ORIGINAL ARTICLE

Prevalence, risk factors and secondary prevention of stroke recurrence in eight countries from south, east and southeast asia: a scoping review

Chin Yi Ying, BHSc[1], Sakinah Harith, PhD[1], Aryati Ahmad, PhD[1], Hassan Basri Mukhali, MMed[2]

[1]School of Nutrition and Dietetics, Faculty of Health Sciences, Universiti Sultan Zainal Abidin, Gong Badak Campus, Kuala Nerus, Terengganu, Malaysia, [2]Faculty of Medicine, Universiti Sultan Zainal Abidin, Medical Campus, Kuala Terengganu, Terengganu, Malaysia

ABSTRACT

Introduction: In most Asian countries, stroke is one of the major causes of mortality. A stroke event is life-changing for stroke survivors, which results in either mortality or disability. Therefore, this study comprehensively focuses on prevalence, risk factors, and secondary prevention for stroke recurrence identified in South, East, and Southeast Asian countries. **Methods:** This scoping review uses the methodological framework of Arksey and O'Malley. A comprehensive search of academic journals (English) on this topic published from 2007 to 2017 was conducted. A total of 22 studies were selected from 585 studies screened from the electronic databases.

Results: First-year stroke recurrence rates are in the range of 2.2% to 25.4%. Besides that, modifiable risk factors are significantly associated with pathophysiological factors (hypertension, ankle-brachial pressure index, atherogenic dyslipidaemia, diabetes mellitus, metabolic syndrome, and atrial fibrillation) and lifestyle factors (obesity, smoking, physical inactivity, and high salt intake). Furthermore, age, previous history of cerebrovascular events, and stroke subtype are also significant influence risk factors for recurrence. A strategic secondary prevention method for recurrent stroke is health education along with managing risk factors through a combination of appropriate lifestyle intervention and pharmacological therapy.

Conclusion: To prevent recurrent stroke, health intervention should be geared towards changing lifestyle to embody a healthier approach to life. This is of great importance to public health and stroke survivors' quality of life.

INTRODUCTION

The American Heart Association (AHA)/American Stroke Association (ASA) have provided an updated definition of stroke. The disease which is broadly characterised as a central nervous system (CNS) infarction included ischaemic stroke (IS) and silent infarction, as well as intracerebral haemorrhage (ICH) and subarachnoid haemorrhage (SAH). CNS infarction is defined as "brain, spinal cord, or retinal cell death attributable to ischaemia, based on neuropathological, neuroimaging, and/or clinical evidence of permanent injury".[1]

Worldwide, stroke is the second leading cause of death after ischaemic heart disease.[2] Stroke attributes to 5.7 million deaths per year and will be ranked as the top four leading causes of death globally in 2030.[2] In most Asian countries, stroke is one of the major causes of death.[2] A stroke event is life-changing for stroke survivors in relation to their physical mobility, behaviour, emotional patterns, and communication skills. Moreover, stroke survivors are at high risk of stroke recurrence.[3]

Stroke recurrence is defined as a new neurological deficit, including ischaemic or haemorrhagic stroke, which occurs any time after the index stroke.[4-6] It is evident that stroke recurrence is in effect a new neurological deficit or a deterioration of an existing deficit. Serious complications can arise from one or more episodes of stroke recurrence that results in either mortality or increased disability.[7]

This review comprehensively focuses on evidence on prevalence, risk factors, and secondary prevention for stroke recurrence identified in countries from South (India), East (China, Taiwan, Japan, Korea), and Southeast Asia (Malaysia, Singapore, Thailand). Our review studied in South, East, and Southeast Asia serves as a precursor to our future study which will be focusing in Malaysia. These countries are earmarked due to their similarity in ethnicity, culture, dietary cultures which can be seen amongst Malaysian population. Therefore, this scoping review's results act as a foundation in investigating various aspects of stroke recurrence.

MATERIALS AND METHODS

Scoping review's purpose is "to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available especially when an area is complex or has not been reviewed comprehensively before".[8] This scoping review covers the relevant available literature on stroke recurrence. This study was conducted to outline prevalence, risk factors, and secondary prevention of stroke recurrence in countries from South (India), East (China, Taiwan, Japan, Korea), and

Southeast Asia (Malaysia, Singapore, Thailand). There is currently no existing guideline for scoping reviews. The methodological framework by Arksey and O'Malley was used for the scoping review, which involved five stages, namely (1) identifying the research questions; (2) identifying relevant studies; (3) study selection; (4) charting the data; and (5) collating, summarising, and reporting the results.[8] A flow diagram referring to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2009)[9] showed the flow of articles from search to its final selection.[9]

Identifying the research questions
The review questions were: (1) What is the prevalence of stroke recurrence in South, East, and Southeast Asian countries?; (2) What are the risk factors associated with stroke recurrence?; and (3) What is the secondary prevention of stroke recurrence?

