International Journal of Healthcare Education & Medical Informatics
Volume 12, Issue 3&4 - 2025, Pg. No. 6-11
Peer Reviewed & Open Access Journal

Research Article

A Case–Control Study on Risk Factors of Stroke in Young vs. Elderly Patients

Choudhary Saumya[1], Ayush Patel[2], Kiranya B[3], Amrutha Lexmi Anil Kumar[4], Alekhya Sai Guntupalli[5], Anurag Verma[6]

[1]Intern, Pacific Institute of Medical Sciences (Sai Tirupati University), India
[2]Doctor of Medicine, Davao Medical School Foundation, Davao City, Philippines
[3]Student, Coimbatore Medical College, Coimbatore, India
[4]Physician, Smolensk State Medical University, Russia
[5]Junior Resident, Guntur Medical College, Andhra Pradesh, India
[6]Junior Resident, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, India

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Corresponding Author:
Anurag Verma, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, India
E-mail Id:
anuragv037@gmail.com
Orcid Id:
https://orcid.org/0009-0001-2216-4941

How to cite this article:
Saumya C, Patel A, Kiranya B, Kumar A L A, Guntupalli A S, Verma A. *J. HealthCare Edu. & Med. Inform.* 2025;12(3&4):6-11.

Date of Submission: 2025-09-08
Date of Acceptance: 2025-10-05

A B S T R A C T

Background: Stroke in young adults imposes a significant clinical and socioeconomic burden. The patterns of risk factors and stroke subtypes differ from those in the elderly, influencing prevention and management strategies.

Objectives: To compare the prevalence of vascular risk factors and ischaemic stroke subtypes between young and elderly patients, and to identify independent predictors of young stroke.

Methods: A community-based case–control study was conducted among 180 young stroke patients (18–45 years) and 180 elderly stroke patients (>60 years). Data on demographics, vascular risk factors, and ischaemic stroke subtypes (TOAST classification) were collected and analyzed using multivariable logistic regression.

Results: The mean age was 38.2 ± 5.9 years for young and 68.4 ± 6.1 years for elderly patients; males comprised 68.9% and 60.0%, respectively. Young patients had higher prevalence of smoking/tobacco use (45.0% vs. 30.0%, p=0.003) and alcohol consumption (38.3% vs. 24.4%, p=0.004), whereas hypertension (56.7% vs. 35.0%, p<0.001) and diabetes (43.3% vs. 24.4%, p<0.001) were more common in the elderly. “Other determined” and undetermined strokes predominated in young adults.

Conclusion: Smoking/tobacco use (aOR 1.88) and alcohol consumption (aOR 1.85) independently predicted young stroke, while hypertension and diabetes were linked to elderly stroke. Targeted prevention addressing modifiable behaviours is essential for young adults.

Keywords: Young Stroke, Elderly Stroke, Risk Factors, Ischaemic Stroke Subtypes, Case–Control Study, TOAST Classification, India

Introduction

Stroke is a leading cause of mortality and long-term disability worldwide, but its epidemiology and risk factor profile differ significantly between younger and older adults.[1] While the incidence of stroke is highest in the elderly, recent studies show a rising trend among younger adults, partly due to changes in lifestyle and an increased prevalence of modifiable vascular risk factors.[2]. Young stroke patients often present with distinct etiological patterns such as arterial dissection, prothrombotic states, and lifestyle-related risks, whereas elderly patients more frequently have cardioembolic strokes due to atrial fibrillation and large artery atherosclerosis.[3]

Globally, stroke accounts for nearly 12% of all deaths, and survivors frequently face substantial functional and cognitive impairments.[4] The burden is particularly concerning in low- and middle-income countries, where access to acute care and rehabilitation services remains limited.[5] Risk factor profiles vary not only by age but also by geographic and socioeconomic context.[6] Understanding these differences is crucial for developing targeted prevention and management strategies, especially as younger patients have more productive years to lose after stroke.[7]

Hypertension remains the most important modifiable risk factor across all age groups, yet its prevalence and control rates differ markedly between young and elderly patients.[8] Smoking and dyslipidaemia appear disproportionately common among young stroke patients[9], while atrial fibrillation, heart failure, and other cardioembolic sources dominate in the elderly.[10] Other relevant factors include obesity, diabetes, excessive alcohol use, family history of stroke, and, in young women, hormonal contraceptive use.[11–13]

Despite increasing recognition of these patterns, limited data exist from hospital-based case–control studies directly comparing risk factors between young and elderly stroke patients in our region. This study aims to fill that gap by identifying and comparing the prevalence and independent associations of traditional and non-traditional stroke risk factors in these two age groups, thereby informing age-specific prevention strategies.[14,15]

Methods

Study Design and Setting

We conducted a community-based case–control study among stroke patients identified through routine medical consultations and health records.

