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Full Length Research Paper

Gender variation in risk factors and clinical presentation of acute stroke, Northeastern Nigeria

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Studies suggest that gender differences exist in patients with stroke. This study is aimed at determining the gender difference in risk factors and clinical presentation of acute stroke among male and female patients. This is a prospective study conducted at the University of Maiduguri Teaching Hospital (UMTH) from 2005 to 2009. All patients admitted through the accident and emergency unit or directly to neurology unit with clinical and radiological proven stroke were enrolled into the study after informed written or oral consent. History with emphasis on clinical presentation and neurological examination were conducted by the authors. The national institutes of health stroke scale (NIHSS) was administered to all enrollees. Ninety-one patients were enrolled for the study, 61 males (63%) and 30 females (37%). There was no significant difference in the mean age (p=0.823). Females were less likely to be formally educated (p=0.024). Females were more likely to be in coma at time of presentation (p=0.003), but there was no significant difference in weakness, facial paralysis, speech or swallowing difficulties, hemianopia, headache and vomiting. Lacunar strokes were more frequent in males (p=0.048). Females were less likely to smoke (p=0.046) or take alcohol (p=0.027). We found 6.67% of the females with eclampsia as the possible cause of stroke. Females had a higher NIHSS on discharge (p=0.047). This finding support gender-related difference in stroke. More research is required to assess gender differences in stroke mortality and morbidity.

Key words: Gender, stroke, risk factor, clinical presentation.

INTRODUCTION

Stroke is a common cause of morbidity and mortality worldwide (Hart et al., 1999). The incidence and mortality for stroke is higher in blacks (Ogun et al., 2005; Wahab et al., 2007; Ottenbacher et al., 2008) and the prevalence is increasing in sub-Saharan Africa (Danesi et al., 2007), due to increasing incidence of hypertension and poor management of cases (Osuntokun et al., 1987). Several studies have shown gender differences in risk factor profile (Di Carlo et al., 2003; Gargano et al., 2008; Holroyd-Leduc et al., 2000; Gall et al., 2010; Reeves et al., 2009; Worrall et al., 2002), and there is now increasing evidence that gender, not only influences stroke presentation and severity (Reid et al., 2008; Petrea et al., 2009), but also the choice and response to therapy (Di Carlo et al., 2003; Smith et al., 2009; Ayala et al., 2002; Kent et al., 2005; Howard et al., 2009; Turtzo and McCullough, 2008).

Studies have shown that females are less likely to be treated with thrombolytics (Gargano et al., 2008; Reeves et al., 2009; Sacco et al., 2009), and it has been recognized that the efficacy of intravenous thrombolysis may be higher in females than males (Sacco et al., 2009). Males have a higher incidence of strokes, but the absolute burden of stroke is greater in females, and is likely to rise (Turtzo and McCullough., 2008; Lewsey et

