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Risk factors, clinical outcomes and predictors of stroke mortality in Sierra Leoneans: A retrospective hospital cohort study

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ABSTRACT

Background: Stroke data from Sierra Leone is limited, despite the increase in global burden of the disease. The aim of this study was to assess the risk factors, clinical outcomes and predictors of stroke mortality at a tertiary hospital in Freetown, Sierra Leone.

Methods: This retrospective cohort study was conducted on stroke patients admitted at the Connaught Teaching Hospital between 1st January to December 31, 2018. Clinical data related to stroke, with variables including patients' demographics, stroke subtype, vascular risk factors, modified Rankin Scale (mRS), and outcomes were documented. In-hospital mortality, associated risk factors and predictors of stroke were determined. The study was approved by the Sierra Leone Ethics and Scientific Review Committee. It was registered under Research Registry https://www.researchregistry.com/browse-the-registry#home/with the unique identifying number researchregistry6009.

Result: We studied 178 (95 male and 83 female) patients. The mean age was 59.8 ± 14.0 years, median was 58.1years (ranging: 29–88 years). The commonest risk factors were hypertension (84.3%), tobacco smoking (35.9%) and alcohol (31.4%). Ischemic stroke confirmed by CT scan was 76.3%. In-hospital mortality was 34.8% and at discharge, mean modified Rankin Score (mRS) was 3.89 ± 1.62. The independent predictors for stroke mortality were: hypertension [AOR = 2.2; C.I 95%: (1.32–3.80), p = 0.001], previous stroke [AOR = 2.31; C.I 95%: (1.43–5.74), p = 0.001], GCS < 8 [AOR = 6.06; C.I 95%: (3.17–12.79), p < 0.001], clinical diagnosis in the absence of imaging [AOR = 3.11; C.I 95%: (2.1–9.87), p = 0.001], hemorrhagic stroke [AOR = 2.96; C.I 95%: (1.96–9.54), p < 0.001], and aspiration pneumonia [(AOR = 3.03; C.I 95%:(1.44–6.36), p = 0.001]. Women had poorer outcome than men.

Conclusion: This study highlights a high stroke mortality in a resource limited hospital, with some stroke patients having difficulties in accessing Computer Tomogram (CT) scan services. It illustrates the need to establish a stroke care setting to improve the quality of stroke care.

1. Introduction

Stroke is a global health issue, representing one of the leading causes of morbidity, mortality and disability [1]. The global burden and clinical outcome of stroke is rapidly evolving, as developing countries are now having a greater burden of cardiovascular disease due to increased life expectancy [2]. This has modified the pattern of cause specific mortality of stroke, with a significant impact on the public health service [3–5]. Of all the documented global stroke-deaths, 80–86% are in low- and middle-income countries (LMIC) [6] and the cause is multifactorial. Poorly controlled blood pressure, partly related to the unavailability of hypertensive medications, lack of public awareness of stroke warning signs, and multiple risk factors of stroke are some of the causes [7].

In Africa, most of the conventional risk factors for stroke are hypertension, diabetes mellitus, smoking, sedentary life, sickle cell, alcohol abuse, antiretroviral drugs and race [5,6,8]. However, hypertension is reported in several studies in Sub-Saharan Africa (SSA) as the commonest identifiable risk factor in more than 80% of published reports [9–11]. Diabetes Mellitus is also a significant risk factor for stroke in SSA, and this can occur independently or together with hypertension

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[8,9,11]. In a community survey of hypertension in Sierra Leone, a high prevalence of hypertension was documented [12,13], hence one can hypothesize a high burden of stroke. In a recent stroke study by Lisk et al., hypertension [77.6%) and diabetes (29.6%) were the commonest risk factors for stroke patients, [14].

The mortality rate of stroke in LMIC is higher than industrial countries due to limited facilities like stroke units [15]. In-hospital stroke mortality ranged from 14.7% in Ethiopia to 41% in the Gambia [11,16]. In Sierra Leone, the Choithrams Stroke Registry (a private health facility) reported an in-hospital mortality of 10.6%, with a poorer stroke outcome in females (14). The last clinical study on hospital-stroke patients admitted at the Connaught Teaching Hospital was published over twenty years ago by Lisk, and this was conducted when there was no Computer Tomogram (CT) scan in Sierra Leone [17]. The in-hospital mortality in that study was 14.9%.

Although stroke has been reported as a leading cause of mortality and morbidity in Sierra Leone [14,17], there is no data regarding the predictor of mortality in stroke patients in this West African country. Hence, the aim of this study is to assess the risk factors, clinical outcomes and predictors of mortality in stroke patients admitted at the Connaught Teaching Hospital.

2. Methods

2.1. Ethics approval and registration

The study was written in accordance to the STROCSS statement guidelines [18]. The study was approved by the Sierra Leone Ethics and Scientific Review Committee. It was also registered under Research Registry with the unique identification number researchregistry6009, that is available at https://www.researchregistry.com/browse-the-registry#home/. Anonymity was maintained using serial coded numbers assigned to the case records and the extracted data was handled with strict confidentiality.

