Original Article

# Prevalence and Clinical Correlates of Microalbuminuria in Patients with Acute Ischemic Stroke

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## Abstract

**Background:** Acute ischemic stroke is a major cause of morbidity and mortality worldwide. Microalbuminuria, a marker of endothelial dysfunction and systemic vascular injury, has been associated with cardiovascular and cerebrovascular diseases. However, its prevalence and clinical correlates in patients with acute ischemic stroke require further evaluation. The objective is to determine the clinical correlations of microalbuminuria and its prevalence in acute ischemic stroke patients. **Material and Methods:** 105 patients who presented with their first acute ischemic stroke within 24 hours after the onset of symptoms were included in this prospective hospital-based comparison analysis. Diagnosis was confirmed by CT brain. Patients were evaluated clinically, radiologically, and through laboratory investigations including urinalysis for albuminuria. **Results:** Among the 105 patients with acute ischemic stroke, the mean age was 55.8 ± 12.8 years, and 72 (68.6%) were male. 32 patients (30.5%) acknowledged smoking, while 46 patients (43.8%) reported drinking alcohol. Microalbuminuria was detected in 50 (47.6%) patients. Neuroimaging revealed involvement of the right middle cerebral artery (RMCA) in 51 (48.6%) patients, left middle cerebral artery (LMCA) in 44 (41.9%), left posterior cerebral artery (LPCA) in 7 (6.7%), and right posterior cerebral artery (RPCA) in 3 (2.9%). Microalbuminuria showed a significant association with male sex (p=0.047). However, no significant associations were observed with age group (p=0.223), loss of consciousness (p=0.443), seizures (p=0.443), aphasia (p=0.525), weakness (p=0.894), or CT brain findings (p=0.504). **Conclusion:** Nearly half of the patients with acute ischemic stroke had microalbuminuria, which was strongly correlated with male sex. These results corroborate the idea that microalbuminuria is a sign of both widespread vascular damage and endothelial dysfunction. Assessment of microalbuminuria may be helpful in the clinical evaluation of patients with acute ischemic stroke because of its ease of use, non-invasiveness, and affordability.

**Keywords:** Acute ischemic stroke; microalbuminuria; endothelial dysfunction; albuminuria; cerebrovascular disease; vascular injury.

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## Introduction

WHO defines stroke as rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than that of vascular origin.[1] Stroke is the second most common cause of death globally, accounting for 6.2 million fatalities in 2015—an increase of 830,000 since 2000. Although the incidence of stroke has increased globally, it is decreasing in wealthy communities and increasing in those with poor access to healthcare.[2] Middle- and low-income nations account for around two-thirds of the world's stroke burden.[3] Compared to Caucasians, stroke rates are higher in Asian and Black African populations. Even though stroke risk increases with age, 25% of strokes occur before the age of 65.[4] After a stroke, 20–25% of patients die, and 40% of those who survive are still dependant six months later. Depending on the kind, intensity, age, comorbidities, efficacy of treatment, and management of consequences, stroke patients have a 20% to 50% chance of dying within the first month following the occurrence. Ischemic stroke and hemorrhagic stroke are the two primary categories of stroke.[5] About 85% of all stroke cases are ischemic strokes, which happen when a thrombus or an embolus blocks a blood vessel.[6]

Modifiable and non-modifiable risk factors are the two categories of stroke risk factors. Genetics, age, gender, race, and family history are the main risk factors that are unchangeable. Modifiable risk factors include arterial hypertension, transient ischemic attack (TIA), prior stroke, cardiac disease, diabetes mellitus, dyslipidemia, obesity, cigarette smoking, alcohol consumption, elevated homocysteine, increased fibrinogen levels, and lack of physical activity.[7] The excretion of albumin in trace amounts that are undetectable with a dipstick is known as microalbuminuria. For untimed samples, the range of urinary

