

THE ASSOCIATION BETWEEN PATIENT PROFILE AND CAREGIVER FACTORS AMONGST RECENT STROKE SURVIVORS ADMITTED TO COMMUNITY HOSPITALS IN SINGAPORE

A/P Gerald Koh Choon-Huat, Ms Julia Tan Shi Yu, Ms Alvona Loh Zi Hui, Ms Ong Peck-Hoon, Dr Wee Liang En, Dr Cynthia Chen, Ms Angela Cheong, Dr Fong Ngan Phoon, Dr Chan Kin Ming, A/P Tan Boon Yeow, Dr Edward Menon, Dr Lee Kok Keng, Prof Robert Petrella, Prof Amardeep Thind

ABSTRACT

Caregivers are important in post-stroke rehabilitation, but little work has been done on the caregivers of stroke survivors in Asian cultures. We examined the association between patient profile (age, gender, socioeconomic status, functional level, religion, and ethnicity) and caregiver availability, number of potential caregivers and primary caregiver identity amongst Singaporean community hospitals' stroke patients.

Data was obtained from all Singaporean community hospitals from 1996-2005. 3796 patients fulfilled inclusion criteria. Mixed logistic regression identified independent predictors of caregiver availability and primary caregiver identity. Mixed Poisson modelling identified independent predictors of the number of caregiver(s).

Among recent stroke survivors, 95.8% (3640/3796) had potential caregivers, of which 94.2% (3429/3640) had identified primary caregivers. Of the latter, 41.2% relied on live-in hired help (foreign domestic workers-FDWs), 27.6% on spouses and 21.6% on first-degree relatives. Independent patient factors associated with caregiver availability and number were older, female, married, higher socioeconomic status, having a religion and lower functional level at admission (all $p < 0.05$). Independent patient factors associated with FDW caregivers were older age, female, Chinese compared to Malay, with higher socioeconomic class and lower functional level at admission ($p < 0.05$).

Caregiver availability for post-stroke patients in Singapore community hospitals is relatively high, with heavy dependence on FDWs.

Keywords:

Stroke Rehabilitation; Caregivers; Singapore

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INTRODUCTION

Stroke is a major global health problem and a leading cause of long-term disability.^{1,2} Most disabled stroke survivors are looked after by caregivers, such as their spouses, children, or friends.³ There is a wealth of literature on the benefits^{4,5} and burdens^{6,7} of caregiving on the caregiver. However, the role of caregivers across different cultures, particularly non-Western ones, is not well understood.^{8,9} In Western populations, caregivers for stroke survivors tend to be female^{10,11} and are usually spouses;¹² while advanced age and female gender of stroke patients are associated with poorer caregiver availability.¹² Contrarily, less is known about caregivers in Asian societies.^{13,14} Given that the negative (e.g. caregiver burden)^{15,16} and positive aspects (e.g. satisfaction of knowing their loved one is getting excellent care, personal growth and increased meaning and purpose in one's life)¹⁷ of the caregiving process in stroke varies depending on sociodemographic factors and the caregiver-patient relationship,¹⁸ cross-cultural differences in carer profiles are likely to exist and affect the caregiving process. More studies are needed on the nature of caregivers and predictors of caregiver availability in Asia, particularly when the burden of stroke is expected to rise significantly in this region in the next few decades.¹⁹⁻²¹

Singapore is a multi-ethnic urbanised Asian society with Chinese, Indians and Malays, and stroke has been the third leading cause of death over the past 40 years.²² As stroke mortality rates fall,²³ the need for post-stroke rehabilitation has correspondingly increased. There has only been one local study on the nature of caregivers published in 1987,¹³ but given demographic trends such as population ageing and declining fecundity rates,²⁴ the nature of caregivers is likely to have changed since then. In particular, employing live-in hired help — foreign domestic workers (FDW) — as caregivers for disabled older persons is increasingly commonplace,^{25,26} like other urbanised Asian societies.^{27,28} Therefore, we conducted a retrospective analysis of stroke patients admitted for rehabilitation into all community hospitals in Singapore over a ten-year period from 1996-2005 to determine the patient factors associated with 1) caregiver availability; 2) number of potential caregivers; and 3) relationship of primary caregiver to patient ("primary caregiver identity").

