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Effects of Interprofessional Nurse-led Rehabilitation Intervention Program for Subacute Stroke Patients and their Caregivers: a non-randomized study

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Abstract

Purpose: *Rehabilitation nursing requires an interdisciplinary comprehensive team approach that allows for enough time to promote patients' functional recovery. We identified the effects of a nurse-led rehabilitation intervention program on subacute stroke patients' activities of daily living, anger, and muscle strength, as well as their chief caregivers' satisfaction.* ***Methods:*** *Intervention group participants (n = 20) completed a rehabilitation intervention program, which integrated physical activities with psychological and social approaches.* ***Results:*** *The program did not significantly improve patients' activities of daily living or anger management; however, it significantly affected both anger-in (t = 3.384, p = .002) and anger-out (t = 2.167, p = .037) attitudes. Caregivers' satisfaction among the intervention group (t = 6.935, p < .001) decreased more significantly than that of the comparison group (t = 0.224, p = .825).* ***Conclusion:*** *Rehabilitation intervention program should enlist nurses' participation and promote a team-based approach during the rehabilitation program. Further, patients and their caregivers should be encouraged to express their emotions during counseling.*

Keywords: *Activities of daily living, Anger, Caregivers, Nursing, Stroke*

1. INTRODUCTION

1.1 Component

The stroke prevalence rate among Koreans aged 50 years or older is also on the rise—increasing from 1.3 in 2012 to 1.8% in 2017 [1]. Thanks to improved treatment for acute stroke patients and control of risk factors, the annual death rate caused by cerebrovascular disease decreased from 51.1 per 100,000 in 2012 to 44.4 in 2017 [2]. The increased survival rate and the advancement of medical techniques means that treatment and nursing for stroke patients is vital [3].

After a stroke, many patients experience physiological symptoms, such as hemiplegia, dysarthrosis, dysdipsia, dysphagia, and dysesthesia as well as cognitive disorders. The emotional changes that stroke patients experience affect not only the patients themselves but also their family members as well as others. Patients

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often express their feelings in an inappropriate way as they fail to control annoyances and anger caused by their physical impairment [4]. One survey conducted with 114 patients with acute stroke sought to identify whether patients were likely to vent anger after the onset of a stroke, revealing that 21 (18%) showed an anger control disorder after the stroke [5]. Adapting to rehabilitation and waiting to recover one's physical functions after causes varied types of stress, which can turn into negative emotions like anger or depression. This may cause a vicious cycle as these negative emotions make conflict with others more likely, thus exacerbating the stress.

Due to the aftereffects of a stroke, family members of the patients typically shoulder most of the burden and responsibility; therefore, the family member who plays the role of chief caregiver may experience significant physical, mental, psychological, and financial hardships [6]. Such burdens include support, searching for solutions, and patients' character changes including loss of motivation for treatment. The nature of the disease makes it difficult for patients to independently maintain their daily lives, thus making it challenging for their major caregiver to engage in social activities [7]. Moreover, if patients require long-term treatment, caregivers' burden hampers patients' recovery and both parties' quality of life [8].

Consequently, researchers have examined the activities of daily living (ADL) of subacute stroke patients. According to the research conducted by Franceschini et al. [9], upper limb function is basis of delicate activities such as eating, wearing, hygiene management, and thus promoting independent daily activities of stroke patients through the recovery of upper limb function. In addition, In the previous study, ADL was significantly positive correlated with self-esteem of the stroke patients [10] and there was a negative correlation with caregiver's burden [11].

Therefore, cooperative approaches among various experts, like physiatrists, rehabilitation nurse specialists, physical therapists, occupational therapists, speech therapists, and voluntary workers, are necessary for rehabilitation interventions, as is education for patients and their caregivers [12]. As such, rehabilitation nursing requires an interdisciplinary comprehensive team approach that allows for enough time to promote patients' functional recovery [13]. Consequently, patients are recommended to complete rehabilitation interventions continuously in a patient room. Specifically, the subacute period is when patients experience neuroplasticity within six months after the onset of the stroke; therefore, rehabilitation should be conducted more intensely [14].

