younger populations. Young stroke is particularly important because affected individuals are often economically productive and may live for decades with residual neurological disability, resulting in considerable personal, social, and healthcare consequences.¹ The risk-factor profile of stroke in young adults differs partly from that observed in older populations. Conventional vascular risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity remain important; however, young patients may additionally have less common etiologies including arterial dissection, thrombophilia, autoimmune disorders, cardioembolic conditions, and substance-related factors. A systematic evaluation of young stroke patients is therefore necessary to identify potentially modifiable and uncommon causes.²

Studies from India have demonstrated an increasing contribution of conventional cardiovascular risk factors to stroke among younger adults. Hypertension, diabetes, dyslipidemia, smoking, and obesity are increasingly encountered in young patients with acute ischemic stroke, emphasizing the changing epidemiological pattern of cerebrovascular disease in this population.³ The etiology of young stroke is nevertheless heterogeneous, and accurate classification based on clinical features, neuroimaging, and appropriate laboratory and cardiovascular investigations is essential for determining the underlying mechanism and planning secondary prevention.⁴

Survival alone does not adequately reflect the burden of stroke in young adults. Neurological complications, including post-stroke epilepsy, may influence long-term morbidity and functional independence.⁵ Furthermore, young stroke survivors may experience persistent limitations in mobility, employment, social participation, emotional well-being, and quality of life, highlighting the importance of rehabilitation and systematic assessment of functional outcomes.⁶ Indian data have also demonstrated that stroke severity and underlying etiology may influence functional recovery and recurrence among young adults with ischemic stroke. Early identification of predictors of poor outcome can therefore facilitate risk stratification, targeted treatment, rehabilitation, and appropriate secondary prevention.⁷ However, institution-specific information regarding the distribution of risk factors, etiological patterns, and short-term outcomes among young stroke patients remains limited. The present retrospective study was therefore undertaken to evaluate the demographic and clinical characteristics, major risk factors, stroke patterns, and outcomes among young patients with stroke and to determine the factors associated with unfavorable functional outcome.

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study was conducted in the Department of Medicine/Neurology at a tertiary care teaching hospital. Medical records of young adult patients diagnosed with acute stroke during the predefined study period were reviewed.

Study Population

The study included 180 consecutive young adult patients diagnosed with acute ischemic or hemorrhagic stroke and admitted during the study period. For the purpose of the present study, young stroke was defined as stroke occurring in patients aged 18–45 years.

Sample Size

A minimum sample size of approximately 165 patients was estimated using the single-proportion formula:

$$[n=\frac{Z^2pq}{d^2}]$$

Considering an anticipated proportion of unfavorable outcome of 30%, 95% confidence level, and 7% absolute precision, the calculated sample size was approximately 165. After allowing for incomplete or unavailable retrospective records, a final sample of 180 patients was considered for the study.

Inclusion Criteria

Patients aged 18–45 years with a clinical diagnosis of acute stroke confirmed by computed tomography (CT) and/or magnetic resonance imaging (MRI) of the brain and having adequate medical records for assessment of risk factors and outcomes were included.

Exclusion Criteria

Patients with transient ischemic attack without radiologically confirmed infarction, traumatic intracranial hemorrhage, intracranial space-occupying lesions mimicking stroke, isolated cerebral venous sinus thrombosis where not included in the predefined stroke definition, and patients with substantially incomplete clinical or outcome records were excluded.

Data Collection

Data were retrieved from inpatient records, discharge summaries, laboratory reports, and available electronic medical records using a structured data collection form. Demographic variables included age, sex, and relevant clinical characteristics.

Information regarding vascular and lifestyle-related risk factors was recorded, including hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol consumption, obesity, previous stroke or transient ischemic attack, family history of stroke, and known cardiovascular disease. Where available, additional young-stroke risk factors such as oral contraceptive use, pregnancy/puerperium, thrombophilia, autoimmune disease, migraine, substance abuse, and arterial dissection were documented.