GERALD KOH CHOON-HUAT, ONG PECK-HOON,
CYNTHIA CHEN, ANGELA CHEONG
Saw Swee Hock School of Public Health,
National University of Singapore,
National University Health System, Singapore

JULIA TAN SHI YU, ALVONA LOH ZI HUI
Yong Loo Lin School of Medicine, National University of Singapore

WEE LIANG EN
Singhealth Internal Medicine Residency, Singapore

CHAN KIN MING
Ang Mo Kio Thye Hua Kwan Hospital, Singapore

TAN BOON YEOW
St Luke's Hospital, Singapore

EDWARD MENON
St Andrew's Community Hospital, Singapore

LEE KOK KENG
Department of Geriatric Medicine, Khoo Teck Puat Hospital, Singapore

ROBERT PETRELLA, AMARDEEP THIND
Department of Family Medicine, Schulich School of Medicine & Dentistry,
University of Western Ontario, London, Ontario, Canada

ROBERT PETRELLA
Lawson Health Research Institute, London, Ontario, Canada

METHODS

Data Extraction

We retrospectively extracted data from the medical records of all stroke patients admitted into all community hospitals across Singapore for rehabilitation from 2nd January 1996 to 31st December 2005. There were four community hospitals in existence during this period [Ang Mo Kio Thye Hua Kwan Hospital (AMKTHKH); Saint Luke's Hospital (SLH); Saint Andrew's Community Hospital (SACH); and Bright Vision Hospital (BVH)], with BVH opening in 2002. Community hospitals in Singapore provide the bulk of inpatient rehabilitative care.²⁹ According to Singapore's Ministry of Health guidelines, community hospitals ensure that these patients achieve their optimal potential before being discharged.³⁰ Rehabilitation is provided every weekday until discharge. Data extraction from non-computerised medical records was manually performed from November 2006 to December 2009 by four research nurses who were trained and supervised by the lead author. We also verified data with acute stroke unit discharge records. Multiple iterations of data cleaning and verification were performed. A 10-percent random sample of subjects was subsequently analysed for accuracy of all data variables extracted by an independent physician and the error rate was found to be only 0.07 percent. The study was approved by the National University of Singapore Institutional Review Board and the ethics committees of all hospitals.

Data Management

We applied the following inclusion criteria: 1) principal admission diagnosis of stroke as defined by WHO criteria; 2) admission for rehabilitation; 3) first admission for stroke; and 4) length of stay >14 days and <90 days. Out of 19,360 observations, 3796 (19.6%) fulfilled these criteria.

Independent Variables

Independent variables comprising patient characteristics were sorted into the three broad categories as they had a direct association with caregiver profile:^{31–33} social (age, gender and marital status); ethnoreligious (ethnicity, religion); and economic (socioeconomic status). We dichotomised age at the cut-off point of 70 as we wanted to divide our study population into roughly equal halves and the mean age of our population was 71.8 years. Furthermore, >70 is the age where functional decline is most marked,^{34–39} elevating the necessity of caregivers. Regarding ethnicity and religion, Singapore is a multi-ethnic and multi-religious country with Buddhism, Islam and Christianity as the major religions. In community hospitals in Singapore, self-reported religion is routinely asked for pastoral and dietary purposes. In this study, having a religion is defined as a subject reporting a religion versus none. Regarding the patient's economic profile, government subsidy level was used as a surrogate measure of socioeconomic status. In all hospitals in Singapore, only patients opting for C-class (non-air-conditioned eight-bedded) or B2-class (non-air-conditioned six-bedded) wards receive government subsidies for hospital stay (75% and 50% subsidy respectively); patients opting for a higher class (i.e. air-conditioned six- to single-bedded) wards do not

receive subsidies. In our study, we dichotomised government subsidy levels into C-class versus B2-class and above, as C-class patients best represented the lower socio-economic class in the Singapore population.

Patients' clinical characteristics were also considered, such as stroke type, Charlson co-morbidity index (a measure of co-morbidity burden),⁴⁰ and functional status. Functional status was assessed using the Shah-modified Barthel Index (BI) which was used by all rehabilitation hospitals in Singapore as recommended by our local Ministry of Health during the study period.²⁹ The Shah-modified BI has a range from 0–100, with five sub-categories for each activity of daily living (ADL) category and 100 possible discrete values.⁴¹ A score of zero reflects complete ADL dependence and 100 reflects complete ADL independence. The Shah-modified BI's scale reliability is better than the original BI⁴² and is widely used. According to the Singapore Ministry of Health's requirements, admission BI must be scored within 48 hours of admission²⁹ and performed by occupational therapists in the respective hospitals. Length of stay and time to rehabilitation (defined as time from onset of stroke to admission into community hospital) were also included as independent variables.

Outcome Measures

We studied the following caregiver factors as dependent variables: 1) caregiver availability; 2) number of potential caregivers; and 3) primary caregiver identity. These were chosen because the caregiver availability directly affected the patient care, while number of potential caregivers indicated potential patient support, and the caregiver identity reflected the degree of "closeness" between patient and caregiver.^{43,44} Caregiver availability referred to presence or absence of at least one potential caregiver. A potential caregiver was defined as anyone aged 18 years and above, living with the stroke patient after discharge and possibly capable of physically caring for the patient. It included family members, relatives, friends, or paid helpers, and there could be more than one. A primary caregiver was defined as the main person among potential caregivers who would provide physical care to the stroke patient after discharge.¹¹ Primary caregiver identity refers to the relationship of the caregiver to the patient, be it spouse, child or parent, FDW, or others.

