ASSOCIATION BETWEEN HYPERTENSION AND STROKE AMONG YOUNG THAI ADULTS IN BANGKOK, THAILAND

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Abstract. A hospital based case-control study was conducted to assess the association between hypertension and stroke among young Thai adults at a private hospital in Bangkok, Thailand. The study population was comprised of 98 inpatients with a first diagnosis of stroke and 98 inpatients without stroke admitted from 2006 to 2008, aged 18-45 years. Cases were matched with controls by sex and five year age group intervals. Risk factors for stroke, including hypertension were collected using a questionnaire. Significant finding on physical examination and blood testing were obtained from the patients' charts. Multivariate analysis revealed significant risk factors for stroke were: diagnosis of hypertension (adjusted OR 8.94; 95% CI 1.47-54.34), family history of stroke (adjusted OR 16.15; 95% CI 1.71-151.82), history of no or irregular exercise (adjusted OR 8.06; 95% CI 1.12-57.60) and having a low high density lipoprotein level (adjusted OR 5.93; 95% CI 1.11-31.52). Hypertension was the greatest risk factor for stroke among young Thai adults. Modification of lifestyle to reduce risk for stroke should focus on exercise, regular health check-ups and adequate treatment of hypertension.

Keywords: hypertension, stroke, young Thais

INTRODUCTION

Over two-thirds of stroke deaths worldwide occur in developing countries (Feigin, 2005). Stroke is common among the older adults, but many people under 65 also have strokes. A stroke in a young adult (<45 years old) is uncommon. The incidence of stroke among young adults was less than 2% in some developing countries in 1990 (Feigin, 2005). Where there has been an increase in incidence of stroke in developing countries, the incidence of stroke among young adults has also increased (Gandolfo and Conti, 2003). Strokes occur in 5% of western European adults (Marini *et al*, 2001), 8% of Americans (Jacobs *et al*, 2002), and 13% of Saudi Arabians (Rajeh and Awada, 2002). In Thailand, stroke is fourth leading cause of death at 28.96 per 100,000 in 2009. In 2008, the death rate from stroke in 15 to 59 years old was 12.00 per 100,000; 16.3 per 100,000 in males, and 7.8 per 100,000 in

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females (Ministry of Public Health, 2008).

There are 2 main types of stroke, ischemic (cerebral infarction) and hemorrhagic [intracerebral hemorrhagic (ICH) and subarachnoid hemorrhagic (SAH)] (Jacobs *et al*, 2002). Risk factors for stroke in young adults are usually the same as in elderly. Risk factors for ischemic stroke include embolism, atherosclerotic diseases, while risk factors for hemorrhagic stroke include substance abuse, trauma, oral contraceptive use, pregnancy and postpartum states, and migraines (Marcoux, 2000). High blood pressure is one of the most common causes of stroke because it puts unnecessary strain on blood vessel walls, causing them to thicken and deteriorate (Marcoux, 2000).

Traditional risk factors of ischemic stroke in young adults include smoking, diabetes mellitus and hypertension (Lipska *et al*, 2007). Studies from Asia showed ischemic and hemorrhagic strokes had the same risk factors, especially a history of hypertension (Park *et al*, 1998; Lipska *et al*, 2007). Other risk factors included a low high density lipoprotein (HDL) level, the presence of three or more components of metabolic syndrome (Rohr *et al*, 1996). In Bangkok, Thailand in 2007, morbidity of essential hypertension was 6.4% for inpatients for all age groups (Bangkok Metropolitan Administration, 2007). Throughout the Kingdom of Thailand, hypertension account for 1,153 of 100,000 inpatient of all age group (Ministry of Public Health, 2008). Finding significant risk factors for stroke can be used to improve health and prevent loss of productivity in younger working persons. The aim of this study was to determine the association between hypertension and stroke among young adults who received treatment for stroke at a private hospital in Bangkok.

MATERIALS AND METHODS

Participants

This hospital-based case-control study was conducted among patients aged 15 to 45 years admitted to a private hospital, in Bangkok, Thailand from 2006 to 2007. Cases were recruited from 98 consecutive patients admitted with a first stroke to the neuro intensive care unit. Stroke was diagnosed with computerized axial tomography (CT) of the brain and/or followed by magnetic resonance imaging (MRI) after arriving at hospital (Brazzelli *et al*, 2010). Hospital controls were patients who did not have stroke or a prior history of stroke or TIA (transient ischemic attack). Controls were recruited from 98 patients admitted with other medical problems during the same time period of the cases, and were matched by gender and 5-year intervals of age group.

