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Research Article

Determinants of Stroke and Its Severity in A Rural Teaching Hospital in Southern Nigeria

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Abstract

Background: There is a paucity of information on the determinants of stroke and severity among indigenous Africans, which is largely preventable. Knowledge of its determinants and severity would influence practice, prevention and better health seeking behaviours. Unfortunately, its awareness is poor among Nigerians at increased risk especially in rural areas.
Method: This was a hospital-based cross sectional study of 152 stroke patients consecutively recruited at the Family Medicine clinics and medical wards of Irrua Specialist Teaching Hospital between March, 2022 and January, 2023. Stroke was diagnosed clinically based on the WHO criteria and its clinical presentation was obtained from medical history and clinical investigations. Stroke severity was determined using the National Institute of Health Stroke Scale (NIHSS). Data was entered into Epi version 3.1 and analysed using SPSS version 20.0.
Results: The patients were all black Africans with a mean age of (66.05±10.43) years with a Male:Female ratio of 1.5:1. Hypertension (91.4%) was the commonest modifiable determinant followed by obesity (64.5%), diabetes mellitus (DM) (48.7%), alcohol consumption (35.5%), dyslipidaemia (21.7%) and cigarette smoking (17.8%). Hemiparesis (100%) was the commonest clinical presentation, followed by dysarthria (77.6%), sudden facial weakness (57.9%), headache (42.8%), and loss of consciousness (39.5%). Ischaemic stroke was a commoner subtype (65.8%). Majority of the patients had moderate stroke severity (79.6%) and elderly subjects were significantly most likely to have severe strokes. Stroke severity seemed to be more on females than males.
Conclusion: The patients were mostly elderly with low socioeconomic status. Hypertension was the commonest determinant and hemiparesis the commonest presentation, meanwhile, convulsion, vomiting, aphasia, coma, and headache were significant presentation in patients with haemorrhagic stroke. The majority of subjects had moderate stroke severity as the elderly were likely to have severe stroke.

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1. Introduction

Stroke is the leading cause of death and adult disability which is likely to worsen in developing countries [1] reported earlier to be the 3rd leading cause of death [2] but now the 2nd leading cause of death [3]. The current prevalence of stroke in Nigeria is 1.14:1000 while the 3-year fatality rate of up to 84% has been reported [1]. There is a high burden and poor outcomes of stroke among Africans attributed to a high prevalence of undiagnosed and untreated cardiovascular risk factors, greater severity of risk factors or higher sensitivity to the risk factors, and lack of access to care [1, 3].

Stroke therefore appears to be a huge problem in Nigeria and imposes a major financial burden on the inadequate healthcare services in the country [4, 5]. Stroke is a common condition in rural areas where most of the population live and where poverty, illiteracy, unavailability and inaccessibility to good health care have played significant roles in the predisposition, management and outcome of stroke, a largely preventable condition [3]. Its clinical presentation should influence practice and prevention especially as a large proportion of Nigerians still leave in poverty [4]. The clinical pattern of stroke are different because of variations in admission policy, diagnostic accuracy, age distribution and related risk factors [6]. The awareness of stroke and stroke manifestation is poor among Nigerians at increased risk for the disease especially in rural areas [7]. An increased awareness and early recognition of common determinants, signs and symptoms will influence better health seeking behaviour in the population. This is paramount because patients who arrived at the emergency room within 3 hours of first symptom tend to have less disability three months after a stroke than those who received delayed care relating to the "window of opportunity" in stroke [8].

Many of those presenting with a stroke have two or more risk factors of which hypertension is the most important modifiable risk [9, 10] and worldwide, the risk of all stroke subtypes increase with increasing blood pressure. Hypertension appears to be most prevalent in blacks; while diabetes mellitus, smoking, atrial fibrillation and MI are common in whites [2]. Its presentation may depend on whether it is an ischaemic or haemorrhagic stroke. Stroke severity provides a measure of stroke-related neurological deficit thereby predisposing to the high burden of care [1]. Stroke severity may depend on numerous factors like age, racial factors, stroke sub-type, and gender among others [1, 4]. Stroke is therefore one condition in which the adage "prevention is better than cure" stands as Africa is at a disadvantaged position with respect to stroke care [11].