Statistical Analysis

For patient factors associated with caregiver availability and primary caregiver identity, bivariate and multivariate analyses were performed using mixed-model logistic regression, adjusting for clustering effects by hospital and year of admission. For the purpose of the latter analysis, we excluded patients who selected "others" as their primary caregiver because their numbers were too small for meaningful analysis. For patient factors associated with number of potential caregivers, bivariate and multivariate analyses were performed using mixed Poisson modelling, adjusting for clustering by hospital and year of admission. As length of stay was skewed to the right, we used the Mann-Whitney-U test for bivariate analysis with caregiver availability and primary caregiver

identity, but used natural log of length of stay for bivariate analysis with number of potential caregivers and all multivariate analyses. For all multivariate models, we used $P < 0.2$ on bivariate analysis as criterion for inclusion of variables; backward regression to construct the most parsimonious model; and included age, gender and ethnicity as common adjustment baseline variables regardless of statistical significance. We used Stata (Version SE 11.0, StataCorp LP, Texas, USA) for statistical analysis and significance level was set at the conventional $P < 0.05$.

RESULTS

Study Population

Socio-demographic and clinical profile of the study population are detailed in **Table I**. Of the 3796 subjects, 3640 (3640/3796=95.9%) had caregivers, of which 211 could not identify a primary caregiver, leaving 3429 (3429/3640=94.2%) subjects who had a primary caregiver. Of those with primary caregivers, 1412 (41.2%) were cared for by FDWs, 947 (27.6%) by spouses, 739 (21.6%) by own child or parent, 303 (8.4%) by other relatives (including in-laws), and 28 (0.8%) by other caregivers (e.g. friends, neighbours or nursing home staff).

Caregiver Factors

On bivariate analysis, patient factors associated with having a caregiver amongst recent stroke survivors undergoing rehabilitation were older age, female gender, Malay (minority) ethnicity compared to Chinese, being married, having a religion, higher socio-economic class, and lower admission BI score (i.e. poorer initial functional status) (**Table II**). In terms of patient factors associated with greater number of potential caregivers, we found associations with being married, having a religion, higher socio-economic status, fewer co-morbidities and lower admission BI score (**Table III**). On bivariate analysis of the 3401 subjects with primary caregivers (excluding the "others" category) and with reference to those who had spouses as primary caregivers, the patient factors associated with reliance on a child or parent were older age, female gender, Malay ethnicity compared with Chinese ethnicity, having a religion, lower socioeconomic status, and lower admission BI scores. The patient factors associated with reliance on other relatives were older age, female gender and lower socioeconomic status, while the patient factors associated with reliance on FDWs were older age, female gender, Chinese compared to Malay or Indian ethnicities, higher socioeconomic status, lower admission BI scores, longer time to rehabilitation, and longer length of stay (**Table IV**).

On multivariate analysis, all the patient factors which were significantly associated with caregiver availability at a bivariate level persisted, with the addition of length of stay (**Table V**). Patient factors independently associated with greater number of potential caregivers were the same for caregiver availability except length of stay was not associated (**Table V**). In the adjusted model with reference to those who had spouse as primary caregiver, religion and admission BI score were no

longer significant patient factors associated with reliance on children or parent; instead, having mixed haemorrhagic and ischaemic strokes (compared to only having haemorrhagic stroke) was an additional factor. In contrast, all the significant patient factors associated with reliance on other relatives at the bivariate level continued to be significant in the multivariate model. The independent patient factors associated with reliance on FDWs were older age, female gender, Chinese compared to Malay ethnicity, higher socioeconomic class, and lower admission BI scores (**Table V**).

DISCUSSION

In this segment, we will be discussing how the patient profile has influenced caregiver factors [1) caregiver availability; 2) number of potential caregivers; and 3) primary caregiver identity]: namely, age and gender associations, marriage status and post-stroke functional status, religion, and ethnicity. Following that, we will expound on primary caregiver identity and the shift towards FDWs, bringing in socio-economic status of the patient as a pertinent factor which may influence the primary caregiver identity.

Interestingly, our findings of age and gender association with caregiver availability differ from that of the Western population.¹² From our national study of stroke patients admitted into community hospitals, those who were older were independently more likely to have a caregiver and more potential caregivers, but less likely to be cared for by their spouse. One plausible explanation is that the older a person is, the greater proportion of their children and grandchildren are above 18 years old (our age criterion for a caregiver), and the higher probability of widowhood.

