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The Vascular Cognitive Impairment and Functional Dependence among Post-stroke Patients at Hospital Universiti Sains Malaysia

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ABSTRACT

The effectiveness of stroke care and treatment recently was associated with increase stroke survivors however, half of them are left with significant vascular cognitive impairment and functional dependence. The aims of this study are to determine the association between Vascular Cognitive Impairment (VCI) with clinical characteristics and functional dependence among 42 post-stroke patients admitted at Hospital Universiti Sains Malaysia (Hosp. USM), Kelantan, Malaysia. Personal information, level of cognitive impairment using Mini-Mental State Examination (MMSE), and functional dependence and independent level using a Barthel index data were collected. The result showed that 23.8% of stroke patients had severe vascular cognitive impairment, 40.5% had mild vascular cognitive impairment, and the other 35.7% had no vascular cognitive impairment. Besides, the functional level indicated that 19.0% of participants were dependent and 81.0% were independent. There was no statistically significant association between vascular cognitive impairment with gender, stroke location, and underlying medical disease. However, a significant and positive correlation was found between the level of vascular cognitive impairment and functional dependence level ($r = 0.553$, $p < 0.001$). An early assessment of the degree of cognitive impairment and functional independence will help enhance the treatment of stroke patients and reduce potential problems such as secondary strokes or other cardiovascular events.

Keywords: Cognitive Impairment; Post-Stroke Patient; Dependence and Independence

INTRODUCTION

Vascular cognitive impairment (VCI) is used to reflect the range of cognitive deficits resulting from cerebrovascular disease, including stroke. Approximately about 50-70% of stroke survivors regain functional independence, while 15-30% were permanently disabled. Stroke is triggered by brain blood flow obstruction, typically caused by a blood vessel bursting or disruption by clotting. It is the second leading cause of death and the third leading cause of disability worldwide World Health Organization (WHO, 2002). Stroke is correlated with social demand and healthcare expenses in many countries such as the US, Europe, and Japan, it is because stroke frequently requires a long-term treatment following post-stroke residual disability (Iwamoto *et al.*, 2010). Berges *et al.*, (2012) reported that out of approximately 5.7 million stroke survivors worldwide are left functionally dependent after hospitalization. Recovery of functional status appeared to plateau between 3 and 12 months after discharge. Benjamin *et al.* (2018) reported that stroke is a major cause of severe long-term disability; about 50% to 70% of stroke patients recovered to their functional independence level after long term rehabilitation, whereas the other 15% to 30% were permanently disabled and usually after three months of stroke, 20% of survivors required institutional treatment.

Vascular cognitive impairment (VCI) is the term used to reflect the range of cognitive deficits due to the

impact of cerebrovascular disease, including stroke (Baker *et al.*, 2018). In stroke research, the International Classification of Functioning, Disability, and Health (ICF) is utilized to classify health and health-related domains. It provides a list of environmental variables that affect the functioning and disability of an individual for a certain health condition (WHO, 2002). The ICF model describes the constraint and important state of a particular category, such as medical complications that commonly affect work, health, and disability of a disease (stroke). Additionally, this framework allows for local and population-wide measurement of brain trauma and injuries and awareness of the true health consequences of an injury. An important aspect of the ICF model is activity, covering functional levels along with cognitive and motor restrictions of patients who suffered from a stroke. Furthermore, ICF explains the impact of a disease on the body function and the behaviour component of contextual factors (patient personal factors), including gender, age, coping styles, social background, education, and patient behavior toward disability. Figure 1 shows the model implemented based on the ICF concept.

