Prevalence of Stroke and Stroke Risk Factors in Thailand: Thai Epidemiologic Stroke (TES) Study

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Objective: *To assess stroke prevalence and stroke risk factors in Thailand.*
Material and Method: *Thai Epidemiologic Stroke (TES) Study is an ongoing, community based cohort study that has been conducted in five geographic regions of Thailand. Baseline health status survey was started in 2004 and enrollment continued until the end of 2006. All participants who were suspicious of being stroke victims were verified. In this analysis, baseline data of 19,997 participants aged 45 to 80 years were identified and analyzed as a cross-sectional analysis.*
Results: *Three hundred and seventy six subjects were proved to have a stroke thus resulting the crude prevalence of stroke to be 1.88% (95% CI, 1.69 to 2.07). Age standardization to Segi world standard population was 1.81% (95% CI, 1.62 to 1.99). Crude prevalence among adults aged ≥ 65 years was 2.70% (95% CI, 2.28 to 3.11). Stroke prevalence differed among five geographic regions of the country (Bangkok 3.34%, Central region 2.41%, Southern 2.29%, Northern 1.46% and Northeastern 1.09%). Using multiple logistic regression analysis, factors associated with higher stroke prevalence were male gender ($p < 0.001$), occupational class ($p < 0.001$), geographic region ($p < 0.001$), hypertension ($p < 0.001$), diabetes mellitus ($p = 0.002$) and hypercholesterolemia ($p = 0.026$).*
Conclusion: *Stroke prevalence in Thailand from TES study is higher than previous studies, but it is lower than developed countries, probably due to high case fatality rate in Thai population. Geographic variation in stroke prevalence is found more in Bangkok, Central and Southern regions. Longitudinal follow-up of TES cohort study will provide further information on risk factors and incidence of stroke.*

Keywords: *Prevalence of stroke, Stroke risk factors, Geographic gradient, Epidemiology of stroke, Thailand*

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Stroke is the second commonest cause of death and adult disability worldwide[1]. An estimated 5.7 million people died in 2005 and 87% of these deaths were in low-income and middle-income countries[2]. Without intervention, the number of global deaths was projected to rise to 6.5 million in 2015 and to 7.8 million in 2030[2]. Despite the advent of treatment of selected patients with stroke, the best approach to reduce the burden of stroke remains prevention[3]. For effective preventive strategies, it is essential to have a good epidemiologic data[4]. Although epidemiologic data in developed countries were well established, there was lack of reliable data in the developing world[4-6].

In Thailand, stroke was the first and third leading cause of death in females and males of all age groups respectively[7,8]. In 1983, one study conducted in Bangkok Metropolitan showed that the prevalence of stroke was 690/100,000 population (age over 20 years)[9]. Another study in 1998, revealed prevalence of stroke in the elderly (aged over 60 years) was 1.12%[10]. However, there were still limited epidemiologic data and up to date measurement is important for planning and delivering an effective health care provision.

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Thai Epidemiologic Stroke (TES) study is the first large community based cohort study being ongoing to investigate the relationship between various risk factors, lifestyles and stroke in Thailand. The objective of the present study was to report the prevalence of stroke and the associations of various risk factors and stroke prevalence by using baseline survey data.

Material and Method

Study population

Thailand is a country in Southeast Asia with a population of 60 million and has four geographical regions[11]. There are 76 provinces and Bangkok is the capital city[11]. TES study is an ongoing, community based cohort study that has been being conducted in five communities including Bangkok and four communities from each geographic region of the country, namely Chiang Mai province (northern region), Khon Kaen province (northeastern region), Chachoengsao province (central region) and Nakhon Si Thammarat province (southern region). The study sample consists of a general population aged 45-80 years who live in the study areas and are willing to cooperate in the long-term cohort phase. The authors recruited participants on the volunteer basis and participants were accrued by approaching directly via address lists, with the assistance of local health personnel, as well as by announcements in local media. Study sample was stratified by study region, namely Bangkok and four geographical regions around the country to ensure that the distribution was proportionately matched by study region with that of Thailand population[11].

Baseline health survey

Baseline health survey took place at the community place between 2004 and 2006. Data collection included measurement of blood pressure and anthropometric data, collection of blood sample after overnight fast and face-to-face interview. Participants who were suspected to have a stroke were interviewed and examined by board-certified neurologists.

Blood pressure was measured three times, one minute apart with the use of an automated blood pressure device (Omron HEM-907, Omron Healthcare Singapore PTE LTD, Singapore) after participants had rested at least for five minutes. The measurement of waist circumference was taken at the level of mid-point between the inferior margin of the last rib and the crest of the ilium in the mid-axillary plane. Weight was measured by using the digital weight measurement machine (TANITA BWB-800, TANITA corporation, Japan). Venous blood samples were obtained after 12-hours overnight fasting. The serum/plasma was sent to the Division of Clinical Chemistry, Department of Pathology, Faculty of Medicine Ramathibodi Hospital for biochemical analysis.