Similarly, female patients were independently more likely to have a caregiver, have more potential caregivers, and not be cared for by a spouse. As women have a longer life expectancy than men, they are unsurprisingly less likely to be cared for by their spouse. That said, we found that female stroke patients were more likely to have a caregiver and more potential caregivers, independent of the patient's age. There have been many studies on the predominance of female caregivers of stroke patients^{3,4} but few have studied the association of gender of stroke patients with caregiver availability. A possible explanation is that women generally have greater social resources and are better at mobilising them than men,¹⁰ leading to greater likelihood of caregivers. There may also be differences in degree of filial piety of children towards fathers and mothers. Filial piety is a set of attitudes, values and social beliefs based on the virtue of respect for one's parents and elders, and has its origins in Asian and Confucian philosophies. In simpler terms, filial piety means being obedient and caring to one's parents, engaging in good conduct both towards parents and outside the home to bring honour to the family. Researchers of cross-cultural attitudes of filial piety have posited that filial piety is stronger in Asian societies compared to the West because in the West, the higher importance placed on individualism causes the needs of the adult child to supersede

obligations to care for their elderly parent.⁴⁵ In the context of inter-generational reciprocity in Singapore, adult children may be more willing to care for their mothers than their fathers, as mothers are often the more nurturing parent. This remains a hypothesis to be tested further.

Expectedly, married stroke patients were independently more likely to have caregivers as they were more likely to have children and grandchildren. Stroke survivors with poorer post-stroke functional status were also more likely to have caregivers. This may point to reverse causality where greater disability in a stroke patient results in greater care needs and therefore, caregivers are likelier to step forward or be employed. While there are studies discussing the effect of having a religion on caregiver burden in Western populations,^{46,47} our study is probably the first to report a positive association between patients having a religion and caregiver availability and number of potential caregivers in a multi-religious Asian population. Explanations for these associations are likely to be complex, especially in our local context. Singapore's three major religions (Buddhism, Islam and Christianity) encourage fecundity, large families and extended family living within the same household, which may explain why having a religion was independently associated with a greater number of potential caregivers. Though these religions uphold the moral importance of respecting parents and elders, congruent to Asian socio-cultural norms,⁴⁸ it is difficult to distinguish the contribution of Asian socio-cultural norms (which are ethnic-specific) from the influence of religion as most Muslims are Malays and most Buddhists are Chinese in Singapore. Ethnic differences also influence the relationship of caregiver to stroke patient in our study. In keeping with other local studies, Malays were likelier to be cared for by their child or parent instead of their spouses, and less likely to rely on FDWs as primary caregivers than Chinese (independent of socioeconomic status).⁴⁹ In the Malay culture and Islamic faith, it is considered a blessing to care for one's parents and to alleviate one's parents' burdens. Hence, Malays are more likely to find caring for their disabled parent their responsibility and prefer to do so. This may explain why Malays are less likely to employ FDWs to care for their parents.

While 82–93 percent of stroke patients in Western studies depended on either their spouse or first-degree relatives as caregivers,^{11,49,50} less than half the patients in our study did so. Instead, two-fifths of primary caregivers of stroke survivors in Singapore were FDWs and greater functional dependency was independently associated with greater likelihood of the stroke survivor being cared for by an FDW than relations. Care for dependent elderly in Singapore was traditionally provided primarily by co-resident family members, especially women.^{51,52} However, with rising affluence and more Singaporean women entering the workforce, this has constrained their ability to perform household chores and care for dependent elderly family members.^C Combined with rapid ageing of Singapore's population, such socio-demographic trends have led to an increase in FDWs from 20,000 in 1987 to more than 100,000 in 1995; one for every eight households in the country.^{54,55} Such trends are not unique to Singapore — the employment of FDWs to care for elderly patients with

stroke has become the norm in many Asian cities such as Taiwan, Hong Kong and Malaysia.^{56,57} In Western countries, the employment of hired help (e.g. nursing aides, home-help staff) to care for stroke survivors is also expected to rise, especially in urbanised areas where similar socio-demographic transitions are occurring. Nevertheless, employing an FDW is not a cheap alternative. Cost includes a monthly government levy of S\$170 (after applicable subsidy accorded for the care of an elderly dependent); the FDW's monthly salary of about S\$500–1000; and the FDW's food and lodging. As the median monthly household income of Singaporeans is S\$7,032, lower-income Singaporean households would find it financially challenging to afford an FDW as a caregiver.⁵⁸ This may also explain why socioeconomic status as measured by government subsidy levels strongly associated with primary caregiver identity — stroke patients from higher socioeconomic status were likelier to have FDWs as their primary caregiver, followed by spouse, child or parent, and lastly by other relatives. With FDWs playing an increasingly important role in the care of stroke survivors, there is a greater need for research on the adequacy of training and skill levels of FDWs in Singapore.