The aim of this study was to evaluate the determinants and severity of stroke in Irrua Specialist Teaching Hospital, Irrua, a rural teaching hospital in Edo State, Southern Nigeria.

2. Method

2.1. Study Setting

The Family Medicine clinics (GOPD and NHIS/Staff clinic) and medical wards of Irrua Specialist Teaching Hospital (ISTH), Edo State, Nigeria. ISTH is located in Irrua, a rural community in Edo State which is strategically located along the Benin-Auchi expressway in Irrua, the headquarters of Esan Central LGA. It serves the Northern and Central Senatorial district of Edo State as well as part of the Southern Senatorial District. In addition, it receives patients from neighbouring states of Delta, Kogi and Ondo. The gateway into hospital services is at the Family Medicine clinics where patients are managed and referrals made to different specialties and subspecialties as the case maybe, or via the Accident and Emergency where patients are stabilized and referred appropriately for in-patient management.

2.2. Study Design

This was an observational cross sectional study.

2.3. Study Population

Our subjects were all adults aged 18 years and above, blacks and resident in Nigeria at the time of the study. For patients who were unconscious, consent was obtained from the family member or the main caregiver. Patients who had cognitive impairment and their care givers could not provide the required information were excluded from the study.

2.4. Sample Size Determination

The sample size was determined using the formula:

$$\mathrm{N} = \frac{\mathrm{Z}^2\mathrm{pq}}{\mathrm{d}^2}$$

where

- N is minimal sample size
- Z is standard score which corresponds to a given confidence interval (in this case 1.96 at 95% confidence interval)
- p is proportion of the target population expected to have stroke (1.14:1000 as prevalence of stroke in Nigeria) [12]
- q is 1-p (1-0.114=0.8), and d is degree of accuracy desired (5% in this case).

$$\mathrm{N} = \frac{1.96^2 \times 0.114 \times 0.8}{0.05^2} = 136.$$

A response rate of 90% was anticipated, thus the sample size was adjusted as follows

$$N_s = \frac{N}{0.9}$$

$$N_s = \frac{136}{0.9} = 152.$$

2.5. Sampling

We recruited 152 consented stroke patients presenting to ISTH. The subjects were consecutively recruited for the study between March, 2022 and January, 2023.

2.6. Data Collection

Data was collected and recorded in a stroke proforma for each patient at the time of presentation in the acute and subacute phase of stroke (less than or equal to 30 days). Data collected included; the biodata, the medical history, clinical examination, diagnostic procedures and their past medical records to determine clinical manifestation and the presence of stroke determinants and National Institute of Health Stroke Scale (NIHSS) score [10].

Stroke was clinically defined in accordance with the WHO criteria as "a rapidly developing clinical sign of focal and/or global disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death with no apparent cause other than of vascular origin [2]. The diagnosis of stroke was made based on the WHO clinical criteria with a high diagnostic accuracy (71%) [5, 13].

Stroke severity was determined using the NIHSS which rates stroke score from minor to severe [10].

Hypertension was defined as a previously recorded SBP >140 mmHg or DPB >90 mmHg on two separate occasions or during the course of stroke admission; those aware of being hypertensive as told by a health professional; or subjects on antihypertensive medications [2].

DM was defined as those who had a prior diagnosis of DM, on oral hypoglycaemic agents or previous FBS level >7 mmol/L or RBS of >11 mmol/L [2]. Transient Ischaemic Attack (TIA) was defined as a sudden onset of focal neurologic deficit with complete recovery within 24 hrs. Atrial fibrillation and myocardial infarction were diagnosed by clinical examination and Electrocardiography (ECG). Heart failure was diagnosed based on clinical examination. HIV infection was diagnosed using ELISA. Hypercholesterolaemia was defined as fasting cholesterol concentration of >5.5 mmol/L (200 mg/dl).