2.2. Study design, setting and cohort group

We conducted this retrospective cohort study on all stroke patients admitted at the Connaught Teaching Hospital between 1st January to December 31, 2018. It is the main public referral hospital in the capital city of Freetown, with an approximated population of 1 million people. The Department of Internal Medicine has 125 beds with an average of 200 new admissions per month. Most stroke patients admitted into the medical wards and intensive care unit were transferred from the emergency department. The only CT scan at the hospital is non-functional hence patients with strokes, who can afford the cost of a CT scan have to do it privately outside the hospital.

2.3. Intervention, patient recruitment and data collection

Hospital registers in each medical ward, Intensive Care Unit (ICU) and Resuscitation Unit were surveyed for the identification of patients with stroke. All medical case records of patients with possible stroke-related hospitalization were manually retrieved and inputted into a data extraction form, which has an advantage of reducing the likelihood of missed data and improving the standardization of medical information. All patients above 18 years, with first-in-lifetime or recurrent strokes were included.

The WHO definition of stroke was used to retain patients diagnosed with stroke and this was supplemented with the availability of a brain computerized tomography (CT). In the absence of a documented CT scan in any patient with a clinical diagnosis of stroke, the case was unlikely to be recruited if the following were present: recent weight loss (suggestive of malignancy or chronic infection), preceding fever (suggestive of abscess), neck rigidity (suggestive of Sub-arachnoid Hemorrhage).

The following variables were recorded: age, gender, marital status, occupation, subtype of stroke, assessment of functional status of stroke survivors by using the Modified Rankin Scale (mRS), admission systolic and diastolic blood pressure (BP) and level of consciousness on admission. The risk factors related to stroke were systematically extracted from patient's records: hypertension, diabetes mellitus, dyslipidaemia, cigarette smoking history, alcohol use, and history of cardiac disease. Stroke types were determined based on cranial CT scans performed within 10 days post-stroke.

2.4. Outcome

The primary outcome of the study was in-hospital stroke mortality or survival on discharge.

2.5. Statistical analysis

All data was analysed using STATA version 15.0. Both descriptive and inferential statistics were determined. Descriptive data were presented as mean ± standard deviation, median with percentile range and relative frequencies. The relationship between various socio-demographic and clinical variables with stroke was analysed with cross tabulation and Chi-square. Student's t-test analysis was used to determine the association between numeric variables and stroke.

Univariate regression analysis was done to identify risk factors associated with stroke, followed by an unconditional multivariate logistic regression analysis to determine the independent predictors of stroke mortality. Unadjusted and adjusted odds ratio (AOR) were developed with the corresponding 95% CI. All tests were two-tailed, with $P < 0.05$ taken as statistically significant.

3. Results

3.1. Socio-demographic characteristic of stroke patients and imaging

There were 1816 medical admission during the study period with stroke related admission accounting for 178 (9.8%). The mean age of patients was 59.8 ± 14.0 years, with an age ranging from 29 to 88 years. (Median = 58.1 years). There was no statistically significant difference in age by gender (male = 58.7 ± 14.2 vs female = 60.9 ± 13.7, p = 0.46). Table 1a showed that the peak age range was 50–59 years, accounting for 52 (29.2%). Stroke in the young (<40 years) contributed 7.3% of the cohort. There were more male than female (53.4% vs 46.6%) patients with a male to female ratio of 1.1:1.0. Employment and marital status are presented in Table 1a.

Of the 178-study population, only 114 (64.0%) confirmed their diagnosis by CT scan, while the rest were diagnosed clinically as these patients were either too sick for transfer to a private CT scan facility or could not afford the cost of doing a CT scan. According to CT scan findings, 87 (76.3%) patients were found to have infarction while 27 (23.7%) had haemorrhagic stroke.

3.2. Baseline clinical characteristics and vascular risk factor

The mean blood pressure was 170.3 ± 16.2 mmHg and 98.5 ± 11.2 mmHg, respectively for systolic and diastolic. In Table 1a, the mean blood pressures in female were higher than male patients without a statistical difference. Table 1b summarized the baseline clinical characteristics of 178 patients with stroke. Only 62.4% patients were admitted within the first 24 h after the onset of the symptoms, while 6.7% patients reported 7 days or more after symptom onset. Hypertension (84.3%) was the commonest risk factor in this study population. This was followed by tobacco smoking (35.9%), alcohol (31.4%), diabetes Mellitus (20.7%), previous stroke (20.2%) and atrial Fibrillation (6.1%).(see Table 1b)

Table 1a
Clinical and Socio-demographic of the stroke patients.

