

Original Article

# The Relationship between Rehabilitation and Changes in Depression in Stroke Patients

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**Abstract.** [Purpose] This study investigated the primary factors behind changes in depressive symptoms among stroke patients after 8 weeks of rehabilitation (physical, occupational, and cognitive therapy). [Methods] This study was conducted using a literature review, and electronic medical records from January, 2008 to December, 2009. Data were collected for 120 subjects with chronic stroke. [Results] Cardiac disorder, left-brain lesion, early-stage depression, activities of daily living, and cognitive function were significant predictors of the changes in depression in chronic stroke patients. [Conclusion] Post-stroke depression can be controlled by rehabilitation. Also, clinicians should comprehend and share the psychological and physical affliction, develop back-up programs, and make them comprehensively available to support the psychological and physical health of subjects with chronic stroke.

**Key words:** Stroke, Rehabilitation, Depression

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## INTRODUCTION

Physical disability occurring due to stroke has a high cost, both socially and domestically. Most of the time, stroke occurs during senior years eliciting a big change in victims' social activity and independence, leading to a decrease in their physical ability<sup>1)</sup>. If subjects with stroke do not receive proper protection and support physically, psychologically, and socially, they may develop mental regression, depression, discouragement, or anxiety<sup>2)</sup>. These mental disorders of chronic stroke continue for a long period and affect stroke patients' quality of life<sup>3)</sup>. Nevertheless, stroke patients' social and psychological issues are typically underestimated by the medical professionals. Therefore, psychological treatment needs to be conducted together with physical treatment in order to improve patients' quality of life. Interest in post-stroke depression in Korea began 20 years ago, and various results on the relationship between the time stroke occurs and its effects on post-stroke depression have been reported<sup>4, 5)</sup>. However, research into the changes in depression still lacks quality and quantity. Clinicians who treat stroke acknowledge the existence of post-stroke depression, but they are most likely to treat it

as a simple physical/psychological symptom which can be taken care of with little effort or even be ignored. Accordingly, this present study examined the extent and necessity of rehabilitation treatments on change in depression for the reduction of psychological stress in chronic stroke patients in order to propose a basis for the establishment of effective rehabilitation planning.

## SUBJECTS AND METHODS

This study used the data of 120 subjects, diagnosed with stroke, who were undergoing rehabilitation therapy (30 minutes, 5 times a week, for 8 weeks) at a university hospital rehabilitation center located in Gyeonggi-do province, from January 2008 to December 2009. Subjects who had a history of mental disorders such as dementia, depression, and anxiety disorders, or were taking anti-depression medications, or had difficulties in communication were excluded from the study. The present study was supported by the Catholic University and approved by the Catholic University Institutional Review Board (Approval # CUMC10U026). All data were collected anonymously from electronic medical records.

We collected subjects' general characteristics such as sex, age, marital status, caregiver, type of insurance, and decision-maker; health-related characteristics such as smoking, alcohol consumption, diabetes, hypertension, cardiac disorder, hyperlipidemia, and history of pre-stroke; and disease-related characteristics such as lesion region, lesion type, duration of the onset of stroke, and whether the patient currently had depression. The clinical findings of

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each subject were measured before and after rehabilitation treatment for physical, functional, and cognitive function.

The Beck Depression Inventory (BDI) was developed by Beck<sup>6</sup>). It is a survey method which is commonly used to evaluate depression. It has 21 questions, each of which are answered on a 4 point Likert scale. In this study, it was used to assess the depression levels of subjects with chronic stroke. It has a cutoff score of 21 which has high validity and reliability,<sup>7</sup> higher scores signifying intensifying symptoms of depression.

For cognitive impairment assessment, we used the Mini-Mental State Examination (MMSE), which is also used to assess the cognitive impairment of patients with serious dementia<sup>8</sup>). In this study, we the used Mini-Mental State Examination-Korean (MMSE-K) to correspond to Korean reality, a tool consisting of 30 questions<sup>9</sup>). The intrarater reliability has an intraclass correlation coefficient (ICC) of 0.99<sup>10</sup>).

The Modified Barthel Index (MBI) was developed by Shah<sup>11</sup>). It has been shown to be a sensitive rating scale<sup>8</sup>). In this study it was used to assess subjects' performance of activities of daily living of the subjects with chronic stroke. We used the Korean Modified Barthel Index" (K-MBI) to correspond to Korean reality, a tool consisting of 10 questions. The intrarater and interrater of reliabilities have ICCs of are 0.89, and 0.95<sup>12</sup>), respectively.

All the results were divided into 2 categories of subjects, those showing >25% improvement, and those with less improvement after 8 weeks of rehabilitation.

