Original Article

The Influence of Demographic, Clinical, Psychological and Functional Determinants on Post-stroke Cognitive Impairment at Day Care Stroke Center, Malaysia

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Abstract

Background: **This study aims to estimate the prevalence and explore the predictors for post-stroke cognitive impairment at the community level in Malaysia.**

Methods: **A total of 50 stroke patients aged 29 to 81–year-old were included in this study. A face to face interview was conducted to gather the demographic and clinical data. Subsequently, assessments including Barthel ADL Index (BI), Addenbrooke's Cognitive Examination-Revised (ACE-R) and Hospital Anxiety and Depression Scale (HADS) were administered to the subjects.**

Results: **The results showed that the prevalence of cognitive impairment was 76% among the studied populations. The subjects' race (Fisher's value= 9.56, $P < 0.05$) and education level (Fisher's value = 7.29, $P < 0.05$) were significantly associated with the cognitive status. The depression score was significantly higher in cognitively impaired group [t (48) = −4.42, $P < 0.001$] while the Barthel Index score was significantly lower in cognitively impaired group (median = 18.00, $P < 0.05$). The univariate logistic analysis demonstrated that Chinese (OR 7.33, 95% CI = 1.61–33.51), lower education level (OR 9.33, 95% CI = 0.89–97.62), right sided lesion (OR 0.29, 95% CI = 0.06–1.54), left face weaknesses (OR 0.40, 95% CI 0.09–1.83), high cholesterol (OR 0.45, 95% CI = 0.12–1.75), depression (OR 2.16, 95% CI = 0.85–1.35), and Barthel Index (OR 0.79, 95% CI = 0.57–1.10) were significant predictors. Finally, multivariate logistic regression verified that depression was the only significant predictor of post-stroke cognitive impairment (OR 2.03, 95% CI = 1.20–3.45).**

Conclusion: **In conclusion, the prevalence of cognitive impairment in this study was higher than other community based studies and depression was a risk factor for cognitive impairment.**

Keywords: *stroke, mild cognitive impairment, risk factors, depression, cerebrovascular disorders*

Introduction

Stroke is a global issue which not only affects developed countries but also developing countries such as Malaysia. This chronic disease was known as the third cause of death among Malaysian population (1). Stroke survivors faced difficulties in later life due to physical disabilities, cognitive impairment and emotional disturbances (2–7). Indeed, the prevalence of cognitive impairment after stroke is high. Sachdev et al. (8), reported that 58% of stroke patients were cognitively impaired while Claesson et al. (9), found that cognitive impairment was reported at approximately 72% at 18 months after a stroke onset. The worst part of cognitive impairment is when it progressed to dementia. The risk factor to develop dementia was doubled among stroke patients (3). In addition, stroke explained 20% of dementia incidences and would accelerate the progression from Cognitive Impairment No Dementia (CIND) to dementia (10).

Therefore, preventive actions are required to decrease the effects of stroke. The earliest review by Gorelick (11) recommended extensive studies to identify the risk factors for post–stroke cognitive impairment in order to improve intervention measures. It then progressed to extensive studies focusing on demographic factors, atherogenic (hypertension, diabetes mellitus, cigarette smoking, etc.), genetic factors and stroke-related factors (location of infarct, infarct number, type

of infarct, etc.) to explore the relationship with cognitive impairment after stroke (8,12–17). Nevertheless, different studies had revealed varieties of risk factors for post–stroke cognitive impairment. However, there was no definite consensus reached by researchers from different countries.

This study aimed to (1) estimate the prevalence of post-stroke cognitive impairment, and (2) explore the risk factors of post-stroke cognitive impairment at the community based level in Malaysia. It focused on four main independent variables including demographic, clinical, psychological, and physical factors. At this moment, no studies were carried out on the prevalence and risk factors of post-stroke cognitive impairment at the community based setting in Malaysia.