Variable	Total	Male	Female	P values
	n = 178 (100%)	n = 95 (100%)	N = 83 (100%)	
Mean age (±SD), years	59.8 ± 14.0	58.7 ± 14.2	60.9 ± 13.7	0.46
Systolic blood pressure, mmHg, mean	170.3 ± 16.2	161.1 ± 15.6	179.6 ± 16.8	**0.003**
Diastolic blood pressure, mmHg, mean	98.5 ± 11.2	93.5 ± 10.5	103.5 ± 11.8	**0.001**
Symptom onset to hospitalization (±SD), hours	48.0 ± 14.7	50 ± 15.8	46 ± 13.6	0.33
Age range, years				0.58
<40	13 (7.3)	10 (10.5)	3 (3.6)	
40 to 49	28 (15.7)	16 (16.8)	12 (14.5)	
50 to 59	52 (29.2)	31 (32.6)	21 (25.3)	
60 to 69	43 (24.2)	16 (16.8)	27 (32.5)	
70 to 79	23 (12.9)	9 (9.5)	14 (16.9)	
>80	19 (10.7)	13 (13.7)	6 (7.2)	
Marital status				0.63
Single	32 (18.0)	9 (9.5)	23 (27.7)	
Married	107 (60.1)	68 (71.6)	39 (47.0)	
Separated	21 (11.8)	13 (13.7)	8 (9.6)	
Widowed	18 (10.1)	5 (5.3)	13 (15.7)	
Employment status prior to stroke				**0.018**
Employed/Business	48 (27.0)	27 (29.5)	20	
Unemployed	89 (50.0)	52 (49.5)	37	
Retired	41 (23.0)	20 (21.0)	20	
Symptom onset to hospitalization				-
<24 h	111 (62.4)	57 (60.0)	54 (65.1)	
1.1–7 days	55 (30.9)	31 (32.6)	24 (28.9)	
>7	12 (6.7)	7 (7.4)	5 (6.0)	
GSC on hospital arrival				
Poor GCS (≤8)	24 (13.5)	8 (8.4)	16 (19.2)	**0.002**
Moderate GCS (9–12)	39 (21.9)	24 (25.3)	15 (18.1)	0.615
Good GCS (13–15)	117 (64.6)	63 (66.3)	52 (62.7)	0.250

Table 1b
Clinical and Socio-demographic of the stroke patients.

Variable	Total	Male	Female	P values
	n = 178 (100%)	n = 95 (100%)	N = 83 (100%)	
Risk factors				–
Hypertension	150 (84.3)	81 (85.2)	69 (83.1)	
Diabetes Mellitus	37 (20.7)	14 (14.7)	23 (27.7)	
Dyslipidaemia	32 (17.9)	11 (11.6)	21 (25.1)	
Tobacco smoking	64 (35.9)	40 (42.1)	24 (28.9)	
Alcohol use	56 (31.4)	38 (40.0)	16 (19.3)	
Atrial Fibrillation	11 (6.1)	8 (8.4)	3 (3.6)	
Previous stroke	36 (20.2)	23 (24.2)	13 (83.1)	
Stroke clinical features				-
Hemiplegia/Hemiparesis	157 (87.6)	87 (91.6)	69 (83.1)	
Cranial nerves deficit	37 (20.8)	26 (27.4)	11 (13.3)	
Headache	108 (60.7)	55 (57.9)	53 (63.9)	
Dizziness	38 (21.3)	18 (18.9)	20 (24.9)	
Alter conscious level	63 (35.4)	32 (33.7)	31 (37.3)	
Slurred speech	24 (13.4)	10 (10.5)	14 (16.9)	
Vomiting	15 (8.4)	6 (6.3)	9 (10.8)	
Convulsion	21 (11.8)	6 (6.3)	15 (18.1)	
Diagnosis of stroke				0.828
Imaging	114 (64.0)	63 (66.3)	51 (61.4)	
Clinically (no imaging)	64 (36.0)	32 (33.7)	32 (38.6)	
Stroke Classification - Imaging				**0.02**
Infarction	87 (76.3)	47 (74.6)	40 ((78.4)	
hemorrhage	27 (23.7)	16 (25.4)	11 (22.6)	
Stroke Type				–
Infarction	87 (48.8)	47 (49.5)	40 (48.2)	
hemorrhage	27 (15.2)	16 (16.8)	11 (13.3)	
Unknown (No Scan)	64 (36.0)	32 (33.7)	32 (38.6)	

3.3. Outcomes and discharge of stroke patients

Out of a total of 178 stroke patients admitted, 116 (65.2%) patients were discharged from the hospital, with a statistically significant gender variation (male: 65.3; vs female 50.6%; p = 0.003), in the 104 patients (58.4%) directly sent home. Discharge Against Medical Advice (DAMA) either by self or family request was documented in 2.8% patients while stroke patients transfer to another private hospital or health facilities was 3.9% (Table 2).

