ปัจจัยเสี่ยงโรคหลอดเลือดสมองในประชากรไทย

Risk Factors for Stroke in Thai Population

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บทคัดย่อ

โรคหลอดเลือดสมองถือเป็นปัญหาสุขภาพระดับโลก และการเข้าใจปัจจัยเสี่ยงต่อโรคหลอดเลือดสมองถือเป็นสิ่งสำคัญในการพัฒนาวิธีและกลไกเพื่อการป้องกันโรคได้อย่างมีประสิทธิภาพ การศึกษานี้เป็นรูปแบบเคส-คอนโทรลมีจุดประสงค์เพื่อค้นหาปัจจัยเสี่ยงต่อการเกิดโรคหลอดเลือดสมองในประชากรไทย เพื่อป้องกันโรคในระดับสาธารณสุขและทำให้สุขภาพของประชาชนไทยดีขึ้น อาสาสมัครที่เข้าร่วมโครงการเป็นผู้ป่วยโรคหลอดเลือดสมอง 957 ราย และผู้ที่ไม่เป็นโรคหลอดเลือดสมอง 997 ราย ความเสี่ยงโรคหลอดเลือดสมองในอาสาสมัครถูกคำนวณเป็นค่า adjusted odds ratios พบว่าอายุ เพศ การดื่มแอลกอฮอล์ การรับประทานอาหารที่ไม่เป็นประโยชน์ต่อร่างกาย และการขาดการออกแรงกายไม่ได้เป็นปัจจัยเสี่ยงต่อโรคหลอดเลือดสมองอย่างมีนัยสำคัญ ในทางกลับกัน อาชีพที่เกี่ยวข้องกับการเกษตรและการไม่ประกอบอาชีพ การมีประวัติคนในครอบครัวเป็นโรคหลอดเลือดสมอง ภาวะความดันโลหิตสูง และระดับคอเลสเตอรอลชนิดดี (HDL) ที่ต่ำ ถือเป็นปัจจัยเสี่ยงโรคหลอดเลือดสมอง ผลการศึกษาอาจเป็นประโยชน์ในการคาดคะเนความเสี่ยงและช่วยในการพัฒนาการประเมินความเสี่ยงโรคหลอดเลือดสมองในรูปแบบคะแนนเพื่อเพิ่มความแม่นยำในการประเมินความเสี่ยง

คำสำคัญ : โรคหลอดเลือดสมอง, ปัจจัยเสี่ยง, เคส-คอนโทรล

Abstract

Stroke is a global health problem and comprehending its risk factors is important in developing methods and mechanisms for effective disease prevention. This case-control study aims to identify risk factors for stroke in the Thai population, prevent disease in the public health, and enhance the health of Thai people. The volunteers participating in the study were 957 stroke patients and 997 without stroke. The risk of stroke among subjects was calculated as adjusted odds ratios. Age, gender, alcohol consumption, the habit of eating unhealthy food, and lack of physical activity are not significant risk factors for stroke. On the other hand, occupations related to agriculture and non-occupations, having a family history of stroke, high blood pressure, and low levels of High-Density Lipoprotein (HDL) were identified as risk factors for stroke. The finding may be utilized in risk prediction and in developing score-based stroke risk assessment.

Keywords: stroke, risk factors, case-control, Thai

Introduction

Stroke constitutes a significant health concern, precipitating disabilities such as compromised speech, weakness, and communication disorders. According to the World Health Organization, it stands as the second most prevalent cause of mortality globally, following heart disease, and concurrently ranks as the foremost cause of disability. Annually, there are over 12 million stroke cases, with approximately one-quarter of individuals aged 25 and older experiencing a stroke in their lifetime.[1] According to the Ministry of Public Health of Thailand, there were 34,545 deaths from stroke in Thailand (53 deaths per 100,000 population) in 2020 with an increasing trend from the past. Well-known risk factors of stroke include hypertension, hypercholesterolemia, coronary artery disease, atrial fibrillation, diabetes mellitus, and obesity. Previous studies found that hypertension, diabetes, dyslipidemia, metabolic syndrome, and atrial fibrillation were risk factors for stroke in Thailand.[2-6] However, there may be other modifiable factors that increase the risk of stroke as well, and there may be some specific issues that impact the increasing risk of stroke in Thai people. This study aims to find out the associations of stroke in Thai people in 5 different regions all over the country and the factors, which are