Studies addressing the rehabilitation process after a stroke have mostly focused on early rehabilitation programs, like passive articulation exercises in the intensive care unit after surgery [15] or visiting care services for chronic patients who have left the hospital [16]. Therefore, it is necessary to develop a rehabilitation program that can be maintained in patients' rooms during the subacute period, can support both physical and emotional recovery, and can offset caregivers' burden. In hospitals, there is a dire need for such subacute rehabilitation programs where both patients and their caregivers have continual access. In addition, the program should address how differences in patients' ability to perform ADL affect caregivers' burden. Consequently, we identified the effects of an interprofessional NUrse-led Rehabilitation Intervention (NURI) program, which consisted of a self-training card that was tailored for subacute stroke patients, to enhance their ADL ability and physical strength and promote counselling and education for patients and their families.

2. MATERIAL AND METHODS

2.1 Design

This quasi-experimental study employed a non-equivalent comparison group pre-post test design (see Table 1). Randomization was not performed because all participants admitted the same ward in one hospital and there were limited resources and ethical considerations.

2.2 Participants and recruitment

A convenience sample of 40 subacute patients without severe limbs motor impairment participated in this study with the non-randomized, non-controlled design. The sample size was estimated using G*Power analysis

program for repeated-measure ANOVA [17]. The sample size was determined to be 34 samples for both groups for repeated measures, at a significance level of .05, correlation of .50, effect size of 0.50, and power of 80%. The effect size was set to the medium size proposed by Cohen [18]. Considering a drop-out rate of 20%, the final required sample size was estimated to 42 participants. Participants included stroke patients who had been admitted for rehabilitation at G University Hospital, located in J City, South Gyeongsang Province during the research period and their caregivers in Korea. Participants' inclusion criteria comprised subacute stroke adult patients aged ≥ 20 years who were receiving active treatment at a rehab center after showing internal physical stability after a stroke. Potential participants also must have understood the purpose of the study and research questions and agreed to participate. Individuals with a cognitive or communication disorder, a severe mental disorder, or those who did not agree to participate were excluded. A total of 40 samples were used for data analysis, and participants comprised 40 individuals (intervention group, n = 20; comparison group, n = 20). Because of the nature of the intervention, neither the patients nor the nurses were blinded to the patient's group assignment. However outcome assessors and data analysts were blinded.

Table 1. Research study design

Group	Pre test (Week 0)	Post test (Week 4)	Pre test (Week 0)	Program (4 weeks)	Post test (Week 4)
Intervention			I1	X	I2
Comparison	C1	C2			

Notes: C1, I1: General characteristics, activities of daily living performance, anger, muscle strength, caregiving satisfaction; C2, I2: activities of daily living ability, anger, muscle strength, caregiving satisfaction; X: Application of the NURI program.
Abbreviations: Intervention group (I), Comparison group (C).

2.3 Instruments

We used a structured survey comprising 50 questions: 24 Korean State-Trait Anger Expression Inventory (STAXI-K) questions, 16 Caregiver Satisfaction Scale (CSS) questions, and 10 general questions. An occupational therapist directly measured patients' ADL ability using 10 questions from the Korean version of Modified Barthel Index (K-MBI) and a physician directly measured muscle strength through manual muscle testing (MMT). Additional NURI program details are also shown in Table 2.

2.3.1 ADL Performance

To measure ADL performance, we used the K-MBI [19], which is the Korean standardized version of the fifth edition of the MBI [20,21]. The K-MBI consists of ten evaluation categories: personal hygiene, bathing, eating, excretion, going up the stairs, wearing clothes, controlling urination/excretion; walking (wheelchair), and moving to chair/bed. At development, the Cronbach's α of the MBI was .87; the Cronbach's α of the K-MBI was reported as .84 [19]; and, in this study, Cronbach's α was .86.

2.3.2 Anger

To measure patients' anger, we used the revised version of the STAXI-K, which Spielberger [22] originally developed and Chon [23] modified and translated into Korean. It comprises 24 questions measured on a 4-point Likert scale: 8 questions address "anger-in," which measures the pain and stress a patient feels internally (instead of venting); 8 questions address "anger-out," which measures the degrees that a patient verbally or physically attacks himself/herself or others and how the patient directly expresses his/her anger; and 8 questions address "anger control," which measures the strategies a patient uses to make himself/herself calm

or if they attempt to resolve a problem in an appropriate way.