At discharge, the mean modified Rankin score (mRS) was 3.89 ± 1.62, with a statistical gender difference (male: 3.51 ± 1.31; female; 4.27 ± 1.93, P = 0.016). Sixty-seven (37.6%) patients had severe physical disability (mRS 4–5) while 19 (10.7%) had a mRS of 0–2. The mean duration of hospital stay for all patient was 10 days (IQR: 8–19). It was 11 days (IQR: 8 -19) for males and 9 days (IQR: 6 -18) for females. In-hospital duration of less than 2 days was documented in 19 (10.7%) patients, while 32 (18.0%) patients stayed in the hospital for more than 14 days.

3.4. In-hospital mortality and predictors of one mortality

Mortality rates were higher in the first week of admission, as 49 patients out of the total deaths of 62 patients (79.0%) died within the first week of admission. The cumulative case fatality rates were 10.1% within the first 48hrs, 27.5% at 7 days, and 34.8% was the overall in-hospital mortality. The mean age (58.4 ± 13.1 years) of stroke survivors, was statistically different from the mean age (61.2 ± 14.8 years) of stroke deaths (p = 0.013). In Table 3, the mean blood pressure among stroke survivors differed from stroke deaths, with a statistical difference in the subgroup. Table 3 also illustrated more stroke deaths among patients whose stroke diagnosis was based on clinical grounds without imaging (see Table 3).

Mortality rates differed by vascular risk factor, with more deaths reported among the subgroup of hypertensives, diabetic and previous stroke (Table 3). Patients who died from stroke had very low Glasgow Coma score at the time of admission and those who survived also had complications related to stroke during the period of hospitalization. (Table 3). More than half (67/116) of the surviving stroke patients had severe disability (mRS: 4–5) at the time of discharge.

Univariate and multivariate logistic regression were conducted to analyze the predictors of in-hospital mortality. Using the univariate analysis, age group [(COR = 0.96; C.I 95%: (0.02–0.70), p = 0.002], hypertension [(COR = 2.65; C.I 95%: (1.57–4.48), p = 0.0003], diabetes mellitus [(COR = 1.41; C.I 95%: (0.73–2.70), p = 0.0001], GCS < 8 on admission [(COR = 0.25; C.I 95%: (0.13–0.48), p < 0.001], previous stroke [(COR = 2.29; C.I 95%: (1.01–5.20), p < 0.001], stroke type [(COR = 3.05; C.I 95%: (1.27–7.31), p = 0.005], aspiration pneumonia [(COR = 2.01; C.I 95%: (1.96–7.94), p = 0.001], and seizure [COR = 1.02; C.I 95%: (1.43–7.94), p = 0.03], were associated with stroke mortality.

Subsequent multivariate analysis and logistic regression modelling revealed that; hypertension [(AOR = 2.2; C.I 95%: (1.32–3.80), p = 0.001], previous stroke [(AOR = 2.31; C.I 95%: (1.43–5.74), p = 0.001], GCS < 8 [(AOR = 6.06; C.I 95%: (3.17–12.79), p < 0.001], clinical diagnosis in the absence of imaging [(AOR = 3.11; C.I 95%: (2.1–9.87), p = 0.001], hemorrhagic stroke [(AOR = 2.96; C.I 95%: (1.96–9.54), p < 0.001], and aspiration pneumonia [(AOR = 3.03; C.I 95%: (1.44–6.36), p = 0.001], were independent predictors of stroke mortality (Table 4).

Table 2
Outcomes and discharge of stroke patients.

