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Original Article

Neuroimaging Findings and Their Prognostic Value in Acute Ischaemic Stroke Patients at University of Maiduguri Teaching Hospital (UMTH), Borno State, Nigeria

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Abstract

Background: Accurate prediction of stroke outcomes in resource-limited settings remains challenging. This study assessed the utility of neuroimaging findings in predicting mortality among acute ischaemic stroke patients at the University of Maiduguri Teaching Hospital, Nigeria.

Methodology: This prospective study enrolled 171 consecutive adults with acute ischaemic stroke between January and December 2023. All patients underwent non-contrast brain CT scanning, with infarct volume calculated using standardized measurements. The primary outcome was 30-day mortality. Multivariate logistic regression analysis identified independent predictors of mortality, which were used to develop a risk stratification system.

Results: Large infarct volume (>100,000 mm³) emerged as the strongest independent predictor of mortality (aOR 6.82, 95% CI 2.05-22.68, p=0.002), followed by multiple territory involvement (aOR 3.42, 95% CI 1.43-8.17, p=0.006). The developed risk score demonstrated good discriminative ability (AUC 0.775, 95% CI 0.689-0.860) and stratified patients into three risk categories with mortality rates of 8.2% (low), 11.8% (intermediate), and 42.0% (high) (p<0.001).

Conclusion: Specific neuroimaging parameters can effectively predict early mortality in acute ischaemic stroke. The developed risk stratification tool could improve patient care in resource-limited settings.

Keywords: Acute Ischemic Stroke; Neuroimaging; Mortality; Risk Stratification; Prognosis; Nigeria

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Introduction

Acute ischaemic stroke is a medical emergency characterized by a sudden decrease in blood flow to the brain, resulting in damage to brain cells and subsequent neurological deficits. This condition is primarily caused by a blockage in one of the blood vessels supplying the brain, often due to blood clots or fatty deposits.[1] Stroke remains a significant global health concern, with a particularly heavy burden in low- and middle-income countries (LMICs). In Nigeria, Africa's most populous nation, stroke is a leading cause of morbidity and mortality, contributing substantially to the country's health challenges.[2] Recent epidemiological trends reveal that while stroke incidence and mortality have plateaued or decreased in high-income countries, LMICs, including Nigeria, are experiencing an alarming increase in stroke burden.[3] The burden of stroke in Nigeria is compounded by limited resources and inadequate healthcare infrastructure, particularly in conflict-affected regions like Borno State.[4]

Neuroimaging plays a crucial role in the diagnosis, management, and prognostication of acute ischaemic stroke. Computed tomography (CT) and magnetic resonance imaging (MRI) are the primary modalities used to visualize ischaemic changes, determine infarct size and location, and guide treatment decisions.[5] While MRI offers superior sensitivity in detecting early ischaemic changes, CT remains more widely available and is often the first-line imaging modality in resource-limited settings.[6]

Infarct volume, as measured on neuroimaging, has emerged as a potential surrogate marker for stroke severity and clinical outcomes. The prognostic value of infarct volume may be influenced by various factors, including the timing of imaging, stroke subtype, and concomitant clinical variables. Several studies have demonstrated correlations between infarct size and functional outcomes in acute ischaemic stroke patients. [7-9] Saver et al. found moderate correlations between subacute CT infarct volume and 3-month clinical outcomes as assessed by widely used neurological and functional assessment scales.[7] Similarly, Vogt et al. reported that initial lesion volume was a strong and independent predictor of stroke outcome at 90 days, even after accounting for age and baseline National Institutes of Health Stroke Scale (NIHSS) score.[8] Watila et al. also investigated the relationship between admission hyperglycaemia, infarct size, and clinical outcomes in Nigerian patients with acute ischaemic stroke.[10] They found that hyperglycaemia was associated with larger infarct volumes and worse functional outcomes.