The characteristics of the subjects are presented as frequencies and percentages. Analysis of variance (ANOVA) was conducted in order to examine the relevance between the changes in depression symptoms and the characteristics of the chronic stroke patients. Hierarchical multiple regression analysis was employed to uncover significant variations ( $p < 0.05$ ) in univariate analysis with respect to factors influencing the changes in post-stroke depression, and forced entry was utilized to identify predictive factors. The general and health-related characteristics of stroke were entered in the first step and the disease-related characteristics of the subjects in the next. Then each of the factors of whether subjects with chronic stroke had depression early, low or high improvement of ADL, and cognitive functions after 8 weeks of rehabilitation, were entered into the prediction model. Statistical analysis was performed using SPSS ver. 17.0.

## RESULTS

As shown in Table 1, after 8 weeks of rehabilitation, change in depression showed significantly positive associations with having had depression symptoms, while the relationship with lesion in the left brain was negative. Also, change in depression was significantly positively associated with improved ADL and cognitive functions. The results of hierarchical multiple regression analyses are presented in Table 2. The result of analyzing factors influencing the change in depression symptoms of chronic stroke by rehabilitation, and modifying factors in the final step, the overall model showed cardiac disorder, depression, and high improve-

**Table 1.** The factors associated with the change in depression of stroke patients

Variables	Characteristics	The change in depression Mean (SD)
Smoking	Yes	-1.07 (7.06)
	No	-2.04 (7.73)
Alcohol intake	Yes	1.20 (7.71)
	No	-2.00 (7.74)
Hypertension	Yes	-1.78 (7.74)
	No	-1.45 (6.96)
Diabetes mellitus	Yes	-1.63 (8.93)
	No	-1.68 (6.73)
Hyperlipemia	Yes	-0.89 (7.08)
	No	-1.89 (7.59)
Heart disease	Yes	-5.58 (6.69)
	No	-1.23 (7.44)
Pre-stroke history	Yes	-3.00 (5.55)
	No	-1.45 (7.73)
Duration after onset of stroke (month)	<3	-2.49 (7.71)
	3 ~ <6	1.00 (6.47)
	6 ~ <12	1.69 (7.84)
	≥12	-3.38 (5.32)
Lesion type	Infarction	-2.08 (7.53)
	Hemorrhage	-1.18 (7.55)
	Both	-3.00 (1.41)
	Left hemisphere	1.11 (6.64)
Lesion region*	Right hemisphere	-3.30 (7.65)
	Both	-1.29 (6.52)
	Etc. (brainstem & other)	-3.67 (11.5)
Depression** (before therapy)	Yes (>21)	-7.48 (7.03)
	No (≤21)	-7.48 (7.03)
Activities of daily living*	High	-3.40 (7.88)
	Low	-0.51 (6.99)
Cognitive function*	High	-6.21 (6.44)
	Low	-1.07 (7.41)

\*  $p < 0.05$ , \*\*  $p < 0.01$

ments in ADL and cognitive functions were significant predictors of change in depression.

## DISCUSSION

Previous studies of the frequency of post-stroke depression have reported small differences in the 20~60% range. In the present study, the frequency of post-stroke depression was 22.5%, lower than the 30% reported by other studies<sup>13, 14</sup>), because we used a cutoff score of 21 compared to 10 used in the other studies.

Post-stroke depression occasionally occurs in the chronic stage, 2~3 years following stroke<sup>15</sup>). Post-stroke depression aggravates neurological and psychological damage, adversely affecting performances on activities of daily living. Since depression increases the risk of suicide as well as raising the death rate, depression needs to be treated with

**Table 2.** Hierarchical multiple regression with the change in depression as the dependent variable

Variables	Characteristics	Model 1	Model 2	Model 3	Model 4	Model 5	
		$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	
General characteristics	Sex	Male	Ref.	Ref.	Ref.	Ref.	Ref.
		Female	-0.28	0.57	0.62	0.16	0.25
	Age (years)	<40	0.31	0.43	1.38	0.95	0.89
		40~64	Ref.	Ref.	Ref.	Ref.	Ref.
	Insurance	$\geq 64$	0.09	0.60	1.42	1.29	1.30
		General	Ref.	Ref.	Ref.	Ref.	Ref.
Automobile		4.50	3.04	5.45	4.96	4.50	
Health characteristics	Cardiac disorder	Industrial casualty	5.60	7.70	7.16	6.66	6.66
		Etc	-0.98	2.17	2.31	2.13	2.28
		Yes	Ref.	Ref.	Ref.	Ref.	Ref.
	Pre-stroke history	No	3.81	3.63	5.26*	5.50*	5.39*
		Yes	Ref.	Ref.	Ref.	Ref.	Ref.
	Disease characteristics	Duration after onset of stroke (month)	No	0.22	0.14	-0.70	-0.65
<3				Ref.	Ref.	Ref.	Ref.
3~<6				1.90	0.27	0.26	0.16
Lesion region		6~<12		5.04	3.42	3.16	3.07
		$\geq 12$		-1.38	-0.46	-0.71	-1.14
		Left hemisphere		Ref.	Ref.	Ref.	Ref.
Depression	Before therapy	Right hemisphere		-4.00*	-2.13	-2.22	-2.31
		Both		-5.11*	-5.11*	-5.05*	-4.98*
		Etc.		-8.31	-6.41	-5.62	-5.44
Activities of daily living	Degree of improvement	No			Ref.	Ref.	
		Yes			-7.15*	-6.60*	-6.37*
		Low				Ref.	Ref.
Cognitive function	Degree of improvement	High			-3.75*	-3.59*	
		Low				Ref.	
		High				-4.21*	
	R <sup>2</sup>	0.081	0.192	0.317	0.382	0.483	
	R <sup>2</sup> Change		0.111	0.125	0.065	0.101	
	F	1.22	1.78	3.22	3.16	2.98	