physical factors (age, gender, occupation, Body Mass Index (BMI), systolic and diastolic blood pressure, and blood lipid profile) and physical activities (smoking, alcoholic drinking, improper diet, and inadequate activity), respectively.

Methods

Study design

This study was part of a health surveillance program from the Thai Health Promotion Foundation of Thailand. The main objective of this study is to find out the risk factors for stroke among the Thai population in all 5 regions. The research methodology involves a questionnaire-based, case-control study with a 1:1 ratio of cases to controls. The questionnaire was developed by a team of experts, and it incorporated a Thai-language version derived from the World Health Organization (WHO) questionnaire.[7] A pilot study was conducted involving 50 stroke patients and 50 control individuals in the pilot hospitals to validate the questionnaire and identify any confusing or ambiguous questions that required correction. All participants were asked to answer the questionnaire, which consisted of 4 parts of behaviors, which were alcoholic drinking, smoking, inadequate body movement activity, and the habit of eating unhealthy food.

Data collection and sampling size

Thai population aged at least 35 years and above, with no underlying stroke, who had been treated at the designated hospitals, were stratified sampling from 11 designated hospitals from five regions of Thailand, which were North, Northeast, West, East-Central-Bangkok, and South. The definition of case was defined as new cases of stroke or being diagnosed with stroke within one month before participating in this study, with confirmed imaging from the designated hospitals. The exclusion criteria were non-Thais, patients who needed critical care and were unable to give information, and who were diagnosed before our set point. Controls were patients at the hospitals at the same or similar age as the cases, had no chronic underlying disease, and lived in nearby areas in each region.

Statistical analysis

Data were descriptively analyzed in terms of percentage, mean, and Standard Deviation (SD) to describe the independent variables. Multiple logistic regression was used to calculate for adjusted Odds Ratio (aOR) and 95% Confidence Interval (95% CI) of each stroke's risk factor. The sample size was calculated according to the formula below,[8] show in Equation 1.

$$n = \left(\frac{r+1}{r}\right)\frac{\bar{p}\,(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p1-p2)^2}$$

(Equation 1)

p1 (The proportion of having risk factors in the control group) = 0.2 and 0.36

α = 0.05, Zα/2' = 1.96

β = 80%, 'Zβ' = 0.84

'r' (the proportion between case and control) = 1

The proportion of having risk factors in the case group or 'p2', show in Equation 2. = 0.23 and 0.403

$$p2 = P_{case\ exp} = \frac{ORp_{controls\ exp}}{P_{controls\ exp}(OR-1)+1} \text{ = 0.23 and 0.403}$$

(Equation 2)

The average p is equal to (0.2+0.23)/2 = 0.215 and (0.36+0.403)/2 = 0.3815. After the calculation, the number of case and control numbers was 535 each. We multiplied the design effect by 1.5, and the number was 820. To avoid the imperfection of the questionnaire, the number was added to 10%, so the final number was 900 cases and 900 controls.

Results

There were 957 stroke and 997 control participants. The majority of controls were females (69.9%), while the majority of cases were male (62%). The average age was 48.13 (±9.51) in controls and 62.79 (±12.54) in stroke participants. Most (66.7% and 66.2% in controls and cases, respectively) were married. In terms of age, the average age among control participants was 48.13 years (±9.51), whereas stroke participants exhibited a notably higher average age of 62.79 years (±12.54). Regarding marital status, a considerable portion of both control and case participants were married, with 67.6% of controls and 66.2% of cases falling into this category. This demographic information provides a foundational overview of the study population (Table 1).

