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Sex disparity in stroke outcomes in a multicenter prospective stroke registry in Vietnam

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Abstract

Background: Although men have a higher rate of stroke than women, it is not clear whether women have a worse outcome after adjusting for confounders such as vascular risk factors, age, stroke severity, and reperfusion therapy. We evaluated sex differences on 90-day functional outcomes after stroke in a multicenter study in Vietnam.

Methods: We recruited patients presenting with ischemic or hemorrhagic stroke at 10 stroke centers in Vietnam for a period of 1 month from 1 August 2022 to 31 August 2022. We reviewed the patient's clinical demographics, time from symptom onset to hospital admission, stroke classification, stroke subtype, stroke severity, characteristics of reperfusion therapy, and 90-day clinical outcome. We compared functional outcomes and predisposing factors at day 90 between men and women after an ischemic and hemorrhagic stroke. Poor outcome was defined as modified Rankin Scale 3–6.

Results: There were 2300 stroke patients included. Men accounted for 61.3% (1410) of participants. Compared to men, women were older (67.7 ± 13.9 vs 63.7 ± 13.3, $P < 0.001$), had a higher rate of diabetes mellitus (21.1% vs 15.3%, $P < 0.001$), a lower rate of tobacco use (1.0 % vs 23.6%, $P < 0.001$), and a lower body mass index (21.4 ± 2.70 vs

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22.0 ± 2.72, P < 0.001). There was a higher rate of intracranial hemorrhage (ICH) in men (21.3% vs 15.6%, P = 0.001), whereas the rate of subarachnoid hemorrhage was higher in women (6.2% vs 3.0%, P < 0.001). For ischemic stroke, door-to-needle time (36.9 ± 17.6 vs 47.8 ± 35.2 min, P = 0.04) and door-to-recanalization time (113.6 ± 51.1 vs 134.2 ± 48.2, P = 0.03) were shorter in women. There was no difference in 90-day functional outcomes between sexes. Factors associated with poor outcomes included age ⩾50 years (adjusted odds ratio (aOR): 1.75; 95% confidence interval (CI): 1.16–2.66), history of stroke (aOR: 1.50; 95% CI: 1.15–1.96), large artery atherosclerosis (aOR: 5.19; 95% CI: 3.90–6.90), and cardioembolism (aOR: 3.21; 95% CI: 1.68–6.16). Factors associated with mortality in patients with acute ischemic stroke included a history of coronary artery disease (aOR: 3.04; 95% CI: 1.03–8.92), large artery atherosclerosis (aOR: 3.37; 95% CI: 2.11–5.37), and cardioembolism (aOR: 3.15; 95% CI: 1.20–8.27).

Conclusion: There were no sex differences in the clinical outcome of stroke and ischemic stroke in this prospective cohort of hospitalized Vietnamese patients.

Keywords
Stroke, ischemic stroke, intracranial hemorrhage, sex, outcome, factor

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Introduction

Stroke is one of the leading causes of death and accounts for a significant burden of morbidity not only in Western countries but also in Asian countries, including Vietnam.[1] The functional outcomes and mortality in ischemic stroke and non-traumatic intracranial hemorrhage (ICH) patients can be sex or gender related.[2,3] This difference may be related to the fact that stroke occurs at a younger age in men, and stroke risk factors such as tobacco use and alcohol consumption are more prevalent in men.[4] In contrast, women are often reported to have stroke at a later age, and correspondingly have a higher rate of atrial fibrillation, as well as severe initial neurologic deficit.[5,6] In Vietnam, there is a lack of data regarding sex differences as related to stroke risk factors, clinical profiles, and clinical outcomes as well as strategies for stroke management and prevention. Understanding these factors may help tailor medical management and stroke education to patients accordingly.

The aim of our study was to determine whether sex is associated with functional outcomes, including mortality in patients presenting with ischemic and hemorrhagic stroke disease in Vietnam.