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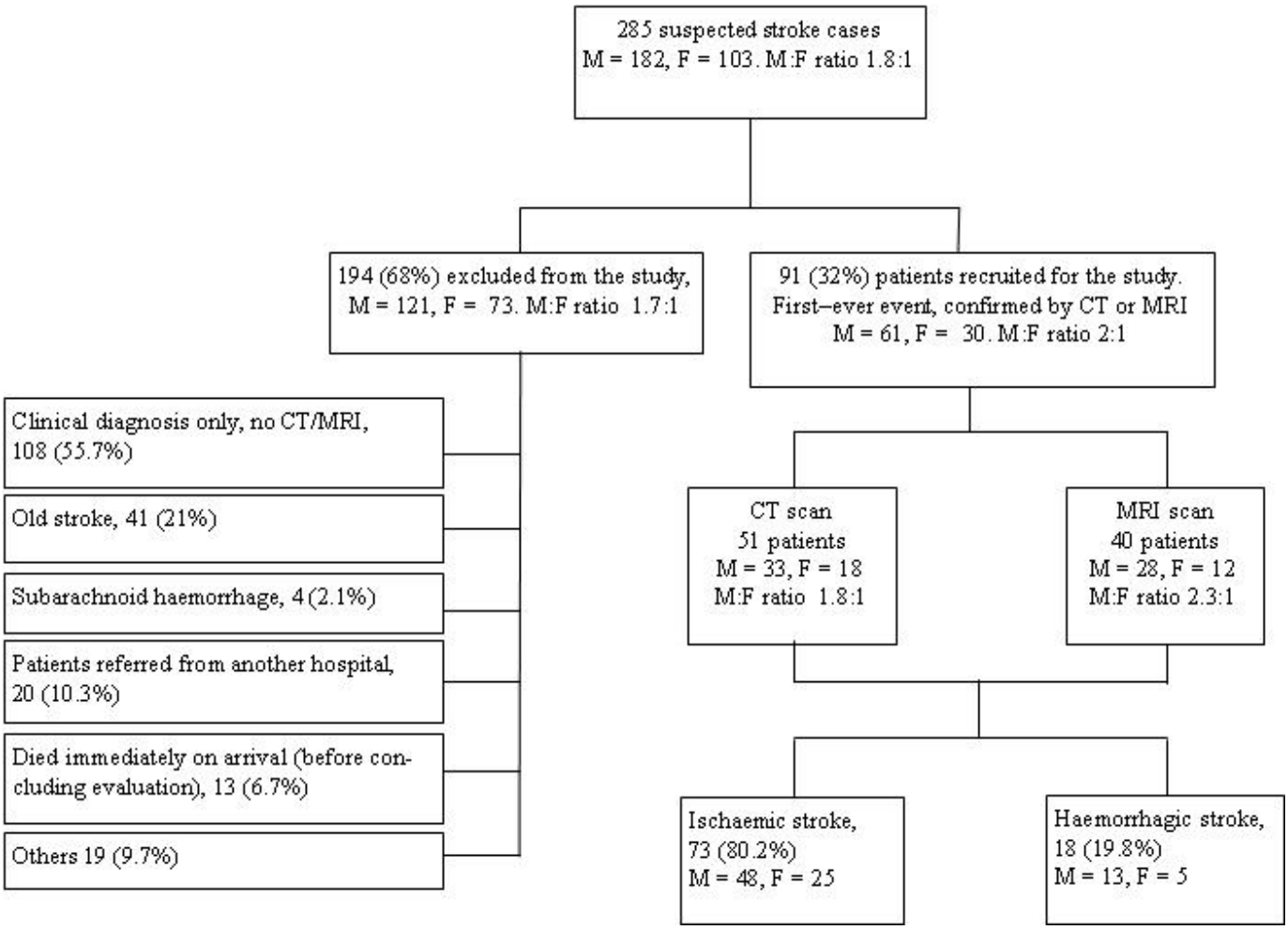

Figure 1. Inclusion and exclusion criteria, diagnosis and type of stroke.

al., 2009). The reasons for the gender differences is multifactorial and a subject for many researches (Turtzo and McCullough, 2008). In resource poor setting like ours, gender related issues in stroke have not been characterized, and appreciation of these differences will help in the management of women with stroke and improve their quality of life (Gargano et al., 2007). Based on the aforementioned observations, we sought to determine gender differences in risk factors and clinical presentation among our patients with acute stroke.

METHODS

The study was conducted at the University of Maiduguri Teaching Hospital (UMTH), a major referral center for North-eastern Nigeria, with about 600 beds. The study was conducted between January 2005 and December 2009. Those recruited for the study are patients with a diagnosis of acute stroke as defined by the WHO criteria (that is, rapidly developing clinical sign of focal and/or global disturbance of cerebral function, with symptoms lasting 24 h or longer or leading to death with no apparent cause other than of vascular origin) (WHO Monica project, 1988) and confirmed by brain computerized tomography (CT) or magnetic resonance imaging (MRI). A written or oral consent was administered to the patients or their next of kin. The consent form was interpreted into the local dialect for those who are not literate. Patients with subarachnoid haemorrhage, subdural haematoma, and past history of stroke were excluded from the study. Those also excluded were suspected stroke patients who had no brain CT or MRI, and those who died within 24 h of admission (Figure 1).