Methods

This was a cross sectional study with non-probability purposive sampling. The ethical approval was obtained from the Ethic Committee of Universiti Kebangsaan Malaysia Medical Centre (UKMMC) on 3rd December 2013.

Subjects

The subjects were recruited from two day care rehabilitation centers established by the National Association of Stroke Malaysia (NASAM) at Ampang and Petaling Jaya and a center under Pertubuhan Kebajikan Islam Malaysia (PERKIM) in Sentul. Between September 2013 and May 2014, there were 256 subjects officially registered in these centers (NASAM Petaling Jaya: 97 subjects; NASAM Ampang: 65 subjects and PERKIM: 94 subjects). The eligibility requirements included; 1) subjects who were confirmed with the diagnosis of stroke; 2) subjects who were stable and able to provide responses; and 3) able to converse in Bahasa Malaysia or English. This study excluded the subjects; 1) who had unclear diagnosis of any diseases, 2) who were undergoing treatment for mental illnesses, 3) with history of mental illnesses, coexisting Alzheimer's diseases, dementia, and brain injuries, and 4) with severe aphasia or unable to provide verbal responses. Out of 256 potential subjects, only 50 subjects agreed and qualified to be involved in this study. A face to face interview was conducted to gather their demographic data and clinical variables. Then, assessments for Barthel Activity of Daily Living (ADL) (18), Addenbrooke's Cognitive Examination-Revised (ACE-R) (19) and Hospital Anxiety and Depression Scale (HADS) (20) were administered. These assessments were conducted by a researcher with psychological background.

Measurements

Demographic and clinical data

This information was self-reported. It consisted of demographic questions such as age, gender, race, marital status, level of education, and socio-economic status. The clinical data included number of stroke attacks, affected lesion and region, alternative treatments, history of hypertension, diabetes mellitus, smoking and heart disease.

Activities of daily life

Barthel ADL Index (BI) was designed by Mahoney and Barthel (18) to measure physical functions of individuals. It has 10 items which measure 10 different activities among the subjects: grooming, feeding, bowel control, bladder control, toilet use, transfer, mobility, dressing, stairs uses, and shower. The score was rated based on the ability to carry out tasks independently or require some assistance. The total score for physical disability was classified as follows: (a) no physical disability = 20, (b) mild impairments = 15-–19, (c) moderately disabled= 10-14, (d) severe disability= 5–9 and (e) very severely disabled= 0–4 (21). ADL showed good internal consistency with Cronbach alpha above 0.8 (0.84, 0.80, and 0.82) within a month and six months of assessments (21).

Cognitive impairment

Addenbrooke's Cognitive Examination-Revised (ACE-R) was used as a screening tool to assess early cognitive dysfunction. ACE was developed by Mathuranath et al. (19) and was revised by Mioshi et al. (22). It comprised of 5 sub-scales on cognitive construct which included (a) concentration/orientation (18 points), (b) memory (26 points), (c) fluency (14 points), (d) language (16 points) (e) views and visuo-spatial (16 points). The total score for ACE-R was 100 and the cut off score from Japan's population was used to represent ASEAN countries. In this study, the cut off score of < 82 was used to indicate cognitive impairment among the subjects. ACE-R from Japanese version that used the cut off score of 82 showed sensitivity = 99% and specificity = 99% to discriminate dementia group (23).

Anxiety and depression

Hospital Anxiety and Depression Scale (HADS) was used to provide a brief state measure of both anxiety (seven items) and depression (seven items). HADS is a self-administered scale with 14-items that was developed by Zigmond and Snaith (20). However, in this study it was fully rated by a researcher after obtaining verbal responses from the subjects. There were four scores of classification: (a) "normal" (0-7) (b) "mild" (8-10) (c) "moderate" (11-14), and (d) "severe" (15-21). A Malay Version of HADS was established and validated in Malaysia. The internal consistency of the scale was excellent (Cronbach's a = 0.88 for Anxiety subscale and 0.79 for Depression subscale), test-retest reliability (ICC=0.35 for Anxiety and 0.42 for Depression subscale) (24).