A stroke-screening questionnaire was developed following a review of the literature[12-15]. The screening questionnaire that the authors used was modified from previous validated study[14,15], which has a high degree of accuracy for stroke screening in the population. The questions composed of the following questions: "Have you ever been told by physician that you had a stroke?", "Have you ever had sudden weakness on one side of your body?", "Have you ever had sudden numbness on one side of your body?", "Have you ever experienced sudden loss of the ability to express yourself verbally?", "Have you ever had sudden loss of vision in one eye or double vision?", "Have you ever had sudden walking difficulty with spinning sensation?". When all questions were answered negatively, participants were considered as being free from stroke. When one or more of the questions were responded positively and/or uncertainly, the participants were interviewed and examined by board-certified neurologists for determining stroke status. Therefore, each participant's stroke status was determined on the basis of face-to-face interview and physical examination results.

Quality assurance and data management

All working personnel in the present study were extensively trained. All case record forms were checked for completeness and consistency with each participant at the survey site. According to the present study standard operating procedures, standard checklist forms were developed to monitor the performance of the working staffs. The laboratory is certified by the Centers for Disease Control, USA-National Heart, Lung and Blood Institute Lipid Standardization Program. Independent double data entry were performed for the open-ended questions, and for the check list questions, electronic data capture using Remark Office OMR version 5 software (Gravic, Inc., PA, USA) were performed. According to Good Clinical Data Management Practices[16], data checking and cleaning were done.

Definitions

The criteria for the diagnosis of stroke were those given by the World Health Organization[17]. For

hypertension, the average of three measurements was used in this analysis and hypertension was defined as blood pressure ≥ 140/90 mmHg or self-reported use of antihypertensive medication. Fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or history of treatment for diabetes was defined as diabetes. Hyperlipidemia was defined by fasting cholesterol ≥ 5.2 mmol/l (200 mg/dl) or self-reported use of medication for hyperlipidemia. Never smokers were those who have never smoked at all, or have smoked less than 100 cigarettes in their lifetime. Current smoker was defined as having smoked 100 cigarettes or more in a lifetime and smokes cigarettes currently. Participants who smoked 100 cigarettes or more in their lifetime but currently do not smoke at all were defined as ex-smokers.

Statistical analysis

In this analysis, the authors did cross-sectional analysis by using baseline health survey data. Age, gender, and region-specific prevalence for stroke were derived and 95% confidence intervals were calculated. The crude rates were standardized to Segi world standard population[18] and the new WHO world standard population[18]. Regarding to demographic data and risk factors, continuous variables were presented as mean and standard deviation (SD). Categorical variables were described with percentages. A univariate logistic model was used to examine the individual relationship between each variable and stroke. After each variable was tested independently in a univariate regression model, those that achieved a p-value < 0.20 were selected for testing in multivariate logistic regression. Odds ratio (ORs) and 95% confidence intervals (CIs) were used to illustrate the association between potential risk factors and stroke. All probability values were two sided and level of significance was set at p-value < 0.05. Statistical analyses were performed using SPSS for Windows version 16.0 (SPSS Inc., Chicago, Illinois, USA).

Ethics

The present study was approved by the Ethical Review Committee for Research in Human Subjects, Ministry of Public Health, Thailand. Signed informed consent was obtained from all participants.

Results

A total of 19,997 participants comprised of 6,803 men and 13,194 women with mean age 59 years (SD 9.0 years) and ranged 45 to 80 years were included in the present study. Comparisons of proportional distribution (%) of the Thai population aged 45 to 80 years[11] with those of the TES study participants, by gender, age, geographical area, religion, educational level and marital status are shown in Table 1.

One thousand and three (5.0%) of the 19,997 participants were suspected to have a stroke as determined by the screening questionnaire. Board-certified neurologists examined all of 1 003 participants and 376 (37.5%) stroke patients were found with crude prevalence of 1.88% (95% CI, 1.69 to 2.07). Among questions that were responded positively, the question that asked "Have you ever been told by a physician that you had a stroke?" had the highest possibility (75.9%) that the participant had a stroke (Table 2).

Men had a higher prevalence than women in all age groups with the overall male to female prevalence ratio of 2.09. Prevalence (%) by age, sex and standardized rates were shown in Table 3. Stroke prevalence increased steadily with age, from 1.10% (95% CI, 0.86 to 1.33) in participants aged 45 to 54 years to 3.14% (95% CI, 2.13 to 4.15) in participants aged 75 to 84 years (Table 3). Among adults aged ≥ 60 years and ≥ 65 years, crude prevalence were 2.56% (95% CI, 2.23 to 2.89) and 2.70% (95% CI, 2.28 to 3.11) respectively. Aged standardized prevalence to Segi world standard population for people aged 65 years or more was 2.60% (95% CI, 2.17 to 3.03). Stroke prevalence differed among five regions and Bangkok had the highest prevalence (Table 4).

