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Original Article

Can the stroke impact scale 3.0 detect cognitive impairments in patients with a recent stroke?

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Abstract. [Purpose] The aim of this study was to identify cognitive impairments in patients with a recent stroke using Stroke Impact Scale 3.0 (SIS). [Participants and Methods] A retrospective cohort study was conducted to evaluate 50 medical records in patients with a recent stroke who have completed a stroke rehabilitation programme. All data were evaluated at St. Finbarr's Hospital in Cork, Ireland. [Results] A total of 41 records met the inclusion criteria, of which 53.7% were male. Regarding the risk factors, most patients complained of hypertension (85.4%), with most being diagnosed with embolic stroke (56.1%). The SIS identified numerous issues in stroke patients, such as persistent problems with memory (36.6%), concentration (29.3%), and solving everyday problems (43.9%). In addition, some patients' responses were negative regarding their emotion such as feeling sad (51.2%), not enjoying things as much as ever (39%), feeling life is not worth living (85.4%) and not smiling or laughing at least once a day (80.5%). [Conclusion] The inclusion of the SIS in the stroke review clinic identified cognitive deficits that may not have otherwise been detected. By using SIS in a systematic and standardised way, deficits can be identified, and appropriate rehabilitation can be provided.

Key words: Cognitive impairments, Stroke, Stroke Impact Scale

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INTRODUCTION

Cognitive impairment can occur in any cognitive domain after a stroke, such as the executive function, memory, language, visuospatial ability, visuoconstructional ability, and global cognitive function. Post-stroke cognitive impairment is common and can play a major role in hindering the recovery of function and return to the pursuit of routine activities[1)]. Furthermore, it occurs regardless of country, race, and diagnostic criteria used[2)]. For example, a study conducted in the United Kingdom by Patel et al.[3)] showed that there was cognitive impairment after stroke in 39% of patients at three months. Sundar and Adwnai[4)] conducted a similar study in India to assess cognitive function three months after ischaemic stroke and showed that 31.7% (52/164)

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of patients had a cognitive dysfunction. In Dublin, 56.6% of stroke survivors were found to have cognitive impairment six months following an ischaemic stroke[5]. Cognitive impairments are common in the acute stage after a stroke and are important predictors of recovery in the long term[6]. Most studies of cognitive domain impairments have reported that up to 50% of stroke survivors may develop new onset or worsening of cognition after a stroke[7–10]. Moreover, pre-morbid cognitive status as well as a history of prior stroke are considered important predictors of recovery from post-stroke cognitive impairment[11].

Various clinical tests are used by health professionals to measure different domains of cognitive ability. These include the Mini-Mintal State Examination (MMSE)[12], Montreal Cognitive Assessment (MoCA)[13], Stroke Impact Scale 3.0 (SIS)[14], and Patient reported Evaluation of Cognitive State (PRECiS)[15]. The SIS 3.0 is designed for repeated administration to track the impact of a stroke on survivors' health and life status over time[16]. It can also be used in clinical and research applications[16]. It was developed in 2003 and assesses 59 items of a patient's quality of life, divided into eight dimensions where a stroke has an overall effect on health and well-being[17]. Internal consistency reliability (Cronbach's α) was high in all SIS 3.0 domains and ranged from 0.89 for the emotional domain to 0.98 for the physical domain[16]. The test-retest reliability showed high intra-class corrections, which ranged from 0.79 for the SIS 3.0 stroke global recovery item to 0.93 for the cognitive domain[16]. The convergent validity was highly correlated when assessed by comparing the results of the index with those gained from a generic patient-reported outcome measure and the EuroQoL EQ-5D[17].