more care and interest in post-stroke rehabilitation<sup>16</sup>). Due to this situation, this research investigated factors that elicit changes in depressive symptoms among stroke patients after 8 weeks of rehabilitation, and compared how the related factors affected change in depression. After 8 weeks of rehabilitation, history of cardiac disorder, lesion in the left brain, early-stage depression, and higher improvement in activities of daily living and cognitive function were identified as factors influencing change in depression.

The factor that had the greatest influence on the change in depression elicited by rehabilitation was early-stage depression at the beginning of the treatment (12.5%). According to research, regular exercise or leisure activities reduced depression in elderly depressive patients, and increased their life satisfaction<sup>17, 18</sup>). However, another study didn't find any significant change in depression symptoms elicited by the physical therapy itself even though the subjects' depression scores reduced by a little<sup>19</sup>). Our present study focused on a broad spectrum of rehabilitation, i.e., physical performance of activities of daily living, and cognitive exercises, rather than physical exercise alone as in the previous study.

The improvement of cognitive function also influenced change in depression (10.1%). Andersen<sup>20</sup>) stated that disorder of cognitive function was the main reason for depression among stroke patients, since the patients who showed improvements in cognitive function also showed improvements in depression. Also, stroke patients who showed improvements in cognitive function in the 3 months following the onset of stroke showed greater improvements in their levels of depression<sup>21</sup>), a result similar to that of our present study. This implies that cognitive function has to be taken care of first in order to improve depression. However, many studies have reported that there is no correlation between depression and cognitive function<sup>22, 23</sup>).

The improvement of activities of daily living influenced change in depression (6.5%). Robinson<sup>24</sup>) conducted a 2 year follow-up study and reported that stroke patients who showed improvements in performance of activities of daily living showed improvements in depression, similar to the results of our present study. Other studies have reported that depression and activities of daily living show a correlation, since the stroke patients who had depression were more de-

pendent on others and had more severe psychological disorders than those who did not have depression<sup>25, 26</sup>). However, it has also been reported that there is no major correlation between depression and activities of daily living<sup>27</sup>).

Left brain lesion and cardiac disorder also influenced change in depression (11.1%). According to the study of Verdelho<sup>28</sup>), similar to the results of our present study, stroke patients who had severe damage in the left brain were more likely to have severe depression than patients who had damage in the other parts of the brain, and that stroke patients who had severe damage in the left-brain, right brain basal ganglia, or frontal pole were more likely to have severe depression than other patients<sup>26</sup>). However, a few studies have also reported that lesion region and post-stroke depression are not correlated<sup>29</sup>). In the present study, patients with cardiac disorder had a higher probability of having severe depression than the patients who did not. This result is supported by the findings of other studies, that patients with myocardial infarction and coronary disease have higher rates of depression<sup>30, 31</sup>). Nevertheless, Leentjens<sup>32</sup>) stated that there were no correlations between hypertension, diabetes, cardiac disorder, or smoking, etc with depression.

The limitations of this study were as follows. First, because our sampling consisted of patients limited to a single university hospital, the current findings cannot be generalized to all victims of stroke. Second, this study ruled out aphasia patients with stroke, since aphasia could have been caused by left brain lesion which could have affected our results. We need to include aphasia patients in a future study. Also, because the present study was conducted only for a short 8-week rehabilitation period, our results cannot be generalized until further studies on the long-term effects of rehabilitation on change in depression symptoms have been performed. Finally, we did not consider factors such as financial problem, social support, self-efficacy, and self-esteem. According to Aben<sup>33</sup>), depression in stroke has a great influence on psychological and environmental factors. The results of the present study are meaningful in that cognitive and physical and functional exercises improved the subjects' depressive symptoms. In addition, our results also provide objective data for studies of the relationship between depression and rehabilitation. To clarify the effectiveness of therapies for reducing post-stroke depression, further study addressing these limitations is needed

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