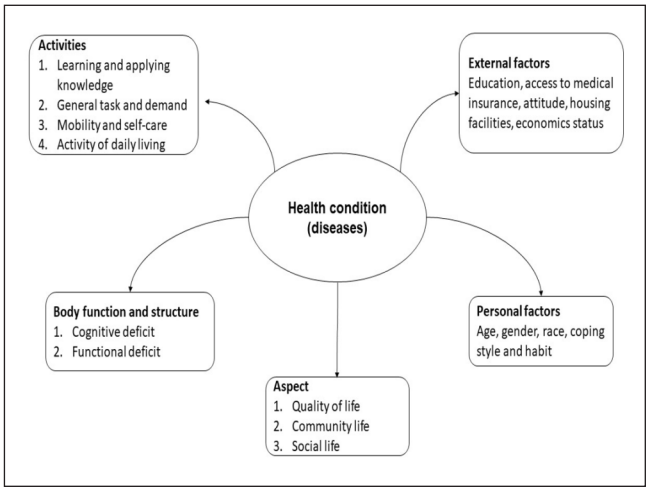

Figure 1: Interactions Between the ICF Components

Vascular Cognitive Impairment and Functional Dependence and Independence

Stroke may lead to cognitive and motor impairment marked by histopathological alterations in the brain region and neuronal loss. The impact of stroke could be physical or cognitive, depending on which portion of the brain is harmed and how seriously it is impaired (Caro *et al.*, 2017). Post-stroke VCI is characterized by changes in thinking, difficulty in problem-solving, memory deficits, loss of attention and executive function, and speech alteration. The prevalence of post-stroke vascular cognitive impairment was 76% in patients aged between 29 to 81 years (Zulkifly *et al.*, 2016). Moreover, patients with a right-side brain lesion showed 0.29 times likely to have a vascular cognitive impairment, whereas the risk is 0.13 times if both sides of the brain were involved. Meanwhile, the subjects who had weakness at the left side of their face were 0.40 times more likely to have a vascular cognitive impairment post-stroke.

Post-stroke VCI, temporary or permanent, can negatively impact patients' independence level in carrying out their daily activities. The common physical effects of stroke are muscle weakness, incontinence, epilepsy, spasticity, numbness and stiffness. On top of that, stroke may lead to the loss of neurological functions such as sudden loss of balance, coordination, or walking ability. Therefore, it is crucial to identify the association between the level of cognitive impairment and post-stroke functional dependence and independence (Yoshida *et al.*, 2012).

Relationship between Vascular Cognitive Impairment with Demographics, Clinical Characteristics and Dependence Level

The relationship between socio-demographic status and post-stroke VCI is complicated, for example, most haemorrhagic stroke patients are between 25 to 34 years, while most ischemic stroke patients are > 65 years old and men are at higher risk of having a stroke at a younger age than women due to behavioral and medical factors like diabetes and hypertension. In addition, on average, the man consumes more alcohol and smoking (Feroz Memon *et al.*, 2016).

Clinical characteristics related to stroke include location and type of brain lesion and underlying medical problems. However, the effects of stroke on cognitive function depend primarily on the location of brain lesionand severity of stroke (NINDS, 2011; Zulkifly *et al.*, 2016). For instance, damage done to a language center located on the dominant side of the brain, known as Broca's area, causes expressive aphasia. People with this type of aphasia have difficulty conveying their thoughts through words or writing. They lose the ability to speak the words they are thinking and to put words together in coherent, grammatically correct sentences.

In contrast, damage to a language center located in a rear portion of the brain, called Wernicke's area, results

in receptive aphasia. People with this condition have difficulty understanding spoken or written language and often have incoherent speech. Moreover, post-stroke survivors might experience emotional disturbances and personality changes due to the physical effects of brain damage (NINDS, 2011).

In terms of the relationship between post-stroke VCI and dependence level, previous studies reported that the Barthel index score is often lower among stroke survivors in the cognitively impaired group (Paker *et al.*, 2010; Zulkifly *et al.*, 2016). Deficits in cognitive function such as attention and perception are important predictors for functional impairment. 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 a low index score in the cognitive impaired group (Zulkifly *et al.*, 2016).

METHODOLOGY

Study Design

A cross-sectional descriptive-correlational approach was utilized in this study to determine the association between Vascular Cognitive Impairment (VCI) and its relationship with clinical characteristics and functional dependence and independence.

