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Original Research Article

Study of risk factors associated with stroke patients admitted in tertiary care hospital: a case control study

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ABSTRACT

Background: Stroke, a major non-communicable disease, is a leading cause of morbidity, mortality, and disability worldwide. Stroke is multifactorial, with modifiable and non-modifiable risk factors including hypertension, diabetes, dyslipidemia, obesity, physical inactivity, smoking, and alcohol use. Identifying these risk factors is essential for targeted prevention strategies. This study aimed to evaluate the association of various risk factors with stroke among patients admitted to a tertiary care hospital and to determine the strength of association specifically with ischemic stroke.
Methods: A hospital-based case-control study was conducted from March 2020 to February 2022 in the Medicine wards and ICU of a tertiary care hospital. A total of 176 stroke cases and 176 age- and sex-matched controls were enrolled. Data on socio-demographics, lifestyle factors, medical history, and anthropometric measurements were collected using a pretested questionnaire.
Results: Physical inactivity (aOR = 1.88; 95% CI: 1.01-3.51; p = 0.047) and abnormal waist-hip ratio (aOR = 0.53; 95% CI: 0.34-0.82; p = 0.005) were independently associated with stroke on multivariable analysis. In univariate analysis, hypertension, diabetes mellitus, tobacco use, alcohol consumption, dyslipidaemia, and positive family history of stroke or other non-communicable diseases showed significant associations with stroke.
Conclusions: Ischemic stroke was the most common subtype in this study. Physical inactivity and abnormal waist–hip ratio were independently associated with stroke, while tobacco use, alcohol consumption, hypertension, diabetes, dyslipidaemia, and family history showed significant univariate associations.

Keywords: Hypertension, Ischemic stroke, Physical inactivity, Risk factors, Waist-hip ratio

INTRODUCTION

Non-communicable diseases (NCDs) are chronic medical conditions not caused by infectious agents, often resulting from a combination of genetic, physiological, environmental, and behavioral factors.[1] Stroke, also known as cerebrovascular accident, is a rapid loss of brain function due to an interruption of the blood supply to the brain, which may result from ischemia caused by thrombosis or arterial embolism, or from hemorrhage. Stroke can lead to hemiparesis or hemiplegia, aphasia, and hemianopia depending on the affected brain region.[2]

Stroke is a multifactorial condition with numerous risk factors, including age, sex, heredity, hypertension, diabetes mellitus, hypercholesterolemia, dietary habits, obesity, smoking, alcohol intake, and physical inactivity.[3,4] While some risk factors are non-modifiable, such as age and heredity, several others are modifiable, and identifying these is crucial for effective prevention strategies.[3] The burden of stroke on public health is significant due to its high morbidity, mortality, and socioeconomic impact. Major risk factors identified in the Indian population include male sex, increasing age, hypertension, diabetes, dyslipidemia, ischemic heart

disease, obesity, lack of physical activity, and alcohol consumption.[5]

The prevalence and incidence of stroke are rising in developing countries, including India, with a notable increase in younger populations. Between 1990 and 2005, the number of stroke cases in India increased by approximately 17%, highlighting the urgent need to understand and manage associated risk factors. Early identification and management of risk factors have been shown to reduce stroke-related morbidity and mortality in developed countries; however, in India, the burden remains substantial due to limited awareness and healthcare access.[3]

Given this context, evaluating the various risk factors associated with stroke in tertiary care settings is essential for implementing effective preventive and management strategies. The present study aims to assess the association between stroke and different risk factors and to determine the strength of these associations specifically with ischemic stroke.

METHODS

Study design

A hospital-based case–control study was conducted to assess the association between stroke and various risk factors among patients admitted to a tertiary care hospital.

Study setting and duration

The study was carried out in the Intensive Care Unit (ICU) and Medicine wards of a tertiary care teaching hospital. The study was conducted over a study period of 2 years from March 2020 to Feb 2022 after obtaining approval from the Institutional Ethics Committee.

Study population

The study population comprised stroke patients admitted to the Medicine department and ICU (cases) and age- and sex-matched individuals without stroke (controls).

Cases: Patients diagnosed with stroke and admitted to the Medicine wards or ICU.

Controls: For each case, one age (±2 years) and sex-matched control was selected from non-vascular patients admitted to medical or surgical wards or from outpatient departments.