Clinical and Laboratory Evaluation

Presenting symptoms, neurological findings, blood pressure, Glasgow Coma Scale score, and National Institutes of Health Stroke Scale (NIHSS) score, where documented, were recorded. Relevant laboratory parameters included complete blood count, blood glucose, HbA1c, renal and liver function tests, serum electrolytes, and lipid profile. Coagulation and thrombophilia investigations were recorded when performed according to clinical indication. Cardiovascular evaluation included electrocardiography, echocardiography, and vascular imaging whenever available. CT/MRI findings were reviewed to classify the stroke as ischemic or hemorrhagic and to determine the anatomical territory involved.

Etiological Classification

Ischemic stroke was categorized according to the available clinical, radiological, and cardiovascular findings. Where sufficient information was available, etiology was classified according to the TOAST classification into large-artery atherosclerosis, cardioembolism, small-vessel occlusion, stroke of other determined etiology, and stroke of undetermined etiology.

Outcome Assessment

The principal outcome was functional status at discharge. Functional outcome was assessed using the modified Rankin Scale (mRS) wherever documented or reconstructed from the recorded functional status. An mRS score of 0–2 was considered a favorable outcome, whereas mRS 3–6 was considered an unfavorable outcome. In-hospital mortality, duration of hospitalization, neurological complications, and recurrence during the available follow-up period were also recorded when available.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range, depending on data distribution. Categorical variables were expressed as frequency and percentage. The Chi-square test or Fisher's exact test was used to determine associations between categorical variables. Continuous variables between favorable and unfavorable outcome groups were compared using the independent-samples t-test or Mann–Whitney U test, as appropriate. Variables showing clinically relevant or statistically significant associations on univariate analysis were entered into binary logistic regression analysis to identify independent predictors of unfavorable functional outcome. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were reported. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 180 young stroke patients aged 18–45 years were included in the retrospective analysis. The mean age of the study population was 38.2 ± 5.6 years, and 116 (64.4%) patients were males. Ischemic stroke was the predominant type, occurring in 132 (73.3%) patients, while 48 (26.7%) had hemorrhagic stroke. Hypertension, dyslipidemia, smoking, diabetes mellitus, and alcohol consumption were the commonly identified risk factors.

Table 1. Demographic and clinical characteristics of young stroke patients (n=180)

Characteristic	Number (n)	Percentage (%)
Age group (years)		
18–25	12	6.7
26–35	44	24.4
36–45	124	68.9
Age, mean $\pm$ SD (years)	38.2 ± 5.6	—
Sex		
Male	116	64.4
Female	64	35.6
Type of stroke		
Ischemic stroke	132	73.3
Hemorrhagic stroke	48	26.7
Presenting manifestations*		
Motor weakness/hemiparesis	143	79.4
Speech disturbance	82	45.6
Altered sensorium	55	30.6
Headache	47	26.1
Seizure	25	13.9
Visual symptoms	17	9.4

*Multiple presenting manifestations could occur in the same patient.

Most patients (68.9%) belonged to the 36–45-year age group, with a clear male predominance (64.4%). Ischemic stroke constituted nearly three-fourths of all strokes. Motor weakness or hemiparesis was the most frequent presenting manifestation (79.4%), followed by speech disturbance (45.6%).

Table 2. Distribution of risk factors among young stroke patients (n=180)

Risk factor	Number (n)	Percentage (%)
Hypertension	91	50.6
Dyslipidemia	72	40.0
Smoking	68	37.8
Alcohol consumption	53	29.4
Diabetes mellitus	43	23.9
Obesity	39	21.7
Family history of stroke	26	14.4
Previous stroke/TIA	18	10.0
Cardiac disease	17	9.4
Migraine	12	6.7
Oral contraceptive use†	9	14.1
Pregnancy/puerperium†	6	9.4
Thrombophilia	8	4.4
Autoimmune disorder	6	3.3
Arterial dissection	5	2.8

*Patients could have more than one risk factor. †Percentage calculated among 64 female patients.

Hypertension (50.6%) was the most common risk factor, followed by dyslipidemia (40.0%), smoking (37.8%), alcohol consumption (29.4%), and diabetes mellitus (23.9%). Less common young-stroke-specific factors included thrombophilia, autoimmune disorders, and arterial dissection.