In univariate analysis, age, male gender, education level, occupation, region, waist circumference, smoking, hypertension, diabetes mellitus and hypercholesterolemia were statistically significant ($p < 0.001$) associated with stroke prevalence (Table 5). After adjustment for potential confounders by multiple logistic regression analysis, factors that remained statistically significant associated with stroke were male gender ($p < 0.001$), occupation ($p < 0.001$), region ($p < 0.001$), hypertension ($p < 0.001$), diabetes mellitus ($p = 0.002$) and hypercholesterolemia ($p = 0.026$) (Table 6). Among well-recognized risk factors, hypertension had the highest odd ratio (OR, 2.80; 95% CI, 2.17 to 3.61; $p < 0.001$).

Discussion

In Thailand, there are only two previous community based studies concerning stroke prevalence[9,10]. In the present study, the sample population of 19 997 aged 45 to 80 years was drawn from five geographic regions of Thailand, showed that crude prevalence of stroke was 1.88% (95% CI, 1.69 to

Table 1. Proportional distribution (%) of Thai population aged 45 to 80 years and of TES study participants, by gender, age, geographical area, religion, educational level and marital status

	Thai population* (n = 14,143,394)		TES study participants (n = 19,997)	
	Men	Women	Men	Women
Age (years)				
45-49	27.0	25.7	15.0	18.3
50-54	20.6	19.7	18.9	20.8
55-59	16.4	16.0	17.3	19.1
60-64	13.8	14.1	15.9	14.3
65-69	10.5	11.1	14.5	13.4
70-74	7.2	8.0	10.9	9.1
75-79	4.1	4.8	6.9	4.5
80	0.5	0.7	0.5	0.3
Geographical area				
Bangkok	9.7	10.0	7.8	12.3
Central region	23.0	23.6	21.8	25.6
Southern region	12.4	12.0	13.7	11.5
Northern region	21.5	20.8	25.3	20.2
Northeastern region	33.7	33.6	31.4	30.4
Religion				
Buddhism	95.4	95.7	99.4	99.0
Others	4.6	4.3	0.6	1.0
Educational level				
Illiterate	9.6	19.3	1.1	3.6
Primary	74.3	72.4	74.8	80.4
Secondary	9.7	4.2	17.5	9.0
University	6.4	4.1	6.6	7.1
Marital status				
Single	3.2	5.6	2.4	7.6
Married	88.2	69.2	88.7	62.6
Widow/widower	7.6	23.6	6.4	22.8
Separated	1.0	1.6	2.5	7.0

* Population and housing census data (aged 45 to 80 years) of the whole kingdom 2000[11]
TES = Thai epidemiologic stroke

Table 2. Stroke (%) by question that was responded positively or uncertainly

Question	Stroke* (%)
One or more of the questions in the questionnaire were responded positively and/or uncertainly (n = 1,003)	37.5
Question that was responded positively.	
Have you ever been told by physician that you had a stroke? (n = 361)	75.9
Have you ever had sudden weakness on one side of your body? (n = 403)	70.0
Have you ever experienced suddenly lost the ability to express yourself verbally?" (n = 322)	67.4
Have you ever had sudden numbness on one side of your body? (n = 406)	65.0
Have you ever had sudden loss of vision in one eye or double vision? (n = 202)	35.1
Have you ever had sudden walking difficulty with spinning sensation? (n = 621)	30.4

* Stroke was verified by history and neurological examination by board-certified neurologist

Table 3. Stroke prevalence (%) by age and gender

	Men			Women			Both gender		
Age group	Pop	No.	PR (95%CI)	Pop	No.	PR (95%CI)	Pop	No.	PR (95% CI)
45-54	2,310	41	1.77 (1.24 to 2.31)	5,166	41	0.79 (0.55 to 1.04)	7,476	82	1.10 (0.86 to 1.33)
55-64	2,260	76	3.36 (2.62 to 4.11)	4,406	60	1.36 (1.02 to 1.70)	6,666	136	2.04 (1.70 to 2.38)
65-74	1,731	60	3.47 (2.60 to 4.33)	2,978	62	2.08 (1.57 to 2.59)	4,709	122	2.59 (2.14 to 3.04)
75-84	502	18	3.58 (1.96 to 5.21)	644	18	2.79 (1.52 to 4.07)	1,146	36	3.14 (2.13 to 4.15)
Total	6,803	195	2.87 (2.47 to 3.26)	13,194	181	1.37 (1.17 to 1.57)	19,997	376	1.88 (1.69 to 2.07)
Age standardized*			2.71 (2.33 to 3.09)			1.34 (1.15 to 1.54)			1.81 (1.62 to 1.99)
Age standardized**			2.74 (2.35 to 3.12)			1.39 (1.18 to 1.60)			1.85 (1.66 to 2.04)