Identifying relevant studies
Search in electronic databases (MEDLINE Complete at EBSCOhost, Scopus, ScienceDirect, and PubMed) was conducted. In addition, relevant research websites such as World Health Organizations (WHO) were explored thoroughly. A comprehensive search of academic journals (English) published on this topic from 2007 to 2017 was conducted. All types of studies, except systematic reviews or review papers, were included in the search. Inclusion criteria was applied to South, East, and Southeast Asian countries. After independent examination by the researchers on eligibility via titles, abstracts, and keywords, a total of 22 studies were selected for this review from 585 studies screened from electronic databases. Key search terms used for searching articles are recorded in Table I.

Study selection
After careful consideration, the reviewed studies were selected if information about: (1) South, East, and Southeast Asian countries; (2) profile of participants (i.e. gender, age, and ischaemic stroke patient); (3) stroke recurrence rate; (4) risk factors or factors associated with stroke recurrence; and (5) secondary prevention of stroke recurrence, were provided.

Charting the data
The country(-ies), author(s), year of publication, type(s) and purpose(s) of study, number of participants, and findings on prevalence, risk factors, and secondary prevention of stroke recurrence relating to South, East, and Southeast Asian countries are summarised in Table II.

Collating, summarising, and reporting the results
Evaluations of the review on prevalence, risk factors, and secondary prevention of stroke recurrence are illustrated in the Table II.

RESULTS
A total of 585 titles were identified during the search. As shown in Figure 1, 22 articles were selected and included at the final stage of screening procedure in this review.[3-7,10-26] Majority of these research are prospective observational studies (14 studies, 63.6%)[3-4, 6,10-15,18-20,23,26] while the others are

retrospective studies (five studies, 22.7%),[5,7,16-17,21] randomised controlled trial (1 study, 4.5%),[24] cross-sectional study (one study, 4.5%),[22] and clinical practice guidelines (one study, 4.5%).[25] The number of participants in the studies ranged from 102 to 20,332 stroke survivors with varying types of stroke, with the participants aged between 19 and 97 years. This article summarises the prevalence, risk factors, and secondary prevention of stroke recurrence as outlined in Table II.

Prevalence of Stroke Recurrence
Fourteen studies in this review examined stroke recurrence rate among stroke patients reported across South, East, and Southeast Asian populations.[3-6,12-21] First-year stroke recurrence rates are in the range of 2.2% to 25.4%.[3-6,12-17] Meanwhile, recurrence rate with various time intervals of follow-up was reported by 2.7% patients within 30 days after their stroke,[13] whereas 3.9% to 16.1% patients reported it in 90 days.[13,18-19] Recurrence rate within two years after stroke was reported to be 12.9% in ischaemic stroke patients.[20] In addition, the rate of stroke recurrence has been reported to be approximately 16% after five years of initial stroke.[21]

Risk Factors of Stroke Recurrence
Stroke recurrence and its associated risk factors have been investigated in this review. After evaluating several studies, risk factors for recurrence after stroke were documented into unmodifiable and modifiable risk factors.[3-7,12-15,17-24] Identification of these risk factors is crucial to prevent recurrent stroke and could be predictors of early stroke recurrence.

Unmodifiable Risk Factors
Age
The association between age and stroke recurrence was examined in three studies.[3,17,21] Age was independently associated with recurrence of stroke within one year after the onset.[3] A hospital-based study by Fu et al. suggested that risk factors for stroke recurrence vary between younger and older patients.[17] Indeed, a study revealed that older patients had an increased risk of mortality in post stroke outcomes due to stroke recurrence, which includes all categories of stroke.[21]

Gender
Only one study reported on gender; nonetheless, it failed to demonstrate any significant association between gender and stroke recurrence.[21]

Previous history of cerebrovascular events
This refers to patients with a history of stroke, including ischaemic stroke (IS), intracerebral haemorrhage (ICH), or subarachnoid haemorrhage (SAH), circulatory ischaemia, transient ischaemic attack (TIA), carotid stenosis or intracranial large artery stenosis (ILAS). These health conditions were identified as independent risk factors for recurrent stroke.[4,7,13,15,18-19] In another study, Fu et al. confirmed that relationship between previous history of cerebrovascular events and stroke recurrence was significantly associated among older stroke patients compared to younger ones.[17]

Stroke subtype

The association between stroke subtype and stroke recurrence was examined in several studies. Ischaemic stroke subtypes were revealed to be significant independent predictors of stroke recurrence.[13,14] Moreover, large-artery atherosclerosis (LAA) subtype was commonly higher in patients with stroke recurrence than in those without it. The difference, nevertheless was statistically, it showed no significance between different subtypes of ischaemic stroke patients.[3]

Modifiable Risk Factors
Pathophysiological Factors
Hypertension

The majority of the studies were concerning the association between hypertension and stroke recurrence, yet the results were different and inconsistent. A positive association between hypertension and stroke recurrence was found in four studies.[7,12,19,22] In contrast, hypertension was not a significant risk factor for recurrent stroke in stroke patients.[17,18] Wang et al. demonstrated a significant association between hypertension and stroke recurrence in only the small-artery occlusion (SAO) subtype, but not in other subtypes such as LAA, cardioembolic, and stroke of other determined and undetermined causes.[15] Therefore, hypertension may not contribute to stroke recurrence equally in all subtypes of ischaemic stroke.