In general, post-stroke rehabilitation interventions are delivered within the first three months following the stroke deficit[18]. Thus, the SIS 3.0 could be used after rehabilitation to investigate further elements such as emotion, communication, memory and thinking, as well as social participation. Moreover, this is a patient reported outcome measure designed to detect the impact of the current stroke deficits on the quality of life to be quantified. Carod-Artal et al.[19] assessed the psychometric attributes of SIS 3.0 in stroke survivors (n=174) and found that it could be used to evaluate health-related quality of life. Another study examined SIS 3.0 to explore clinical changes in everyday life at three and twelve months post-stroke, revealing that the strength and emotion domains were lower at twelve months than at three months[18].

The current research is important in terms of highlighting that stroke rehabilitation generally focuses on physical and functional recovery, with little emphasis on cognitive rehabilitation to improve executive functioning. The recognition and identification of specific post-stroke cognitive impairment are essential, so that focused cognitive rehabilitation, vocational rehabilitation, psychological and social support can be provided where appropriate. Such an investigation will provide an opportunity to review any unmet needs in the stroke rehabilitation follow-up service. The purpose of this study was to identify cognitive impairments in patients who have recently suffered a stroke and have completed a stroke rehabilitation programme using SIS 3.0.

PARTICIPANTS AND METHODS

A retrospective cohort study was conducted to review 50 medical records of post-stroke patients in Cork, Ireland. The records were taken from the stroke rehabilitation unit, and the Assessment and Treatment Centre of St. Finbarr's Hospital. The study was approved by the Clinical Research Ethics Committee, Cork City in May 2017. All participants agreed when admitted to the hospital that their data would be used for research. This study was performed from May to September 2017.

The inclusion criteria to review the records were as follows: (a) post-stroke patient must be 65 years old or more; (b) post-stroke patient must complete stroke rehabilitation at St. Finbarr's Hospital; (c) post-stroke patient must be reviewed at the stroke clinic at the Assessment and Treatment Centre at least six weeks after discharge from St Finbarr's Hospital; (d) post-stroke patient must have completed the SIS; (e) post-stroke patient must have been assessed using MoCA and MMSE on admission to, or discharge from, the hospital if possible; (f) it must be his/her first ever stroke; (g) only stroke patients are eligible for the study; and (h) the patient must have been admitted to the hospital between January 2016 and July 2017.

The exclusion criteria to review medical records were as follows: (a) post-stroke patient is less than 65 years old; (b) post-stroke patient has not completed his/her rehabilitation programme at the time of the study; (c) post-stroke patient completed his/her rehabilitation in another hospital; (d) post-stroke patient has not yet been reviewed at the stroke review clinic of the Assessment and Treatment Centre; (e) post-stroke patient has not completed the SIS; (f) he/she has a recurrent stroke; (g) patient has other neurological diseases alongside the stroke; (h) patient has other neurological diseases that would potentially affect cognition prior to stroke onset; and (i) he/she was admitted to the hospital before January 2016.

The research instrument was SIS 3.0 which is a scale designed for repeated administration to track changes of health status following stroke over time; it can also be used in clinical and research applications. It contains a 59-item measure, with items under subheadings in eight domains: strength domain (four items); memory and thinking domain (seven items); emotion (nine items); communication (seven items); specific functional tasks (ten items); mobility (nine items); hand function (five items); and participation and role function (eight items)[20]. Each item was rated on a five-point Likert scale in terms of the difficulty the patient had experienced in completing each item. In addition, an extra question related to functional stroke recovery asked the patients to rate, on a scale from 0 to 100, how much he/she had recovered from his/her stroke. However, three domains related to cognitive status, including memory and thinking domain, mood and emotions domain, and participation/role function were only used and discussed in the current study. The SIS outcome measure was collected at least six weeks after discharge from rehabilitation admission of patients who had been admitted between January 2016 and July 2017. Standard descriptive statistics were used to describe the data using Microsoft Excel.