Table 3. Stroke characteristics, severity and clinical outcomes (n=180)

Parameter	Number (n)	Percentage (%)
Ischemic stroke etiology (n=132)		
Large-artery atherosclerosis	34	25.8
Cardioembolism	22	16.7
Small-vessel occlusion	28	21.2
Other determined etiology	20	15.2
Undetermined etiology	28	21.2
NIHSS severity at admission (n=180)		
Mild (0–4)	53	29.4
Moderate (5–15)	87	48.3
Moderate-to-severe (16–20)	25	13.9
Severe (>20)	15	8.3
Functional outcome at discharge (mRS)		
Favorable outcome (mRS 0–2)	125	69.4
Unfavorable outcome (mRS 3–6)	55	30.6
In-hospital mortality	12	6.7
Length of hospital stay, mean ± SD	8.7 ± 4.2 days	—

Among ischemic stroke patients, large-artery atherosclerosis was the most frequently identified etiological category (25.8%), while 21.2% remained of undetermined etiology. Most patients had mild-to-moderate neurological deficits at presentation. At discharge, 125 (69.4%) patients had a favorable functional outcome, while 55 (30.6%) had an unfavorable outcome. Overall in-hospital mortality was 6.7%.

Table 4. Factors associated with unfavorable functional outcome (mRS 3–6)

Risk factor	Favorable outcome (n=125)	Unfavorable outcome (n=55)	p-value	Adjusted OR (95% CI)
Age >35 years	82 (65.6%)	42 (76.4%)	0.151	1.42 (0.70–2.89)
Hypertension	55 (44.0%)	36 (65.5%)	0.008	1.98 (1.01–3.89)
Diabetes mellitus	23 (18.4%)	20 (36.4%)	0.009	2.08 (1.01–4.30)
Dyslipidemia	46 (36.8%)	26 (47.3%)	0.186	1.28 (0.66–2.48)
Smoking	43 (34.4%)	25 (45.5%)	0.158	1.24 (0.63–2.46)
Hemorrhagic stroke	24 (19.2%)	24 (43.6%)	<0.001	2.56 (1.25–5.24)
Admission NIHSS >15	12 (9.6%)	28 (50.9%)	<0.001	6.18 (2.72–14.05)
Altered sensorium	25 (20.0%)	30 (54.5%)	<0.001	2.73 (1.30–5.74)

OR: odds ratio; CI: confidence interval; NIHSS: National Institutes of Health Stroke Scale; mRS: modified Rankin Scale. Unfavorable functional outcome was significantly more frequent among patients with hypertension, diabetes mellitus, hemorrhagic stroke, higher admission NIHSS, and altered sensorium. On multivariable logistic regression, admission NIHSS >15 was the strongest independent predictor of unfavorable outcome (adjusted OR 6.18; 95% CI 2.72–14.05), followed by altered sensorium and hemorrhagic stroke. Hypertension and diabetes mellitus also remained independently associated with poor functional outcome.

DISCUSSION

Stroke in young adults represents an important clinical problem because of its substantial effects on long-term functional ability, employment, family responsibilities, and quality of life. In the present retrospective analysis of 180 patients aged 18–45 years, most patients were in the 36–45-year age group, males predominated, and ischemic stroke was considerably more frequent than hemorrhagic stroke. Conventional modifiable vascular risk factors were common, and nearly one-third of patients had an unfavorable functional outcome at discharge. In the present study, 64.4% of patients were males and 68.9% belonged to the 36–45-year age group. Ischemic stroke constituted 73.3% of cases. Similar observations have been reported in hospital-based studies of young adults, where ischemic stroke predominated and conventional vascular risk factors constituted an increasingly important component of the etiological profile. Shivde et al. also emphasized the heterogeneous nature of stroke among young adults and the importance of systematic risk-factor assessment and etiological subtyping.⁸

Hypertension was the most frequent risk factor in our study, affecting 50.6% of patients, followed by dyslipidemia (40.0%), smoking (37.8%), alcohol consumption (29.4%), and diabetes mellitus (23.9%). These findings demonstrate that conventional vascular risk factors, traditionally associated with older stroke populations, are also highly relevant among younger adults. Gökçimen and Kozak similarly observed that hypertension, smoking, dyslipidemia, and other vascular factors contributed substantially to ischemic stroke among young adults.⁹ The high frequency of modifiable risk factors in our population is particularly important from a preventive perspective. The international review by Amoah et al. highlighted geographical variations in young-stroke incidence and risk-factor patterns while demonstrating the important contribution of hypertension, smoking, obesity, diabetes, and dyslipidemia.¹⁰ Early screening and adequate control of these factors may therefore reduce the burden of premature cerebrovascular disease.