Pop = number of population; No. = number of stroke; PR = prevalence rate
* Age standardized to Segi world standard population
** Age standardized to new WHO standard population

Table 4. Stroke prevalence (%) by region

Region	Pop	No.	Crude prevalence (95% CI)	Age standardized* (95% CI)	Age standardized** (95% CI)
Bangkok	2,154	72	3.34 (2.58 to 4.10)	3.06 (2.35 to 3.77)	3.20 (2.42 to 3.98)
Central region	4,857	117	2.41 (1.98 to 2.84)	2.36 (1.94 to 2.79)	2.39 (1.95 to 2.84)
Southern region	2,448	56	2.29 (1.70 to 2.88)	2.15 (1.59 to 2.71)	2.25 (1.67 to 2.84)
Northern region	4,392	64	1.46 (1.10 to 1.81)	1.47 (1.11 to 1.83)	1.45 (1.10 to 1.81)
North-eastern region	6,146	67	1.09 (0.83 to 1.35)	1.04 (0.79 to 1.30)	1.08 (0.81 to 1.35)

Pop = number of population; No. = number of stroke
* Age standardized to Segi world standard population
** Age standardized to new WHO standard population

2.07). The presented crude prevalence among adults aged ≥ 60 years was 2.56% (95% CI, 2.23 to 2.89) which was higher than that of the previous study (1.12%) in 1998[10]. This finding may be due to lifestyle change associated with rapid economic development, improved survival from communicable disease that led to raising the life expectancy and levels of cardiovascular risk factors such as sedentary life style, obesity, hypertension, diabetes mellitus and hyperlipidemia, which is referred to as the epidemiological transition[19-22].

Comparison of stroke prevalence across studies is not straightforward due to several factors, including differences in age and sex distribution of the study population, methodological approaches, case ascertainment and study period. However, the authors crude prevalence of 2.70% (95% CI, 2.28 to 3.11) for adults aged ≥ 65 years was similar to those of the elderly from Nigeria (2.41%)[23] and Bolivia (1.93%; 95% CI, 0.23 to 3.63)[24] but lower than crude prevalence in the elderly reported from other populations including Taiwan (5.08%)[25], Singapore (7.67%)[26], Korea (9.9%)[27] and Spain (3.5%)[28]. Data from the previous studies in USA, New Zealand, Taiwan, United Kingdom, Netherlands and Italy showed that the aged standardized prevalence for people aged 65 years or more ranged from 4.61% to 7.33%[29] which is higher than the present study (2.60%; 95% CI, 2.17 to 3.03).

When comparing the age-specific prevalence among the different countries, Fig. 1 shows that the stroke prevalence in the present study is higher than those in Bolivia[24] and South Africa[32] and is lower than those from other countries particularly the United Kingdom[33], USA[34] and Singapore[26].

Compared with developed countries, the presented prevalence was lower especially in the elderly. Difference in prevalence may be explained by the difference in incidence and/or case fatality rate.

Table 5. Comparision of sociodemographic data and risk factors of stroke and non- stroke participants

	Stroke (n = 376)	Non- stroke (n = 19,621)	OR	95% CI	p-value*
Age (year; mean, SD)	62.2, 8.7	59.0, 9.0	1.04	1.03 to 1.05	<0.001
Gender (male, %)	51.9	33.7	2.12	1.73 to 2.60	<0.001
Marital status					0.563
Single (%)	4.3	5.9	1.00	-	
Married (%)	72.8	71.4	1.40	0.84 to 2.32	
Widow/widower (%)	16.8	17.3	1.34	0.77 to 2.32	
Separated (%)	6.1	5.4	1.55	0.81 to 2.94	
Education level					<0.001
Illiterate (%)	3.7	2.7	1.69	0.85 to 3.35	
Primary (%)	72.0	78.6	1.13	0.72 to 1.77	
Secondary (%)	18.7	11.7	1.96	1.20 to 3.21	
University (%)	5.6	6.9	1.00	-	
Occupation					<0.001
Agricultural class (%)	14.6	30.7	1.00	-	
Non-manual class (%)	3.5	5.4	1.33	0.72 to 2.44	
Manual class (%)	25.3	35.4	1.50	1.07 to 2.09	
Unemployed/ house work (%)	56.6	28.5	4.17	3.09 to 5.62	
Personal income (< 5000 Thai baht**/month; %)	70.7	70.6	0.97	0.79 to 1.25	0.975
Region					<0.001
Bangkok (%)	19.1	10.6	3.14	2.24 to 4.39	
Central region (%)	31.1	24.2	2.24	1.65 to 3.03	
Southern region (%)	14.9	12.2	2.12	1.48 to 3.04	
Northern region (%)	17.0	22.1	1.34	0.95 to 1.89	
Northeastern region (%)	17.8	31.0	1.00	-	
BMI (kg/m^2; mean, SD)	24.5, 4.1	24.4, 4.2	1.01	0.99 to 1.03	0.423
Waist circumference (cm; mean, SD)	85.1, 11.4	82.3, 11.0	1.02	1.01 to 1.03	<0.001
Smoking status					<0.001
Never (%)	55.9	70.4	1.00	-	
Ex-smoker (%)	29.6	15.7	2.37	1.87 to 3.00	
Current (%)	14.5	13.9	1.31	0.97 to 1.78	
Hypertension (%)	73.0	43.2	3.55	2.82 to 4.47	<0.001
Diabetes mellitus (%)	28.2	15.9	2.06	1.64 to 2.60	<0.001
Hypercholesterolemia (%)	77.1	65.7	1.76	1.38 to 2.24	<0.001