Beyond infarct size, other neuroimaging features such as lesion location and vascular territory involved have shown prognostic significance. Saeed et al. demonstrated that infarction size, along with stroke severity and leucocytosis, was associated with early neurological deterioration in acute ischaemic stroke.[11] Additionally, studies have explored the impact of factors such as serum calcium levels and socioeconomic status on infarct characteristics and stroke outcomes. [12, 13]

Despite the growing body of evidence supporting the use of neuroimaging findings as prognostic markers, there is a paucity of data from sub-Saharan Africa, particularly Nigeria. The unique challenges faced by healthcare systems in this region, including limited access to advanced neuroimaging technologies and specialised stroke care, underscore the need for context-specific research on the prognostic value of neuroimaging findings in acute ischaemic stroke. To address this gap in knowledge, we aimed to investigate the neuroimaging findings and their prognostic value in acute ischaemic stroke patients at the University of Maiduguri Teaching Hospital (UMTH), Borno State, Nigeria. Our study had three primary objectives: to determine the association between neuroimaging findings and mortality risk in acute ischaemic stroke patients at UMTH, to identify neuroimaging features that are predictive of poor outcomes and increased mortality in this patient

population, and to develop a neuroimaging-based scoring system for early mortality risk stratification in acute ischaemic stroke patients at UMTH.

By examining the prognostic significance of neuroimaging findings in our setting, we aim to develop a prediction model using baseline sociodemographic characteristics and computerised tomography findings. This model will aid in the early identification of high-risk groups among acute ischaemic stroke patients, contributing to more accurate risk stratification tools tailored to our local context. Such an approach will help us devise pertinent strategies to reduce mortality risk, particularly relevant to our patient population. The development of a neuroimaging-based scoring system for early mortality risk stratification could be particularly valuable in our resource-limited environment, where rapid triage and targeted interventions are crucial. This tool could help clinicians identify high-risk patients who may benefit from more intensive monitoring and management, potentially improving outcomes and reducing mortality rates.

Furthermore, this research has the potential to guide clinical decision-making, resource allocation, and patient management strategies in the care of acute ischaemic stroke patients in Nigeria and similar settings. The knowledge gained could inform future research into targeted therapeutic interventions and preventive strategies tailored to the needs of stroke patients in these contexts.

Methodology

Study Design and Setting:

This prospective study was conducted at the University of Maiduguri Teaching Hospital (UMTH), Borno State, Nigeria, from January 2023 to December 2023. We enrolled 171 consecutive adult patients (≥18 years) presenting to UMTH with symptoms of acute ischaemic stroke within one week of onset. The diagnosis was confirmed by a brain CT scan, and patients with stroke mimics or haemorrhagic stroke were excluded from the study.

Sample Size and Sampling Technique

The sample size was determined based on the requirement of at least 10 events per predictor variable for developing a prognostic model.[14]Based on a previously reported 30-day mortality rate of 29.3% in acute ischaemic stroke patients from a similar setting,[15] we calculated that approximately 171 patients would be necessary to ensure adequate statistical power for the prognostic model development.

We employed a non-probability, purposive sampling technique through consecutive recruitment of all eligible patients who presented to the Accident and Emergency Department or were referred to the Neurology unit of UMTH during the study period. Eligible patients included adults aged 18 years and above presenting with symptoms of acute ischaemic stroke within seven days of onset and confirmed by brain CT scan. Patients with stroke mimics, haemorrhagic stroke, or previous stroke were excluded. The calculated sample size was achieved within the 12-month study period, from January 2023 to December 2023.

Data Collection and Clinical Assessment

At admission, all eligible patients underwent systematic evaluation using a standardised stroke proforma. This captured comprehensive data including demographics, medical history, symptom onset time, and clinical presentation. Initial neurological assessment included consciousness level evaluation using the Glasgow Coma Scale (GCS), with coma defined as GCS ≤8. Stroke severity was assessed using validated scales including the National Institutes of Health Stroke Scale (NIHSS), Modified Rankin Scale (mRS), and Barthel Index (BI). These assessments were performed at

admission, day 7, day 14, and day 30. For analytical purposes, stroke severity was dichotomised, with severe stroke defined as NIHSS>8, mRS>3, or BI <60, and less severe stroke as NIHSS ≤8, mRS 0-2, or BI ≥60.

