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Role of Intensive Inpatient Rehabilitation for Prevention of Disability after Stroke: The Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) Study



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Highlights

- This study provided current status of intensive rehabilitation treatment during subacute stage and functional outcome at chronic stage in the first-ever stroke patients in Korea.
- This information will be valuable for establishing comprehensive and systematic care system for stroke patients.

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Conflict of Interest

The authors have no potential conflicts of interest to disclose.

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ABSTRACT

The objective was to investigate the effects of the intensive inpatient rehabilitation treatment during subacute phase to reduce disabilities at chronic phase in patients with first-ever stroke. This study presents interim results of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO). Stroke patients who transferred to the rehabilitation department during the 1st hospitalization were classified into the intensive rehabilitation group, and the other stroke patients were classified into the nonintensive rehabilitation group. Disability grade at subacute phase and 6 months after stroke was defined using the Korean modified Barthel Index (K-MBI). The change of disability grade at chronic phase was analyzed by the intensive inpatient rehabilitation treatment. A total of 5,380 first-ever stroke patients were included in this analysis. Among these 5,380 patients, 1,162 and 4,218 patients were classified into the intensive rehabilitation group and the non-intensive rehabilitation group, respectively. The proportion of patients to improve the disability grade at 6 months after stroke was significantly higher in the intensive rehabilitation group than the non-intensive rehabilitation group with severe functional impairment at subacute phase ($p < 0.05$). This

study revealed that the intensive inpatient rehabilitation treatment during subacute stage could significantly improve the disability grade at chronic phase in first-ever stroke patients.

Keywords: Stroke; Rehabilitation; Disability; Independence; Cohort

INTRODUCTION

Stroke is a major cause of long-term disability and the leading preventable cause of disability in Korea as well as the world [1]. Disability after stroke can make a serious burden on patients, caregivers, and society [2]. As the prevalence of stroke increases by population ageing, the burden of disability is also to become an increasingly important public health concern [3]. Proper stroke healthcare services should be provided in order to reduce the burden of post-stroke disability [3]. The current best practice in stroke management is to reduce the initial impact, take precautions to avoid the complications, and to maximize functional level [4].

The well-organized, multidisciplinary inpatients care in a stroke patient rehabilitation unit is strong evidence to improve survival, recovery, and returning home compared with conventional wards during acute phase [3]. In addition, early stroke rehabilitation is known to be an effective and essential therapy in gaining functional independence and preventing complications [3,5]. Recent prospective studies on early rehabilitation treatment after stroke have proven its safety, efficiency, and efficacy toward functional recovery [6,7]. Therefore, transferring stroke patients with disabilities from an acute setting to an inpatient rehabilitation treatment is recommended as soon as they are medically stable [8]. In spite of these strong evidences in other countries, there are lack of studies regarding roles of the inpatient rehabilitation treatment to reduce the post-stroke disability in Korea.

In this study, we analyzed the current status of the intensive inpatient rehabilitation treatment and the incidence of disability after stroke in Korea using data of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) [9] to provide the useful information to establish the policy for disabled person after stroke. In addition, we investigated the effects of the intensive inpatient rehabilitation treatment during subacute phase to reduce the disability at chronic phase in patients with first-ever strokes.

MATERIALS AND METHODS

The Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO)

The KOSCO study is a 10-year long-term follow-up study of stroke patients using a prospective multi-center design investigating residual disabilities, activity limitation, and quality of life in patients who have suffered a first-ever stroke. While ischemic and hemorrhagic strokes are included, transient ischemic attacks are excluded. The detailed rationale and protocol of KOSCO was described in a previous article [9]. Written informed consent was obtained from all patients prior to inclusion in the study, and the study protocol was approved by the local ethics committee of each hospital.

To increase and maintain interrater reliability and accuracy, all raters in the KOSCO study underwent standardized training program at the beginning of and every 3 months during the

course of the study. The initial training program with a one-day workshop was performed three times before the enrollment. After the initial training program, only raters who passed the standardized examination for functional assessments including on-line tests of Korean modified Barthel Index (K-MBI) could participate in the data collection. The training program consisted of a one-day workshop in addition to one-to-one education by an experienced rater for one week. The same regulation applied to additional raters who participated in the data collection.