Sample and Setting

The participants of this research were stroke patients who were admitted to Hospital USM from February to March 2019 regardless of their ethnicity, prejudice and faiths. The inclusion criteria were male and female stroke patients who were admitted to medical and surgical wards in Hospital USM, > 18 years old and proficient in Bahasa Malaysia. Meanwhile, the exclusion criteria include patients who were visually impaired, other neurological conditions or mental illness.

Instrumentation

Personal Data Collection

This section consisted of 8 items that included age, gender, ethnicity, marital status, highest educational level, stroke type, underlying medical problem, and family history of stroke.

Mini-Mental State Examination (MMSE)

Mini-Mental State Examination (MMSE) was used to determine the participants' cognitive level via questions classified into six categories: orientation, registry, attention and calculus, recall memory, language, and construct. The score ranged from 0 points: major cognitive impairment level up to 30 points: a better cognitive capacity or no cognitive problem (Caro *et al.*, 2017). This study used the Malay version MMSE with a scoring level of cognitive impairment as presented in Table 1.

Table 1: The Level of Cognitive Impairment

Level of Cognitive Impairment	Score
Severe cognitive impairment	0-17
Mild cognitive impairment	18-23
No cognitive impairment	24-30

Barthel Index

This section included 10 questions to measure the functional dependence and independence of stroke patients in their daily activities. The Barthel index was created to assess improvement levels of disability after stroke, including feeding, transfer, personal hygiene, getting on and off the toilet, self-bathing, walking on a level surface, ascending and descending stairs, dressing and undressing, and bowel and bladder control. Participants earn points depending on whether they need or may accomplish the assignment independently through physical support. A score of zero points indicated dependence in daily life, whereas a score of 100 represents independence in daily activities (Cech & Martin, 2012). Table 2 shows the scoring of the dependence and independence level.

Table 2: The Level of Functional Dependence and Independence

Level of Functional Dependence and Independence	Score
Dependent (with help)	0-50
Independent	51-100

Validity and Reliability

All the tools were subjected to instrument translation, content validity and feedback, and item analysis for the validation process. The MMSE used in this study, originally in English, was previously translated into Bahasa Malaysia by Zarina, Zahiruddin & AH (2007). Meanwhile, the reliability of MMSE and the Barthel-index were determined using Cronbach's alpha test. The Cronbach's alpha obtained for translated MMSE was 0.752 and for Barthel-index was 0.917.

RESULTS

Socio-Demographic of Participants and Clinical Characteristics

Table 3 shows the summary of the analysis of socio-demographic data of stroke patients who were admitted to medical and surgical wards of Hospital USM. The age of the participants was ranged from 43-88 years old with a mean of 63 years old. There are (n=23, 54.8%) were male and (n=19, 45.2%) were female.

Table 3: Socio-Demographic and Clinical Characteristic of Participants (n =42)

Variables	Description	Frequency (%)
Age	< 54 years old	10 (23.8)
	≥ 54 years old	32 (76.2)
Gender	Male	23 (54.8)
	Female	19 (45.2)
Race	Malay	38 (90.5)
	Chinese	3 (7.1)
	Indian	1 (2.4)
Marital Status	Married	28 (66.7)
	Widow	6 (14.3)
	Divorced	8 (19.0)
Level of Education	Primary School	5 (11.9)
	Secondary School	24 (57.1)
	STPM/Matriculation/Foundation/Diploma	3 (7.1)
	Adult school	3 (7.1)
	others	7 (16.7)
Body affected	Left Body	31 (73.8)
	Right Body	11 (26.2)
Stroke Type	Acute Ischemic Stroke	34 (80.9)
	Recurrent Ischemic stroke	5 (11.9)
	Transient Ischemic Attack	3 (7.1)
Underlying Medical Problem (Diabetes, Hypertension, Hyperlipidemia)	Yes	34 (81.0)
	No	8 (19.0)
Family History of Stroke	Yes	10 (23.8)
	No	32 (76.2)

The Level of Cognitive Impairment of Participants

Table 4 shows about 23.8% of stroke patients had severe cognitive impairment assessed using MMSE, another 40.5% recorded mild cognitive impairment and 35.7% had no cognitive impairment. The findings indicated that more than half of the respondents had a cognitive problem post-stroke.