Table 1. Demographic characteristic

Demographics		Male		Female	
		N=22	(53.7%)	N=19	(46.4%)
Age	65–70	10	(45.4%)	4	(21%)
	71–75	2	(9%)	0	(0%)
	76–80	7	(31.8%)	5	(26.3%)
	More than 80	3	(13.6%)	10	(52.6%)
Stroke risk factors	Age ≥ 65	22	(100%)	19	(100%)
	Atrial fibrillation	6	(27.2%)	5	(26.3%)
	Hypertension	19	(86.4%)	16	(84.2%)
	Diabetes	5	(22.7%)	2	(10.5%)
	Smoking	6	(27.2%)	4	(21%)
	Hypercholesterolemia	7	(31.8%)	8	(42%)
	Heart diseases	0	(0%)	1	(5.2%)
	Carotid stenosis	6	(27.2%)	3	(15.8%)
	Others	11	(50%)	7	(36.8%)
Type of stroke	Cerebral thrombosis	5	(22.7%)	5	(26.3%)
	Cerebral embolism	14	(63.6%)	9	(47.4%)
	Haemorrhagic stroke	3	(13.6%)	5	(26.3%)
The affected area of brain	Right hemisphere	13	(59%)	12	(63%)
	Left hemisphere	6	(27.3%)	7	(36.8%)
	Posterior circulation	2	(9%)	0	(0%)
	Both right and left hemisphere	1	(4.5%)	0	(0%)
Arterial territory affected	Anterior cerebral artery	1	(4.5%)	0	(0%)
	Middle cerebral artery	11	(50%)	11	(57.9%)
	Posterior cerebral artery	3	(13.6%)	2	(10.5%)
	Basilar artery branches	2	(9%)	3	(15.8%)
	Internal carotid artery	2	(9%)	1	(5.2%)
	Not mentioned	3	(13.6%)	2	(10.5%)
Stroke syndrome/clinical deficit	Motor arm weakness	19	(86.4%)	14	(73.7%)
	Motor leg weakness	17	(77.3%)	13	(68.4%)
	Dysphagia	10	(45.4%)	3	(15.8%)
	Hemianopia	6	(27.3%)	3	(15.8%)
	Sensory less	13	(59%)	12	(63.2%)
	Dysarthria/dysphasia	11	(50%)	12	(63.2%)
	Poor memory	7	(31.8%)	11	(57.6%)
	Facial asymmetry	14	(64.6%)	12	(63.2%)
	Other are affected	2	(9%)	5	(26.3%)
Acute stroke unit	Patients had MoCA test	13	(59%)	4	(21%)
	Patients had MMSE test	5	(22.7%)	1	(5.3%)
Stroke rehabilitation unit	Patients had MoCA test	2	(9%)	2	(10.5%)
	Patients had MMSE test	1	(4.5%)	2	(10.5%)
Stroke review clinic	Patients had MoCA test	13	(59%)	10	(52.6%)
	Patients had MMSE test	1	(4.5%)	1	(5.3%)

MoCA: Montreal Cognitive Assessment; MMSE: Mini-Mintal State Examination.

RESULTS

Table 1 below illustrates the demographic characteristics and relevant clinical data of post-stroke survivors. In total, 50 records were reviewed but only 41 records were selected for the study. Records were excluded because of age (less than 65 years old), recurrent stroke, and other neurological diseases such as Parkinson's disease. A total of 41 participants were recruited for the study, 22 of whom were male (53.7%) and 19 were female (46.4%). Among the risk factors, most males and females were diagnosed with hypertension, representing 86.4% and 84.2% respectively. In terms of stroke type, embolic stroke was the most common in both males and females, 63.6% and 47.4% respectively. In addition, the right hemisphere was the most affected side in both genders, with 59% for males and 63% for females.

Table 1 also illustrates the main characteristics of the participants such as the affected arterial territory, stroke clinical deficit, as well as the MoCA and MMSE tests. It is apparent that very few people had anterior cerebral artery deficit, whereas most participants had a middle cerebral artery deficit (50% of males and 57.9% of females). Regarding the clinical deficits, more males were affected than were females, except for the dysarthria/dysphasia (females 63.2% and males 50%). During admission to the hospital, 43.9% of participants (n=18) had the memory and thinking tests (MoCA and MMSE) and experienced memory problems, while 56.1% of participants (n=23) did not have a memory and thinking test. It can be seen

clearly that the MoCA was more commonly used than MMSE for stroke patients in the acute stroke unit (59%), the stroke rehabilitation unit (9%), and the stroke review clinic (59%).