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albumin excretion is 20–200 mg/L; for timed urine collections, it is 30–300 mg every 24 hours.[8] Microalbuminuria, a symptom of abnormal vascular permeability, could be the kidney's warning sign for a markedly increased risk of cerebrovascular disease. Microalbuminuria has been associated with clinical risk factors for stroke, such as diabetes, hypertension, age, history of myocardial infarction, obesity, smoking, and left ventricular hypertrophy. One indicator of extensive vascular injury is microalbuminuria. It is often accompanied by elevated von Willebrand factor and/or factor VIII activity, all of which are recognized indicators of endothelial dysfunction, and represents systemic transcapillary albumin leakage.[9]

Several cross-sectional and prospective studies have demonstrated an association between microalbuminuria and an increased risk of cerebrovascular disease. Microalbuminuria may be a helpful indicator in individuals with acute ischemic stroke since it is becoming more widely acknowledged as a sign of endothelial dysfunction and widespread vascular injury.[10] Therefore, the aim of this study was to determine the prevalence of microalbuminuria in patients with acute ischemic stroke and to evaluate its clinical implications. Due in large part to changes in the population and an increase in modifiable risk factors, stroke is becoming a major cause of early mortality and disability in low- and middle-income countries like India. Consequently, developing countries are burdened by both communicable and non-communicable diseases.[11] Stroke is more common among the impoverished due to shifting exposure to risk factors and, more significantly, restricted access to expensive stroke care. Financial difficulty is exacerbated by the fact that the majority of stroke survivors continue to live with disability and that family members bear the majority of the expenditures of continuing rehabilitation and long-term care.[12] Stroke is the primary cause of persistent adult impairment and the second most prevalent cause of death worldwide, after coronary artery disease (CAD). One in five women and one in six men will experience a stroke in their lives after the age of 55.[13] In underdeveloped nations, over four-fifths of all strokes take place. The identification of atherosclerosis as an inflammatory condition has led to the hunt for new risk factors for stroke, such as microalbuminuria.[14] Slightly elevated urinary albumin excretion was initially demonstrated in patients with diabetes mellitus, where it was shown to be associated with atherogenic changes in cardiovascular risk profiles and increased mortality. In addition to being a sign of overall endothelium damage and endothelial dysfunction, microalbuminuria is a predictor of eventual renal disease.[15] This is thought to be a precursor to the atherosclerotic process that causes coronary artery disease. The association between microalbuminuria and the development of vascular illness is further supported by its association with acute ischemic heart disease, diastolic dysfunction, congestive heart failure, acute stroke, peripheral arterial disease, carotid atherosclerosis, and arterial hypertension. Therefore, rather than being merely an indication of impaired renal function, microalbuminuria may be utilized as a diagnostic window for the whole vasculature.[16]

**Objectives:** To determine the clinical correlations of microalbuminuria and its prevalence in acute ischemic stroke patients.

## Materials and Methods

This prospective, time-bound, hospital-based study was carried out between 2020 and 2022 at the District Hospital in Tumkur, Karnataka. The study comprised patients who had their first acute ischemic stroke within 24 hours of the onset of symptoms. The diagnosis of acute ischemic stroke was confirmed by CT brain imaging.

**Sample size Calculation:**

$$n = \frac{Z^2_{\left(1-\frac{\alpha}{2}\right)} * P * (1-p)}{d^2}$$

Where

Outcome variable = Prevalence of microalbuminuria

p = Expected prevalence of microalbuminuria = 47% (0.47)

d = Absolute precision = 10% (0.10)

Z = 1.96 is the standard normal deviation for a 95% confidence level.

96 individuals was the minimal sample size that was determined. The total sample size was calculated to be 105 individuals after taking into consideration a 10% non-response rate.

All eligible patients underwent detailed clinical evaluation, laboratory investigations, and radiological assessment. Urinary albumin excretion was assessed to determine the presence of microalbuminuria. Clinical, laboratory, and radiological variables were recorded and analyzed to ascertain the microalbuminuria prevalence and its association with clinical and radiological characteristics in patients with acute ischemic stroke.

