Section: General Medicine

Original Research Article

A STUDY OF ANALYSIS OF SERUM ALBUMIN LEVEL AS A PREDICTOR OF FUNCTIONAL OUTCOME FOLLOWING ISCHEMIC STROKE IN A TERTIARY CARE HOSPITAL

V.Pattu Swarnalatha[1], B.Gowtham[2], S.Amalan[3]

[1]Associate Professor, Department of General Medicine, Government Thoothukudi Medical College, Tamilnadu, India.
[2]Senior Resident, Department of General Medicine, Indira Medical College and Hospitals, Tamilnadu, India.
[3]Professor, Department of Emergency Medicine, Government Tirunelveli Medical College, Tamilnadu, India.

Received : 10/01/2026
Received in revised form : 08/02/2026
Accepted : 27/02/2026

Keywords:
Albumins, Functional Recovery, Ischemic Stroke, Motor Recovery, Prognosis, Serum Biomarkers.

Corresponding Author:
Dr. B.Gowtham,
Email: gowthambalaji231@gmail.com

DOI: 10.47009/jamp.2026.8.2.29

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (2); 148-152

ABSTRACT

Background: Ischaemic stroke is a major cause of disability and mortality. The early identification of reliable predictors of functional recovery is important for clinical management. This study aimed to evaluate the role of serum albumin levels as a predictor of functional outcomes following acute ischaemic stroke. **Materials and Methods:** This prospective observational study was conducted at the Government Thoothukudi Medical College Hospital over 12 months. One hundred adult patients with acute ischaemic stroke were included in the study. Serum albumin was measured at admission, and functional outcomes were assessed using the modified Rankin Scale (mRS) and Medical Research Council (MRC) grading up to three months. **Results:** Among 100 patients with ischaemic stroke, 46% were aged 60–70 years, with 54% males. Hypertension (67%), diabetes (49%), and smoking (36%) were common, and 50% presented within 4–6 hours (mean 5.77±2.06 hours). Most had moderate stroke (89%) with mean NIHSS of 11.42±3.17; MCA territory was involved in 66%. Mean serum albumin was 3.10±0.51 g/dL, with hypoalbuminaemia in 75%. All had poor mRS at admission; good outcome (mRS 0–3) occurred in 33% at discharge and 70% at 3 months ($p<0.0001$). MRC grade 0 was seen in 88% initially, while 71% achieved grades 3–4 at 3 months. Mean albumin was higher in good versus poor outcomes (3.37±0.34 vs. 2.56±0.29 g/dL; $p<0.0001$). **Conclusion:** Serum albumin level at admission is a significant predictor of functional recovery after ischaemic stroke. Routine assessment of serum albumin levels may aid in early prognostication and guide supportive care.

INTRODUCTION

Stroke is a major neurological disorder and a serious public health problem worldwide. It is the third leading cause of death and one of the main causes of long-term disability among adults. The lifetime probability of stroke has risen by nearly 50% over the last two decades, with approximately one in four adults expected to suffer a stroke at some point in life.[1] According to the World Health Organisation, the number of disability-adjusted life years lost due to stroke rose from roughly 137 million in 2000 to about 160 million in 2021.[1] In 2019, low-, lower-middle-, and upper-middle-income countries accounted for about 86% of deaths due to stroke and nearly 89% of stroke-related disability-adjusted life years, and the majority of the global stroke incidence was concentrated in these regions.[2]

Developing nations face a growing problem with their healthcare systems due to population ageing and lifestyle changes. These shifts have led to a higher prevalence of non-communicable diseases, such as stroke. In Nigeria, about one-third of stroke patients die within four weeks, while another one-third survive with permanent disability.[4] In China, stroke is the leading cause of adult disability according to the update of national stroke statistics.[5] The economic burden and prolonged dependency associated with stroke emphasise the need for strategies focused on early assessment and rehabilitation.[6]

Because stroke outcomes vary widely, early identification of prognostic factors is important for estimating recovery, guiding in-hospital care, and planning follow-up care. Factors such as stroke severity, stroke subtype, advanced age, impaired consciousness, and hyperglycaemia are associated

ISSN (O): 2687-5365; ISSN (P): 2753-6556

with poor outcomes after acute stroke. Many of these indicators depend on imaging or specialised evaluation and may not be consistently available. Even with advances in acute stroke management, functional outcomes remain poor, requiring the need for simple biochemical markers that support prognostic assessment.[7]