Methods

We evaluated consecutive patients with acute ischemic or hemorrhagic stroke prospectively enrolled in 10 hospitals with stroke units, stroke departments, or stroke centers from North to South Vietnam, for a 1-month period from 1 August 2022 to 31 August 2022. We reviewed the patients' clinical demographics, vascular risk factors, onset to hospital admission time, and laboratory and radiological findings.

We reviewed the patients' clinical demographics, vascular risk factors, and body mass index (BMI). All participants' baseline National Institutes of Health Stroke Scale (NIHSS) scores were evaluated by certified stroke neurologists. Stroke types included ischemic stroke and transient ischemic attack (TIA), intracerebral hemorrhage, subarachnoid hemorrhage (SAH), and cerebral venous thrombosis (CVT). The diagnosis of TIA was based on tissue or time-based definitions, as a transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction.[7] Most patients underwent magnetic resonance imaging (MRI); however, a small number of patients with TIA were diagnosed by computed tomography (CT) alone. Stroke subtypes were determined based on the Trial of Org 10172 in acute stroke treatment classification.[8] To determine the differences in the medical attention for intravenous thrombolysis (IVT) between men and women, we investigated the patients' hospital arrival time and performance of intervention (intravenous tissue plasminogen activator (IV t-PA) and/or mechanical thrombectomy). We compared the above various parameters between sexes. The functional outcomes of survivors were determined using the modified Rankin Scale (mRS) score at 90 days. The primary outcome was the 90-day mRS, dichotomized as functional independence or good outcome (mRS ⩽ 2) and poor outcome (mRS > 2). These assessments were performed via telephone or face-to-face interviews in the outpatient clinic. This study was approved by the ethics committee of Bach Mai Hospital (No-1575/QĐ-BVBM). As the study carried little to no risk to the patient, there was waiver of informed consent.

Statistical analysis

The patient clinical characteristics were summarized. Subgroups were described with descriptive statistics. The categorical variables were compared using Fisher's exact test or Pearson's chi-square test. Student's t-test and

Mann–Whitney U test were used for the comparison of continuous variables. The odds ratios (ORs) for the comparison of the two groups were reported with 95% confidence intervals (CIs) and P values using logistic regression analysis. To evaluate the association between the independent factors and the long-term functional outcomes after stroke, a multivariable model was created with a backward elimination method, and the probability threshold for removal was set at 0.10. The ORs were adjusted for factors that could affect treatment outcomes, including age, female sex, hypertension, diabetes, tobacco use, history of stroke, history of coronary heart disease, atrial fibrillation, thrombolytic therapy, intracranial atherosclerosis stenosis, and stroke subtype. A P value less than 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 21 (IBM Co., Armonk, NY, USA).

Results

During the observation period, 2310 patients with stroke were enrolled in this study. At 90 days, there were 10 patients lost to follow-up. We therefore analyzed 2300 stroke patients with women comprising 38.7% (890 patients) of participants. The mean age was 65.3 ± 13.7 years, and the median (interquartile range (IQR)) NIHSS score was 7 (3–12). The baseline variables, vascular risk factors, and stroke type stratified according to sex are summarized in Table 1. Women were significantly older (67.7 ± 13.9 vs 63.7 ± 13.3, $P < 0.001$). Women had a higher prevalence of atrial fibrillation, diabetes mellitus, and a lower prevalence of tobacco use than men. Women had a significantly lower BMI (21.4 ± 2.70 vs 22.0 ± 2.72, $P < 0.001$) than men. There was a higher prevalence of intracerebral hemorrhage in men, but a lower prevalence of SAH than women. Time from symptom onset to hospital arrival and 90-day mRS are shown in Table 2. There was no difference in time from symptom onset to hospital arrival and 90-day mRS between men and women for ischemic or hemorrhagic stroke, whether inclusive or excluding CVT and SAH diagnoses (Tables 2 and 3).