* Univariate logistic regression analysis

** Average exchange rate in 2009 was 35 Thai baht = one US Dollar

At present, there is no data on incidence of stroke in Thailand. However, the worldwide variation in stroke incidence may be relatively small[29]. In general, stroke mortality in Asian countries except Japan and Singapore is higher than in Western countries[35]. From available data in Thailand[7], stroke is the first leading cause of death in the people aged 60 years or more. Therefore, the lower prevalence in the present study may be due to a higher case fatality rate in the presented population.

As in some previous stroke prevalence studies showing a geographic gradient[28,30,36,37], the authors also found that there were geographic differences in stroke prevalence. The presented prevalence was highest in Bangkok and lowest in north-eastern region (Table 4). In addition, prevalence was higher in the central and southern region when compared with those of northern and north-eastern region. This fact has been observed in a previous study in Thailand[10] (Fig. 2). The complex interplay between lifestyle, vascular risk factors and health-seeking behavior and their impact on stroke incidence and mortality may explain these geographic differences.

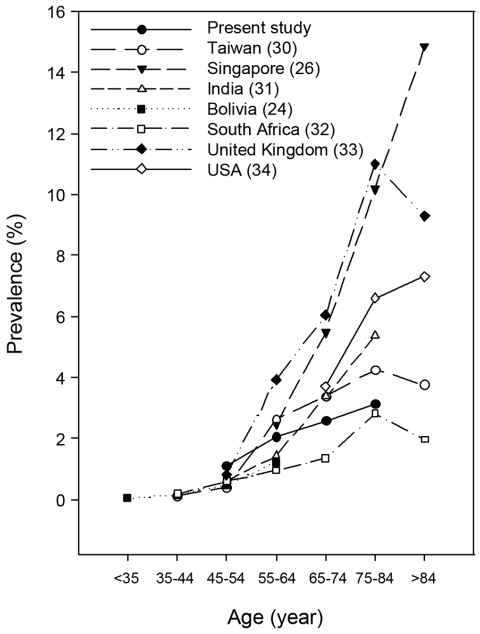

Fig. 1 Prevalence of stroke per 100 population in selected countries (reference are in perentheses)

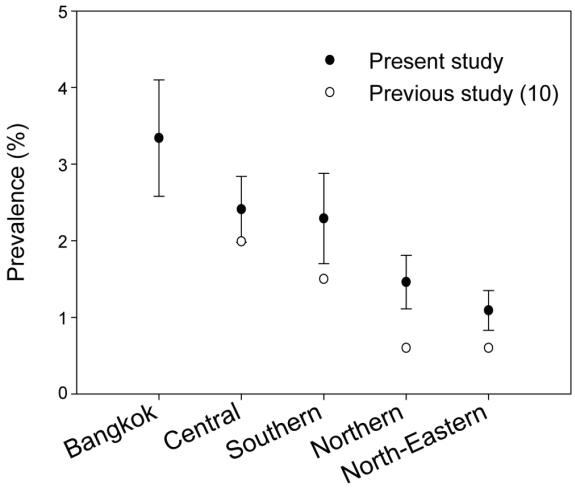

Fig. 2 Comparison of stroke prevalence by region with previous study from Thailand (reference is in parenthesis)

In the previous prevalence studies of stroke, hypertension[27,30,38], current smoking[27], male gender[28,39], urban areas[28], diabetes mellitus[30,38], heart disease[30], age[37,39], polycythemia[37], high consumption of alcohol[37], area of residence[37], irregular heartbeats[38], lower education[39], nationality[39], family history of stroke[30,39] and living alone[39] have been found to be associated with stroke prevalence. In the present study, factors associated with stroke prevalence were male gender, occupational class, region of residence, hypertension, diabetes mellitus and hypercholesterolemia (Table 6). However, a prevalence study is seldom of direct interest in etiologic applications[40] and it is possible that the strength of an association between risk factor and disease may be underestimated if comparison is based on prevalence[30].