More research could be done to explore what is already known about caregiving and healthcare of stroke patients in Singapore compared to other countries. For instance, the identity of caregivers as FDWs compared to spouse could be unique to Singapore due to our large intake of FDWs.⁵⁹ Additionally, filial piety in Asian countries like Singapore may determine the identity of the caregiver to be the patient's child instead of spouse.⁴⁸ We can then further explore the cultural differences in attitudes towards caregiving by using other Asian and Western values to find out the burden on caregivers.⁶⁰

The main strength of our study is the comprehensiveness of the study sample — our sample comprised all stroke patients admitted to all community hospitals in Singapore over ten years. Nevertheless, our study has its inevitable limitations. As data was extracted retrospectively, the reliability of our data depended on the completeness of the original medical records. In terms of external generalisability, though our findings may not apply to patients of a different diagnosis, period, setting, or to other countries with different socio-cultural contexts, it does provide useful insights to help identify profiles of stroke patients who may require more support in this sub-acute period — a crucial period for rehabilitation and recovery.

CONCLUSION

In urbanised Singapore, caregiver availability for post-stroke patients is relatively high. However, there is heavy dependence on FDWs to shoulder this caregiver burden. FDWs are associated with improved financial status and increased proportion of women working. Additionally, factors such as age, gender, socioeconomic status, functional level, religion, and ethnicity of recent stroke survivors are associated with caregiver availability, number of potential caregivers and/or primary caregiver identity in a multi-ethnic Asian society.

Corresponding author (including reprint requests)

A/Prof Gerald Koh,
Saw Swee Hock School of Public Health,
National University of Singapore, #10-03-G, Tahir
Foundation Building, Block MD1, 12 Science Drive 2,
Singapore 117549.
Fax: +65 6779 1489
Telephone: +65 516 4979
Email: gerald_koh@nuhs.edu.sg

Author contributions

- GCHK has full access to all of the published data in the study and takes responsibility for the content and integrity of this article.
- Study concept and design: GCHK.
- Acquisition of data: All authors.
- Analysis and interpretation of data: All authors.
- Drafting of the manuscript: All authors.
- Critical revision of the manuscript for important intellectual content: All authors.
- Study supervision: GCHK.

Declaration of Conflicts of Interest

The authors declare that they have no conflict of interest in relation to this article.

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Table I. Characteristics of stroke rehabilitation patients admitted to Singaporean community hospitals from 1996-2005 (N=3796)

Characteristic	n (%) [*]
Age (years)	
≤ 70	1547 (40.8)
> 70	2249 (59.2)
Mean ± SD	71.8± 10.2
Community Hospital	
Hospital A	838 (22.1)
Hospital B	2165 (57.0)
Hospital C	764 (20.1)
Hospital D	29 (0.8)
Gender	
Male	1843 (48.6)
Female	1953 (51.5)
Ethnicity	
Chinese	3280 (86.4)
Malay	327 (8.61)
Indian	157 (4.1)
Others	32 (0.8)
Marital Status	
Never married, widowed or divorced	1794 (47.3)
Married	2000 (52.7)
Religion	
No	378 (10.0)
Yes	3417 (90.0)
Government subsidy level	
Low or no subsidy	2065 (54.4)
High subsidy	1731 (45.6)
Caregiver availability	
No	156 (4.1)
Yes	3640 (95.9)
Number of caregivers [†]	
0	156 (4.1)
1	631 (16.6)
2	1183 (31.2)
3	1167 (30.7)
4	469 (12.4)
5	141 (3.7)
6	32 (0.8)
7	10 (0.3)
8	5 (0.1)
9	2 (0.1)
Has primary caregiver [‡]	
No	211 (5.8)
Yes	3429 (94.2)
Relationship of primary caregiver to patient [§]	
Spouse	947 (27.6)

Child/parent	739 (21.6)
Other relatives	303 (8.4)
Foreign domestic worker (live-in hired help)	1412 (41.2)
Others (e.g. friends, neighbours, nursing home staff)	28 (0.8)
Stroke type	
Infarct	3247 (85.5)
Bleed	478 (12.6)
Both	71 (1.9)
Charlson Co-Morbidity Index	
0	827 (21.8)
1 – 3	1163 (30.6)
4 – 6	1664 (43.8)
≥ 7	142 (3.7)
Admission BI score (units)	
Mean ± SD	42.8 ± 24.4
Discharge BI score (units)	
Mean ± SD	59.2 ± 26.6
Time to rehabilitation (days)	
Mean ± SD	14.00 ± 6.47
Length of stay (days)	
Median (IQR)	35.0 (25.0 - 49.0)
Mean ± SD	37.3 ± 16.3
Year of Admission	
1996	234 (6.2)
1997	415 (10.9)
1998	445 (11.7)
1999	457 (12.0)
2000	413 (10.9)
2001	420 (11.1)
2002	347 (9.1)
2003	399 (10.5)
2004	355 (9.4)
2005	311 (8.2)

* Numbers may not add up to total because of untraceable data. Only valid percentages are shown.