Of 1673 patients presenting with ischemic stroke, IVT was administered in 8.1% of the overall cohort and endovascular therapy in 8.0%, with no difference between women and men. Women had shorter door-to-needle times (36.9 ± 17.6 vs 47.8 ± 35.2, $P = 0.04$), shorter door-to-groin time (84.9 + 35.9 vs 93.8 + 39.3, $P = 0.21$) and door-to-recanalization time for thrombectomy (113.6 ± 51.1 vs 134.2 ± 48.2, $P = 0.03$). As for ischemic stroke subtype, women had a lower prevalence of large artery atherosclerosis (21.4% vs 27.7%, $P = 0.004$) but more stroke of undetermined etiology (26.0% vs 20.8%, $P = 0.01$) (Table 3). At 90-day follow-up, there was no difference in clinical outcomes between men and women, whether of ischemic or hemorrhagic stroke subtype (Tables 2 and 3).

In patients with acute ischemic stroke, age ⩾50 (adjusted odds ratio (aOR): 1.75; 95% CI: 1.16–2.66; $P = 0.002$), previous history of stroke (aOR: 1.50; 95% CI: 1.15–1.96; $P < 0.001$), large artery atherosclerosis (aOR: 5.19; 95% CI: 3.90–6.90; $P < 0.001$), and cardioembolism (aOR: 3.21; 95% CI: 1.68–6.16; $P < 0.001$) were independent predictors of poor functional outcome (mRS 3–6) at 90 days (Table 4). Previous history of coronary artery disease (aOR: 3.03; 95% CI: 1.03–8.92; $P = 0.02$), large artery atherosclerosis (aOR: 3.37; 95% CI: 2.11–5.37; $P < 0.001$), and cardioembolism (aOR: 3.15; 95% CI: 1.20–8.27; $P < 0.001$) were independent predictors of mortality (mRS 6) at 90 days (Table 5).

In patients with ICH, sex was not a predictor of 90-day poor outcome or mortality, nor were other factors found to be associated (Tables 6 and 7).

Discussion

In this large national prospective study of patients admitted with ischemic and hemorrhagic stroke in Vietnam, we found that there was a lower proportion of admissions in women compared to men. Women were older than men (median 4 years), which is a common trend in sex disparities worldwide.[4,5,9] Women had higher rates of diabetes mellitus and atrial fibrillation, whereas men had higher rates of tobacco use and BMI, which are risk factors for stroke. However, there were no sex differences in the severity of their presentation by the NIHSS scale, which is in contrast to studies from Korea showing that women presented with a higher initial NIHSS score.[5] Although there was a significant difference in some risk factors between men and women, there was no effect on 90-day functional outcomes or mortality. Notably, in our study, the rate of stroke in young patients accounted for 7.2%, which is a similar rate to a previous report in Western countries.[10] Hypertension was the most common risk factor in patients with stroke, present in more than two-thirds of stroke patients, which is in line with that reported by stroke studies from other countries.[11,12]

The lower proportion of female patients admitted with stroke in our Vietnamese hospitalized patient sample is concordant with two other single-center studies in Vietnam, whereby women accounted for 44% and 39% of admitted patients at stroke centers in Ho Chi Minh and Da Nang centers, respectively.[13,14] The reasons for the lower rate of women admitted with stroke are not clear, but may be driven by the significantly higher proportions of tobacco use in men (over 20% higher in men than women) and related pathophysiology of large artery atherosclerosis stroke. Our study also shows that the rate of TIA and ischemic stroke accounts for three-quarters of stroke patients, whereas the rate of ICH accounted for one-quarter. This result differs from that of Western countries where the

Table 1. Differences in baseline characteristics between men and women.

