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Predictors of In-Hospital Mortality among Stroke Patients Admitted to the Neurology Department of the Sino-Central African Friendship University Hospital in Bangui, Central African Republic

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Abstract

Introduction: Stroke is a major public health concern due to its high frequency, mortality rate, and the resulting physical and cognitive disabilities. Numerous studies have reported particularly high stroke-related mortality rates in Sub-Saharan Africa. However, few studies have investigated stroke mortality and its associated factors in the Central African Republic. The objective of this study was to identify predictors of mortality among patients admitted for stroke. **Methods:** We conducted a retrospective study from December 31, 2021, to December 31, 2023, including patients hospitalized at the Sino-Central African Friendship Hospital. Sociodemographic characteristics, medical history, severity indicators associated with the neurological presentation, and vital outcomes were collected. Univariate and multivariable logistic regression analyses were performed to identify factors associated with mortality. **Results:** A total of 129 medical records of patients with stroke were reviewed. The study population consisted of 55.8% men, with a mean age of 59.8 years (95% CI: 57.5 - 62.2). The mean time from symptom onset to hospital admission was 7 days (95% CI: 5 - 9). The main reasons for hospitalization were headache (62%), sudden-onset unilateral motor deficit (58.1%), and language disorders (41%), followed by impaired consciousness and dizziness. The overall mortality rate was 12%. Hyperthermia ($p = 0.049$), language disorders ($p = 0.014$), and neurological deterioration ($p = 0.028$) were identified as independent predictors of mortality. **Conclusion**: Stroke-related in-hospital mortality remains high in

our study and across Africa in general. These findings highlight the need for healthcare authorities in our country to implement more effective stroke management strategies in order to improve patient survival.

Keywords

Stroke, Mortality, Predictive Factors, Prognosis, Bangui

1. Introduction

Stroke is a major medical emergency and a significant public health concern worldwide. Each year, approximately 15 million people experience a stroke, among whom nearly 5 million die and another 5 million are left with permanent disabilities [1]. In developing countries, stroke represents the second leading cause of death [2], and more than 80% of stroke-related deaths occur in these settings. The global burden of stroke is expected to increase substantially, with an estimated 23 million incident cases by 2030, of which developing countries are expected to account for a considerable proportion [3] [4].

Mortality varies according to stroke subtype, ranging from approximately 8% - 12% for ischemic stroke to 37% - 38% for hemorrhagic stroke [5]. Several factors influence stroke outcomes, including stroke severity, advanced age, associated comorbidities, and the effectiveness of complication management. In-hospital mortality rates range from 3% to 11% in high-income countries and from 7% to 15% in low- and middle-income countries [6]. In sub-Saharan Africa, mortality rates are substantially higher, ranging from 11% to 43.4%, which is three to four times higher than those reported in developed countries [7] [8].

In Bangui, stroke is the leading neurological cause of hospitalization and accounts for nearly two-thirds of neurological deaths. A previous study conducted in the Neurology Department of Bangui reported that stroke represented 8.8% of hospital admissions, with an in-hospital mortality rate of 33% [9]. Despite the considerable burden of stroke in the Central African Republic, data regarding factors associated with mortality remain scarce.

In a context characterized by limited healthcare resources, identifying factors associated with stroke mortality is essential for improving patient management and optimizing resource allocation. Understanding these predictors may facilitate early risk stratification and support the implementation of targeted interventions aimed at reducing mortality.

Therefore, the aim of this study was to identify independent predictors of in-hospital mortality among patients admitted for stroke to the Neurology Department of the Sino-Central African Friendship University Hospital in Bangui, Central African Republic.

Specifically, the objectives were:

- To describe the sociodemographic, clinical, and paraclinical characteristics of stroke patients;

- To determine the in-hospital mortality rate;
- To identify independent predictors of mortality among hospitalized stroke patients.

2. Methods

Study Design and Setting: We conducted a retrospective longitudinal analytical study in the Neurology Department of the Sino-Central African Friendship University Hospital (CHUASC) in Bangui, Central African Republic. This department is the country's main referral center for neurological diseases. The study covered a two-year period from January 1, 2022, to December 31, 2023.