History and examination was conducted and documented in the UMTH stroke proforma which include the following: age, gender, educational level, risk factors such as, hypertension (current blood pressure values 140/95 mmHg or features of long standing hypertension), atrial fibrillation (AF), Transient Ischaemic Attack (TIA), diabetes mellitus (DM), smoking, alcohol consumption and a diagnosis of HIV infection; level of consciousness was evaluated by the Glasgow Coma Scale, a GCS $\leq$ 8 is taken as coma. Weakness, dysphasia, dysathria, hemianopia and swallowing were also assessed. Based on the CT or MRI, patients were grouped into haemorrhagic or ischaemic stroke. Ischaemic stroke subtype was further classified into Total anterior circulation stroke (TACS), Partial anterior circulation stroke (PACS), Posterior circulation stroke (POCS) and Lacunar stroke. Other necessary investigations were done to assess risk factors. The National Institutes of Health

Table 1. Comparison of demographic and clinical characteristics of subjects by sex.

	Females	Males	p-value
Demographic characteristic			
Total	30 (36.55%)	61(63.45%)	0.028*
Mean age	55.57 + 12.417	56.15 + 11.143	0.823
Median age	55 (35-80)	57 (24-80)	
Formal education †	4 (8.8%)	31 (33.18%)	0.024*
Stroke type			
Haemorrhagic	5(16.7%)	13 (21.3%)	0.812
Ischaemic	25 (83.3%)	48 (78.7%)	0.812
Clinical syndrome of Ischaemic stroke			
TACS	8 (32%)	14 (29.17%)	0.975
PACS	15 (60%)	25 (52.08%)	0.624
POCS	1(4%)	2 (4.17%)	1.000
Lacunar	1(4%)	7 (14.58%)	0.048*
Risk profile			
Hypertension	25 (83.33%)	49 (.80.33%)	0.953
Diabetes	2 (6.67%)	3 (4.91%)	1.000
TIA	2 (6.67%)	5 (8.20%)	1.000
Smoking	0 (0.0%)	10 (16.39)	0.046*
Alcohol	1 (3.33%)	15 (24.59%)	0.027*
HIV	1 (3.33%)	3 (4.91%)	1.000
Atrial fibrillation	2 (6.67%)	1(1.64%)	0.523
Antiphospholipid syndrome	1 (3.33%)	0 (0.0%)	0.725
Heart failure	1 (3.33%)	1 (1.64%)	1.000
Eclampsia	2 (6.67%)	-	-

TACS – total anterior circulation stroke, PACS-partial anterior circulation stroke, POCS – posterior circulation stroke, TIA – transient ischaemic attack. *p value $\leq$ 0.05 from student's t – test; † - have at least a secondary school education (about 12 years of formal education)

Stroke Scale (NIHSS) was used to assess stroke severity on admission and discharge. Duration of hospital stay was recorded only for those who survived till time of discharge. Death within 30 days attributable to the stroke was recorded from date of stroke admission. Student's t-test and the Z-test were used to assess continuous variables. All statistical data were analyzed using SPSS (version 16.1) software.

RESULTS

During the five year period 285 patients had a diagnosis of suspected stroke, 194 patients were excluded from the study as shown in Figure 1. Ninety-one patients were registered for the study. All recruited patients were blacks residing in Nigeria. There were 61 males (67%) and 30 females (33%), M:F ratio was 2:1. mean age 57.5 + 11.0 years for males and 55.3 + 11.0 years for females (p =0.823). Compared to males, females were less likely to be formally educated (at least a secondary school education) compared to males, 8.8% versus 33.2% (p=0.024). Table 1 shows stroke subtypes. There was no statistical difference in stroke subtype; as 25 females (83.3%) compared to 48 males (78.7%) had CT/MRI evidence of infarction (p=0.812), while 5 females (16.7%) compared to 13 males (21.3%) had haemorrhagic stroke (p=0.812). Apart from lacunar stroke that was more likely to occur in males (p=0.048), there was no major difference in clinical syndrome of ischaemic stroke.

