

Characteristics, risk factors and case fatality rate of stroke in hospitalized patients in semi-urban South–South Nigeria

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Abstract

Background: Stroke causes death and disability worldwide. Hypertension is the most prevalent risk factor. In Nigeria, studies on outcome and risk factors of stroke are from urban-based hospitals. This study aims to look at stroke outcome and the major modifiable risk factors of hospitalized stroke patients in semi-urban Nigeria.

Methods: The medical records of stroke patients admitted between March 2008 and February 2010 were reviewed retrospectively. The relevant demographic, clinical and laboratory data of each patient were retrieved.

Results: A total of 99 cases of stroke made up of 51 males and 48 females were reviewed. Mean age of the subjects was 66.22 ± 12.67 years. Mean systolic blood pressure and diastolic blood pressure at presentation were 171.41 ± 39.10 mmHg and 100.44 ± 21 mmHg, respectively. About 61.6% were known hypertensives, while 31.3%, not previously known to be hypertensive, had SBP ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. Overall, 85.9% of the subjects had SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg. In all, 46.5% had SBP ≥ 180 mmHg, and 63% of this number had SBP ≥ 200 mmHg; 42.4% had DBP ≥ 110 mmHg. Other major risk factors were hypercholesterolaemia (34.4%), diabetes mellitus (16.6%), previous cerebrovascular accident (15.2%) and smoking (9.4%). In all, 31.3% had two or more modifiable stroke risk factors. 36.4% of the subjects were comatose. Overall case fatality rate was 45.8%, 75% of the subjects with coma died, compared to 27.6% without coma ($p < 0.01$).

Conclusion: Mortality in our stroke patients is high. Hypertension is the commonest modifiable risk factor, and the presence of coma at presentation is associated with poor prognosis.

Keywords

Stroke, risk factors, case fatality rate, coma

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Introduction

Stroke is an important cause of death and disability worldwide,¹ and mortality from stroke is more in Blacks than Whites.² Stroke is the most common reason for neurological admission in many Nigerian tertiary hospitals³ and contributes significantly to hospital mortality rates.³

Among the risk factors for stroke, especially among Blacks, hypertension occupies a prime position^{2,4,5} and is considered the most important modifiable stroke risk factor.^{2,6,7} Other well-documented risk factors for stroke in Blacks include advancing age, diabetes mellitus (DM) and smoking.⁸ Hypertension, DM and smoking are becoming more important public health concerns in developing countries, and they contribute to the increasing burden of cardiovascular diseases, including stroke.²

Outcome for stroke is influenced by its severity, presence of co-morbid disease, timely medical intervention based on prompt identification of stroke type, age and race, among

other factors. In rural areas, patients may delay accessing medical care because of cultural beliefs and practices, socio-economic factors and distance to appropriate medical centres. In addition, awareness of stroke warning signs has been shown to be poor in Nigerians at risk of developing stroke.⁹ This may prevent early presentation, and thus lead to poor outcome. Studies on stroke outcome in West Africa are mainly from hospitals based in urban centres.^{5,10,11} Less data

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Table 1. Baseline clinical features of stroke patients at presentation.

Parameter	Mean \pm SD
Age (years)	66.22 \pm 12.67
SBP (mmHg)	171.41 \pm 39.1
DBP (mmHg)	100.44 \pm 21.13
Pulse rate (bpm)	87.98 \pm 19.10
Respiratory rate (cpm)	25.63 \pm 5.30
Temperature ($^{\circ}$ C)	36.79 \pm 1.00

SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure.

are available on the modifiable risk factors and outcome of stroke from predominantly rural communities in Africa.¹²

The aim of this study is to determine the prevalence of modifiable risk factors of stroke and case fatality rate (CFR) in a hospital sited in a semi-urban area in South-South Nigeria. The knowledge so gained would be useful in developing interventional measures that would help reduce the burden of stroke in rural areas.

Materials and methods

Study type

This was a retrospective study of stroke patients seen from March 2008 to February 2010.

Patients

Irrua Specialist Teaching Hospital (ISTH) is a referral tertiary centre in Edo State for hospitals in the Edo North and Central senatorial districts and its environs. All patients with diagnosis of stroke between March 2008 and February 2010 were included in the study.

Records of all patients admitted to our hospital via accident and emergency, clinic and intensive care unit with diagnosis of stroke were retrieved. Data were extracted from multiple sources including case records, ward, emergency room records and death certificates. Data were extracted from records using a structured questionnaire.