Selection of KOSCO participants

This study presents interim KOSCO study results, focusing on disability grade of first-ever stroke patients 6 months after onset. Data obtained from patients who were recruited to the KOSCO study group from August 2012 to January 2016 were analyzed in this study.

Stroke patients who transferred to the rehabilitation department after acute stroke care were classified into the intensive rehabilitation group, and the other stroke patients were classified into the non-intensive rehabilitation group. Baseline assessment was done at the day of transferring to the rehabilitation department and the day of discharge in the intensive rehabilitation group and the non-intensive rehabilitation group, respectively.

Disability grade at baseline and six months after stroke

In this study, functional outcome at baseline and six months after stroke was defined using the K-MBI [10]. The K-MBI assesses limitations in daily living activities, with scores ranging from 0 (completely dependent) to 100 (completely independent). MBI scores were stratified into seven disability grades according to the Korean brain disability grade criteria by Korean Ministry of Health and Welfare: Grade 1 disability group (K-MBI, 0–32); Grade 2 disability group (K-MBI, 33–53); Grade 3 disability group (K-MBI, 54–69); Grade 4 disability group (K-MBI, 70–80); Grade 5 disability group (K-MBI, 81–89); Grade 6 disability group (K-MBI, 90–96); and No disability group (K-MBI, 99–100).

Baseline stroke severity

Initial stroke severity was recorded using medical chart review at the time of hospital arrival based on the National Institute of Health Stroke Scale (NIHSS) [11] and Glasgow Coma Scale (GCS) [12] for ischemic and hemorrhagic strokes, respectively. In addition, NIHSS at day 7 was administered for total stroke patients.

Demographic and clinical characteristics of the patients

Data on clinical characteristics such as comorbidity and data on demographic characteristics such as age group, sex, educational level, and pre-stroke functional level were documented by the hospital staff during acute treatment. Comorbidity was assessed using the combined condition- and age-related score in the Charlson comorbidity index [13]. Educational level was asked and patients chose an answer from following options; elementary school graduate or less, middle school graduate, high school graduate, and Bachelor's degree or higher [14]. Pre-stroke functional level was assessed using modified Rankin scale [15]. The following comorbidities were recorded during admission to the hospital: hypertension (systolic blood pressure > 160 mmHg, diastolic blood pressure > 90 mmHg, or history of hypertension or medical treatment); diabetes mellitus (elevated blood glucose level > 126 mg/dL or history of diabetes or medical treatment); coronary heart disease (documented by standard ECG or coronary imaging study or history of coronary heart disease or medical treatment); atrial fibrillation (documented by standard ECG, long-term ECG, or history of atrial fibrillation or

medical treatment); and hyperlipidemia (elevated LDL cholesterol level > 160 mg/dL, elevated total cholesterol level > 240 mg/dL, or history of hyperlipidemia or medical treatment).

Statistical analysis

Descriptive statistics were used to provide information on patient demographic and clinical characteristics. An independent t-test was performed for the comparison of continuous variables between the intensive rehabilitation group and the non-intensive rehabilitation group. The χ^2 test was used for categorical variables. Results for the continuous variables are given as means (standard deviation), and those of the categorical variables are given as numbers (percentage). p values less than 0.05 were considered statistically significant. All analyses were performed using SPSS version 23.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

Study population

Between August 2012 and January 2016, from 10,636 stroke patients who provided informed consent, 8,010 stroke patients participated in this follow-up study which is a participation rate of 75.3% in the nine tertiary hospitals in Korea. 753 patients were expired until 6 months after stroke onset. A total of 5,384 patients were assessed at 6 months after stroke onset, and a follow-up rate was 76.6%. Of these 5,384 patients, 4 patients were excluded because of incomplete data. Therefore, a total of 5,380 first-ever stroke patients were included in the final analysis. Among these 5,380 patients, 1,162 and 4,218 patients were classified into the intensive rehabilitation group and the non-intensive rehabilitation group, respectively (Fig. 1).