Neuroimaging Protocol:

All patients underwent non-contrast brain computed tomography (CT) using a GE Brightspeed 16-slice scanner. The imaging protocol comprised axial sections parallel to the orbitomeatal line, with 2-4 mm sections for sellar and suprasellar regions, and 5 mm sections from the suprasellar region to the vertex. In accordance with established guidelines, contrast was not administered to patients presenting within 48 hours of symptom onset. CT scans were independently reviewed by a consultant radiologist and the primary investigator to assess stroke confirmation and type, infarct location and vascular territory. Infarct volume was calculated using the formula $0.5 \times A \times B \times C$, where A represents the largest diameter, B the largest perpendicular distance, and C the vertical diameter.

Follow-up and Outcome Assessment:

Patient management adhered to standardised institutional stroke care protocols throughout the study period. All patients were followed for 30 days post-admission or until death, whichever occurred first. Follow-up assessments were conducted through the neurology outpatient clinic for discharged patients, with telephone contact maintained with caregivers when needed to minimise loss to follow-up. The primary outcome measure was 30-day mortality, defined as death occurring between admission and day 30.

Data Analysis

All statistical analyses were performed using R software (version 4.3.0).[16] Continuous variables were tested for normality using the Shapiro-Wilk test and visual inspection of histograms. Data are presented as mean ± standard deviation for normally distributed variables and median (interquartile range) for non-normally distributed variables. Categorical variables are expressed as frequencies and percentages. Baseline characteristics were compared between survivors and non-survivors using the Wilcoxon rank-sum test for continuous variables, and chi-square or Fisher's exact tests for categorical variables, as appropriate. Univariate and multivariate logistic regression analyses were performed using the 'stats' package to identify neuroimaging predictors of 30-day mortality. Variables demonstrating significant associations ($p<0.05$) in univariate analysis were included in the multivariate model. Results are presented as odds ratios (OR) with 95% confidence intervals (CI).

Development of Risk Score

The neuroimaging-based risk score was developed utilising significant predictors from the multivariate analysis. Points were assigned based on β coefficients from the logistic regression model, with the total score ranging from 0 to 3. Patients were stratified into three risk categories (low, intermediate, and high) based on their total scores.

Model Performance

The discriminative ability of the risk score was assessed utilising ROC curve analysis with the 'pROC' package, generating area under the curve (AUC) values and 95% CI. Survival analysis was performed using the 'survival' package for generating Kaplan-Meier curves, with differences between risk groups evaluated using the log-rank test. The 'survminer' package was utilised for visualising survival curves and risk tables. Calibration was assessed by comparing predicted and observed

mortality rates across risk categories. For all analyses, a two-sided p-value <0.05 was considered statistically significant.

Ethical Considerations

This study was conducted after obtaining ethical approval from the Research and Ethics Committee of the University of Maiduguri Teaching Hospital (UMTH), Nigeria (approval number: UMTH/REC/612). Written informed consent was obtained from all eligible patients prior to their enrolment in the study. For patients who were unable to provide informed consent due to the severity of their stroke, consent was obtained from their next of kin or legal representative. Patient confidentiality was maintained throughout the study by using anonymised data for analysis. All study procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and adhered to Good Clinical Practice guidelines. The study protocol was designed and implemented with careful consideration of patient welfare and autonomy, ensuring minimal risk to participants whilst maximising potential benefits to stroke care and research.

Results

Sociodemographic and Baseline Characteristics

Among 171 patients with acute ischaemic stroke, there was a slight male predominance (54.4%). The age distribution showed that half of the patients (50.9%) were middle-aged (45-64 years), with notable sex differences in age distribution. Females showed a higher proportion of elderly patients (>64 years: 41.0% vs 23.7%), while males had more middle-aged presentations (62.4% vs 37.2%). Significant gender disparities were observed in socioeconomic characteristics. Males demonstrated substantially higher employment rates (66.7% vs 12.8%) and tertiary education attainment (34.4% vs 3.8%). Marital status showed marked differences, with 32.1% of females being separated compared to none of the males. Urban residence was predominant in both groups (approximately 70%) (Table 1).