Statistical Analysis

All statistical tests were performed using the Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics were reported in the frequency and percentage for categorical data while Mean (SD) or median (interquartile range [IQR]) for continuous data. The odd ratios (OR) were estimated to indicate the strength of relationship between the independent variables and the dependent variables (cognitively impaired vs and intact). In the first place, demographic, clinical variables, anxiety, depression and Barthel index scores were compared between both groups (cognitively impaired and intact). Subsequently, Chi square test and Fisher's exact test were used for categorical variables while independent t-test and Mann-Whitney U-test were used for continuous variables. Next, all of the studied variables were introduced into univariate logistic regression analysis. Finally, any variables with P values of < 0.25 were introduced into multivariate regression analyses with "backward" procedure in SPSS. The level of significance with P values < 0.05 indicated significant predictor in a regression model.

Results

Subject Characteristics

Fifty subjects that participated in this study were recruited from three different day care rehabilitation centers. The mean age of these subjects were 60.46 (11.40). The number of subjects in the age bands below 40, 41-50, 51-60, and 61 years and above were 2, 6, 15, and 27 respectively. Fifty six percent of the subjects were male, 50% were Chinese, 72% were married, and 50% of them had secondary education. The majority of the subjects had the first stroke attack (78%), while 60% involved right lesion and 52% were not reported with speech deficits. Besides relying on modern treatments, 86% of the subjects sought help from alternative methods which were mainly acupunture (68%) and traditional massage (64%). More than half of them had high blood pressure (66%) and high cholesterol level (52%). The majority of the subjects reported within a normal range for anxiety (86%) and depressive (88%) symptoms. Half of them had mild physical ability (50%). There were 38 (76%) subjects classified with cognitive impairment and the remaining 12 (24%) were cognitively intact. This classification was based on ACE-R where the prevalence rate of cognitive impairment was higher than Mini-Mental State Examination (MMSE) which was known as the gold standard test to screen cognitive status [cognitively impaired: 21 (42%); cognitively intact: 29 (58%)]. The mean score for ACE-R was 65.26 (18.95) while the score for MMSE was 22.94 (5.5).

Prevalence of Cognitive Impairment, Demographic Variables and ACE-R Score

The mean age for cognitively impaired group was higher than cognitively intact group but was not statistically significant [cognitively impaired = 61.87 (10.99); cognitively intact = 56.00(12.03); P = 0.151]. There was a significant association between the race of the subjects with cognitive impairment (Fisher's value = 9.56, $P < 0.05$). The level of education showed a significant association with cognitive status as well (Fisher's value = 7.29, $P < 0.05$). In contrast, age, gender and marital status did not show any significant association with cognitive status. The mean scores for ACE-R and other cognitive domains (i.e. attention & orientation, memory, fluency, language, visuospatial) were significantly higher in cognitively intact than impaired group (Table 1).

Prevalence of Clinical Factors

As shown in table 2, the number of stroke attacks, affected lesion, affected face, affected speech, traditional massage and acupuncture were not significantly associated with cognitive status even when the frequencies were higher in the cognitively impaired than in cognitively intact group. The subjects who had blood pressure, high cholesterol, diabetes mellitus, smoking habit and heart disease did not show significant association with cognitive impairment.

Prevalence of Psychological Distress and Functional Status

As seen in table 3, the median anxiety score was lower in the cognitively impaired group (median = 3.00) than the cognitively intact group (median = 4.00) without significant differences (P = 0.766). Meanwhile, the mean depression score in the cognitively impaired group was statistically higher than the cognitively intact group [t (48) = -4.42, P = 0.000]. The median Barthel Index score in the cognitively impaired group was 18 and 20 for cognitively intact subjects (P = 0.024).