The length of time in days in the following sites, acute stroke unit, stroke rehabilitation and stroke review clinic. The median length of time in the acute stroke unit for the 41 participants was nine days (interquartile range=15), 25 days in the stroke rehabilitation unit (interquartile range=42), and it was 49 days (interquartile range=14) before their first visit to the stroke review clinic.

Table 2 illustrates the information about seven questions that were asked to participants about memory and thinking status after stroke. Approximately one third of the participants reported having difficulty with their memory and thinking ability in all the seven questions. This study found that 36.6% of the participants (n=15) reported having a difficulty in remembering things that people had just told them. Almost 30% of participants reported having difficulty with their concentration. Importantly, when participants were asked about their ability to solve every day problems, 43.9% of them experienced difficulty.

Table 3 provides the results obtained regarding changes in mood and the ability to control emotions after stroke. During admission to the hospital, none of the participants had a mood and emotions test. The overall results showed that almost 50% of the participants were positive, except in four questions that asked the participants about feeling sad, enjoying things as much as ever, and feeling life is worth living as well as smiling and laughing at least once a day, in which the responses were negative, 51.2%, 39%, 85.4%, and 80.5% respectively. Half of participants reported that they felt sad and nearly one third of the participants (29.3%) reported that a little of the time they felt that they had nothing to look forward to. In addition, 39% of participants answered that none of the time did they enjoy things, and 31.7% of them felt nerves. Surprisingly, 85.4% (n=35) of the participants felt life is not worth living, with 80.5% (n=33) of them reporting that they did not smile or laugh at least once a day.

Table 4 shows the results to eight questions designed to ask stroke survivors about their ability to participate in usual day-to-day activities. In general, the responses were negative, except for the participants' ability to participate in social activities, active recreation and their ability to help others. Although 70.7% of the participants stated that they were never limited in their work and majority of them reported that they socialised 'some or a little of the time', 39% of them stated that they did not have a role as a family member or friend. In terms of the respondents' participation in religious activities and controlling their life as they wished, 78% did not participate in religious activities and around 70.7% did not have the ability to control their life as they wished, which indicated that they had significant negative behaviour that needs to be addressed.

DISCUSSION

This study aimed to identify cognitive impairments in patients with recent stroke who had completed a stroke rehabilitation programme using SIS 3.0. With regards to the first domain, around one third of the participants reported difficulty in their memory and thinking and 43.9% of the participants experiencing difficulty in solving everyday problems. Nonetheless, Pohjasvaara et al.[21] found that one third of participants developed vascular dementia after three months. Hence, it could be assumed that a memory problem would be noticed three months after rehabilitation, which is supported by a study by Cullen et al.[10] who concluded that 33% of their stroke survivors developed vascular dementia within one year following the stroke.

The second domain concerns mood and emotions following stroke. During the admission to the acute stroke unit in the hospital, it was apparent that none of the participants had a mood and emotions test. However, some changes in mood, in terms of depression, were noted among the participants in the stroke review clinic. Nearly 51.2% of participants (n=21) felt sad, 17.1% of participants (n=8) felt a burden to someone, 39% of them (n=16) did not enjoy things as much as they had previously, 85.4% felt depressed (felt that life was not worth living) and 33 participants (80.5%) did not smile or laugh at least once a day. These results concur with a study conducted by Kauhanen et al.[22] who reported that over half the participants in their study developed post-stroke depression at three months. There is, however, another explanation, the findings of the current study suggest that age and gender might constitute risk factors for depression. As mentioned in the results (Table 2), there were 25 participants aged over 76 years old and around 60% of them were female. Hackett and Anderson[23] evaluated previous studies that were related to depression after stroke, concluding that the risk of depression was related to an increased age and to women.