Information on social habits such as alcohol intake and cigarette smoking were also obtained; smokers were considered as those who had smoked consistently for more than a year inclusive of those who had stopped smoking < 6 months [2]. Consistent cigarette smoking was defined as >1 cigarette/day for >1 year, and significant alcohol intake was estimated as >200g/week for more than a year [2].

2.7. Statistical Analysis

Data was analysed using SPSS version 20.0. Test for statistical significance was carried out using the Chi-square. A P-value of < 0.05 was considered significant. The Chi-square test was used to compare difference in percentage of risk factors and clinical manifestation.

2.8. Ethical Consideration

Clearance was obtained from the Ethics and Research Committee of ISTH, Edo State (ISTH/ETHIC/COM/27). Consent was sought from the participants and for those unconscious, consent was sought from the immediate family member or the primary care provider. The study was conducted in line with the Helsinki guidelines on research involving human subjects.

3. Results

Majority of the patients with stroke (65.8%) were above 60 years of age. Most of them were males which constituted 59.2% while females made up 40.8%. The male to female ratio was 1.5:1. Over ninety eight percent (98.7%) of the patients were married and most of them (53.9%) were Esan. Trading and farming were their principal occupations which constituted 38.8% and 34.2% respectively. The sociodemographic characteristics of the stroke patients are as outlined in Table 1.

Table 2 illustrates the Age and Educational Status Distribution of the patients. The mean age (±SD) of the respondents was 65.24 (±10.6) years. For males, it was 64.70 (±10.6) years while that for females was 66.02 (±10.0) years. Females were older than males but there was no statistically significant difference in the mean age of respondents based on sex (t=1.943, df= 150, p= 0.054). More female stroke patients (75.8%) were above 60 years compared to males which were 58.9%. There was a statistically significant association between the gender and ages of stroke patients as well as their sex and educational status.

Table 1: Characteristics of Stroke Patients (N=152)

Variable	Frequency (n)	Percent (%)
Age group (in years)		
<40	1	0.7
40-60	51	33.7
>60	100	65.8
Sex		
Male	90	59.2
Female	62	40.8
Ethnic group		
Esan	82	54.0
Benin	24	15.8
Igbo	23	15.1
Etsako	7	4.6
Yoruba	4	2.6
Others	12	7.9
Marital status		
Single	2	1.3
Married	150	98.7
Occupation		
Farmer	52	34.2
Trader/ Businessman	59	38.8
Civil servant	39	25.7
Self employed	2	1.3
Educational status		
No formal education	35	23.0
Primary	38	25.0
Secondary	40	26.3
Tertiary	39	25.7
Religion		
Christianity	146	96.1
Islam	6	3.9

Table 2: Age and Educational Status Distribution of Stroke Patients by Sex (N=152)

	Sex		
Characteristic	**Male N = 90**	**Female N = 62**	**Significance test**
Age (in years)			
< 40	0(0.0)	1(1.6)	χ^2 = 6.806
40-60	37(41.1)	14(22.6)	df = 2
>60	53(58.9)	47(75.8)	p = 0.033*
Educational status			
No formal Education	11(12.2)	24(38.7)	χ^2 = 20.433
Primary	20(22.2)	18(29.0)	df=3
Secondary	28(31.1)	12(19.4)	p < 0.001**
Tertiary	31(34.4)	8(12.9)	

*Significant at p < 0.05

Most of the stroke patients who were above 60 years (32.0%) did not have any formal education. There was a statistically significant association between the ages of the stroke patients and their educational status (P<0.001) as younger patients were more likely to be educated Table 3.