Variable	Total (N = 2300)	Men (n = 1410)	Women (n = 890)	P value
	n (column %)			
Age, mean (year)	65.3 ± 13.7	63.7 ± 13.3	67.7 ± 13.9	<0.001
⩽45 years	166 (7.3)	107 (7.7)	59 (6.7)	0.40
>45 years[a]	2112 (92.7)	1291 (92.3)	821 (93.3)	
NIHSS[a], median (IQR)	7 (3–12)	7 (3–12)	7 (3–12)	0.82
Risk factors				
Hypertension	1767 (76.8)	1086 (77)	681 (76.5)	0.78
Diabetes mellitus	404 (17.6)	216 (15.3)	188 (21.1)	<0.001
Current or previous history of tobacco	342 (14.9)	333 (23.6)	9 (1.0)	<0.001
Previous history of coronary artery disease	21 (0.9)	14 (1.0)	7 (0.8)	0.61
Previous history of cerebrovascular disease	403 (17.5)	260 (18.4)	143 (16.1)	0.14
Previous history of atrial fibrillation	125 (5.4)	65 (4.6)	60 (6.7)	0.03
BMI[a]	21.8 ± 2.73	22.0 ± 2.72	21.4 ± 2.70	<0.001
Classification of stroke				
Ischemic stroke and TIA	1752 (76.2)[b]	1064 (75.5)	688 (77.3)	0.31
Intracerebral hemorrhage	439 (19.1)	300 (21.3)	139 (15.6)	0.001
Subarachnoid hemorrhage	97 (4.2)	42 (3.0)	55 (6.2)	<0.001
CVT	12 (0.5)	4 (0.3)	8 (0.9)	0.07

NIHSS: National Institutes of Health Stroke Scale; IQR: interquartile range; BMI: body mass index; TIA: transient ischemic attack; CVT: cerebral venous thrombosis.
[a]Data were missing for age in 22 patients (12 men and 10 women), NIHSS in 7 patients (2 men and 5 women), and BMI in 674 patients (410 men and 264 women).
[b]There were 134 patients with large vessel occlusion who received thrombectomy.

rate of ischemic stroke is very high with 88% comprising ischemic stroke, whereas the rate of intracerebral hemorrhage and SAH is lower.[15] Although there was no sex difference in the incidence of ischemic stroke, there was a sex difference in the rates of ICH and SAH, with a higher rate of ICH in men while SAH was more prevalent in women.

The time from symptom onset to admission in our hospitals was often late, with only a third of patients presenting within the first 6 h of onset, a much lower percentage compared with similar studies.[16] Perhaps, this is due to the low awareness of the Vietnamese people about stroke, and the underdeveloped pre-hospital emergency system. This delay in presentation, as well as a lower rate of access to alteplase and thrombectomy amid the pandemic, could explain a lower rate of IVT as well as mechanical thrombectomy in our cohort (Table 3).[17–21] However, compared to the 8.4% rate of IVT utilization reported of acute ischemic stroke admissions in a 2009–2017 Nationwide Inpatient Sample in the United States,[22] our similar IVT rate of 8.1% may reflect overlapping eligibility criteria for IVT across two independent samples. Our study also found no difference in 90-day treatment outcomes between men and women in terms of good functional outcome, poor functional outcome, and mortality.

Among ischemic stroke patients, door-to-needle time and door-to-recanalization time were both shorter in women compared to men. The reason for this differential in time is unclear, perhaps related to the lower rate of large artery atherosclerosis in women,[23] and the probable longer duration of treating patients with symptomatic intracranial arterial stenosis. This time differential merits further study to ensure timely access to reperfusion therapy in both men and women. Moreover, the lower rate of large artery atherosclerosis in women may be related to the significantly

Table 2. Time to hospital arrival and 90-day outcomes between men and women for ischemic and hemorrhagic stroke.