Clinical Presentation and Risk Factors

Hypertension emerged as the most prevalent risk factor, present in 77.6% of survivors and 22.4% of non-survivors. Diabetes mellitus showed a significant association with mortality ($p=0.007$), with diabetic patients experiencing higher mortality rates (38.9%). The most common presenting complaint was sudden-onset limb weakness, though patients presenting with loss of consciousness demonstrated significantly higher mortality (52.9%, $p=0.014$). Previous TIA and stroke history showed no significant association with mortality (Table 2).

Neurological Features and Initial Severity

Initial neurological assessment revealed significant differences between survivors and non-survivors. Non-survivors presented with lower median Glasgow Coma Scale scores (10.0 vs 15.0, $p<0.001$) and higher stroke severity scores. The NIHSS scores were markedly elevated in non-survivors (median 25.0 vs 11.0, $p<0.001$), as were modified Rankin Scale scores (5.0 vs 4.0, $p<0.001$). Barthel Index ADL scores were significantly lower in non-survivors (10.0 vs 25.0, $p<0.001$). The presence of arterial wall thickness was significantly associated with mortality (33.3% vs 13.5%, $p=0.003$) (Table 3).

Neuroimaging Predictors of Mortality

Analysis of neuroimaging revealed several significant predictive features. Non-survivors demonstrated substantially larger infarct volumes (median 140,786 mm^3 vs 9,736 mm^3, $p<0.001$) and more frequently showed multiple territory involvement ($p<0.001$). Infarct location analysis showed varying mortality rates across different regions, with hemispheric infarcts being the most common and showing a 23.6% mortality rate. Internal capsule and brain stem infarcts showed better survival

rates, while cerebellar infarcts demonstrated poorer outcomes (Table 4). In multivariate analysis, after adjusting for confounders, large infarct volume (>100,000 mm³) emerged as the strongest independent predictor of mortality (adjusted OR 6.82, 95% CI 2.05-22.68, p=0.002). Multiple territory involvement also showed strong predictive value (adjusted OR 3.42, 95% CI 1.43-8.17, p=0.006). Hemispheric location, though significant in univariate analysis, did not maintain independent predictive value after adjustment (adjusted OR 0.39, 95% CI 0.09-1.66, p=0.202) (Table 5).

Development and Validation of Risk Stratification System

Based on the identified predictors, we developed a neuroimaging-based risk score incorporating two key components: infarct volume and territory involvement. Points were assigned based on regression coefficients: 0-2 points for infarct volume (small=0, medium=0, large=2) and 0-1 points for territory involvement (single=0, multiple=1), yielding a maximum possible score of 3 points. The risk score demonstrated good discriminative ability (AUC 0.775, 95% CI 0.689-0.860) for predicting 30-day mortality. Patients were stratified into three risk categories: low (0-1 points, n=85, 49.7%), intermediate (2 points, n=17, 9.9%), and high (3 points, n=69, 40.4%). The corresponding mortality rates showed a clear gradient: 8.2%, 11.8%, and 42.0%, respectively (p<0.001) (Table 6).

Survival analysis using Kaplan-Meier curves demonstrated significant differences in survival patterns across risk categories (log-rank test, p<0.001) (Figure 1). The high-risk group showed markedly reduced survival probability, with early separation of curves occurring within the first week. ROC curve analysis confirmed the robust predictive performance of the risk score (Figure 2), suggesting its potential utility in early prognostication and clinical decision-making for acute ischaemic stroke patients. This risk stratification system, based on readily available neuroimaging features, provides a practical tool for early mortality risk assessment, potentially facilitating more targeted management strategies and resource allocation in acute stroke care.

Table 1. Sociodemographic Characteristics by Sex Among Stroke Patients (N=171)