Ankle-brachial pressure index (ABI). Abnormal ABI was associated to atherothrombosis. Only one study looked into the association between abnormal ABI and stroke recurrence. The result showed that it was a significant independent predictor for stroke recurrence in patients with mild stroke.[14]

Atherogenic dyslipidaemia (AD) and hyperlipidaemia

AD is defined as having low high-density lipoprotein cholesterol (HDL-C) (<40 mg/dl) and high triglycerides (≥200 mg/dl) levels in both men and women.[20] The relationship between AD and stroke recurrence was examined in three studies. Zhao et al. found that ischaemic stroke patients with AD had significantly higher risk of stroke recurrence than those without it and the risk was more pronounced among stroke patients of LAA subtype.[20] In other words, recurrence in stroke patients can be predicted by low levels of HDL-C and elevated levels of serum triglyceride. The results were consistent with other studies whereby low HDL-C levels were considered as a significant risk factor for stroke recurrence.[3,7] Besides that, a few studies had shown that hyperlipidaemia was demonstrated to be a risk factor for subsequent stroke and other vascular events.[7,23]

Diabetes mellitus

The association between diabetes mellitus and stroke recurrence was discovered in nine studies.[6,7,12,13,15,17-19,22] The results demonstrated that diabetes mellitus was an independent risk factor for recurrent stroke in stroke patients.[6,7, 12,13,15,17,19,22] Nonetheless, Pan et al. determined that this association was only found in the SAO subtype and, not in other stroke subtypes.[6] In addition, evidence showed that it was not a strong risk factor in young men.[17] Nevertheless, the results were inconsistent as Chen et al. discovered that diabetes mellitus was not a significant risk factor for stroke recurrence.[18]

Metabolic syndrome (MetS)

MetS is defined according to the International Diabetes Federation (IDF) criteria. Individuals are considered to have MetS if they have central obesity (waist circumference ≥90 cm for Asian men or ≥80 cm for Asian women), in addition to any two of four additional factors such as elevated triglyceride levels (≥150 mg/dl), decreased HDL-C levels (<40 mg/dl in males; <50 mg/dl in females), elevated blood pressure, and elevated FPG levels (≥100 mg/dl).[5] The association between MetS and stroke recurrence was determined in two studies. Kono et al. found that MetS was associated with stroke recurrence;[14] nonetheless, Mi et al. discovered the reverse.[5]

Atrial fibrillation (AF)

Relationship between AF and stroke recurrence was evaluated in five studies.[12,13,15,18,19] A significant association between AF and stroke recurrence was determined in these studies.[12,13,15,19] Nevertheless, Chen et al. found contradictory results.[18]

Lifestyle factors
Obesity.
The association between obesity and stroke recurrence was observed in two studies. Obesity or body mass index (BMI) greater than or equal to 25 kg/m^2 was determined to be an independent predictor for stroke recurrence.[14,18]

Smoking. The impact of smoking on stroke recurrence was examined. The study by Xu et al. showed that smoking was significantly associated with stroke recurrence.[12]

Physical inactivity

Two studies examined the relationship between physical inactivity and stroke recurrence as their relationship has not yet been renowned. Physical inactivity was found to be significantly associated with stroke recurrence.[14,24]

Table I: Key terms in the scoping review

Key search terms
"Stroke Recurrence" AND Prevalence AND "Risk Factor*" AND "Secondary Prevention"
"Recurrent stroke*" AND Prevalence AND "Risk Factor*" AND "Secondary Prevention"
"Stroke Recurrence" AND (Incidence OR Occurrence) AND "Risk Factor*" AND "Secondary Prevention"
"Recurrent stroke*" AND (Incidence OR Occurrence) AND "Risk Factor*" AND "Secondary Prevention"
"Stroke Recurrence" AND (Incidence OR Occurrence) AND "Risk Factor*" AND "Relapse Prevention"
"Recurrent stroke*" AND (Incidence OR Occurrence) AND "Risk Factor*" AND "Relapse Prevention"

Table II: Prevalence, risk factors, and secondary prevention associated with stroke recurrence