Table 3: Age and Educational Status Distribution of Patients (N=152)

Characteristic	**Age (Years)**			
Educational Status	**<40 N=1 N (%)**	**40 – 60 N=51 N (%)**	**>60 N=100 N (%)**	**Test statistic**
No formal educ.	0(0.0)	3(5.9)	32(32.0)	χ^2 = 26.219
Primary	1(100.0)	8(15.7)	29(29.0)	df = 6
Secondary	0(0.0)	22(43.1)	18(18.0)	p < 0.05
Tertiary	0(0.0)	18(35.3)	21(21.0)	p < 0.001**

*Significant at p <0.05, **Significant at p < 0.001

Risk factors like diabetes, previous history of stroke, obesity, previous history of TIA, previous history of heart failure were commoner among females representing 53.2%, 8.1%, 79.0%, 14.5%, and 3.2% respectively. There was no statistically significant gender difference in the frequency of hypertension, diabetes mellitus, previous history of stroke and TIA. The proportion of those who smoked cigarette or consumed alcohol was higher among males than females representing 30% and 57.8% respectively. There was a statistically significant gender association between smoking, alcohol consumption and sex of stroke patients (P<0.001). Other risk factors like obesity and atrial fibrillation were statistically significant in females in this study Table 4.

Table 4: Gender Distribution of Modifiable and Non- Modifiable Risk Factors among the Subjects (N=152)

Characteristic	Sex		**Significance test**
	Male N = 90	**Female N = 62**	
Hypertension			
Yes	82(91.1)	57(91.9)	χ^2= 0.032
No	8(8.9)	5(8.1)	df=1
			p = 0.858
Diabetes			
Yes	41(45.6)	33(53.2)	χ^2= 0.865
No	49(54.4)	29(46.8)	df=1
			p = 0.352
Alcohol Consumption			
Yes	52(57.8)	2(3.2)	χ^2= 47.696
No	38(42.2)	60(96.8)	df=1
			p <0.001**
Cigarette Smoking			
Yes	27(30.0)	0(0.0)	χ^2= 22.618
No	63(70.0)	62(100.0)	df=1
			p <0.001**
Previous History of TIA			
Yes	7(7.8)	9(14.5)	χ^2= 1.770
No	83(92.2)		df=1
			p = 0.188
Obesity			
Yes	49(54.5)	49(79.0)	χ^2= 9.67
No	41(45.5)	13(21.0)	df=1
			p = 0.002*
Previous History of Stroke			
Yes	2(2.2)	5(8.1)	χ^2= 2.852
No	88(97.8)	57(91.9)	df= 1
			p = 0.093
Drug Use			
Yes	1 (1.1)	0 (0.0)	χ^2= 0.69
No	89 (98.9)	62 (100)	df=1
			p = 0.405
Sickle Cell Disease			
Yes	0 (0.0)	0 (0.0)	N.A
No	90 (100)	62 (100)	
History of Heart Failure			
Yes	0 (0.0)	2 (3.2)	χ^2= 2.94
No	90 (100)	60 (96.8)	df=1
			p <0.086
History of Myocardial Infarction			
Yes	0 (0.0)	0 (0.0)	N.A
No	90 (100)	62 (100)	
Atrial Fibrillation			
Yes	0 (0.0)	5 (8.1)	χ^2= 7.50
No	90 (100)	57 (91.9)	df=1
			p = 0.006*

*Significant at $p < 0.05$

The risk factors for stroke among respondents are summarised in Figure 1. The study found hypertension to be the greatest risk factor for stroke among respondents (91.4%). This was followed by obesity (64.5%), DM (48.7%) and Alcohol consumption (35.5%).