Study Population: The study included adult patients admitted to the Neurology Department with a diagnosis of acute stroke during the study period. Both ischemic and hemorrhagic strokes were considered.

Inclusion Criteria: Patients were eligible if they met all of the following criteria:

- Age ≥ 18 years;
- Clinical diagnosis of stroke characterized by the sudden onset of a focal neurological deficit;
- Stroke confirmed by brain computed tomography (CT);
- Availability of complete medical records, including clinical, laboratory, and neuroimaging data.

Exclusion Criteria: Patients were excluded if:

- Their medical records were incomplete or unavailable;
- Neuroimaging findings did not confirm the diagnosis of stroke;
- Essential clinical or outcome data were missing.

Data Collection: Data were extracted from patients' medical records using a standardized data collection form. The following variables were collected:

Sociodemographic Characteristics: Age, Sex, Marital status, Educational level, Occupation, and Place of residence.

Medical History and Vascular Risk Factors: Hypertension, Diabetes mellitus, Previous stroke, Dyslipidemia, Cardiac disease, Family history of cardiovascular disease, Smoking status and Alcohol consumption. Definitions of vascular risk factors were based on internationally accepted criteria. Hypertension was defined as blood pressure ≥ 140/90 mmHg or current antihypertensive treatment. Diabetes mellitus was defined as a known history of diabetes, HbA1c ≥ 6.5%, or fasting blood glucose ≥ 2 g/L.

Clinical Variables: Clinical data collected at admission included:

- Time from symptom onset to hospital admission;
- Level of consciousness;
- Body temperature;
- Blood pressure;
- Neurological deficits;
- Language impairment;
- Seizures;

- Dysphagia;
- Neurological deterioration during hospitalization.

Paraclinical Investigations

The following investigations were reviewed when available: Complete blood count, Blood glucose, Renal function tests, Lipid profile, Coagulation profile, Brain CT findings, Carotid Doppler ultrasound and Transthoracic echocardiography. Stroke subtype was classified as ischemic or hemorrhagic according to CT findings.

Outcome Measure: The primary outcome was in-hospital mortality, defined as death occurring during hospitalization. Patients were categorized into two groups according to their status at discharge: survivors and non-survivors.

Statistical Analysis: Data were entered into Microsoft Excel 2013 and analyzed using Stata version 18 (StataCorp, College Station, TX, USA). Categorical variables were expressed as frequencies and percentages, whereas continuous variables were presented as means with standard deviations or medians with interquartile ranges, as appropriate. Associations between explanatory variables and mortality were assessed using Pearson's chi-square test or Fisher's exact test for categorical variables. Continuous variables were compared using Student's t-test.

Variables associated with mortality in univariate analysis and those considered clinically relevant were entered into a multivariable logistic regression model to identify independent predictors of mortality. Adjusted odds ratios (aORs) with their 95% confidence intervals (95% CIs) were calculated. A two-sided p-value < 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted in accordance with the ethical principles of biomedical research. Patient anonymity and confidentiality were strictly maintained throughout data collection and analysis. As this was a retrospective study based on routinely collected hospital data, no direct patient contact was required.

3. Results

3.1. Patient Characteristics

A total of 129 patients hospitalized for stroke during the study period were included in the analysis. Men accounted for 55.8% (n = 72) of the study population, yielding a male-to-female ratio of 1.26. The mean age was 59.8 years (95% CI: 57.5 - 62.2), with most patients aged over 60 years.

Most patients resided in Bangui (67.4%), while 32.6% were referred from other provinces. No significant association was found between mortality and age group ($p = 0.30$), sex ($p = 0.80$), educational level ($p = 0.30$), marital status ($p = 0.40$), occupation ($p = 0.60$), or place of residence ($p = 0.20$). See Table 1.

3.2. Clinical Presentation

The median delay between symptom onset and hospital admission was 7 days (in-

terquartile range: 5 - 9 days). The most frequent presenting symptoms were headache (62%), sudden-onset motor deficit involving one side of the body (58.1%), language impairment (41%), altered consciousness, and dizziness. Hypertension was the most common vascular risk factor, followed by diabetes mellitus and a family history of stroke. Ischemic stroke was the predominant subtype, accounting for 60.2% of cases.

