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Community Walking Training Program Improves Walking Function and Social Participation in Chronic Stroke Patients

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Stroke patients live with balance and walking dysfunction. Walking is the most important factor for independent community activities. The purpose of this study was to investigate the effect of a community walking training program (CWTP) within the real environment on walking function and social participation in chronic stroke patients. Twenty-two stroke patients (13 male, 50.45 years old, post stroke duration 231.64 days) were randomly assigned to either the CWTP group or the control group. All subjects participated in the same standard rehabilitation program consisting of physical and occupational therapy for 60 min per day, five times a week, for four weeks. In addition, the CWTP group participated in CWTP for 30 min per day, five times a week, for four weeks. Walking function was assessed using the 10-m walk test (measurement for 10-meter walking speed), 6-min walk assessment (measurement of gait length for 6-minutes), and community gait assessment. Social participation was assessed using a social participation domain of stroke impact scale. In walking function, greater improvement was observed in the CWTP group compared with the control group ($P < 0.05$). In addition, social participation improved more in the CWTP group compared with the control group ($P < 0.05$). These findings demonstrate the efficacy of CWTP on walking function and social participation in chronic stroke patients. Therefore, we suggest that CWTP within the real environment may be an effective method for improving walking function and social participation of chronic stroke patients when added to standard rehabilitation.

Keywords: community; gait; rehabilitation; social participation; stroke
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Introduction

Stroke can result in several different disabilities depending on the degree and location of brain injury, and generally stroke patients live with balance and gait dysfunction caused by decreased mobility, weakened muscular strength, abnormal posture control, and cognitive dysfunction (Bonan et al. 2004). In particular, walking is the most important factor for independent activities of daily living in the community (Ada et al. 2009).

Thus, many therapeutic methods for improvement of independent walking ability in stroke patients have been attempted, such as task-related circuit training (Dean et al. 2000), community-based physical activity programs (Stuart et al. 2009), and virtual reality training (Cho and Lee 2013). However, most studies on stroke rehabilitation have been conducted in clinical or hospital settings, where it is difficult to reflect home environmental conditions and a complex external environment (Park et al. 2011).

Recently, community-based ambulation training has been used as a therapeutic method to enhance walking ability in stroke patients (Stuart et al. 2009; Park et al. 2011). Community walking is defined as a complicated and challenging activity requiring the ability to walk at a given speed for a minimum requisite distance and to adapt to changes in various environments (Shumway-Cook et al. 2002). For successful reintegration into community life after stroke, walking training within a real community environment is needed, as well as indoor walking training that is predictable and simple (Lord and Rochester 2005). A recent advance is recognition that successful stroke rehabilitation is determined by the degree of social participation after hospital discharge (Hamzat and Kobiri 2008). In particular, previous studies emphasized the importance of evaluating the degree of social participation in stroke rehabilitation (Rochette et al. 2001; Noreau et al. 2004) However, despite the recognition that real community environments and evaluation of social participation are important factors in stroke rehabilitation, investigations considering these factors are insufficient.

Thus, the purpose of this study was to investigate the effect of a community walking training program (CWTP)

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within a real environment on walking function and social participation in chronic stroke patients. We hypothesized that chronic stroke patients would show improvement in walking function and social participation after four weeks of CWTP.

Subjects and Methods

Participants

Thirty stroke patients undergoing standard rehabilitation were recruited from the inpatient rehabilitation hospital. Subjects were screened according to the following inclusion and exclusion criteria. The inclusion criteria for this study were categorized as 1) hemiparesis from a single stroke occurring at least six months before, 2) sufficient cognition to follow simple instructions and understand the purpose of the study (Korean version of the Mini-Mental State Examination score of ≥ 24 points), 3) gait speed < 0.8 m/s (Patla and Shumway-Cook 1999; Taylor et al. 2006), 4) ability to walk 10 m independently without an assistive device, 5) absence of a musculoskeletal condition that could potentially affect the ability to walk safely, and 6) absence of hemispatial neglect. Exclusion criteria for the study were 1) participation in other studies or rehabilitation programs or 2) severe heart disease or uncontrolled hypertension and pain. Four of the 30 potential subjects were excluded because they failed to meet the inclusion criteria. Finally, 26 subjects were included in this study.