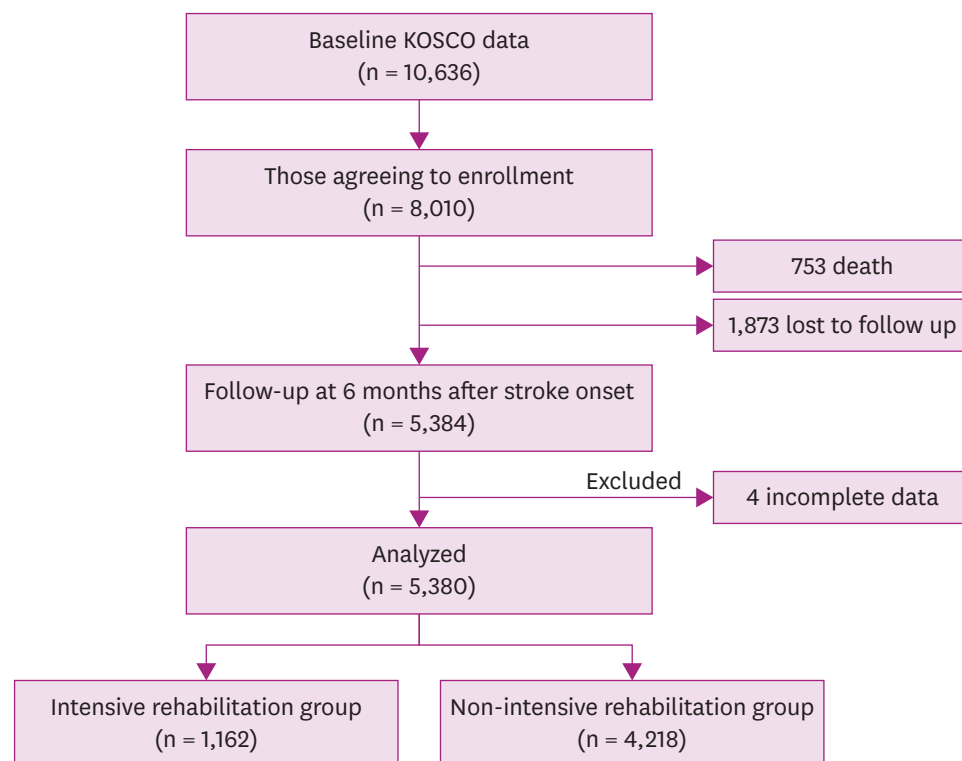


Fig. 1. Summary of the study population.

KOSCO, Korean Stroke Cohort for Functioning and Rehabilitation.

Current status of the intensive inpatient rehabilitation in the 1st hospitalization

Seventy-eight point nine percent of stroke patients were consulted to the rehabilitation department during the 1st hospitalization. The average duration of rehabilitation therapy was 20.5 minutes per working-day without transferring to the rehabilitation department. Only 21.6% of stroke patients were transferred to the rehabilitation department after acute stroke care. The average duration of rehabilitation therapy was 149.0 minutes per working-day after transferred to the rehabilitation department during hospitalization. There was a significant difference in the duration of rehabilitation therapy b transferring to the rehabilitation department ($p < 0.05$). Fig. 2 showed the current status of the intensive inpatient rehabilitation treatment in the 1st hospitalization according to the disability grade at baseline. According to the lower functional level, larger number of stroke patients were received the intensive inpatient rehabilitation therapy.

Demographic and clinical characteristics of the patients

The basic characteristics of the patients are presented in Table 1. From the subjects included in this study, 79.6% was diagnosed as ischemic stroke, and 20.4% was diagnosed as hemorrhagic stroke. The mean age of patients was 64.3 years, and the ratio of males to females was 1.42:1. There was no significant difference in age and sex between the intensive rehabilitation group and the non-intensive rehabilitation group. The educational level was significantly higher in the intensive rehabilitation group than the non-intensive rehabilitation group ($p < 0.05$). The proportion of hemorrhagic stroke patients was significantly higher in the intensive rehabilitation group than the non-intensive rehabilitation group ($p < 0.05$). Stroke severity at initial admission and day 7 was more severe in the intensive rehabilitation group than the non-intensive rehabilitation group ($p < 0.05$). The duration of total hospitalization was significantly longer in the intensive rehabilitation group than the non-intensive rehabilitation group ($p < 0.05$).

