



Original Research Article

HYPERTENSION AS A MAJOR MODIFIABLE RISK FACTOR FOR STROKE AND ITS SUBTYPE IN YOUNG ADULTS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY FROM SOUTH-EAST RAJASTHAN, INDIA

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ABSTRACT

Background: Stroke is one of the leading causes of mortality and long-term disability worldwide. Although traditionally considered a disease of older adults, the incidence of stroke among younger individuals has increased substantially over the last two decades. The rising prevalence of modifiable cardiovascular risk factors, particularly hypertension, diabetes mellitus, dyslipidaemia, tobacco use, and unhealthy lifestyle practices, has contributed significantly to this trend. Young-onset stroke results in considerable socioeconomic losses because it affects individuals during their most productive years of life. However, region-specific data regarding the prevalence of conventional risk factors and the socio-demographic profile of young stroke patients are limited in India, particularly in South-East Rajasthan. **Objectives:** To determine the prevalence of hypertension among young adult stroke patients and evaluate its association with stroke subtype.

Materials and Methods: A hospital-based cross-sectional study was conducted among 220 CT/MRI-confirmed stroke patients aged 18–50 years admitted at Government Medical College and Associated group of Hospitals, Kota, Rajasthan, between March 2025 and February 2026. Socio-demographic and vascular risk factor data were collected by face to face interview using a pre-tested questionnaire.

Results: Ischemic stroke constituted 70.9% of cases and haemorrhagic stroke 29.1%. Hypertension was present in 150 (68.18%) participants and showed a statistically significant association with stroke subtype ($p=0.0047$). Other risk factor which were found associated with stroke were obesity, diabetes, dyslipidaemia, smoking, tobacco and alcohol.

Conclusion: Hypertension is the most important major determinant of stroke among young adults in South-East Rajasthan. Early detection and effective control of hypertension, together with comprehensive risk-factor screening, health education, and lifestyle modification interventions, are essential to reduce the growing burden of young-onset stroke. Strengthening preventive strategies under national non-communicable disease programmes may substantially reduce morbidity and improve long-term outcomes in this vulnerable population.

Keyword: Hypertension, Stroke, morbidity, non-communicable disease, Young adults.

INTRODUCTION

Stroke is a major public health problem and remains one of the leading causes of mortality, long-term disability, and loss of productive life worldwide. According to the World Health Organization (WHO), stroke is defined as a rapidly developing clinical syndrome of focal or global disturbance of cerebral function, lasting for more than 24 hours or leading to death, with no apparent cause other than a vascular origin. It results from an interruption of blood supply to the brain due to either occlusion of a cerebral artery (ischaemic stroke) or rupture of a blood vessel (haemorrhagic stroke).^[1-3] Advances in acute stroke management and rehabilitation have improved survival rates; however, the overall burden of stroke continues to increase because of demographic transitions, ageing populations, and the growing prevalence of non-communicable diseases.^[2-5]

Globally, stroke is the second leading cause of death and the third leading cause of disability-adjusted life years (DALYs) lost. The Global Burden of Disease (GBD) study estimates that more than 12 million new stroke cases occur every year, with approximately 6.5 million stroke-related deaths worldwide.^[2,3] More importantly, nearly two-thirds of the global stroke burden is borne by low- and middle-income countries, where limited health infrastructure, delayed diagnosis, and poor control of vascular risk factors contribute to higher morbidity and mortality.^[2,4,5] In these settings, the epidemiological transition from communicable to non-communicable diseases has accelerated the incidence of cardiovascular and cerebrovascular disorders, making stroke an increasingly important public health challenge.^[4,6,7]

Traditionally, stroke has been considered a disease of older adults; however, recent evidence suggests a worrying increase in the incidence of stroke among young adults. Young adult stroke is commonly defined as stroke occurring between 18 and 50 years of age. Approximately 10–15% of all strokes now occur in this age group, and several studies have demonstrated a steady rise in young-onset stroke over the last two decades.^[8-12] Unlike stroke in the elderly, stroke among young adults affects individuals during the most economically productive and socially active period of their lives. Consequently, it results not only in premature mortality but also in prolonged disability, loss of employment, financial hardship, caregiver burden, and significant psychosocial consequences.^[8,10-12] The long-term impact on families and society is therefore disproportionately greater than that associated with stroke occurring later in life.^[9-12]

