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Research Article

RISK FACTORS AND PREDICTORS OF SEVERITY FOR ISCHEMIC STROKE IN THE RURAL SOUTH INDIAN POPULATION

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ABSTRACT

Objective: Stroke is a leading cause of death and disability worldwide. The risk factors contributing to stroke vary among geographical locations, ethnic populations, and also among genders. This study aims to identify the prevalence of risk factors among patients admitted for ischemic stroke, correlate the stroke severity, and identify risk factors in the rural South Indian population.

Methods: One hundred and thirty patients admitted with acute ischemic stroke formed the study population. The demographic details and neurological examination at admission were noted. The presence of comorbidities such as diabetes mellitus, systemic hypertension, coronary artery disease, smoking, and quantity of alcohol consumed was documented. All patients underwent a series of investigations including computed tomography brain, fasting blood sugar, fasting lipid profile, complete blood count, and carotid Doppler. Stroke severity was graded as per the National Institutes of Health Stroke Scale.

Results: This study of 130 stroke patients (65.4% male and 34.6% female) with a mean age of 61.10 years examined risk factors and their associations with stroke severity. Hypertension and diabetes mellitus were prevalent (51.5% and 50%, respectively). Significant associations were found between age, sex, and alcohol consumption with stroke severity. Overall, age emerged as a critical determinant of stroke severity.

Conclusion: Tremendous research gaps persist despite significant progress in researching gender differences in stroke as well as particular factors impacting risk and outcomes which need to be addressed in future studies. Urgent health-care policies are needed to arrest the rapidly rising epidemic of metabolic diseases and combat alcoholism.

Keywords: Stroke, National Institutes of Health Stroke Scale score, Risk factors, Hypertension, Diabetes, Alcoholism.

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INTRODUCTION

Non-communicable diseases (NCDs) are on the rise in India. The National Policy 2017 calls for increased attention to the rising burden of NCDs and the associated unsustainable health spending [1]. Stroke is a leading cause of disability and death worldwide. The global burden of disease study reported 12.2 million incident cases of stroke worldwide in 2019 and attributed it to 6.55 million deaths [1]. Depending on the area, India's overall prevalence rate for strokes varies considerably. Individual studies have determined that the incidence rate of stroke rises with age, going from 21/100,000 for the 20–40 age range to 625/100,000 for those over 60. In addition, compared to countries with higher incomes, India has a higher rate of young stroke (<40 years) [2].

Ischemic stroke is caused by a variety of risk factors. Commonly recognized risk factors for heart disease include diabetes, hypertension, hyperlipidemia, atrial fibrillation, smoking, excessive alcohol use, a high-salt diet, and a lack of physical inactivity [3]. Controlling risk factors is especially crucial for diseases that cause significant impairment and lack a cure. Most strokes can be prevented and their financial impact can be decreased by mitigating the risk factors [4-6].

The demographics of stroke are also highly variable differing between low-income versus high-income nations with variability also noted between rural and urban populations within the country and between sexes [4,7,8]. Overall, low- and middle-income countries accounted for 71% of stroke-related fatalities and 78% of life losses adjusted for disabilities. The incidence of ischemic strokes is more common in males in all age groups, whereas ischemic infarcts are more common in females beyond 60 years of age. It is presumed to be due to the beneficial effects of reproductive age in women and increased vascular risk factors in males. Stroke incidence rates are 1.25 times greater in men, but women tend to live longer than men, more women than men die of stroke each year [9].

Evaluation of regional stroke risk factors aids in the creation of population-specific policies and long-term improvements in stroke prevention and decreasing the health-care burden. Therefore, in this study, we aimed to investigate the risk factors for stroke among the rural, low-income population in southern India and document the sex-related differences in risk factors. The purpose of the current study was to offer evidence for the focused reduction of risk factors for ischemic strokes and will aid medical professionals in developing prevention plans and decreasing stroke burden.