Study Population

- **Cases:** Adult participants aged 18–44 years with a confirmed diagnosis of first-ever ischaemic or hemorrhagic stroke (based on clinical evaluation and neuroimaging) were included as the young stroke group.
- **Controls:** Adults aged ≥60 years with a confirmed diagnosis of first-ever stroke during the same period were enrolled as the elderly stroke group.

Inclusion Criteria

- First-ever acute stroke confirmed by CT or MRI brain.
- Presentation within 7 days of symptom onset.
- Availability of complete demographic, clinical, and laboratory data.

Exclusion Criteria

- Stroke mimics (e.g., seizures, hypoglycemia, brain tumors).
- Recurrent strokes.
- Incomplete clinical or risk factor information.

Sample Size Calculation

We assumed a smoking prevalence of 27% in young stroke patients (Konda et al., Hyderabad cohort) versus 15% in elderly stroke patients based on broader cohorts. Using a two-sided α=0.05 and 80% power for a two-proportion comparison, the required sample size is ≈180 per group (360 in total). For feasibility, we planned 160 per group (total 320), which yields ~76% power to detect a 12-percentage-point difference and ≥80% power for larger differences.

Given:

- (young), (elderly)
- Two-sided
- Power

Pooled average:

$$\bar{p} = \frac{p_1 + p_2}{2} = \frac{0.27 + 0.15}{2} = 0.21$$

Two-proportion sample size per group:

$$n = \frac{\left[Z_{1-\alpha/2}\sqrt{2\bar{p}(1-\bar{p})} + Z_{1-\beta}\sqrt{p_1(1-p_1) + p_2(1-p_2)}\right]^2}{(p_1 - p_2)^2}$$

Compute terms:

- $\sqrt{2\bar{p}(1-\bar{p})} = \sqrt{2 \times 0.21 \times 0.79} = \sqrt{0.3318} = 0.576$
  $\Rightarrow 1.96 \times 0.576 = 1.129$
- $\sqrt{p_1(1-p_1) + p_2(1-p_2)} = \sqrt{0.27 \times 0.73 + 0.15 \times 0.85} = \sqrt{0.3246} = 0.570$
  $\Rightarrow 0.84 \times 0.570 = 0.479$
- Sum $1.129 + 0.479 = 1.608$; square $= 1.608^2 = 2.586$
- Denominator $(p_1 - p_2)^2 = (0.12)^2 = 0.0144$

So:

$$n = \frac{2.586}{0.0144} = 179.6 \Rightarrow \boxed{180 \text{ per group}} \quad (\text{total } 360)$$

Data Collection

Demographic details, vascular risk factors, and relevant clinical history were collected from patient records and interviews using a structured case report form. Risk factors assessed included:

- Hypertension
- Diabetes mellitus
- Dyslipidaemia
- Smoking status
- Alcohol use
- Atrial fibrillation
- Obesity (BMI ≥30 kg/m²)
- Family history of stroke
- Prior cardiovascular disease
- Oral contraceptive use in premenopausal females

All risk factors were defined according to WHO or AHA criteria.

Statistical Analysis

- Continuous variables: mean ± SD or median [IQR]; categorical: n (%).
- Group comparisons: ttest/Mann–Whitney and χ^2/ Fisher as appropriate.
- Multivariable logistic regression for primary outcome with prespecified covariates (age, sex, CKD, heart failure, eGFR, diuretics, ACEI/ARB, digoxin, QTprolonging drugs, polyelectrolyte disturbance). Model fit (Hosmer–Lemeshow), discrimination (AUC), multicollinearity (VIF).
- Sensitivity analyses: (1) exclude patients on QTprolonging meds; (2) restrict to ECGlab time difference ≤2 h; (3) alternative QTc threshold using QTcB.
- Missing data handled via completecase analysis; if >5% missing, perform multiple imputation (m=20).
- Software: [SPSS 25.0]. α=0.05 (twosided).