2.3.3 MMT

An MMT [24] was used to differentiate patients' muscle strength. Scores are categorized across five levels per physicians' assessment of patients' muscle strength in their shoulders, elbows, wrists, and knees: 0 = "no muscular contraction" to 5 "the patient can do active and normal joint exercises, even with gravity and enough resistance." In other words, higher scores indicate greater muscle strength.

2.3.4 CSS

The CCS measures the overall positive emotions that the chief caregivers feel while taking care of their patients. We used the CCS that was translated into Korean by Son [25], which consists of 16 questions measured using a 4-point Likert scale from 1 (totally disagree) to 4 (totally agree); higher scores indicate greater caregiver satisfaction. Cronbach's αs for the Korean versions and in this study were .90, and .93 respectively.

2.3.5 General characteristics

Patients' general characteristics consisted of 10 questions addressing their sex, age, education, medical history, lesions, cognitive function, ADL performance, disease development period, relationship with their chief caregiver, and living arrangement.

2.3.6 Intervention: NURI program

The intervention was designed to increase the rehabilitation strategies including ADL performance training and ROM exercises with self-exercise cards; self-management education; and family counselling. The framework of the intervention was derived from the theoretical and empirical literature related to interprofessional rehabilitation (see Table 2). The rehabilitation training cards were accompanied by the motion instruction including a series of photographs and explanations text tailored specifically for each patient's degree rehabilitation to ensure their adherence.

Table 2. NURI program for the stroke patients and their caregivers

Session	Goal	Contents	Duration (minutes)
Admission	Program introduction Examining patients' general characteristics	Introducing the NURI program including the personalized rehabilitation training cards, family counseling, and self-management education Measuring patients' present health status—K-MBI, STAXI-K, and MMT—and caregivers' satisfaction	50
1 week	Selecting and applying patients' personalized rehabilitation training cards Reinforcement of program performance through counseling & education	Selecting the personalized rehabilitation training cards Explaining and demonstrating the ROM exercises and AD: performance training to the patients and their caregivers using the training cards Checking the performance of training cards daily Family counseling Education on self-management Encouraging implementation and requests for cooperation in rehabilitation care programs using the training cards	50
2 weeks	Selecting and applying patients'	Selecting the personalized rehabilitation training cards Explaining and demonstrating the ROM exercises and	50

	personalized rehabilitation training cards Reinforcement of program performance through education	ADL performance training to the patients and their caregivers using the training cards Checking the performance of training cards daily Education on self-management Checking the performance of the NURI program (ROM exercises and ADL training) using the training cards Encouraging implementation and requests for cooperation in rehabilitation care programs using the training cards	
3 weeks	Selecting and applying patients'' personalized rehabilitation training cards Reinforcement of program performance through education	Selecting the personalized rehabilitation training cards Explaining and demonstrating the ROM exercises and ADL performance training to the patients and their caregivers using the training cards Checking the performance of training cards daily Education on self-management Checking the performance of the NURI program (ROM exercises and ADL training) using the training cards Encouraging implementation and requests for cooperation in rehabilitation care programs using the training cards	50
4 weeks	Selecting and applying patients' personalized rehabilitation training cards Reinforcement of program performance through counseling & education	Selecting the personalized rehabilitation training cards Explaining and demonstrating the ROM exercises and ADL performance training to the patients and their caregivers using the training cards Checking the performance of training cards daily Family counseling Education on self-management Checking the performance of the NURI program (ROM exercises and ADL training) using the training cards Encouraging implementation and requests for cooperation in rehabilitation care programs using the training cards	50
Completion	Program completion and evaluation	Measuring patients' present health status—K-MBI, STAXI-K, and MMT—and caregivers' satisfaction.	50

Abbreviations: Korean version of Modified Barthel Index (K-MBI), Korean State-Trait Anger Expression Inventory (STAXI-K), Manual muscle testing (MMT), Nurse-led rehabilitation intervention (NURI), Range of motion (ROM); activities of daily living (ADL).

2.4 Data collection

Data were collected from August 6, 2016 to June 30, 2017. We acquired approval from the institutional review board of G University Hospital, a tertiary hospital with 900 beds, which is in Jinju City, South Gyeongsang Province (GNUH 2016-06-012-002) prior to conducting this study. Considering ethics, we provided the participants with a full explanation of the necessity and purpose of this research, its benefits, their ability to cease participation, data collection methods, and the amount of time the study would take to complete. We asked participants to voluntary complete the self-reported survey after receiving written consent.

