EFFECTS OF A MULTIDISCIPLINARY SUPERVISED EXERCISE PROGRAM ON MOTOR PERFORMANCE AND QUALITY OF LIFE IN COMMUNITY-DWELLING CHRONIC STROKE SURVIVORS IN KOREAN

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Abstract. Studies of strengthening and physical conditioning rehabilitation programs on stroke survivors have shown an increase in their physical function and quality of life (QOL). In this study the effectiveness of two exercise regimens was assessed: 1) a 24-week multidisciplinary supervised exercise program and 2) a 24-week self-monitored conditioning exercise program. Twenty-eight subjects (17 men and 11 women) were allocated to take part in either a multidisciplinary supervised program or a self-monitored exercise program. The primary outcomes were the results of the Wolf Motor Function Test (Korean version), Motor Activity Log (Korean version) and Stroke Short Form – Quality of Life assessment (Korean version). Both groups showed improvement in motor capacity and quality of life, but the improvements achieved by the multidisciplinary supervised group were greater than those of the self-monitored group. A multidisciplinary supervised program was more effective than a self-monitored program for stroke rehabilitation.

Keywords: stoke survivors, exercise program, motor performance, quality of life

INTRODUCTION

Approximately 80% of individuals who suffer a stroke have upper and lower extremity impairment; their functional ability results in handicap of activities of daily living and participation in community life (Anderson *et al*, 1990; Nakayama *et al*, 1994). Disabilities that result from stroke, such as muscle weakness, pain, spasticity, and poor balance, can lead to reduced tolerance to activity, an even more sedentary lifestyle, and additional declines in function and disability (Janice *et al*, 2003).

Only a small proportion of activities can be performed by survivors of stroke with sufficient capacity to enable them to function effectively within their community. Several studies found that only 7% of stroke patients who are discharged from rehabilitation were able to participate in community activities (Corr and Bayer,

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1992; Hill *et al*, 1997).

One concept of community-based rehabilitation (CBR) is a quick, cheap, episodic distribution of some appliances for physically disabled people living in a rural area. Rehabilitation, which is considered as functional restoration, can be achieved only by empowering the disabled. Effective rehabilitation occurs in the community where people live and is supported by secondary and tertiary centers to assist with difficulties encountered (Stordeur and Stille, 1989; Bion, 1994).

The American Heart Association (AHA) recommended stroke survivors perform regular physical activity, suggesting the need for reasonable and practicable programs (Kelly-Hayes *et al*, 1998). Supervised programs carried out over a number of weeks enhance physical ability, but little is known about their true effectiveness. Supervised programs that educate people regarding exercises, which are supervised at home or at a fitness center are obviously more reasonable and cost-effective than unsupervised exercise programs, but their effectiveness and degree to which the effects are retained are unclear (Janice *et al*, 2003).

The purpose of the present study was to determine the efficacy of a multidisciplinary supervised exercise program on motor performance and quality of life of stroke survivors.

MATERIALS AND METHODS

Subjects

Participants were recruited from community-dwelling stroke survivors enrolled in a public health center community database. The inclusion criteria were: 1) suffered only a single stroke, 2) in a chronic stage after stroke (*ie*, >1 year since the event), 3) 50 years of age or older, 4) independently mobile within the community (any walking aid), and 5) having a Korean Mini Mental Status Examination score of ≥24. The exclusion criteria were: 1) presence of other neurologic conditions, 2) unstable cardiovascular condition, and 3) presence of other diseases that prevented the subject from performing the exercise training. Those who passed the initial interview were then asked to attend the research laboratory for further screening. Ethical approval for the study was obtained from the Inje University research ethics committee and subjects provided written informed consent prior to participation in the study. Their anonymity was preserved. The characteristics of the subjects are summarized in Table 1.