Characteristics	Female (n=78)	Male (n=93)	Total (N=171)
Age group			
<45 years	17 (21.8)	13 (14.0)	30 (17.5)
45-64 years	29 (37.2)	58 (62.4)	87 (50.9)
>64 years	32 (41.0)	22 (23.7)	54 (31.6)
Marital status			
Married	53 (67.9)	90 (96.8)	143 (83.6)
Separated	25 (32.1)	0 (0.0)	25 (14.6)
Single	0 (0.0)	3 (3.2)	3 (1.8)
Employment status			
Employed	10 (12.8)	62 (66.7)	72 (42.1)
Retired civil servant	3 (3.8)	12 (12.9)	15 (8.8)
Unemployed	65 (83.3)	19 (20.4)	84 (49.1)
Literacy level			
Non-formal	57 (73.1)	39 (41.9)	96 (56.1)
Primary	4 (5.1)	4 (4.3)	8 (4.7)
Secondary	14 (17.9)	18 (19.4)	32 (18.7)
Tertiary	3 (3.8)	32 (34.4)	35 (20.5)
Address			
Rural	24 (30.8)	28 (30.1)	52 (30.4)
Urban	54 (69.2)	65 (69.9)	119 (69.6)

Table 2. Clinical Characteristics of Stroke Patients by 30-day Mortality Status

Characteristics	Survivors (n=133)	Non-survivors (n=38)	P-value
Duration of illness to presentation, days†	2.59 ± 1.49	2.34 ± 1.48	0.359‡
Presenting Complaint, n (%)			0.014*
Weakness of limbs of sudden onset	85 (78.7)	23 (21.3)	
Weakness with expressive aphasia	37 (86.0)	6 (14.0)	
Weakness with global aphasia	3 (100.0)	0 (0.0)	
Weakness with LOC	8 (47.1)	9 (52.9)	
Medical History, n (%)			
Hypertension	118 (77.6)	34 (22.4)	1.000†
Diabetes mellitus	22 (61.1)	14 (38.9)	0.007§
Previous TIA	7 (70.0)	3 (30.0)	0.694†
Previous stroke	8 (80.0)	2 (20.0)	1.000†
Risk Factors, n (%)			
Cigarette smoking	20 (76.9)	6 (23.1)	1.000§
Alcohol use	6 (60.0)	4 (40.0)	0.232†
Obesity	4 (80.0)	1 (20.0)	1.000†

†Data presented as mean ± standard deviation; ‡Independent t-test; *Fisher-Freeman-Halton exact test; §Pearson's chi-square test; †Fisher's exact test; LOC = Loss of consciousness; TIA = Transient ischaemic attack.

Table 3. Clinical and Neurological Features at Presentation by Mortality Status

Clinical Features	Survivors (n=133)	Non-survivors (n=38)	P-value
Clinical Parameters			
Temperature, °C	36.7 (36.4-37.0)	37.0 (36.4-38.2)	0.006†
Waist circumference, cm	78.0 (69.0-84.0)	80.0 (76.0-84.0)	0.232†
Glasgow Coma Scale	15.0 (13.0-15.0)	10.0 (6.0-15.0)	<0.001†
Stroke Severity Scores			
Modified Rankin Scale	4.0 (4.0-4.0)	5.0 (4.0-5.0)	<0.001†
NIHSS	11.0 (9.0-14.0)	25.0 (15.0-30.0)	<0.001†
Barthel Index ADL	25.0 (15.0-50.0)	10.0 (0.0-20.0)	<0.001†
Arterial Wall Thickness, n (%)			0.003‡
Absent	83 (86.5)	13 (13.5)	
Present	50 (66.7)	25 (33.3)	
Neurological Deficits, n (%)			
Aphasia	39 (81.3)	9 (18.8)	0.546‡
Dysarthria	2 (66.7)	1 (33.3)	0.532*
Dysphagia	3 (60.0)	2 (40.0)	0.308*
Cranial nerve deficits	66 (77.6)	19 (22.4)	1.000‡

Cranial Nerve Affected, n (%)			0.909§
None	67 (77.9)	19 (22.1)	
7th cranial nerve	61 (77.2)	18 (22.8)	
6th cranial nerve	3 (100.0)	0 (0.0)	
6th and 7th cranial nerve	2 (66.7)	1 (33.3)	

*Fisher's exact test; †Mann-Whitney U test; ‡Pearson's chi-square test; §Fisher-Freeman-Halton exact test; NIHSS = National Institutes of Health Stroke Scale; ADL = Activities of Daily Living