The strengths of the present study are large sample size and the fact that participants were drawn from the general population from five distinct geographic regions around the country rather than a selected population. Assessments of all participants were performed by well-trained personnel using standardized protocol under standardized quality control system. Presence of stroke was verified via interview and full physical examination from board-certified neurologists rather than relying on participant

Table 6. Adjusted odds ratio for prevalent stroke

	OR	95%CI	p-value*
Age (year)	1.00	0.98 to 1.01	0.379
Sex (male)	2.30	1.69 to 3.13	<0.001
Education level			0.524
Illiterate	1.59	0.73 to 3.44	
Primary	1.47	0.84 to 2.57	
Secondary	1.53	0.86 to 2.71	
University	1.00	-	
Occupation			<0.001
Agricultural class	1.00	-	
Non-manual class	1.46	0.71 to 3.02	
Manual class	1.45	1.01 to 2.10	
Unemployed/house work	3.90	2.74 to 5.55	
Region			<0.001
Bangkok	2.13	1.48 to 3.09	
Central region	1.97	1.41 to 2.74	
Southern region	2.57	1.75 to 3.77	
Northern region	1.26	0.87 to 1.82	
Northeastern region	1.00	-	
Waist circumference (cm)	1.00	1.00 to 1.01	0.414
Smoking status			0.055
Never	1.00	-	
Ex-smoker	1.46	1.06 to 2.01	
Current	1.13	0.77 to 1.66	
Hypertension	2.80	2.17 to 3.61	<0.001
Diabetes mellitus	1.47	1.15 to 1.89	0.002
Hypercholesterolemia	1.35	1.04 to 1.75	0.026

* Multivariate logistic regression analysis

self-report. However, the present study has some limitations. The authors recruited participants on the volunteer basis so our study sample was not established by random sampling but it covers all major demographic strata of the Thai general population aged 45 to 80 years (Table 1). The present stroke prevalence might have been underestimated because stroke patients with very severe disabilities may not have been able to come to participate in the study. However, geographic variation in stroke prevalence that was found in the present study could be more valid because the authors collected data from each area by the same standard methodology so the bias could be lie in the same direction and internal comparison between each area could be relevant. Furthermore, geographic variation in stroke prevalence remained statistical significance after adjustment for several potential confounding variables.

In conclusion, the present stroke prevalence was higher than that of previous studies in Thailand but lower than those of developed countries, especially in the elderly group. The authors found geographic differences in stroke prevalence. Male gender, occupational class, region of residence, hypertension, diabetes mellitus and hypercholesterolemia were significantly associated with stroke prevalence. The longitudinal follow-up of the TES study cohort is now ongoing and will provide further valuable information within three years.

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Potential conflicts of interest

None.

References

1. Bonita R, Mendis S, Truelsen T, Bogousslavsky J, Toole J, Yatsu F. The global stroke initiative. Lancet Neurol 2004; 3: 391-3.
2. Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. Lancet Neurol 2007; 6: 182-7.
3. Sacco RL, Benjamin EJ, Broderick JP, Dyken M, Easton JD, Feinberg WM, et al. American Heart Association Prevention Conference. IV. Prevention and Rehabilitation of Stroke. Risk factors. Stroke 1997; 28: 1507-17.
4. Truelsen T, Bonita R, Jamrozik K. Surveillance of stroke: a global perspective. Int J Epidemiol 2001; 30 (Suppl 1): S11-6.
5. Poungvarin N. Stroke in the developing world. Lancet 1998; 352 (Suppl 3): 19-22.
6. Feigin VL. Stroke in developing countries: can the epidemic be stopped and outcomes improved? Lancet Neurol 2007; 6: 94-7.
7. Ministry of Public Health. Burden of disease and injuries in Thailand. Priority setting for policy [database on the Internet]. 2002 [cited 2009 Feb 11]. Available from: http://thaibod.org/documents/BURDEN.pdf.
8. Poungvarin N. Burden of stroke in Thailand. Int J Stroke 2007; 2: 127-8.
9. Viriyavejakul A, Poungvarin N, Vannasaeng S. The prevalence of stroke in urban community of Thailand. J Neurol 1985; 232 (Suppl): 93.
10. Viriyavejakul A, Senanarong V, Prayoonwiwat N, Praditsuwan R, Chaisevikul R, Poungvarin N. Epidemiology of stroke in the elderly in Thailand. J Med Assoc Thai 1998; 81: 497-505.
11. National Statistical Office, Thailand. The 2000 population and housing census [database on the Internet]. 2000 [cited 2009 Feb 11]. Available from: http://web.nso.go.th/eng/en/pop2000/