Table 1 Characteristics of participants

Characteristic	Control	Case
Male	300 (30.1)	593 (62.0)
Female	697(69.9)	364 (38.0)
Age		
Mean ± SD	48.13±9.51	62.79±12.54
> 60	106 (10.6)	564 (58.9)
40-59	675 (67.7)	359 (37.5)
< 40	216 (21.7)	34 (3.6)
Marital status		
Married	670 (67.6)	629 (66.2)
Single/Widowed/Divorced/Separated	321 (32.4)	321 (33.8)
Education		
Elementary school or below	229 (23.0)	678 (71.0)
Middle school	110 (11.1)	93 (9.7)
High school/ Vocational Certificate/ High Vocational Certificate	272 (27.4)	121 (12.7)
Bachelor's degree or higher	383 (38.5)	63 (6.6)
Job/career		
Unemployed/housewife/college student/monk or priest	79 (8.3)	382 (41.2)
Daily labor	122 (12.8)	152 (16.4)
Agriculture (Farming and Fishery)	74 (7.7)	202 (21.8)
Private company's employees	122 (12.8)	25 (2.7)
Business's owner	63 (6.6)	108 (11.6)
Government's personnel	496 (51.9)	59 (6.4)

When comparing the association between physical factors and stroke, elevated systolic and diastolic blood pressure levels demonstrate a significant association with an increased likelihood of stroke, with respective adjusted Odds Ratios (aOR) of 5.57 (95% Confidence Interval [CI]: 2.85-10.88) for systolic blood pressure and 4.19 (95% CI: 1.93-9.06) for diastolic blood pressure. This observation underscores the substantial impact of high blood pressure as a risk factor for stroke. Furthermore, an adverse lipid profile, specifically low High-Density Lipoprotein (HDL) levels (<40), is identified as a contributing factor to an increased risk of stroke, with an adjusted Odds Ratio of 3.6 (95% CI: 1.98-6.54). This emphasizes the relevance of lipid profile assessment, particularly the role of low HDL, in the context of stroke risk assessment. The provided Odds Ratios and Confidence Intervals offer a quantitative understanding of the magnitude and precision of these associations (Table 2).

Table 2 Association between physical factors and stroke

Physical factor	OR	95% CI	Adjusted OR	95% CI	p-value
Age					
> 60	31.09	14.30-67.59	8.96	1.09-73.71	0.041
40-59	10.72	8.37-13.72	1.73	0.97-3.10	0.062
< 40	1		1		
Gender					
Male	3.78	3.14-4.57	3.57	2.21-5.78	<0.001
Female	1		1		
Occupation					
None/ housewife/ university student/ monk, priest	40.65	28.29-58.42	66.13	30.22-144.74	<0.001
Day laborer	10.47	7.31-15.01	20.87	10.00-43.54	<0.001
Agriculture (Farming and Fishery)	22.95	15.71-33.53	41.78	18.50-94.35	<0.001
White collar/ staff in private sectors	1.72	1.04-2.86	4.32	1.72-10.84	0.002
Entrepreneur	14.41	9.55-21.75	13.11	6.54-26.28	<0.001