In relation to the third domain, which concerns participation and role function, these activities are strongly associated with the executive function in the prefrontal cortex. The results of this study show that three out of four patients do have the ability to control as they wish. The impairment in the prefrontal cortex could lead to executive dysfunction, such as the inability to make a decision and difficulty in planning[24]. Indeed, the present study found that more than half of the patients reduced their participation in activities as a result of executive dysfunction. Prior studies have noted the importance of executive function rehabilitation, as between 19% and 75% of stroke survivors presented with executive dysfunction[25, 26]. This study suggests that executive function rehabilitation would improve different aspects of functions, especially those that focus on planning, multitasking and making decisions. This could be introduced in the early stages of rehabilitation, especially for stroke patients who had MCA occlusion and/or posterior circulation occlusion[27]. Stroke survivors should also be informed about the potential impact of stroke on cognition, which would help them and their families to prevent further cognitive deterioration. In addition, healthcare professionals may do not have enough knowledge about cognitive impairments after stroke[28]. Therefore, educational trainings should be provided to healthcare professionals to increase their level of knowledge

Table 2. Stroke survivors' memory and thinking

In the past week, how difficult was it for you to:	Not difficult at all	A little difficult	Somewhat difficult	Very difficult	Extremely difficult
Remember things that people just told you?	26 (63.4%)	10 (24.4%)	5 (12.2%)	0 (0%)	0 (0%)
Remember things that happened the day before?	34 (82.9%)	4 (9.8%)	3 (7.3%)	0 (0%)	0 (0%)
Remember to do things (e.g. keep scheduled appointments or take medication)?	28 (68.3%)	8 (19.5%)	4 (9.8%)	1 (2.4%)	0 (0%)
Remember the day of the week?	39 (95.2%)	1 (2.4%)	1 (2.4%)	0 (0%)	0 (0%)
Concentrate?	29 (70.7%)	9 (22%)	3 (7.3%)	0 (0%)	0 (0%)
Think quickly?	25 (61%)	11 (26.8%)	3 (7.3%)	2 (4.9%)	0 (0%)
Solve everyday problems?	23 (56.1%)	12 (29.3%)	4 (9.8%)	1 (2.4%)	1 (2.4%)

Table 3. Stroke survivors' feeling about changes in mood and emotion

In the past week, how often did you:	None of the time	A little of the time	Some of the time	Most of the time	All of the time
Feel sad?	20 (48.8%)	10 (24.4%)	11 (26.8%)	0 (0%)	0 (0%)
Feel that there is nobody you are close to?	38 (92.7%)	2 (4.9%)	1 (2.4%)	0 (0%)	0 (0%)
Feel that you are a burden to others?	34 (82.9%)	6 (14.7%)	0 (0%)	1 (2.4%)	0 (0%)
Feel that you have nothing to look forward to?	27 (65.9%)	12 (29.3%)	0 (0%)	1 (2.4%)	1 (2.4%)
Blame yourself for mistakes that you made?	38 (92.7%)	2 (4.9%)	1 (2.4%)	0 (0%)	0 (0%)
Enjoy things as much as ever?	16 (39%)	16 (39%)	8 (19.5%)	1 (2.5%)	0 (0%)
Feel quite nervous?	28 (68.3%)	10 (24.4%)	3 (7.3%)	0 (0%)	0 (0%)
Feel that life is worth living?	35 (85.4%)	5 (12.2%)	1 (2.4%)	0 (0%)	0 (0%)
Smile and laugh at least once a day?	33 (80.5%)	7 (17.1%)	1 (2.4%)	0 (0%)	0 (0%)

