Original Article

A review of stroke admissions at a tertiary hospital in rural Southwestern Nigeria

Olufemi O. Desalu, Kolawole W. Wahab, Bimbo Fawale[1], Timothy O. Olarenwaju, Olusegun A. Busari[1], Adebowale O. Adekoya[2], Joshua Oluwafemi Afolayan[1]

Department of Medicine, University of Ilorin Teaching Hospital Ilorin, [1]Department of Medicine, Federal Medical Centre Ido- Ekiti, [2]Department of Medicine, Lagos State University Teaching hospital Ikeja lagos, Nigeria

Correspondence to: Olufemi O Desalu, Department of Medicine, University of Ilorin Teaching Hospital, PMB 1459, Ilorin, Nigeria. E-mail: femuy1967@yahoo.co.uk

Abstract

Background: Stroke is a common neurological disorder and is the third leading cause of death and a major cause of long-term disability. The disease is expected to increase in low- and middle-income countries like Nigeria. There is no information on stroke in rural Nigeria.
Objectives: To review the clinical patterns, risk-factors, and outcome of stroke in a tertiary hospital in rural Nigeria and examine the rural-urban variation of stroke hospitalization in Nigeria.
Materials and Methods: We carried out a retrospective study of patients who had a clinical diagnosis of stroke at the Federal Medical Centre, Ido-Ekiti, South-western Nigeria between November 2006 and October 2009.
Results: A total of 101 patients who had stroke were admitted during this review period, accounting for 4.5% of medical admission and 1.3% of total hospital admission. Women accounted 52.5% of cases, with a male to female ratio of 1 : 1.1. Their mean age was 68 ± 12 years. Stroke occurrences increased with age, as almost half (49.5%) of the cases were aged ≥70 years and majority (84.2%) of them were in low socioeconomic class. The mean hospital stay for stroke treatment was 12 ± 9 days, Glasgow coma score on admission was 11 ± 4. Ischemic stroke was 64.4%; hemorrhagic stroke, 34.7%; and indeterminate, 1.0%. Hypertension (85.2%), diabetes mellitus (23.8%), and tobacco smoking (22.8%) were the common identifiable risk factors for stroke. Of all the patients, 69% had ≥2 risk factors for stroke. Thirty-day case fatality was 23.8%; it increases with age and was higher among men than women (29.2 vs 18.9%) and in patients with diagnosis of hemorrhagic stroke (34.3 vs 18.5%). The numbers of identifiable risk factors of stroke has no effect on the 30-day case fatality. When compared with stroke in urban areas of Nigeria, we found no differences in frequency of hospitalization (1.3 vs 0.9 – 4%) and the major risk factor (hypertension). Hemorrhagic stroke was more common in urban than in the rural community (45.2 – 51 vs 34.7%) and the 30-day case fatality was lower in the rural community (23.8 vs 37.6 – 41.2%).
Conclusion: Stroke is also a common neurological condition in rural Nigeria, in view of the fact that almost 70% of the patients had ≥2 risk factors of stroke. We recommend that, sustainable, community-friendly intervention programmes are incorporated into the health care system for the early prevention, recognition, and modification of the risk factors in persons prone to the disease.

Keywords: Clinical patterns, Nigeria, outcome, risk factor, rural-urban variations, stroke

Résumé

Background: Accident vasculaire cérébral est un trouble neurologique courant et est la troisième cause de décès et une cause majeure d'invalidité de longue durée. La maladie devrait augmenter en low - and middle - income pays comme le Nigeria. Il aucune information sur les accidents vasculaires cérébraux dans les régions rurales du Nigéria est.
Objectifs: Pour examiner le schémas cliniques, les facteurs de risque et les résultats d'accident vasculaire cérébral dans un hôpital de soins tertiaires dans les régions rurales du Nigéria et examiner la variation rurale-urbaine d'hospitalisation de l'accident vasculaire cérébral au Nigeria.

