

Predictors of Stroke Subtype and Severity in Patients of a Tertiary Care Hospital, Dehradun

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Abstract

Context: Stroke caused 6.7 million deaths worldwide in 2013. In India, the cumulated incidence of stroke was 105–152/100,000 persons per year in last decade. Dearth of data on predictors of stroke subtype and severity in India lead to this study. **Aims:** (1) To categorize presenting stroke patients by subtype and severity. (2) To establish association of risk factors with above. (3) To predict subtype and severity by risk factors. **Settings and Design:** Hospital-based cross-sectional analytic, retrospective study. **Subjects and Methods:** A predesigned, pretested, semi-structured questionnaire with standard tool (National Institute of Health Stroke Scale Score), informed consent after prior approval of institutional ethics and research committees. **Statistical Analysis Used:** Percentages, proportions, Chi-square trends, linear regression, independent *t*-test, and analysis of variance (ANOVA). **Results:** Mean age of 102 patients was 62.1 (± 12.8 years). Stroke subtype associated with socioeconomic status ($\chi^2 = 6.38775$, $P = 0.0115$) and stroke severity ($\chi^2 = 18.98$, $P = 0$) and stroke severity associated with stroke subtype ($\chi^2 = 9.79366$, $P = 0.0018$). Stroke subtype could be predicted by stroke severity and stroke severity by subtype, sex, and dyslipidemia (regression models). Independent *t*-test revealed excessive alcohol intake was a significant predictor and one-way ANOVA revealed education was a significant predictor of severe stroke. **Conclusions:** Stroke subtype is significantly associated with higher socioeconomic status and severe stroke. Stroke severity is significantly associated with hemorrhagic stroke. Stroke subtype, sex, dyslipidemia, alcohol intake, and education may act as predictors of stroke severity.

Keywords: Hemorrhagic stroke, ischemic stroke, national institute of health stroke scale score, risk factors

INTRODUCTION

Stroke is a sudden onset neurologic deficit of cerebrovascular origin with hypertension, diabetes mellitus, tobacco use, atrial fibrillation or atherosclerosis as risk factors.^[1] Out of 17.5 million deaths due to cardiovascular diseases worldwide, 6.7 million (38.3%) were due to stroke in 2013.^[2] In India, the cumulated incidence of stroke is 105–152/100,000 persons per year and the crude prevalence of stroke is 44.29–559/100,000 persons in different parts of the country in the last decade. These values are higher than those of high-income countries.^[3] Risk factors for stroke can be fixed or modifiable. Former include age, gender, race, heredity, and previous vascular event. Latter include hypertension, heart disease (atrial fibrillation, heart failure, endocarditis), diabetes, hyperlipidemia, smoking, excess alcohol consumption, polycythemia, oral contraceptive usage, and social deprivation.^[4] Effective tobacco control, adequate nutrition, and development of healthy cities are

important strategies for primordial prevention. Poly-pill strategies, the use of mobile technology (m-Health) with dietary interventions including salt reduction aid primary prevention of stroke. Good inter-sector coordination, political will and campaigns can successfully implement secondary prevention strategies. Surveillance and registries such as the WHO's noncommunicable disease programs across high- and low-income countries collaborate.^[5] An extensive analysis of changing patterns of stroke and its major risk factors across Indian states between 1990 and 2016 showed a six times increase in disability-adjusted life years. The prevalence of stroke in 2016 was 6.5 million (6.3–7.4 million), 2.3 times

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more than 1990. Age standardized prevalence also increased in all epidemiological transition level (ETL) state groups. The prevalence of systolic hypertension, hyperlipidemia and raised fasting plasma glucose showed a consistent increase in all ETL state groups from 1990 to 2016.^[6] The poor are increasingly affected by stroke in India due to changing population exposures to risk factors and inability to afford the high cost of stroke care.^[7] Mortality rate due to hemorrhagic stroke is higher in low- and middle-income countries.^[8] Under-diagnosis of hypertension and other risk factors, delayed presentation to the hospital, poor risk factors control and failure to adhere to the treatments present main challenges. Etiologic investigation for stroke is also usually not performed due to many logistic constraints.^[9] Most data regarding management, follow-up and prevention of stroke are from developed countries. There is dearth of data on predictors of stroke subtype and severity especially from middle-income countries like India. A lot needs to be done to overcome the current challenges concerning risk factors and clinical profile of stroke in India. Hence, this study was planned to assess predictors of stroke subtypes and severity among hospitalized stroke patients.