Conditions during discharge	Total patients n = 178 (100%)	Male n = 95 (100%)	Female N = 83 (100%)	P values
Home discharge	104 (58.4)	62 (65.3)	42 (50.6)	**0.003**
Referred to another hospital	7 (3.9)	2 (2.1)	5 (6.0)	0.460
DAMA on self or family request	5 (2.8)	3 (3.2)	2 (2.4)	0.460
In-hospital death	62 (34.8)	24 (25.3)	38 (45.8)	**0.013**
GSC at discharge (Alive patients)	**n = 116 (%)**	**n = 67 (%)**	**n = 49 (%)**	
Poor GCS (≤8)	3 (2.6%)	1 (1.5)	2 (4.1)	0.350
Moderate GCS (9–12)	9 (7.8%)	3 (4.5)	6 (12.2)	0.615
Good GCS (13–15)	104 (89.7%)	63 (94.0)	41 (83.7)	0.250
mRS at discharge (@ 30days)				
mRS (mean ± SD)	3.89 ± 1.62	3.51 ± 1.31	4.27 ± 1.93	**0.016**
mRS: 0–2 (mild disability)	19 (10.7)	11 (11.6)	8 (9.6)	–
mRS: 3 (moderate disability)	30 (16.9)	23 (24.2)	7 (8.4)	0.203
mRS: 4–5 (severe disability)	67 (37.6)	37 (38.9)	30 (36.1)	0.367
mRS: 6 (death)	62 (34.8)	24 (25.3)	38 (45.8)	**0.012**
Length of hospital stay (days)				
Median (IQR: Q1 -Q3)	10 (8–19)	11 [8–19]	9 (6–18)	–
<2days	19 (10.7)	6 (6.3)	13 (21.7)	0.145
2.01–7 days	68 (38.2)	42 (44.2)	26 (31.3)	0.130
7.01–14 days	59 (33.1)	29 (30.5)	30 (36.1)	0.117
>14 days	32 (18.0)	18 (18.9)	14 (16.9)	0.260
Case fatality of stroke patients	**Cumulative deaths/case fatality %**	**Cumulative death/case fatality %**	**Cumulative deaths/case fatality %**	–
<2days	18 (10.1)	8 (8.4)	10 (12.0)	
2.01–7 days	49 (27.5)	20 (21.1)	29 (34.9)	
7.01–14 days	57 (32.0)	23 (24.2)	34 (41.0)	
>14 days	62 (34.8)	24 (25.3)	38 (45.8)	
In-hospitality weekly death	**Weekly death n = 62 (%)**	**Weekly death n = 24 (%)**	**Weekly death n = 38 (%)**	–
1st week	49 (79.0)	20 (83.3%)	29 (76.3)	
2nd week	8 (12.9)	3 (12.5)	5 (13.2)	
3rd & 4th week	5 (8.1)	1 (4.1)	4 (10.5)	
Complications				-
Chest infection/ Aspiration	46 (18.0)	20 (21.1)	26 (31.3)	
Bedsores	13 (7.3)	9 (9.5)	4 (4.8)	
Seizures	22 (12.4)	10 (10.5)	22 (26.5)	
Urinary tract infection	37 (20.8)	21 (22.1)	16 (19.3)	

4. Discussion

This is the first reported stroke study in the CT scan era conducted at the Connaught Teaching Hospital in Sierra Leone. Stroke accounted for 9.8% of the total admissions in our medical department and it is higher than the Gambian stroke study (5%), Southwestern Nigeria (4.5%) but lower than the Jimma, Ethiopia stroke study of 16.5% [19–21]. The high stroke admission rate in Sierra Leone compared to other West African countries, might be related to the lack of stroke awareness, poor vascular risk factors control and high hypertension prevalence in Sierra Leone [12,13].

Table 3
Characteristics of stroke patients according to in-hospital mortality.

Variable	Total n = 178 (100%)	Alive n = 116 (%)	Died N = 62 (%)	P values
Mean age (±SD), years	59.8 ± 14.0	58.4 ± 13.1	61.2 ± 14.8	**0.0013**
Systolic blood pressure, mmHg, mean	170.35 ± 16.2	161.1 ± 15.6	179.6 ± 16.8	**0.003**
Diastolic blood pressure, mmHg, mean	98.5 ± 11.2	93.5 ± 10.5	103.5 ± 11.8	**0.001**
Modified Rankin score at discharge, mean	4.20 ± 1.63	3.61 ± 1.36	4.78 ± 1.89	**<0.001**
Age range, years				0.58
<40	13 (7.3)	10 (8.6)	3 (4.8)	
40 to 49	28 (15.7)	23 (19.8)	5 (8.1)	
50 to 59	52 (29.2)	41 (35.3)	11 (17.4)	
60 to 69	43 (24.2)	30 (25.9)	13 (21.0)	
70 to 79	23 (12.9)	7 (6.1)	16 (25.8)	
>80	19 (10.7)	5 (4.3)	14 (22.6)	
Marital status				0.63
Single	32 (18.0)	22 (19.0)	10 (16.1)	
Married	107 (60.1)	74 (63.8)	33 (53.2)	
Separated	21 (11.8)	15 (12.9)	6 (9.6)	
Widowed	18 (10.1)	5 (4.3)	13 (20.9)	
Employment status prior to stroke				**0.018**
Employed/Business	48 (27.0)	36 (31.0)	12 (19.4)	
Unemployed	89 (50.0)	69 (59.5)	20 (32.3)	
Retired	41 (23.0)	11 (9.5)	30 (48.4)	
GSC on hospital arrival	**n = 178 (%)**	**n = 116 (%)**	**n = 62 (%)**	
Poor GCS (≤8)	24 (13.5)	7 (6.0)	17 (27.4)	**0.0011**
Moderate GCS (9–12)	37 (21.9)	11 (9.5)	26 (41.9)	0.615
Good GCS (13–15)	117 (64.6)	98 (84.5)	19 (30.7)	0.250
Diagnosis of stroke	**n =178 (100%)**	**n = 116 (100%)**	**N= 62 (100%)**	0.828
Imaging	114 (64.0)	89 (76.7)	25 (40.3)	
Clinically diagnosis (no scan)	64 (36.0)	27 (23.3)	37 (59.7)	
Stroke Classification - Imaging	**n = 114 (100%)**	**n = 89 (100%)**	**N= 25 (100%)**	**0.02**
Infarction	87 (76.3)	83 (93.3)	4 (16.0)	
Hemorrhage	27 (23.7)	6 (6.74)	21 (84.0)	
Stroke Type				
Infarction	87 (48.8)	83 (71.6)	4 (6.5)	–
hemorrhage	27 (15.2)	6 (5.2)	21 (33.9)	
Unknown (CT Scan not done)	64 (36.0)	27 (23.2)	37 (59.7)	
Vascular risk factors	**n =178 (100%)**	**n = 116 (100%)**	**N= 62 (100%)**	-
Hypertension	150 (84.3)	103 (88.8)	47 (75.8)	
Diabetes Mellitus	37 (20.7)	9 (7.8)	28 (45.2)	
Dyslipidaemia	32 (17.9)	26 (22.4)	38 (61.3)	
Alcohol use	64 (35.9)	26 (22.4)	38 (61.3)	
Tobacco smoking	56 (31.4)	38 (40.0)	16 (19.3)	
Atrial Fibrillation	10 (34.5)	7 (11.3)	3 (3.6)	
Previous stroke	36 (20.2)	8 (6.9)	28 (45.2)	
Complications				–
Chest infection/Aspiration	46 (18.0)	17 (14.7)	29 (46.7)	
Bedsores	13 (7.3)	8 (6.9)	5 (8.1)	
Seizures	22 (12.4)	13 (11.2)	9 (14.5)	
Urinary tract infection	37 (20.8)	21 (18.1)	16 (25.8)	