Sample size and sampling method

The sample size was calculated using the two-sample proportion formula for case–control studies, based on exposure proportions to major risk factors reported in recent literature. Sample size for each risk factor was calculated independently, and the maximum feasible sample size was selected based on obesity as a risk factor, assuming an odds ratio of 2.1, 80% power, and 5% level of significance. The final sample size was 176 cases and 176 controls, making a total of 352 participants. The calculated sample size was verified using OpenEpi version 3 (SSCC module).

Cases were selected using a consecutive sampling method until the desired sample size was achieved. For each case, one age (±2 years) and sex-matched control was selected on the same day or the next day.

Inclusion criteria for cases

Patients with sudden onset neurological deficit of vascular origin persisting for more than 24 hours, stroke confirmed by MRI or non-contrast CT scan were included.

Exclusion criteria for cases

Patient with transient ischemic attack or undefined prior neurological events, inability to provide consent with no valid respondent available, refusal to participate were excluded.

Inclusion criteria for controls

Individuals without history of stroke or vascular disease, visitors or relatives of patients and OPD attendees with minor illnesses such as refractive errors, cataracts, communicable diseases, dermatological conditions, animal bites, or routine physical check-ups.

Exclusion criteria for controls

Patients with history of stroke or transient ischemic attack, admission for myocardial infarction or bypass graft surgery, pregnant or lactating women, unwillingness to participate were excluded.

Data collection methods

Data collection was initiated after obtaining ethical clearance and permission from the Head of the Department of Medicine. Written informed consent was obtained from all participants or valid surrogate respondents. Stroke cases were identified daily from Medicine wards and ICU and enrolled after confirmation by physicians or neurologists.

Study tools

A pre-designed, semi-structured and pilot-tested questionnaire was used to collect data. Information collected included socio-demographic details (age, sex, education, occupation, marital status, religion, type of family, socioeconomic status), lifestyle factors (tobacco use, alcohol intake, diet, physical activity), and medical history (hypertension, diabetes mellitus, cardiac disease,

dyslipidemia, and family history of vascular diseases). Socioeconomic status was assessed using the modified BG Prasad classification (2020). Anthropometric measurements such as waist and hip circumference were recorded using standard techniques.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 21.0. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were summarized as proportions with 95% confidence intervals. Association between stroke and various risk factors was assessed using the chi-square test. The strength of association was estimated using odds ratios with 95% confidence intervals. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 176 stroke cases and 176 age- and sex-matched controls were included. The majority of participants were aged 61-70 years (cases 38.1%, controls 41.5%), with no significant difference in age distribution (p=0.89). Males constituted 63.1% in both groups. Religion, educational status, family type, marital status, and socio-economic class were comparable between cases and controls (all p>0.05) (Table 1).

Table 1: Socio-demographic characteristics of cases and controls (n=176).

Variable	Category	Cases (n=176), N (%)	Controls (n=176), N (%)	P value*
Age group (years)	<40	30 (17.0)	29 (16.4)	0.89
	41-50	20 (11.4)	21 (11.9)	
	51-60	37 (21.0)	35 (19.9)	
	61-70	67 (38.1)	73 (41.5)	
	71-80	19 (10.8)	15 (8.5)	
	>80	3 (1.7)	3 (1.7)	
Sex	Male	111 (63.1)	111 (63.1)	Matched
	Female	65 (36.9)	65 (36.9)	
Religion	Hindu	153 (86.9)	162 (92.0)	0.08
	Muslim	14 (8.0)	12 (6.8)	
	Buddhist	9 (5.1)	2 (1.1)	
Educational status	Illiterate	76 (43.2)	68 (38.6)	0.20
	Primary	52 (29.5)	60 (34.1)	
	Middle	31 (17.6)	24 (13.6)	
	Secondary	13 (7.4)	14 (8.0)	
	≥Higher secondary	4 (2.3)	10 (5.7)	
Type of family	Joint	18 (10.2)	15 (8.5)	0.64
	Nuclear	43 (24.4)	50 (28.4)	
	Three-generation	115 (65.3)	111 (63.1)	
Marital status	Married	164 (93.2)	165 (93.8)	0.80
	Unmarried	5 (2.8)	6 (3.4)	
	Widow/widower	7 (4.0)	5 (2.8)	
Socio-economic class (BG Prasad)	II	0 (0)	2 (1.1)	0.22
	III	11 (6.3)	12 (6.8)	
	IV	79 (44.9)	91 (51.7)	
	V	86 (48.9)	71 (40.3)	

*Statistically significant.