SUBJECTS AND METHODS

This cross-sectional analytic study in retrospective design was carried out on stroke patients of a tertiary care hospital from October 2018 to January 2020. Data collection and management were done by investigators themselves and by close supervision of concerned junior residents. Prior approval of institutional ethics and research committees was obtained.

Selection and description of participants

Inclusion criteria were patients of stroke admitted to the hospital with an established diagnosis (of hemorrhagic stroke with contrast-enhanced computed tomography scan head and that of ischemic stroke with magnetic resonance imaging scan), informed consent of patient and ability of patient to respond to questions and commands of the National Institute of Health Stroke Scale (NIHSS).^[10] Exclusion criteria were unresponsive patients and those unable to meet diagnostic criteria established for the purpose of this study by the neurologist.

Technical information

The main objective of study was to predict subtype and severity of stroke by the presence of selected risk factors. Secondary outcomes were categorization of presenting stroke patients into hemorrhagic and ischemic groups, determination of severity of stroke by use of NIHSS Score, and establishment of association of risk factors with stroke categories. Interview and examination were done as per predesigned, semi-structured questionnaire which was pretested in first 10 subjects and modified thereafter.

Statistics

Data thus collected were entered into Microsoft excel and percentages, proportions calculated. Epi info Stat CalC (latest mobile version) was used to calculate Chi-square trends to establish

the association of risk factors with stroke categories. Further in depth analysis of all variables with logistic and linear regression, independent *t*-test and analysis of variance (ANOVA) was done in SPSS version 23.0 (IBM Bengaluru, Karnataka, India) to predict subtype and severity by the presence of risk factors.

RESULTS

A total of 102 patients were studied. Majority of the patients, i.e., 28 (27.4%) were in age group of 61–70 years, followed by 26 (25.5%) in age group of 21–60 years and 20 (19.6%) in 41–50 years age group. The mean age was 62.1 (± 12.8 years). Twenty-three (22.5%) patients were females and 79 (77.5%) males. Maximum patients, i.e., 27 were illiterate (26.5%), followed by educated till high school (22, 21.6%) and intermediate (20, 19.6%).

Most were semi-professional by occupation (30, 29.4%) or currently unemployed (25, 24.5%). Nearly half (50, 49.0%) belonged to upper social class by B. G. Prasad Socioeconomic Classification (AICPI 2019), followed by upper middle class (25, 24.5%). Majority of patients were of medium build/normal body mass index (BMI) (43, 42.1%). Sixty-two (60.8%) patients were diagnosed with ischemic stroke and 40 (39.2%) with hemorrhagic stroke.

Most patients had reported to health facility within 6 h of onset of symptoms (56, 54.9%). Twenty (19.6%) patients gave a history of first degree relative having stroke and 26 (25.5%) gave history of previous stroke. Seventy-five (73.5%) of the stroke patients had history of hypertension and 34 (33.3%) had history of diabetes. Fourteen (13.7%) of the stroke patients had dyslipidemia, 44 (43.1%) were smokers and 38 (37.2%) gave a history of excessive alcohol consumption.

Fifty-two (50.9%) patients had NIHSS in the range of 1–10, 30 (29.4%) had NIHSS in range of 11–20 and 20 (19.6%) had NIHSS ≥ 21 .

Table 1 shows Chi-square trends for the association of risk factors-stroke subtype is significantly associated with socioeconomic status ($\chi^2 = 6.38775$, $P = 0.0115$) and stroke severity ($\chi^2 = 18.98$, $P = 0$), stroke severity is significantly associated with stroke subtype only ($\chi^2 = 9.79366$, $P = 0.0018$).

Table 1: Association of risk factors with stroke subtype and severity

Dependent variable	Risk factor	χ^2	<i>P</i>
Stroke sub type	Sex	0.914571	0.3389
	Education	0.451511	0.5016
	Socioeconomic status	6.38725	0.0115
	Dyslipidemia	0.995836	0.3183
	Stroke severity	18.98	0
Stroke severity	Sex	2.1867	0.1392
	Education	0.833205	0.3613
	Socio economic status	0.111135	0.7389
	Dyslipidemia	9.79366	0.889
	Stroke sub type	9.79366	0.0018

Since both the dependent variables were influencing one another, an in depth analysis of all risk factors with each was done using SPSS version 23.0 to find out independent predictors of stroke subtype and severity. Step-wise LR model of stroke patients taking stroke subtype as dependent variable showed a significant correlation with stroke severity only ($P = 0.003$) as depicted in Table 2.