prelim_e.htm
12. Sorensen SP, Boysen G, Jensen G, Schnohr P. Prevalence of stroke in a district of Copenhagen the copenhagen city heart study. Acta Neurol Scand 1982; 66: 68-81.
13. O'Mahony PG, Dobson R, Rodgers H, James OF, Thomson RG. Validation of a population screening questionnaire to assess prevalence of stroke. Stroke 1995; 26: 1334-7.
14. Meschia JF, Brott TG, Chukwudelunzu FE, Hardy J, Brown RD Jr, Meissner I, et al. Verifying the stroke-free phenotype by structured telephone interview. Stroke 2000; 31: 1076-80.
15. Jones WJ, Williams LS, Meschia JF. Validating the questionnaire for verifying stroke-free status (QVSFS) by neurological history and examination. Stroke 2001; 32: 2232-6.
16. Society for Clinical Data Management, Good clinical data management 2005, version4 [database on the Internet]. 2005 [cited 2011 Mar 7]. Available from: http://www.scdm.org/publications/
17. Aho K, Harmsen P, Hatano S, Marquardsen J, Smirnov VE, Strasser T. Cerebrovascular disease in the community: results of a WHO collaborative study. Bull World Health Organ 1980; 58: 113-30.
18. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJL, Lazano R, Inoue M. Age standardization of rates: a new WHO standard [database on the Internet]. 2001 [cited 2008 Oct 30]. Available from: http://www.who.int/healthinfo/paper31.pdf.
19. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation 2001; 104: 2746-53.
20. Tatsanavivat P, Klungboonkrong V, Chirawatkul A, Bhuripanyo K, Manmontri A, Chitanondh H, et al. Prevalence of coronary heart disease and major cardiovascular risk factors in Thailand. Int J Epidemiol 1998; 27: 405-9.
21. Sritara P, Cheepudomwit S, Chapman N, Woodward M, Kositchaiwat C, Tunlayadechanont S, et al. Twelve-year changes in vascular risk factors and their associations with mortality in a cohort of 3499 Thais:the Electricity Generating Authority of Thailand Study. Int J Epidemiol 2003; 32: 461-8.
22. InterASIA Collaborative Group. Cardiovascular risk factor levels in urban and rural Thailand-The International Collaborative Study of Cardiovascular Disease in Asia (InterASIA). Eur J Cardiovasc Prev Rehabil 2003; 10: 249-57.
23. Danesi M, Okubadejo N, Ojini F. Prevalence of stroke in an urban, mixed-income community in Lagos, Nigeria. Neuroepidemiology 2007; 28: 216-23.
24. Nicoletti A, Sofia V, Giuffrida S, Bartoloni A, Bartalesi F, Bartolo ML, et al. Prevalence of stroke: a door-to-door survey in rural Bolivia. Stroke 2000; 31: 882-5.
25. Huang ZS, Chiang TL, Lee TK. Stroke prevalence in Taiwan. Findings from the 1994 National Health Interview Survey. Stroke 1997; 28: 1579-84.
26. Venketasubramanian N, Tan LC, Sahadevan S, Chin JJ, Krishnamoorthy ES, Hong CY, et al. Prevalence of stroke among Chinese, Malay, and Indian Singaporeans: a community-based tri-racial cross-sectional survey. Stroke 2005; 36: 551-6.
27. Han MK, Huh Y, Lee SB, Park JH, Lee JJ, Choi EA, et al. Prevalence of stroke and transient ischemic attack in Korean elders: findings from the Korean Longitudinal Study on Health and Aging (KLoSHA). Stroke 2009; 40: 966-9.
28. Diaz-Guzman J, Bermejo-Pareja F, Benito-Leon J, Vega S, Gabriel R, Medrano MJ. Prevalence of stroke and transient ischemic attack in three elderly populations of central Spain. Neuroepidemiology 2008; 30: 247-53.
29. Feigin VL, Lawes CM, Bennett DA, Anderson CS. Stroke epidemiology: a review of population-based studies of incidence, prevalence, and case-fatality in the late 20th century. Lancet Neurol 2003; 2: 43-53.
30. Hu HH, Chu FL, Chiang BN, Lan CF, Sheng WY, Lo YK, et al. Prevalence of stroke in Taiwan. Stroke 1989; 20: 858-63.
31. Das SK, Banerjee TK, Biswas A, Roy T, Raut DK, Mukherjee CS, et al. A prospective community-based study of stroke in Kolkata, India. Stroke 2007; 38: 906-10.
32. Connor MD, Thorogood M, Casserly B, Dobson C, Warlow CP. Prevalence of stroke survivors in rural South Africa: results from the Southern Africa Stroke Prevention Initiative (SASPI) Agincourt field site. Stroke 2004; 35: 627-32.
33. O'Mahony PG, Thomson RG, Dobson R, Rodgers H, James OF. The prevalence of stroke and associated disability. J Public Health Med 1999; 21: 166-71.
34. Mittelmark MB, Psaty BM, Rautaharju PM, Fried LP, Borhani NO, Tracy RP, et al. Prevalence of cardiovascular diseases among older adults. The Cardiovascular Health Study. Am J Epidemiol 1993; 137: 311-7.
35. Ueshima H, Sekikawa A, Miura K, Turin TC,