† A caregiver was defined as any person aged 18 years and above, living with the stroke patient and potentially capable of physically caring for the patient. Percentages reported based on those with caregiver available as denominator.

‡ A primary caregiver was defined as the main caregiver who would actually provide physical care to the stroke patient after discharge. This variable only applies to the proportion of respondents who indicated that they have a potential caregiver (n=3640).

§ Percentages reported based on those who had a primary caregiver.

Table II. Patient factors for caregiver availability among stroke rehabilitation patients admitted to Singaporean community hospitals from 1996-2005 on bivariate analysis (N=3796)

Characteristic	No caregiver (n=156) n (%)	Caregiver (n=3640) n (%)	OR or Exp(B) (95% CI)*	P-value
Age (years)				
≤ 70	76 (48.7)	1471 (40.4)	1.00	-
> 70	80 (51.3)	2169 (59.6)	1.36 (0.99-1.88)	0.061
Mean (SD)	70.1 (10.3)	71.9 (10.2)	-	0.042
Gender				
Male	90 (57.7)	1753 (48.2)	1.00	-
Female	66 (42.3)	1887 (51.8)	1.47 (1.06-2.03)	0.021
Ethnicity				
Chinese	144 (92.3)	3136 (85.2)	1.00	-
Malay	5 (3.2)	322 (8.9)	2.87 (1.16-7.05)	0.022
Indian	5 (3.2)	30 (0.8)	1.40 (0.57-3.48)	0.465
Others	2 (1.3)	30 (0.8)	0.61 (0.12-2.61)	0.505
Marital Status				
Never married, widowed or divorced	141 (90.4)	1653 (45.4)	1.00	-
Married	15 (9.6)	1985 (54.6)	11.18 (6.53- 19.11)	<0.001
Religion				
No	29 (18.6)	349 (9.6)	1.00	-
Yes	127 (81.4)	3290 (90.4)	2.20 (1.44-3.35)	<0.001
Government subsidy level				
Low or no subsidy	42 (26.9)	2023 (55.6)	1.00	-
High subsidy	114 (73.1)	1617 (44.4)	0.26 (0.18-0.38)	<0.001
Stroke type				
Bleed	22 (14.1)	456 (12.5)	1.00	-
Infarct	131 (84.0)	3116 (85.6)	1.11 (0.32-3.86)	0.865
Both	3 (1.9)	68 (1.9)	1.18 (0.75-1.89)	0.465
Charlson Co-Morbidity Index				
0	20 (12.8)	807 (22.2)	1.00	-
1 – 3	65 (41.7)	1098 (30.2)	0.47 (0.21-1.09)	0.078
4 – 6	65 (41.7)	1599 (43.9)	0.69 (0.30-1.56)	0.369
≥ 7	6 (3.9)	136 (3.7)	0.62 (0.21-1.84)	0.385
Admission BI score (units) †				
Mean (SD)	56.6 (21.0)	42.2 (24.3)	0.97 (0.96-0.98)	<0.001
Time to rehabilitation (days) †				
Mean (SD)	14.9 (6.5)	13.9 (6.5)	0.98 (0.96-1.00)	0.086
Length of stay (days) ‡				
Median (IQR)	36.5 (26-53)	35 (25-49)	-	0.053

NC: Cannot be calculated.

Numbers may not add up to total because of untraceable data. Only valid percentages are shown.

* Adjusted for clustering by community hospital and year of admission

† Exp(B) reported instead of OR.

‡ Mann-Whitney-U test used to generate p-value.

Table III. Patient factors for number of potential caregivers among stroke rehabilitation patients with caregivers admitted to Singaporean community hospitals from 1996-2005 on bivariate analysis (N=3796)

Characteristic	β (95%CI)*	P-value
Age (years)		
≤ 70	0.00	-
> 70	0.01 (-0.03-0.05)	0.623
Continuous	0.001 (-0.001-0.003)	0.572
Gender		
Male	0.00	-
Female	-0.02 (-0.06-0.02)	0.322
Ethnicity		
Chinese	0.00	-
Malay	0.02 (-0.05-0.09)	0.526
Indian	-0.04 (-0.14-0.06)	0.464
Others	-0.21 (-0.46-0.03)	0.087
Marital Status		
Never married, widowed or divorced	0.00	-
Married	0.25 (0.21-0.30)	<0.001
Religion		
No	0.00	-
Yes	0.09 (0.02-0.16)	0.015
Government subsidy level		
Low or no subsidy	0.00	-
High subsidy	-0.15 (-0.19--0.10)	<0.001
Stroke type		
Bleed	0.00	-
Infarct	0.08 (-0.07-0.24)	0.289
Both	0.01 (-0.05-0.07)	0.752
Charlson Co-Morbidity Index		
0	0.00	
1 – 3	-0.10 (-0.16--0.04)	0.001
4 – 6	-0.07 (-0.13--0.16)	0.011
≥ 7	-0.15 (-0.27--0.03)	0.013
Admission BI score (units)	-0.003 (-0.004--0.002)	<0.001
Time to rehabilitation (days)	0.000 (-0.003-0.003)	0.989
Ln Length of stay (days)	0.02 (-0.03-0.06)	0.519