Table 4
Predictors of in-hospital mortality in patients.

Variables		Stroke		Univariate OR		Multivariate OR	
		Alive n = 116%	Dead N = 62%	COR (95% CI)	p-value	AOR (95% CI)	p-value
Sex	Male	67 (57.8)	24 (38.7)	ref		ref	
	Female	49 (42.2)	38 (61.3)	1.44 [1.18–2.65]	0.33	[1.15–1.73]	0.88
Age group (years)	<40	10 (8.6)	3 (4.8)	ref		ref	
	40 to 49	23 (19.8)	5 (8.1)	0.43 [0.23–0.79]	**0.006**	2.72 [0.03–228]	0.658
	50 to 59	41 (35.3)	11 (17.4)	0.19 [0.09–0.42]	**<0.0001**	0.35 [0.01–12.7]	0.570
	60 to 69	30 (25.9)	13 (21.0)	0.01 [0.01->20]	0.076	–	–
	70 to 79	7 (6.1)	16 (25.8)	0.96 (0.02–0.70]	**0.002**	1.35 [0.01–12.7]	**0.0012**
	>80	5 (4.3)	14 (22.6)	0.43 [0.04–0.60)	**<0.0001**	2.92 [0.03–228]	**0.0001**
Marital status	Single	22 (19.0)	10 (16.1)	ref		ref	
	Married	74 (63.8)	33 (53.2)	0.34 [0.20–0.59]	**<0.001**	0.70 [0.06–8.48]	0.780
	Separated	15 (12.9)	6 (9.6)	1.50 [0.15–15.00]	0.730	–	–
	Widowed	5 (4.3)	13 (20.9)	0.01 [0.01->20]	0.999	–	–
Hypertension	No	13 (11.2)	15 (24.2)	ref		ref	
	Yes	103 (88.8)	47 (75.8)	2.15 [1.57–4.48]	**0.0003**	2.2 [1.32–3.80]	**0.001**
Diabetes Mellitus	No	107 (92.4)	34 (54.8)	ref		ref	
	Yes	9 (7.8)	28 (45.2)	1.41 [0.73–2.70]	**0.01**	0.39 [0.02–9.59]	0.65
Dyslipidemia	No	105 (90.5)	41 (66.1)	ref		–	–
	Yes	11 (9.4)	21 (33.7)	0.83 [0.42–1.65]	0.60	–	–
Alcohol use	No	90 (77.6)	24 (38.7)	ref		–	–
	Yes	26 (22.4)	38 (61.3)	0.31 [0.16–0.60]	0.89	–	–
Tobacco smoking	No	37 (31.9)	19 (30.6)	ref		ref	
	Yes	79 (68.1)	43 (69.4)	0.39 [0.20–0.77]	**0.007**	0.7 [0.23 ->20]	0.56
Atrial Fibrillation	No	112 (96.6)	55 (88.7)	ref		–	–
	Yes	4 (34.5)	7 (11.3)	1.50 [0.15–15.00]	0.730	–	–
Previous stroke	No	108 (93.1)	34 (54.8)	ref		ref	
	Yes	8 (6.9)	28 (45.2)	2.29 [1.01–5.20]	**<0.001**	2.31 [1.43–5.74]	**0.001**
GCS ≤8 on admission (Coma)	No	112 (96.6)	42 (67.7)	Ref		Ref	
	Yes	4 (3.4)	20 (32.3)	3.2 [1.3–4.8]	**<0.001**	6.06 [3.17–12.79]	**< 0.001**
Urine infection	No	95 (81.9)	46 (74.2)	Ref		Ref	
	Yes	21 (18.1)	16 (25.8)	1.27 [1.07–1.50]	**0.05**	0.36 [0.17–0.79]	0.18
Stroke diagnosis	Imaging	89 (76.7)	25 (40.3)	Ref		Ref	
	Clinical	27 (23.2)	37 (59.7)	2.2 [3.11–7.18]	**<0.001**	3.11 [2.1–9.87]	**< 0.001**
Type of the stroke	Infarction	83 (71.6)	4 (6.5)	ref		ref	
	Hemorrhage	6 (5.2)	21 (33.9)	3.05 [1.27–7.31]	**0.005**	2.96 [1.96–9.54]	**< 0.001**
	Undetermined	27 (23.2)	37 (59.7)	3.50 [1.60–7.72]	**0.03**	3.13 [1.3–6.1]	**0.001**
Swallowing difficulty	No	89 (76.7)	51 (82.3)	ref			
	Yes	27 (23.3)	11 (17.4)	0.80 [0.49–1.33]	0.393	–	–
Aspiration pneumonia	No	99 (85.3)	33 (53.2)	ref		ref	
	Yes	17 (14.7)	29 (46.7)	2.01 [1.96–7.94]	**0.001**	3.03 [1.44–6.36]	**0.001**
Seizure	No	103 (88.8)	53 (85.5)	ref		ref	
	Yes	13 (11.2)	9 (14.5)	1.02 [1.43–7.94]	**0.03**	1.12 [1.01–5.04]	0.18