Alcohol abuse (p=0.027) and smoking (p=0.046) were more frequent in males. No significant difference was observed for risk factors such as hypertension (p=0.953), diabetes mellitus (p=1.000), TIA (p=1.000), AF (0.523), human immunodeficiency (HIV) virus infection (p=1.000), antiphospholipid syndrome (p=0.725) and heart failure (p=1.000). About 6.7% of our pregnant female patients had eclampsia. Table 2 shows that females were more likely to be in coma compared to males (p=0.003). There was no major difference between gender regarding side of weakness, facial weakness, hemianopia, headache, vomiting, speech and swallowing problems. Males were

Table 2. Clinical state at time of presentation and stroke severity.

	Females	Males	p-value
Clinical state at presentation			
Right hemiparesis	15 (50.0%)	30 (49.2%)	1.000
Left hemiparesis	12 (40.1%)	26 (42.6%)	0.999
Facial weakness	22 (73.3%)	31 (50.8%)	0.068
Coma	9 (30.0%)	3 (4.92%)	0.003*
Headache	6 (20.0%)	10 (16.4%)	0.896
Vomiting	5 (16.7 %)	6 (9.8%)	0.544
Hemianopia	2 (6.7%)	4 (6.6%)	1.000
Aphasia	6 (53.3%)	32 (52.5%)	1.000
Dysarthria	4 (13.3%)	4 (6.6%)	0.505
Dysphagia	4 (13.3%)	8 (13.1%)	1.000
Mean SBP	148.47 + 29.143	158.10 + 37.941	0.225
min-max	(110-220)	(90-250)	
Mean DBP	90.47 + 18.320	100.05 + 22.631	0.047*
min-max	(60-130)	(40-150)	
Mean Random blood sugar (mmol/L)	6.274 + 2.4882	6.104 + 2.6922	0.772
Stroke severity			
NIHSS			
Admission	18.17 + 7.649	15.02+ 7.327	0.061
Discharge	16.96 + 15.961	10.86 + 12.310	0.047*
Duration of in-hospital stay	43.00 ± 33.1days	33.92 ± 27.3days	0.168
30-Day fatality	9(30.0%)	9(14.75%)	0.175

SBP – systolic blood pressure, DBP – diastolic blood pressure. NIHSS – national institutes of health stroke scale. *p value $\leq$ 0.05 from student's t – test.

Table 3. Summary of significant differences.

Females>Males	Males>Females
Less likely to be Educated	Lacunar strokes
Coma on admission	Smoking
Higher NIHSS score on discharge	Alcohol
	Higher diastolic BP

NIHSS – National Institutes of Health Stroke Scale.

more likely to have a higher diastolic blood pressure (DBP) at presentation (p=0.047). There was no gender difference in mean admission random blood sugar (p=0.772). Compared to males, females had more severe stroke on discharge (NIHSS, p=0.047). There was no significant difference in duration of hospital stay, or 30-day case fatality. Summary of significant differences is shown in Table 3.