Stepwise multivariable linear regression model of stroke patients taking stroke severity as dependent variable showed that that stroke subtype, sex and dyslipidemia were significant correlates with P values of 0.01, 0.013, and 0.020, respectively [Table 3].

Mean (standard deviation [SD]) of stroke severity according to various factors using independent t -test showed that excessive alcohol intake was a significant predictor (P value 0.042) and mean (SD) of stroke severity according to various factors using one way ANOVA showed that education was a significant predictor (P value 0.002) as depicted in Table 4.

DISCUSSION

In this hospital-based cross-sectional analytic study, the mean age of patients was 62.1 (± 12.8) years. Twenty-three (22.5%) patients were females and 79 (77.5%) males. Maximum patients were illiterate (26.5%), semi-professional by occupation (30, 29.4%), belonged to upper social class (50, 49.0%) and were of medium build/normal BMI (43, 42.1%). Sixty-two (60.8%) patients were diagnosed with ischemic stroke and 40 (39.2%) with hemorrhagic stroke. Stroke subtype associated with socioeconomic status ($\chi^2 = 6.38775$, $P = 0.0115$) and stroke severity ($\chi^2 = 18.98$, $P = 0$) and stroke severity associated with stroke subtype ($\chi^2 = 9.79366$, $P = 0.0018$).

In a cross-sectional study from a tertiary care hospital in South-west Rajasthan in India, the mean age of stroke was 60.46 ± 14.84 years which is nearly similar to that in the current study.^[11]

Sex differences in predictors and overall risk of stroke are of growing importance as per a review article where women were

found to have a higher life time risk of stroke and account for more than half of all stroke deaths.^[12] Again women wait longer for brain imaging as compared to men and are less likely to receive intravascular tissue plasminogen activator. However in a study conducted in the USA gender was not related to triage in critical care beds or emergency severity index level. Hence, emergency department triage protocols for stroke patients may be effective in minimizing gender disparities in care.^[13] However, male sex has been observed as a predictor of stroke in diabetic patients.^[14] As far as risk association of sex with ischemic as well as hemorrhagic stroke is concerned, two independent studies confirm the findings of the present study.^[15,16] In a cross sectional survey on prevalence and risk factors of ischemic stroke in rural areas of Liaoning province of China, male sex was a significant risk factor.^[15] However, in a prospective study to evaluate potential risk factors for unruptured intracranial aneurysm and aneurysmal sub arachnoid hemorrhage in Norway, female sex was associated with both the diseases.^[16]

In a prospective community-based cohort study to evaluate epidemiology and risk factors of stroke in University of Sao Paulo, Brazil (EMMA Study) low education was associated with increased severity and hence higher risk of death, particularly after 6 months among ischemic stroke cases (odds ratio [OR] 4.31, 95% confidence interval [CI] 1.34–13.91).^[17] Low education is related to poor stroke outcome also.^[18]

In a cross-sectional survey of Jiangxi province in China using simple random sampling method, drinking alcohol was associated with stroke prevalence.^[19] In yet another study which was a retrospective clinical analysis of patients admitted to a Medical University hospital in China, it was concluded that alcohol use was significantly associated with higher severity (Hunt and Hess Score) of small intracranial aneurysm rupture.^[20] Regular alcohol consumption is related to poor stroke outcome whereas higher frequency of alcohol intake is associated with hemorrhagic subtype of stroke.^[18] Latter finding was not confirmed by the present work. In the cross-sectional study from a tertiary care hospital of Rajasthan mentioned earlier,^[11] dyslipidemia was found in 25.8% subjects with stroke as a risk factor. In a multicenter cross-sectional survey from South western China, dyslipidemia was one of the stronger contributors for stroke.^[21] However, in a national registry of hospitalized patient based data from the second largest city of Czech Republic hyperlipidemia showed 61% prevalence as a risk factor in ischemic stroke patients over a period of 1 year.^[22] Higher prevalence of subtype hemorrhagic stroke with dyslipidemia was found as an incident finding in Italy.^[23]

Since in the current work, step wise logistic regression model of stroke patients taking stroke subtype as dependent variable showed a significant correlation with stroke severity only, we can say that there was no predictor for stroke subtype, only higher socio economic status was associated with it significantly ($\chi^2 = 6.38775$, $P = 0.0115$), as replicated in other works.^[7]