Univariate Analysis of Demographic, Clinical, Psychological, and Physical Factors

The odds for cognitive impairment to occur among studied variables were obtained from logistic regression analysis. The P values of < 0.25 were used as the cut-off score to indicate significant odds. The results from table 4 demonstrated that Chinese were 7.33 times more likely to experience cognitive impairment than Malay. Subjects with lower education level were more likely to have cognitive impairment (primary education showed 9.33 and secondary education showed 6.13 times

Table 1: Demographic data and ACE-R score with cognitive status

	Cognitively impaired (n = 38)	Cognitively intact (n = 12)	*P* value
Age [n (%)]			0.236 ¥
Below 40	1(2.6)	1(8.3)	
41-50	3 (7.9)	3(25.0)	
50-60	12 (31.6)	3(25.0)	
60 and above	22 (57.9)	5(41.7)	
Gender [n (%)]			0.852 €
Male	21 (55.3)	7 (58.3)	
Female	17 (44.7)	5 (41.7)	
Race [n (%)]			0.007* ¥
Malay	9 (23.7)	9 (75.0)	
Chinese	22 (57.9)	3 (25.0)	
Indian	7 (18.4)	0 (0)	
Marital Status [n (%)]			0.606 ¥
Single	6 (15.8)	2 (16.7)	
Married	26 (68.4)	10 (83.3)	
Divorced	1 (2.6)	0 (0)	
Widowed	5 (13.2)	0 (0)	
Education level [n (%)]			0.043* ¥
No schooling	3 (7.9)	0 (0)	
Primary education	8 (21.1)	1 (8.3)	
Secondary education	21 (55.3)	4 (33.3)	
Tertiary education	6 (15.8)	7 (58.3)	
ACE-R [Mean (SD)]	58.34 (16.34)	87.17 (2.89)	< 0.001** ¶
Attention & Orientation	13.66 (3.91)	17.00 (1.13)	< 0.001** ¶
Memory	13.05 (5.65)	22.92 (2.02)	< 0.001** ¶
Fluency	3.24 (2.83)	8.92 (2.07)	< 0.001** ¶
Language	17.34 (4.74)	24.00 (1.91)	< 0.001** ¶
Visuospatial	11.05 (3.47)	14.33 (1.72)	< 0.001** ¶

¥ Fisher's Exact Test; € Chi Square test; ¶ Independent t-test; *P < 0.05; **P < 0.001.

the odds). With regards to clinical factors, right side brain lesion showed 0.29 times of likelihood to have cognitive impairment. If both sides of the brain were involved, it is 0.13 times of likelihood to have cognitive impairment. Meanwhile, the subjects who had weakness at the left side of

Table 2: Clinical factors with cognitive status

	Cognitively impaired (n = 38)	Cognitively intact (n = 12)	*P* value
Number of stroke attack (n (%))			> 0.950[¥]
1 time	29 (76.3)	10 (83.3)	
2 time	6 (15.8)	1 (8.3)	
3 time	3 (7.9)	1 (8.3)	
Affected lesion [n (%)]			0.138 [¥]
Left	16 (42.1)	2 (16.7)	
Right	21 (55.3)	9 (75)	
Right & Left	1 (2.6)	1 (8.3)	
Affected face [n (%)]			0.524 [¥]
Not involved	20 (52.6)	4 (33.3)	
Left	10 (26.3)	5 (41.7)	
Right	8 (21.1)	3 (25.0)	
Affected speech [n (%)]			0.874 [€]
Yes	18 (47.4)	6 (50)	
No	20 (52.6)	6 (50)	
Alternative treatment [n (%)]			
Traditional massage	23 (60.5)	9 (75)	0.362 [€]
Acupuncture	27 (71.1)	7 (58.3)	0.410 [€]
Faith Healer	4 (10.5)	0 (0)	0.560
Health Problem [n (%)]			
Blood pressure	25 (65.8)	8 (66.7)	0.955 [€]
High Cholesterol	18 (47.4)	8 (66.7)	0.243 [€]
Diabetes mellitus	18 (47.4)	4 (33.3)	0.393 [€]
Smoking	7 (18.4)	2 (16.7)	0.890 [€]
Heart disease	3 (7.9)	1 (8.3)	0.961 [€]

[¥] Fisher's Exact Test; [€] Chi Square test.