Table 4: Frequency and Percentage Level of Cognitive Impairment of Participants (n= 42)

Level of Cognitive Impairment	Frequency (%)
Severe cognitive impairment (0-17)	10 (23.8)
Mild cognitive impairment (18-23)	17 (40.5)
No cognitive impairment (24-30)	15 (35.7)

Fisher's exact test analysis showed that there is no statistically significant association between adherence to antihypertensive medicines and sex ($p = 0.856$) and there is no statistically significant association was found between the area of the body affected post-stroke and vascular cognitive impairment ($p = 0.666$). Furthermore, cognitive disability and the underlying medical conditions were not statistically significantly associated ($p = 0.148$) with the level of cognitive impairment.

Table 5: The Association between the Level of Vascular Cognitive Impairment and Selected Socio-Demographic and Clinical Characteristics of Participants (n = 42)

Variables		Level of Cognitive Impairment, n (%)			*p*-value
		Severe Cognitive Impairment (0-17)	Mild Cognitive Impairment (18-23)	No Cognitive Impairment (24-30)	
Gender	Male	5 (21.7)	9 (39.1)	9 (39.1)	0.367
	Female	5 (26.3)	8 (42.1)	6 (31.6)	
Body Affected	Left Body	8 (25.8)	11 (35.5)	12 (38.7)	0.666
	Right Body	2 (18.2)	6 (54.5)	3 (27.3)	
Underlying Medical Problem (Diabetes, Hypertension, Hyperlipidemia)	Yes	8 (23.5)	16 (47.1)	10 (29.4)	0.148
	No	2 (25.0)	1 (12.5)	5 (62.5)	

**Tested using Fisher's exact test*
*** p-value ≤0 .05 is considered significant*

The Level of Functional Dependence and Independence of Participants

Table 6 and 7 show that more than half of stroke patients depended on others to perform functional activities of daily living such as getting on and off the toilet (57.1%), walking on a level surface (81.0%), ascending and descending stairs (88.1%), and dressing, which includes tying shoelaces and fastening fasteners (88.1%). Based on the Barthel Index test, the results show 19% (8 patients) were dependent and 81.0% (34 patients) were independent. The overall score indicated that most post-stroke patients in this study had a high level of functional ability except in certain tasks mentioned above.

Table 6: Frequency and Percentage Level of Functional Dependence and Independence of Participants (n = 42)

Level of Functional	Frequency (%)
Dependent with help (0 - 50)	8 (19.0)
Independent (51 - 100)	34 (81.0)

Table 7: Frequency and Percentage of Items in Barthel Index Test of Participants (n=42)

Variables	Dependent with Help	Independent
Feeding	12 (28.6%)	30 (71.4%)
Transfer	20 (47.6%)	22 (52.4%)
Personal hygiene	7 (16.7%)	35 (83.3%)
Getting on and off the toilet	24 (57.1%)	18 (42.9%)
Self bathing	21 (50.0%)	21 (50.0%)
Walking on a level surface	34 (81.0%)	8 (19.0%)
Ascending and descending stair	37 (88.1%)	5 (11.9%)
Dressing	37 (88.1%)	5 (11.9%)
Controlling bowel	3 (7.1%)	39 (92.9%)
Controlling bladder	3 (7.1%)	39 (92.9%)

Association between the Level of Vascular Cognitive Impairment and Functional Dependence and Independence of Participants (n=42).

Table 8 presented the result of analysis using Pearson-correlation, it's revealed that there are association between Vascular Cognitive Impairment and Functional Dependence and Independence (r = 0.553, $p < 0.001$).