Lifestyle risk factors differed significantly between groups. Physical inactivity was more common among cases (30.1%) than controls (19.8%) (p=0.02). Tobacco use was significantly higher among cases (55.7%) compared to controls (40.9%) (p=0.005), and smoking prevalence was also significantly greater among cases (39.2% vs. 22.2%; p=0.00024). Alcohol consumption patterns differed significantly (p=0.0049), with moderate and heavy drinking more frequent among cases. Abnormal waist–hip ratio was significantly higher among cases (58.0%) than controls (43.8%) (p=0.007), whereas salt intake did not differ significantly (p=0.997) (Table 2).

Clinical and metabolic risk factors showed significant associations with stroke. Hypertension (35.8% vs. 19.3%; p=0.0006), diabetes mellitus (31.8% vs. 22.2%; p=0.04), dyslipidaemia (27.3% vs. 18.2%; p=0.04), and positive family history of stroke or NCDs (9.1% vs. 2.3%; p=0.01) were significantly more prevalent among cases, while cardiac disease showed no significant difference (p=0.09) (Table 3).

On univariate analysis, physical inactivity (cOR 1.88; 95% CI: 1.01-3.51; p=0.047) and abnormal waist-hip ratio (cOR 0.53; 95% CI: 0.34-0.82; p=0.005) were

significantly associated with stroke. Multivariable logistic regression confirmed that physical inactivity (aOR 1.88; 95% CI: 1.01-3.51; p=0.047) and waist-hip ratio (aOR 0.53; 95% CI: 0.34-0.82; p=0.005) remained independently associated with stroke after adjusting for potential confounders (Table 4 and 5).

Table 2: Distribution of lifestyle and behavioral risk factors among stroke cases and controls.

Risk factor	Category	Cases (n=176), N (%)	Controls (n=176), N (%)	P value*
Physical activity	Sedentary	53 (30.1)	35 (19.8)	0.02
	Active	123 (69.8)	141 (80.2)	
Tobacco use	Non-user	78 (44.3)	104 (59.1)	0.005
	User	98 (55.7)	72 (40.9)	
Smoking	No	107	147	0.00024
	Yes	69	39	
Alcohol consumption	Non-drinker	102 (58)	122 (69.3)	0.0049
	Light	18 (10.2)	26 (14.8)	
	Moderate	47 (26.7)	22 (12.5)	
	Heavy	9 (5.1)	6 (3.4)	
Salt intake	Normal (≤5 g/day)	95 (54)	102 (58)	0.997
	Excess (>5 g/day)	81 (46)	74 (42)	
Waist-hip ratio	Normal	74 (42)	99 (56.3)	0.007
	Abnormal	102 (58)	77 (43.8)	

*Statistically significant.

Table 3: Distribution of clinical and metabolic risk factors among stroke cases and controls.

Risk factor	Category	Cases (n=176), N (%)	Controls (n=176), N (%)	P value*
Hypertension	No	113 (64.2)	142 (80.7)	0.0006
	Yes	63 (35.8)	34 (19.3)	
Diabetes mellitus	No	120 (68.2)	137 (77.8)	0.04
	Yes	56 (31.8)	39 (22.2)	
Cardiac disease	No	164 (93.2)	171 (97.2)	0.09
	Yes	12 (6.8)	5 (2.8)	
Dyslipidaemia	No	128 (72.7)	144 (81.8)	0.04
	Yes	48 (27.3)	32 (18.2)	
Family history of stroke/NCDs	Absent	160 (90.9)	172 (97.7)	0.01
	Present	16 (9.1)	4 (2.3)	

*Statistically significant.

Table 4: Univariate analysis of various risk factors for stroke.

Study variables	Odds ratio (cOR)	95% CI	P value
F/H/O HTN	1.584	0.721-3.481	0.252
F/H/O stroke	2.660	0.819-8.638	0.103
Tobacco use	1.786	0.965-3.307	0.065
Alcohol consumption	0.978	0.515-1.856	0.946
Physical inactivity	1.881	1.009-3.507	0.047
H/O HTN	1.559	0.871-2.788	0.135
H/O DM	0.998	0.564-1.767	0.995
H/O hypercholesterolemia	1.007	0.566-1.790	0.982
W-H ratio	0.525	0.335-0.824	0.005

Table 5: Multivariable logistic regression of risk factors for stroke.