Serum albumin is a plasma protein produced by the liver that plays a major role in maintaining oncotic pressure. It contributes to antioxidant defence and inflammation modulation. Albumin acts as a carrier for several endogenous substances and helps to preserve vascular integrity. Serum albumin concentration is used as an indicator of nutritional status. It is also a negative acute-phase protein with reduced synthesis during inflammatory states. Low serum albumin levels have been linked to adverse outcomes in various clinical conditions.[8]

Clinical studies have reported an association between low serum albumin levels and unfavourable outcomes after ischaemic stroke. Lower admission albumin levels were associated with higher mortality and greater disability. Patients with better functional recovery tended to have higher serum albumin levels. Experimental work suggests that albumin may reduce cerebral oedema and improve microcirculatory flow. Serum albumin levels often decline during the first week after stroke.[8,9]

Evidence focusing specifically on serum albumin as a predictor of functional outcomes remains limited in tertiary care settings. Therefore, this study aims to evaluate serum albumin levels as predictors of functional outcomes following ischaemic stroke at a tertiary care hospital.

MATERIALS AND METHODS

This prospective observational study was conducted on 100 ischaemic stroke patients admitted to the medical wards of Government Thoothukudi Medical College Hospital from February 2023 to February 2024. The study was performed in collaboration with the Departments of Cardiology and Biochemistry. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all patients.

Inclusion and exclusion criteria

The study included patients >18 years of age who were admitted within 24 h of an ischaemic stroke, had muscle power of Medical Research Council (MRC) grade 3/5 or below, remained hospitalised for more than five days, and showed evidence of malnutrition after the acute event.

Patients <18 years of age, those who were discharged or died within five days of admission, and those with pre-existing conditions associated with low serum albumin levels, such as severe anorexia nervosa, sepsis, liver cirrhosis, nephrotic syndrome, or protein-losing gastrointestinal disorders, were excluded.

Methods

All patients were clinically examined and underwent brain imaging at the time of admission. Stroke severity was assessed at admission using the National Institutes of Health Stroke Scale (NIHSS) by trained physicians. The site of infarction was identified using computed tomography or magnetic resonance imaging of the brain and classified according to the vascular territory involved.

Serum albumin levels were measured upon admission. Patients were grouped based on serum albumin values into high albumin (>5.5g/dL), normal (3.5–5.5 g/dL), mild hypoalbuminemia (3.1–3.5 g/dL), moderate hypoalbuminemia (2.6–3.0 g/dL), and severe hypoalbuminemia (≤2.5 g/dL).

Data collected from each patient included age, sex, height, weight, history of hypertension, diabetes mellitus, dyslipidaemia, ischaemic heart disease, atrial fibrillation, transient ischaemic attack, smoking status, and alcohol use. For laboratory analysis, 2 mL of venous blood was drawn at admission into a red-topped serum separator tube. The sample was kept at room temperature for approximately 1 h to allow clotting and then centrifuged. Serum was separated using a Pasteur pipette, and serum albumin was estimated using routine laboratory methods.

Functional status was assessed using the Modified Rankin Scale (mRS); a 7-point clinician-reported ordinal scale ranging from 0 (no symptoms) to 6 (death) that measures post-stroke disability. It was assessed at admission, discharge, day 7, and at 3 months. Motor power was evaluated using the MRC muscle strength scale, a 0–5 grading system from no contraction (0) to normal strength (5) based on movement against gravity and resistance, at admission, day 7, and 3 months. Based on the 3-month mRS, patients were categorised into good outcome (mRS 0–3) and poor outcome (mRS 4–6) groups. Admission serum albumin levels were then compared between these groups to determine their association with functional recovery.

Statistical Analysis

The data were analysed using SPSS v29. Categorical variables were analysed using the Chi-square test. Comparison was performed using the independent samples Student's t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

Among the 100 patients with ischaemic stroke, the majority were aged 60–70 years (46%), with a mean age of 61.15 ± 8.64 years. Male patients accounted for 54% of the cases, while female patients comprised 46%. [Table 1]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Distribution of patients by age group and gender

Variable	Category	N (%)
Age group (years)	40–49	12 (12%)
	50–59	28 (28%)
	60–70	46 (46%)
	>70	14 (14%)
	Mean ± SD	61.15 ± 8.64
Gender	Male	54 (54%)
	Female	46 (46%)

Hypertension was the most common risk factor (67%), followed by diabetes mellitus (49%) and smoking (36%). Half of the patients were admitted within 4–6 h of symptom onset (50%), with a mean onset-to-admission time of 5.77 ± 2.06 h.[Table 2]