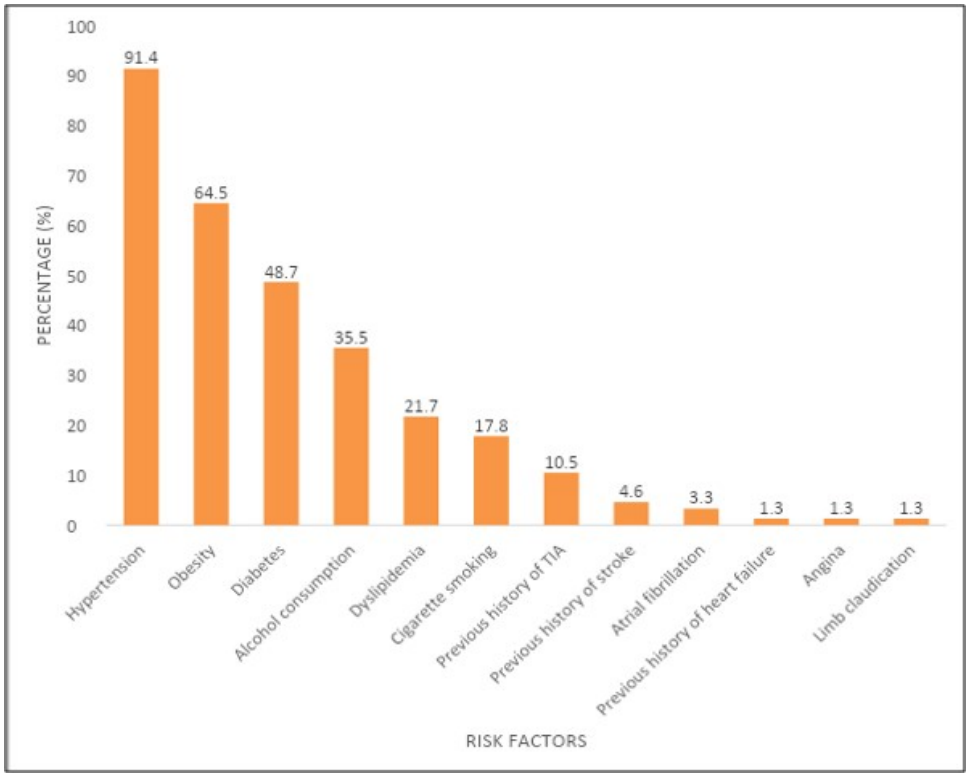

Figure 1: Risk Factors for Stroke among Respondent

Majority of patients suffered from ischaemic stroke 100 (65.8%) as only 52 (34.2%) had haemorrhagic stroke Figure 2.