Physical factor	OR	95% CI	Adjusted OR	95% CI	p-value
Public government officers/ staff	1		1		
BMI (km/m2)					
>23.0 (Overweight-Obese)	1.26	1.04-1.52	N/A	N/A	N/A
<18.5 (Underweight)	2.91	1.87-4.51	N/A	N/A	N/A
18.5-23.0 (Normal)	1		1.00		
Systolic BP					
≥ 140 (Hypertension)	14.33	10.82-18.98	5.57	2.85-10.88	<0.001
< 140 (Normal)	1		1.00		
Diastolic BP					
≥ 90 (Hypertension)	7.15	5.30-9.66	4.19	1.93-9.06	<0.001
< 90 (Normal)	1		1.00		
≥ 126 (Abnormal)	66.48	21.16-208.88	95.03	19.73-457.82	<0.001
< 126 (Normal)	1		1.00		
Total cholesterol level (mg/dL)					
≥ 200 (Abnormal)	0.67	0.54-0.83	N/A	N/A	N/A
< 200 (Normal)	1		1.00		
LDL level					
≥ 150 (Abnormal)	1.02	0.77-1.36	N/A	N/A	N/A
< 150 (Normal)	1		1.00		
HDL level (mg/dL)					
< 40 (Abnormal)	7.22	4.90-10.62	3.60	1.98-6.54	<0.001
≥ 40 (Normal)	1		1.00		
Triglyceride level (mg/dL)					
> 150 (Abnormal)	2.60	2.00-3.39	N/A	N/A	N/A
≥ 150 (Normal)	1		1.00		

In the evaluation of the association between physical activities and stroke, no significant differences were identified concerning their association with the incidence of stroke, except for the status of nicotine addiction, as indicated by the Fagerström Test for Nicotine Dependence (FTND) score. The higher the score, the higher the chances of developing a stroke (Table 3).

Table 3 Association between physical activity and stroke

Factor	OR	95% CI	Adjusted OR	95% CI	p-value
Age					
≥ 60	31.09	14.30-67.59	7.58	3.29-17.47	<0.001
40-59	10.72	8.37-13.72	4.86	3.53-6.70	<0.001
< 40	1		1.00		
Gender					
Male	3.78	3.14-4.57	2.28	1.68-3.10	<0.001
Female	1		1.00		
Occupation					
None/ housewife/ university student/ monk, priest	40.65	28.29-58.42	17.33	11.14-26.94	<0.001
Day laborer	10.47	7.31-15.01	6.18	4.06-9.40	<0.001
Agriculture (Farming and Fishery)	22.95	15.71-33.53	9.20	5.88-14.38	<0.001
White collar/ staff in private sectors	1.72	1.04-2.86	1.76	1.00-3.11	0.051
Entrepreneur	14.41	9.55-21.75	12.01	7.49-19.25	<0.001
Public government officers/ staff	1		1.00		

Factor	OR	95% CI	Adjusted OR	95% CI	p-value
Alcohol drinking status					
Yes	1.19	0.97-1.45			
No	1				
Current alcohol drinking status (AUDIT score)					
Harmful (>20)	4.00	2.32-6.92			
Hazardous (16-19)	1.68	0.93-3.02			
Non-hazardous (Low risk & Occasion, <16)	0.93	0.74-1.16			
Non-drink	1				
Smoking status					
Currently smoking	4.53	3.39-6.07			
Stop smoking	14.14	9.06-22.05			
Never	1				
Status of nicotine addiction (FTND score)					
≥6 (high)	30.23	7.26-125.92	22.13	4.39-111.62	<0.001
<6 (low)	3.79	2.80-5.12	2.55	1.67-3.90	<0.001
Ex-smoker	14.14	9.06-22.05	6.63	3.78-11.62	<0.001
Non-smoker	1		1.00		
Metabolic Equivalent of Task (MET)					
Adequate	1.00	0.77-1.29			
Inadequate	1				
Physical activity level					
Low	1.02	0.79-1.33			
Moderate	1.07	0.80-1.43			

Factor	OR	95% CI	Adjusted OR	95% CI	p-value
High	1				
Likely to eat sweet food					
Usually	1.03	0.62-1.71			
Frequently	0.96	0.80-1.16			
Never/Sometimes	1				
Likely to eat fatty food					
Usually	1.29	0.80-2.07			
Frequently	0.94	0.78-1.14			
Never/Sometimes	1				
Likely to eat salty food					
Usually	0.58	0.29-1.17			
Frequently	1.35	1.12-1.61			
Never/Sometimes	1				

When comparing all factors relating to stroke, age groups and genders were not the factors associated with stroke significantly. People aged at least 60 years and above tended to have more association with stroke than those aged less than 40 years insignificantly. Males associated 1.97 times more than females for stroke insignificantly. For occupation, working in the agriculture field tended to have the highest risk of stroke at 81.51 (23.09-287.79), followed by people with no work at 81.51 (23.09-287.79) and 66.77 (18.03-247.25) times higher than public government officers/ staff.