The relevant demographic and clinical data of each patient retrieved were age, sex, date of admission, accompanying symptoms and signs, duration of symptoms, risk factors and primary outcome, using a standardized questionnaire. The measure of outcome considered was mortality during hospitalization. Only cases with clinical features that met the World Health Organization (WHO)¹³ definition of stroke were selected. Patients with incomplete data were excluded from the final analysis.

Computed tomography (CT) brain scan was not routinely done as there is no facility for CT brain scans in our centre to determine the stroke type. However, patients who could afford CT brain scan were referred to the nearest hospital about 130

km away where the facility was available after stabilization, and were not included in the analysis for mortality. Patients who were discharged against medical advice were also excluded.

Ethical approval was obtained from the Research and Ethics committee of our institution.

Statistical analysis

Data were analysed using SPSS Version 12 for Windows[®]. Continuous data were expressed as means (standard deviation (SD)) and ranges. For categorical data, significance testing for differences between proportions was calculated using the chi-square. Statistical test significance was set at $p < 0.05$.

Results

The total number of admissions to the medical wards was 2912, and stroke constituted about 3.4% (99) of this during the period under review. In all, 51 (51.5%) of the stroke patients were males, while 48 (48.5%) were females.

Age

The mean age of the subjects was 66.22 \pm 12.67 years (age range 35–95 years). In all, 43 (43.4%) were aged \geq 70 years and 53 (53.5%) were aged between 40 and 69 years, while only 3 (3.0%) were aged $<$ 40 years.

Ethnicity/educational status

A total of 65 (65.7%) of the subjects were natives of the area (Esan land) where the hospital is located, and 74 (74.7%) had primary or no formal education.

Risk factors

In all, 61 patients (61.6%) were known to have hypertension, while an additional 31.3% (31) not previously known to be hypertensive had elevated blood pressure (BP) at presentation (systolic blood pressure (SBP) \geq 140 mmHg and/or diastolic blood pressure (DBP) \geq 90 mmHg). The mean SBP and DBP at presentation were 171.41 \pm 39.10 mmHg and 100.44 \pm 21.13 mmHg, respectively (Table 1). Overall, 85.9% (85) of the subjects had SBP \geq 140 mmHg and/or DBP \geq 90 mmHg at presentation and persisted till patients were discharged or died. Also, at presentation, 46.5% (46) had SBP \geq 180 mmHg, and 63% (29) of this number had SBP \geq 200 mmHg; 42.4% (42) had DBP \geq 110 mmHg.

The prevalence of other major stroke risk factors was hypercholesterolaemia (34.4%), DM (16.6%), previous cerebrovascular accident (CVA; 15.2%) and smoking (9.4%) (Figure 1). Proteinuria (not due to urinary tract infection) was seen in 45.5% of cases; 81.3% of diabetics had concomitant hypertension; and 31.3% of the patients had two or more modifiable stroke risk factors.

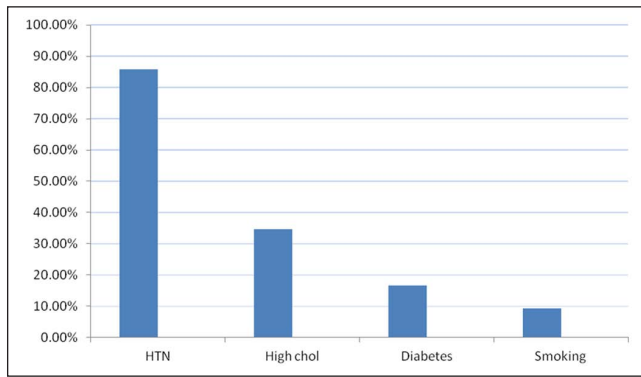


Figure 1. Relative frequency of major modifiable risk factors for stroke. HTN: hypertension; High Chol: high total cholesterol.

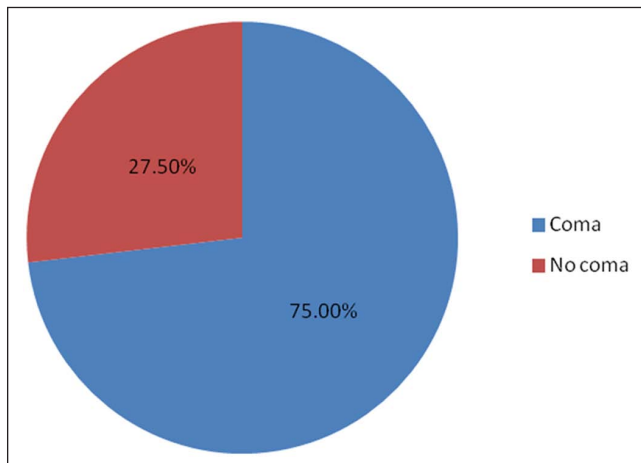


Figure 2. Case fatality rate for patients with or without coma.

