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Components of Metabolic Syndrome and Stroke: A Case-Control Study in Bangladesh

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Abstract **Original Research Article**

Background*:** Stroke is increasingly recognized as a global public health concern which is one of the leading causes of death and disability. Metabolic syndrome increases the risk of developing stroke. Recently, studies have been undergone world-wide on metabolic syndrome and stroke but studies are yet limited among Bangladeshi population. Thus, the aim of this study was to investigate the relationship between metabolic syndrome and stroke in Bangladeshi population. ***Methods*:** This center-based case-control study was conducted from January 2020 to January 2021 among 66 cases and 66 age and sex matched controls at National Institute of Neurosciences and Hospital (NINS), Dhaka, Bangladesh. Participants were interviewed by a pre-tested semi-structured questionnaire. A checklist was used to document waist circumference, blood pressure and reports of biochemical investigations. ***Results*:** Mean age of the cases was 54.36 ± 9.94 years and controls was 52.66 ± 9.03 years. Among the components of metabolic syndrome, hypertension ($p < 0.05$, OR 1.51, 95% CI 1.04-2.19), elevated triglyceride ($p < 0.05$, OR 1.74, 95% CI 1.21-2.50) and reduced HDL ($p = 0.018$, OR 2.436, 95% CI 1.066-5.566) were associated with stroke. The proportion of abdominal obesity in cases was 22.7% while a higher proportion was found in controls (30.3%). This study revealed a significant association between metabolic syndrome and stroke ($\chi^2 = 7.891$, $p < 0.05$, OR 0.354, 95% CI 0.17- 0.74). ***Conclusion: This study showed that components of metabolic syndrome were more prevalent in stroke.

Keywords: Metabolic Syndrome, Components, Stroke.

INTRODUCTION

Stroke presents a significant global health challenge and one of the major causes of morbidity and mortality worldwide. Stroke is the sudden death of some brain cells due to lack of oxygen when the blood flow to the brain is lost by blockage or rupture of an artery to the brain. It is also a leading cause of dementia and depression [1]. According to the World Health Organization (WHO), stroke is the second leading cause of mortality and third leading cause of disability. Over four decades, the stroke incidence in developing and under developed countries has more than doubled [1]. Comparing with people in the developed countries, people in developing countries also experience a higher stroke mortality and disability rate [2]. Stroke is the third leading cause of death in Bangladesh. The World Health Organization (WHO) ranks Bangladesh's death rate due to stroke as number 84 in the world [3]. Metabolic syndrome (MetS) is really not a single disease but a constellation of several interrelated vascular risk factors and metabolic abnormalities. The main components of metabolic syndrome are dyslipidemia (elevated triglycerides and decreased high density lipoproteins), elevated blood pressure, hyperglycemia and centrally distributed obesity [4, 5]. The worldwide prevalence of metabolic syndrome is high and continuously increasing. Current global estimate of metabolic syndrome is about 20-30% of the adult population [6, 7]. The risk of developing metabolic syndrome is escalating an alarming rate in South Asia particularly in India and Bangladesh [8, 9].

In Bangladesh, the prevalence of metabolic syndrome has been revealed to be 24.5% among rural population and 45% among urban population using IDF definition [10, 11]. The prevalence of MetS was significantly higher with a history of stroke (43.5%) than in subjects with no history of stroke (22.8%) among US adults.12 A hospital-based prospective observational study conducted in Bangladesh showed prevalence of metabolic syndrome was 46% among acute stroke patients [13] metabolic syndrome has emerged as a major health care challenge in the 21st century which is frequently associated with preventable death. Meaningful global strategies must reduce the morbidity and mortality associated with the MetS epidemic. Hence, the notion of this study was to evaluate that the MetS is associated with an increased risk for future stroke and reaffirms the need to develop preventive strategies directed to control the syndrome and each of its component conditions.

OBJECTIVE OF THE STUDY

The objective of this study was to find the association between components of metabolic syndrome and stroke

MATERIALS AND METHODS

This hospital based case-control study was conducted from January 2020 to January 2021 at National Institute of Neurosciences and Hospital (NINS), Dhaka, Bangladesh. The study included 132 participants: 66 diagnosed patients of stroke as cases and an equal number of age and sex matched participants with no history of stroke as controls.