Although conventional vascular factors predominated, less frequent causes such as cardiac disease, thrombophilia, autoimmune disorders, and arterial dissection were also identified. Bukhari et al. emphasized that young stroke has a broader etiological spectrum than stroke in older adults and may be related to cardioembolism, arterial dissection, hematological abnormalities, autoimmune disorders, pregnancy-related factors, and substance use.¹¹ These observations support comprehensive etiological investigation in young patients, particularly when conventional risk factors do not adequately explain the event. In the present study, motor weakness or hemiparesis was the most common presentation, followed by speech disturbance and altered sensorium. Fraser et al. emphasized that stroke in younger individuals requires timely recognition because diagnostic delay may occur when cerebrovascular disease is considered less likely solely on the basis of age.¹² Increased awareness among patients and healthcare professionals may facilitate earlier neuroimaging, treatment, and secondary prevention.

Functional outcome is particularly relevant in young stroke survivors because disability may persist throughout several decades of productive life. In our study, 69.4% of patients achieved a favorable functional outcome (mRS 0–2) at discharge, while 30.6% had an unfavorable outcome and 6.7% died during hospitalization. Gurková et al. demonstrated that the consequences of stroke in young adults extend beyond neurological impairment and may substantially affect physical functioning, psychological health, social participation, employment, and overall quality of life.¹³ Thus, functional recovery and reintegration into society should remain important components of long-term stroke care.

Neurological severity at admission was strongly related to outcome in our analysis. Admission NIHSS >15 was the strongest independent predictor of unfavorable functional outcome (adjusted OR 6.18; 95% CI 2.72–14.05). Altered sensorium and hemorrhagic stroke were also independently associated with poor outcome. Goel similarly emphasized the importance of clinical severity and prognostic markers in determining outcomes among patients with young stroke.¹⁴ Early identification of high-risk patients may therefore facilitate appropriate intensive monitoring, treatment, and rehabilitation. Hypertension and diabetes mellitus also remained independently associated with unfavorable functional outcome in the present study. Although dyslipidemia and smoking were common, they did not independently predict discharge outcome after adjustment for other variables. Chaudhary et al. demonstrated that long-term outcomes following ischemic stroke are influenced by multiple demographic, clinical, and vascular factors, reinforcing the importance of comprehensive secondary prevention and continued follow-up.¹⁵

Overall, our findings indicate that young stroke is no longer predominantly associated with unusual or rare etiologies. Conventional and potentially modifiable vascular risk factors constitute a substantial proportion of the disease burden. Greater stroke severity, hemorrhagic stroke, altered sensorium, hypertension, and diabetes were associated with unfavorable outcomes. These findings emphasize the need for early risk-factor detection, rapid stroke recognition, appropriate etiological evaluation, and structured rehabilitation among young adults.

Limitations

The retrospective and single-center nature of the study limited the availability and completeness of some clinical and laboratory variables. Specialized investigations for thrombophilia, autoimmune disorders, and uncommon etiologies were not uniformly performed in all patients. Functional outcome was primarily assessed at discharge; therefore, the study could not fully characterize long-term recovery, recurrence, return to employment, or quality of life.

CONCLUSION

Young stroke predominantly affected patients in the 36–45-year age group, with a male predominance and ischemic stroke being the most frequent type. Hypertension, dyslipidemia, smoking, alcohol consumption, and diabetes mellitus were the major modifiable risk factors. Most patients achieved a favorable functional outcome; however, approximately one-third had significant disability or death at discharge. Higher admission NIHSS, hemorrhagic stroke, altered sensorium, hypertension, and diabetes mellitus were important predictors of unfavorable outcome. Early identification and aggressive management of modifiable vascular risk factors, together with prompt treatment and rehabilitation, may improve outcomes and reduce the long-term burden of stroke among young adults.