Table 3: Psychological distress and functional status with cognitive status

	Cognitively impaired (n = 38)	Cognitively intact (n = 12)	All (n = 50)	*P* value
Anxiety [Median (IQR)]	3.00 (2.00-6.00)	4.00 (0.25-5.00)	3.00 (2.00-5.25)	0.766 [b]
Depression [Mean (S.D)]	5.29 (2.53)	1.83 (1.70)	4.46 (2.77)	< 0.001[** a]
Barthel Index [Median (IQR)]	18.00 (16.00-20.00)	20.00 (19.00-20.00)	19.00 (16.00-20.00)	0.024[* b]

[a]: Independent t test; [b]: Mann-Whitney U-test; *$P < 0.05$; **$P < 0.001$; IQR: Interquartile Range.

Table 4: Univariate logistic regression analysis of demographic, clinical, psychological and physical factors

Variable	% Cognitively impaired (n = 38)	% Cognitively intact (n = 12)	OR[a]	95% CI	*P* value
Age					
Below 40	2.6	8.3	1.00		
41-50	7.9	25.0	1.00	0.04 – 24.55	> 0.950
50-60	31.6	25.0	4.00	0.19 – 84.20	0.373
60 and above	57.9	41.7	4.00	0.23 – 82.98	0.323
Gender					
Male	55.3	58.3	1.00		
Female	44.7	41.7	1.13	0.31 – 4.22	0.852
Race					
Malay	23.7	75	1.00		
Chinese	57.9	25	7.33	1.61 – 33.51	0.010**
Indian	18.4	0	1.62 x 109	< 0.001	> 0.950
Marital Status					
Single	15.8	16.7	1.00		
Married	68.4	83.3	0.87	0.15 – 5.03	0.873
Divorced	2.6	0	5.38 x 108	< 0.001	> 0.950
Widowed	13.2	0	5.38 x 108	< 0.001	> 0.950
Education level					
No schooling	7.9	0	1.88 x 109	< 0.001	> 0.950
Primary education	21.1	8.3	9.33	0.89 – 97.62	0.062*
Secondary education	55.3	33.3	6.13	1.33 – 28.21	0.020**
Tertiary education	15.8	58.3	1.00		
Number of stroke attack					
1 time	76.3	83.3	1.00		
2 time	15.8	8.3	2.07	0.22 – 19.35	0.524
3 time	7.9	8.3	1.03	0.10 – 11.12	0.978
Affected lesion					
Left	42.1	16.7	1.00		
Right	55.3	75	0.29	0.06 – 1.54	0.147*
Right & Left	2.6	8.3	0.13	0.01 – 2.88	0.194*
Affected face					
Not involved	52.6	33.3	1.00		
Left	26.3	41.7	0.40	0.09 – 1.83	0.237*
Right	21.1	25	0.53	0.10 – 2.94	0.470
Affected speech					
Yes	47.4	50	0.90	0.25 – 3.30	0.874
No	52.6	50	1.00		

(Table 4 continue)

(Table 4 continued)

