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The Risk Factors of Metabolic Syndrome among Stroke Patients

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Abstract: Background the metabolic syndrome has known as an independent risk factor of stroke. The occurrence of this syndrome is due to genetic factors and lifestyle.*Methods*:224 stroke patients were evaluated for this study. This was a cross-sectional study of stroke patients from Komfo Anokye Teaching Hospital. Adult enrolees were eligible for inclusion. Other criteria for inclusion were patients with stroke within twenty-four hours of onset without any medication. Fasting blood sugar, lipid profile and blood pressure were measured. The National Cholesterol Education Program Adult Treatment Panel III and WHO guidelines were used to determine the stroke patients. *Results*: Based on the NCEP criteria 46.88%were classified to have metabolic syndrome, while the WHO criteria gave 10.27% of the stroke patients to have metabolic syndrome. Beside of metabolic syndrome, prevalence of metabolic syndrome components was significantly higher in stroke patients *Conclusion:* Stroke patients have all the risk factors of metabolic syndrome. The general population should also be educated for primary prevention measures for all age groups and both genders.

1. INTRODUCTION

Stroke is the most common reason of disability effects of more than 700 000 individuals and the third cause of death in the world per year (Air *et al*., 2007). Metabolic syndrome (MetS) is known as an independent risk factor of cardiovascular disease and stroke either (Cortez *et al*., 2011). The MetS rate depends on genetic and nongenetic (Koradi*et al*., 2011) and the metabolic syndrome characterizes by cluster of risk factors including obesity, insulin resistance, hypertension, hypertriglyceridemia and low HDL cholesterol (Hwang et al.,2011) demonstrated that according to NECP criteria FBS was the most important factor of increasing cardiovascular disease (Ford *et al* .,2002)The progressive increase in obesity, cardiovascular disease and metabolic syndrome prevalence motivated the National Cholesterol Education Program (NCEP), on its third panel, to propose clinical criteria to define metabolic syndrome by the presence of, at least, three altered factors; high blood pressure (BP), hypertriglyceridaemia, low HDL cholesterol, high plasma glucose and abdominal obesity. The presence of metabolic syndrome is associated with a higher risk of developing diabetes mellitus and cardiovascular diseases (Rutler*et al*., 2005).This study was preformed to evaluate the metabolic syndrome rate in stroke patients. In the study, the prevalence of metabolic syndrome among stroke patients was investigated, using the NCEP and WHO diagnostic criteria

2. METHODOLOGY

Stroke in-patients were selected from the Komfo Anokye Teaching Hospital (KATH) in Kumasi, from specific wards for male and female stroke patients. There were 117 males and 107 females within an age range of 25-120 years. The inclusion criteria for the selection were patients who have had a stroke in less than twenty-four hours without any medication. The patients were those admitted with sudden onset of characteristic neurological deficit and having distinctive neurological signs. Patients with loss of consciousness due to head injury, coma, trauma, tumour, poisoning or epilepsy were not included. This was a cross-sectional study. A questionnaire was administrated to each patient's caregiver in order to obtain the following information; demographic features (age, sex), socio-economic status (education and employment), medical history with specific attention to hypertension and diabetes and lifestyle (smoking and drinking). The study started from October 2009 and ended in January 2011. The Committee for Human Research Publications and Ethics of the KomfoAnokye Teaching Hospital gave the approval for the study.

2.1. Specimen Collection and Processing

About 5 ml of venous blood specimens were collected into non- anticoagulated tubes and were labelled with patients identifications. Another 5 ml of their blood were also collected into

ethylenediaminetetra acetic acid (EDTA) tubes. The blood specimens in both tubes were centrifuged to obtain serum and plasma, respectively. The samples were centrifuged in a speed of 12000-13000 rpm at 5 minutes.

2.2. Fasting Blood Sugar and the Lipid Profile

The test was done with Biotechnical Instrument (BT-3000 PLUS; made in Vila do Conde, Portugal) an automated analyzer.