Matériaux et procédés: Nous avons effectué une étude rétrospective de patients ayant subi un diagnostic clinique d'accident vasculaire cérébral à la Medical Centre fédéral, Ido-Ekiti, Nigeria sud-ouest entre novembre 2006 et octobre 2009.

Résultats: Un total de 101 patients qui avaient des accidents vasculaires cérébraux ont été admis au cours de cette période d'examen, soit 4,5% de admission médicale et 1,3% du total d'hospitalisation. Les femmes représentaient 52,5% des cas, avec un mâle, femelle ratio de 1: 1.1. Leur âge moyen était de 68 ± 12 ans. Accident vasculaire cérébral occurrences augmentées avec l'âge, comme presque de moitié (49,5%) de les affaires étaient âgés. ≥70 ans et la majorité (84,2%) d'entre eux ont été en classe socio-économique faible. L'hôpital moyenne rester pour le traitement de l'AVC était ± 12 9 jours, score de coma de Glasgow à l'admission a été de 11 ± 4. AVC ischémique a été de 64,4%. AVC hémorragique, 34,7%. et pour une période indéterminée, 1,0%. L'hypertension (85,2%), diabète sucré (23,8%) et le tabac fumer (22,8%) était les identifi mesure de facteurs de risque communs d'accident vasculaire cérébral. Tous les patients, 69% avaient ≥2 facteurs de risque pour les accidents vasculaires cérébraux. Trente jours de létalité était de 23,8% ; Il augmente avec l'âge et était plus élevé chez les hommes que les femmes (29,2 vs 18,9%) et chez les patients atteints de diagnostic d'accident vasculaire cérébral hémorragique (34,3 vs 18,5%). Le nombre de risques mesure identifi facteurs d'accident vasculaire cérébral n'a aucun effet sur la létalité de 30 jours. Comparativement aux accidents vasculaires cérébraux dans les zones urbaines du Nigéria, Nous avons ne trouvé aucune différence dans la fréquence d'hospitalisation (1,3 vs 0,9 – 4%) et le facteur de risque majeur (hypertension). AVC hémorragique était plus courante en urbains que dans la communauté rurale (45,2 – 51 vs 34,7%) et les 30 jours taux de létalité était plus faible dans la communauté rurale (23,8 vs 37,6 – 41,2%).

Conclusion: L'AVC est également un bon neurologique condition dans les régions rurales du Nigéria, compte tenu du fait que presque 70% des patients avaient ≥2 facteurs de risque d'accident vasculaire cérébral. Nous recommandons que, à une intervention durable, facile à la communauté des programmes sont incorporées dans le système de soins de santé pour la prévention précoce, la reconnaissance et la modification cation de les facteurs de risque chez les personnes sujettes à la maladie.

Mots clés: Clinique patterns, Nigéria, résultat, facteur de risque, variations rural-urbain, accident vasculaire cérébral

Introduction

Stroke is defined as a rapidly developed global or focal neurological deficit lasting more than 24 hours or leading to death with no apparent cause other than vascular origin.[1] It is a common neurological disorder and is the third leading cause of death (after heart disease and cancer)[2] and a major cause of long-term disability among survivors.[2,3] Stroke affects both gender and is increasingly common from the sixth decade, although young patients are not exempted.[2] People of African descent are more susceptible than their Caucasian counterparts.[4] In Africa, the frequency of stroke hospitalization ranges from 0.9 to 4.0%; it accounts for 0.5 to 45% of neurological admissions and has been found to be the eighth leading cause of death in Nigeria.[5,6] The burden of prolonged hospitalization on the family of stroke patients, the aftermath of disability from the disease, and the economic implication on survival of stroke patients, as well as the overstretching of health facilities have been previously explored.[7-9]

In Africa, most of the population lives in the rural areas, where poverty, illiteracy, unavailability, and inaccessibility to good health care have played significant roles in the predisposition, management, and outcome of stroke.[10] The aims of this study were to review the risk factors, clinical pattern, and outcome of stroke in a tertiary hospital in rural Nigeria and make comparisons with what have been documented on the disease in urban settings in the country.