Table 8: Association between the Level of Vascular Cognitive Impairment and Functional Dependence and Independence of Participants (n= 42)

Variables	Level of Vascular Cognitive Impairment Using MMSE	
	r	*p*-value
Level ofFunctional Dependence and Independence (Barthel Index)	0.553	0.000

DISCUSSION

The Level of Cognitive Impairment in Post-Stroke Patients

Based on Table 4, there are 64.3% (27/42) of post-stroke patients had cognitive impairment. This finding was in line with previous studies that reported most stroke patients were diagnosed with cognitive impairment following a stroke (Stephens *et al.*, 2004; Dong *et al.*, 2010). Stroke is a chronic disease that can highly affect cognitive functions depending on which part of the brain is injured and severely compromised (Mellon *et al.*, 2015).

Association between the Level of Cognitive Impairment and Selected Socio-Demographic and Clinical Characteristic of Participants

The findings showed there is no significant correlation between VCI and gender, which was in agreement with the study by Douiri, Rudd & Wolfe (2013) reported that no correlation between the gender of cognitive impairment after stroke. Futhermore Gibson & Attwood, (2016) stated that the occurrence of stroke in males and females is usually comparable until after the age of 85 because during age > 85 females constitute the group with the highest risk of stroke.

The results of this study demonstrated that there is the absence of a statistically significant relationship between VCI post-stroke with stroke location. On the contrary, a previous study by Renjen, Chaudhari & Meman (2016) reported that the level of cognitive impairment was associated with stroke location, considering the size or volume of the affected region in the brain. It was reported that left-hemisphere lesions (80.7%) could be correlated with a greater risk of cognitive impairment (Renjen, Chaudhari & Meman, 2016). Furthermore, no significant differences were found between the level of cognitive impairment and with an underlying medical issue (p = 0.148). Conversely, the result of the previous study showed that hypertension diabetes mellitus, hyperlipidaemia, smoking, and atrial fibrillation, contribute as a risk factor for stroke and cognitive impairment post-stroke. It is might be due to this study has a small sample size.

Association between the Post-Stroke Level of Vascular Cognitive Impairment and Functional Dependence and Independence

Based on the Pearson-correlation test, the result showed that there was a clear correlation ($r = 0.553$, $p < 0.001$) between the degree of VCI and functional dependency and independence among post-stroke patients in Hospital USM (Table 8). Additionally, a study by Paker *et al.* (2010) demonstrated significant changes following recovery in stroke patients with and without vascular cognitive impairment that determine using the Barthel index. The finding highlighted that the rehabilitation of patients with vascular cognitive impairment could contribute to significant functional recovery. Furthermore, it can be concluded that the majority of patients with significant vascular cognitive impairment (23.8%) contributed to a decrease in functional level during the performance of tasks such as getting on and off the toilet (57.1%), walking on a level surface (81.0%), ascending and descending stairs (88.1%), and dressing involving tying of shoelaces, fastening fasteners (88.1%). Based on the findings of Jones, McClean & Stanford (2018) the duration of in-patient stroke stay in hospital depends on the phase-type recovery model. The initial recovery period depends on

the form of stroke and patients' age. Since most participants belonged to the gerontology group, their age may lead to slow recovery in vascular cognitive impairment and functional status.

CONCLUSION

This study concluded that cognitive impairment levels were not statistically associated with identified socio-demographic and clinical properties (gender, stroke location and underlying medical condition). However the were association between the degree of VCI and functional dependency and independence among post-stroke patients. Early assessment of cognitive dysfunction and functionality will help optimize stroke patients' treatment and prevent further complications such as recurrent stroke or other cardiovascular problems.

Conflict of Interest

The authors declare that they have no conflict of interests.

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Ethical approval to conduct this study was obtained from the Research Ethical Committee (Human), Universiti Sains Malaysia (USM/JEPeM/18110715) 29th January, 2019 to 28th January, 2020. Permission to carry out this research was granted by the Director of HOSP.

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