Despite the impact of hypertension on stroke, a history of hypertension and hyperlipidemia were identified as preventive factors for stroke. The familial history of stroke emerged as a notable risk factor, displaying a high adjusted odds ratio of 128.79 (95% CI 49.47-335.26). Furthermore, a systolic blood pressure of at least 140 and above, exhibited a significant association with stroke among the participants. Within the scope of this study,

hyperlipidemia did not show a statistically significant association with stroke, except for low High-Density Lipoprotein (HDL), which was found to be correlated with a 3.36-fold increase in the likelihood of experiencing a stroke (1.31-8.56 times).

For smoking, the more nicotine addiction, the higher the risk of stroke of participants, especially if the FTND score is at least 6 and above, the risk of stroke is higher at 24.88 (1.51-410.93) times when compared to non-smokers (Table 4).

Table 4 All factors relating to stroke

Factor	β	SE	Adjusted OR	95% CI	p-value
Age (year)					
≥ 60	0.32	1.12	1.38	0.15-12.30	0.776
40-59	-0.14	0.45	0.87	0.36-2.09	0.754
< 40			1		
Gender					
Male	0.68	0.42	1.97	0.87-4.44	0.103
Female			1		
Occupation					
No work (unemployment/ house-wife/ university student/ monk/ priest)	4.20	0.67	66.77	18.03-247.25	<0.001
Day laborer	3.65	0.66	38.53	10.56-140.55	<0.001
Agriculture (Farming and Fishery)	4.40	0.64	81.51	23.09-287.79	<0.001
White collar/ staff in private sectors	2.64	0.75	13.97	3.19-61.13	<0.001
Entrepreneur	3.75	0.65	42.57	11.87-152.72	<0.001
Public government officers/ staff			1		

Factor	β	SE	Adjusted OR	95% CI	p-value
History of hypertension in family					
Yes	-3.38	0.57	0.03	0.01-0.11	<0.001
No			1		
History of stroke in family					
Yes	4.86	0.49	128.79	49.47-335.26	<0.001
No			1		
History of hyperlipidemia in family					
Yes	-2.01	0.51	0.13	0.05-0.36	<0.001
No			1		
Blood pressure (mmHg)					
≥ 140 (Hypertension)	2.70	0.45	14.81	6.19-35.42	<0.001
< 140 (Normal)			1.00		
Blood HDL level (mg/dL)					
< 40 (Abnormal)	1.21	0.48	3.36	1.31-8.56	0.011
≥40 (Normal)			1.00		
Status of nicotine addiction (FTND score)					
≥6 (high)	3.21	1.43	24.88	1.51-410.93	0.025
<6 (low)	2.04	0.68	7.72	2.05-29.11	0.003
Ex-smoker	1.79	0.72	5.99	1.46-24.53	0.013
Non-smoker			1.00		

Discussion

According to the World Health Organization (WHO), American Heart Association (AHA), and Stroke Association (United Kingom), common medical conditions that increase risk factors for stroke are hypertension, hypercholesterolemia, diabetes, a personal or family history of stroke or heart attack, older age, and lifestyle risk factors are overweight, physical inactivity, smoking, and alcohol abuse.[9-11]

In this study, certain physical factors exhibited a statistically significant association with an increased risk of stroke, which were occupational groups, a familial history of stroke, high blood pressure, and low levels of High-Density Lipoprotein (HDL). However, no significant correlation was observed between the absence of physical activity and stroke in this study.