Traditional massage					
Yes	60.5	75	0.51	0.12 – 2.20	0.367
No	39.5	25	1.00		
Acupuncture					
Yes	71.1	58.3	1.75	0.46 – 6.73	0.413
No	28.9	41.7	1.00		
Faith Healer					
Yes	10.5	0	5.70 x 104	< 0.001	> 0.950
No	89.5	100	1.00		
Blood pressure					
Yes	65.8	66.7	0.96	0.24 – 3.80	0.955
No	34.2	33.3	1.00		
High Cholesterol					
Yes	47.4	66.7	0.45	0.12 – 1.75	0.249*
No	52.6	33.3	1.00		
Diabetes mellitus					
Yes	47.4	33.3	1.80	0.46 – 7.00	0.396
No	52.6	66.7	1.00		
Smoking					
Yes	18.4	16.7	1.13	0.20 – 6.34	0.890
No	81.6	83.3	1.00		
Heart disease					
Yes	7.9	8.3	0.94	0.09 – 10.01	0.961
No	92.1	91.7	1.00		
Anxiety [Median (IQR)]	3.00 (2.00-6.00)	4.00 (0.25-5.00)	1.07	0.85 – 1.35	0.563
Depression [Mean (S.D)]	5.29 (2.53)	1.83 (1.70)	2.16	0.85 – 1.35	0.001***
Barthel Index [Median (IQR)]	18.00 (16.00-20.00)	20.00 (19.00-20.00)	0.79	0.57 – 1.10	0.162*

[a] Crude Odds Ratio; *$P < 0.25$; **$P < 0.05$; ***$P < 0.01$

Table 5: Multivariate logistic regression analysis of risk factors for cognitive impairment

Variable	B	OR[a]	95% CI	*P* value
Race				
Malay	0	1.00		
Chinese	1.03	2.81	0.40 – 19.59	0.296
Indian	21.04	1.37 x 109	< 0.001	> 0.950
Depression	0.71	2.03	1.20 – 3.45	0.009**

[a]: Adjusted Odds Ratio; *$P < 0.05$; **$P < 0.01$.

their face showed 0.40 times more likely to have cognitive impairment and those who reported high cholesterol level were 0.45 times more likely to have cognitive impairment.

In addition, those who were depressed might be 2.16 times more likely to be cognitively impaired than those who were not depressed and a person with 1 score increase in Barthel Index had 0.79 times the odds to have cognitive impairment. On the other hand, other variables such as older age (OR = 4.00, 95% CI = 0.23–82.98), female (OR = 1.13, 95% CI = 0.31–4.22), married (OR = 0.87, 95% CI =0.15–5.03), experienced three times stroke attacks (OR = 1.03, 95% CI = 0.10–11.12), affected speech (OR = 0.90, 95% CI = 0.25–3.30), traditional massage (OR = 0.51, 95% CI = 0.12–2.20), acupuncture (OR = 1.75, 95% CI = 0.46-6.73), blood pressure (OR = 0.96, 95% CI = 0.24–3.80), diabetes mellitus (OR = 1.80, 95% CI = 0.46–7.00), smoking (OR = 1.13, 95% CI = 0.20–6.34), heart disease (OR = 0.94, 95% CI = 0.09–10.01) and anxiety (OR = 1.07, 95% CI = 0.85-1.35) were not significant predictors.

Multivariate Analysis of Predictors for Cognitive Impairment

All of the variables which significantly predicted the cognitive status ($P < 0.25$) in the univariate analyses were introduced into the multivariate logistic regression analysis by choosing "backward elimination likelihood ratio (LR)" method (Table 5). These variables were race, education level, affected lesion, affected face, high cholesterol, depression and Barthel Index. Both race and depression were the only predictors left in the model. However, only depression was (OR = 2.03, 95% CI = 1.20–3.45) identified as a significant risk factor for poststroke cognitive impairment.

Discussion

Objective 1: To estimate the prevalence of cognitive impairment among stroke patients using Addenbrooke's Cognitive Examination-Revised (ACE-R) (Malaysian Version)