Components of Metabolic Syndrome

National Cholesterol Education Program Adult Treatment Panel III (NCEP/ATP-III) and modified by the Asia–Pacific criteria, defined the diagnostic criteria for metabolic syndrome.[14,15] These criteria are as such, hypertension (blood pressure≥130/85 mmHg or ongoing anti-hypertensive treatment), hyperlipidemia (TG≥150 mg/dL or HDL≤40 mg/dL in men and 50 mg/dL in women or ongoing anti-lipidemic treatment), hyperglycemia (FPG≥110 mg/dL, previously physician-diagnosed type 2 diabetes mellitus [T2DM] or ongoing antidiabetic treatment) and obesity (BMI≥25 kg/m2 or waist circumference≥90 cm for men and 80 cm for women).

Written consent from all the participants was taken after making them aware of the study purpose. Participants were interviewed by a pre-tested semi-structured questionnaire. A checklist was used to document waist circumference, blood pressure and reports of biochemical investigations. The ethical approval was given by the Institutional Review Board of the institute and the place of study. Statistical Package for Social Science (SPSS) version 26 for Windows was used to analyze the data. Descriptive statistics were computed for socio-demographic variables both for cases and controls. Chi-square test was carried out to assess the association of qualitative data. To assess strength of associations, Odds Ratio (OR) and their corresponding 95% confidence interval (CI) were calculated. Statistical significance was defined as $p < 0.05$. Analyzed data were presented through tables.

RESULTS

Among 132 participants, 66 were cases and 66 were control. Table I shows demographic characteristics of the participants. Mean age for control was 52.66 ± 9.03 years and mean age for case was 54.36 ± 9.94 years slightly higher Male 54.5% and female 45.45% were equally distributed between case and controls. Occupation of the cases and controls was categorized into six groups. 39.4% were housewife in controls and 40.9% were housewife in case group. 80.3% controls were non-smoker and 66.7% cases non-smoker. Only 12.1% in controls and 16.7% in cases were current smoker. In this study, there was no significant association (Table I).

The proportion of abdominal obesity was found in cases 22.7% while 30.3% in controls. Raised fasting glucose level was found 37.9% among cases and 25.8% among controls. There was no significant association (p-value > 0.05). 65.2% cases had reduced HDL level while 45.5% control had reduced HDL level. Chi-square test revealed significant association (p-value < 0.05). Cases were 2.4 (OR 2.436; 95% CI 1.066-5.566) times more likely to have reduced HDL level than controls. 37.9% of the controls had raised triglyceride level while majority of the cases had raised triglyceride level 65.2%. There was significant association (p-value <0.05) (OR 1.74, 95% CI 1.21-2.50) (Table 4.16). The proportion of raised BP was 39.4% among the controls while 75.8% cases had raised BP. Chi-square test revealed a significant association between BP and stroke (p-value < 0.05) (OR 1.51, 95% CI 1.04-2.19) (Table II).

50.0% of the cases had metabolic syndrome while 26.2% controls had metabolic syndrome. Chi-square test revealed significant association between metabolic syndrome and stroke (p-value < 0.05) (OR 0.354; 95% CI 0.17-0.74) (Table III).

Table I: Demographic Characteristics of the Participants

Characteristics	Control (N=66)	Case (N=66)	χ^2 (Df)	p-value
	n (%)	n (%)		
Age in years				
< 40	6 (9.1)	6 (9.1)	1.06,	Ns
40-49	24 (36.4)	19 (28.8)		
50-59	21 (31.8)	22 (33.3)		
> 60	15 (22.7)	19 (28.8)		
Mean ± SD	52.66 ± 9.03	54.36 ± 9.94		
Sex				
Male	36 (54.55)	36 (54.55)		
Female	30 (45.45)	30 (45.45)		
Occupation				
Unemployed	8 (12.1)	10 (15.2)	1.6, 5	Ns
Service holder	8 (12.1)	7 (10.6)		
Business	9 (13.6)	9 (13.6)		
Housewife	26 (39.4)	27 (40.9)		
Retired	4 (6.1)	6 (9.1)		
Others	11 (16.7)	7 (10.6)		
Smoking				
Current	8 (12.1)	11 (16.7)	4.38, 3	Ns
Occasional	1 (1.5)	5 (7.6)		
Ex-smoker	4 (6.1)	6 (9.1)		
Never	53 (80.3)	44 (66.7)		

