

A CROSS-SECTIONAL OBSERVATIONAL STUDY ON PREVALENCE OF METABOLIC SYNDROME IN STROKE PATIENTS IN TERTIARY CARE TEACHING HOSPITAL

D V Madhavi Kumari¹, Jyothi Valluru², Kadiyala Madhulika³, Ravi Teja⁴

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Corresponding Author:

Dr. Kadiyala Madhulika,

Email: madhulikakadiyala7@gmail.com

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¹Associate Professor, Department of Neurology, GGH, Vijayawada, Andhra Pradesh, India

²Assistant Professor, Department of General Medicine, GGH, Vijayawada, Andhra Pradesh, India

³5th Year, Pharm D Student, Department of Pharmacy Practice, Vijaya Institute of Pharmaceutical Sciences for Women, Vijayawada, Andhra Pradesh, India

⁴Senior Resident, Department of Neurology, GGH, Vijayawada, Andhra Pradesh, India

ABSTRACT

Background: Stroke is a leading cause of morbidity and mortality worldwide. Metabolic syndrome, characterized by abdominal obesity, hypertension, hyperglycemia, hypertriglyceridemia, and low HDL cholesterol, is strongly associated with increased stroke risk, recurrence, and poor outcomes. Early identification of metabolic abnormalities may help reduce stroke burden. This study aimed to assess the prevalence of metabolic syndrome among stroke patients and evaluate its impact on stroke severity and functional outcomes. **Materials and Methods:** A hospital-based cross-sectional observational study was conducted in the Department of Neurology at New Government General Hospital, Vijayawada, from September 2024 to February 2025. A total of 200 stroke patients aged above 20 years were included. Metabolic syndrome was diagnosed using NCEP ATP III criteria. Clinical data, laboratory investigations, and neuroimaging findings were recorded. Stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS), and functional outcomes were evaluated using the Modified Rankin Scale (MRS). Statistical analysis was performed using the Chi-square test. **Result:** Among 200 patients, 86.5% were above 40 years and 65.5% were males. Ischemic stroke was the predominant subtype. Hypertension (96.5%) and elevated fasting blood glucose (90%) were the most common components of metabolic syndrome. Increased waist circumference was observed in 23.5%, low HDL cholesterol in 20%, and elevated triglycerides in 11% of patients. Most patients presented with moderate stroke severity (68.5%) and moderate functional disability (39.5%). No statistically significant association was found between individual metabolic components and stroke subtype. **Conclusion:** Metabolic syndrome components, particularly hypertension and hyperglycemia, are highly prevalent among stroke patients. Although individual components were not significantly associated with stroke subtype, their overall high prevalence highlights the importance of early detection and aggressive management of metabolic risk factors to reduce stroke-related morbidity and improve outcomes.

INTRODUCTION

Stroke is a medical emergency that occurs when the blood supply to the brain is disrupted, leading to lack of oxygen and death of brain cells. It may occur due to blockage of a blood vessel (ischemic stroke) or rupture of a vessel causing bleeding (hemorrhagic stroke). Ischemic stroke is the most common type, accounting for about 85% of cases, and is usually caused by arterial blockage due to atherosclerotic plaque and clot formation. Hemorrhagic stroke accounts for nearly 13% of cases and results from

rupture of a weakened blood vessel, leading to bleeding into the brain tissue. Stroke severity measured using the National Institutes of Health Stroke Scale (NIHSS) is an important predictor of outcomes. Stroke remains a major global health problem. Approximately 6.6 million Americans over 20 years have experienced stroke, with higher occurrence among elderly individuals and women.^[1] In India, the burden of stroke-related complications is high. The overall prevalence ranges from 15% to 50%, which is higher than in the general population.^[2]

Metabolic syndrome is commonly seen in stroke patients and is diagnosed using the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria. It is characterized by a cluster of conditions including abdominal obesity, hypertension, hyperglycemia/diabetes mellitus, hypertriglyceridemia, and low HDL cholesterol.³ Studies report that 30% to 60% of stroke patients have metabolic syndrome. It is associated with increased stroke risk, poorer recovery, higher recurrence, and increased mortality. Early detection and management of metabolic syndrome are essential to reduce stroke risk and improve long-term outcomes.^[3]