REFERENCES

1. Rasing A, Hilken NAA, de Leeuw FE. Young stroke: an update on epidemiology, emerging risk factors, and future research directions. *Int J Stroke*. 2026;21(1):6-13. doi: 10.1177/17474930251400524.
2. Mussa R, Ambler G, Ozkan H, Thiankhaw K, Aboughdir M, Smedley I, et al. Risk factors, mechanisms, and clinical outcomes of stroke in young adults presenting to a North Central London stroke service: UCL Young Stroke Systematic Evaluation Study (ULYSSES). *Eur Stroke J*. 2025;10(3):844-852. doi: 10.1177/23969873251314360.
3. Sharma S, Bhutani N, Singh K, Gupta S, Agrawal P, Gupta P. A comparative study of risk factors across young and old acute ischemic strokes: a hospital-based study in North India. *J Assoc Physicians India*. 2025;73(5):29-33. doi: 10.59556/japi.73.0929.
4. Tan BYQ, Tan SML, Ng MJB, et al. Ischaemic stroke in young adults: an overview of the classification, risk factors, aetiologies and outcomes. *Singapore Med J*. 2025;67(3):138-148. doi: 10.4103/singaporemedj.SMJ-2024-010.
5. Verburgt E, Fellah L, Ekker MS, et al. Risk of poststroke epilepsy among young adults with ischemic stroke or intracerebral hemorrhage. *JAMA Neurol*. 2025;82(6):597-604. doi: 10.1001/jamaneurol.2025.0465.
6. Chandler C, Clarissa C, Putri AF, Aviles L, Choi H, Hewitt J, et al. Young Adults Rehabilitation experiences and Needs following Stroke (YARNS): a scoping review of the rehabilitation care experiences and outcomes of young adults post-stroke. *PLoS One*. 2025;20(1):e0279523. doi: 10.1371/journal.pone.0279523.
7. Reddy B, Kathuveetil A, Sreedharan SE, Jissa VT, Sylaja PN. Ischemic stroke in young adults in India: predictors of recurrence and functional outcome. *Ann Indian Acad Neurol*. 2024;27(5):512-519. doi: 10.4103/aian.aian_376_24.
8. Shivde S, et al. Risk factors and stroke subtyping in young adults: a study from a tertiary care hospital in South India. *Cureus*. 2024;16:e63640. doi: 10.7759/cureus.63640.
9. Gökçimen G, Kozak HH. Ischemic stroke in young adults: risk factors, etiology, and outcome. *Turk J Neurol*. 2024;30(2):108-116. doi: 10.55697/tnd.2024.142.
10. Amoah D, Schmidt M, Mather C, Prior S, Herath MP, Bird ML, et al. An international perspective on young stroke incidence and risk factors: a scoping review. *BMC Public Health*. 2024;24:1627.
11. Bukhari S, Yaghi S, Bashir Z. Stroke in young adults. *J Clin Med*. 2023;12(15):4999. doi: 10.3390/jcm12154999.
12. Fraser S, Pabst L, Smith F. Stroke in the young. *Curr Opin Neurol*. 2023;36(2):131-139. doi: 10.1097/WCO.0000000000001145.
13. Gurková E, Štureková L, Mandysová P, et al. Factors affecting the quality of life after ischemic stroke in young adults: a scoping review. *Health Qual Life Outcomes*. 2023;21:4. doi: 10.1186/s12955-023-02090-5.
14. Goel D. Risk factors, etiology and prognostic markers in patients of young stroke: a prospective observational study. *Int J Res Med Sci*. 2023;11. doi: 10.18203/2320-6012.ijrms20231617.
15. Chaudhary D, Anyaehie M, Demiraj F, et al. Comparison of long-term outcomes and associated factors between younger and older rural ischemic stroke patients. *J Clin Med*. 2022;11(5):1430. doi: 10.3390/jcm1105143