Table II: Components of Metabolic Syndrome and Stroke

Components	Control (N = 66)	Case(N =66)	χ^2 Df	p-value	OR (95% CI)
	n (%)	n (%)			
Abdominal Obesity					
Present	20 (30.3)	15 (22.7)	4.18,	0.336	
Absent	46 (69.7)	51 (72.3)			
Fasting glucose level					
Raised	17 (25.8)	50 (37.9)	2.235, 1	0.225	
Normal	49 (74.1)	41 (62.1)			
HDL level					
Reduced	30 (45.5)	43 (65.2)	5.18, 1	0.018	2.436 (1.066-5.566)
Normal	36 (54.5)	23 (34.8)			
Triglyceride level					
Raised	25 (37.9)	43 (65.2)	9.83, 1	1 <0.00,	1.74 (1.21-2.50)
Normal	23 (34.8)	41 (62.1)			
Blood pressure					
Raised	25 (37.9)	43 (65.2)	9.83, 1	<0.00, 1	1.74 (1.21-2.50)
Normal	41 (62.1)	23 (34.8)			

Table III: Association between Metabolic Syndrome and Stroke

Metabolic Syndrome	Control (N = 66)	Case (N= 66)	χ^2 Df	p-value	OR (95% CI)
	n (%)	n (%)			
Absent	49 (74.2)	33 (50.0)	7.891, 1	0.004	0.354 (0.17-0.74)
Present	17 (26.2)	33 (50.0)			

DISCUSSION

Stroke constitutes a major global public health burden and there is a strong association between the components of metabolic syndrome and stroke. Most of the previous studies involving metabolic syndrome and stroke were conducted in other parts of the world [12, 16, 17]. So far reviewed, in the context of Bangladesh some studies were conducted about the extent and prevalence of stroke and prevalence of metabolic syndrome [3, 10, 18, 19]. But studies on the association between metabolic syndrome and stroke are yet limited. To explore the influence, initiative was taken to carry out this case-control study. Hence, this case-control study demonstrated the association of metabolic syndrome with stroke. In this study, the mean age of the participants with stroke for control group was 52.66 ± 9.03 years and mean age for case group was 54.36 ± 9.94 years.

The present study showed that hypertension was present significantly in a higher proportion among stroke patients compared to the non-stroke controls (χ^2 = 17.87, p <0.05). A study conducted among Bangladeshi population showed the same findings: the prevalence of hypertension among stroke patients was 68% [13]. Majority of the cases had low HDL level. Current study revealed a strong association between stroke and reduced HDL level (p <0.05). Cases were 2.4 (OR 2.436; CI 1.066-5.566) times more likely to have reduced HDL level than controls. In some univariate analysis, components of metabolic syndrome were evaluated where low HDL were observed among cases compared to controls (P < 0.05), similar to Shah *et al*., Safoury *et al*., and Agamia *et al*., [20-22]. Among the cases and controls, 37.9% of the controls had raised triglyceride level while the majority of the cases had raised triglyceride level 65.2%. There was significant association (p-value is <0.05). Other studies from different countries showed similar findings [12, 13, 16, 17]. In this study, 37.9% cases and 25.8% controls had raised fasting blood glucose. But the Chi-square test revealed no significant association which found in contrast with the study by Shenoy *et al*., Maluki *et al*., and Wali *et al.*, [23-25]. These studies had observed significantly higher fasting plasma glucose in cases than to controls [20-22, 26]. Current study showed controls (30.3%) had a higher proportion of abdominal obesity than cases (22.7%). Other studies showed significant association between stroke and abdominal obesity which is an important component of metabolic syndrome. A case-control study showed abdominal obesity was higher in stroke patients than controls, 85% of patients and 65% of controls had high waist circumference (p= 0.007) [17].

CONCLUSION

This case-control study found that metabolic syndrome was significantly associated with stroke. Moreover, among the components of metabolic syndrome, hypertension, elevated triglyceride and reduced HDL level also showed significant association with stroke independently. Greater emphasis needs to be placed on the early diagnosis and treatment of people at risk for metabolic syndrome.

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