DISCUSSION AND CONCLUSION

This is the first study in Northeastern Nigeria to examine gender differences in stroke. The main findings in this study show that, females were slightly younger than males. Females were less likely to be educated, engage in smoking or consume alcohol. Females were more likely to be in coma, and have severe stroke on discharge. Our study showed no gender difference in other risk factors. Reports elsewhere have clearly shown significant differences in risk factors, hypertension is commoner in females in several studies ((Di Carlo et al., 2003; Gargano et al., 2008; Gall et al., 2010; Reeves et al., 2009; Worrall et al., 2002), but it is not universal (Hart et al., 1999). Atrial fibrillation (AF) is also commoner in females (Di Carlo et al., 2003; Gargano et al., 2008; Holroyd-Leduc et al., 2000). Males were more likely to have DM and heart disease (Holroyd-Leduc et al., 2000; Gall et al., 2010). We reported a higher mean diastolic blood pressure in males, despite the high prevalence of eclampsia in females; likely explanations may be that patients with eclampsia were more likely to receive aggressive antihypertensive treatment early on admission (Conde-Agudelo and Kafury-Goeta, 1998). The higher DBP may as well be due to the younger age of our patients, as males have a higher prevalence of hypertension at a much lower age (Andersen et al., 2010).

Our study shows that the proportion of our patients with DM and AF is low; this low prevalence is in conformity with a study in Mozambique (Damasceno et al., 2010). A study by Hajat et al. (2001) showed that blacks appear to suffer less from DM and AF. Recently, AF seem to be reducing in whites due to improved treatment of high blood pressure and use of anticoagulants (Lakshminarayan, 2006). We observed that alcohol consumption and smoking is commoner in males and is in accordance with the findings in other studies ((Di Carlo et al., 2003; Gargano et al., 2008; Gall et al., 2010; Worrall et al., 2002). Females in our environment are less likely to indulge in some of these social habits, as it is considered culturally unacceptable. Eclampsia is a unique risk factor in females and an important medical condition in sub-Saharan Africa because of poor maternal health care. Eclampsia is complicated by stroke in about 4.9% of patients ((Conde-Agudelo and Kafury-Goeta, 1998). With improved maternal health care the incidence of eclampsia could significantly reduce (Audu et al., 2002). Studies have reported that females were older, since they were more likely to survive into old age than males, an age where strokes are common (Smith et al., 2009; Stuart-Shor et al., 2009; Förster et al., 2009), but studies in Nigeria have reported a lower mean age for stroke both in males and females (Wahab et al., 2007; Bwala, 1989). After the age of 65 years, the prevalence of hypertension increases in females and levels of in males after that age (Andersen et al., 2010). The lower age of females in this study (though not statistically significant) should be interpreted with caution; unlike other studies where females were significantly older than males, it will be difficult to draw such conclusion in this study owing to the smaller number of female participants, lower life expectancy, high maternal mortality, and living in a community where females are less likely to seek medical attention due to socioeconomic reasons (Osuntokun et al., 1987; Kapral et al., 2002).

Our report shows that females were less formally educated and this may have a significant influence on stroke presentation in females. Level of education may affect employment and income, and this may invariably affect drug compliance and quality of care (Di Carlo et al., 2003). The study by Worral et al. (2002) showed that, females had a lower household income and thus influencing stroke presentation and care. This study showed that males were more likely to have lacunar strokes. Studies have reported that POCS is commoner in males and TACS was more common in females (Petrea et al., 2009; Smith et al., 2009). The explanation given was that, AF is commoner in females and hence a higher embolic phenomena (Howard et al., 2009), this may explain why females are more likely to have anterior circulation stroke. A different study by Förster et al. (2009) reported that, small embolic and lacunar stroke was commoner in males. AF is commoner in older females, but the females in our study are younger, and so we are not likely to get similar findings as aforestated.