Objectives

- To assess the prevalence of metabolic syndrome among stroke patients.
- To identify the specific risk factors/components of metabolic syndrome such as (Waist circumference, Hypertriglyceridemia, Dyslipidemia, Hypertension and Diabetes mellitus).
- To evaluate the impact of metabolic syndrome on stroke severity and mortality.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted in the inpatient setting of the Department of Neurology at New Government General Hospital, Gunadala, Vijayawada. The study was carried out over a period of six months, from September 2024 to February 2025.

A total of 200 case records of stroke patients admitted to or consulting the Neurology Department were included in the study. Patients aged above 20 years who provided written informed consent were considered eligible. Individuals diagnosed with components of metabolic syndrome, including

hypertension, diabetes mellitus, hypertriglyceridemia, dyslipidemia, and increased waist circumference, were included. Patients who were unwilling to provide consent, aged below 20 years, on hemodialysis, pregnant or lactating women, cancer patients, HIV patients, and those who were critically or terminally ill with severe psychiatric illness or had incomplete medical records were excluded. Patients diagnosed with cardioembolic stroke were also excluded from the study.

Data were collected from patient case sheets, including demographic details, clinical history, laboratory investigations, and neuroimaging findings such as CT and MRI. Metabolic syndrome was diagnosed based on the presence of abdominal obesity, hypertension, dyslipidemia, hypertriglyceridemia, and insulin resistance manifested as diabetes mellitus or impaired glucose tolerance. Stroke severity and functional status were assessed using standardized scales, including the National Institutes of Health Stroke Scale (NIHSS), Modified Rankin Scale (MRS), Barthel Index (BI), and Stroke Impact Scale (SIS).

A structured data collection form was designed to record patient demographics, past medical history, imaging findings, and clinical assessment scores. Information was obtained from medical records as well as through interaction with patients or their caregivers.

Ethical approval for the study was obtained from the Institutional Ethics Committee of Siddhartha Medical College and Government General Hospital, Vijayawada, on 30th August 2024 (Approval No: IECSMCGGH/2024/AP/225).

The collected data were entered into Microsoft Excel for analysis. Statistical analysis was performed using GraphPad Prism (Version 9.5.1). The Chi-square test was applied to compare categorical variables and assess the association between metabolic syndrome components and stroke-related parameters.

RESULTS

Table 1: Age Distribution of Stroke Patients

	Number (n)	Percentage (%)
<40 Years	27	13.5
>40 Years	173	86.5
p = 0.491 (Age vs Stroke Type – Not Significant)		

Table 2: Gender Distribution of Stroke Patients

	Number (n)	Percentage (%)
Male	131	65.5
Female	69	34.5
p = 0.890 (Age vs Gender – Not Significant)		

Prevalence of metabolic syndrome

Table 3: Prevalence of Individual Components of Metabolic Syndrome (n=200)

	Number (n)	Percentage (%)
Hypertension	193	96.5
Elevated Fasting Blood Glucose	180	90.0
Increased Waist Circumference	47	23.5
Low HDL Cholesterol	40	20.0
Elevated Triglycerides	22	11.0

SPECIFIC RISK FACTORS OF METABOLIC SYNDROME

Table 4: Waist Circumference According to Stroke Type

	Normal n (%)	Increased n (%)
Ischemic (n=136)	101 (74.3)	35 (25.7)
Hemorrhagic (n=17)	15 (88.2)	2 (11.8)
Recurrent (n=47)	37 (78.7)	10 (21.3)

Table 5: Triglyceride Levels According to Stroke Type

	Normal n (%)	Elevated n (%)
Ischemic	121 (88.3)	16 (11.7)
Hemorrhagic	15 (93.8)	1 (6.3)
Recurrent	42 (89.4)	5 (10.6)

Table 6: HDL Cholesterol According to Stroke Type

	Normal n (%)	Low HDL n (%)
Ischemic	105 (76.6)	32 (23.4)
Hemorrhagic	15 (93.8)	1 (6.3)
Recurrent	40 (85.1)	7 (14.9)