	Total (N = 2300) (%)	Men (n = 1410) (%)	Women (n = 890) (%)	P value
	n (column %)			
Time to hospital arrival with CVT and SAH				
⩽4.5 h	534 (23.2)	336 (23.8)	198 (22.2)	0.38
4.5–6.0 h	238 (10.3)	149 (10.6)	89 (10.0)	0.66
6.0–24 h	764 (33.2)	464 (32.9)	300 (33.7)	0.69
⩾24 h	764 (33.2)	461 (32.7)	303 (34.0)	0.50
Time to hospital arrival without CVT and SAH				
n	2191	1364	827	
⩽4.5 h	514 (23.5)	330 (24.2)	184 (22.2)	0.30
4.5–6.0 h	226 (10.3)	147 (10.8)	79 (9.6)	0.36
6.0–24 h	727 (33.2)	449 (32.9)	278 (33.6)	0.74
⩾24 h	724 (33.0)	438 (32.1)	286 (34.6)	0.23
90-day mRS with CVT and SAH				
0–2	1449 (63)	888 (63)	561 (63)	0.98
3–5	599 (26)	363 (25.7)	236 (26.5)	0.68
6 (mortality)	252 (11.0)	159 (11.3)	93 (10.4)	0.54
90-day mRS without CVT and SAH				
0–2	1381 (63.9)	856 (62.8)	525 (63.5)	0.73
3–5	581 (26.5)	357 (26.2)	224 (27.1)	0.64
6 (mortality)	229 (10.5)	151 (11.1)	78 (9.4)	0.22

CVT: cerebral venous thrombosis; SAH: subarachnoid hemorrhage; mRS: modified Rankin Scale.

lower rate of tobacco use in women compared to men. The significantly higher rate of tobacco use in men in our study is similar to that reported by the ANGEL-ACT prospective large vessel occlusion registry in China.[24] This suggests an opportunity to engage men in Vietnam for tobacco cessation education for primary and secondary stroke prevention. In contrast, a stroke of undetermined etiology was higher in women, but all these factors seemed to have no effect on 90-day outcomes. BMI, a growing risk factor for stroke,[25] was higher in men compared to women in our cohort. While the range was normal for both men and women, the median BMI value was lower than that which has been reported in other Asian and Western cohorts with stroke.[26,27]

Analysis of factors influencing poor outcome among acute ischemic stroke patients in our study included age, history of stroke, TOAST classification of large artery atherosclerosis, and cardioembolism, which are concordant with factors associated with poor outcome reported in other stroke studies.[28,29] Factors that influenced mortality in ischemic stroke included a history of coronary artery disease, large artery atherosclerosis, and cardioembolism. These findings may indicate a need for close follow-up and aggressive medical management of patients harboring these aforementioned risk factors to prevent untoward events. The results of our study on mortality as well as the results of 90-day functional outcomes in ischemic and hemorrhagic stroke patients also did not differ between men and women.

The study has limitations. First, the enrollment period was 1 month, so it is not possible to represent the results across 1 year, especially when stroke may be related to seasonal factors. Second, we used mRS as a functional outcome measure that may not be as representative of all the

Table 3. Reperfusion therapy, TOAST classification, and 90-day outcomes in ischemic stroke between men and women.

	Total (N = 1673)	Men (n = 1015)	Women (n = 658)	P value
	n (column %)			
Type of reperfusion				
Intravenous thrombolysis	135 (8.1)	89 (8.8)	46 (7.0)	0.19
Thrombectomy	134 (8.0)	82 (8.1)	52 (7.9)	0.89
Time to treatment				
Door to needle[a] (minutes, IQR)	43.9 ± 30.5	47.8 ± 35.2	36.9 ± 17.6	0.04
Door to groin time[a] (minutes, IQR)	90.5 ± 38.1	93.8 ± 39.3	84.9 ± 35.9	0.21
Door-to-recanalization time[a] (minutes, IQR)	126.6 ± 50.1	134.2 ± 48.2	113.6 ± 51.1	0.03
Ischemic stroke subtype				
Large artery atherosclerosis	422 (25.2)	281 (27.7)	141 (21.4)	0.004
Cardioembolism	145 (8.7)	80 (7.9)	65 (9.9)	0.16
Small-vessel occlusion	707 (42.3)	430 (42.4)	277 (42.1)	0.91
Stroke of other determined etiologies	17 (1.0)	13 (1.3)	4 (0.6)	0.18
Stroke of undetermined etiology	382 (22.8)	211 (20.8)	171 (26.0)	0.01
90-day mRS				
0–2	1128 (67.4)	691 (68.1)	437 (66.4)	0.48
3–5	407 (24.3)	239 (23.5)	168 (25.5)	0.35
6	138 (8.3)	85 (8.40)	53 (8.10)	0.82

TOAST: Trial of ORG 10172 in acute stroke treatment; IQR: interquartile range: mRS: modified Rankin Scale.
[a]Data were missing for door-to-needle time in 6 patients (6 men and 0 women), door-to-groin time in 9 patients (4 men and 5 women), and door-to-recanalization time in 12 patients (5 men and 7 women).