Our study showed that females were more likely to be in coma at presentation compared to males; this is in keeping with other studies (Di Carlo et al., 2003; Gall et al., 2010). A study by Lisabeth et al. (2009) showed that, women were more likely to have a change in level of consciousness and may be attributable to; stroke severity, delays in seeking care, delays in prompt diagnosis and differences in access to acute stroke therapy. This study did not show any difference in clinical conditions such as headache, vomiting, speech and swallowing difficulties, and is congruent with other studies (Stuart-Shor et al., 2009; Barrett et al., 2007). Di Carlo et al. (2003) reported that, these symptoms were more in females since they were more likely to be in coma. In our study, females were more likely to have a higher NIHSS on discharge compared to males; a possible reason may be due to higher number of lacunar strokes occuring in males. Those with non-lacunar stroke are more likely to have a worse stroke and higher fatality rate compared to those with lacunar stroke (Sacco et al., 2006). Several studies indicate that females were more likely to have a severe stroke on admission and have worse outcomes after stroke (Lewsey et al., 2009; Shobha et al., 2010; Hill et al., 2006). Other reports have shown no difference in stroke severity (Petrea et al., 2009; Förster et al., 2009; Jongbloed, 1986). We reported no gender difference in the duration of hospital admission; this is in agreement with a study by Zhu et al. (2009).

Our study shows no gender difference in fatality, this is in keeping with some studies (Di Carlo et al., 2003; Forster et al., 2009), while other studies reported a higher mortality (Gall et al., 2010; Reeves et al., 2009). The difference in quality of care, increasing age and higher stroke severity were the explanation given for a higher mortality in females. Several studies have shown that gender influences response to therapy (Smith et al., 2009; Ayala et al., 2002; Kent et al., 2005; Howard et al., 2009; Turtzo and McCullough, 2008). A study by Sacco et al. (2009) showed that, primary prevention of stroke with aspirin was effective in females than males, as well as response to thrombolytics. Some of the limitations of our study include, a smaller sample size compared to other similar studies. This study did not take into account the effect of stroke treatment, especially gender differences in the use of thrombolytic agents for stroke treatment. We also did not assess long-term outcome. The absence of data on blood lipids is another limitation in this study.

In conclusion, we found that gender differences exist in our stroke patients. Females were more likely to be unconscious and have a worse stroke on discharge. They were less likely to be educated. Men were more likely to have lacunar stroke, and more likely to smoke and consume alcohol. These gender differences in risk profile should influence risk stratification and treatment. Our environment is a resource poor setting, it will be

important to educate the populace on prevention of stroke.

REFERENCES

Andersen KK, Andersen ZJ, Olsen TS (2010) Age- and Gender-Specific Prevalence of Cardiovascular Risk Factors in 40 102 Patients With First-Ever Ischemic Stroke. A Nationwide Danish Study. Stroke, 41: 2768-2774.

Audu BM, Obed JY, Kyari O (2002). Review of factors predisposing to eclampsia and outcome. Trop. J. Obstetr. Gynaecol., 19: 23.

Ayala C, Croft JB, Greenlund KJ, Keenan NL, Donehoo RS, Malarcher AM, Mensah GA (2002). Sex Differences in US Mortality Rates for Stroke and Stroke Subtypes by Race/Ethnicity and Age, 1995-1998. Stroke, 33: 1197-1201.

Barrett KM, Brott TG, Brown RD Jr, Frankel MR, Worrall BB, Silliman SL (2007). Sex Differences in Stroke Severity, Symptoms, and Deficits after First-Ever Ischemic Stroke. J. Stroke Cerebrovasc. Dis., 16: 34-39.

Bwala SA (1989). Stroke in sub-Saharan Nigerian hospital: A retrospective study. Trop. Doctor, 19: 11-14.

Conde-Agudelo A, Kafury-Goeta AC (1998). Epidemiology of eclampsia in Colombia. Int. J. Gynaecol. Obstet., 61: 1-8.

Damasceno A, Gomes J, Azevedo A, Carrilho C, LoboV, Lopes H, Madede T, Pravinrai P, Silva-Matos C, Jalla S, Stewart S, Lunet N (2010). An Epidemiological Study of Stroke Hospitalizations in Maputo, Mozambique. High Burden of Disease in a Resource-Poor Country. Stroke, 41: 2463-2469.

Danesi M, Okubadejo N, Ojini F (2007). Prevalence of stroke in an urban mixed income community in Lagos, Nigeria. Neuroepidemiology, 28: 216- 223.