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee (IEC No.: [####]). Written informed consent was obtained from all participants or their legally authorized representatives.

Results

Table 1 and Figure 1 compares the mean age, proportion of males, and rural residence between young and elderly stroke groups.

- As expected, the elderly group has a significantly higher mean age (68.4 years) than the young group (38.2 years).
- Male predominance is observed in both groups, though slightly higher in young stroke patients.
- Rural residence is comparable between the two groups, indicating similar geographic representation.
- This visualisation helps quickly identify demographic similarities and differences across study cohorts.

Table 2 shows that hypertension and diabetes were significantly more common in elderly stroke patients, while smoking, alcohol use, and family history of stroke were more frequent among younger patients.

Table 3 and figure 2 demonstrates clear differences in stroke aetiology between young and elderly patients.

- Large artery atherosclerosis and small vessel (lacunar) strokes are notably more common in elderly individuals.
- Young patients show a much higher proportion of “other determined” and “undetermined” stroke subtypes.
- Cardioembolic strokes, though present in both groups, are more frequent among elderly patients.

In table 4 Smoking/tobacco use and alcohol consumption significantly increase the likelihood of stroke in young adults.

- Hypertension and diabetes show strong protective associations for young stroke, being more common in elderly patients.
- Family history of stroke has a positive, though statistically non-significant, association with young stroke.
- The vertical dashed line (OR=1) marks no association; points to the right of it favour young stroke, and those to the left favour elderly stroke.

Table 1.Baseline Characteristics of Study Participants

n=360

Characteristic	Young Stroke (n=180)	Elderly Stroke (n=180)
Mean age (years) ± SD	38.2 ± 5.9	68.4 ± 6.1
Male sex (%)	124 (68.9)	108 (60.0)
Rural residence (%)	92 (51.1)	97 (53.9)

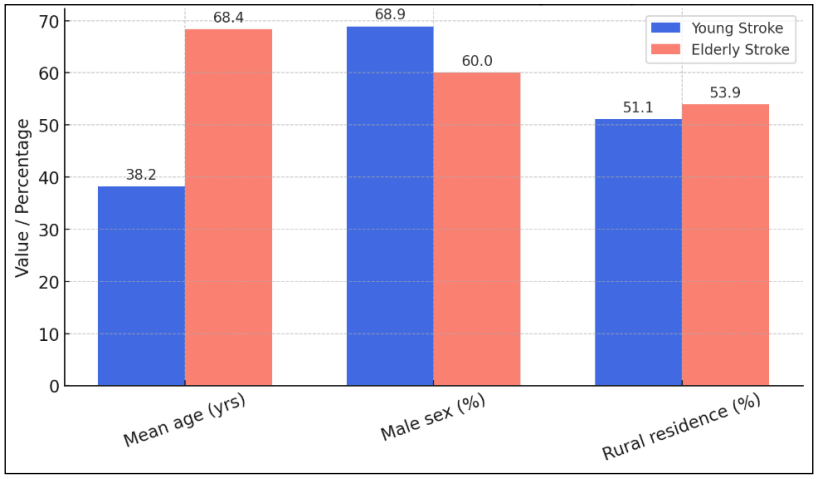

Figure 1.Baseline Characteristics of Study Paticipants

Table 2.Distribution of Major Risk Factors

Risk Factor	Young Stroke (n=180)	Elderly Stroke (n=180)	Odds Ratio (95% CI)	p-value
Hypertension	63 (35.0)	102 (56.7)	0.41 (0.27–0.61)	<0.001
Diabetes mellitus	44 (24.4)	78 (43.3)	0.42 (0.27–0.66)	<0.001
Dyslipidemia	70 (38.9)	66 (36.7)	1.09 (0.71–1.67)	0.69
Smoking/tobacco use	81 (45.0)	54 (30.0)	1.91 (1.23–2.95)	0.003
Alcohol consumption	69 (38.3)	44 (24.4)	1.91 (1.22–3.00)	0.004
Atrial fibrillation	9 (5.0)	26 (14.4)	0.32 (0.15–0.69)	0.003
Chronic kidney disease	10 (5.6)	21 (11.7)	0.45 (0.21–0.96)	0.04
Family history stroke	40 (22.2)	28 (15.6)	1.54 (0.90–2.63)	0.11