**Inclusion Criteria**

1. Patients who are at least eighteen years old, regardless of gender, and who present with their first acute ischemic stroke within twenty-four hours of the onset of symptoms, as defined by the WHO definition of stroke.
2. Ischemic stroke confirmed by CT brain imaging.
3. Patients with hypertension, irrespective of treatment status, were included in the study.

**Exclusion Criteria**

1. Patients with haemorrhagic stroke.
2. Patients with diabetes mellitus.
3. Patients with systemic infections including bacterial meningitis.
4. Patients with renal insufficiency of any etiology.
5. Patients with abnormal urinalysis suggestive of urinary tract infection, overt proteinuria, or other renal pathology.

**Data Collection:** Patients who met the requirements for inclusion and exclusion were added to the trial. A detailed clinical evaluation, laboratory investigations, and radiological assessment were performed for all participants. Relevant demographic and clinical information, including medical history, medication history, and findings from physical examination, were documented using a systematic method for gathering patient data.

**Statistical Analysis:** After entering the data into Microsoft

Excel, for analysis, SPSS version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 were utilized. The mean ± standard deviation (SD) was used to describe continuous variables, whilst frequencies and percentages were used to report categorical data. In order to assess correlations between categorical variables, the Chi-square test was employed. Odds ratios (ORs) with 95% CIs were calculated when suitable. A p-value was considered statistically significant if it was less than 0.05.

## Results

The study included a total of 105 participants with acute ischemic stroke. The participants' median age was 55 years (range: 20–84 years), and their mean age was 55.8 ± 12.8 years. The age groups of 41–50 years and 51–60 years accounted for 30 patients each (28.6%), with the 61–70-year age group coming in second (20.0%). Males constituted 68.6% of the study population, with a male-to-female ratio of approximately 2.2:1. Smoking and alcohol consumption were reported in 32 (30.5%) and 46 (43.8%) patients, respectively. Neuroimaging revealed involvement of the right middle cerebral artery (RMCA) territory in 51 (48.6%) patients and the left middle cerebral artery (LMCA) territory in 44 (41.9%) patients. Posterior circulation strokes were less common, involving the left posterior cerebral artery (LPCA) in 7 (6.7%) patients and the right posterior cerebral artery (RPCA) in 3 (2.9%) patients.

**Table 1: Baseline Demographic, Clinical, Radiological, and Laboratory Characteristics of Patients with Acute Ischemic Stroke (n = 105)**

| Variable | Category/Statistic | Value |
|---|---|---|
| Age group, n (%) | ≤30 years | 3 (2.9) |
| | 31–40 years | 6 (5.7) |
| | 41–50 years | 30 (28.6) |
| | 51–60 years | 30 (28.6) |
| | 61–70 years | 21 (20.0) |
| | 71–80 years | 13 (12.4) |
| | >81 years | 2 (1.9) |
| Age (years) | Mean ± SD | 55.8 ± 12.8 |
| Sex, n (%) | Male | 72 (68.6) |
| | Female | 33 (31.4) |
| Smoking status, n (%) | Yes | 32 (30.5) |
| | No | 73 (69.5) |
| Alcohol consumption, n (%) | Yes | 46 (43.8) |
| | No | 59 (56.2) |
| CT brain findings, n (%) | Right middle cerebral artery (RMCA) | 51 (48.6) |
| | Left middle cerebral artery (LMCA) | 44 (41.9) |
| | Left posterior cerebral artery (LPCA) | 7 (6.7) |
| | Right posterior cerebral artery (RPCA) | 3 (2.9) |
| Albuminuria status, n (%) | Microalbuminuria | 50 (47.6) |
| | Normoalbuminuria | 55 (52.4) |
| Systolic blood pressure (mmHg) | Mean ± SD | 163.2 ± 97.4 |
| Diastolic blood pressure (mmHg) | Mean ± SD | 90.4 ± 15.1 |
| Total cholesterol (mg/dL) | Mean ± SD | 179.5 ± 49.2 |
| LDL cholesterol (mg/dL) | Mean ± SD | 111.0 ± 27.2 |
| HDL cholesterol (mg/dL) | Mean ± SD | 46.2 ± 8.4 |
| Triglycerides (mg/dL) | Mean ± SD | 196.8 ± 33.8 |
| Blood urea (mg/dL) | Mean ± SD | 26.2 ± 5.3 |
| Serum creatinine (mg/dL) | Mean ± SD | 0.80 ± 0.19 |
| Glasgow Coma Scale score | Mean ± SD | 10.0 ± 2.1 |