2.3. Blood Pressure

Blood pressure was taken using a mercury sphygmomanometer and stethoscope. Measurements were taken from the left upper arm after patients had been sitting for 5 minute in accordance with recommendation of American Heart Association (Booth, 1999).

3. DEFINITION OF THE METABOLIC SYNDROME

The US National Cholesterol Education Program Adult Treatment Panel III (2001) requires at least, three of the following: central obesity: waist circumference ≥ 102 cm or 40 inches (male), ≥ 88 cm or 36 inches 54 (female)

TG ≥ 1.7 mmol/L, HDL-C < 1.03mmol,L (male), < 1.29mmol/L(female)

Blood pressure ≥ 130/85 mmHg, Fasting plasma glucose ≥ 6.1 mmol/L (110 mg/dl)

The prevalence of the metabolic syndrome was also defined by a modification of the WHO definition. A participant had WHO-defined metabolic syndrome if he or she had diabetes, impaired glucose tolerance, impaired fasting glucose or insulin resistance, plus two or more of the following abnormalities:

Blood pressure: ≥ 140/90 mmHg

Dyslipidaemia: triglycerides (TG): ≥ 1.695 mmol/L and high density lipoprotein-cholesterol (HDL-C) ≤ 0.9 mmol/L (male), ≤ 1.0 mmol/L (female)

Central obesity: waist:hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m²

Microalbuminuria: urinary albumin excretion ratio ≥ 20 μg/min or albumin: creatinine ratio ≥ 30 mg/g.

Statistical Analysis

Statistical analysis was conducted by calculating simple means and standard error of mean for continuous variables, and frequency counts and percentages for categorical variables. Fischer's, test, Pearson's correlation and student's t-test analyses were carried out on variables. Significance was set at $p<0.05$.

4. RESULTS

4.1. Use of NCEP for Identifying Subjects with Metabolic Syndrome

The US National Cholesterol Education Program Adult Treatment Panel III (2001) requires at least, three of the following:

Central obesity: waist circumference ≥ 102 cm or 40 inches (male), ≥ 88 cm or 36 inches 54 (female)

TG ≥ 1.7 mmol/L

HDL-C < 1.03mmol,L (male), < 1.29mmol/L(female)

Blood pressure ≥ 130/85 mmHg

Fasting plasma glucose ≥ 6.1 mmol/L (110 mg/dl)

Table1. *Proportions of stroke patients with dyslipidaemia, hyperglycaemia and elevated blood pressure*

M.S Components	Female	Male	Total
Triglycerides (≥1.7mmol/L)	64(28.57)	74(33.04)	138(61.61)
HDL – C (<1.03mmol/L for male, <1.29mmol/L for female)	52(23.21)	49(21.88)	92(41.07)
Fasting Blood Sugar (≥ 6.1mmol/L)	51(22.77)	76(33.93)	127(56.70)
Blood Pressure (≥ 130/85 mmHg)	85(37.95)	89(39.73)	174(77.68)

Where, n=frequency and the corresponding percentage in parentheses.

The proportions of patients with dyslipidaemia, according to NCEP criteria were determined, based on the sex of the stroke patients. The percentages of patients with elevated triglyceride, elevated sugar and high blood pressure were higher in males than in the females while reduced HDL-C was higher in the females than males.

Table2. *Proportion of stroke patients by age having component of metabolic syndrome according to NCEP criteria*

M.S Components	Age (years)						
	25 - 40	41 - 56	57 - 72	73 - 88	89 - 104	105 - 120	TOTAL
Blood Pressure Diastolic (≥130 mmHg)	8(3.57)	57(25.45)	87(38.84)	48(21.43)	8(3.57)	3(1.34)	211(94.2)
Blood Pressure Systolic (≥ 85 mmHg)	7(3.13)	41(18.30)	88(39.29)	43(19.19)	7(3.13)	2(0.89)	188(83.93)
Triglycerides (≥1.7 mmol/L)	4(1.79)	20(8.93)	58(25.89)	35(15.62)	7(3.12)	1(0.45)	125(55.80)
HDL – C (<1.03 mmol/L for male, <1.29 mmol/L for female)	3(1.34)	13(5.80)	34(15.18)	19(8.48)	6(2.68)	2(0.89)	77(34.38)
Fasting Blood Sugar (≥ 6.1mmol/L)	2(0.89)	17(7.59)	50(22.32)	24(10.71)	4(1.79)	0(0.00)	97(43.30)

Where, n=frequency and the corresponding percentage in parentheses.