Disability grade at baseline and six months after stroke

Table 2 shows the change of disability grade in the intensive rehabilitation and the non-intensive rehabilitation groups. In each group, there was a significant improvement of the disability grade from baseline to 6 months after stroke onset ($p < 0.05$). The disability grade

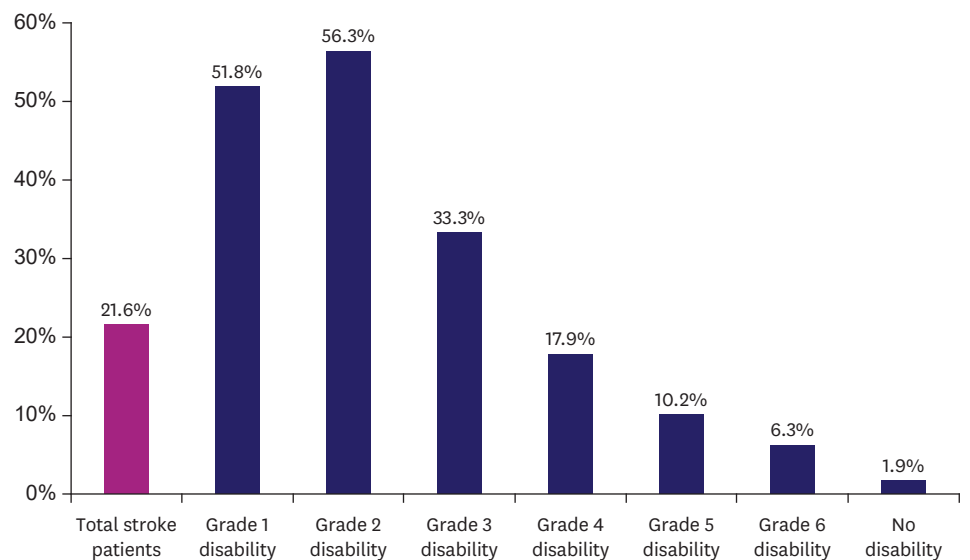


Fig. 2. Rate of the intensive inpatient rehabilitation treatment in the 1st hospitalization according to baseline functional level.

Table 1. Distribution of general and clinical patient characteristics

Variables	Total (n = 5,380)	Intensive rehabilitation group (n = 1,162)	Non-intensive rehabilitation group (n = 4,218)	p value
Stroke type (ischemic: hemorrhagic)	79.6:20.4	68.3:31.7	82.7:17.3	< 0.001*
Age (yr)	64.3 ± 13.0	64.1 ± 13.0	64.4 ± 13.0	0.497
Sex (male:female)	58.6:41.4	57.4:42.6	58.9:41.1	0.346
Body mass index	23.7 ± 3.3	23.5 ± 3.3	23.8 ± 3.3	0.040*
Educational level				0.018*
Elementary school graduate or less	32.9	30.8	33.5	
Middle school graduate	17.1	19.6	16.4	
High school graduate	29.7	31.0	29.4	
Bachelor's degree or higher	20.3	18.6	20.7	
Medical history				
Hypertension (yes)	54.8	58.5	53.8	0.004*
Diabetes mellitus (yes)	22.7	23.9	22.4	0.259
Coronary heart disease (yes)	6.4	5.9	6.5	0.394
Atrial fibrillation (yes)	9.4	9.1	9.5	0.673
Hyperlipidemia (yes)	13.8	15.4	13.4	0.083
CCAS	4.7 ± 1.6	4.8 ± 1.8	4.7 ± 1.6	0.687
Premorbid mRS (score)	0.2 ± 0.4	0.1 ± 0.3	0.2 ± 0.4	< 0.001*
NIHSS initial (score)	4.7 ± 5.2	7.7 ± 6.3	4.0 ± 4.6	< 0.001*
GCS initial (score)	13.0 ± 3.1	11.8 ± 3.7	13.6 ± 2.4	< 0.001*
NIHSS at day 7 (score)	4.3 ± 5.2	9.4 ± 8.4	2.9 ± 5.0	< 0.001*
Interval to transfer to REH (day)	16.3 ± 14.2	16.3 ± 14.2	-	-
Duration of REH hospitalization (day)	33.4 ± 24.4	33.4 ± 24.4	-	-
Duration of total hospitalization (day)	19.5 ± 25.8	50.1 ± 34.8	11.1 ± 13.5	< 0.001*

All values are expressed as mean ± standard deviation or percentage (%).