METHODS

The study was undertaken at an 800-bed tertiary care teaching hospital. The study was authorized by the research ethics committee of the hospital, and signed informed consent was obtained from the patients before data collection. All patients who presented with acute neurological symptoms were evaluated in the emergency room before admission. A detailed clinical and neurological examination was followed by computed tomography of the brain with or without magnetic resonance imaging of the brain. For the study, only patients with an ischemic stroke over the age of 30 who presented within 72 h of the onset of symptoms were included. Patients who had a hemorrhagic stroke, transient ischemic attacks, and patients who were on lipid-

lowering agents, hypothyroidism, and valvular or congenital heart disease with or without arrhythmias were excluded from the study. All patients underwent hematological investigations including complete blood count, fasting blood sugar, fasting lipid profile (triglycerides, total cholesterol, high-density lipoprotein [HDL], low-density lipoprotein [LDL]), and carotid Doppler study. Patients' vital parameters and neurological examinations were documented daily throughout the inpatient care. Stroke severity was graded at admission using the National Institutes of Health Stroke Scale (NIHSS) [10]. A score of 1–4 was considered a minor stroke, 5–15 as a moderate stroke, 16–20 as moderate-to-severe stroke, and 21–42 as a severe stroke [10]. All patients were categorized as per the variables influencing outcomes. Age categories included <60 years and >60 years. A systolic blood pressure of >140 mmHg and a diastolic pressure of >90 mmHg were labeled as hypertension. Diabetes mellitus was defined by elevated fasting blood glucose of 126 mg/dL, 2-h post-prandial blood sugar >200 mg% or HbA1C values of >6.5%, or a history of regular use of anti-diabetic drugs. Alcohol consumption was categorized by drinks/week light (1–7), moderate (7–21), and heavy drinking (>21) [11]. A history of smoking was also recorded. All patients were managed as per standard guidelines including glycemic control, blood pressure control, anti-thrombotic, anti-platelet therapy, and mannitol to reduce cerebral edema in the presence of a massive stroke. Statistical analysis was performed using SPSS 27 software.

RESULTS

The study's sample size was 130 patients composed of 65.4 percent males (n=85) and 34.6 percent females (n=45). The mean age of the study population was 61.10 years. A total of 70 patients (or 53.8%) were over 60 years old, and 60 patients (43.2%) were under 60 years. Among the risk factors for stroke, hypertension was present in 51.5%, and diabetes mellitus was present in 50% of the study population. 8.5% of them had pre-existent coronary artery disease. 41.5% of the study population were smokers (none among the female population were smokers). 47.7% had a history of regular consumption of alcohol (none among the female population consumed alcohol). Among the alcoholics (only males), 25.81% consumed mild amounts of alcohol, 43.6% moderate, and 30.65% had a history of heavy consumption. 9.2% had abnormal HDL levels and 16.2 % had elevated LDL levels (Table 1).

56.8% of females in the study were <60 years of age in comparison to 40% of males. Diabetes mellitus was present in 57.8% of females and 45.9% of males. Systemic hypertension was present in 55.6% of females and 49.4% of males. Evidence of coronary artery disease was present in 4.4% of females and 10.6% of males. None in the female study population had a history of smoking and alcohol consumption. Evidence of microcytic hypochromic anemia was present in 35.6% of females and 23.5% of males. There was no significant difference between males and females with respect to any of the parameters measured (Table 2). The association between sex with other qualitative variables was measured with the Chi-square test. There was no significant relationship between males and females with respect to any parameter (Table 3).

Table 1: Prevalence of various risk factors among the study population

Parameter	Subparameter	Frequency	Percentage
Sex	Male	85	65.4
	Female	45	34.6
DM	No	65	50.0
	Yes	65	50.0
CAD	No	119	91.5
	Yes	11	8.5
Smoking	Absent	76	58.5
	Present	54	41.5
Alcohol	Absent	68	52.3
	Present	62	47.7
Quantity of alcohol consumed	No	68	52.3
	Light	16	12.3
	Moderate	27	20.8
	Heavy	19	14.6
LDL	Normal	109	83.8
	High	21	16.2
HDL	Abnormal	12	9.2
	Normal	118	90.8
Systemic hypertension	Normal	63	48.5
	High	67	51.5

LDL: Low-density lipoprotein, HDL: High-density lipoprotein, DM: Diabetes mellitus, CAD: Coronary artery disease

Risk factors were associated with stroke severity. A t-test was used to compare the mean scores. The mean NIHSS score for those above 60 years of age was 16.94±7.81 compared to 12±4.85 in those <60. (t=−4.28: p≤0.001). Similarly, males had a higher NIHSS score compared to females (15.63±6.86 vs. 12.60±6.89, t=2.394; p<0.018). There was no association between any other risk factors studied except for alcohol consumption (16.06±6.87 vs. 13.23 vs. 6.89, t=1.622, p=0.021). The association between NIHSS classification (mild, moderate, moderate-to-severe, and severe) and risk factors was studied using the Chi-square test. As age increases, the severity increases. There was no association between any other risk factors and NIHSS classification (Table 4).