In all, 33 (33.3%) patients, not previously known to be diabetic subjects, were found to have elevated blood sugar on admission; 36 (36.4%) of the subjects were brought in coma (mean ± standard deviation (SD) of Glasgow coma score (GCS) on admission was 5.01 ± 1.81). Only 20.2% (20) of our patients presented to the hospital within 3 h of onset, while 41.4% (41) came to the hospital after 24 h.

CFR

The total mortality on the medical wards was 427 during the period of review, and mortality from stroke contributed about 8.9% (38) to this number. The overall CFR for stroke (excluding those who discharged against medical advice (n = 10) and those who were referred (n = 6)) was 45.8% (38/83).

CFR by level of consciousness

Out of the 32 patients (excluding those discharged against medical advice and transferred to other centres) with coma,

Table 2. Case fatality rate (CFR) by age groups.

Age (years)	Survived	Dead	DAMA	Transferred	Total	CFR (%)
<40	1	2	0	0	3	66.7
40–49	3	2	1	0	6	40.0
50–59	9	7	3	2	21	43.8
60–69	11	12	2	1	26	52.2
70–79	11	10	4	1	26	47.6
≥80	10	5	0	2	17	33.3
Total	45	38	10	6	99	45.8

DAMA: discharge against medical advice.

24 (75%) died, compared to 14 (27.5%) out of 51 patients without coma ($\chi^2 = 14.37, p = 0.000$) (Figure 2).

CFR by gender

The overall CFR for men and women were 50% and 43.9%, respectively ($\chi^2 = 0.31, p = 0.58$).

CFR by age group

Table 2 shows CFR by age groups. Patients below 40 years had the highest CFR (66.7%). When the age was grouped into <70 years and ≥70 years, CFR was 48.9% for those aged <70 years and 41.7% for those aged ≥70 years ($\chi^2 = 0.72; p = 0.40$).

Discussion

Our centre is a referral hospital located in the Edo Central Senatorial district of Edo State, Nigeria. This senatorial district is mainly rural and is made up of five Local Government Areas, with a population of about 591,534 people.¹⁴ The main tribe is Esan, and the main occupation is subsistence farming.

Stroke patients constituted about 3.4% of the total admissions to the medical wards, and it contributed about 8.9% to the total deaths recorded during the period under review. This finding is similar to the 8% reported in Lagos.³ Taking into account the many possible causes of death in the medical wards in a developing country, this may be significant.

Diagnosis of stroke is clinical and by neuro-imaging, but CT or magnetic resonance imaging (MRI) brain scan is necessary for characterizing the stroke subtypes^{15,16} as this information is important to guide acute management. Our centre does not have either of the above-mentioned brain imaging equipment and diagnosis was clinical, using the WHO¹³ criteria. The Siriraj stroke score validation studies have given various sensitivity results in African Nigerians,^{17,18} and so may not be relied upon to clinically determine stroke types in Nigerians. Even in centres where CT brain scan is available, the high cost may deter patients from using it. A Nigerian study put the percentage of patients who could

afford CT brain at 9%,¹⁷ which is not too different from the 6% found in this study. The inability to determine stroke subtype in our centre poses serious restriction on the proper management of stroke patient in the acute stages.

A recent study among Nigerians at increased risk of stroke demonstrated a poor knowledge of stroke warning signs among this group of patients.⁹ This has the potential for causing delay in seeking medical attention with consequent adverse influence on outcome. About 41.4% of our subjects sought medical attention after 24 h of onset of symptoms of stroke.