The proportions of patients with various metabolic risk factors were stratified by their ages, according to NCEP criteria. From Table 6 ,the ages between 57-72 had the highest frequencies for all the components, followed by the ages between 41-56.The risk factor highest prevalence was seen in blood pressure which had a total of 211(94.2%) of elevated diastolic and 188 (83.93%)for systolic. This was followed by triglyceride for which 55.8% of the subjects had elevated values. The fasting blood sugar posed the lowest risk.

Table3. *Prevalence of M.S Components according to NCEP criteria for Stroke Patients*

Sex	M.S Components				
	0	1	2	3	Total
Female	4(3.74)	18(16.82)	35(32.71)	50(46.73)	107(100)
Male	5(4.27)	18(15.38)	39(33.33)	55(47.01)	117(100)
Total	9(4.02)	36(16.07)	74(33.04)	105(46.88)	224(100)

Where, n = frequency and the corresponding percentage in parentheses.

The prevalence of metabolic syndrome components according to NCEP criteria was determined for stroke patients according to the subjects who had the designated risk factors. According to Table 7, it was only nine of the patients (4.02% of the overall population) who did not have any of the risk factors or components of metabolic syndrome. On the other hand, the patients who had metabolic syndrome; that is, those who had three of the risk factors were 105, constituting 46.88% of the overall population. The percentages of the patients with metabolic syndrome in both sexes were almost the same; 47.01% were males, compared to 46.73% of females.

4.2. Use of WHO Criteria for Determining Presence of Metabolic Syndrome

The World Health Organization criteria (1999) require presence of one of diabetes mellitus, impaired glucose tolerance, impaired fasting glucose or insulin resistance, AND two of the following:

Blood pressure: ≥ 140/90 mmHg

Dyslipidaemia: triglycerides (TG): ≥ 1.695 mmol/L and high density lipoprotein-cholesterol (HDL-C) ≤ 0.9 mmol/L (male), ≤ 1.0 mmol/L (female)

Central obesity: waist:hip ratio > 0.90 (male); > 0.85 (female), or body mass index > 30 kg/m²

Microalbuminuria: urinary albumin excretion ratio ≥ 20 μg/min or albumin: creatinine ratio ≥ 30 mg/g

Table4. *Proportions of stroke patients with dyslipidaemia, hyperglycaemia and elevated blood pressure*

M.S Components	Female	Male	Total
Triglycerides (≥1.6957mmol/L)	63(28.13)	75(33.48)	138(61.61)
HDL – C (≤0.9mmol/L for male, ≤ 1.0mmol/L for female)	34(15.18)	39(17.41)	73(32.58)
Fasting Blood Sugar (≥ 6.1mmol/L)	51(22.77)	76(33.93)	127(56.69)
Blood Pressure (≥ 140/90 mmHg)	86(38.39)	96(42.86)	174(81.25)

Where, n = frequency and the corresponding percentage in parentheses.

The proportions of patients with dyslipidaemia, according to WHO criteria were determined, according to the sex of the stroke patients. The percentage of patients with elevated triglyceride, elevated sugar and high blood pressure were higher in males than in the females while reduced HDL-C was higher in the females than males.