Table 4. Ability to participate in the activities

During the past 4 weeks, how much of the time have you been limited in:	None of the time	A little of the time	Some of the time	Most of the time	All of the time
Your work (paid, voluntary or other)	29 (70.7%)	2 (4.9%)	4 (9.8%)	3 (7.3%)	3 (7.3%)
Your social activities?	10 (24.4%)	15 (36.6%)	14 (34.1%)	2 (4.9%)	0 (0%)
Quiet recreation (crafts, reading)?	18 (43.9%)	10 (24.4%)	7 (17.1%)	5 (12.2%)	1 (2.4%)
Active recreation (sports, outings, travel)?	8 (19.5%)	15 (36.6%)	13 (31.7%)	4 (9.8%)	1 (2.4%)
Your role as a family member and/or friend?	16 (39%)	15 (36.58%)	8 (19.5%)	2 (4.9%)	0 (0%)
Your participation in spiritual or religious activities?	32 (78%)	6 (14.7%)	3 (7.3%)	0 (0%)	0 (0%)
Your ability to control your life as you wish?	29 (70.7%)	10 (24.4%)	1 (2.4%)	1 (2.5%)	0 (0%)
Your ability to help others?	7 (17.1%)	15 (36.6%)	9 (22%)	7 (17.1%)	3 (7.2%)

regarding potential post-stroke cognitive deficits. This study has a number of limitations, for example, the sample size was relatively small, and it was only conducted in one city in Ireland. Consequently, it may difficult to generalise the results of this study to different countries.

In conclusion, this study found that the SIS conducted in the stroke review clinic identified cognitive deficits, which may not otherwise have been detected. By using SIS in a systematic, standardised way, deficits can be identified, so that further support and appropriate rehabilitation can be provided where necessary. These problems could be addressed if healthcare staff encouraged stroke survivors to participate in social activities involving other stroke patients. Further investigation of executive dysfunction following stroke is necessary to manage this problem in the early stages of rehabilitation. This research provides a base for future research in reviewing the current assessment tools employed to examine post-stroke cognitive deficits.

Conflict of interest

None.

REFERENCES

1) Lazar R, Festa J: Neurovascular neuropsychology. New York: Springer, 2011.

2) Sun JH, Tan L, Yu JT: Post-stroke cognitive impairment: epidemiology, mechanisms and management. Ann Transl Med, 2014, 2: 80. [Medline]