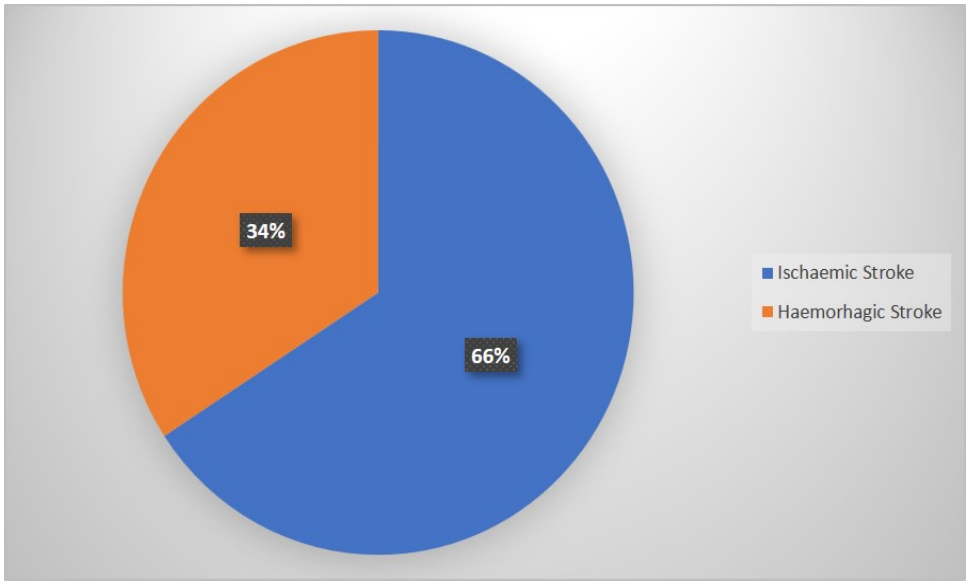

Figure 2: Clinical Stroke Sub-Type among Patients

Majority of the patients 121 (79.6%) had moderate stroke, while 24 (15.8%) had minor stroke. Only 7 (4.6%) patients had severe stroke. The stroke severity among respondents is illustrated in Figure 3.

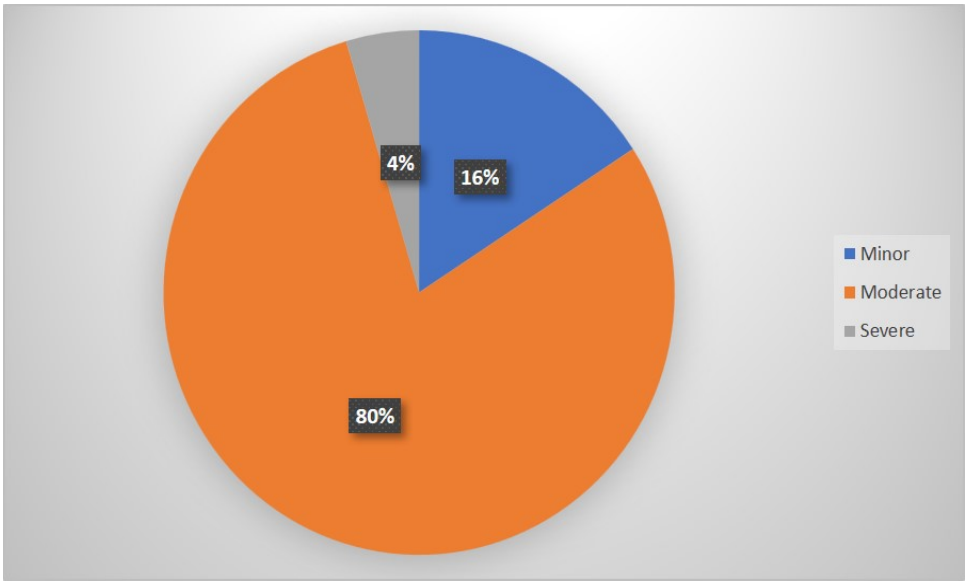

Figure 3: Stroke severity among Study Participants

Gender presentation of clinical features of stroke among study participants are shown in Table 5. Dysarthria, left hemiparesis, vomiting, convulsion, loss of consciousness, headache, vertigo, and sensory deficit were higher among males than females. However, there was no statistically significant association in relation to gender.

As regard the stroke sub-types, more females (74.2%) compared to males (60.0%) had ischaemic stroke while more males (40%) had haemorrhagic stroke. There was no statistically significant relationship between the stroke-sub type and sex of the patients (P=0.070).

4. Discussion

A total of 152 consented patients who were all black Africans with stroke were seen. This was high compared to other hospital based studies [1, 14]. This could be due to ISTH being strategically located along the Benin-Auchi Expressway in Irrua, the headquarters of Esan Central Senatorial district and it receives patients from neighbouring states of Delta, Kogi and Ondo. It could also suggest increase stroke prevalence due to increasing major risk factors like hypertension and DM [14].

The study setting is rural where educational attainment is low and trading and farming are the principal occupations. This low level of education and low socioeconomic status may also contribute to the increased stroke prevalence as the prevalence of stroke is high in low income regions (please rephrase the statement and make the message clear) according to findings from a study by Fekede in Ethiopia [15].