Hypertension has been well established as an important risk factor for stroke, especially in the Africans. Among our subjects, elevated BP in the hypertensive range was found in 85 (85.9%), while 61.6% were already known to have a history of hypertension. Most were poorly compliant with medications (73.6%). Our study confirms high prevalence of hypertension among stroke patients in Nigeria as reported by previous studies from other parts of the country.^{12,19,20} A study conducted in an urban tertiary hospital (Lagos University Teaching Hospital) in Lagos, Nigeria, found hypertension as the commonest risk factor for first stroke among the patients studied.²¹ In that study, 77.4% were known hypertensives compared to 61.7% in our study; 22.6% of the Lagos stroke patients compared to 31.3% of our patients were undiagnosed hypertensives before stroke occurred. Overall, 79.1% of the stroke subjects in the Lagos study had hypertension, while our study recorded 85.6% among our stroke patients at first presentation, a figure almost similar to the 82.5% and 81.3% found by the Benin²² and Kano²³ researchers in the metropolitan urban capital cities of Edo and Kano States. Desalu et al.¹² reported similar figure of 85.2% in a rural town in Ido, Southwestern Nigeria. The Gambian study¹³ found hypertension in 48% of their patients. These results may mean that hypertension as a risk factor for stroke may not be of similar magnitude across the West African subregion, but is a very common risk factor in Nigeria, irrespective of the geographical region or whether the community is rural or urban. Furthermore, the diagnosis of hypertension without appropriate measures taken to control BP may not translate to reduction in stroke incidence.

The high prevalence of hypertension as a risk factor for stroke may reflect the high burden of hypertension in our communities.¹⁹

When compared to other modifiable risk factors like diabetes, hypercholesterolaemia, and smoking, elevated BP was significantly the most common risk factor ($p < 0.0001$). It was therefore not surprising to find the mean SBP and mean DBP at 171.41 ± 39.1 mmHg and $100.44 \pm$ mmHg, respectively, at presentation; however, it was of concern to find that 46 (46.5%) and 42 (42.4%) patients had $SBP \geq 180$ mmHg and $DBP \geq 110$ mmHg, respectively, at first examination, especially since the area is mainly rural. These very high BP values may pose significant risk to the development of stroke. A 10-mmHg rise in DBP has been found to increase

stroke risk by 86% in Blacks.²⁰ Very high SBP has also been shown to increase stroke risk in Blacks as well²⁴ and may predispose to greater mortality in stroke patients.²⁵

Hypercholesterolaemia was the second most frequent stroke risk factor in our subjects, a finding which suggests that abnormally elevated serum cholesterol may not be uncommon among rural populations in Nigeria. Karaye et al.²⁶ found 70% prevalence of dyslipidaemia among stroke patients in Kano, Northern Nigeria. Our study found a much lower dyslipidaemia rate (33%) compared to that from Kano, but much higher than a recent study by Alkali et al.²⁷ from Abuja which found a rate of 18.4%. The reason for the difference between the prevalence of dyslipidaemia in this study and others may be due to differences in the definition of dyslipidaemia. One or more components of what constitute dyslipidaemia were used in the definition of dyslipidaemia in most studies.^{26,27} In our study, hypercholesterolaemia was defined as total cholesterol greater than 200 mg/dl. Abnormal cholesterol increases the risk of stroke when in association with either hypertension or DM alone or in combination with both.

Diabetes was prevalent in 17% of our patients. This is similar to the study by Owolabi et al.²³ but lower than Desalu et al.¹² and Alkali et al.²⁷ which reported 23.8% and 23.5%, respectively. Our study showed that most diabetic patients presenting with stroke had coexistent hypertension, thus suggesting that the presence of hypertension increases the likelihood of stroke in our diabetic patients. A study in Nigeria has shown that hypertension with concomitant diabetes increases the risk of stroke seven-fold.²² Many of our patients had hyperglycaemia at presentation, some of them not previously known to be diabetic. Hyperglycaemia is known to be common in acute ischaemic stroke and may lead to adverse outcome,²⁸ thus emphasizing the need for routine blood sugar estimation in stroke patients on first contact and during the acute phase of stroke.

Smoking, although well documented as a modifiable risk factor for stroke in Blacks, is thought not to be a common risk factor in Africans.⁸ In the rural areas in Edo state, smoking is undertaken mostly by men as was the case in this study where those (9.4%) who smoked were all men compared to 11.25% in the study done in Benin City, Nigeria,²² and 52% in the Gambian study.¹¹

The high prevalence of proteinuria may reflect the very high percentage of subjects with hypertension complicated by nephrosclerosis. Diabetes coexisting with hypertension in a sizeable number of our patients may also contribute to the high prevalence of nephropathy as evidenced by proteinuria. Diabetes coexisting with hypertension, not properly managed, leads to onset of nephropathy earlier than either disease alone.

The prevalence of previous stroke (15.5%) in our patients is closer to the 14.9% found in Ido Ekiti, Southwestern Nigeria¹² and 18.8% in Abuja.²⁷ In the Gambian study, it was 12%. This finding may indicate that recurrent stroke is common in West

Africa, further re-emphasizing the importance of secondary preventive measures in stroke patients in West Africa.