CCAS, combined condition- and age-related score; GCS, glasgow coma scale; NIHSS, National Institutes of Health stroke scale; mRS, modified rankin scale, REH, rehabilitation department.

*p < 0.05.

at baseline and 6 months after stroke onset was significantly improved in the intensive rehabilitation group than the non-intensive rehabilitation groups (p < 0.05).

Fig. 3 shows the improvement and worsening of disability grade from baseline to 6 months after stroke in each group. The proportion of stroke patients with the improvement of disability grade in the intensive rehabilitation and the non-intensive rehabilitation groups was 73.2% and 52.0%, respectively. Results indicate that the intensive rehabilitation treatment during subacute phase would give 21.2% higher chance to improve the disability compared to non-intensive rehabilitation treatment in stroke patients. The proportion of stroke patients who maintained disability grade in the intensive rehabilitation and the non-intensive rehabilitation groups were 23.7% and 43.3%, respectively. The proportion of stroke patients with worsened disability grade was 3.1% and 4.7% in the intensive rehabilitation and the non-intensive rehabilitation groups, respectively. This indicates the intensive rehabilitation during subacute phase would have 1.6% lower chance to worsen the disability compared to non-intensive rehabilitation in

Table 2. Change of disability grade from baseline to 6 months after stroke onset

Disability grade	Total (n = 5,380)		Intensive rehabilitation group (n = 1,162)		Non-intensive rehabilitation group (n = 4,218)	
	Baseline	6 mon	Baseline	6 mon	Baseline	6 mon
Grade 1	911 (16.9)	475 (8.8)	472 (40.6)	439 (18.0)	209 (10.4)	266 (6.3)
Grade 2	483 (9.0)	247 (4.6)	272 (23.4)	211 (10.2)	119 (5.0)	128 (3.0)
Grade 3	438 (8.1)	198 (3.7)	146 (12.6)	292 (9.6)	111 (6.9)	87 (2.1)
Grade 4	722 (13.4)	274 (5.1)	129 (11.1)	593 (9.2)	107 (14.1)	167 (4.0)
Grade 5	805 (15.0)	311 (5.8)	82 (7.1)	723 (9.8)	114 (17.1)	197 (4.7)
Grade 6	521 (9.7)	424 (7.9)	33 (2.8)	488 (11.4)	132 (11.6)	292 (6.9)
No disability	1,500 (27.9)	3,451 (64.1)	28 (2.4)	1,472 (31.8)	370 (34.9)	3,081 (73.0)

Values are presented as number (%).