Fifty patients (47.6%) with acute ischemic stroke had microalbuminuria. The correlation was not statistically significant (p=0.223), despite the fact that the prevalence of microalbuminuria varied among age groups. A significant association was observed between sex and microalbuminuria (p=0.047), with male patients demonstrating a higher prevalence than female patients (54.2% vs. 33.3%). The odds of microalbuminuria were lower in women (OR=0.423, 95% CI: 0.179–0.999). Microalbuminuria did not significantly correlate with aphasia (p=0.525), weakening pattern (p=0.894), loss of consciousness (p=0.443), seizures (p=0.443), or CT brain abnormalities (p=0.504).

**Table 2: Association of Clinical and Radiological Variables with Microalbuminuria in Patients with Acute Ischemic Stroke (n = 105)**

| Variable | Category | Microalbuminuria n (%) | Normoalbuminuria n (%) | Total n (%) | Odds Ratio (95% CI) | p-value |
|---|---|---|---|---|---|---|
| Age group | ≤30 years | 0 (0.0) | 3 (100.0) | 3 (2.9) | – | 0.223 |
| | 31–40 years | 5 (83.3) | 1 (16.7) | 6 (5.7) | | |
| | 41–50 years | 14 (46.7) | 16 (53.3) | 30 (28.6) | | |
| | 51–60 years | 14 (46.7) | 16 (53.3) | 30 (28.6) | | |
| | 61–70 years | 9 (42.9) | 12 (57.1) | 21 (20.0) | | |
| | 71–80 years | 6 (46.2) | 7 (53.8) | 13 (12.4) | | |
| | >81 years | 2 (100.0) | 0 (0.0) | 2 (1.9) | | |
| Sex | Female | 11 (33.3) | 22 (66.7) | 33 (31.4) | 0.423 (0.179–0.999) | 0.047* |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Male | 39 (54.2) | 33 (45.8) | 72 (68.6) | Reference | |
| Loss of consciousness | No | 42 (46.2) | 49 (53.8) | 91 (86.7) | Reference | 0.443 |
| | Yes | 8 (57.1) | 6 (42.9) | 14 (13.3) | 0.643 (0.206–2.002) | |
| Seizure | No | 42 (46.2) | 49 (53.8) | 91 (86.7) | Reference | 0.443 |
| | Yes | 8 (57.1) | 6 (42.9) | 14 (13.3) | 0.643 (0.206–2.002) | |
| Aphasia | No | 33 (50.0) | 33 (50.0) | 66 (62.9) | Reference | 0.525 |
| | Yes | 17 (43.6) | 22 (56.4) | 39 (37.1) | 1.294 (0.584–2.868) | |
| Weakness | Left-sided | 27 (49.1) | 28 (50.9) | 55 (52.4) | – | 0.894 |
| | No weakness | 7 (50.0) | 7 (50.0) | 14 (13.3) | | |
| | Right-sided | 16 (44.4) | 20 (55.6) | 36 (34.3) | | |
| CT brain findings | LMCA | 22 (50.0) | 22 (50.0) | 44 (41.9) | – | 0.504 |
| | LPCA | 5 (71.4) | 2 (28.6) | 7 (6.7) | | |
| | RMCA | 22 (43.1) | 29 (56.9) | 51 (48.6) | | |
| | RPCA | 1 (33.3) | 2 (66.7) | 3 (2.9) | | |

Data are presented as n (%). To evaluate associations, the Chi-square test was employed. When appropriate, odds ratios (ORs) with 95% confidence intervals (CIs) were computed for binary variables. For statistical significance, a p-value of less than 0.05 was used.