Compliance to medication was very poor among the patients who developed stroke. This may explain the higher mean BP observed and the hyperglycaemia recorded. Encouraging patients to be more compliant with medication could potentially reduce the incidence of stroke due to hypertension and diabetes. Majority of the subjects were elderly, a finding consistent with other reports on Blacks.^{3,22,23,27}

CFR was 45.8%. It was higher than the 16.2% reported in Lagos, Southwestern Nigeria, by Danesi et al. and 37% by Owolabi and Nalado²³ in Kano, Northwestern Nigeria. Our finding is not too dissimilar from the 41% found in an urban medical centre in Gambia in West Africa¹¹ In addition, Longo-Mbenza et al.²⁹ reported a similar CFR of 44% of overall stroke in Kinshasa. This poor outcome in our study may be due to many factors including poor control of BP and blood sugar, non-availability of a neurologist during the period under review, the presence of co-morbid diseases, late presentation to hospital, the high incidence of coma and the inability to determine stroke subtype because of lack of CT brain scan or MRI, which would have guided acute management, among others.

In our study, age and gender did not influence mortality. This finding is similar to that by Owolabi and Nalado.²³

About 36.4% (36) of the subjects were brought in comatose (GCS < 10), compared to 28% in Kano²³ and 12% in the Gambian study.¹¹ In all, 75% of our comatose patients died. Mortality when coma was present was significantly higher than when it was absent ($p < 0.005$). Coma as a measure of severity is more common among our stroke patients compared to Kano²³ and Gambia,¹¹ and may partly explain the excess mortality during hospitalization in our patients.

In our communities, traditional medicine is patronized by many individuals. Weakness of the limbs or face, especially if of sudden onset, is commonly attributed to supernatural causes by indigenes, hence the resort to herbalists for treatment in some instances. Therefore, not all stroke patients present to the hospital. Some relatives of patients, or patients themselves, particularly when the limb weakness is not improving fast enough in their opinion, would initiate discharge against medical advice to go to herbalist homes for continuation of treatment.

Inability to do CT brain scan or MRI for our patients is a limitation to this study, as the frequency of ischaemic or haemorrhagic subtypes could not be ascertained for sure. This, however, does not affect the result as the study did not require such classification. The high prevalence of sudden onset of coma associated with very high BP values and consequent increase in mortality among our patients would suggest that the haemorrhagic subtype may be common. This would need to be confirmed by further studies combining both imaging techniques and autopsies.

Conclusion

The most common modifiable risk factor for stroke in this study is hypertension and confirms earlier reports in Nigerian Africans. Fortunately, hypertension is amenable to treatment and lifestyle modification measures.

Therefore, screening for hypertension and other modifiable risk factors for cardiovascular diseases, in conjunction with adequate treatment and lifestyle modification measures, in African Nigerians in rural and urban areas, can potentially reduce the incidence of stroke and mortality there from.

Mortality among hospitalized Nigerian stroke patients in rural areas is high and confirms the finding of poor outcome in West Africa. The presence of loss of consciousness at presentation is associated with poor prognosis.

Declaration of conflicting interests

The authors declare no conflict of interest.

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References

1. Murray CJL and Lopez AD. Quantifying the burden of disease and injury attributable to ten major risk factors. In: Murray CJL and Lopez AD (eds) *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020*. Cambridge, MA: Harvard University Press, 1996, chapter 6.
2. Gaines K and Burke G. Ethnic differences in stroke: black-white differences in the United States population. SECORDS Investigators (Southeastern Consortium on Racial Differences in Stroke). *Neuroepidemiology* 1995; 14: 209–239.
3. Ojini FI and Danesi MA. The pattern of neurological admissions at the Lagos University Teaching Hospital. *Niger J Clin Pract* 2003; 5: 38–41.
4. Osuntokun BO, Bademosi O, Akinkugbe OO, et al. Incidence of stroke in an African City: results from the stroke registry in Ibadan, Nigeria, 1973–1975. *Stroke* 1979; 10: 205–207.
5. Osuntokun BO. Epidemiology of stroke in Blacks Africa. *Hyperten Res Clin Exp* 1994; 17: S1–S10.
6. Gillum RF. Coronary heart disease, stroke, and hypertension in a US National cohort: the NHANES I Epidemiologic Follow-up Study. *Ann Epidemiol* 1996; 6: 259–262.
7. Walker R. Hypertension and stroke in Sub-Saharan Africa. *Trans R Soc Trop Med Hyg* 1994; 88: 609–611.
8. Gillum RF. Risk factors for stroke in blacks: a critical review. *Am J Epidemiol* 1999; 150(12): 1266–1274.
9. Wahab KW, Okokhere PO, Ugheoke AJ, et al. Awareness of warning signs among suburban Nigerians at high risk of stroke is poor: a cross-sectional study. *BMC Neurol* 2008; 8: 18.
10. Walker RW, Rolf M, Kelly PJ, et al. Mortality and recovery after stroke in the Gambia. *Stroke* 2003; 34: 1604–1609.
11. Garbusinski JM, van der Sande MAB, Bartholome EJ, et al. Stroke presentation and outcome in developing countries: a prospective study in the Gambia. *Stroke* 2005; 36: 1388–1393.