Although not statistically significant, the study showed that more male patients were affected by strokes than female patients and this is similar to other studies in different settings [14,23]. The preponderance of male stroke patients might be attributed to risk factors such as cigarette smoking, and alcohol consumption, which are more common among men in Sierra Leone compared to women [13]. However other stroke studies in the subregion have demonstrated female preponderance [24,25].

The mean age of 59.8 ± 14.0 years in this study, was slightly lower than the mean age of 62.9 years reported by Lisk et al. in Sierra Leone [14] but in accordance with other underdeveloped countries stroke studies reporting the mean age range of 50–65 years [19,20,22,24]. In Africa, stroke occurs at an earlier age in comparison to industrialized countries because most reported stroke studies in Africa are hospital-based with age selection bias [4,5,26]. Hence community-based studies are needed to clearly establish the age distribution of stroke in our country.

About three-quarter (76.3%) of patients whose stroke was confirmed by CT scan had ischemic strokes while 23.7% patients had haemorrhagic strokes. This is consistent with other similar studies reporting more ischemic strokes than hemorrhagic stroke [4,12,14,20,23]. The SIREN study reported hemorrhage as the most common subgroup of stroke among young West Africans below the age of 50 years, while in other African studies, irrespective of age, hemorrhage was the most common

subgroup reported [22,27,28]. The geographical disparity in the frequency of stroke subtype might be due to age distribution of the population, risk factor profiling, study design, study setting, admission policy and diagnostic accuracy between different populations.

Hypertension (84.3%) was the most common risk factor documented in this study and is within the range of 82.5%–91.7%, reported by most African stroke studies [11,14,22,27–30]. The SIREN and INTERSTROKE studies suggested that hypertension is the major risk factor for stroke especially in low-income countries [28,31]. Tobacco smoking was the second common risk factor in our study. Since these risk factors were easily detected in our study, antihypertensive management and strategies for stopping smoking should be implemented. Atrial fibrillation as a risk factor was very low in our study, and this might be attributed to the limited access to electrocardiography at the time of admission. Limited access to ECG is not unique to this study as it was also reported in Malawi and Madagascar [32,33].

Ten days was the median length of in-hospital stay and was similar to the 9.21 days reported by Fekadu et al. [27]. However, longer in-hospitals stay ranging between 12 and 19 days have been reported in Africa [19,24,29,34,35]. The shorter length of hospital stay in our study, could be attributed to the high in-hospital mortality documented within the first week of admission (79% of the total deaths) and Discharge-Against-Medical-Advice (DAMA).

The most common complications documented were chest infection, aspiration pneumonia and urinary tract infections, with bed-sore reported amongst in-patients staying longer than 2 weeks. Infections and bedsores are frequent complications of immobile stroke patients and both are preventable [36,37]. In a resource poor nation like Sierra Leone, emphasis should be placed on preventable measures like swallowing assessment before oral feeds, using pressure mattresses to protect bony areas, regular positioning of the patient and avoiding indwelling urinary catheters if possible.

Most stroke survivors in this study had severe disability (mRS 4–5) at the time of discharge, which is similar to findings reported from other African countries [11,16,34]. The severe disability in stroke patients at the time of discharge could be attributed to the lack of adequate stroke rehabilitation services and management in LMIC.