Table 4. Neuroimaging Characteristics by Mortality Status

Imaging Features	**Survivors (n=133)**	**Non-survivors (n=38)**	**P-value**
Number of Areas Affected	1.0 (1.0-1.0)	1.5 (1.0-2.0)	<0.001†
Infarct Volume, mm³	9,736 (2,346-117,337)	140,786 (117,050-240,360)	<0.001†
Location of Infarct, n (%)			0.038*
Hemispheric	110 (76.4)	34 (23.6)	
Internal capsule	12 (100.0)	0 (0.0)	
Basal ganglia	5 (71.4)	2 (28.6)	
Brain stem	4 (100.0)	0 (0.0)	
Thalamus	2 (100.0)	0 (0.0)	
Cerebellum	0 (0.0)	2 (100.0)	

†Mann-Whitney U test; *Fisher-Freeman-Halton exact test

Table 5. Neuroimaging Predictors of Mortality: Unadjusted and Adjusted Analyses

Neuroimaging Features	**Unadjusted**			**Adjusted***		
	OR	95% CI	P-value	aOR	95% CI	P-value
Infarct Volume			<0.001			0.003
Small (<20,000 mm³)	1.0	Reference	-	1.0	Reference	-
Medium (20,000-100,000 mm³)	1.51	0.29-7.96	0.631	1.51	0.23-10.15	0.671
Large (>100,000 mm³)	8.39	3.38-20.85	<0.001	6.82	2.05-22.68	0.002
Number of Areas Affected	6.77	3.02-15.20	<0.001	3.42	1.43-8.17	0.006
Infarct Location						
Non-hemispheric	1.0	Reference	-	1.0	Reference	-
Hemispheric	1.78	0.58-5.50	0.318	0.39	0.09-1.66	0.202

*Adjusted for all other variables in the model; OR = Odds Ratio; CI = Confidence Interval

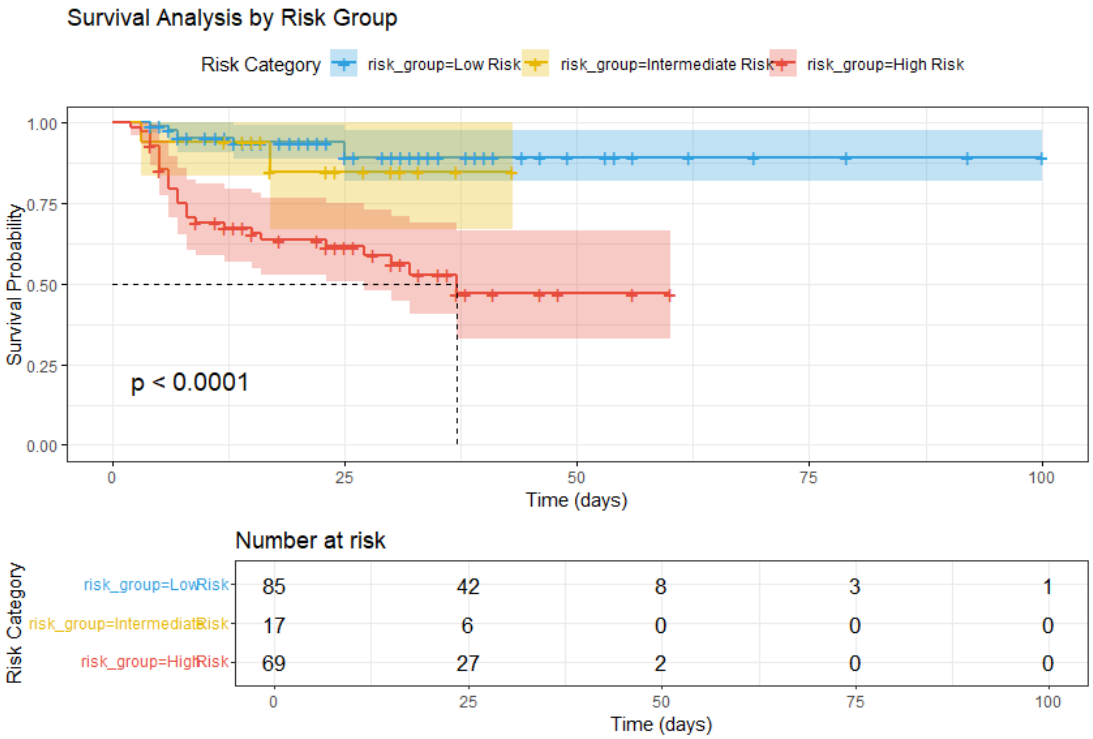

Figure 1. Kaplan-Meier Survival Curves Stratified by Neuroimaging Risk Score Categories: Log-rank test p < 0.001