Experimental protocol

The subjects were divided into two groups (with the aid of a random-numbers table), of different exercise regimens: a multidisciplinary, supervised exercise program (n=14, 9 men and 5 women), and a self-monitored exercise program (n=14, 8 men and 6 women). The multidisciplinary, supervised exercise program comprised 1.5-hour sessions performed 3 days/week for 24 weeks (MS group). The self-monitored exercise program was also performed 3 days/week for 24 weeks (SM group).

An occupational therapist, a physical therapist, and an exercise instructor supervised each exercise session for the MS group, which included 4-5 participants/day. The exercise programs took place at a rehabilitation care unit at a community public health center. The exercise sessions included: 1) warm-up exercises (10 minutes), 2) main exercises (70 minutes), and 3) cool-down exercises (10 minutes). Warm-up and cool-down exercises con-

Table 1
Subject characteristics at baseline (n = 28).

Characteristics	Multidisciplinary supervised exercise group (n=14)	Self-monitored exercise group (n=14)
Demographics		
Age (years)	60.36 ± 9.11	61.35 ± 10.01
Height (cm)	164.29 ± 7.31	161.36 ± 6.98
Weight (kg)	64.64 ± 8.55	59.21 ± 7.40
Stroke characteristics		
Paretic side (left)	8	9
Paretic side (right)	6	5
Post stoke duration (years)	5.5 ± 2.1	5.6 ± 1.5

sisted of slowly walking, mild stretching, and muscular relaxation exercises. The main exercise used procedures modified from those recommended for healthy elderly adults and consisted of a graded exercise program (depending on subject preference and capability) and focused on functional upper-extremity tasks. The subjects in the MS group were also provided with advice on how to progress in the exercises (Table 2). The SM participants were not given any further instructions regarding exercises. The maximum time period for each exercise was 5 minutes, which included a rest period if required. Participants were instructed to stop exercising if they felt pain or were tired.

Assessment

Before and after the 24-week intervention period, clinical evaluations, comprised of the Wolf Motor Function Test (Korean version) (WMFT), the Motor Activity Log (Korean version) (MAL), and the Stroke Short Form - Quality of Life (Korean version) (SS-QOL) evaluation were conducted by a pair of blinded raters (one occupational therapist and one physical therapist) with the aid of videotapes.

The WMFT is comprised of 15 tasks and quantifies upper-extremity movement through timed joint-segment movements and functional tasks. The scores for the 15 tasks are summed and averaged to yield a mean functional ability score. The time (in seconds) required to complete each task is recorded (Morris *et al*, 1997; Wolf *et al*, 2002; Park *et al*, 2004).

The MAL is comprised of 30 functional tasks (*eg*, putting on shoes, opening a drawer) and is administered as a semi-structured interview. Two scores, based on a 6-point ordinal scale, are assigned for each item, one for the amount of use (AOU), and one for the quality of movement (QOM). The scores for the 30 items are averaged to obtain a mean score. The AOU and QOM scores are summed and averaged to yield a single MAL score for each participant (Taub *et al*, 2000; Kang, 2006).

The SS-QOL is assessed using the stroke-specific quality of life (QOL) questionnaire that was recently developed to assess the QOL of stroke patients. It has 12 main sub-domains with a total of 49 items: energy, family roles, language, mobility, mood, personality, self-care, social

Table 2
Exercise programs.

Main exercise (70 minutes)	Description
Shoulder and elbow exercises (35 minutes)	
Theraband exercise (10 minutes)	Flexion/extension/abduction/adduction (shoulder and elbow)
Arm cycle exercise (10 minutes)	Manual mode
Functional activity (15 minutes)	Push and pull a weight box/lifting a weight box off a shelf
Wrist and hand exercises (35 minutes)	
Theraband exercise (10 minutes)	Flexion/extension/supination/pronation (wrist)
Hand exercises (10 minutes)	Hand exercise, finger ball exercise
Functional activity (15 minutes)	Pick up objects of various sizes and shapes, fine motor task

Table 3
Outcome measurements (WMFT, MAL) (n = 28).