Table 7: Hypertension According to Stroke Type

	Present n (%)	Absent n (%)
Ischemic	132 (96.4)	5 (3.6)
Hemorrhagic	16 (100)	0
Recurrent	45 (95.7)	2 (4.3)

Table 8: Fasting Blood Glucose According to Stroke Type

	Elevated n (%)	Normal n (%)
Ischemic	122 (89.1)	15 (10.9)
Hemorrhagic	14 (87.5)	2 (12.5)
Recurrent	44 (93.6)	3 (6.4)

Impact of metabolic syndrome on stroke severity and mortality

Table 9: Stroke Severity Based on NIHSS (n=200)

	Number (n)	Percentage (%)
Mild	51	25.5
Moderate	137	68.5
Moderate-Severe	8	4.0
Severe	4	2.0

Table 10: Functional Outcome Based on Modified Rankin Scale (MRS)

MRS Score	Disability Level	Number (n)	Percentage (%)
0-1	No / Minimal Disability	52	26
2	Slight Disability	36	18
3	Moderate Disability	79	39.5
4	Moderately Severe	25	12.5
5	Severe Disability	8	4

Demographic Characteristics

[Table 1] shows the age distribution of stroke patients. Out of 200 patients, 27 (13.5%) were aged below 40 years, whereas 173 (86.5%) were above 40 years. Stroke was predominantly observed in the older age group. There was no statistically significant association between age category and stroke type ($p = 0.491$).

[Table 2] presents the gender distribution. Among the study population, 131 (65.5%) were males and 69 (34.5%) were females, indicating a male predominance. No statistically significant association was observed between age and gender ($p = 0.890$).

Prevalence of Metabolic Syndrome

[Table 3] summarizes the prevalence of individual components of metabolic syndrome among stroke patients. Hypertension was the most common

component, observed in 193 patients (96.5%), followed by elevated fasting blood glucose in 180 patients (90%). Increased waist circumference was present in 47 patients (23.5%), low HDL cholesterol in 40 patients (20%), and elevated triglycerides in 22 patients (11%). These findings indicate a high burden of metabolic abnormalities among stroke patients.

Specific Risk Factors of Metabolic Syndrome

[Table 4] shows waist circumference distribution according to stroke type. Increased waist circumference was observed in 25.7% of ischemic stroke patients, 11.8% of hemorrhagic stroke patients, and 21.3% of recurrent stroke patients. The majority in all categories had waist circumference within normal limits.

[Table 5] presents triglyceride levels by stroke type. Elevated triglycerides were noted in 11.7% of

ischemic, 6.3% of hemorrhagic, and 10.6% of recurrent stroke patients. Most patients across all stroke types had normal triglyceride levels.

[Table 6] describes HDL cholesterol levels according to stroke type. Low HDL cholesterol was found in 23.4% of ischemic stroke patients, 6.3% of hemorrhagic stroke patients, and 14.9% of recurrent stroke patients.

[Table 7] shows the distribution of hypertension among stroke types. Hypertension was highly prevalent across all categories: 96.4% in ischemic stroke, 100% in hemorrhagic stroke, and 95.7% in recurrent stroke patients.

[Table 8] presents fasting blood glucose levels according to stroke type. Elevated fasting blood glucose was observed in 89.1% of ischemic stroke patients, 87.5% of hemorrhagic stroke patients, and 93.6% of recurrent stroke patients.

Overall, hypertension and hyperglycemia were the most frequent metabolic risk factors across all stroke types.

Impact of Metabolic Syndrome on Stroke Severity and Functional Outcome

[Table 9] shows stroke severity assessed by the National Institutes of Health Stroke Scale (NIHSS). Most patients (68.5%) had moderate stroke severity, while 25.5% had mild stroke. Moderate-severe and severe strokes were observed in 4% and 2% of patients, respectively. This indicates that the majority of patients presented with moderate neurological impairment.