3) Patel M, Coshall C, Rudd AG, et al.: Natural history of cognitive impairment after stroke and factors associated with its recovery. Clin Rehabil, 2003, 17: 158–166. [Medline] [CrossRef]
4) Sundar U, Adwani S: Post-stroke cognitive impairment at 3 months. Ann Indian Acad Neurol, 2010, 13: 42–46. [Medline] [CrossRef]
5) Mellon L, Brewer L, Hall P, et al. ASPIRE-S study group: Cognitive impairment six months after ischaemic stroke: a profile from the ASPIRE-S study. BMC Neurol, 2015, 15: 31. [Medline] [CrossRef]
6) Nys GM, Van Zandvoort MJ, De Kort PL, et al.: Domain-specific cognitive recovery after first-ever stroke: a follow-up study of 111 cases. J Int Neuropsychol Soc, 2005, 11: 795–806. [Medline] [CrossRef]
7) Hyndman D, Pickering RM, Ashburn A: The influence of attention deficits on functional recovery post stroke during the first 12 months after discharge from hospital. J Neurol Neurosurg Psychiatry, 2008, 79: 656–663. [Medline] [CrossRef]
8) Espárrago Llorca G, Castilla-Guerra L, Fernández Moreno MC, et al.: Post-stroke depression: an update. Neurologia, 2015, 30: 23–31. [Medline]
9) Sörös P, Harnadek M, Blake T, et al.: Executive dysfunction in patients with transient ischemic attack and minor stroke. J Neurol Sci, 2015, 354: 17–20. [Medline] [CrossRef]
10) Cullen B, O'Neill B, Evans JJ, et al.: A review of screening tests for cognitive impairment. J Neurol Neurosurg Psychiatry, 2007, 78: 790–799. [Medline] [CrossRef]
11) Suzuki M, Sugimura Y, Yamada S, et al.: Predicting recovery of cognitive function soon after stroke: differential modeling of logarithmic and linear regression. PLoS One, 2013, 8: e53488. [Medline] [CrossRef]
12) Folstein MF, Folstein SE, McHugh PR: "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res, 1975, 12: 189–198. [Medline] [CrossRef]
13) Nasreddine ZS, Phillips NA, Bédirian V, et al.: The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc, 2005, 53: 695–699. [Medline] [CrossRef]
14) Duncan PW, Bode RK, Min Lai S, et al. Glycine Antagonist in Neuroprotection Americans Investigators: Rasch analysis of a new stroke-specific outcome scale: the Stroke Impact Scale. Arch Phys Med Rehabil, 2003, 84: 950–963. [Medline] [CrossRef]
15) Patchick E, Vail A, Wood A, et al.: PRECiS (Patient Reported Evaluation of Cognitive State): psychometric evaluation of a new patient reported outcome measure of the impact of stroke. Clin Rehabil, 2016, 30: 1229–1241. [Medline] [CrossRef]
16) Vellone E, Savini S, Fida R, et al.: Psychometric evaluation of the Stroke Impact Scale 3.0. J Cardiovasc Nurs, 2015, 30: 229–241. [Medline] [CrossRef]
17) Jenkinson C, Fitzpatrick R, Crocker H, et al.: The Stroke Impact Scale: validation in a UK setting and development of a SIS short form and SIS index. Stroke, 2013, 44: 2532–2535. [Medline] [CrossRef]
18) Guidetti S, Ytterberg C, Ekstam L, et al.: Changes in the impact of stroke between 3 and 12 months post-stroke, assessed with the Stroke Impact Scale. J Rehabil Med, 2014, 46: 963–968. [Medline] [CrossRef]
19) Carod-Artal FJ, Coral LF, Trizotto DS, et al.: The stroke impact scale 3.0: evaluation of acceptability, reliability, and validity of the Brazilian version. Stroke, 2008, 39: 2477–2484. [Medline] [CrossRef]
20) The rehabilitation measures database. Rehab Measures: Stroke impact scale. http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=934 (Accessed Aug. 7, 2017)
21) Pohjasvaara T, Erkinjuntti T, Ylikoski R, et al.: Clinical determinants of poststroke dementia. Stroke, 1998, 29: 75–81. [Medline] [CrossRef]
22) Kauhanen M, Korpelainen JT, Hiltunen P, et al.: Poststroke depression correlates with cognitive impairment and neurological deficits. Stroke, 1999, 30: 1875–1880. [Medline] [CrossRef]
23) Hackett ML, Anderson CS: Predictors of depression after stroke: a systematic review of observational studies. Stroke, 2005, 36: 2296–2301. [Medline] [CrossRef]
24) Burgess PW, Alderman N, Forbes C, et al.: The case for the development and use of "ecologically valid" measures of executive function in experimental and clinical neuropsychology. J Int Neuropsychol Soc, 2006, 12: 194–209. [Medline] [CrossRef]
25) Leśniak M, Bak T, Czepiel W, et al.: Frequency and prognostic value of cognitive disorders in stroke patients. Dement Geriatr Cogn Disord, 2008, 26: 356–363. [Medline] [CrossRef]
26) Zinn S, Bosworth HB, Hoenig HM, et al.: Executive function deficits in acute stroke. Arch Phys Med Rehabil, 2007, 88: 173–180. [Medline] [CrossRef]
27) Park KC, Yoon SS, Rhee HY: Executive dysfunction associated with stroke in the posterior cerebral artery territory. J Clin Neurosci, 2011, 18: 203–208. [Medline] [CrossRef]
28) Almalki O, Alshehri MA, El-Sodany AM, et al.: The awareness of healthcare staff towards post-stroke cognitive impairment: a cross sectional study. J Phys Ther Sci, 2018, 30: 883–887. [Medline] [CrossRef]