Materials and Methods

This was a retrospective study carried out at the Federal Medical Centre, Ido-Ekiti in South Western, Nigeria. The study centre is a tertiary hospital that serves as a referral centre for Ekiti State. The hospital also runs an internship and postgraduate training in internal medicine. The hospital has a consultant neurologist and five other internists.

We retrieved and reviewed the medical case records of all patients who had a clinical diagnosis of stroke in the hospital between November 2006 and October 2009. The medical records of the stroke cases were carefully reviewed to obtain necessary data. The cases that had complete information and met the World Health Organization[1] clinical criteria for diagnosis and classification of stroke subtypes were studied. Socio-demographic information, clinical features, identified risk factors, comorbid conditions, drug history and compliance, duration of hospitalization, and the outcome of management were extracted from their case records. In addition, neurological examination findings at admission, hematological and biochemical results were obtained. Computerized tomography (CT) scan was not done except in two patients, due to non-affordability and non-availability of CT scan in

the hospital. However, the WHO criterion which has been shown to have a high sensitivity among Nigerians was used to determine the pathological stroke type.[10]

The data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 15 (SPSS Inc., Chicago, IL, USA). Descriptive and frequency statistics were obtained for the variables of interest. Chi square was used to test for statistical significance between categorical variables. A *P* value of <0.05 was considered statistically significant.

Results

Of the patients admitted during the study period (3 years), 101 were clinically diagnosed to have stroke. It accounted for 4.5% of medical admission and 1.3% of total hospital admission over the same period. The age of the patients ranged from 38 to 95 years with a mean age of 68 ± 12 years. Almost half (49.5%) of the stroke patients were aged 70 years and above. The frequency of stroke also increased with the age of the patients. Of the 101 patients, 48 (47.5%) were males and 53 (52.5%) were females with a male to female ratio of 1 : 1.1. By stratifying the patients into upper and low socioeconomic class, using their level of education and occupation, 85 (84.2%) belonged to low socioeconomic class. The mean hospital stay was 12 ± 9 days, mean Glasgow coma score on admission was 11 ± 4 and mean blood glucose on presentation was 8.5 ± 6.3 mmol/l. The other characteristics of the patients are shown in Table 1.

By using WHO criteria, 65 (64.4%) had ischemic stroke while 36 (34.7%) had hemorrhagic, with intracerebral hemorrhage accounting for 31.7% and subarachnoid hemorrhage accounting for 3.0%. One case (1%) was indeterminate due to insufficient data [Table 2]. The clinical presentations of the stroke patients are shown in Table 3.

Systemic hypertension (86, 85.2%) emerged as the commonest modifiable risk factor for stroke. Others include diabetes mellitus (24, 23.8%), tobacco smoking (23, 22.8%), previous transient ischemic attack (TIA) (19, 18.8%), previous stroke (15, 14.9%), and alcohol consumption >40 g/day (12, 11.9%). Seventy stoke patients (69.3%) had two or more risk factors for stroke while 31 (30.7%) had one risk factors for stroke. The identified risk factors for stroke are shown in Table 4.

A total of 24 (23.8%) patients died within 30 days of hospitalization, three of them (3.0%) died within 24 hours and they all had hemorrhagic stroke. Of these 24, 14 (58.3%) were men and 10 (41.7%) were women. Gender-specific death rate was 29.2% and 18.9% for men and women, respectively. Mortality within 30 days of hospitalization was significantly higher among patients with recurrent stroke (7, 43.8%) compared with those with first ever stroke (17, 20.0%). Twelve (34.3%) patients that presented with hemorrhagic stroke died within 30 days compared with 12 (18.5%) of 65 patients with ischemic stroke. Of the 31 patients that had <2 risk factors, seven (25.0%) died within 30 days compared with 17 (24.3%) of 70 patients with ≥2 risk factor for stroke. The number of identifiable risk factors of stroke has no significant effect on the outcome of 30-day case fatality. The thirty days mortality according to the stroke types, number of occurrence, and risk factors are shown in Table 5.