Country	Study	Types & Purpose of the study	Participants characteristics	Prevalence prevention	Risk factors	Secondary
China	Xu et al., 2007[12]	Prospective cohort study • To analyze the stroke recurrence determinants in Chinese patients	First-ever IS; n=834; age range: 19-97 years old; male: 66.7% female: 33.3%	• First-year recurrence rate: 11.2% • Recurrence rate is higher in Chinese IS patients compared to Western populations.	Increased risk of stroke recurrence associated with uncontrollable hypertension, AF and smoking essation.	No findings
India	Das et al., 2010[11]	Prospective observational study • To evaluate the socioeconomic factors related to discontinuation of secondary prevention of stroke	Stroke patients; n=1212; male: 58.4% (mean age 58 ± 2); female: 41.6% (mean age 56 ± 2)	No findings	No findings	Discontinuation secondary prevention treatment was significantly associated with distance, economy status, poor awareness on stroke, low educational level, types of stroke, cost of treatment and disability status.
Taiwan	Fu et al., 2010[4]	Prospective observational study • To identify the incidence and risk factors of stroke recurrence after stroke stratified by ILAS	IS or TIA patients; n=693; mean age: 66.4 ± 11.7 years; male: 64% female: 36%	Annual stroke recurrence rate: 8.6% Stroke recurrence rate: First-month: 2.3% 31-90 days: 1.5% 91-365 days: 3% 365-730 days: 1.2%	History of IS and ILAS were associated with increased risk of stroke recurrence.	No findings
Japan	Kono et al., 2011[14]	Prospective observational study • To determine the stroke recurrence rate and risk factors of vascular events after mild IS	Acute IS patients; mRS 0-1; n=102; mean age: 64 years; male: 76.5% female: 23.5%	Stroke recurrence rate: 1-year: 18.9% 2-year: 23.8% 3-year: 29.0%	Stroke recurrence or cardiovascular events was significantly predicted by abnormal ABI, MetS, stroke subtypes, salt intake and poor lifestyle management (lower physical activity & higher salt intake).	No findings
China	Liu et al., 2011[22]	Cross-sectional study • To determine the relationships between socioeconomic status and cardiovascular and behavioral factors	Stroke or TIA patients; n=2354; average age: 64.1 years; male: 64.9% female: 35.1%	No findings	Cardiovascular risk factors (hypertension & diabetes mellitus) increased the risk of stroke recurrence.	Education was crucial in controlling the established cardiovascular risk factors.
Thailand	Suanprasert & Tantirithisak, 2011[7]	Retrospective study • To investigate risk factors of IS recurrence	Recurrent IS patients n=67; male: 64.2% female: 35.8%; age range: 44-92 years; Patients without IS n=167; male: 56.9% female: 43.1%; age range: 34-90 years	No findings	Risk factors including blood pressure, FPG, HDL-C and LDL-C levels were associated with recurrent IS.	Statin and folic acid therapies were used for protection of recurrent IS.

A scoping review

Table II: Prevalence, risk factors, and secondary prevention associated with stroke recurrence

Country	Study	Types & Purpose of the study	Participants characteristics	Prevalence prevention	Risk factors	Secondary
Singapore	Venketasubra manian et al., 2011[25]	Ministry of Health Clinical Practice Guidelines • To support clinicians and hospital administrators to create local protocols	No findings	No findings	No findings	Recommendation for secondary prevention including blood pressure lowering, antidiabetic therapy and lifestyle modification (diet, smoking cessation, drinking, obesity & physical activity)
China	Chen et al., 2012[18]	Prospective cohort study • To determine predicative risk factors in TIA & minor IS patients	TIA & minor IS patients; NIHSS score of 1 to 3; n=620; mean age: 72 ± 10.9 years	14-day recurrence rate: 9.3% 90-day recurrence rate: 16.1%	Risk factors of recurrent stroke were symptom duration of at least 1 hour, speech impairment, limb weakness, BMI (at least 25kg/m²) and previous history of cerebrovascular events.	No findings
Japan	Kuwashiro et al., 2012[3]	Prospective observational cohort study • To identify the predisposing factors associated with stroke recurrence within the first 12 months	IS patients; n=260; mean age: 71 ± 11 years; male: 58% female: 42%	First-year recurrence rate: 9.6%	Aging and low HDL-C levels were independent risk factors for IS recurrence.	No findings
China	Mi et al., 2012[5]	Retrospective cohort study • To investigate the relationship of MetS with stroke recurrence	IS patients; n=2639; mean age: 71 ± 11 years; male: 58% female: 42%	First-year recurrence rate: 7.4%	MetS may not be predictive for stroke recurrence while high FPG was a predictor for stroke recurrence.	No findings
Japan	Kono et al., 2013[24]	Randomized controlled trial • To assess the relationship of lifestyle intervention and the onset of new vascular events	Mild stroke patients; n=70; male: 68.6% (mean age: 63.5 years); female: 31.4%	No findings	Higher salt intake and physical inactivity were associated with stroke recurrence.	Lifestyle interventions (moderate-intensity physical activity & salt restriction) and appropriate medication improved the vascular risk factors and also reduced the incidence of vascular events.
Malaysia	Neelamegam et al., 2013[26]	Community-based incidence study • To explore the stroke incidence in the south-west region of the Penang Island, Malaysia	Stroke patients (First-ever and recurrent); n=228; male: 53.1% female: 46.9%	Stroke incidence rate: 67 per 100,000 (age adjustment to 2010 Malaysian population).	No findings	No findings