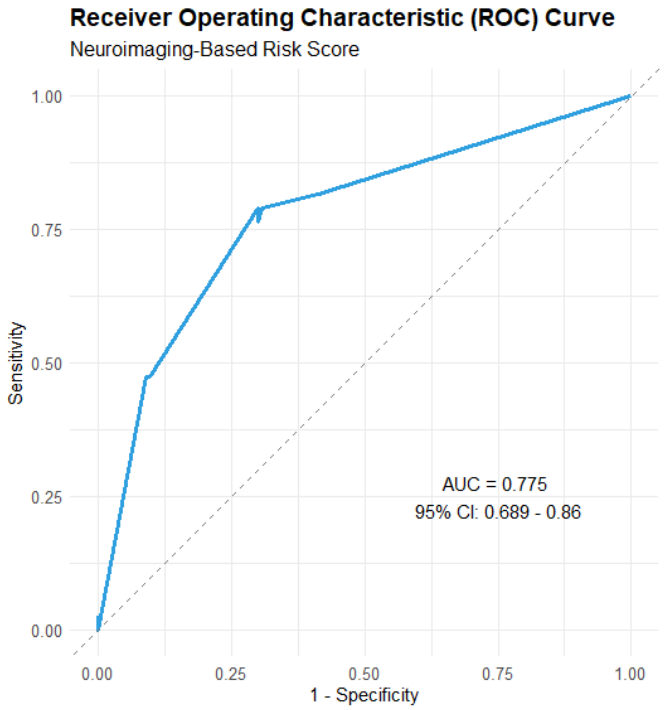

Figure 2. Receiver Operating Characteristic Curve for Neuroimaging-Based Risk Score in Predicting 30-day Mortality: AUC = 0.775 (95% CI: 0.689-0.860)

Table 6. Development of a Neuroimaging-Based Risk Score for 30-day Mortality in Acute Ischaemic Stroke

A. Score Components

Variable	Definition	β Coefficient	Points Assigned
Infarct Volume			
Small	Reference	-	0
Medium	20,000-100,000 mm³	0.061	0
Large	>100,000 mm³	1.584	2
Territory Involvement			
Single area	Reference	-	0
Multiple areas	≥2 areas	1.196	1

B. Risk Stratification Based on Total Score

Risk Category	Total Score	n (%)	Mortality Rate, %	P value*
Low	0-1	85 (49.7)	8.2	<0.001
Intermediate	2	17 (9.9)	11.8	
High	3	69 (40.4)	42.0	

*Fisher's Exact Test

Note: Total score ranges from 0-3 points, calculated as the sum of points from infarct volume (0-2) and territory involvement (0-1). Points were assigned based on β coefficients from multivariable logistic regression analysis.

Discussion

Our study provides significant insights into the prognostic value of neuroimaging findings in acute ischaemic stroke and introduces a novel risk stratification tool particularly relevant to the West African context. Most notably, infarct volume emerged as the strongest independent predictor of mortality, with non-survivors demonstrating substantially larger infarct volumes (median 140,786 mm³ vs 9,736 mm³, p<0.001). This relationship persisted after adjusting for confounders, with large infarct volumes (>100,000 mm³) showing the highest adjusted odds ratio (6.82, 95% CI 2.05-22.68, p=0.002). Multiple territory involvement proved to be another significant predictor (adjusted OR 3.42, 95% CI 1.43-8.17, p=0.006), suggesting that both size and distribution of infarcts contribute substantially to mortality risk.