Takashima N, Kita Y, et al. Cardiovascular disease and risk factors in Asia: a selected review. Circulation 2008; 118: 2702-9.
36. Li SC, Schoenberg BS, Wang CC, Cheng XM, Bolis CL, Wang KJ. Cerebrovascular disease in the People's Republic of China: epidemiologic and clinical features. Neurology 1985; 35: 1708-13.
37. Jaillard AS, Hommel M, Mazetti P. Prevalence of stroke at high altitude (3380 m) in Cuzco, a town of Peru. A population-based study. Stroke 1995; 26: 562-8.
38. Fuh JL, Wang SJ, Larson EB, Liu HC. Prevalence of stroke in Kinmen. Stroke 1996; 27: 1338-41.
39. Jungehulsing GJ, Muller-Nordhorn J, Nolte CH, Roll S, Rossnagel K, Reich A, et al. Prevalence of stroke and stroke symptoms: a population-based survey of 28,090 participants. Neuroepidemiology 2008; 30: 51-7.
40. Greenland S, Rothman KJ. Measures of occurrence. In: Rothman KJ, Greenland S, Lash TL, editors. Modern epidemiology. 3rd ed. Philadelphia: Lippincott Williams& Wilkins; 2008: 32-50.

ความชุกโรคหลอดเลือดสมองและปัจจัยเสี่ยงโรคหลอดเลือดสมองในประเทศไทย: โครงการศึกษาระบาดวิทยาโรคหลอดเลือดสมองในประเทศไทย

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วัตถุประสงค์: *เพื่อศึกษาความชุกของโรคหลอดเลือดสมองและปัจจัยเสี่ยงโรคหลอดเลือดสมองในประเทศไทย*
วัสดุและวิธีการ: *โครงการศึกษาระบาดวิทยาโรคหลอดเลือดสมองในประเทศไทยเป็นโครงการศึกษาวิจัยในชุมชนชนิดติดตามไปข้างหน้าในระยะยาวโดยได้ดำเนินการใน 5 พื้นที่ของประเทศไทย ได้สำรวจสถานะสุขภาพของอาสาสมัครในช่วงเวลาตั้งแต่ปี พ.ศ. 2547-2549 อาสาสมัครที่ถูกสงสัยว่าป่วยด้วยโรคหลอดเลือดสมองได้รับการตรวจสอบยืนยันทุกราย การวิเคราะห์ในครั้งนี้ได้ใช้ข้อมูลการสำรวจสถานะสุขภาพของอาสาสมัครจำนวน 19,997 ราย อายุ 45-80 ปี มาทำการวิเคราะห์ในลักษณะของภาคตัดขวาง*
ผลการศึกษา: *พบผู้ป่วยโรคหลอดเลือดสมอง 376 ราย ความชุกและความชุกปรับฐานอายุโดยใช้ Segi world standard population เท่ากับ 1.88% (95% CI, 1.69-2.07) และ 1.81% (95% CI, 1.62-1.99) ตามลำดับ ความชุกในกลุ่มอายุมากกว่าหรือเท่ากับ 65 ปี เท่ากับ 2.70% (95% CI, 2.28-3.11) ความชุกของโรคหลอดเลือดสมองมีความแตกต่างกันระหว่างพื้นที่ (กรุงเทพมหานคร 3.34%, ภาคกลาง 2.41%, ภาคใต้ 2.29%, ภาคเหนือ 1.46% และภาคตะวันออกเฉียงเหนือ 1.09%) การวิเคราะห์ด้วยเทคนิคการถดถอยพหุโลจีสติกส์ พบว่าปัจจัยที่สัมพันธ์กับความชุกของโรคหลอดเลือดสมองคือ เพศชาย ($p < 0.001$), อาชีพ ($p < 0.001$), พื้นที่ที่อาศัย ($p < 0.001$), ความดันโลหิตสูง ($p < 0.001$), เบาหวาน ($p = 0.002$) และภาวะไขมันในเลือดสูง ($p = 0.026$)*
สรุป: *การศึกษานี้พบว่าความชุกของโรคหลอดเลือดสมองในประเทศไทยเพิ่มขึ้นเมื่อเทียบกับการศึกษาในประเทศไทยในอดีตแต่น้อยกว่าในประเทศที่พัฒนาแล้ว ซึ่งอาจเป็นเพราะอัตราการตายของผู้ป่วยโรคหลอดเลือดสมองในประเทศไทยสูงกว่าประเทศที่พัฒนาแล้ว ความชุกของโรคหลอดเลือดสมองมีความแตกต่างกันระหว่างพื้นที่ กล่าวคือความชุกค่อนข้างสูงในกรุงเทพมหานคร, ภาคกลาง และภาคใต้ การติดตามอาสาสมัครต่อไปในระยะยาวจะได้ข้อมูลเกี่ยวกับปัจจัยเสี่ยงมากยิ่งขึ้นตลอดจนทราบอุบัติการณ์โรคหลอดเลือดสมองในประเทศไทย*