In the present study, the prevalence of post-stroke cognitive impairment was 76% in patients aged 29 to 81 years (mean age: 60.46). This prevalence was higher as compared to previous studies. The difference in the prevalence from other studies might be due to the difference in the setting of the study, younger age group, and different assessment tool used to screen cognitive impairment. For example, the prevalence of post-stroke CI in a hospital setting ranged from 7.5% to 72% (8,9,25,26). However, the prevalence of CI in this study was still higher as compared to other community based studies. For instance, there were 11.6% cognitive impairment reported by De Ronchi et al. (10), 11.8% cognitive impairment at three years of stroke reported in a study by Liman et al. (15), 21% and 24% cognitive impairment at 14 years and three months of onset reported by Douiri et al. (27) and 10.9% mild cognitive impairment was reported by Knopman et al. (13). The large difference in the prevalence of cognitive impairment reported in this study compared to previous studies was due to the tool used which was ACE-R while the other studies used MMSE with a cut off score of < 24 to indicate cognitively impaired group. Even though MMSE was sensitive to detect dementia, it was insensitive to detect early changes of dementia or mild cognitive deficits (28,29). MMSE was also weak in the ability to measure executive functions such as abstract thinking, judgement, problem solving, perception and verbal fluency (12, 23). Furthermore, several researchers envisaged weaknesses in MMSE to screen cognitive functions among patients with subcortical infarctions and small vessel disease. This was because MMSE could not differentiate between focal and diffuse lesion and insensitive to right-sided lesion (30–32). Besides that, the types of stroke would also determine the frequency of cognitive impairment. A study conducted by Khedr et al. (33) reported that the frequency of dementia in ischemic stroke was higher (76.5%) than hemorrhagic stroke (23.5%). However, the present study was unable to specify the stroke types of subjects because most of the subjects were unaware of their stroke types in addition to the absence of medical records in the centers.

Objective 2: To explore the risk factors of post-stroke cognitive impairment at the community based level.

Univariate analyses indicated that cognitive impairment was associated with race and level of education. It was frequently reported among Chinese and those who had lower education level (i.e. secondary education). This might happen due to the imbalance in the subject's distribution where more than half of the subjects were Chinese and attained secondary education level. In the present study, there was no significant relationship between cognitively impaired and intact group with age, gender distribution, marital status, number of stroke attacks, affected lesion, affected face and speech, alternative treatment received, blood pressure, high cholesterol level, diabetes mellitus, smoking and heart disease.

These results supported previous studies which also did not show significant differences between impaired and intact groups (8,17). Nevertheless, depression and Barthel index scores indicated significant differences between the two groups. The mean depression score was higher in the cognitively impaired group which might indicate that depressive symptoms were associated with poststroke cognitive impairment. One study showed that 60% of patients who were presented with depressive symptoms were also 54.5% impaired cognitively. Meanwhile, after 6 months of having post-stroke depressive symptoms, there were 34.7% of subjects who were reported with cognitive impairment in 40.4% of patients (34). In addition, lower Barthel index score in cognitively impaired group was consistent with previous findings where researchers also reported that the impaired group had lower median Barthel index upon discharge and also at 12 months after stroke (35). This occurred due to deficits in cognitive function such as attention and perception which were important predictors for functional impairment (36). Indeed, the reduction in the ability to recover in personal activities of daily living (P-ADL) such as eating, dressing, toileting, bathing and grooming would lead to low index score in the impaired group (35).

This study also found that depression was positively correlated with cognitive status. It was hypothesised that stroke patients with depression performed lower in cognitive function such as memory, organization skills, problem solving, and reasoning. This finding was consistent with the study by Nys et al. (37) where the researchers stated that patients with severe depressive symptoms were three times more likely to have cognitive impairment than patients with mild depressive symptoms. In addition, post-stroke depression had significant relationships with slow processing speed, poorer verbal memory and increase impact of interference (38). The negative correlation between Barthel index and cognitive status indicated that lower score in physical functioning was associated with cognitive impairment. This might explain that patients who were highly dependent in daily activities usually reported severe cognitive impairment. For example, stroke patients with executive dysfunction had problems with self-care activities involving shopping, housing/gardening, transporting and performing games/hobbies. Meanwhile, patients with mild deficits of attention had significant difficulties in a wide range of ADL tasks such as eating, food preparation, dressing, showering, toilet use and transferring (7). These results confirmed the findings from previous paper which discovered the association between dementia and cognitive impairment with a lower Bathel index score (25). Apart from that, anxiety did not show significant relationship with cognitive impairment because of the timing of the assessment. The subjects at the time of assessment were not experiencing significant fear to attempt to walk without assistance despite assurance and were not feeling anxious about future attack because most of the subjects attended the center for more than three months. The anticipatory fears of patients of their stroke were reduced by time and most of the subjects participated in this study were at the chronic phase where some of them had already attended the center since a few years ago. The anxiety symptoms had subsided at the point of study among the subjects because anxiety was more frequent in the early stages of post-stroke (38).