Table 4. Multivariable logistic regression analysis regarding the predictors of poor functional outcome (mRS: 3–6) at 90 days in 1673 acute ischemic stroke patients.

	90-day mRS score: 3–6			
Variable	Unadjusted OR	95% CI	P value	Adjusted OR (95% CI)
Women	1.08	0.87–1.33	0.48	1.11 (0.88–1.41)
Age (year)				
>45	1.66	1.0–2.76	0.05	1.55 (0.90–2.67)
⩾50	1.81	1.23–2.66	0.002	1.75 (1.16–2.66)
Risk factors				
Hypertension	0.96	0.75–1.23	0.76	0.91 (0.69–1.20)
Diabetes mellitus	1.04	0.80–1.34	0.77	1.05 (0.80–1.39)
Tobacco use	0.84	0.63–1.14	0.26	0.92 (0.66–1.28)

(Continued)

Table 4. (Continued)

Variable	90-day mRS score: 3–6			
	Unadjusted OR	95% CI	P value	Adjusted OR (95% CI)
Previous history of stroke	1.55	1.21–1.98	<0.001	1.50 (1.15–1.96)
Previous history of coronary artery disease	1.70	0.70–4.14	0.23	1.30 (0.50–3.37)
Previous history of atrial fibrillation	2.45	1.69–3.56	<0.001	1.64 (0.84–3.21)
Thrombolysis	1.11	0.77–1.61	0.56	1.06 (0.71–1.59)
Intracranial arterial stenosis	0.94	0.58–1.52	0.79	0.54 (0.32–0.90)
Stroke subtype				
Large artery atherosclerosis	2.71	2.16–3.40	<0.001	5.19 (3.90 -6.90)
Cardioembolism	2.13	1.51–3.01	<0.001	3.21 (1.68–6.16)
Stroke of other determined etiologies	0.86	0.30–2.46	0.78	2.83 (0.93–8.57)
Stroke of undetermined etiology	1.23	0.97–1.56	0.09	2.82 (2.11–3.79)

mRS: modified Rankin Scale; OR: odds ratio; CI: confidence interval.

Table 5. Multivariable logistic regression analysis regarding the predictors of mortality (mRS: 6) at 90 days in acute ischemic stroke patients.

Variable	90-day mRS score: 6			
	Unadjusted OR	95% CI	P value	Adjusted OR (95% CI)
Women	0.96	0.67–1.37	0.82	0.97 (0.65–1.43)
Age (year)				
>45	1.50	0.60–3.77	0.38	1.55 (0.59–4.07)
Risk factors				
Hypertension	0.70	0.47–1.03	0.07	0.66 (0.44–1.01)
Diabetes mellitus	1.29	0.85–1.94	0.23	1.41 (0.91–2.17)
Tobacco use	0.94	0.57–1.56	0.82	1.04 (0.60–1.79)
Previous history of stroke	0.86	0.55–1.35	0.52	0.82 (0.57–1.37)
Previous history of coronary artery disease	3.81	1.36–10.64	0.02	3.03 (1.03–8.92)
Previous history of atrial fibrillation	3.09	1.90–5.02	<0.001	1.65(0.63–4.31)
Thrombolysis	1.44	0.81–2.54	0.21	1.19 (0.65–2.16)
Intracranial arterial stenosis	0.73	0.29–1.83	0.50	0.44 (0.17–1.14)
Stroke subtype				
Large artery atherosclerosis	2.18	1.52–3.12	<0.001	3.37 (2.11–5.37)
Cardioembolism	2.92	1.84–4.63	<0.001	3.15 (1.20–8.27)
Stroke of other determined etiologies	1.49	0.34–6.58	0.64	3.59 (0.75–17.17)
Stroke of undetermined etiology	0.62	0.39–0.99	0.04	1.318 (0.74–2.34)

mRS: modified Rankin Scale; OR: odds ratio; CI: confidence interval.