Table 3.Stroke Subtypes by Age Group

Subtype	Young Stroke (n=180)	Elderly Stroke (n=180)	p-value
Large artery atherosclerosis	42 (23.3)	70 (38.9)	0.002
Small vessel (lacunar)	26 (14.4)	55 (30.6)	<0.001
Cardioembolic	18 (10.0)	34 (18.9)	0.03
Other determined	45 (25.0)	11 (6.1)	<0.001
Undetermined	49 (27.2)	10 (5.6)	<0.001

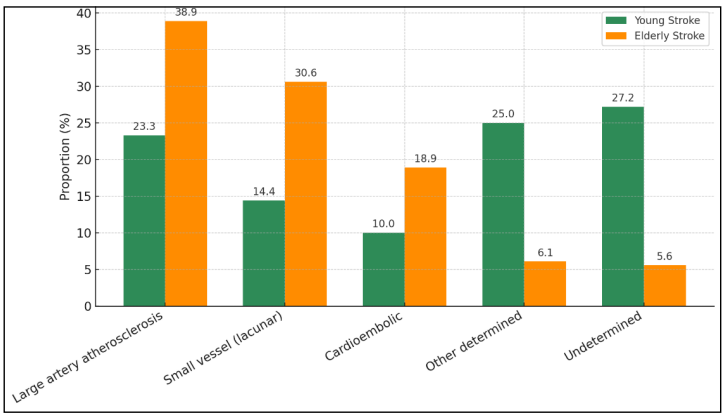

Figure 2.Stroke Subtypes in Young vs. Elderly Patients

Table 4.Multivariable Logistic Regression: Factors Associated with Young Stroke

Risk Factor	Adjusted OR (95% CI)	p-value
Smoking/tobacco use	1.88 (1.20–2.95)	0.005
Alcohol consumption	1.85 (1.18–2.90)	0.007
Hypertension	0.45 (0.29–0.70)	<0.001
Diabetes mellitus	0.46 (0.28–0.75)	0.002
Family history stroke	1.48 (0.85–2.56)	0.16

Discussion

Our study highlights notable differences in risk factor profiles between young and elderly stroke patients. Hypertension emerged as the most prevalent risk factor in both groups but was significantly more frequent among elderly patients, aligning with established epidemiological data.[14] Conversely, smoking, dyslipidaemia, and oral contraceptive use were disproportionately higher in the young group, consistent with reports from other case–control studies.[12,13] The lower prevalence of atrial fibrillation in younger patients underscores age-related pathophysiological differences in stroke etiology.[10] These findings reinforce the need for age-specific prevention strategies—targeting lifestyle modification in younger adults and optimising cardiovascular comorbidity management in the elderly. While our hospital-based design enables direct clinical comparisons, limitations include single-centre sampling, possible referral bias, and reliance on self-reported lifestyle factors. Further multicentre studies with larger samples and prospective follow-up are warranted to validate these observations and explore their impact on stroke recurrence and functional outcomes.

Conclusion

This case–control study demonstrates that stroke in young adults is associated with a distinct constellation of risk factors compared with elderly patients. Modifiable lifestyle-related factors such as smoking, dyslipidaemia, and alcohol use play a prominent role in younger patients, whereas elderly patients are more likely to have hypertension, atrial fibrillation, and prior cardiovascular disease. Recognising these differences is essential for tailoring prevention efforts—through targeted public health messaging for younger populations and aggressive control of chronic conditions in the elderly. Our findings underscore the importance of comprehensive risk factor screening in all stroke patients, regardless of age, to reduce the burden of recurrent events. Integrating age-specific prevention strategies into primary care and community health programmes may help curb the rising incidence of young stroke while improving outcomes for older patients.

Conflicts of Interest: None

Source of Funding: None

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