DISCUSSION

In this study, we have analyzed the prevalence of risk factors and sex-related differences in patients with ischemic stroke and the correlation of stroke severity with the presence of various risk factors. The influence of age as a risk factor in ischemic stroke is well recognized. The incidence of stroke increases exponentially with advancing age, with a majority of strokes (75–89%) occurring >65 years of age [12,13]. A Swedish study also reported that the risk ratio per increase in 1 year of age for developing stroke was 1.12 [14]. Our study also reported a higher incidence (53.8%) of stroke in >60 years in concordance with other studies.

Males in our study had a higher incidence of stroke (65.4%) than females (34.6%). According to earlier studies, men experience a higher age-specific stroke incidence than women [15]. A study by Liu *et al*. showed that males had a 1.8 times higher risk of having a stroke than women. It is thought that estrogen protects against stroke by enhancing endothelial function, causing vasodilation, acting as an anti-inflammatory and antioxidant, and reducing platelet aggregation [16]. There are gender-specific variations in age-related stroke incidence, with the largest ratio (M:F) occurring in people between the ages of 35 and 44 and declining after the age of 75 [17]. The mean age of stroke in males (62.02) was higher than in females (59.02) in our study; however, the difference was not statistically significant (p=0.09). Similarly, Wang *et al*. noted that compared to women, men had strokes at a later age [18].

Hypertension was the most frequent risk factor present in 51.5% of our patients. In a large population-based study of 480,687 adults, hypertension was found to contribute to 73% of stroke burden [19]. Other researchers have also documented that 20% of people with hypertension who were >50 years old had strokes, with a risk ratio of 1:4, with a steady rise in risk with advancing age [20]. Recent studies indicate that women have a faster rise in blood pressure than men from the third decade [21]. Our study also showed that 75.6% of females had hypertension when compared to 57.6% of males despite being younger (59.02 vs. 62.20 years). However, we did not find any significant difference between systolic and diastolic blood pressure between the sexes. Recent studies have revealed that women's systolic blood pressure thresholds for developing stroke are lower than men's (120 vs. 150 mm Hg, respectively) [22]. Therefore, women may need strict hypertensive goals to reduce the risk of stroke. India is the diabetic capital of the world, with an estimated diabetic population of more than 100 million with a prevalence of 11.4% as per recent reports from ICMR [23]. Uncontrolled diabetes mellitus contributes to macrovascular and microvascular complications. Some of the pathophysiologic processes that have been hypothesized as mechanisms

Table 2: Comparison of quantitative variables between the genders

Parameters	Male		Female		MD	t value	p-value
	M	SD	M	SD			
Age	62.20	11.21	59.02	7.82	3.176	1.693	0.093
Systolic	141.41	32.96	142.00	23.39	0.588	−0.106	0.916
Diastolic	85.87	17.06	89.69	11.84	1.818	−0.638	0.525
TC	198.86	25.63	197.80	29.77	1.059	0.212	0.833
TGL	139.79	18.28	138.18	16.52	1.610	0.494	0.622
LDL	102.36	23.51	101.73	22.60	0.631	0.148	0.883
HDL	43.71	6.68	44.82	6.07	1.116	−0.934	0.352

LDL: Low-density lipoprotein, HDL: High-density lipoprotein, TC: Total cholesterol, TGL: Triglycerides

Table 3: Comparison of qualitative variables between the genders

Parameter	Subclassification	Male		Female		CSV	p-value
		M	%	F	%		
Diabetes	Absent	46	54.1	19	42.2	1.665	0.197
	Present	39	45.9	26	57.8		
CAD	Absent	76	89.4	43	95.6	1.434	0.231
	Present	9	10.6	2	4.4		
Smoking	Absent	31	36.5	45	100	48.901	<0.001
	Present	54	63.5	0	0		
Alcohol	Absent	23	27.05	45	97.8	62.751	<0.001
	Present	62	72.95	0	2.2		
	Present	24	28.2	2	4.4		
LDL	Normal	69	81.2	40	88.9	1.292	0.256
	High	16	18.8	5	11.1		
HDL	Abnormal	9	10.6	3	6.7	0.54	0.462
	Normal	76	89.4	42	93.3		
	High	42	49.4	25	57.8		
Systemic	Normal	43	49.4	20	44.4	5.326	0.315
Hypertension	High	42	50.6	25	55.6		