* Adjusted for clustering by community hospital and year of admission

Table IV. Patient factors for primary caregiver identity of stroke rehabilitation patients admitted to Singaporean community hospitals from 1996-2005 on bivariate analysis (N=3401)*

Characteristic	Relationship of primary caregiver to stroke patient n (%)				OR or Exp(B) (95% CI)		
	(1) Spouse (n=947)	(2) Child or parent (n=739)	(3) Other relative (n=303)	(4) Foreign domestic worker (n=1412)	(2) vs. (1)	(3) vs. (1)	(4) vs. (1)
Age (years)							
≤ 70	605 (63.9)	229 (31.0)	103 (34.0)	414 (29.3)	1.00	1.00	1.00
> 70	342 (36.1)	510 (69.0)	200 (66.0)	998 (70.7)	4.03 (3.28- 4.96) [†]	3.52 (2.66- 4.64) [†]	4.15 (2.46- 4.97) [†]
Mean (SD)	66.6 (9.8)	73.8 (9.6)	73.4 (10.4)	74.5 (9.1)	†	†	†
Gender							
Male	703 (74.2)	273 (36.9)	117 (38.6)	548 (38.8)	1.00	1.00	1.00
Female	244 (25.8)	466 (63.1)	186 (61.4)	864 (61.2)	4.91 (3.99- 6.06) [†]	4.77 (3.60- 6.31) [†]	4.82 (3.99- 5.83) [†]
Ethnicity							
Chinese	782 (82.6)	595 (80.5)	252 (83.2)	1287 (91.2)	1.00	1.00	1.00
Malay	103 (10.9)	108 (14.6)	37 (12.2)	63 (4.5)	1.41 (1.05- 1.90) [‡]	1.16 (0.77- 1.75)	0.35 (0.25- 0.49) [†]
Indian	49 (5.2)	35 (4.7)	12 (4.0)	48 (3.4)	0.91 (0.58- 1.42)	0.76 (0.40- 1.46)	0.60 (0.39- 0.91) [‡]
Others	13 (1.4)	1 (0.1)	2 (0.7)	14 (1.0)	0.09 (0.01- 0.71) [‡]	0.47 (0.10- 2.13)	0.57 (0.27- 1.25)
Religion							
No	100 (10.6)	46 (6.2)	22 (7.3)	149 (10.6)	1.00	1.00	1.00
Yes	847 (89.4)	693 (93.8)	281 (92.7)	1262 (89.4)	1.81 (1.25- 2.61) [‡]	1.47 (0.90- 2.40)	1.06 (0.80- 1.40)
Government subsidy level							
Low or no subsidy	568 (60.0)	380 (51.4)	149 (49.2)	844 (59.8)	1.00	1.00	1.00
High subsidy	379 (40.2)	359 (48.6)	154 (50.8)	568 (40.2)	1.42 (1.16- 1.76) [†]	1.86 (1.38- 2.52) [†]	0.72 (0.57- 0.90) [†]
Stroke type							
Bleed	118 (12.5)	93 (12.6)	39 (12.9)	180 (12.8)	1.00	1.00	1.00
Infarct	812 (85.7)	632 (85.5)	257 (84.8)	1202 (85.1)	1.03 (0.48- 2.21)	1.23 (0.47- 3.22)	1.07 (0.55- 2.08)
Both	17 (1.8)	14 (1.9)	7 (2.3)	30 (2.1)	0.98 (0.73- 1.32)	0.93 (0.63- 1.37)	0.97 (0.75- 1.26)
Charlson Co-Morbidity Index							
0	213 (22.5)	129 (17.5)	64 (21.1)	367 (26.0)	1.00	1.00	1.00
1 – 3	286 (30.2)	235 (31.8)	106 (35.0)	369 (26.1)	1.31 (0.95- 1.80) [§]	1.02 (0.54- 1.92)	0.66 (0.43- 1.03) [§]
4 – 6	416 (43.9)	344 (46.6)	124 (40.9)	617 (43.7)	1.33 (0.99- 1.80) [§]	0.84 (0.45- 1.54)	0.74 (0.48- 1.13) [§]