India is experiencing a particularly alarming rise in the incidence of stroke among younger individuals. The average age of stroke onset in India has been reported to be nearly a decade earlier than that observed in many developed countries.^[6,7] Rapid

urbanization, changing dietary patterns, sedentary lifestyles, increased psychosocial stress, tobacco and alcohol consumption, and a growing prevalence of hypertension and diabetes mellitus have collectively contributed to this epidemiological shift.^[13,14,18,19] In addition, poor awareness regarding early warning symptoms, delayed health-seeking behaviour, and inadequate control of chronic diseases further aggravate the burden of stroke in the Indian population.^[6,7,19] With a large proportion of the country's population belonging to the younger age group, the increasing incidence of stroke among young adults represents a significant challenge for the healthcare system.^[6,7]

Among the various determinants of stroke, hypertension is recognised as the single most important and modifiable risk factor. Elevated blood pressure contributes to both ischaemic and haemorrhagic stroke through multiple pathophysiological mechanisms, including endothelial dysfunction, accelerated atherosclerosis, small vessel disease, and vascular wall degeneration.^[15-18] Numerous epidemiological studies have shown that effective control of hypertension can substantially reduce the risk of first-ever and recurrent stroke.^[13,15,16,18] However, hypertension often remains undiagnosed or poorly controlled among younger adults because of inadequate screening, low perceived risk, and poor treatment adherence.^[13,17,18] Consequently, many individuals present with cerebrovascular events before the underlying condition is recognized.^[13,17]

Apart from hypertension, several other conventional risk factors play an important role in the development of stroke in young adults. Diabetes mellitus contributes to vascular endothelial damage and accelerates atherosclerotic changes, while dyslipidaemia promotes plaque formation and arterial occlusion.^[13,18,20] Tobacco smoking and smokeless tobacco use increase the risk of thrombosis, inflammation, and vascular injury, whereas excessive alcohol consumption is associated with hypertension, cardiac arrhythmias, and haemorrhagic stroke.^[13,18,19] Obesity, physical inactivity, unhealthy dietary habits, and chronic psychological stress further amplify the risk of cerebrovascular disease.^[13,18,21] In addition to these traditional risk factors, certain age-specific conditions such as pregnancy and puerperium, oral contraceptive use, congenital heart disease, patent foramen ovale, inherited thrombophilias, autoimmune disorders, and post-infectious hypercoagulable states have also been implicated in the aetiology of stroke among younger populations.^[9-12]

Ischaemic stroke constitutes the majority of stroke cases in young adults, although haemorrhagic stroke is also relatively common, particularly in individuals with uncontrolled hypertension or vascular malformations.^[2,9-12] The distribution of stroke subtypes and their associated risk factors varies across geographical regions and populations due to

differences in genetic predisposition, environmental exposures, lifestyle practices, and healthcare access.^[6,7,9-12] Therefore, understanding the local epidemiological profile of stroke is essential for developing effective preventive and management strategies.^[6,7,15,16]

Rajasthan, particularly the south-east Hadoti region, represents a unique demographic setting characterised by a mix of rural, semi-urban, and urban populations with varying socioeconomic and cultural backgrounds. The region has witnessed a progressive increase in lifestyle-related non-communicable diseases, including hypertension, diabetes, and obesity. Government Medical College, Kota, being a major tertiary care referral centre, receives a large number of stroke patients from the entire Hadoti region and neighbouring districts of Madhya Pradesh. Despite the substantial patient load, there is a paucity of region-specific data regarding the prevalence of conventional vascular risk factors, socio-demographic determinants, and stroke subtypes among young adults. Furthermore, limited information is available regarding the knowledge, attitudes, and practices of these patients concerning non-communicable disease risk factors and lifestyle modification.