Table 1: Clinical and socio-demographic characteristics of the patients				
Characteristics	Male	Female	Total	*P* values
	n = 48	n = 53	n = 101	
Mean age (SD), years	69 (12)	68 (13)	68 (12)	0.69
Age range, years				
30 – 39	0 (0)	1 (1.9)	1 (1.0)	
40 – 49	4 (8.3)	1 (1.9)	5 (5.0)	
50 – 59	6 (12.5)	5 (9.4)	11 (10.9)	
60 – 69	20 (41.7)	14 (26.4)	33 (33.7)	
70 – 79	12 (25.0)	19 (35.8)	31 (30.7)	
≥80	6 (12.5)	13 (24.5)	19 (18.8)	0.141
Socioeconomic status				
Upper	14 (29.2)	2 (3.8%)	16 (15.8%)	
Low	34 (70.8%)	51 (96.2%)	85 (84.2%)	<0.001
Marital status				
Married	3 (6.3)	18 (34.0)	21 (20.8%)	
Unmarried	45 (93.8%)	35 (66.0)	80 (79.2%)	<0.001
Hospital stay	10 (8)	13 (10)	12 (9)	0.101
Glasgow coma score	12 (4)	10 (5)	11 (4)	0.030
Admission plasma glucose	7.6 (5.9)	9.2 (6.6)	8.5 (6.3)	0.368

Values are mean (SD) and n (%), SD = standard deviation

Table 2: Stroke types in the studied patients

Types	Frequency	(%)
Intra-cerebral hemorrhagic	32	31.7
Subarachnoid hemorrhagic	3	3.0
Ischemic	65	64.4
Indeterminate	1	1.0

$x^2 = 61$, df = 3, $P < 0.001$

Table 4: Identified modifiable risk factors for stroke

Risk factors	Frequency (n)	(%)
Hypertension	86	85.2
Diabetes mellitus	24	23.8
Tobacco smoking	23	22.8
Previous transient ischemic attack	19	18.8
Previous stroke	15	14.9
Excess alcohol >40 g/day	1	11.9
Cardiomyopathy/valvular	11	10.9
Cardiac arrhythmias	9	8.9
Obesity	6	5.9
Dyslipidemia	3	3.0
Carotid artery stenosis	1	1.0
Oral contraceptive pills	1	1.0

Table 3: Stroke clinical features in rural hospital

Clinical features	Frequency (n)	(%)
Hemiplegia/hemiparesis	87	86.1
Cranial nerve deficit	64	63.4
Headache	32	31.9
Dizziness	22	21.8
Altered level of consciousness	20	19.8
Slurred speech	16	15.8
Vomiting	16	15.8
Blurring of vision	9	8.9
Convulsion	5	4.9

Table 5: Thirty days mortality according to the stroke types, number of occurrence, and risk factors

Variables	Death in 30 days n (%)	P value
Types of stroke		
Ischemic	12 (18.5)	
Hemorrhagic	12 (34.3)	0.18
Frequency of stroke		
First ever	17 (20.0)	
Recurrent	7 (43.8)	0.04
No. of risk factor		
<2	7 (25.0)	
≥2	17 (24.3)	0.62

Total number of stroke cases = 101

Discussion

The pattern and outcome of stroke in rural Nigeria has not been widely studied and this is why our study is important in this regard. This retrospective study shows that stroke was responsible for 4.5% of medical admissions and 1.3% of total hospital admissions during the period reviewed. These findings are similar to what have been reported from many hospital-based studies in Africa.[11] However, the admission rate as a result of stroke is low when compared with the findings of Njoku *et al.* in north western Nigeria.[9] Although not statistically significant, we found that stroke was less frequent among men (47.5%) than women (52.5%) and the male to female ratio was 1 : 1.1. This ratio is similar to the findings of two studies in an urban setting of Southern Nigeria[7,12] but is different from other studies that reported a male predominance.[9,13-15] The trend in our study might be due to greater life expectancy among the women, as 60.3% of the women having stroke were aged ≥70 years. Furthermore, the lack of awareness and insufficient treatment of conventional stroke risk factors in women may also be considered as probable explanations, because 96.2% of the women having stroke fall into lower socioeconomic status. Socioeconomic status is function of the educational attainment, income, and type of occupation. This explanation was corroborated by a study in our centre that found that patients with higher education and men were more aware of their increased risk factor for stroke than those with low education and women.[16] Other reasons are the use of oral contraceptives (OCP),