Di Carlo A, Lamassa M, Baldereschi M, Pracucci G, Basile AM, Wolfe CDA, Giroud M, Rudd A, Ghetti A, Inzitari D (2003). Outcome of Acute Stroke in Europe: Data from a Multicenter Multinational Sex Differences in the Clinical Presentation, Resource Use, and 3-Month Hospital-Based Registry. Stroke, 34: 1114-1119.

Förster A, Gass A, Kern R, Wolf ME, Ottomeyer C, Zohsel K, Hennerici M, Szabo K (2009). Gender Differences in Acute Ischemic Stroke: Etiology, Stroke Patterns and Response to Thrombolysis. Stroke, 40: 2428-2432.

Gall SL, DonnanG, Dewey HM, Macdonell R, Sturm J, Gilligan A, Srikanth V, Thrift AG (2010). Sex differences in presentation, severity, and management of stroke in a population-based study. Neurology, 74: 975-981

Gargano JW, Reeves MJ and for the Paul Coverdell National Acute Stroke Registry Michigan Prototype Investigators (2007). Sex Differences in Stroke Recovery and Stroke-Specific Quality of Life: Results From a Statewide Stroke Registry. Stroke, 38: 2541-2548.

Gargano JW, Wehner S, Reeves M (2008). Sex Differences in Acute Stroke Care in a Statewide Stroke Registry. Stroke, 39: 24-29.

Hajat C, Dundas R, Stewart JA, Lawrence E, Rudd AG, Howard R, Wolfe CDA (2001). Cerebrovascular Risk Factors and Stroke Subtypes Differences between Ethnic Groups. Stroke, 32: 37-42.

Hart CL, Hole DJ, Smith GD (1999). Risk factors and 20-year stroke mortality in men and women in the Renfrew/Paisley study in Scotland. Stroke, 30: 1999-2007.

Hill MD, Kent DM, Hinchey JA, RowleyH, Buchan MA, Wechsler LR, Higashida RT, Fischbein NJ, Dillon WP, Gent M, Firszt CM, Schulz GA, Furlan AJ (2006). On behalf of the PROACT-2 investigators. Sex based differences in the effect of intraarterial treatment of stroke. Analysis of the PROACT – 2 study. Stroke, 37: 2322-2325.

Holroyd-Leduc JM, Kapral MK, Austin PC, TuSex JV (2000). Differences and Similarities in the Management and Outcome of Stroke patients. Stroke, 31: 1833-1837.

Howard VJ, Voeks JH, Lutsep HL, Mackey A, Milot G, Sam AD II, Tom M, Hughes SE, Sheffet AJ, Longbottom M, Avery JB, Hobson RW II, Brott TG (2009). Does Sex Matter? Thirty-Day Stroke and Death Rates after Carotid Artery Stenting in Women Versus Men: Results From the Carotid Revascularization Endarterectomy Versus Stenting Trial (CREST) Lead-in Phase. Stroke, 40: 1140-1147.

Jongbloed L (1986). Prediction of function after stroke: a critical review. Stroke, 17: 765-776.

Kapral MK, Wang H, Mamdani M, Tu JV (2002). Effect of socioeconomic status on treatment and mortality after stroke. Stroke, 33: 268-275.

Kent DM, Price LL, Ringleb P, Hill MD, Selker HP (2005). Sex-based differences in response to recombinant tissue plasminogen activator in acute ischemic stroke: a pooled analysis of randomized clinical trials. Stroke, 36: 62-65.

Lakshminarayan K, Solid CA, Collins AJ, Anderson DC, Herzog CA (2006). Atrial fibrillation and stroke in the general Medicare population: a 10 year perspective (1992–2002). Stroke, 37: 1969-1974.