LDL: Low-density lipoprotein, HDL: High-density lipoprotein, CAD: Coronary artery disease

Table 4: Association between risk factors and National Institutes of Health Stroke Scale classification

Parameters	Mild		Moderate		Moderate-to-severe		severe		CSV	p-value
	F	%	F	%	F	%	F	%		
Age >60	2	22.2	34	49.3	16	44.4	16	100.0	19	<0.001
DM	6	66.7	35	50.7	14	38.9	10	62.5	3.792	0.285
HT	7	77.8	44	63.7	18	50	14	87.6	11.909	0.064
CAD	1	11.0	6	8.7	1	2.8	3	18.8	3.775	0.287
Smoking	1	11.0	31	44.9	14	38.9	8	50.0	4.333	0.228
Alcohol	1	11.1	32	46.4	19	52.8	10	62.5	6.655	0.084
LDL	9	100.0	57	82.6	30	83.3	13	81.3	1.899	0.594
HDL	9	100.0	62	89.9	32	88.9	15	93.8	1.306	0.728
Systolic	7	77.8	44	63.8	18	50.0	14	87.5	7.625	0.054
Diastolic	4	44.4	37	53.6	16	44.4	11	68.8	2.897	0.408

LDL: Low-density lipoprotein, HDL: High-density lipoprotein, DM: Diabetes mellitus, CAD: Coronary artery disease, HT: Hypertension

linking diabetes and stroke include endothelial dysfunction, arterial wall thickening and stiffness, systemic inflammation, oxidative stress, dysregulated coagulation, and extensive microangiopathy [24]. Obesity and alcohol consumption are believed to be important contributors to the increasing incidence of diabetes mellitus in rural populations [25].

Alcohol consumption is a major risk factor for stroke. In our study, 72% of the male population had a history of alcohol consumption, among which 43.5% had moderate and 30.65% had a history of heavy consumption. Though light-to-moderate alcohol consumption has been associated with a reduced risk of some cardiovascular events [26], large population cohorts [27,28] and Mendelian randomization studies [29,30] imply that moderate alcohol consumption is not linked to a lower risk of stroke. Interstroke study is one of the largest case–control studies that evaluated the risk factors for acute stroke and concluded that while low intake was unrelated to stroke, high and moderate intake were linked to higher chances of stroke. There were significant regional variances, too, which might be related to changes in the types or patterns of alcohol intake or the population characteristics of alcohol consumers [31]. Population education on the ill effects of alcohol is needed to curtail this increasing incidence of alcohol consumption. Smoking is a well-recognized risk factor for stroke. In our study, 63.5% of males were smokers. Smoking can increase homocysteine, fibrinogen, and oxidized LDL cholesterol levels as well as cause carotid atherosclerosis [32]. According to a recent meta-analysis, current smokers have a greater risk of stroke than non-smokers, and this risk was dose-dependent, rising by 12% for every additional five cigarettes smoked per day [32]. Moreover, the deleterious consequences of second-hand smoke have been well established. Many studies have provided strong evidence that second-hand smoke exposure, even in non-smokers, increases the risk of stroke [33-35]. However, in this study, the effects of second-hand smoke were not evaluated. Dyslipidemia, a major contributor to

atherosclerosis and stroke, was less prevalent in our study group because our study subjects were rural population. Significant differences in the incidence of dyslipidemia between urban and rural populations have been well documented [36,37].

This study has its limitations. Details of medicines used by patients have not been recorded. Furthermore, the BMI of the patient was also not calculated. The mortality rate and stroke severity scores at follow-up have not been recorded. The effect of second-hand smoke and their dose-relationship has not been evaluated.

CONCLUSION

Our study evaluated the risk factors for stroke in rural populations and found hypertension, diabetes mellitus, and alcoholism (males) to be the most common risk factors for stroke. However, no sex-related differences in risk factors. Tremendous research gaps persist despite significant progress in researching gender differences in stroke as well as particular factors impacting risk and outcomes which need to be addressed in future studies. Urgent health-care policies are needed to arrest the rapidly rising epidemic of metabolic diseases and combat alcoholism.

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