Measurements	Multidisciplinary supervised exercise group			Self-monitored exercise group		
	Pre-test	Post-test	p	Pre-test	Post-test	p
WMFT (Functional ability)	2.41 ± 0.94	2.54 ± 0.97	0.004[b]	2.36 ± 1.15	2.37 ± 1.17	0.336
WMFT time(s)	34.14 ± 33.18	29.59 ± 31.85	0.028[a]	36.51 ± 8.97	35.96 ± 9.01	0.021[a]
MAL (AOU)	1.75 ± 1.27	1.91 ± 1.34	0.002[b]	1.77 ± 1.65	1.84 ± 1.73	0.021[a]
MAL (QOM)	1.78 ± 1.28	1.95 ± 1.35	0.000[b]	1.77 ± 1.65	1.81 ± 1.63	0.389

Values are mean ± SD, [a]p<.05, [b]p<0.01

roles, thinking, upper extremity function, vision, and work/productivity (Williams *et al*, 1999).

The overall reliability of the Korean versions of the instruments were high as were the reliability of the measurements for the subsections of this assessment. All evaluation sheets were validated Korean versions of the questionnaires with the appropriate translation process used.

Data and statistical analyses

We used descriptive statistics to characterize the demographics and performance for each group. All data are expressed as mean ± SD, and the level of statistical significance was set at p<0.05 (two-tailed). Paired t-tests were used to examine differences between repeated pre- and post-tests.

RESULTS

Our study indicated a significant effect on total score and times for the WMFT (from 2.41 to 2.54, p=0.004; from 34.14 s to 29.59 s, p=0.028, respectively), MAL (AOU and QOM: from 1.75 to 1.91, p=0.002; from 1.78 to 1.95, p=0.000, respectively), and SS-QOL survey [energy (p=0.046), family roles (p=0.003), mobility (p=0.019), mood (p=0.001), personality (p=0.045), social roles (p=0.012), thinking (p=0.007), and upper extremity (p=0.005)] in the MS

Table 4
Outcome measurements (SS-QOL) (n = 28).

Measurements	Multidisciplinary supervised exercise group			Self-monitored exercise group		
	Pre-test	Post-test	p	Pre-test	Post-test	p
Energy	3.62 ± 0.87	3.98 ± 0.93	0.046[a]	3.55 ± 0.96	3.62 ± 0.91	0.082
Family roles	3.57 ± 0.53	3.83 ± 0.60	0.003[b]	3.60 ± 0.46	3.71 ± 0.55	0.140
Language	3.57 ± 1.32	3.60 ± 1.29	0.165	3.57 ± 1.08	3.57 ± 1.08	0.336
Mobility	3.33 ± 0.90	3.51 ± 0.74	0.019[a]	3.33 ± 0.87	3.36 ± 0.87	0.040[a]
Mood	3.47 ± 0.40	3.63 ± 0.41	0.001[b]	3.29 ± 0.62	3.33 ± 0.63	0.019[a]
Personality	3.07 ± 0.54	3.31 ± 0.81	0.045[a]	3.12 ± 0.70	3.24 ± 0.80	0.097
Self-care	4.00 ± 0.74	4.14 ± 0.63	0.055	4.03 ± 0.98	3.96 ± 0.91	0.336
Social roles	3.11 ± 0.65	3.26 ± 0.68	0.012[a]	2.96 ± 0.59	3.07 ± 0.60	0.088
Thinking	2.67 ± 1.07	2.88 ± 1.20	0.007[b]	2.69 ± 0.76	2.86 ± 0.74	0.028[a]
Upper extremity	3.21 ± 0.78	3.47 ± 0.79	0.005[b]	3.13 ± 0.99	3.27 ± 1.02	0.006[b]
Vision	3.81 ± 0.93	3.83 ± 0.96	0.336	3.76 ± 0.82	3.79 ± 0.82	0.336
Work	3.33 ± 0.55	3.43 ± 0.62	0.105	3.00 ± 0.74	3.10 ± 0.73	0.040[a]

Values are mean ± SD, [a]p<.05 [b]p<0.01.

group. For the SM group, a significant effect was seen for median time for the WMFT (from 36.51 s to 35.96 s, p=0.035), MAL (AOU and QOM; from 1.77 to 1.84, p=0.021; from 1.77 to 1.81, p=0.389, respectively), and SS-QOL survey [mobility (p=0.040), mood (p=0.019), thinking (p=0.028), upper extremity (p=0.006), and work (p=0.040)] (Tables 3 and 4).