The patients were black Africans and data indicate a high burden of stroke in black Africans [16]. Females were more likely not to have any formal education when compared to males which was significant. Low educational attainment in females may translate to low income, low socioeconomic status and ignorance which increase their risk of stroke [17]. On the other hand, males were more likely to be educated, yet developed stroke. This could be due to males indulging in risky behaviours like alcohol use and smoking which make them more prone to developing Stroke.

The M:F ratio was 1.5:1 reflecting a slight male preponderance in keeping with other studies [1, 14, 18]. The male sex has been recognized as a non-modifiable risk factor for stroke [14].

Majority of the patients were elderly and may reflect the increase prevalence of stroke with age [14]. The mean age of the patients was 66.05 years. The mean age of stroke onset in Nigeria is reported to be 61 years [19]. In developed countries, half of strokes occur about the 7^{th} decade, but in Africa and Nigeria in particular, stroke occurs 1 to 2 decades earlier corroborating our findings. Female stroke patients were on the average older than the males. The mean age of the females was 66.02 years while males was 64.70 years. This was not significant. However, there was a statistically significant elderly female stroke patient. This finding corroborates findings of the Framingham study which observed that females developed stroke an average 5 years later than males [20]. Again, circulating oestrogens have a protective effect against ischaemic stroke especially of the non-cardioembolic type, the effect of which ceases with menopause [21, 22].

Hypertension was the commonest stroke determinant. Others were obesity, DM, alcohol intake, dyslipidaemia and cigarette smoking. Hypertension is the most significant factor for stroke worldwide [15, 18, 23]. In this rural environment, it may reflect poor community awareness, health practices and access to health care including different patient related factors. Even when blacks are treated for hypertension, they are less likely than the white race to be adherent. This may prompt one to believe that many with hypertension may not be controlled. Additionally, adherence with long term treatment is a great challenge to achieve the optimum outcome as uncomplicated hypertension is usually asymptomatic and denial of the disease is common. Obesity, DM, Dyslipidaemia are common risk also reported by [7] in Abakiliki. With the adoption of Western dietary habits by our population in place of our indigenous high fibre diet, these may constitute significant risk factors coupled with an increase sedentary lifestyle due to a flourishing sedentary social behavioural pattern like use of phones, televisions and other sedentary social media activities. Other risks like AF, previous heart failure, and angina were not as common as reported too by [20]. Although these contributed smaller proportions to stroke risk in this environment, they should however, in no way be neglected as they remain important risk factors for stroke.

Awareness of stroke requires early recognition of clinical or warning presentations for early presentation and prompt management. Its awareness is poor among Nigerians. Hence a profile of stroke determinants and clinical presentation can be incorporated into community education sessions for stroke awareness and prevention. Hemiparesis was the commonest manifestation of stroke in subjects. This may

Table 5: Gender Presentation of clinical Profile of Stroke among Subjects (N=152)