Country	Study	Types & Purpose of the study	Participants characteristics	Prevalence prevention	Risk factors	Secondary
Singapore	Sun et al., 2013[21]	Retrospective cohort study • To investigate the post stroke outcomes due to stroke recurrence	IS, ICH & SAH; n=12,559; mean age: 76.3 ± 13.8 years; male: 54.0% female: 46.0%	5-year recurrence rate: 15.7%	Risk of stroke recurrence increased with age in all stroke categories, but not gender.	No findings
China	Wang et al., 2013[15]	Prospective observational study • To explore whether hypertension leads to the recurrence of certain subtypes of ischemic stroke	IS patients; n=11560; mean age: 65.5 ± 12.3 years; male: 61.6% female: 38.4%	First-year recurrence rate: 17.7%	Hypertension is associated with stroke recurrence in patients with small-vessel diseases, not other subtypes of IS.	No findings
35 countries	Estol et al., 2014[10]	Epidemiological study • To investigate the correlation between blood pressure in the different racial-ethnic groups and stroke recurrence rate of HS and IS.	IS patients; n=20,332; average age: 66 ± 8.6 years; male: 64% female: 36%	5-year stroke recurrence rate: Hispanics: 8.18% Asian: 8.80% European/Caucasian: 9.04% Black African: 9.19%	No findings	No findings
Korea	Kang et al., 2016[13]	Prospective observational study • To estimate stroke recurrence and MI rates during first year	Acute IS (first & recurrent stroke) patients; n=12,227; mean age: 70 ± 13 years; male: 58.7% female: 41.3%	30-day recurrence rate: 2.7% 90-day recurrence rate: 3.9% 1-year recurrence rate: 5.7%	Diabetes mellitus and prior stoke history were independently predictive for stroke recurrence.	No findings
Japan	Nakano et al., 2015[16]	Retrospective cohort study • To investigate the incidence of PSD	Post stroke patients (IS & ICH); n=112; mean age: 73.6 ± 10.4 years old; male: 61.6% female: 38.4%	Annual stroke recurrence rate: 2.2%	No findings	No findings
China	Zhao et al., 2015[20]	Prospective hospital-based study • To investigate whether AD contributed to stroke recurrence in different subtypes of IS	IS; n=510; average age: 60.69 ± 13.90 years; male: 37.5% female: 62.5%	2-year recurrence rate: 12.9%	AD was significantly associated with increased risk of stroke recurrence in IS patients, specifically in LAA subtype.	No findings
China	Wu et al., 2015[19]	Prospective observational study • To identify factors associated with early stroke recurrence, stroke disability and all-cause death of a minor stroke	Minor stroke patients with NIHSS < 4; n=4669; age: 55-74 years; male: 64.5% female: 35.5%	3-month recurrence rate: 9.8%	Hypertension, diabetes mellitus, AF, CHD and previous stroke history were significantly associated with stroke recurrence.	No findings
China	Fu et al., 2015[17]	Retrospective hospital-based study • To investigate the risk factors of stroke recurrence in stroke patients unrelated to AF in young and older than 65 years old patients	Stroke patients unrelated to AF; n=1017; mean age: 63.26 ± 0.61 years; young patients: < 65 years; older patients: ≥ 65 years	First-year recurrence rate: 25.4%	Older patients (≥ 65 years): Previous history of MI, IS or TIA, diabetes mellitus and coronary atherosclerotic disease Young patients (< 65 years): Hypertension, coronary atherosclerotic heart disease, previous history of IS or TIA	No findings

Table II: Prevalence, risk factors, and secondary prevention associated with stroke recurrence

Country	Study	Types & Purpose of the study	Participants characteristics	Prevalence prevention	Risk factors	Secondary
Japan	Nomura et al., 2015[23]	Prospective cohort observational study • To compare the vascular events rates between patients with and without hyperlipidaemia	IS patients; n=449; mean age: 67.6 ± 10.4 years; male: 64.8% female: 35.2%	No findings	Patients with hyperlipidaemia had a significantly higher rate of vascular events compared with those without hyperlipidaemia.	Statins managed to reduce stroke recurrence rate in patients with hyperlipidaemia.
China	Pan et al., 2016[6]	Prospective observational study • To determine whether diabetes mellitus contributes to the prognosis of minor stroke or its specific subtype	Minor IS; n=4548; average age: 64.1 years; male: 64.9% female: 35.1%	First-year stroke recurrence rate: 13.0%	Diabetes mellitus significantly associated with stroke recurrence in small-artery occlusion subtype, but not in other subtypes of minor stroke	No findings

Abbreviations:

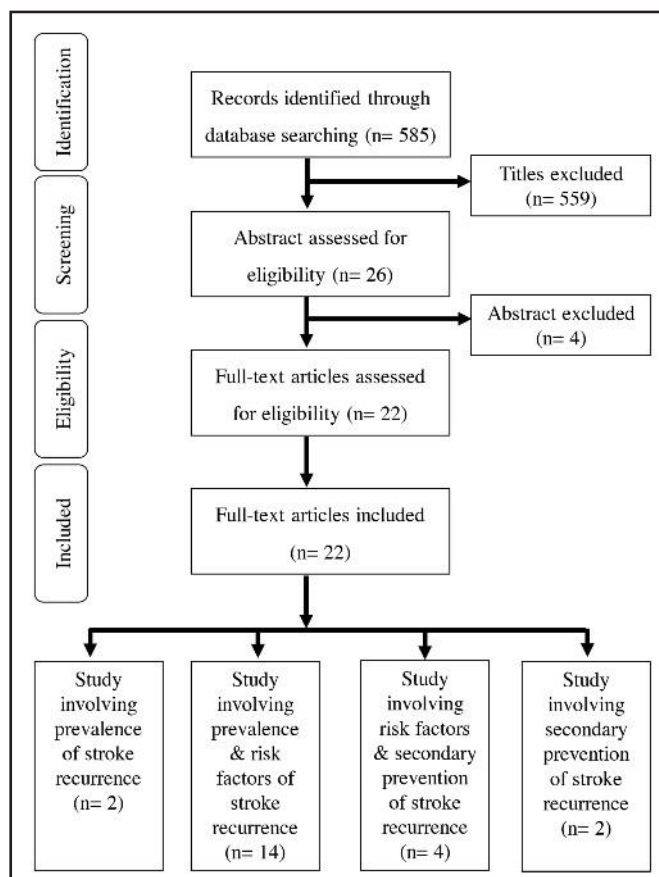|		
ABI: Ankle-brachial pressure index	AD: Atherogenic dyslipidaemia	AF: Atrial fibrillation
BMI: Body mass index	CHD: Coronary heart disease	FPG: Fasting plasma glucose
HDL-C: High-density lipoprotein cholesterol	HS: Haemorrhagic stroke	LAA: Large-artery atherosclerosis
LDL-C: Low-density lipoprotein cholesterol	ICH: Intracerebral haemorrhage	ILAS: Intracranial large artery stenosis
IS: Ischaemic stroke	MetS: Metabolic syndrome	MI: Myocardial infarction
mRS: Modified Rankin Scale	NIHSS: National Institute of Health Stroke Scale	PSD: Poststroke dementia
SAH: Subarachnoid haemorrhage	TIA: Transient ischaemic attack	

Fig. 1: PRISMA Flow chart of scoping review (based on framework by Arksey & O' Malley, 2005[8], Moher et al., 2009[9]).

High salt intake
The association between high salt intake and stroke recurrence was evaluated in two studies.[14,24] Higher salt intake was significantly associated with higher stroke recurrence.[14,24]

Secondary Prevention of Stroke Recurrence
The primary concept for secondary prevention is through modification of risk factors. If modification of risk factors is not properly managed, risk of stroke recurrence is high. Thus, to prevent stroke recurrence effectively, optimal management of risk factors, especially the modifiable ones at a certain level is important for the outcome and quality of life among stroke patients. An integration of appropriate pharmacological treatment and lifestyle modification was emphasized to prevent recurrent stroke and vascular consequences.[22,24,25]

Healthy lifestyle interventions can be achieved by controlling body weight, increasing daily physical activity, reducing salt intake, smoking cessation, alcohol reduction, and lastly modifying dietary patterns such as low saturated fat intake, caloric restriction, and increase potassium-rich foods.[18,24]

Other than that, persistent health education was the strongest associated factor in secondary stroke prevention.[22] Lastly, the findings in Suanprasert and Tantirithisak stated that folic acid and statin therapies were important for stroke recurrence protection.[7]

DISCUSSION
Stroke is one of the major causes of death in most Asian countries. According to Nomura et al., stroke continues to be one of the leading causes of death in Japan.[23] Stroke also causes higher risk of physical disability among stroke survivors.[3] Moreover, stroke recurrence may increase the disability of patients, even leading to possible mortality.[7] Two types of strokes reacted differently, for example, ischaemic stroke patients had a higher recurrence rate and late mortality whereas haemorrhagic stroke patients had a higher early mortality rate.[21]

In this review, the recurrence rate is about 1 in 4 persons within one year. And as time goes on, their chance of getting recurrent stroke will decrease. Therefore, it is imperative that stroke survivors are preventing another stroke by adhering to secondary stroke prevention strategies during the highest risk time.

The high recurrence rate could be due to the increased prevalence of recurrent risk factors such as dyslipidaemia, diabetes mellitus, and obesity.[14] In addition, race could also be a possible reason for high rates of stroke recurrence. It had been demonstrated by Sacco et al. that Asian populations such as Chinese, Koreans, and Japanese tend to have a higher stroke incidence and stroke recurrence compared to Western populations.[27]

Identifying risk factors for subsequent stroke events in stroke survivors would vary depending on different geographical regions.[13] In this review, the risk factors of stroke recurrence are divided into unmodifiable risk factors which are age and previous history of cerebrovascular events, while the modifiable risk factors include hypertension, ABI, AD, diabetes mellitus, MetS, AF, obesity, smoking, physical inactivity and high salt intake.