Table 2: Distribution of clinical risk factors and time to hospital admission

Variable	Category	N (%)
Risk factors	Hypertension	67 (67%)
	Diabetes mellitus	49 (49%)
	Dyslipidaemia	29 (29%)
	Ischemic heart disease	29 (29%)
	Smoking	36 (36%)
	Alcohol use	24 (24%)
	No risk factor	1 (1%)
Onset to admission time (hours)	≤3	16 (16%)
	4–6	50 (50%)
	7–10	34 (34%)
	Mean ± SD	5.77 ± 2.06

Most patients had moderate stroke severity (89%), with a mean NIHSS score of 11.42 ± 3.17. The middle cerebral artery territory was the most commonly involved (66%), whereas anterior cerebral artery involvement was observed in 34% of cases. Most patients had low serum albumin levels at admission, with moderate hypoalbuminaemia in 31% and mild hypoalbuminaemia in 26% of cases. Severe hypoalbuminaemia was present in 18% of patients, while only 22% had normal albumin levels. The mean serum albumin concentration was 3.10 ± 0.51 g/dL. [Table 3]

Table 3: Distribution of Stroke Severity, Vascular Territory Involvement, and Serum Albumin

Variable	Category	N (%)
NIHSS score	Moderate stroke (5–15)	89 (89%)
	Moderate to severe stroke (16–20)	11 (11%)
Mean NIHSS score		11.42 ± 3.17
Stroke territory	Left MCA	31 (31%)
	Right MCA	29 (29%)
	MCA (unspecified)	6 (6%)
	ACA	34 (34%)
Serum Albumin (g/dL)	Severe hypoalbuminemia	18 (18%)
	Moderate hypoalbuminemia	31 (31%)
	Mild hypoalbuminemia	26 (26%)
	Normal	22 (22%)
	High	3 (3%)
Mean Serum Albumin (g/dL)		3.10 ± 0.51

At admission, all patients had poor functional status (mRS 4–6). This improved over time, with good functional outcome (mRS 0–3) seen in 33% at discharge and 70% at 3 months. At admission, 88% had MRC grade 0, but by the 7th day, most patients improved to grades 1–3 (87%). At 3 months, 71% achieved MRC grades 3–4. [Table 4]

Table 4: Progression of Functional Outcome and Motor Recovery

Variable	Parameters	Grades/Scores	Frequency (%)
mRS progression (Scores)	Admission	4–6	100 (100%)
	Discharge	0–3	33 (33%)
		4–6	67 (67%)
	7th day post stroke	0–3	27 (27%)
		4–6	73 (73%)
	3rd month	0–3	70 (70%)
		4–6	30 (30%)
MRC motor power progression (Grades)	Admission	0	88 (88%)
		1	6 (6%)
		2	6 (6%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

	7th day post stroke	0	9 (9%)
		1	30 (30%)
		2	35 (35%)
		3	22 (22%)
		4	4 (4%)
	3rd month	1	3 (3%)
		2	26 (26%)
		3	47 (47%)
		4	24 (24%)

All patients had poor functional status at admission, while at 3 months, 70% achieved significantly good recovery ($p < 0.0001$). Patients with a good functional outcome had significantly higher mean serum albumin levels (3.37 ± 0.34 g/dL) compared to those with a poor outcome (2.56 ± 0.29 g/dL) ($p < 0.0001$). [Table 5]

Table 5: Association Between Serum Albumin and Functional Recovery at 3 Months

Variable	Parameters	Values	p-value
Functional recovery	On Admission	Poor: 100 (100%)	<0.0001
	At 3rd month	Good: 70 (70%) Poor: 30 (30%)	
Comparison of serum albumin between functional outcomes at 3 months	Good outcome (n=70)	3.37 ± 0.34	<0.0001
	Poor outcome (n= 30)	2.56 ± 0.29	

DISCUSSION

The present study showed that ischemic stroke predominantly affected older adults, with most patients presenting with moderate stroke severity, delayed hospital arrival, and a high burden of vascular risk factors. A large proportion of patients had low serum albumin levels at admission, and higher albumin levels were strongly associated with better functional recovery at three months.