hormone replacement therapy, and pregnancy however only 0.6% of the studied patients used OCPs. Prestroke disability and socio-demographic factors have been noted to contribute to the high rate of institutionalization observed in women.[17] Until early 1980s, the burden of stroke in women was often underestimated and once considered primarily a disease of men.[1] Recent data on stroke statistics in United State of America show that 60 000 more women than men have a stroke each year, and stroke is currently emerging as a major public health problem for women as well.[18]

In this study, the occurrence of stroke increased positively with the age of the patient in both gender; this finding agrees with previous and recent studies which opined that stroke increases with age.[9,11-14] We found that 49.5% of cases occurred in age group ≥70 years, unlike in the urban area of Nigeria.[7,10,19] The urban areas are characterized by job opportunities, less-aged population, modern social amenities, high population density, overcrowding environmental problems like pollution luxurious and stressful living condition. Some of these characteristics of urban living have been associated with risk factors for stroke and they might be responsible for the increased occurrence of stroke in patients <70 years of age in the urban areas. Our study also showed that majority (84.2%) of the stroke patients belonged to the lower socioeconomic class. This is a reflection of the general trend in rural

Nigeria where poor income earning is the rule. As a result of the skewed distribution of socioeconomic status, it was difficult drawing reliable conclusion. Our study also revealed that ischemic stroke (64.4%) was significantly more common than hemorrhagic stroke (34.7%); this pattern is consistent with other studies.[12-14,15,20] However, it is in contrast to other studies[7,9] where hemorrhagic stroke was more common than ischemic stroke. The geographical disparity in the findings in the various studies concerning the relative frequency of stroke subtypes have been attributed to population migration, diagnostic accuracy, admission policy, age distribution, and prevalence of stroke-related risk factors.[21,22] In this study, hypertension was the most predominant risk factor for stroke (85.2%); our finding is closer to 82.5 to 83.9% reported in other stroke studies in urban Nigeria.[9,13,14,23,24] The risk of stroke has been strongly related to both systolic and diastolic blood pressure;[23] in addition, the risk for first ever stroke or recurrent stroke appears to be log-linear throughout normal ranges.[23] A rise of 10 mmHg in the mean arterial pressure leads to about 20 to 30% increase in stroke risk.[23,24] Systemic hypertension was followed by diabetes mellitus (23.8%) which has been ranked second in a similar study.[12] The frequency of DM in our stroke patients is closer to 26.3% in Benin city, Nigeria[23] but higher than 8% in the North Eastern Nigeria.[15] DM is major risk factor for the development of atherosclerosis and the excess risk of stroke in patients with diabetes mellitus is about four times higher when compared with normal individuals.in a general population[25] Therefore it is vital to ensure good glyceamic control in those with condition to prevent the development of stroke. Tobacco smoking was ranked third in the risk factors of stroke and the rate was 22.8% among our patients; this rate of smoking is higher than 11.3% in another study in Nigeria[23] and 6% in Saudi Arabia[13] but far less than 44% in Pakistan.[26]

Cigarette smoking was reported to be a significant risk factor in a case-control study among Nigerians.[23] The effect of tobacco smoking has been said to be dose related, heavy smokers are more likely to develop stroke; however, the risk of having the disease reduces with smoking cessation.[26,27] TIA was the fourth most prevalent risk factor and the fifth was previous stroke. The frequency of TIA among our patient was higher than 9% in Saudi Arabia and 2.1% in Pakistan.[13,26] Matsumoto *et al.* and Mohr *et al.* in their studies observed that 10 to 14% of strokes are preceded by TIAs, and as a risk factor, conferred an independent relative risk of 3.9%.[28,29]