Study variables	Odds ratio(aOR)	95% CI	P value
F/H/O HTN	1.584	0.721-3.481	0.252
F/H/O stroke	2.660	0.819-8.638	0.103
Tobacco use	1.786	0.965-3.307	0.065

Continued.

Study variables	Odds ratio(aOR)	95% CI	P value
Alcohol consumption	0.978	0.515-1.856	0.946
Physical inactivity	1.881	1.009-3.507	0.047
H/O HTN	1.559	0.871-2.788	0.135
H/O DM	0.998	0.564-1.767	0.995
H/O hypercholesterolemia	1.007	0.566-1.790	0.982
W-H ratio	0.525	0.335-0.824	0.005

DISCUSSION

The present study found that stroke occurred more frequently among males and individuals aged 61-70 years; however, no statistically significant association was observed between stroke and socio-demographic variables including age group, religion, educational status, marital status, family type, or socio-economic class. This lack of association is likely attributable to age and sex matching of cases and controls. Similar male predominance and age distribution have been reported in studies from Pakistan, Bangladesh, and Iraq, where males constituted approximately 55-65% of stroke patients and the mean age ranged between 57 and 62 years.[6-8] In contrast, Hasan et al reported a higher burden of stroke among illiterate individuals and those from lower socio-economic strata, suggesting that socio-demographic determinants may vary across populations and settings.[9]

Lifestyle and behavioral risk factors showed important differences between cases and controls. Tobacco use and smoking were significantly more prevalent among stroke cases, and alcohol consumption patterns differed significantly between the two groups. These findings are consistent with earlier studies that have identified tobacco and alcohol use as important modifiable risk factors for stroke.[6,10,12] However, in the present study, tobacco and alcohol use did not retain statistical significance on multivariable analysis, suggesting that their effects may be mediated through other coexisting risk factors.

Physical inactivity emerged as a key determinant of stroke in this study. Sedentary behavior was significantly more common among cases and remained independently associated with stroke on multivariable logistic regression (aOR=1.88; 95% CI: 1.01-3.51). This finding is in agreement with studies by Demile et al and Deoke et al, which reported two- to threefold higher odds of stroke among physically inactive individuals.[1,12] Reduced physical activity may contribute to stroke risk through its effects on obesity, hypertension, dyslipidaemia, and glucose metabolism.

Among anthropometric measures, abnormal waist–hip ratio showed a significant independent association with stroke (aOR=0.53; 95% CI: 0.34-0.82), highlighting the importance of central adiposity in stroke risk. Similar associations between central obesity and stroke have been reported by Albitar et al and Dewangan et al.[1,10] Differences in findings across studies may be related to variations in obesity definitions, anthropometric indicators used, and population characteristics.

Clinical and metabolic risk factors such as hypertension, diabetes mellitus, dyslipidaemia, and family history of stroke or other non-communicable diseases were significantly more common among stroke cases on univariate analysis. These findings are consistent with previous studies that have established these conditions as important contributors to stroke risk.[6-10] However, none of these factors retained independent significance in multivariable analysis in the present study, possibly due to interrelationships among risk factors or limited statistical power.

This study has few limitations. As this was a hospital-based case-control study, the findings may not be generalizable to the community at large. Recall bias may have occurred while collecting information on lifestyle-related risk factors. The temporal relationship between risk factors and stroke could not be firmly established. Additionally, residual confounding by unmeasured variables cannot be completely ruled out.

CONCLUSION

The study shows that ischemic stroke was the predominant subtype and was significantly associated with modifiable risk factors. Physical inactivity and abnormal waist–hip ratio emerged as independent predictors of stroke, while tobacco use, alcohol consumption, hypertension, diabetes mellitus, dyslipidaemia, and family history showed significant associations on univariate analysis. Socio-demographic factors were not significantly associated with stroke. These findings highlight the need for preventive strategies targeting physical inactivity, central obesity, and vascular risk factor control to reduce the burden of ischemic stroke.

Recommendations

In view of the significant association of physical inactivity and waist-hip ratio with stroke, preventive strategies should primarily focus on lifestyle modification. Primordial and primary prevention measures should promote regular physical activity through early adoption of healthy habits, community

awareness, and creation of activity-friendly environments. Adults should be encouraged to achieve recommended levels of physical activity to reduce stroke risk. Secondary prevention through routine screening and early management of modifiable risk factors is essential, while tertiary prevention should emphasize rehabilitation to minimize disability among stroke patients.

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