The in-hospital mortality was 34.8%. This was comparable to the 33.3% reported by Damasceno et al. in Mozambique [38] and the 30% reported by Stenumgård et al. in Madagascar [34]. Stroke mortality rates higher than this study have been reported by Walker et al. in Gambia 57%, Atadzhanov et al. in Zambia 40% and Agyemang et al. in Ghana 43% [19,39,40]. The Sierra Leone Choithrams Hospital Stroke Registry reported a much lower stroke mortality rate of 10.3% in comparison to this study, even though a higher mortality in hemorrhagic strokes was reported by the registry [14]. However, lower stroke mortality rates have been documented in Nigeria (23.8%), Kenya (5%) and Ethiopia (12.0%) [7,30,41]. Stroke mortality rates varied across several African studies, reflecting the differences in access to quality healthcare systems, absence of national health insurance schemes, lack of trained medical workforce, lack of diagnostic imaging, inappropriate treatment and absence of in-hospitals stroke units.

Mortality rates in the hemorrhagic subgroup was significantly higher than ischemic stroke, and this finding is similar to other studies reported in Africa [11,14,39,42]. Women had poor stroke outcome than males in this study ($p = 0.013$). This finding is similar to the Sierra Leone Choithrams Stroke Registry and other African studies [14,33,43].

The high stroke mortality (79.0%) documented within the first week of admission in our study, is higher than the 62.1% stroke deaths within the first week of admission in Ashante, Ghana [44]. In Singapore, Ong et al. reported half of the total stroke deaths occurring during the first week of admission [45]. The early deaths within the first week of stroke onset could be attributed to the direct effects of neurological damage [46]. However, in countries where there are established and well-organized stroke services, there is a significant reduction in stroke mortality and morbidity [1,2,46].

Age, hypertension, diabetes mellitus, GCS <8 on admission, previous stroke, stroke subgroup, aspiration pneumonia and seizures were associated with stroke mortality outcomes and these findings in our study were consistent with other studies [7,9,23,24]. The independent predictors of mortality in our study were hypertension, previous stroke, GCS <8, clinical diagnosis in the absence of brain imaging, hemorrhagic stroke, and aspiration pneumonia. Depressed level of consciousness (GCS<8) was the single most powerful independent predictor of stroke mortality in this study, as these patients were 6 times more likely to die from stroke than patients with GCS > 8. Patients with hemorrhagic stroke, aspiration pneumonia, and stroke diagnosed without brain imaging were 3 times more likely to die from stroke in this study. Similar results have been reported in other studies [47–52]. Those patients whose diagnosis were made clinically without brain imaging (no CT scan) had higher mortality because they were sicker or more likely to come from a poorer socio-economic background. Consequently, these patients cannot afford CT scan and probably other medications and support required for an adequate stroke management.

4.1. Strengths and limitations

As a hospital-based and single-center study it has some limitation because it does not reflect the true picture of stroke as patients with critically acute stroke may die before hospitalization while relatively mild strokes may not present to the hospital. It is also associated with referral bias and may not reflect the true burden and outcome of stroke in our community. The small sample size and absence of CT scan diagnosis in one-third of the patients may present another limitation to our findings. Despite these limitations, we believe that our assessments of the risk factors, clinical outcomes and predictors of mortality in stroke patients admitted at the Connaught Teaching Hospital are valid.

5. Conclusion

The findings of this study provide evidence of the stroke burden and outcomes that is similar to other low- and middle-income countries. It highlights a high stroke mortality, with majority of the deaths occurring in the first week. These deaths were disproportionately from hemorrhagic stroke while stroke survivors had high disability on discharge. The most powerful independent predictor for death was depressed conscious level. Strokes occurred more frequently in men than in women but with a more unfavorable outcome in females. The major known risk factors were high blood pressure and smoking.

Access to evidence-based standards of stroke care was limited by lack of local resources, as some stroke patients had difficulties accessing CT services, thereby resulting in poor outcomes as a result of the inability to differentiate hemorrhagic from ischemic stroke. To provide effective and efficient services to stroke patients, health policy makers should make available all requisite diagnostic tools to facilitate appropriate intervention and to make sure that health professionals working with stroke patients are trained. This study has illustrated the need for further research, to explore reasons for inadequacies in the health system in Sierra Leone and the need of establishing a stroke care setting for the adoption of improved quality stroke care strategies.

Consent for publication

Not applicable.

Ethical approval

The study was approved by the Sierra Leone Ethics and Scientific Review Committee.

Source of funding

None.

Author's contributions

JBWR, EC and VYC contributed to the concept of the study design, drafting of the manuscript, analysis and interpretation of data. DRL reviewed all stages of the drafted manuscript for important intellectual content. All authors approved the final version of the manuscript.

Registration of research studies

This study has been registered under the unique identifying number researchregistry6009 and is available at https://www.researchregistry.com/browse-the-registry#home/

Guarantor

James Baligeh Walter Russell.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.amsu.2020.10.060.

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