*Statistically significant association

## Discussion

In individuals suffering from acute ischemic stroke, the prevalence and clinical correlations of microalbuminuria were assessed in this study. Fifty of the 105 individuals were found to have microalbuminuria, resulting in a frequency of 47.6%. This data suggests that around half of individuals with acute ischemic stroke have extensive arterial damage and endothelial dysfunction. The mean age of the patients was 55.8 ± 12.8 years, and 68.6% of them were male. The majority of patients were between the ages of 41 and 60, highlighting the increasing burden of stroke in the economically productive age population. Similar demographic trends have been reported in previous studies, where ischemic stroke predominantly affected middle-aged and elderly individuals due to the higher prevalence of vascular risk factors.[17]

Microalbuminuria was more frequently observed among male patients than female patients (54.2% vs. 33.3%), and this association was statistically significant (p = 0.047). Female sex was associated with lower odds of microalbuminuria (OR: 0.423, 95% CI: 0.179–0.999). This finding may reflect the greater burden of smoking, alcohol consumption, hypertension, and atherosclerotic risk factors among men.[18] Similar sex-based differences have been reported in previous studies evaluating microalbuminuria in cerebrovascular disease. No significant association was observed between microalbuminuria and age group (p = 0.223), loss of consciousness (p = 0.443), seizures (p = 0.443), aphasia (p = 0.525), weakness pattern (p = 0.894), or CT brain lesion location (p = 0.504). Although patients with posterior circulation involvement demonstrated relatively higher proportions of microalbuminuria, the small sample size within each subgroup may be the reason why these results did not attain statistical significance.

Microalbuminuria is increasingly recognized as a marker of systemic endothelial dysfunction rather than merely an indicator of renal injury. Increased urinary albumin excretion reflects widespread vascular permeability and early atherosclerotic changes, which may contribute to cerebrovascular disease. Previous research has supported microalbuminuria's function as a marker of widespread vascular injury by showing a correlation between it and unfavorable cerebrovascular outcomes.[22,23]

The findings of the present study support the observation that microalbuminuria is common among individuals suffering from acute ischemic stroke and could function as a straightforward, inexpensive, and non-invasive marker of vascular damage.[24] Early identification of microalbuminuria may help clinicians recognize patients with underlying endothelial dysfunction and a greater burden of vascular risk factors. However, there are several restrictions on the study. The results may not apply to a larger population because the study was conducted in a single hospital. The ability to identify meaningful correlations with specific clinical factors may have been hampered by the very small sample size. In addition, long-term follow-up and functional outcome assessment were not performed. Notwithstanding these drawbacks, the study offers a basis for more extensive prospective research and emphasizes the potential value of microalbuminuria as a measure of endothelial dysfunction and vascular injury in individuals with acute ischemic stroke.

## Conclusion

Patients with acute ischemic stroke were more likely to have microalbuminuria, which affected almost half (47.6%) of the study sample. There was a strong correlation between male sex and microalbuminuria, whereas age, loss of consciousness, seizures, aphasia, weakness pattern, and CT brain findings were not significantly associated. These results corroborate the idea that microalbuminuria is a sign of both global vascular injury and systemic endothelial dysfunction in acute ischemic stroke patients. Because microalbuminuria assessment is simple, non-invasive, and inexpensive, it may be useful in the clinical evaluation of individuals suffering from acute ischemic stroke.

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## Conflicts of interest

There are no conflicts of interest.

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