Lewsey JD, Gillies M, Jhund PS, Chalmers JWT, Redpath A, Briggs A, Walters M, Langhorne P, Capewell S, McMurray JJV, MacIntyre K (2009). Sex Differences in Incidence, Mortality, and Survival in Individuals With Stroke in Scotland, 1986 to 2005. Stroke, 40: 1038-1043.

Lisabeth LD, Brown DL, Hughes R, Majersik JJ, Morgenstern LB (2009). Acute Stroke Symptoms. Comparing Women and Men Stroke, 40: 2031-2036.

Ogun SA, Ojini FI, Ogungbo B, Kolapo KO, Danesi MA (2005). Stroke in South West Nigeria. A 10-year review. Stroke, 36: 1120-1122.

Osuntokun BO, Adeuja AOG, Schoeber BS, Bademosi O, Nottidge VA, Olumide AO, Ige O, Yaria F, Bolis CL (1987). Neurological disorders in Nigerian Africans; a community based study. Acta Neurol. Scand., 75: 13-21.

Ottenbacher KJ, Campbell J, Kuo Y-F, Deutch A, Ostir GV, Granger CV (2008). Racial and Ethnic Differences in Postacute Rehabilitation Outcomes after Stroke in the United States. Stroke, 39: 1514-1519.

Petrea RE, Beiser, AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA (2009). Gender Differences in Stroke Incidence and Poststroke Disability in the Framingham Heart Study. Stroke, 40: 1032-1037.

Reeves MJ, Fonarow GC, Zhao X, Smith EE, Schwamm LH (2009). Quality of Care in Women with Ischemic Stroke in the GWTG Program. Stroke, 40: 1127-1133.

Reid JM, Dai D, Gubitz GJ, Kapral MK, Christian C, Phillips SJ (2008). Gender Differences in Stroke Examined in a 10-Year Cohort of Patients Admitted to a Canadian Teaching Hospital. Stroke, 39: 1090-1095.

Sacco S, Cerone D, Carolei A (2009). Gender and stroke: acute phase treatment and prevention. Jan-Mar; Funct. Neurol., 24(1): 45-52.

Sacco S, Marini C, Totaro R, Russo T, Cerone D, Carolei A (2006). A population-based study of the incidence and prognosis of lacunar stroke. Neurology. May 9, 66(9): 1335-1338.

Shobha N, Sylaja PN, Kapral MK, Fang J, Hill MD (2010). Differences in stroke outcome based on sex. Neurology, 74: 767-771.

Smith DB, Murphy P, Santos P, Phillips M, Wilde M (2009). Gender Differences in the Colorado Stroke Registry. Stroke, 40: 1078-1081.

Stuart-Shor EM, Wellenius GA, Dellolacono DM, Mittleman MA (2009). Gender Differences in Presenting and Prodromal Stroke Symptoms. Stroke, 40: 1121-1126.

Turtzo LC, McCullough LD (2008). Sex Differences in Stroke. Cerebrovasc Dis., 26: 462-474.

Wahab KW, Sani MU, Samaila AA, Gbadamosi A, Olokoba AB (2007). Stroke at a tertiary medical institution in Northern Nigeria: Patient's profile and predictors of outcome. Sahel Med. J., 10: 6-10.

WHO Monica project, Principal investigators (1988). The World Health Organization Monica project (monitoring trends and determinants in cardiovascular disease) a major international collaboration. J. Clin. Epid., 41: 105-114.

Worrall BB, Johnston KC, Kongable G, Hung E, Richardson D, Gorelick PB (2002). Stroke Risk Factor Profiles in African American Women. An Interim Report from the African-American Antiplatelet Stroke Prevention Study. Stroke, 33: 913-919.

Zhu HF, Newcommon NN, Cooper ME, Green TL, Seal B, Klein G, Weir NU, Coutts SB, Watson T, Barber PA, Demchuk AM, Hill MD (2009). Impact of a Stroke Unit on Length of Hospital Stay and In-Hospital Case Fatality. Stroke, 40: 18-23.