2.5 Statistical Analysis

Data were analysed using SPSS 21.0, and significance was set at $p < .05$. Shapiro-Wilk normality test was used to test the normality of the outcome variables. First, the general characteristics, disorder-related characteristics, ADL performance level, anger management, muscle strength, and caregiving satisfaction of

the intervention and comparison groups were analysed based on frequency, percentage, mean, and standard deviation; second, chi-square tests, Fisher's exact tests, and independent t-tests were conducted to test the homogeneity of participants' general and disorder-related characteristics and research variables; third, paired t-tests, independent t-test, and repeated measures ANOVA were conducted to compare the effectiveness of the NURI program between groups; and, fourth, the credibility of the survey as measuring the caregivers' satisfaction was analysed with Cronbach's α.

3. RESULTS

A total of 75 stroke patients were eligible to participate in the NURI program. Of those, 45 patients enrolled in the study. The 45 patients were assigned either to the intervention group (n= 23), or to the conventional group (n=22). Two withdrew from the study just after assignment because they were transferred to the other hospitals. One participant in the intervention group and two in the conventional did not return the post-intervention questionnaire giving no specific reasons. The five drop-outs did not differ significantly from the other participants at baseline.

There were no significant differences between groups regarding general and disease-related characteristics, and homogeneity was achieved (see Table 3). Although the intervention group scored higher than the comparison group on ADL ability and lower on shoulder and wrist flexion as well as chief caregivers' satisfaction, these results were non-significant (see Table 4).

Table 3. Homogeneity of baseline demographic, stroke, and clinical variables (N = 40)

Variables		Total (N = 40)	Comparison group (n = 20)	Intervention group (n = 20)	χ^2	*p*
		n (%)	n (%)	n (%)		
Sex	Male	23 (57.5)	11 (55.0)	12 (60.0)	0.102	.749
	Female	17 (42.5)	9 (45.0)	8 (40.0)		
Education	None	2 (5.0)	2 (10.0)	0	6.387	.172
	Primary	16 (40.0)	8 (40.0)	8 (40.0)		
	Middle	2 (5.0)	2 (10.0)	0		
	High	13 (32.5)	5 (25.0)	8 (40.0)		
	≥ College	7 (17.5)	3 (15.0)	4 (20.0)		
Marital status	Single	2 (5.0)	0	2 (10.0)	5.999	.112
	Married	29 (72.5)	16 (80.0)	13 (65.0)		
	Divorced	2 (5.0)	0	2 (10.0)		
	Bereaved	7 (17.5)	4 (20.0)	3 (15.0)		
Age (years)	40–59	13 (32.5)	4 (20.0)	9 (45.0)	4.707	.095
	60–69	14 (35.0)	10 (50.0)	4 (20.0)		
	≥ 70	13 (32.5)	6 (30.0)	7 (35.0)		
Stroke type	Hemorrhage	15 (38.5)	8 (40.0)	7 (36.8)	2.996	.224
	Infarct	22 (56.4)	10 (50.0)	12 (63.2)		
	Trauma	2 (5.1)	2 (10.0)	0		
Chief caregiver	Spouse	24 (60.0)	13 (65.0)	11 (55.0)	4.403	.111
	Child	13 (32.5)	7 (35.0)	6 (30.0)		
	Sibling	3 (7.5)	0	3 (15.0)		

Abbreviations: number of participants (n), Chi-squared (χ^2).

3.1 Feasibility

The four-week program was well-received and well-tolerated based on participants' comments, their regular attendance, and the low attrition rate. Participants were able to engage in the intervention without undue frustration and discuss their experiences on the weekly sessions.