In our study, most patients were aged 60–70 years, with a male predominance. Hypertension was the most common risk factor, followed by diabetes mellitus and smoking. Most patients presented within 4 to 6 hours of symptom onset. Similarly, Sylaja et al. reported that patients with ischaemic stroke had a median age of 61 years (interquartile range 52–71 years), and males constituted approximately 67% of the study population, showing that ischaemic stroke was more common in older adults and men.10 A study by Al Harthi et al. in the Oman stroke cohort found that hypertension was the most common risk factor (72.5%), followed by diabetes mellitus (54.4%). More than half of the patients with ischaemic stroke (53.7%) presented to the hospital on the day of symptom onset, indicating delayed arrival for acute care.[11] In the study by Geela et al., hypertension was the most common risk factor, present in 63.4% of patients, followed by smoking in 23.8% and diabetes mellitus in 18.8%. All patients had at least one identifiable vascular risk factor.[12] These studies support our findings by demonstrating similar age distribution, male predominance, and risk factor profiles in ischaemic stroke populations, with hypertension consistently emerging as the leading risk factor and delayed hospital presentation commonly observed across different geographic settings.

Our study showed that most patients presented with moderate stroke severity and predominantly middle cerebral artery involvement. Hypoalbuminemia was common at admission, with many patients showing reduced serum albumin levels of varying degrees of severity. Similarly, Al Harthi et al. found that most ischemic stroke patients presented with mild to moderate severity, with 68.1% classified as mild and 23.8% as moderate based on NIHSS scores, while only 8.1% had severe or very severe stroke at presentation.[11] Huang et al. in a study of ICU-based AIS cohort, patients with higher BAR values, reflecting lower serum albumin levels, had significantly higher ICU, 30-day, 90-day, and 365-day mortality rates, confirming that reduced serum albumin at admission was common and strongly associated with poor outcomes.[13] These studies support our findings by showing similar stroke severity patterns at presentation and confirming that low serum albumin at admission is common and strongly associated with worse clinical outcomes in ischemic stroke patients.

In this study, functional and motor recovery improved significantly over the follow-up period, with mRS and MRC scores showing gains by three months. At three months, 70% achieved good outcomes, and higher admission serum albumin levels were strongly associated with favourable recovery ($p < 0.0001$). Similarly, Idicula et al. reported that functional outcomes improved, with a median day-7 mRS of 2 (IQR 1–3) and admission NIHSS 4 (IQR 1–8). Higher serum albumin levels independently predicted favourable outcomes (OR 1.12, 95% CI 1.05–1.20; $p = 0.001$).[14] Wei et al. reported that lower admission serum albumin levels independently predicted poor 3-month functional outcomes (OR 0.913, 95% CI 0.878–0.950; $p < 0.05$), supporting the association between hypoalbuminemia and unfavourable recovery observed in the present study.[15] Ranran et al. reported that higher serum albumin levels were independently associated with better functional

ISSN (O): 2687-5365; ISSN (P): 2753-6556

status, with each 1 g/L increase reducing severe ADL impairment by 7%. Patients in higher albumin quartiles had significantly lower odds of poor functional outcome (adjusted OR as low as 0.55, p = 0.04).[16] These studies support our findings by consistently showing that higher admission serum albumin levels predict better functional recovery, while hypoalbuminemia is independently associated with poor short- and long-term outcomes after ischaemic stroke.

The findings of this study strengthen the existing evidence that serum albumin is a simple, accessible, and clinically relevant predictor of functional outcomes following ischaemic stroke, particularly in resource-limited settings.

Limitations

This single-centre study with a limited sample size may restrict generalisation. Serum albumin levels were assessed only at admission. Nutritional and inflammatory factors were not fully evaluated, and functional outcomes beyond three months were not assessed.

Clinical implications

Serum albumin levels may aid in the early risk assessment of stroke patients. Future studies should include larger populations, repeated albumin measurements, and longer follow-up periods. Routine albumin assessment and nutritional support may improve functional recovery after strokes.

CONCLUSION

Serum albumin level at admission is a useful predictor of functional outcomes following ischaemic stroke. Functional and motor recovery improved significantly over the months follow-up period. Patients with higher serum albumin levels achieved better recovery, whereas hypoalbuminaemia was associated with persistent disability. Serum albumin reflects both nutritional and systemic health status in patients with acute stroke. Routine assessment of serum albumin levels may assist in early prognostication and clinical decision-making.