Data collection

The present study was approved by Ethics Committee on Human Rights Related to Research Involving Human Subjects from Mahidol University and the hospital study site. Hospital records of cases and controls were reviewed and demographic data (age, sex, and occupation), lipid profile (LDL, HDL) were records one week after the stroke, and physical data (weight and height). Body mass index (BMI) = (weight in kg/height in meter^2) was calculated. The definitions for underweight and thin (BMI <18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI = 25-29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2) followed WHO criteria (WHO Experts Consultation, 2004).

A history of hypertension, diabetes mellitus, cardiovascular disease before the stroke, a family history of stroke, and a history of smoking, alcohol consump-

Table 1
Demographic characteristics, genetic factors and past chronic conditions of the study population.

Variables	Cases (*n*=98), number (%)	Controls (*n*=98), number (%)	*p*-value[a]
Age			
≤25	4 (4.1)	6 (6.1)	0.374
>25-45	94 (95.9)	92 (93.9)	
Mean age	40.12 (6.07)	38.47 (6.17)	
Sex			
Male	66 (67.3)	66 (67.3)	0.560
Female	32 (32.7)	32 (32.7)	
Types of Work			
Mild and moderate work	91 (92.9)	93 (94.6)	0.384
Heavy work	7 (7.1)	5 (5.1)	
Past medical history			
Hypertension	61 (62.2)	13 (13.3)	<0.001
Diabetes mellitus	14 (14.3)	12 (12.2)	0.417
Hyperlipidemia	34 (34.7)	30 (30.6)	0.324
Cardiovascular disease	20 (20.4)	3 (3.1)	<0.001
Family			
Hypertension	36 (36.7)	25 (25.5)	0.061
Stroke	26 (26.5)	12 (12.2)	0.009

[a]*p*-value from chi-square test

tion, and exercise habits were obtained. A questionnaire was used to determine if the patients had type A behavior (Sykes *et al*, 1992). The sample size calculation was based on the relative risk of stroke with hypertension (3.75) (Wolf *et al*, 1991) and the prevalence of patients admitted to the hospital with hypertension in Bangkok, Thailand during 2007 (6.4%) (Bangkok Metropolitan Administration, 2007). The minimum sample size was determined to be 94 cases and 94 controls (Dean *et al*, 2010).

Statistical analysis

The prevalence of each risk factors among cases and controls was assessed. Multiple logistic regression analysis was used to assess the adjusted odds ratio (OR) with 95% confident interval (CI) for each stroke risk factor. Detection of interaction term and the collinearity between two independent variables were determined and used in the final model. The dependent variable was stroke (yes/no). The independent variables were diagnosis of hypertension before stroke (yes, no), diagnosis of diabetes mellitus before stroke (yes, no), diagnosis of cardiovascular disease before stroke (yes, no), family history of stroke (yes, no), smoking (current, ex, never), exercise (< 3 times a week, ≥ 3 times a week), type of occupation (mild and moderate work, heavy work), personality type (type A, non-type A), alcohol consumption (current, used to drink, never drank), BMI (< 18.5, 18.5-24.9, 25-29.9, ≥ 30). LDL cholesterol level

(high,normal) and HDL cholesterol level (low,normal), gender (male,female) and age in years. Model fitness was determined with Hosmer and Lemeshow test ($p = 0.442$) (Hosmer and Lemeshow, 2000). Associations were considered significant at $p < 0.005$.

RESULTS

The average age of the cases was 40.12 (6.07) years and controls was 38.47 (6.17) years ($p = 0.06$) with a ratio of males to females of 2 : 1. Fifty-five cases (45.9%) of stroke were hemorrhagic stroke and 53 cases (54.1%) were ischemic stroke. The prevalence of hypertension was significantly higher among cases than controls (62.2% and 13.3%, respectively) ($p < 0.001$) (Table 1). The prevalences of current smoking and irregular exercise were also higher among cases than controls ($p = 0.006$ and $p < 0.001$) (Table 2). The prevalences of high intake of fruit and vegetable were higher among control than cases ($p < 0.001$) (Table 2). Cases had a higher prevalence of high LDL levels and low HDL levels than controls ($p = 0.003$ and $p < 0.001$)(Table 2). The results from multiple logistic regression in the final model demonstrated the significant risk factors for stroke were hypertension (OR 8.94; 95%CI 1.47- 54.34), family history of stroke (OR 16.15; 95%CI 1.71-151.82), irregular exercise (OR 8.06; 95%CI 1.12-57.60), and having a low HDL level (OR 5.93; 95%CI 1.11-31.52) (Table 3).