Table 4. Homogeneity of baseline research variables (N = 40)

		Comparison group (n = 20)		Intervention group (n=20)		Test statistic	*p*
		mean (sd)	95% CI	mean (sd)	95% CI		
Activities of daily living (K-MBI)		43.80 (30.02)	[30.6, 57.0]	45.85 (18.35)	[37.8, 53.9]	0.261[a)]	.796
Anger (STAXI-K)	Anger-in	16.90 (5.36)	[14.5, 19.3]	14.55 (3.22)	[13.1, 16.0]	1.681 [a)]	.103
	Anger-out	18.15 (3.77)	[16.5, 19.8]	16.95 (4.17)	[15.1, 18.8]	0.954 [a)]	.346
	Anger-control	20.30 (3.92)	[18.6, 22.0]	20.85 (4.48)	[18.9, 22.8]	0.413 [a)]	.682
Muscle strength (MMT)	Shoulder flexion	3.60 (1.57)	[2.91, 4.29]	3.15 (1.35)	[2.56, 3.74]	0.973 [a)]	.337
	Wrist flexion	3.70 (1.69)	[2.96, 4.44]	2.95 (1.73)	[2.19, 3.71]	1.387 [a)]	.174
	Knee flexion	3.70 (1.38)	[3.10, 4.30]	3.65 (1.39)	[3.04, 4.26]	0.114 [a)]	.910
	Ankle flexion	3.45 (1.60)	[2.75, 4.15]	3.95 (1.54)	[3.28, 4.63]	1.006 [a)]	.321
Caregiving satisfaction (CSS)		49.20 (10.52)	[44.6, 53.8]	45.90 (8.56)	[42.1, 49.6]	1.088 [a)]	.283

Notes: [a)]t value resulted from independent t test.
Abbreviations: standard deviation (sd), confidence interval (CI), Korean version of Modified Barthel Index (K-MBI), Manual muscle testing (MMT), Korean State-Trait Anger Expression Inventory (STAXI-K), Caregiver Satisfaction Scale (CSS).

3.2 Effect of the NURI program

Table 5 illustrate the ADL changes after the intervention among both groups. Both comparison and intervention groups showed a significant improvement in ADL performance before and after the intervention, and there was no significant difference between groups.

Table 5. Comparison of activities of daily living between groups (N = 40)

	Pre-test		Post-test		Post-pre		Test statistic		d
	mean (sd)	95% CI	mean (sd)	95% CI	mean (sd)	95% CI			
Comparison group (n = 20)	43.80 (30.02)	[30.6, 57.0]	62.30 (30.73)	[48.8, 75.8]	18.50 (17.51)	[10.8, 26.2]	4.725a)**	0.585[b)]	0.18
Intervention group (n = 20)	45.85 (18.34)	[37.8, 53.9]	67.00 (18.55)	[58.9, 75.1]	21.15 (10.23)	[16.7, 25.6]	9.246a)**		

Notes: [a)]t value resulted from paired t test. [b)]repeated measures ANOVA. ***p* < .001.

Abbreviations: standard deviation (sd), confidence interval (CI), Cohen's d as effect size (d) (small (0.2), medium (0.5), large (0.8) effect).

Table 6 shows changes in anger-in, anger-out, and anger control for both comparison and intervention groups. After the program, the anger-in and anger-out scores of the comparison group decreased more significantly than that of the intervention group. However, there was only a near-significant change in anger control after the intervention. The results of the non-synchronized comparison between groups also showed a significant difference in both anger-in and anger-out (but not anger control).

Table 6. Comparisons of anger between groups (N = 40)

		Pre test		Post test		Post-Pre		Test statistic		d
		mean (sd)	95% CI	mean (sd)	95% CI	mean (sd)	95% CI			
Anger-in	Comparison group (n = 20)	16.90 (5.36)	[14.5, 19.3]	16.25 (5.97)	[13.6, 18.9]	-0.65 (6.59)	[-3.54, 2.24]	0.441[a)]	3.384[b)]*	1.07
	Intervention group (n = 20)	14.55 (3.22)	[13.1, 16.0]	10.90 (3.78)	[9.24, 12.6]	-3.65 (3.30)	[-5.1, -2.2]	4.951[a)]**		
Anger-out	Comparison group (n = 20)	18.15 (3.77)	[16.5, 19.8]	17.70 (5.71)	[15.2, 20.2]	-0.45 (4.74)	[-2.53, 1.63]	-0.425[a)]	2.167[b)]*	0.69
	Intervention group (n = 20)	16.95 (4.17)	[15.1, 18.8]	14.20 (4.42)	[12.3, 16.1]	-2.75 (3.81)	[-4.42, -1.08]	3.228[a)]*		
Anger-control	Comparison group (n = 20)	20.30 (3.92)	[18.6, 22.0]	18.90 (5.88)	[16.3, 21.5]	-1.40 (3.12)	[-2.77, -0.03]	2.008[a)]	2.005[b)]	0.63
	Intervention group (n = 20)	20.85 (4.47)	[18.9, 22.8]	22.75 (6.25)	[20.0, 25.5]	1.90 (6.22)	[-0.83, 4.63]	1.367[a)]		

Notes: [a)]t value resulted from paired t test. [b)]repeated measures ANOVA. *$p < .05$. **$p < .001$.
Abbreviations: standard deviation (sd), confidence interval (CI), Cohen's d as effect size (d) (small (0.2), medium (0.5), large (0.8) effect).