Table 6. Multivariable logistic regression analysis regarding the predictors of poor functional outcome (mRS: 3–6) at 90 days in 439 ICH patients.

	90-day mRS score: 3–6			
Variable	Unadjusted OR	95% CI	P value	Adjusted OR (95% CI)
Women	0.90	0.60–1.36	0.62	0.83 (0.54–1.28)
Age (year)				
>45	1.38	0.79–2.40	0.26	1.44 (0.81–2.54)
Risk factors				
Hypertension	0.91	0.57–1.44	0.67	0.87 (0.54–1.40)
Diabetes mellitus	0.79	0.43–1.47	0.45	0.76 (0.40–1.42)
Tobacco use	0.84	0.51–1.37	0.48	0.79 (0.47–1.33)
Previous history of stroke	1.30	0.70–2.39	0.41	1.30 (0.69–2.42)
Previous history of coronary artery disease	N/A			
Previous history of atrial fibrillation	N/A			

ICH: intracranial hemorrhage; mRS: modified Rankin Scale; OR: odds ratio; CI: confidence interval; N/A: not applicable.

Table 7. Multivariable logistic regression analysis regarding the predictors of mortality (mRS: 6) at 90 days in ICH patients.

	90-day mRS score: 6			
Variable	Unadjusted OR	95% CI	P value	Adjusted OR (95% CI)
Women	0.78	0.47–1.30	0.33	0.69 (0.40–1.19)
Age (year)				
>45	1.0	0.51–1.98	0.99	1.16 (0.57–2.36)
Risk factors				
Hypertension	0.59	0.35–0.99	0.043	0.59 (0.34–1.01)
Diabetes mellitus	0.68	0.29–1.58	0.37	0.69 (0.29–1.62)
Tobacco use	0.70	0.37–1.33	0.27	0.63 (0.32–1.24)
Previous history of stroke	1.24	0.62–2.48	0.54	1.30 (0.63–2.67)
Previous history of coronary artery disease	N/A			
Previous history of atrial fibrillation	3.86	0.24–62.24	0.31	4.52 (0.27–76.40)

mRS: modified Rankin Scale; ICH: intracranial hemorrhage; OR: odds ratio; CI: confidence interval; N/A: not applicable.

sequelae as assessments of the quality of life. We did not record data on activities of daily living or discharge disposition, which may provide a more complete perspective of the patient's outcome. While most patients with TIA had MRI to rule out acute infarction, a subset of patients were diagnosed by CT. Misclassification of TIA diagnosis with other stroke mimics such as seizure, migraine, and other transient neurological disorders could have been possible. We did not study presence of concomitant COVID-19 infection, psychological or sociocultural factors, rehabilitation or discharge factors, and caregiver support after stroke, which may affect a patient's recovery after stroke.[18,30,31] In our study, we only followed patients for 90 days after stroke. Capturing longer-term data at 6 months or 1 year may further inform the patient's clinical outcomes after stroke. This study was conducted exclusively in a hospitalized patient population sample of 10 centers in Vietnam; hence, its results may not be generalizable. However, as the

risk factor profile mirrors that which has been reported in China from the ANGEL-ACT study, this suggests greater applicability of the findings in our study to other ethnic populations.

Conclusion

In this prospective Vietnamese hospitalized sample of patients admitted with ischemic and hemorrhagic stroke, our study showed no sex differences with regard to 90-day functional outcome after stroke. Differences found in vascular risk factors between men and women present opportunity for targeted stroke prevention.

Declaration of conflicting interests

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