Table 1. Association between sociodemographic characteristics and patient outcome.

Variables	Category	Vital Status			p-value
		Alive	Deceased	Total	
Age Group	<40 years	4	1	5	**0.3**
	40 - 49 years	23	0	23	
	50 - 60 years	35	6	41	
	>60 years	52	8	60	
Sex	Female	50	7	57	**0.8**
	Male	64	8	72	
Educational Level	None	15	0	15	**0.3**
	Primary	24	5	29	
	Secondary	43	7	50	
	Higher education	32	3	35	
Marital Status	single	47	5	52	**0.4**
	Married	40	4	44	
	Cohabiting	10	1	11	
	Divorced/Widowed	17	5	22	
Occupation	Unemployed	36	7	43	**0.6**
	Farmer/Artisan	9	1	10	
	Trader	20	3	23	
	Civil servant	49	4	53	
Residence	Bangui	79	8	87	**0.2**
	Other regions (Provinces)	35	7	42	

In-Hospital Mortality

Among the 129 patients included in the study, 15 died during hospitalization, resulting in an overall in-hospital mortality rate of 12%. See Table 2.

Hospital Complications Associated with Mortality

Several in-hospital complications were significantly associated with mortality.

Dysphagia was observed in 53 patients and was significantly associated with death ($p = 0.03$). Neurological deterioration occurred in 41 patients and showed a strong association with mortality ($p < 0.001$). Cardiac complications were also significantly associated with death ($p = 0.003$). Likewise, pulmonary complications

were more frequent among non-survivors and were significantly associated with mortality ($p < 0.001$).

No significant association was observed between urinary tract infection and mortality ($p = 0.50$).

Table 2. Association between in-hospital complications and patient outcome.

Variables	Category	Vital Status			p-value
		Alive	Deceased	Total	
Dysphagia	No	71	5	76	**0.03**
	Yes	43	10	53	
Neurological Deterioration	No	85	3	88	**0**
	Yes	29	12	41	
Cardiac Complications	No	87	6	93	**0.003**
	Yes	27	9	36	
Urinary Tract Infection	No	40	4	44	**0.5**
	Yes	74	11	85	
Pulmonary Complications	No	110	11	121	**0**
	Yes	4	4	8	

3.3. Multivariable Analysis of Mortality Predictors

Multivariable logistic regression analysis was performed to identify independent predictors of in-hospital mortality. The final model demonstrated excellent discriminative ability, with an area under the receiver operating characteristic (ROC) curve of 0.972. After adjustment for potential confounding factors, three variables remained independently associated with mortality:

- Hyperthermia (body temperature ≥ 38˚C) was associated with a markedly increased risk of death (adjusted OR = 90.44; 95% CI: 1.02 - 7986.28; p = 0.049);
- Language impairment was a strong independent predictor of mortality (adjusted OR = 125.53; 95% CI: 2.67 - 5907.38; p = 0.014);
- Neurological deterioration during hospitalization was the strongest predictor of death (adjusted OR = 178.86; 95% CI: 1.73 - 18499.55; p = 0.028).

Two additional variables showed borderline statistical significance:

- Admission more than 24 hours after symptom onset (adjusted OR = 40.38; 95% CI: 0.98 - 1661.99; p = 0.051);
- Family history of stroke (adjusted OR = 22.99; 95% CI: 0.91 - 581.44; p = 0.057).

No significant associations were observed for age, sex, level of consciousness, seizure occurrence, stroke subtype, dysphagia, cardiac complications, or pulmonary infection after adjustment in the multivariable model. Overall, delayed hospital admission, hyperthermia, language impairment, and neurological deterioration appeared to be the major determinants of mortality among stroke patients in this cohort.

4. Discussion

4.1. Study Limitations

This study has several limitations that should be acknowledged. First, its retrospective design exposed the analysis to missing data and potential information bias. Second, several medical records were incomplete or unavailable, which may have led to an underestimation of the actual number of stroke cases. Third, some potentially relevant clinical, radiological, and biological variables were not systematically documented and therefore could not be included in the analysis. Finally, this was a single-center study conducted in the national referral neurology department, which may limit the generalizability of the findings to the entire population of the Central African Republic. Despite these limitations, the study provides valuable insights into factors associated with stroke mortality in a resource-limited setting.