Identifying the prevalence and pattern of modifiable risk factors among young stroke patients has important implications for public health planning. Since many of these determinants are preventable or controllable, early identification through systematic screening and community-based interventions can reduce the incidence of first-ever stroke and prevent recurrence.^[13,15-18] Programmes promoting regular blood pressure monitoring, diabetes screening, tobacco and alcohol cessation, healthy dietary practices, and increased physical activity can significantly reduce the burden of stroke among younger populations.^[13,15,18,19] In addition, strengthening awareness regarding the warning symptoms of stroke and the importance of early hospital presentation may improve treatment outcomes and reduce disability.^[6,7,15,16]

The present hospital-based cross-sectional study was therefore undertaken to estimate the prevalence of conventional risk factors, particularly hypertension, among young adult stroke patients admitted to a tertiary healthcare centre in South-East Rajasthan. The study also aims to describe the socio-demographic characteristics of these patients, determine the distribution of stroke subtypes, and assess their knowledge, attitudes, and practices related to non-communicable disease risk factors.

The findings of this study are expected to generate region-specific evidence that will contribute to the formulation of targeted preventive strategies, strengthen existing non-communicable disease control programmes, and ultimately reduce the burden of stroke and its long-term consequences among young adults.

MATERIALS AND METHODS

This hospital-based descriptive cross-sectional study was undertaken in the Neurology Unit and medical wards of Government Medical College and Associated Hospitals, Kota, Rajasthan. Young adults aged 18–50 years with neuroimaging-confirmed stroke were consecutively enrolled after obtaining informed consent. A total of 220 participants fulfilled the inclusion criteria. Data regarding socio-demographic profile and conventional risk factors including hypertension, diabetes mellitus, dyslipidaemia, obesity, smoking, tobacco use and alcohol intake were collected using a pre-tested semi-structured questionnaire. Hypertension was defined by previous diagnosis, current antihypertensive treatment or blood pressure $\geq 140/90$ mmHg. Data were entered and analysed using standard statistical methods. Frequencies, percentages and chi-square tests were used, with $p \leq 0.05$ considered statistically significant.

RESULTS

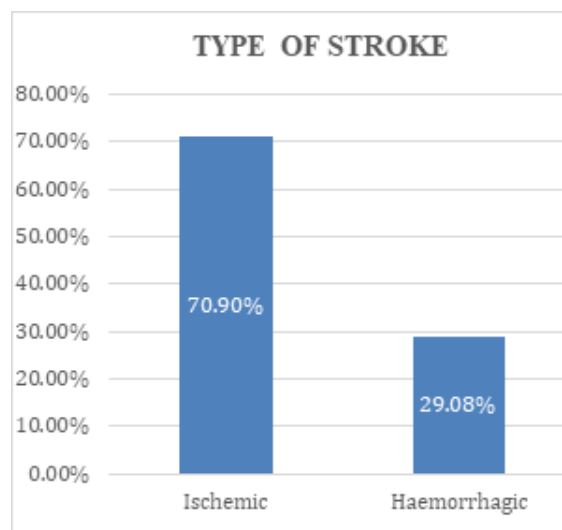


Figure 1: Distribution of study participants according to type of stroke

Table 1: Distribution of study participants according to type of stroke

Type Of Stroke	Number	Percentage (%)
Ischemic	156	70.90%
Haemorrhagic	64	29.08%

In Table 1: Out of the total study population of 220, ischemic stroke was observed in 70.90% (n = 156) of patients, whereas 29.08% (n = 64) were diagnosed with haemorrhagic stroke.

Table 2: Association between hypertension and type of stroke in young adults

Risk Factor	Total stroke patient (N)	Ischemic stroke (n1)	Haemorrhagic stroke (n2)	P-Value
Hypertension	150	53	97	0.0047

In Table 2: A statistically significant association was found between stroke subtype and hypertension ($p = 0.0047$), indicating that stroke types differ significantly among hypertensive individuals.

A total of 220 young stroke patients were included. Ischemic stroke was the predominant subtype (70.9%), while haemorrhagic stroke accounted for 29.1% of cases. Hypertension was identified in 150 participants (68.18%) and emerged as the most common conventional vascular risk factor. A statistically significant association was observed between hypertension and stroke subtype ($p=0.0047$). Obesity was present in 45.35% of participants and also showed a highly significant association. Tobacco use, smoking, diabetes mellitus, dyslipidaemia and alcohol consumption were frequently observed but did not reach statistical significance. Most patients belonged to the 40–50 year age group and lower-middle socioeconomic class.