Table 2: Step-wise logistic regression model of stroke patients taking stroke subtype as dependent variable

Variables	B	SE	OR	95% CI	P
Stroke severity	-0.191	0.065	0.826	0.728-0.937	0.003

SE: Standard error, CI: Confidence interval, OR: Odds ratio

Table 3: Step-wise multivariable linear regression models of stroke patients taking stroke severity as dependent variable

Variables	B	SE	t	P
Stroke subtype	-4.977	1.444	-3.446	0.001
Sex	4.895	1.888	2.592	0.013
Dyslipidemia	6.904	2.858	2.416	0.020

$R^2=0.43$. SE: Standard error

Table 4: Mean standard deviation of stroke severity according to various factors

Variables	Mean	SD	P
Excessive alcohol			
Yes	8.20	3.98	0.042**
No	5.27	7.25	
Smoking			
Yes	8.91	5.56	0.244**
No	10.69	7.38	
Diabetes			
Yes	9.76	7.24	0.883**
No	10.00	6.47	
Hypertension			
Yes	9.94	7.07	0.977**
No	9.88	5.17	
History of AF			
Yes	11.67	1.16	0.648**
No	9.86	6.80	
Previous embolism			
Yes	7.00	3.67	0.534**
No	10.00	6.71	
Previous stroke			
Yes	10.33	7.05	0.557**
No	9.78	6.59	
Previous MI			
Yes	8.00	3.56	0.745**
No	10.03	6.80	
Family history			
Yes	9.75	8.43	0.470**
No	11.16	7.63	
Care seeking interval (h)			
0-6	11.22	7.98	0.633**
>6	10.47	7.60	
BMI			
Thin	13.48	5.88	0.186*
Normal	9.85	8.13	
Overweight/obese	9.92	8.01	
SES			
I	10.21	6.16	0.463*
II	12.46	8.09	
III	12.11	11.41	
IV	5.50	2.12	
Education			
Illiterate	14.38	8.27	0.002*
Primary	19.67	9.35	
Middle	8.60	4.88	
Higher	8.33	4.10	
Intermediate	9.80	7.53	
Graduate	6.94	4.39	
Others	8.00	4.14	
Sex			
Male	10.31	7.52	0.176**
Female	12.86	8.52	
Age			
41-50	11.00	8.94	0.193*
51-60	9.12	6.99	

Contd...

Table 4: Contd..

Variables	Mean	SD	P
61-70	13.36	7.46	
71-80	9.62	7.36	

**P: Independent t-test, *P: One-way ANOVA. BMI: Body mass index, AF: Atrial fibrillation, MI: Myocardial infarction, SES: Socioeconomic status

However, in the present study, stepwise multivariable linear regression model of stroke patients taking stroke severity as dependent variable showed that that stroke sub type, sex, and dyslipidemia were significant correlates. Mean (SD) of stroke severity according to various factors using independent t-test showed that excessive alcohol intake was a significant predictor and mean (SD) of stroke severity according to various factors using one-way ANOVA showed that education was a significant predictor.

There is evidence that stroke subtype is associated with stroke severity. In EMMA study quoted earlier,^[17] risk of death (hence severity) due to hemorrhagic stroke was greater than that for ischemic stroke and reached its maximum 10 days after the event (OR 3.31, 95% CI 1.55–7.05). Proof that intracranial hemorrhage is associated with greater average initial stroke severity, higher mortality, and poorer long-term neurologic outcomes than ischemic stroke is available from Cochrane central register of controlled trials.^[24]

That sex is a predictor of stroke severity has already been discussed.^[12-14]

Serum triglyceride levels were independent predictors of stroke severity in A, B, O blood subtypes in a study where NIHSS scores 0–5 were minor strokes and NIHSS scores ≥ 6 were severe strokes.^[25]

That higher frequency of alcohol intake results in higher severity and hemorrhagic stroke has been discussed earlier.^[18,20]

Low education is related to higher severity stroke and poor stroke outcome.^[18]

CONCLUSIONS

Stroke subtype is significantly associated with higher socioeconomic status and severe stroke. Stroke severity is significantly associated with hemorrhagic stroke. Stroke subtype, sex, dyslipidemia, alcohol intake, and education of subjects may act as predictors of stroke severity. Hence, our public health efforts can be channelized toward these patients on a priority/high risk basis.

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Conflicts of interest

There are no conflicts of interest.

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