4.2. Sociodemographic Characteristics

Age and Sex: The mean age of patients in our study was 59.8 years. This finding is consistent with reports from Burkina Faso, Madagascar, and the Republic of Congo, where mean ages of 59.07, 60.53, and 62.70 years, respectively, have been reported [10]-[12]. In contrast, studies conducted in Europe reported substantially older populations, with mean ages of 73 years in France [13], 72.4 years in Geneva [14], and 71.9 years in Spain [15]. This younger age at stroke onset in African populations may be explained by the earlier exposure to modifiable vascular risk factors and lower life expectancy compared with high-income countries. Similarly, a comparative study demonstrated that stroke occurs approximately ten years earlier among Africans than among African Americans and European Americans [16].

A male predominance was observed in our cohort, with a sex ratio of 1.2. This finding is in agreement with several African studies reporting male predominance [17]-[19], although female predominance has also been described in Burkina Faso [10] and Côte d'Ivoire [20]. Such discrepancies may reflect differences in study populations, healthcare access, and sociocultural factors. Neither age ($p = 0.30$) nor sex ($p = 0.80$) was significantly associated with mortality in our study. Similar findings have been reported elsewhere. However, several studies have identified advanced age as a major predictor of stroke mortality, particularly among patients aged 60 years and older [21] [22]. The increased mortality observed among elderly patients is often attributed to the higher prevalence of comorbid conditions such as heart failure, atrial fibrillation, chronic kidney disease, and frailty.

Vascular Risk Factors: Hypertension (86.4%) and diabetes mellitus (38%) were the most prevalent vascular risk factors in our cohort. Hypertension remains the most important modifiable risk factor for stroke worldwide and has been consistently reported across African studies [23]-[25] as well as in high-income countries [26]. Although mortality appeared slightly higher among patients with hypertension, diabetes, or a history of previous stroke, these differences did not reach sta-

tistical significance. In contrast, Mananjo *et al.* reported hypertension (p = 0.01), smoking (p = 0.01), and previous stroke (p = 0.009) as significant predictors of acute stroke mortality [27]. The absence of a significant association in our study may be related to the relatively small sample size and limited statistical power.

In-Hospital Mortality: The overall in-hospital mortality rate was 12%, which is comparable to rates reported in Gabon (9.5%) [28] and Burkina Faso (12.5%) [29]. However, higher mortality rates have been documented in several African studies [9] [30]-[32]. These differences may be explained by variations in study design, patient characteristics, follow-up duration, and healthcare resources. In contrast, mortality rates reported in developed countries are substantially lower, ranging from 3.3% in Denmark to approximately 8% in Canada and the Netherlands [33]-[35].

The lower mortality observed in high-income countries is largely attributable to early admission to specialized stroke units, rapid neuroimaging, thrombolytic therapy, and comprehensive multidisciplinary care. In many African countries, including the Central African Republic, the absence of stroke units, delayed access to neuroimaging, and limited availability of reperfusion therapies continue to negatively affect patient outcomes.

Delay in Hospital Admission: In our study, nearly one-third of patients were admitted more than 24 hours after symptom onset. Delayed admission showed a strong trend toward association with mortality in multivariable analysis. Several factors may explain this delay, including poor recognition of stroke warning signs, initial recourse to traditional medicine, financial constraints, and delayed referral to specialized healthcare facilities. Similar findings have been reported in the Central African Republic by Mbellesso *et al.* [36] and in Senegal [37]. Delayed hospital presentation remains a major challenge in low-resource settings and significantly reduces opportunities for timely intervention and optimal management.

Altered Consciousness and Neurological Severity: Although no patient presented with a Glasgow Coma Scale score below 8, altered consciousness at admission was associated with increased mortality risk. Altered consciousness is widely recognized as a marker of severe brain injury and poor neurological status. Our findings are consistent with previous studies conducted in Africa [38] [39] and in developed countries [40]-[42], where impaired consciousness was associated with poor functional outcomes and increased mortality. Early identification of patients with severe neurological impairment is therefore essential for optimizing monitoring and supportive care.