Furthermore, 35% of the patients with TIAs are at

risk of having a stroke within four years.[28,29]

The overall intrahospital mortality in this study was 26.7%, with 3.0% dying within 24 hours, 10.9% within 7 days, and 23.8% within 30 days of hospitalization. We found the mortality rate to be lower when compared with report from urban Nigeria where it is 37.6 to 41.2%.[7,9,29] Our study also revealed that mortality of stroke increases with age, it was higher among the men than women (29.2 *vs* 18.9%) and in patients with diagnosis of hemorrhagic stroke (34.3 *vs* 18.5%). These outcomes agree with the report of other studies.[7,9] In this study we found that the number of risk factors for stroke in our patients does not have any significant impact on the thirty day mortality. This may be due to the fact that 70% of them had ≥ 2 risk factors and also the small number of the patients. Similarly a study in northern Nigeria also found that 81.5% of stroke patients had three or more risk factors.[30] In particular, cardiovascular risk factors tend to have a multiplicative effects on overall risk for stroke[1,4] and therefore in management of stroke, it imperative to address all the risk factors and not just focus on few ones.

This was a retrospective study and, as such, have certain inherent limitations, such as poor or incomplete medical record keeping, missing data and lack of essential, specific diagnostic facilities, as well as poor follow-up clinic visitation, and under reporting of death after hospital discharge. Despite these limitations, we have been able to review the pattern of stroke in a rural population of Nigeria.

Conclusion

There were no differences in frequency of hospitalization and most predominant risk factors for stroke in urban and rural areas of Nigeria. Hemorrhagic stroke was more common in urban than in the rural areas. The 30 days mortality in our study was 27.7%, and lower than 37.6 to 41.2% in the urban areas. Considering the fact that the knowledge and perception of stroke risk factors and its warning sign are low in the hospital patients and health workers,[16,31,32] we recommend that the awareness of stroke and its risk factors should be increased among the rural populace, and community-friendly intervention programmes aimed at preventing and modifying the risk factors in persons prone to diseases are incorporated into health care system, so that they are recognized early and effectively managed.

Acknowledgements

We want to recognize the efforts of the head of department and staff of health record department Federal Medical Centre Ido-Ekiti Nigeria for their assistance in retrieving case record of enrolled patients.