Age had been determined as an immutable risk factor for stroke recurrence in which older patients had a higher risk of stroke recurrence.[21] Well-controlled systolic and diastolic blood pressure reduced the incidence of stroke recurrence.[7,25] For example, by controlling blood pressure stroke patients were able to halve the risk for stroke recurrence.[12] In addition, the study found out that stroke patients with AD were more prone to have type 2 diabetes mellitus, and higher BMI and fasting plasma glucose values; therefore, IS patients with AD had significantly higher risk of stroke recurrence than those without. There was clear evidence that HDL-C helped in preventing atherosclerosis and acted as an antioxidant.[20] Thus, stroke survivors are recommended to increase HDL-C levels.

Indeed, stroke patients with diabetes mellitus appeared to be older, many were female, and most were obese and had more vascular risk factors (namely previous stroke history, hypertension, dyslipidaemia).[6] These may be due to diabetes mellitus being associated with endothelial dysfunction and increased platelet aggregation. Diabetes glucose control was recommended among diabetic stroke patients to reduce microvascular and possibly macrovascular complications.[25]

Although many traditional risk factors for stroke recurrence have been identified, other new modifiable risk factors remain to be explored. For instance, MetS provided a new focus. Patients with MetS were more likely to be female, younger, and non-smokers, and rarely have a previous history of AF compared to stroke patients without a metabolic syndrome.[5] Besides that, obesity was a newly identified risk factor which made it a new content for the study of stroke recurrence. Therefore, controlling body weight was important as a long term lifestyle changes.[18]

Evidence showed that risk for recurrence was detected to be slightly higher in current smokers compared to non- or former smokers.[12] Thus, smoking cessation was recommended for patients with stroke.[25] In addition, increase in exercise helps to prevent stroke recurrence by improving insulin sensitivity and increasing HDL-C levels in stroke patients.[18, 24] Furthermore, moderate intensity physical activities were recommended for most days of the week, which should last for at least 30 minutes to have a good effect on vascular health, including anti-inflammatory and antioxidant effects.[14, 24-25]

High prevalence of stroke recurrence highlighted the importance of secondary prevention.[7] Secondary prevention refers to standard therapeutic guideline for patients with stroke as these patients have another recurrent stroke or other vascular events within a few years.[24] It was observed that recurrence rates were significantly higher in stroke patients who failed to execute secondary preventive treatment.[11] Better control and early awareness of risk factors could bring about effective stroke recurrence prevention.[18, 22]

Persistent health education among patients with a more educated profile instead of income or occupation would adhere to better self-management of the disease due to higher rates of awareness, control of cardiovascular risk factors, and lifestyle behaviours.[22] Nevertheless, usually education does not make any difference after young adulthood. Therefore, a successful intervention to reduce stroke recurrence is to develop and implement stroke education programmes through appropriate techniques to deliver the messages effectively.

Interestingly, a study in Thailand showed that folic acid was associated with decreased incidence of recurrent stroke. This makes therapeutic modification of stroke possible, using dietary supplements like folic acid, and vitamins B6 and B12 that reduces homocysteine levels in stroke patients.[7]

Finally, this scoping review noticed that there was limited evidence on prevalence rates, risk factors, and secondary prevention of stroke recurrence among other Asian countries besides those countries in this review. Therefore, future collaborative researches are necessary to address the overall prevalence rates and guidelines of secondary prevention in terms of lifestyle modification based on Asian populations.

CONCLUSION
In conclusion, screening for stroke recurrence risk factors will help in decreasing the burden of cerebrovascular diseases in the community, especially when stroke incidence in low- middle income countries in Asia is on a rising trend. Health system planning on controlling risk factors for stroke recurrence protects and reduces recurrent stroke attacks. To prevent recurrent stroke, health intervention should be geared towards changing lifestyle to embody a healthier approach to life. This is of great importance to public health and quality of life of stroke survivors.