[Table 10] presents functional outcomes based on the Modified Rankin Scale (MRS). Moderate disability (score 3) was the most common outcome, seen in 39.5% of patients. Minimal or no disability (scores 0–1) was observed in 26% of patients. Moderately severe disability (12.5%) and severe disability (4%) were less common. These findings suggest that a significant proportion of patients experienced moderate functional impairment following stroke.

DISCUSSION

The present cross-sectional study assessed the prevalence of metabolic syndrome (MetS) among stroke patients and evaluated the association of its individual components with stroke type and severity. Our findings demonstrate a high burden of metabolic abnormalities among stroke patients, particularly hypertension (96.5%) and elevated fasting blood glucose (90%), with ischemic stroke being the predominant subtype.

Stroke was more common in individuals above 40 years (86.5%) and was more prevalent among males (65.5%) in our study. Tripathy et al. also reported male predominance (63.4%) among stroke patients.⁴ However, Kumar et al. observed higher prevalence of metabolic syndrome among female stroke patients,⁵ suggesting possible regional or demographic variations.

The clustering of metabolic risk factors was evident in a substantial proportion of patients in our study. Kishore Kumar et al. reported a 56% prevalence of metabolic syndrome among stroke patients.⁶ Similarly, Binu Mathew et al. observed a 60% prevalence of MetS among ischemic stroke patients in a South Indian population.⁷ Soumil Bera et al. documented an even higher prevalence (66.96%) among ischemic stroke patients in a tertiary care setting.⁸ These findings are comparable to our observations and support the strong association between metabolic syndrome and stroke in Indian populations.

Hypertension was the most prevalent component in our study (96.5%). Koren-Morag et al. demonstrated that metabolic syndrome increased the odds of ischemic stroke or TIA by 1.49-fold, with hypertension being one of the strongest predictors.⁹ Elevated fasting blood glucose was present in 90% of our patients. The ACROSS-China study by Mi et al. showed that elevated fasting plasma glucose independently predicted stroke recurrence.¹⁰ This finding supports the dominant contribution of glycemic abnormalities observed in our study.

Low HDL cholesterol and elevated triglycerides were less frequent in our cohort (20% and 11%, respectively). However, Kurl S et al. reported that impaired fasting glucose and low HDL cholesterol were significant predictors of cardiovascular mortality,¹¹ indicating that lipid abnormalities contribute significantly to vascular risk.

In our study, ischemic stroke was the most common subtype. Kumar et al. reported that 85.71% of stroke patients with metabolic syndrome had ischemic stroke,⁵ which is consistent with our findings. Similarly, Mathew et al. found a strong association between metabolic syndrome and ischemic stroke.⁷ Our analysis did not show a statistically significant association between individual MetS components and stroke subtype. Comparable findings were reported in the ACROSS-China study, where metabolic syndrome lost its independent predictive value after adjusting for its components.¹⁰

Most patients in our study had moderate stroke severity (68.5%) and moderate disability on Modified Rankin Scale. Prospective studies have shown that metabolic syndrome significantly increases the risk of stroke and cardiovascular mortality. Kurl et al. demonstrated a 2.41-fold increased risk of ischemic stroke among individuals with metabolic syndrome.¹¹ These findings suggest that metabolic syndrome not only predisposes individuals to stroke but may also adversely affect long-term outcomes.

Our findings are consistent with multiple national and international studies demonstrating a high prevalence of metabolic syndrome among stroke patients. Hypertension and hyperglycemia were the most prominent components, similar to previously published literature. Although individual components appear to drive the risk, the clustering effect of metabolic syndrome represents a significant public health burden. Early identification and

aggressive management of modifiable metabolic risk factors are essential to reduce stroke incidence, recurrence, and disability.

CONCLUSION

This study shows a high prevalence of metabolic syndrome components among stroke patients, particularly hypertension and elevated fasting blood glucose. Stroke was more common in males and individuals above 40 years of age, with ischemic stroke being the most frequent subtype. Most patients presented with moderate stroke severity and moderate functional disability. Although individual metabolic factors were not significantly associated with stroke subtype, their high overall prevalence highlights the importance of early detection and proper management of metabolic risk factors to reduce stroke risk and improve outcomes.

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