Table 7 presents the changes in muscle strength of both comparison and intervention groups. The muscle strength of the comparison group did not significantly change after the intervention except their knee joints; however, the intervention group showed a significant improvement in all four joints. However, the non-synchronized results did not show any significant difference in comparing the muscle strength before and after the intervention between the two groups.

Table 7. Comparisons of muscle strength between groups (N = 40)

		Pre test		Post test		Post-Pre		Test statistic		d
		mean (sd)	95% CI	mean (sd)	95% CI	mean (sd)	95% CI			
Shoulder flexion	Comparison group (n = 20)	3.60 (1.57)	[2.91, 4.29]	3.75 (1.55)	[3.07, 4.43]	0.15 (0.37)	[-0.01, 0.31]	1.831[a)]	0.780[b)]	0.25
	Intervention group (n = 20)	3.15 (1.35)	[2.56, 3.74]	3.40 (1.27)	[2.84, 3.96]	0.25 (0.44)	[0.06, 0.44]	2.517[a)]*		
Wrist flexion	Comparison group (n = 20)	3.70 (1.69)	[2.96, 4.44]	3.85 (1.63)	[3.14, 4.56]	0.15 (0.37)	[-0.01, 0.31]	1.831[a)]	1.269[b)]	0.40
	Intervention group (n = 20)	2.95 (1.73)	[2.19, 3.71]	3.20 (1.61)	[2.49, 3.91]	0.25 (0.44)	[0.06, 0.44]	2.517 [a)]*		
Knee	Comparison	3.70	[3.1,	3.95	[3.43,	0.25	[0.06,	2.517	0.000[b)]	0

flexion	group (n = 20)	(1.38)	4.3]	(1.19)	4.47]	(0.44)	0.44]	a)*		
	Intervention group (n = 20)	3.65 (1.39)	[3.04, 4.26]	3.95 (1.15)	[3.45, 4.45]	0.30 (0.47)	[0.09, 0.51]	2.850 a)*		
Ankle flexion	Comparison group (n = 20)	3.45 (1.60)	[2.75, 4.15]	3.85 (1.39)	[3.24, 4.46]	0.40 (0.88)	[0.01, 0.79]	2.027 a)	0.972	0.31
	Intervention group (n = 20)	3.95 (1.54)	[3.28, 4.63]	4.25 (1.21)	[3.72, 4.78]	0.30 (0.47)	[0.09, 0.51]	2.850 a)*		

Notes: a)t value resulted from paired t test. b)repeated measures ANOVA. *p < .05. **p < .001.
Abbreviations: standard deviation (sd), confidence interval (CI), Cohen's d as effect size (d) (small (0.2), medium (0.5), large (0.8) effect).

Lastly, table 8 describes the changes in caregivers' satisfaction between both the comparison and intervention groups. After the NURI program, caregiving satisfaction among the intervention group showed a significant decrease compared to the comparison group, which was also present in the non-synchronized comparison as well.

Table 8. Comparisons of caregiving satisfaction between groups (N = 40)

	Pre test		Post test		Post-Pre		Test statistic		d
	mean (sd)	95% CI	mean (sd)	95% CI	mean (sd)	95% CI			
Comparison group (n = 20)	49.20 (10.52)	[44.6, 53.8]	49.25 (10.72)	[44.5, 54.0]	0.05 (1.00)	[-0.39, 0.49]	0.224a)	2.080b)*	0.66
Intervention group (n = 20)	45.90 (8.56)	[42.1, 49.6]	55.40 (7.74)	[52.0, 58.8]	9.50 (6.13)	[6.81, 12.2]	6.935a)**		

Notes: a)t value resulted from paired t test. b)repeated measures ANOVA. *p < .05. **p < .001.
Abbreviations: standard deviation (sd), confidence interval (CI), Cohen's d as effect size (d) (small (0.2), medium (0.5), large (0.8) effect).