References

1. Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: Result of WHO collaborative study. Bull World Health Organ 1980;88:113-30.
2. Schulte BPM. Neuroepidemiology of cerebrovascular disease: An overview in advances in neurology. In: Chopra JS, editor. Proceedings of the XIVth World Congress of Neurology, New Delhi, India; 1989. P. 3.
3. Murray CJL, Lopez AD. Global mortality, disability and the contribution of risk factors: Global Burden of Disease Study. Lancet 1997;349:1436-42.
4. Agyemang C, Addo J, Bhopal R, Aikins Ade G, Stronks K. Cardiovascular disease, diabetes and established risk factors among populations of sub-Saharan African descent in Europe: A literature review. Global Health 2009;5:7.
5. Ojini FI, Danesi MA. Pattern of neurological admissions at the Lagos University Teaching Hospital. Nig J Clin Pract 2003;5:38-41
6. World Health Organisation (WHO) Country mortality Fact Sheet 2006 Nigeria. Death and DALY estimates by cause, 2002. Available at http://www.who.int/entity/healthinfo/statistics/bodgbddeathdalyestimates.xis
7. Ogun SA, Ojini FI, Ogungbo B, Kolapo KO, Danesi MA. Stroke in south west Nigeria: A 10-year review. Stroke 2005;36:1120-2.
8. Osuntokun BO, Adeuja AO, Schoenberg BS, Bademosi O, Nottidge VA, Olumide AO, *et al*. Neurological disorders in the Nigerian Africans: A community-based study. Acta Neurol Scand 1987;75:13.
9. Njoku CH, Aduloju AB. Stroke in Sokoto, Nigeria: A five year retrospective study. Ann African Med 2004;3:73-6.
10. Ogun SA, Oluwole O, Fatade B, Ogunseyinde AO, Ojini FI, Odusote KA. Comparison of the Siriraj stroke score and the WHO criteria in the clinical classification of stroke subtypes. Afr J Med Sci 2002;31:13-6.
11. Odusote K. Management of stroke. Nigerian Med Pract 1996;32:56-62.
12. Onwuchewa A, Bellgam H, Asekomeh G. Stroke at the university of Port Harcourt teaching hospital, rivers state, Nigeria. Trop Doct 2009;39:150-2.
13. al Rajeh S, Awada A, Niazi G, Larbi E. Stroke in a Saudi Arabian National Guard Community Analysis of 500 Consecutive Cases From a Population-Based Hospital. Stroke 1993;24:1635-9.
14. Osuntokun BO. Stroke in Africans. Afr J Med Sci 1997;6:39-55.
15. Bwala SA. Stroke in a sub-Saharan Nigerian hospital: A retrospective study. Trop Doct 1989;19:11-4.
16. Ajayi AO, Ojo OO. Knowledge and perception of stroke among at risk medical out-patients in a tertiary health institution in Nigeria. Ann Afr Med 2007;6:51-3.
17. Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA. Gender differences in stroke incidence and poststroke disability in the Framingham heart study. Stroke 2009;40:1032-7.
18. Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, *et al*. Heart disease and stroke statistics-2008 update: A report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation 2008;117: 25-146. Osuntokun BO. Epidemiology of stroke in black Africa. Hypertens Res Clin Exp 1994;171-10.
19. Timmis GC. Cardiovascular reviews. Baltimore, London: William and Wilkins; 1980. P. 266-7.
20. Warlow CP. Epidemiology of stroke. Lancet 1998;352:1-4.
21. Sudlow CLM, Warlow CP. Comparing stroke incidence worldwide: What makes studies comparable? Stroke 1996;27:550-8.
22. Amu E, Ogunrin O, Danesi M. Re - appraisal of risk factors for stroke in Nigerian Africans: A prospective case - control study. AJNS 2005;24:20-7.
23. Walker R. Hypertension and stroke in sub-Saharan Africa. Trans R Soc Trop Med Hyg 1994;88:609-11.
24. Sacco RL. Risk factors and outcome for ischemic stroke. Neurology 1995;45:10-4.
25. Hasan SR, Khan GAS. Frequency of known risk factors of stroke and its outcome in patients' admitted in Sindh Government Qatar hospital Karachi. Pak J Med Sci 2007;23:634-6.
26. Colditz GA, Bonita R, Stampfer MJ, Willett WC, Rosner B, Speizer FE, *et al*. Cigarette smoking and risk of stroke in middle aged women. N Engl J Med 1988;318:937-41.
27. Matsumoto N, Whisnant JP, Kurland LT, Okazaki H. Natural history of stroke in Rochester, Minnesota, 1955 through 1969: An extension of a previous study. Stroke 1973;4:20.
28. Mohr JP, Caplan LR, Melski JW, Goldstein RJ, Duncan GW, Kistler JP, *et al*. The Harvard Cooperative Stroke Registry. A prospective study. Neurology 1987;28:754.
29. Ojini FI, Ogun SA, Danesi MA. Thirty days case fatality of stroke at LUTH. Nig Q J Hosp Med 2004;14:64-6.
30. Karaye KM, Nashabaru I, Fika GM, Ibrahim DA, Maiyaki BM, Ishaq NA, *et al*. Prevalence of traditional cardiovascular risk factors among Nigerians with stroke. Cardiovasc J Afr. 2007;18:290-94
31. Wahab KW, Okokhere PO, Ugheoke AJ, Oziegbe O, Asalu AF, Salami TA. Awareness of warning signs among suburban Nigerians at high risk for stroke is poor: A cross-sectional study. BMC Neurol 2008;8:18.
32. Akinyemi RO, Ogah OS, Ogundipe RF, Oyesola OA, Oyadoke AA, Ogunlana MO, *et al*. Knowledge and perception of stroke amongst hospital workers in an African community. Eur J Neurol 2009;16:998-1003.