Concerning the occupational group, the 'Agriculture' and 'No work' groups exhibited the highest susceptibility to stroke development.

All types of occupations differ in many aspects, such as workload, physical activity, environmental exposure, long working hours, shift work, exposure to chemical substances/dust/extreme temperature/noise, and stress levels.[12] Our study's findings suggest that the level of physical activity may not significantly impact the incidence of stroke. Regarding stress, the existing literature presents conflicting perspectives: some studies posit that stress can elevate blood pressure, thereby contributing to stroke,[13-18] while others report no discernible associations between stress and stroke incidence.[19-20] Those engaged in agricultural labor may confront exposure to harmful chemicals during spraying or the use of chemical insecticides, endure elevated temperatures during rice cultivation or planting, and contend with stress induced by low income, a prevalent issue among farmers and planters in Thailand, who commonly grapple with substantial debt due to their meager earnings.[21]Conversely, individuals classified under the 'No work' category, although possibly not subjected to high occupational workloads, may encounter financial challenges in the absence or scarcity of income. Consequently, it is imperative to conduct further investigations to ascertain whether the observed correlation between occupational types and stroke is causal or if it is influenced by confounding variables.

History of stroke in the family is the risk factor in this study. The examples of possible reasons were genetic, behavioral environment, and stress in the family. This result correlated with previous studies.[22-24] The history of stroke in the family could be

useful information for preventive medicine doctors to impart crucial knowledge and guidance to other family members.

The association between hypertension and the risk of stroke is unsurprising, given that hypertension is a widely acknowledged risk factor for stroke. This correlation has been substantiated as a risk factor for stroke within the Thai population across five distinct regions. The mechanism behind this relationship is the detrimental effects of elevated blood pressure on blood vessels, which lead to the rupture of blood vessels, precipitating hemorrhagic strokes, or the formation of blood clots that impede blood flow within vessels, thereby causing ischemic strokes.

An association was observed between low levels of High-Density Lipoprotein (HDL) cholesterol and an elevated likelihood of stroke incidents. This finding is consistent with prior studies, which have indicated that diminished levels of HDL cholesterol heighten the risk of initial ischemic stroke,[25] while increased levels of HDL cholesterol serve to diminish the risk of stroke.[26-29]

Limitations

Selection bias might occur due to the stratified sampling of the population from designated hospitals in the provinces, caused by limitations on the number of cases and study expenses. The researchers attempted to mitigate this limitation by trying to select the most similar controls in the case's community. Moreover, recall bias might occur due to participants' memory of the exposure.

Public Health Recommendations

Health education on stroke and preventive methods is of paramount importance and should be actively promoted within the general population. Utilizing tools such as stroke risk scores can prove invaluable in conducting widespread primary screening.[30-32] For populations identified as high-risk, these scores can facilitate monitoring the reduction of modifiable risk factors. The findings of this research could be applied to conduct a pilot study for the implementation of stroke prevention strategies, including the establishment of active surveillance in agricultural and unemployed populations, as well as the introduction of stroke screening specifically targeting individuals with hypertension combined with

low levels of High-Density Lipoprotein (HDL). This could represent a small but significant contribution to refining the formulation of stroke risk scores in the future.

Conclusion

The study identified several physical factors that significantly contributed to the risk of strokes. These included occupational groups, a familial history of stroke, elevated blood pressure, and diminished levels of High-Density Lipoprotein (HDL). Interestingly, the absence of physical activity exhibited no association with the risk of stroke. Health education and health promotion targeted at high-risk populations as pivotal strategies could be useful for mitigating the overall risk of strokes in the Thai population.

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Conflicts of interests

All authors declare that they have no conflicts of interest.

แนะนำการอ้างอิงสำหรับบทความนี้

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