DISCUSSION

This hospital based case-control study conducted among young adults in Thailand. Having a history of hypertension was a risk factor for stroke, along with having a history of cardiovascular disease, having a family history of stroke, exercising irregularly, and having a low HDL level (Table 3). The association between hypertension and stroke was the same as in a hospital based case-control study of ischemic stroke in southern India (Lipska, 2007), and a population based case-control study of ischemic stroke in Baltimore-Washington, USA (Rohr *et al*, 1996). A study in Korea demonstrated hypertension as an important risk factor for both intracerebral hemorrhage (ICH) and subaracnoid hemorrhage (SAH) (Park *et al*, 1998). These studies confirmed the role of hypertension as a risk factor for stroke. Hypertension can lead to plaque rupture, clot formation and embolization of the clot to cerebral artery causing a stroke. The present study also showed lack of or irregular exercise increased risk of stroke. Other studies have shown an inverse dose-response relationship between physical activity and morbidity from coronary heart disease (CHD), stroke and cancer (Hu *et al*, 2000; Blair *et al*, 2001). Low HDL levels can increased risk for heart disease, especially among men with low HDL levels. Men also have an increased incidence of atherosclerotic heart disease. Results from a study in Europe demonstrated lower risk of stroke with higher HDL levels among men, but among women a high HDL was associated with a significantly higher risk of non-fatal stroke and cerebral infarction (Bots *et al*, 2002). The present study showed increased risk of stroke when HDL levels were lower than normal, whether or not they were male or female patients. This finding needs further investigation.

There was no significant association between diabetes mellitus and stroke in this study contrary to other studies (Park *et al*, 1998), including a study in Bangkok, Thailand, which reported the prevalence of stroke as 3.5% among diabetic patients,

Table 2
Behavioral and biological factors of the study population.

Variables	Cases (*n*=98), number (%)	Controls (*n*=98), number (%)	*p*-value[a]
Smoking history			
Current smoking	28 (28.6)	13 (13.3)	0.006
Used to smoke	15 (15.3)	9 (9.2)	
Never smoked	55 (56.1)	76 (77.6)	
Alcohol consumption			
Current drinker	26 (26.5)	9 (9.3)	0.659
Used to drink	13 (13.3)	28 (28.6)	
Exercise			
Exercise irregularly	9 (9.2)	43 (43.9)	<0.001
Regular exercise	89 (90.8)	55 (56.1)	
Types of works			
Mild to moderate work	91 (92.9)	93 (94.9)	0.384
Heavy work	7 (7.1)	5 (5.1)	
Body mass index (kg/m^2)			
<18.5	27 (36.5)	42 (44.2)	0.548
18.6-24.9	15 (20.3)	19 (20.0)	
≥25	32 (43.2)	34 (35.8)	
Behavior			
Type A	88 (89.8)	82 (83.7)	0.146
Non-type A	10 (10.2)	16 (16.3)	
Fatty food intake			
Low	37 (37.8)	47 (48.0)	0.097
High	61 (62.2)	51 (52.0)	
Salt intake			
Low	45 (45.9)	51 (52.0)	0.238
High	53 (54.1)	47 (48.0)	
Fruit and vegetable intake			
Low	30 (30.6)	9 (9.2)	<0.001
High	68 (69.4)	89 (90.8)	
Low density lipoprotein			
Normal	10 (10.2)	2 (2.0)	0.003
High	51 (52.0)	38 (38.8)	
Unknown	37 (37.8)	58 (59.2)	
High density lipoprotein			
Normal	26 (26.5)	32 (32.7)	0.001
Low	26 (26.5)	7 (7.1)	
Unknown	46 (46.9)	59 (60.2)	

[a]*p*-value from chi-square test

and found the risk for stroke increased when diabetic patients had hypertension (Plengvidhya *et al*, 2006). Smoking common among young adults, has been shown to be risk factor for both ischemic and hemorrhagic stroke (Rohr *et al*, 1996;

Table 3
Crude and adjusted odds ratio (OR) with 95% confident intervals (95%CI) for stroke by potential risk factors.