Table5. *Proportion of stroke patients by age, having components of metabolic syndrome according to WHO criteria*

M.S Components	Age (years)						
	25 - 40	41 - 56	57 - 72	73 - 88	89 - 104	105 - 120	TOTAL
Blood Pressure Diastolic (≥140 mmHg)	6(2.68)	30(13.39)	76(33.93)	36(16.07)	5(2.23)	3(1.34)	156(69.64)
Blood Pressure Systolic (≥ 90 mmHg)	4(1.79)	28(12.50)	60(26.79)	27(12.05)	6(2.68)	1(0.45)	126(56.25)
Triglycerides (≥1.695 mmol/L)	4(1.79)	20(8.93)	58(25.89)	35(15.62)	7(3.12)	1(0.45)	125(55.80)
HDL – C (<0.9 mmol/L for male, <1.0 mmol/L for female)	5(2.23)	20(8.93)	54(24.11)	30(13.39)	6(2.68)	2(0.89)	117(52.23)
Fasting Blood Sugar (≥ 6.1mmol/L)	2(0.89)	17(7.59)	50(22.32)	24(10.71)	4(1.79)	0(0.00)	97(43.30)

Where, n=frequency and the corresponding percentage in parentheses.

The prevalence of metabolic syndrome components by WHO criteria were determined according to ages. From Table 9, the ages between 57-72 had the highest frequencies for all the components, followed by the ages between 41-56.The highest prevalence of risk factors was seen in blood pressure which had a total of 156(69.64%) of elevated diastolic and 126(56.2%)for systolic . This was followed by triglyceride for which 55.8% of the subjects had elevated values .The fasting blood sugar posed the lowest risk.

Table6. *Prevalence of M.S Components according to WHO for the Stroke Patients*

Sex	M.S Components				
	0	1	2	3	Total
Male	14(11.97)	44(37.61)	44(37.61)	15(12.82)	117(100)
Female	16(14.95)	43(40.19)	40(37.38)	8(7.48)	107(100)
Total	30(13.39)	87(38.84)	84(37.50)	23(10.27)	224(100)

Where, n=frequency and the corresponding percentage in parentheses.

The prevalence of metabolic syndrome components, according to WHO criteria was determined for stroke patients, using the designated risk factors. The males had a metabolic syndrome prevalence of 12.82% while the females had 7.48%. The females who had none of the risk factors were more than the males; 14.95% as against 11.97%.

5. DISCUSSION

Using the NCEP criteria for metabolic syndrome, gave a higher prevalence of metabolic syndrome of 46.88%, as compared to the WHO standard, which gave 10.27% (Tables 7 and 10 respectively). Similar to the findings of this study, Lee *et al.* (2004) and Xavier *et al,* (2009) found higher prevalence of metabolic syndrome among Singaporeans and Japanese, respectively, using NCEP and WHO criteria. This is also similar to a study by Turpin *et al* (2008) which had the prevalence of metabolic syndrome to be 10% (for WHO) and 62% (for NCEP) in 200 preeclampsia pregnant women. Metabolic syndrome is a known cardiovascular disease risk factor and has been associated with high risk of stroke in many studies. Ding *et al.* (2010), as well as Liu *et al.,* (2011) have suggested a dose-response correlation between metabolic syndrome components and risk of

cardiovascular disease and incidence of stroke. Considering the different components of the metabolic syndrome, elevated blood pressure (hypertension) was the most prevalent component in both NCEP and WHO criteria, as shown in Tables 5 and 9 respectively. This finding is similar to what Magid*et al*. (2004) observed in a study on stroke patients in Saudi Arabia, where hypertension was seen as a major risk factor for stroke.It was observed that the prevalence of metabolic syndrome components increased with age but was reduced in the oldest age group (Tables 6 and 9). Such an observation was also made by Tan *et al*. (2004), likewise Lee*et al* (2004), whose studies showed the prevalence of metabolic syndrome increased with age but was reduced in the oldest age group. The rise in metabolic syndrome and stroke has been reported to be highest in adults above their menopausal and androposal stages. This contradicts results shown elsewhere (Tan *et al*., 2004; Lee, 2004).This is seen in the ages between 57-72 years for all the metabolic syndrome components in both NCEP and WHO criteria; this can be seen in Tables 6 and 9 respectively.

6. CONCLUSION

As the frequency of metabolic syndrome in stroke patients is higher than controls, it is important to change the lifestyle in order to control this syndrome.

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