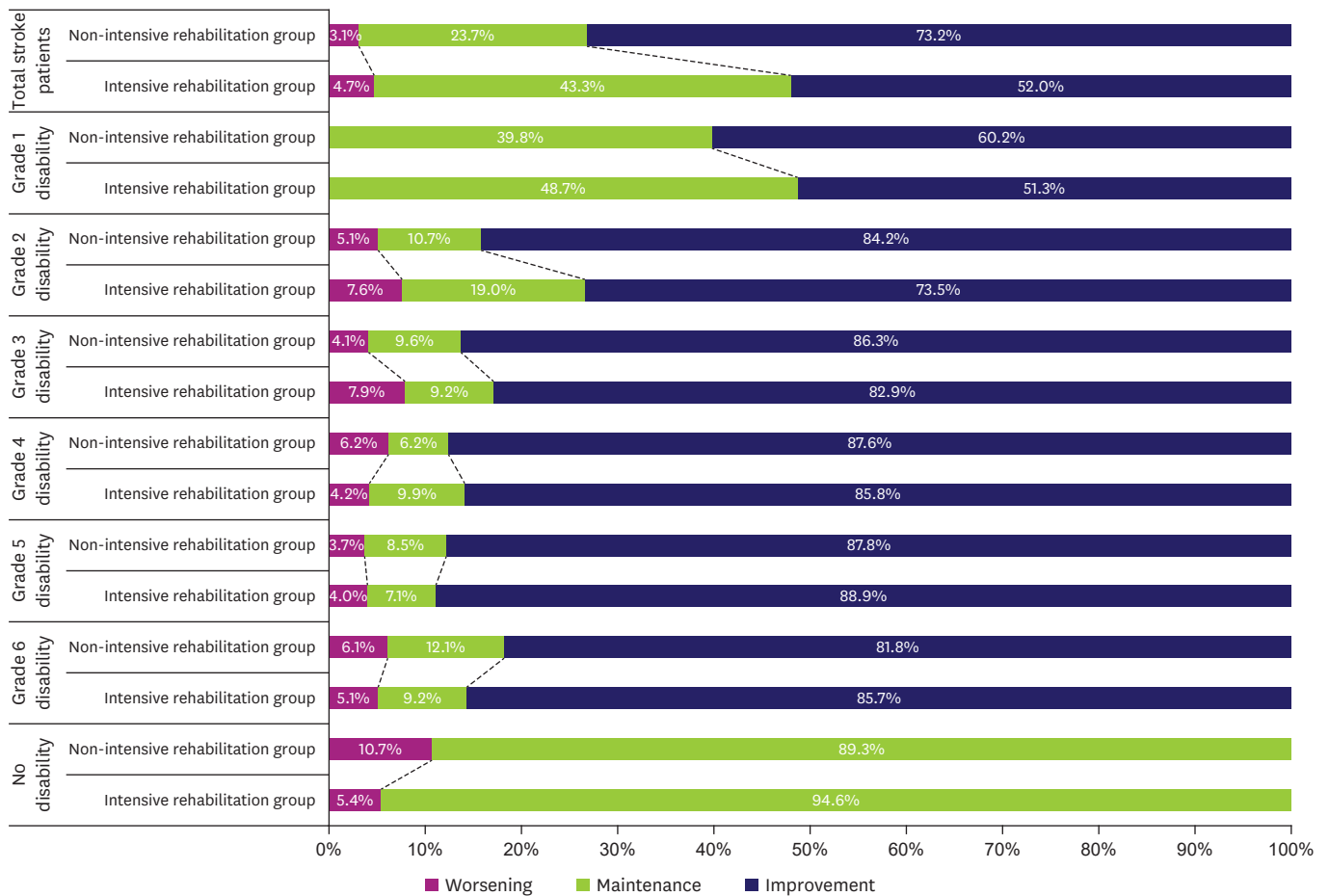


Fig. 3. Change of disability grade from baseline to 6 months after stroke onset according to baseline functional level.

stroke patients. There was a significant difference in the change of disability grade between the intensive rehabilitation and the non-intensive rehabilitation groups in total stroke patients ($p < 0.001$). Especially, there was a significant difference in the change of disability grade between the intensive rehabilitation and the non-intensive rehabilitation groups in stroke patients with grade 1 and 2 disability at baseline ($p = 0.007$ and $p = 0.014$).

DISCUSSION

This study demonstrated the current status of the intensive inpatient stroke rehabilitation treatment during the 1st hospitalization in Korea. This study also revealed that the intensive inpatient stroke rehabilitation treatment during subacute phase could significantly improve the disability grade and prevent the worsening of disability grade in chronic stroke phase with severe functional dependency at subacute phase.