Risk factors of stroke	Crude odds ratio		Adjusted odds ratio[a]		*p*-value
	OR	95%CI	OR	95%CI	
History of hypertension					
Yes	10.78	5.28-21.97	8.94	1.47-54.34	0.019[c]
No	1[b]		1[b]		
History of diabetes mellitus					
Yes	1.00	0.45-2.17	0.91	0.10-7.96	0.954
No	1[b]		1[b]		
History of cardiovascular disease					
Yes	8.12	2.32-28.33	14.55	0.46-459.54	0.134
No	1[b]		1[b]		
Family history of stroke					
Yes	2.58	1.22-5.49	16.15	1.71-151.82	0.015[c]
No	1[b]		1[b]		
Smoking history					
Current smoke	0.77	0.26-2.22	3.77	0.61-23.08	0.155
Ex smoking	0.33	0.16-0.70	1.57	0.02-87.21	0.833
Non smoke	1[b]		1[b]		
Exercise					
Irregularly	7.73	3.49-17.09	8.06	1.12-57.60	0.037[c]
Regular	1[b]		1[b]		
Behavior					
Type A	1.71	0.73-3.99	1.28	0.15-10.45	0.805
Non-type A	1[b]		1[b]		
BMI					
≥ 25 kg/m^2	1.19	0.51-2.73	1.20	0.10-13.31	0.935
< 18.5 kg/m^2	0.81	0.35-1.87	0.72	0.05-8.79	0.768
18.5-24.9 kg/m^2	1[b]		1[b]		
Alcohol drinking					
Current drinker	0.96	0.50-1.82	0.55	0.07-4.10	0.601
Used to drink	1.49	0.59-3.75	5.25	0.28-98.77	0.263
Non drinker	1[b]		1[b]		
LDL					
High	0.268	0.056-1.297	0.64	0.038-10.799	0.771
Normal	1[b]		1[b]		
HDL					
Low	4.571	1.712-12.205	5.93	1.11-31.52	0.038[c]
Normal	1[b]		1[b]		

[a]Adjusted for all variables in table including age, gender and types of work
[b]Reference group; [c]p<0.05

Park *et al*, 1998), but the present study and another study in Korea (Park *et al*, 1998) did not demonstrate this association.

The site of the present study was a private hospital in urban Bangkok, Thailand among subjects with an income above average, who could afford to pay for health care at a higher price than government hospitals. In our study, the cases did not usually use government hospitals, worked in an office, had no time for exercise, spent leisure time for meeting with others, drank alcohol and coffee, occasionally smoked. Young adults with the above characteristics represent a common lifestyle among middle or upper socioeconomic status living in Bangkok, Thailand.

The Fourth National Health Examination Survey conducted by the Ministry of Public Health in 2007-2008 found among the studied population, among those found to have hypertension in Bangkok, 28.1% had been previously diagnosed with hypertension and the hypertension was under control, 26.4% had been previously diagnosed with hypertension but their blood pressures were under poor control, 8.7% had been previously diagnosed with hypertension but were not receiving any treatment, and 36.8% had no previous diagnosis of hypertension and were unaware they had hypertension. This survey reported an overall prevalence of stroke among Thais aged 15 to 29 of 0.3% (0.2% among males, 0.5 among females), among Thais aged 30 to 44 years of 0.8% (0.9% among males, 0.8% among females), and among Thai aged 45 to 59 years of 1.9% (2.4% among males, 1.5% among females) (Ministry of Public Health, 2009).

This study population size did not allow a separate analysis each for ischemic and hemorrhagic stroke. Selection of controls is often the most difficult part of case-control studies, especially selection of hospital controls. This study tried to select controls from patients with a variety of diagnoses with the expectation that no particular risk factors would be over-represented. Limitations of this study included the small sample size resulted in a large 95%confidence interval which is very wide and they were missing lipid level.

In conclusion, the present study confirms regular exercise, not smoking, and regular health check-ups to determine the presence of hypertension and lipid levels, along with treatment may prevent stroke. Controlling hypertension is necessary to prevent stroke. Ministry of Public Health, Thailand produced risk factors assessment score cards for stroke which include the following risk factors: smoking, being overweight or obese, inadequate exercise, family history of stroke, elevated total cholesterol, and hypertension. A prospective study should be carried out to determine stroke risk factors among young Thai adults.

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