The role of neuroimaging in acute stroke management has evolved significantly in recent years. Abdalkader et al. [17] demonstrate that neuroimaging plays a pivotal role not only in diagnosis but increasingly in prognosis and treatment decisions. Our findings align with this evolving understanding and particularly with Ospel et al.'s ESCAPE-NA1 trial results, which demonstrated a non-linear relationship between infarct volume and outcomes.[18]

The ESCAPE-NA1 trial showed excellent outcomes (83.3%) for small infarcts (<15mL), with progressively declining outcomes through intermediate volumes, culminating in consistently poor outcomes (12.3%) for large infarcts (>200mL).

Recent literature has established several fundamental aspects of stroke mortality and outcomes. The 2022 World Stroke Organization Global Fact Sheet [19] confirms stroke's position as the second-leading cause of death globally, with deaths increasing from 2.04 million in 1990 to 3.29 million in 2019, as noted by Fan et al. [20]. This global perspective is further refined by OECD data, which indicates approximately 8.0% of ischaemic stroke patients die within 30 days of hospital admission, though this rate shows marked variation across different healthcare systems and geographical regions.

Our risk stratification system, which uniquely incorporates both volume and territory involvement, achieved notable discriminative ability (AUC 0.775) for predicting 30-day mortality. These findings parallel recent work by Fan et al. [20], who found that moderate to severe white matter changes were associated with substantially increased odds of 90-day unfavourable outcomes and mortality. The system successfully stratified patients into three risk categories with clearly differentiated mortality rates: low risk (8.2%), intermediate risk (11.8%), and high risk (42.0%). The simplicity of our scoring system, while maintaining robust predictive capabilities, makes it particularly valuable in resource-limited settings.

Our findings regarding gender disparities in socioeconomic characteristics extend previous work in important ways. The marked differences observed in employment rates (12.8% vs 66.7%) and tertiary education attainment (3.8% vs 34.4%) between females and males suggest that social determinants may play a more substantial role in stroke outcomes than previously recognised. This observation builds upon a study on socioeconomic status and stroke outcomes, providing additional evidence for the need to consider social factors in stroke care.[21]

The methodological approach in our study builds upon previous work in predictive modelling. Mittal and Goel demonstrated the value of combining clinical and imaging parameters in mortality prediction [22], while Someeh et al. showed how advanced analytical approaches could enhance predictive accuracy.[23] Our focus on readily available neuroimaging parameters, while potentially missing some subtle predictive features, maintains clinical practicality while achieving robust predictive performance.

Several limitations warrant careful consideration. Unlike Fekadu et al.'s study [15], which tracked outcomes for 60 days, our focus was primarily on early mortality. While Khandare et al.'s work [24] suggests the utility of biomarkers like S100B and NSE in stroke assessment, our study did not incorporate biochemical markers. The single-centre design may limit generalisability across different healthcare settings and populations. Additionally, as noted in a study, the lack of adjustment for some baseline covariates could impact the precision of our risk estimates.[20]

The implications for clinical practice are substantial and multifaceted. The strong predictive value of infarct volume and territory involvement supports the need for rapid, comprehensive imaging in acute stroke. Our three-tier risk stratification system provides clinicians with a practical tool for the early identification of high-risk patients who may benefit from more intensive monitoring and intervention. The marked gender disparities in socioeconomic characteristics suggest the need for a broader consideration of social factors in stroke care, whilst the clear mortality gradient across risk categories can inform decisions about resource allocation and intensity of care.

Future research directions should focus on external validation of the risk stratification system in diverse populations and healthcare settings. Integration of biomarker data with imaging findings may provide additional predictive value. The potential integration of advanced imaging techniques and artificial intelligence approaches, as suggested by recent studies, could further enhance the predictive capabilities of our scoring system.[23]

In conclusion, our study provides robust evidence for the predictive value of combined infarct volume and territory assessment in acute ischaemic stroke mortality, particularly relevant for resource-limited settings. The findings align with and extend current literature on stroke outcomes, offering a practical tool for early risk stratification. The identification of significant socioeconomic disparities suggests the need for broader approaches to stroke care that address both biological and social determinants of outcomes. As stroke care continues to evolve, the integration of comprehensive prognostic tools with emerging biomarkers and imaging approaches will be crucial for optimising patient outcomes across various healthcare settings.

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