



## **Determinants of Mortality in First-Ever Stroke Patients in the Suburban Malaysia: A Retrospective Hospital-Based Study, 2005-2011**

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### **Dear Editor-in-Chief**

Stroke is defined as “rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin” (1). Stroke is recognized as ten leading causes of mortality worldwide in 2011 with increasing trend of mortality over the past decade (2). Alarming, mortality due to stroke and heart disease has been projected to increase to almost 23.6 million in 2030 (3). In Malaysia, diseases of the circulatory system which include stroke ranked first in the list of principal causes of mortality (4). This imposes a significant burden on total health expenditure. Based on Health Expenditure Report 1997-2011, the total health expenditure for Malaysia increased from RM 8,188 million in year 1997 to RM 37,871 million in year 2011 for the total population of 29,062,000. For the same period, the health spending as a share of Gross Domestic Product (GDP) ranged from 2.9% to 4.3% of GDP. The per capita spending on health ranged from RM 636 (USD 233) to RM 1,303 (USD 426). The health spending of GDP in Malaysia is similar to the other countries in Asia

such as Thailand, Bangladesh, Philippines, India, Sri Lanka and Indonesia (5). Establishing contemporary information on the determinants of mortality on first-ever, stroke patients in Malaysia would prove to be valuable for an improved and informed healthcare provision of stroke care and preventive measures especially for possible discrepancies between urban and rural areas in Malaysia. This study aimed to identify the significant determinants of mortality among first-ever stroke patients in suburban region in Malaysia.

Medical records from 1<sup>st</sup> January 2005 to 31<sup>st</sup> December 2011 of stroke patients admitted to Hospital Universiti Sains Malaysia, Kelantan, Malaysia were retrospectively reviewed. The inclusion criteria were clinically diagnosed first-ever stroke patients aged 18 and above. First-ever, stroke patient was defined as patient with no evidence of previous stroke and confirmed by computed tomography (CT) scan or magnetic resonance imaging (MRI) and neurological examination during admission. Recurrent stroke patients or patients with any neurological deficit due to epilepsy, tumor, infection or any traumatic causes were excluded.

The study received approval from the Human Ethics Committee of Universiti Sains Malaysia (USM/KK/PPP/JEPeM (256.4(2.9))).

A single researcher extracted the required information from the medical records by using a standardized data collection sheet and verified by another researcher. Information on demographic characteristics, past medical history and clinical characteristics of first-ever stroke patients were retrieved. The event in this study was the survival time of first-ever stroke patients, measured in days.

The survival time was defined as the time interval between time of diagnosis and time of death of stroke. The censored observations were patient who did not experience event such as those who were still alive at the end of the study period and who were lost to follow-up. Data entry and data analysis was performed using Stata/SE version 11 software. The potential determinants of mortality among first-ever stroke patients were analyzed by using multiple Cox proportional hazards regression.

**Table 1:** Prognostic factors of mortality among first-ever stroke patients admitted in HUSM using multiple Cox Proportional Hazards Regression (n=430) (Final model)

Variable	Regression coefficient (b)	Adjusted HR (95% CI)	Wald statistic	P-value
Gender				
Female	0	1		
Male	-1.245	0.288 (0.140, 0.595)	-3.36	0.001
Fasting blood sugar (FBS)	0.089	1.093 (1.045, 1.143)	3.92	<0.001
Marital status				
Never married	0	1		
Married	-2.205	0.110 (0.045, 0.270)	-4.82	<0.001
Widowed	-2.152	0.116 (0.036, 0.374)	-3.61	<0.001
Divorced	-1.763	0.171 (0.021, 1.432)	-1.63	0.103
Diastolic blood pressure	0.024	1.024 (1.010, 1.038)	3.47	0.001
Urea	0.030	1.030 (1.001, 1.060)	2.03	0.043
Systolic blood pressure	-0.016	0.984 (0.975, 0.994)	-3.31	0.001
Rheumatic heart disease				
No	0	1		
Yes	1.766	5.848 (1.982, 17.256)	3.20	0.001
Smoking status				
Never smoke	0	1		
Ever-smoker	1.482	4.402 (1.921, 10.089)	3.50	<0.001
Current smoker	1.442	4.230 (2.051, 8.726)	3.90	<0.001
Seizure/ fit				
No	0	1		
Yes	-0.983	0.374 (0.189, 0.740)	-2.83	0.005
Glasgow coma scale (GCS)	-0.311	0.733 (0.687, 0.782)	-9.35	<0.001
Usage of aspirin				
No	0	1		
Yes	-0.572	0.564 (0.342, 0.932)	-2.24	0.025
Age at the time of diagnosis (years)	0.041	1.042 (1.023, 1.062)	4.33	<0.001

HR hazard ratio, CI confidence interval

Backward stepwise cox proportional hazards regression model applied.

Two-way interaction and multicollinearity were unlikely.

The preliminary final model was properly specified.

Hazard function plot, Log-minus-log plot, Schoenfeld partial residuals plot, scaled and non-scaled Schoenfeld residuals test and C-statistics were applied to check model assumption.

Regression diagnostics were performed by Cox-Snell residual, Martingale residual, Deviance residual and influential analysis.

Influential outliers were identified by calculating the percent changes of regression coefficient. If the changes were less than 20%, the outlier was not influential.

Two influential outliers were detected and were decided to be removed from the model.

A total of 432 (70.5%) out of 613 stroke patients met the criteria. Among these, 101 (23.4%) died. More than half of the patients were identified as ischemic stroke (54.4%), followed by intracerebral hemorrhage (37.5%) and subarachnoid hemorrhage (8.1%). Mean age at the time of diagnosis was 59.16 years (SD=13.47), 53.9% of the patients were males and ethnic Malay predominance (90.5%). The significant determinants of mortality (Table 1) in the study included socio-demographic (age at the time of diagnosis, gender and marital status), past medical history (rheumatic heart disease, smoking status) and clinical characteristics (fasting blood sugar, diastolic blood pressure, urea, systolic blood pressure, seizure, Glasgow Coma Scale score, on aspirin). Contemporary data on the important findings highlighted determinants of mortality amongst first-ever stroke patients managed in predominantly rural setting in Malaysia. These data build on previous limited studies with multivariable analysis of stroke in Malaysia. Such data can provide additional guidance on stroke care, secondary and primary stroke prevention by the health authorities in Malaysia. Further studies should be implemented to observe the variation in stroke mortality as well as the determinants between different regions in the country.

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