Multivariate logistic regression showed that depression was the only significant predictor for cognitive impairment in the regression model. This result confirmed the finding from previous study which demonstrated that depression in patients with right hemispheric lesions was linked to difficulty in identifying and describing feelings (alexithymic emotional processing) (39). Meanwhile, depression in patients with left hemispheric lesions was associated with the compromised planning of cognitive strategies (40). Depressed mood was heightened among stroke survivors because they had to face difficulties in daily living, functional loss and deficits in cognition such as memory, nonverbal problem solving, attention and psychomotor speed (41). Cognitive factors such as speed of processing and problem in verbal memory were more related to mood disturbances because it could lead an individual to feel depressed due to slowness and perceived memory deficits (38). Stroke patients also had problems in executive functions which were shown to be associated with depressive symptoms (42-43). The underlying reason which explained severe depressive symptoms in patients with depressive-executive dysfunction were disturbances in the frontal-subcortical circuit structures. These structures were affected due to brain infarct (43). More than half of the subjects (60%) in this study encountered right brain lesion. Therefore, it might indicate that the subjects had difficulty to identify and describe their own feelings than the ability to plan the tasks. Nevertheless, this study was not able to identify the number of subjects who were affected in executive function because

no information on specific region of brain and no formal neuropsychological tests were performed.

The strength of this study included the setting of the study in which this was the first study on post-stroke cognitive impairment conducted at community based centers in Malaysia. Hence, the distributions of subjects were homogenous because it comprised of mild, moderate and severe stroke survivors who might not be present at hospital based studies. However, this study has a few limitations. Firstly, even though efforts were made to filter the subjects with our exclusion methods, we could not be certain that the subjects who had pre-stroke cognitive impairment were not included in this study. Secondly, clinical variables were obtained as self-reported data. Certain information might be inaccurate or ambiguous such as affected brain lesion, hypertension, diabetes and hypercholesterolemia. Thirdly, we were unable to access medical records and neurological signs of subjects such as types of stroke, types of lesion, vascular territory and localized region because the centers did not have detailed records. These information might add to the richness of the data. Fourthly, the exclusion of non-Malay speakers, anon-English speakers and aphasic people might underestimate the severe cases of stroke. This selection could be considered as a determining factor for sampling bias. Fifthly, the small sample size in this study reduced the statistical power and generalization of the results.

Conclusion

In conclusion, this study demonstrated that the prevalence of post-stroke cognitive impairment in the community based setting is high. Therefore, future study is recommended to use ACE-R or the new version, ACE-III as a measurement tool to assess cognitive status and validate this result. We showed that depression is the only significant predictor for cognitive impairment. Knowing this, we may consolidate our knowledge of the risk factors for post-stroke cognitive impairment to increase the effectiveness of preventive strategies and avoid deterioration of cognitive states to dementia.

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Conflict of Interest

None.

Funds

None.

Authors' Contributions

Conception and design: MFMZ, SEG, NCH, PS
Analysis and interpretation of the data, drafting of the article, provision of study materials or patients, collection and assembly of data: MFMZ
Critical revision of the article for important intellectual content, final approval of the article: SEG, NCH, PS
Statistical expertise: NCH
Administrative, technical, or logistic support: SEG, NCH

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