4. DISCUSSION

Regarding ADL performance and muscle strength, although both groups showed significant improvements, there was no significant differences between the groups. One prior study measured the vertical distance, MMT, and K-MBI of stroke patients who experienced shoulder subluxation after letting them exercise in bed for three weeks, revealing greater progress among the patients who exercised more [26]. Consequently, exercise using the training cards in bed would have a negligible effect as there is a key qualitative and quantitative gap in time and expertise compared to overall rehabilitation treatment.

The ROM exercise provided by the NURI program also showed a significant difference in the muscle strength of the lesion needed to be recovered between before and after the intervention. This means that the developed program boosted the effects by increasing time and intensity to the regular rehabilitation training provided by therapists as the program was repetitively and continuously provided by nurses. Although this result was consistent with a previous study [27,28] that showed a positive effect of elastic-band exercises on the grip strength of stroke patients, the current study did not use any specific training tools. In addition, although we showed a similar improvement in the muscle strength of the comparison group, the improvement in the intervention group was comparably higher, highlighting the value of the program. Therefore, we revealed that it is possible to improve patients' physical functions by utilizing self-management (i.e., patient-tailored training cards in their hospital room) instead of completing rehab at a treatment center.

We discovered a significant decrease in anger-in and anger-out among the intervention group after the NURI program. Perhaps patients benefitted from talking about the shock and burden of their stroke and sharing

their stories during the counselling. This result is backed by previous research that showed that receiving counselling with one's family/caregivers is effective at easing anger [29,30]. Consequently, promoting patients and their families to express anger is needed in intervention programs.

The families of an individual who had a stroke face burdens related to the patients' risk of a cognitive disorder, negative reaction, anti-social acts, and high dependency, which can damage the familial relationship and lead to depression [31]. However, after program completion, the intervention group caregivers expressed significantly higher satisfaction with caregiving in this study. Therefore, rehabilitation programs should consider not only patients, but also their family members.

In addition, our program was team-based, including input from physiatrists, occupational therapists, and counsellors during design. The basic concept of the NURI program lies in a team approach and it is critical that nurses take leadership roles to ensure that various intervention tools, including counselling, education, and rehabilitation training, are utilized. So far, interprofessional interventions led by nurses have been actively applied only with mentally ill patients, seniors with delirium, or at chief healthcare sectors in local communities [32-34]. However, it seems meaningful to implement the current program by enlisting the cooperation of various health professionals at rehab centers.

In this study, we continued counselling and education with family members while applying the program with patients, and, by doing so, the program contributed to both easing patients' anger and improving caregivers' satisfaction. In Korea, it has been suggested that family members should be included in interventions for stroke patients [35]. Patients' chief caregivers are often described as a "hidden patient" [36], indicating the physical and mental toll caregiving takes on an individual, which can lead to chronic diseases like hyperlipidaemia, high blood pressure, and back injuries [37]. When stroke patients depend more on their chief caregivers for their physical and cognitive functions, chief caregivers burdens grow further and their quality of life deteriorates [38]. Therefore, it is necessary to develop and establish a timely rehabilitation program including both stroke patients and their chief caregivers. Further, it is necessary to review the applicability of the program, including consideration of the working conditions of clinical professionals.

The purpose of this study was to investigate the effects of NURSE-led rehabilitation intervention program on subacute stroke patients. Most of the previous studies focused on physical activities, but this study is meaningful in that it confirmed the effects of intervention that integrates physical activities and psychological and social approaches on the satisfaction of the chief caregivers as well as Patients' ADL, anger and muscle strength of subacute stroke patients.

Future experimental studies should include a random control group by recruiting participants who have similar neuro-anatomical lesions as we failed to consider differences in brain lesion between both groups. Further, longitudinal research is needed to identify how the application of the NURI program with stroke patients affects their long-term physical, social, and psychological symptoms and their long-term relationship with their chief caregivers. It is also necessary to continuously develop and apply sustainable rehabilitation intervention programs that can be continued even after leaving the hospital. Lastly, it is necessary to increase the ease of implementing this program so that it does not consume too much of nurses' time or energy.

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