DISCUSSION

Our study demonstrated it is possible for community-dwelling stroke survivors to achieve significant gains in motor and performance, and QOL by taking part in a 24-week MS or SM program. Using the WMFT, MAL, and SS-QOL as outcome measures, we found a significant difference in the total pre- *versus* post- program scores.

We designed rehabilitation programs that could easily be implemented in the community, since they did not require costly one-on-one training ratios, specialized settings, or expensive equipment. The implementation of our program has certain advantages. Since the participants are community-dwelling chronic stroke survivors, the program was conducted in a public health center close to the rehabilitation service and does not require one-on-one supervision, which makes it cheaper than other programs that require individual supervision (Gelber *et al*, 1995; Welsh and Rutherford, 1996; Macko *et al*, 2001; Eng *et al*, 2003). The setting also provides opportunities for social interaction and many participants found the social aspect particularly enjoyable (Potempa *et al*, 1995; Ada *et al*, 2003).

Some remarkable differences were found between the results of the MS and SM groups. The performance times on the WMFT, and the MAL and SS-QOL scores showed significantly greater improvement with the MS group than with the SM group. These findings may reflect both

the psychological aspect and the positive environment associated with the MS program. They also demonstrate there may be a supportive role played by therapist supervision, or positive psychological effects associated with being involved in a service group. The findings of this study demonstrate that MS exercise programs are more effective than SM programs at improving physical performance and QOL.

More stroke survivors return home after treatment without undergoing a formal inpatient rehabilitation program (Taub *et al*, 1993), making it likely at most people recovering from a stroke are not functioning at an optimal level when they first return to the community. This may be interpreted as a heightened risk for disability with subsequent reductions in activity level and deterioration in both physical and mental health (Mayo *et al*, 1999; Garrett *et al*, 2004). The depression often suffered by stroke survivors is a treatable condition; early diagnosis is of greatest importance in order to prevent progression to a chronic depressive disorder. Depression slows down the process of rehabilitation, exerting a negative influence on all aspects of the recovery process (Rejeski *et al*, 1996; Rimmer and Braddock, 2002). We have shown an exercise program that focuses on and improves motor function is meaningful to the subjects and has a demonstrable impact on performance and satisfaction with this performance, which is relevant to activities of daily living. This relationship between physical activity and QOL concurs with the findings of studies examining other chronic diseases (Wyller *et al*, 1998; Texeira-salmela *et al*, 1999; Pang *et al*, 2005).

The effect on QOL can be considered as important as the effect on physical function. We have shown short-term community-based exercise can improve functional motor capacity and QOL in stroke survivors. Exercise can have a demonstrable impact on performance of activities considered meaningful to the participants and may promote exercise adherence. Both MS and SM exercise regimens were more effective than the usual approach, with the MS regimen being more effective than the SM regimen.

This study had several limitations. First, environmental constraints made it impossible to blind the participants to the study group they were assigned to. However, the use of standard and objective measures and self-reports should have reduced the possibility of bias. Second, the relatively small number of participants involved in this study could have influenced the results, although they do reflect the expectations. A larger number of measurements would probably strengthen the results. Furthermore, the findings may be partly affected by the dominance of the affected upper limb, a factor that was not taken into consideration in this study. In most cases, the unaffected upper limb becomes the dominant side after stroke because ultimately it becomes the most usable upper limb.

This study shows the implementation of an MS exercise program is feasible and beneficial for improving motor performance and quality of life in stoke survivors. It provides a model for CBR of the stroke survivors in the community. Further study is required to assess the efficacy and cost-effectiveness of such a program.

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