Characteristic	Sex		**Significance test**
	Male N = 90	**Female N = 62**	
Dysarthria			
Yes	72(80.0)	46(74.2)	χ^2= 0.713
No	18(20.0)	16(25.8)	df=1
			p = 0.399
Facial Weakness			
Yes	59(65.6)	29(46.8)	χ^2= 5.312
No	31(34.4)	33(53.2)	df=1
			p = 0.021
Hemiplegia/Hemiparesis (Lt)			
Yes	89(98.9)	60(96.8)	χ^2= 0.85
No	1(1.1)	2(3.2)	df=1
			p = 0.356
Hemiplegia/Hemiparesis (Rt)			
Yes	39(43.3)	27(43.5)	χ^2= 0.032
No	51(56.7)	35(56.5)	df=1
			p = 0.858
Vomiting			
Yes	15(16.7)	9(14.5)	χ^2= 0.128
No	75(83.3)	53(85.5)	df=1
			p = 0.721
Convulsion			
Yes	14(15.6)	6(9.7)	χ^2= 1.110
No	76(84.4)	56(90.3)	df=1
			p = 0.292
Headache			
Yes	37(41.1)	28(45.2)	χ^2= 0.246
No	53(58.9)	34(54.8)	df=1
			p = 0.620
Loss of Consciousness			
Yes	37(41.1)	23(37.1)	χ^2= 0.248
No	53(58.9)	33(62.9)	df=1
			p = 0.619
Vertigo			
Yes	37(41.1)	21(33.9)	χ^2= 0.815
No	53(58.9)	41(66.1)	df=1
			p = 0.367
Dysphasia			
Yes	2(2.2)	1(1.6)	χ^2= 1.736
No	88(97.8)	61(98.4)	df=1
			p = 0.791
Aphasia			
Yes	15(16.7)	13(21.0)	χ^2= 0.452
No	75(83.3)	49(79.0)	df = 1
			p = 0.501
Sensory Disturbance			
Yes	20(22.2)	11(17.7)	χ^2= 0.454
No	70(77.8)	51(82.3)	df = 1
			p = 0.500
Stroke Sub-Type			
Ischaemic	54(60.0)	46(74.2)	χ^2= 3.286
Haemorhagic	36(40.0)	16(25.8)	df = 1
			p=0.070

*Significant at $p < 0.05$, **Significant at $p < 0.001$

strengthen its sensitivity for the diagnosis of stroke in this locality. Other clinical manifestation included dysarthria, facial weakness, headaches, loss of consciousness, vertigo, dysphasia, vomiting and convulsion reported too by [20].

Ischemic stroke was the predominant subtype similar to findings by [7] and also corroborated the fact that females were more likely to have ischemic stroke while males were more likely to have haemorrhagic stroke. In particular, clinical features of convulsion, vomiting, aphasia, loss of consciousness, and headache were statistically significant in subjects with haemorrhagic than ischemic stroke ($p<0.001$) [7]. These symptoms feature prominently in the WHO clinical differentiation of haemorrhagic and ischemic stroke. However, definitive distinction requires neuroimaging.

Majority of subjects had moderate stroke (79.6%) while 15.8% had minor stroke and as low as 4.6% had severe stroke. The burden of stroke using the NIHSS score seems to be higher in females than males, this was corroborated by [10] as they are more likely to be in coma, have more severe stroke events and are less likely to recover [10]. There was a statistically significant association between stroke severity and age as elderly subjects were more likely to have severe stroke ($p<0.001$) reported too by [1] in their study. This may be related to the fact that the ageing brain is more susceptible to severe infarction in whom the disease is more likely to be fatal or lead to long term disability.

5. Conclusion

The peak age of onset of stroke occurred around the 6^{th} decade with a slight female preponderance. Hypertension was the predominant determinant of stroke while others included obesity, DM, alcohol intake, dyslipidaemia and cigarette smoking. Hemiparesis was the most important clinical manifestation. Others included dysarthria, facial weakness, sudden headaches and loss of consciousness. Their presence should heighten clinical suspicion of stroke as well as symptoms of loss of consciousness, headaches, aphasia, vomiting which may clinically increase suspicion of a haemorrhagic stroke.

Moderate stroke severity was the commonest clinical severity type rated with the NIHSS score which was higher among the females and significantly related to age.

Article Information

Ethics approval and consent to participate: Ethical approval was obtained from the Ethics and Research Committee of ISTH, Edo State (ISTH/ETHIC/COM/27). Consent was sought from the participants and for those unconscious, consent was sought from the immediate family member or the primary care provider. The study was conducted in line with the Helsinki guidelines on research involving human subjects.

Consent for publication: Not Applicable

Availability of data and materials: All data generated or analysed during this study are included in this published article.

Competing Interests: Authors have declared that no competing interests exist.

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Disclaimer (Artificial Intelligence): The author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.), and text-to-image generators have been used during writing or editing of manuscripts.

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