Hyperthermia: Hyperthermia emerged as an independent predictor of mortality in our study. Similar observations have been reported by Mananjo *et al.* [27] and by Roy *et al.* in India [43]. Several mechanisms may explain this association. Fever increases cerebral metabolic demand and oxygen consumption in already compromised brain tissue, thereby exacerbating ischemic injury and promoting cerebral edema and hemorrhagic transformation [44]. Furthermore, hyperthermia may reflect underlying infectious complications, which themselves contribute to poor outcomes. Because fever represents a potentially modifiable factor, early

identification and aggressive management of hyperthermia should be considered an integral component of acute stroke care.

Hospital Complications: Dysphagia was common in our cohort and was significantly associated with mortality. Dysphagia increases the risk of aspiration pneumonia, which is a major determinant of poor outcomes after stroke. Smithard *et al.* demonstrated a significant relationship between swallowing disorders and pulmonary infections during the first week following cerebral infarction [45]. Likewise, Hilker *et al.* reported that aspiration pneumonia increased mortality threefold among stroke patients [46]. Previous studies have also shown that pneumonia accounts for nearly one-quarter of deaths occurring within the first month after stroke [47]. In addition to dysphagia, neurological deterioration, cardiac complications, and pulmonary diseases were strongly associated with mortality. These findings highlight the importance of early detection and management of in-hospital complications to improve survival outcomes among stroke patients. See **Table 3**.

Table 3. Independent factors associated with mortality: results of the final multivariable logistic regression model.

Variables	Categories	OR (95% CI)	p-value
Age Group	50 - 60 years	0.01 (0.00 - 6.28)	0.160
	>60 years	0.01 (0.00 - 3.98)	0.132
	40 - 49 years		
Sex	Male	0.56 (0.02 - 16.49)	0.738
	Female		
Family History	Yes	22.99 (0.91 - 581.44)	0.057
	No	—	—
Time to Admission	>24 hours	40.38 (0.98 – 1661.99)	0.051
	≤24 hours	—	—
Level of Consciousness	Altered	1.19 (0.03 - 44.99)	0.927
	Normal	—	—
Seizures	Yes	26.06 (0.00 - 2.64 × 10^7)	0.644
	No	—	—
Language Impairment	Oui	**125.53 (2.67 - 5907.38)**	**0.014**
	No	—	—
Body Temperature	≥38˚C	**90.44 (1.02 - 7986.28)**	**0.049**
	<38˚C	—	—
Lesion Territory	Hemorrhagic stroke	16.53 (0.37 - 740.11)	0.148
	Other	—	—
Etiology	Hypertension	0.13 (0.00 - 41.77)	0.492
	Other	—	—

Continued

Dysphagia	Yes	0.35 (0.03 - 3.84)	0.389
	No	—	—
Neurological Deterioration	Yes	**178.86 (1.73 - 18499.55)**	**0.028**
	No	—	—
Cardiac Complications	Yes	0.30 (0.02 - 5.47)	0.418
	No	—	—
Pulmonary Infection	Yes	0.43 (0.00 - 310.03)	0.802
	No	—	—

aOR: Adjusted Odds Ratio; CI: Confidence Interval; p-value: Level of significance.

5. Conclusions

Stroke remains a major cause of morbidity and mortality in the Central African Republic and throughout sub-Saharan Africa. In this study, the overall in-hospital mortality rate was 12%, highlighting the persistent burden of stroke in resource-limited settings. Hyperthermia, language impairment, and neurological deterioration during hospitalization were identified as independent predictors of mortality. These factors likely reflect severe neurological injury and underscore the importance of close clinical monitoring and early management of high-risk patients.

Although delayed hospital admission and a positive family history of stroke did not reach statistical significance in the final multivariable model, they showed a strong trend toward association with mortality and warrant further investigation in larger studies. Our findings emphasize the need to strengthen stroke care through earlier recognition of warning signs, rapid referral to specialized facilities, improved management of acute complications, and the development of dedicated stroke units. Such measures could contribute substantially to reducing stroke-related mortality and improving patient outcomes in the Central African Republic. In the future, multicenter studies involving larger populations are needed to validate these findings and to develop locally adapted prognostic models for stroke patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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