					1.79) [§]	1.57)	1.13)
					1.55	0.85	0.86
≥ 7	32 (3.4)	31 (4.2)	9 (3.0)	59 (4.2)	(0.89- 2.72)	(0.33- 2.15)	(0.47- 1.57)
Admission BI score (units) [¶]							
Mean (SD)	47.2 (23.2)	43.4 (23.8)	45.1 (22.9)	36.7 (24.3)	0.98 (0.97- 0.99) [†]	0.99 (0.99- 1.00)	0.98 (0.97- 0.99) [†]
Time to rehabilitation (days) [¶]							
Mean (SD)	13.4 (6.5)	13.8 (6.3)	13.4 (6.3)	14.3 (6.5)	1.00 (0.99- 1.02)	0.99 (0.97- 1.02)	1.01 (1.00- 1.02) [‡]
Length of stay (days) ^{**}							
Median (IQR)	35 (25-47)	34 (25-49)	35 (25-47)	37 (26-51)	-	-	‡

Numbers may not add up to total because of untraceable data. Only valid percentages are shown.

* Of the 3640 patients with caregivers, 211 patients who were unable to identify a primary caregiver and 28 patients who identified their primary caregiver as "others"- e.g. friends, neighbours- were excluded from this analysis.

† P-value <0.001

‡ 0.001 ≤ P-value < 0.05

§ 0.05 ≤ P-value < 0.1

|| 0.1 ≤ P-value < 0.2

¶ Exp(B) reported instead of OR.

** Mann-Whitney-U test used to generate p-value.

Table V. Patient factors for caregiver availability, number of potential caregivers and primary caregiver identity among stroke rehabilitation patients admitted to Singaporean community hospitals from 1996-2005 on multivariate analysis

Characteristic	Caregiver availability (n=3796)		Number of caregivers (n=3796)		Relationship of primary caregiver to stroke patient (n=3401)					
					Child or parent vs. spouse		Other relatives vs. spouse		Foreign domestic worker vs. spouse	
	OR or Exp(B) (95% CI)	P- value	β (95% CI)	P- value	OR or Exp(B) (95% CI)	P- value	OR or Exp(B) (95% CI)	P- value	OR or Exp(B) (95% CI)	P- value
Age group (>70 vs. \leq 70 years old)	1.53 (1.06- 2.23)	0.024	0.06 (0.02-0.11)	0.009	4.55 (3.16- 5.73)	<0.001	4.12 (3.03- 5.59)	<0.001	4.06 (3.28- 5.02)	<0.001
Gender (females vs. males)	2.15 (1.47- 3.13)	<0.001	0.07 (0.02- 0.11)	0.005	5.81 (4.61- 7.32)	<0.001	5.91 (4.33- 8.05)	<0.001	4.79 (3.85- 5.96)	<0.001
Ethnicity*										
Malay vs. Chinese	2.33 (0.91- 5.97)	0.078	0.01 (-0.06- 0.09)	0.762	1.64 (1.18- 2.29)	0.003	1.39 (0.87- 2.18)	0.160	0.35 (0.23- 0.53)	<0.001
Indian vs. Chinese	1.70 (0.59- 4.88)	0.323	-0.02 (-0.13- 0.09)	0.694	1.36 (0.84- 2.21)	0.209	0.90 (0.44- 1.87)	0.787	0.79 (0.48- 1.30)	0.355
Marital status (married vs. not married)	16.2 (8.9-29.5)	<0.001	0.29 (0.24-0.34)	<0.001	NA [†]	NA [†]	NA [†]	NA [†]	NA [†]	NA [†]
Religion (yes vs. no)	1.70 (1.03- 2.81)	0.037	0.08 (0.01-0.16)	0.028	-	-	-	-	-	-
Government subsidy level (high subsidy vs. no or low subsidy)	0.31 (0.20- 0.46)	<0.001	-0.12 (-0.16-- 0.07)	<0.001	1.41 (1.11- 1.78)	0.006	2.15 (1.51- 3.04)	<0.001	0.70 (0.53- 0.90)	0.006
Admission BI score [‡]	0.97 (0.96- 0.98)	<0.001	-0.003 (-0.004-- 0.002)	<0.001	-	-	-	-	0.98 (0.97- 0.99)	<0.001
Ln length of stay [‡]	0.57 (0.38- 0.86)	0.008	-	-	-	-	-	-	-	-
Stroke type (vs. bleed)										
Infarct	-	-	-	-	0.93 (0.32- 2.75)	0.902	-	-	-	-
Both	-	-	-	-	0.58 (0.37- 0.91)	0.018	-	-	-	-

Most parsimonious model presented; age, gender and ethnicity were included as common baseline variables.

NA: Not applicable.

* The Others category for ethnicity was dropped because of the small numbers in this category.

† Marital status was excluded from the final multivariate model as spouse was the reference group of the outcome variable.

‡ Exp(B) reported instead of OR