REFERENCES

1. Stroke. WHO 2025. https://www.who.int/news-room/fact-sheets/detail/stroke (accessed February 2, 2026).
2. GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol 2021;20:795–820. https://doi.org/10.1016/S1474-4422(21)00252-0.
3. Li XY, Kong XM, Yang CH, Cheng ZF, Lv JJ, Guo H, et al. Global, regional, and national burden of ischemic stroke, 1990-2021: an analysis of data from the global burden of disease study 2021. EClinicalMedicine 2024;75:102758. https://doi.org/10.1016/j.eclinm.2024.102758.
4. Abubakar S, Sabir A, Ndakotsu M, Imam M, Tasiu M. Low admission serum albumin as prognostic determinant of 30-day case fatality and adverse functional outcome following acute ischemic stroke. Pan Afr Med J 2013;14:53. https://doi.org/10.11604/pamj.2013.14.53.1941.
5. Wang YJ, Li ZX, Gu HQ, Zhai Y, Zhou Q, Jiang Y, et al. China stroke statistics: An update on the 2019 report from the National Centre for Healthcare Quality Management in Neurological Diseases, China national clinical research center for neurological diseases, the Chinese stroke association, national center for chronic and non-communicable disease control and prevention, Chinese center for disease control and prevention and institute for global neuroscience and stroke collaborations. Stroke Vasc Neurol 2022;7:415–50. https://doi.org/10.1136/svn-2021-001374.
6. Zawiah M, Khan AH, Farha RA, Usman A, Al-Ashwal FY, Akkaif MA. Assessing the predictive value of neutrophil percentage to albumin ratio for ICU admission in ischemic stroke patients. Front Neurol 2024;15:1322971. https://doi.org/10.3389/fneur.2024.1322971.
7. Corso G, Bottacchi E, Tosi P, Caligiana L, Lia C, Veronese Morosini M, et al. Outcome predictors in first-ever ischemic stroke patients: A population-based study. Int Sch Res Notices 2014;2014:904647. https://doi.org/10.1155/2014/904647.
8. Tsogka A, Ellul J, Chroni E, Safouris A, Psychogios K, Veltsista D, et al. Serum biomarkers in acute ischemic stroke: Clinical applications and emerging insights. J Clin Med 2025;14. https://doi.org/10.3390/jcm14217748.
9. Zhou H, Wang A, Meng X, Lin J, Jiang Y, Jing J, et al. Low serum albumin levels predict poor outcome in patients with acute ischaemic stroke or transient ischaemic attack. Stroke Vasc Neurol 2021;6:458–66. https://doi.org/10.1136/svn-2020-000676.
10. Sylaja PN, Neto G, Sedani R, Pandian JD, Vijaya P, Jena NN, et al. Ischemic stroke management in India: Insights from the Indian Registry of Stroke Care Quality. Cerebrovasc Dis 2025:1–12. https://doi.org/10.1159/000548960.
11. Al Harthi HA, Al Kashmiri A, Zakaryia LM, Al-Lawati JA, Najem OM, Al-Lawati I, et al. Clinical profile of stroke patients presenting to the Emergency Department of a major stroke centre in Oman. Sultan Qaboos Univ Med J 2022;22:91–7. https://doi.org/10.18295/squmj.4.2021.062.
12. Geela P, Puri I, Meena B, Meena M, Singh Jatu M, Kochar SK, et al. The clinical profile and outcome of ischemic stroke patients admitted at a tertiary care center in western Rajasthan. Int J Pharma Clin Res 2023;15(6);1664-1673. https://impactfactor.org/PDF/IJPCR/15/IJPCR%2CVol15%2CIssue6%2CArticle217.pdf (accessed February 3, 2026).
13. Huang Y, Li Z, Wang J, Wang D, Yin X. Association of the blood urea nitrogen to serum albumin ratio and all-cause mortality in critical ill acute ischemic stroke patients: a retrospective cohort study of MIMIC-IV database 3.0. Front Nutr 2024;11:1509284. https://doi.org/10.3389/fnut.2024.1509284.
14. Idicula TT, Waje-Andreassen U, Brogger J, Naess H, Thomassen L. Serum albumin in ischemic stroke patients: the higher the better. The Bergen Stroke Study. Cerebrovasc Dis 2009;28:13–7. https://doi.org/10.1159/000215938.
15. Wei C, Yang Y, Hu Y, Xia X, Feng W, Li X. Serum albumin and total bilirubin are associated with poor outcomes in patients with acute ischemic stroke. Neuroscience 2025;579:321–8. https://doi.org/10.1016/j.neuroscience.2025.06.010.
16. Ranran B, Shi Y, Li M, Liu X, Ma Z, Huang Y, et al. Association between serum albumin and severe impairment of activities of daily living in patients with stroke: a cross-sectional study. Front Neurol 2024;15:1501294. https://doi.org/10.3389/fneur.2024.1501294.

ISSN (O): 2687-5365; ISSN (P): 2753-6556