Many stroke survivors are left with sequelae to some degree [2]; however, there was a lack of studies to report the proportion of patients with disability after stroke in Korea. The present results showed that 35.9% of stroke survivors were having some degree of disability at 6 months after onset. Especially, 13.4% of stroke survivors belonged to the grade 1 or 2

disability at 6 months after stroke. The study results provide the important information to establish the policy for disabled person after stroke. The higher functional dependency in stroke patients is likely to be more burdens to caregivers and society [2]. In this study, 73.2% of stroke patients showed the improvement of disability grade at 6 months after the intensive inpatient rehabilitation treatments, however, only 52.0% of stroke patients showed the improvement without the intensive inpatient rehabilitation treatment. In addition, there were significant effects of the intensive inpatient rehabilitation treatments to improved the disability grade in stroke patients with higher functional dependency at subacute phase. This study results support that subacute stroke patients with low functional independency should be provided with the proper inpatient rehabilitation treatments. In spite of these results, a large proportion of stroke patients were not received the intensive inpatient rehabilitation treatments in the 1st hospitalization in Korea. Therefore, proper guidelines for transferring optimal candidates from acute care setting to inpatient rehabilitation service should be developed for stroke care system.

The comprehensive rehabilitation therapy is the current best practice in stroke management to reduce the initial impact and to maximize functional capability [4]. Transferring to the rehabilitation department means that the intensive inpatient rehabilitation service can be provided to stroke patients in Korea. Chang et al. [16] reported that only 12.9% of stroke patients were transferred to the rehabilitation department between January 2008 and December 2009 in three tertiary hospital of Korea. In the present study, the transfer rate was 21.6% which is higher than previous study [16]. The increased rate in this study may reflect the improvement of stroke care quality during the past several years in Korea. However, among stroke patients with grade 1 disability at subacute phase, 48.2% did not receive intensive inpatient rehabilitation treatment during their 1st hospitalization, and 48.7% of these patients maintained or worsened their disability grade at chronic phase. In addition, among 43.7% of stroke patients who belonged to the grade 2 disability at subacute phase, 26.5% maintained or worsened disability grade at chronic phase. The duration of hospitalization was significantly longer in the intensive rehabilitation group than the non-intensive rehabilitation group. In addition, the educational level in the intensive rehabilitation group was significantly higher than the non-intensive rehabilitation group. The educational level could be used as an indicator of socioeconomic status [17]. Additional medical cost for intensive inpatient rehabilitation treatments or unawareness of importance of rehabilitation treatment might prevent them receiving intensive rehabilitation treatment in stroke patients with low socioeconomic status. Therefore, financial support of rehabilitation treatment cost within the social welfare system would be a good strategy for stroke patients to participate in rehabilitation treatment program because total social burden for taking care of disability became higher if patients' residual disabilities are severe or worsened. Further economical analysis could provide better evidence to establish the stroke rehabilitation system in patients with low socioeconomic status.

A strict definition should be needed for the history of hypertension in KOSCO study, because the acute hypertensive response is very common in acute stroke period [18]. The definition of hypertension in this study was 160/90 which is similar to acute stroke registry such as the Korean Stroke Registry [19] and the Framingham Cohort [20].

There are several limitations in this study. First, we used the disability grade according to the Korean brain disability grade criteria by Korean Ministry of Health and Welfare because one of the objectives in this study was to provide the useful information to establish the stroke

care policy in Korea. However, this stratification system is not commonly used in research with stroke patients. This is one of the limitations in this study. The intensive rehabilitation treatment was defined as transferring to the rehabilitation department after acute stroke care. This definition is very simple to classify stroke patients into two groups and there was a significant difference in the amount of rehabilitation treatment between the two groups. In addition, the proper education for stroke patients and caregivers could be usually provided during the hospitalization. Therefore, the intensive rehabilitation treatment can be defined as this study defined in Korean stroke research. However, this definition cannot be generalized in other countries with different stroke medical care system. Some characteristics at baseline showed significant differences between the two groups. These differences could influence on the disability grade at chronic stroke phase. Characteristics of medical care after the 1st hospitalization also could affect the disability grade at chronic stroke phase. Further study utilizing multi-factor analysis will be needed to clarify these limitations. We collected data from the tertiary hospitals which might not be fully reflected the general characteristics of Korean stroke patients.

In spite of these limitations, this study provided current status of intensive inpatient rehabilitation treatment during subacute stage and functional outcome at chronic stage in the first-ever stroke patients in Korea. This information will be valuable to establish comprehensive and systematic care system for stroke patients. It is necessary to develop standardized clinical practice guidelines for intensive inpatient rehabilitation care of stroke patients to improve disability grades.

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