REFERENCES
1. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A et al. An updated definition of stroke for the 21st century. Stroke 2013; 44(7): 2064-89.
2. Mathers CD, Ma Fat D, Boerma JT. The Global Burden of Disease: 2004 Update. Geneva: World Health Organ; 2008.
3. Kuwashiro T, Sugimori H, Kamouchi M, Ago T, Kitazono T, Iida M. Lower levels of high-density lipoprotein cholesterol on admission and a recurrence of ischemic stroke: a 12-month follow-up of the Fukuoka Stroke Registry. J Stroke Cerebrovasc Dis 2012; 21(7): 561-68.
4. Fu MH, Chang KC, Huang YC. Recurrent ischemic stroke is predicted by intracranial large artery stenosis identified by brain MRA: an observational study of 693 patients from Kaohsiung, Taiwan. Acta Neurol Taiwan 2010; 19(4): 253-62.
5. Mi D, Jia Q, Zheng H, Hoff K, Zhao X, Wang C et al. Metabolic syndrome and stroke recurrence in Chinese ischemic stroke patients–the ACROSS- China study. PLoS One 2012; 7(12): e51406.
6. Pan Y, Wang Y, Li H, Gaisano HY, Wang Y, He Y. Association of diabetes and prognosis of minor stroke and its subtypes: a prospective observational study. PLoS One 2016; 11(4): e0153178.
7. Suanprasert N, Tantirithisak T. Impact of risk factors for recurrent ischemic stroke in Prasat Neurological Institute. J Med Assoc Thai 2011; 94(9): 1035-43.
8. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol 2005; 8: 19-32.
9. Moher D, Liberati A, Tetzlaff J, Altman DG, Prisma Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009; 6(7): e1000097.
10. Estol CJ, Bath PM, Gorelick PB, Cotton D, Martin RH. Differences in ischemic and hemorrhagic recurrence rates among race-ethnic groups in the PRoFESS secondary stroke prevention trial. Int J Stroke 2014; 9(A100): 43-7.
11. Das K, Ghosh M, Khanna B, Banerjee M, Mondal GP, Singh OP et al. Discontinuation of secondary preventive treatment of stroke: an unexplored scenario in India. Clin Neurol Neurosurg 2010; 112(9): 766-9.
12. Xu G, Liu X, Wu W, Zhang R, Yin Q. Recurrence after ischemic stroke in Chinese patients: impact of uncontrolled modifiable risk factors. Cerebrovasc Dis 2007; 23(2-3): 117-20.
13. Kang K, Park TH, Kim N, Jang MU, Park SS, Park JM et al. Recurrent stroke, myocardial infarction, and major vascular events during the first year after acute ischemic stroke: the multicenter prospective observational study about recurrence and its determinants after acute ischemic stroke I. J Stroke Cerebrovasc Dis 2016; 25(3): 656-64.
14. Kono Y, Yamada S, Kamisaka K, Araki A, Fujioka Y, Yasui K et al. Recurrence risk after noncardioembolic mild ischemic stroke in a Japanese population. Cerebrovasc Dis 2011; 31(4): 365-72.
15. Wang Y, Xu J, Zhao X, Wang D, Wang C, Liu L et al. Association of hypertension with stroke recurrence depends on ischemic stroke subtype. Stroke 2013; 44(5): 1232-37.
16. Nakano Y, Deguchi K, Yamashita T, Morihara R, Matsuzono K, Kawahara Y et al. High incidence of dementia conversion than stroke recurrence in poststroke patients of late elder society. J Stroke Cerebrovasc Dis 2015; 24(7): 1621-28.
17. Fu GR, Yuan WQ, Du WL, Yang ZH, Fu N, Zheng HG et al. Risk factors associated with recurrent strokes in young and elderly patients: a hospital-based study. Int J Gerontol 2015; 9(2): 63-6.
18. Chen C, Zhao Y, Zhang J, Wang H, Wang X, Ma X et al. Analysis of multiple risk factors for the recurrence of nondisabling stroke. J Natl Med Assoc 2012; 104(7-8): 331-5.

19. Wu L, Wang A, Wang X, Zhao X, Wang C, Liu L et al. Factors for short-term outcomes in patients with a minor stroke: results from China National Stroke Registry. BMC Neurol 2015; 15(1): 253.

20. Zhao L, Wang R, Song B, Tan S, Gao Y, Fang H et al. Association between atherogenic dyslipidemia and recurrent stroke risk in patients with different subtypes of ischemic stroke. Int J Stroke 2015; 10(5): 752-58.

21. Sun Y, Lee SH, Heng BH, Chin VS. 5-year survival and rehospitalization due to stroke recurrence among patients with hemorrhagic or ischemic strokes in Singapore. BMC Neurol 2013; 13(1): 133.

22. Liu Q, Wang M, Guo J, Li J, Li C, Qian, M. Effect of socioeconomic status on secondary prevention of stroke. Int J Qual Health Care 2011; 23(4): 405-412.

23. Nomura E, Suzuki A, Inoue I, Nakagawara J, Takahashi K, Takahashi T et al. Subsequent Vascular Events after Ischemic Stroke: The Japan Statin Treatment against Recurrent Stroke—Longitudinal. J Stroke Cerebrovasc Dis 2015; 24(2): 473-9.

24. Kono Y, Yamada S, Yamaguchi J, Hagiwara Y, Iritani N, Ishida S et al. Secondary prevention of new vascular events with lifestyle intervention in patients with noncardioembolic mild ischemic stroke: a single-center randomized controlled trial. Cerebrovasc Dis 2013; 36(2): 88-97.

25. Venketasubramanian N, Pwee KH, Chen CPL. Singapore ministry of health clinical practice guidelines on stroke and transient ischemic attacks. Int J Stroke 2011; 6(3): 251-8.

26. Neelamegam M, Looi I, Cheah WK, Narayanan P, Hamid AMA, Ong LM. Stroke incidence in the South West District of the Penang Island, Malaysia: PEARLs: Penang Acute Stroke Research Longitudinal Study. Prev Med 2013; 57: S77-S79.

27. Sacco RL, Adams R, Albers G, Alberts MJ, Benavente O, Furie K et al. Guidelines for prevention of stroke in patients with ischemic stroke or transient ischemic attack: a statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke: cosponsored by the Council on Cardiovascular Radiology and Intervention: the American Academy of Neurology affirms the value of this guideline. Stroke 2006; 37: 577–617.