12. Desalu OO, Wahab KW, Fawale B, et al. A review of stroke admission at tertiary hospital in rural Southwestern Nigeria. *Ann Afr Med* 2011; 10: 80–85.
13. World Health Organization. *Cerebrovascular disorders* (off-set publication). Geneva: World Health Organization, 1978.
14. National Population Commission. *2006 population and housing census of the Federal Republic of Nigeria* (Edo State priority tables), vol. 1. Abuja, Nigeria: National Population Commission, 2006.
15. Chalela JA, Kidwell CS, Nentwich LM, et al. Magnetic resonance imaging and computed tomography in emergency assessment of patients with suspected acute stroke: a prospective comparison. *Lancet* 2007; 369: 293–298.
16. Kidwell CS, Chalela JA, Saver JL, et al. Comparison of MRI and CT for acute intracerebral hemorrhage. *JAMA* 2004; 292(15): 1823–1830.
17. Ogun SA, Oluwole O, Fatade B, et al. Comparison of the Siriraj Stroke Score and the WHO criteria in the clinical classification of stroke subtypes. *Afr J Med Med Sci* 2002; 31: 13–16.
18. Kolapo KO, Ogun SA, Danesi MA, et al. Validation study of the Siriraj Stroke Score in African Nigerians and evaluation of discriminant values of its parameters. *Stroke* 2006; 37: 1997–2000.
19. Okokhere PO and Akhidenor I. Hypertension in a rural Esan community: a preliminary report. *Ann Med Res* 2008; 2: 30–36.
20. Neaton JD, Kuller LH, Wentworth D, et al. Total and cardiovascular mortality in relation to cigarette smoking, serum cholesterol concentration, and diastolic blood pressure among black and white males followed up for five years. *Am Heart J* 1984; 108: 759–769.
21. Okubadejo NU, Ojini FI, Dawodu CO, et al. Does diagnosis of hypertension prevent stroke? A preliminary investigation of relative frequency of undiagnosed and previously diagnosed hypertension before first stroke in a Lagos hospital. *Nig Q J Hosp Med* 2002; 12: 10–12.
22. Amu E, Ogunrin O and Danesi M. Re-appraisal of risk factors for stroke in Nigerian Africans – a prospective case-control study. *Asian J Neurosurg* 2005; 24: 20–27.
23. Owolabi LF and Nalado AM. Factors associated with death and predictors of one-month mortality from stroke in Kano, Northwestern Nigeria. *J Neurosci Rural Pract* 2013; 4: S56–S61.
24. Giles WH, Kittner SJ, Hebel JR, et al. Determinants of black-white differences in the risk of cerebral infarction: the National Health and Nutrition Examination Survey Epidemiology Follow-up Study. *Arch Intern Med* 1995; 155: 1319–1324.
25. M'Buyamba-Kabangu JR, Longo-Mbenza B, Tambwe MJ, et al. J-shaped relationship between mortality and admission blood pressure in black patients with acute stroke. *J Hypertens* 1995; 89: 63–65.
26. Karaye KM, Nashabaru I, Fika GM, et al. Prevalence of traditional cardiovascular risk factors among Nigerians with Stroke. *Cardiovasc J Afr* 2007; 18: 290–294.
27. Alkali NH, Bwala SA, Akano AO, et al. Stroke risk factors, subtypes, and 30-day case fatality in Abuja, Nigeria. *Niger Med J* 2013; 54: 129–135.
28. Levetan CS. Effect of hyperglycemia on stroke outcomes. *Endocr Pract* 2004; 10: 34–39.
29. Longo-Mbenza B, Lelo TM and Mbulu PJ. Rates and predictors of stroke-associated case fatality in black Central African patients. *Cardiovasc J Afr* 2008; 19: 72–76.