DISCUSSION

The present hospital-based cross-sectional study was undertaken to assess the prevalence of conventional risk factors, socio-demographic profile, and type of stroke among young adults admitted to a tertiary healthcare centre in South-East Rajasthan. The findings highlight the growing burden of stroke in the younger population and reaffirm the important role of traditional modifiable vascular risk factors, particularly hypertension.^[8-10,13,15,18,22]

In the present study, the majority of patients belonged to the 43–47 years age group, indicating that the risk of stroke increases in the later years of young adulthood. Similar findings have been reported by Konda et al. and Shivde et al., who observed that a substantial proportion of young stroke patients were in the later part of the young-adult age range.^[22,23] The cumulative exposure to conventional cardiovascular risk factors with advancing age may explain this trend.^[8-12,22,23]

A slight male predominance was observed in the study population, which is consistent with previous Indian and international studies. Konda et al. and Ekker et al. also reported a higher proportion of males among young stroke patients.^[8,22] This may be attributed to greater exposure to behavioural risk factors such as tobacco use, alcohol consumption, and occupational stress among men.^[13,18,22] However, the relatively high proportion of female patients in the present study also indicates that stroke among young women is an important emerging concern.^[8-12,23]

The socio-demographic analysis revealed that most participants belonged to the lower-middle socioeconomic class and had educational attainment up to high school or graduation level. Lower

socioeconomic status may contribute to poor awareness, delayed diagnosis, and inadequate control of chronic diseases such as hypertension and diabetes mellitus, thereby increasing the risk of cerebrovascular events.^[4,6,7]

Hypertension emerged as the most common and significant modifiable risk factor among young stroke patients in the present study. This finding is in agreement with studies conducted by Ram et al., Huliappa et al., and Konda et al., all of which identified hypertension as a leading contributor to stroke.^[19,22,24] Persistent uncontrolled blood pressure causes progressive vascular damage and substantially increases the risk of both ischaemic and haemorrhagic stroke.^[15-18] The high prevalence of hypertension in the present study emphasizes the need for routine blood pressure screening and early treatment among younger adults.^[15-18,24]

Other conventional risk factors, including diabetes mellitus, dyslipidaemia, tobacco use, alcohol consumption, and obesity, were also frequently observed. These findings are comparable with those reported in previous Indian studies and reflect the ongoing epidemiological transition towards lifestyle-related non-communicable diseases.^[6,7,13,18,22,24] The coexistence of multiple risk factors further increases the likelihood of stroke and underlines the importance of a comprehensive risk-factor reduction strategy.^[13,15,16]

The present study found that ischaemic stroke was more common than haemorrhagic stroke among young adults. Similar observations have been reported by Kaur et al. and Ram et al., where ischaemic stroke constituted the majority of cases.^[19,20] The predominance of ischaemic stroke may be explained by the increasing prevalence of atherosclerotic and metabolic risk factors in the younger population.^[13,18,22,23]

The findings of the present study underscore the importance of strengthening preventive strategies aimed at early identification and control of modifiable vascular risk factors. Community-based screening for hypertension and diabetes, promotion of healthy lifestyles, tobacco and alcohol cessation programmes, and regular health check-ups among young adults may help reduce the growing burden of stroke in this economically productive age group.^[13,15-18,24] Although the study provides valuable region-specific data from South-East Rajasthan, its hospital-based cross-sectional design limits the generalisability of the findings to the wider community. Nevertheless, the study reinforces the pivotal role of hypertension and other conventional cardiovascular risk factors in the occurrence of young adult stroke and highlights the need for targeted preventive interventions.^[13,15-18,22-24]

CONCLUSION

Hypertension emerged as the leading and most significant modifiable risk factor among young adults with stroke in South-East Rajasthan. The significant association between hypertension and stroke subtype highlights the importance of early detection, regular screening and effective blood pressure control. Integrated public health interventions targeting hypertension and associated lifestyle factors have the potential to reduce the burden of premature cerebrovascular disease.

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