The subjects were briefed on the experimental procedure, and written consents were collected from all subjects prior to the experiment. Human subject ethical approval was obtained from the relevant committee in the Sahmyook University institutional review board prior to conducting the experiment.

Procedures

This study applied a randomized pretest/posttest control group design. Twenty-six stroke patients were randomly assigned to either the CWTP group (n = 13) or the control group (n = 13) prior to the pretest. For randomization, sealed envelopes were prepared in advance and marked on the inside with an O or X. All subjects participated in a training program for four weeks after the pretest. The posttest was conducted three days after the end of the intervention period. All measurements were performed while patients were admitted in the rehabilitation ward, and the assessor was blinded. Two subjects each in the CWTP and control groups dropped out due to health conditions, personal reasons, or discharge. Thus, 11 subjects from each group were included in the final analysis.

All subjects participated in the same standard rehabilitation program consisting of conventional physical and occupational therapy. Conventional physical therapy, including increased trunk stability, lower-extremity muscle strength, and gait, was performed for 30 min per day, five times a week, for four weeks. Occupational therapy, consisting of an upper-extremity training program for activities of daily living, was performed for 30 min per day, five times a week, for four weeks. In addition, the CWTP group participated in the CWTP program for 30 min per day, five times a week, for four weeks.

Intervention (community walking training program)

According to previous studies, environmental dimensions, such as ambient conditions, terrain characteristics, external physical load, attentional demands, postural transition, traffic level, time constraints, and walking distance, contribute to the level of community ambulation (Shumway-Cook et al. 2002). Thus, our CWTP was composed of various real community environments, including walking near the hospital setting, walking outside of the hospital setting on uneven ground, walking outside of the hospital setting on uneven ground with obstacles, and visiting a shopping center (Fig. 1).

Walking near the hospital setting during the first week was performed on a 200-m route including the lobby, hallway, and near the hospital. In the second week, walking outside of the hospital setting on uneven ground was performed near the hospital on a 300-m route, including pavement, a ramp, and stairs. In the third week, walking outside of the hospital setting on uneven ground was performed on a 400-m route, including a gradual slope, crosswalk, and an unpaved road with obstacles. In the fourth week, subjects visited a shopping center near the hospital.

Measurements

Walking function: Walking function was measured using the 10-m walk test, 6-min walk assessment, and community walk assessment. The 10-m walk test was measured with a stopwatch; the test was repeated three times, and the average time was calculated (Lord et al. 2004). The 6-min walk assessment measures gait length and speed for 6 min (Flansbjer et al. 2006). Subjects walked at a comfortable speed inside a rectangular line with a 30-m perimeter. Subjects were informed about the method before the test without warming up. Gait speed and breaks were controlled by the subjects themselves, depending on their ability and following a conversation about guidelines and what to expect. The community gait assessment route was 300 m, including a 150-m pedestrian walkway, 100-m park trail, a 20° slope, 10 stairs, and a visit to a convenience store. Assessment was conducted at a comfortable gait speed, and the subjects could take a rest when they wanted. For accurate assessment and safety, an evaluator followed the subject (Taylor et al. 2006). The community gait assessment was performed in a new place to exclude the learning effect of training (Park et al. 2011).

Social participation: Social participation was measured using the stroke impact scale (SIS). The SIS is a self-administered questionnaire composed of a total of 64 questions in eight domains including strength, hand function, mobility, and activities of daily living/instrumental activities of daily living, emotion, communication, memory, and social participation. The SIS is reliable, valid, and sensitive to changes in stroke-related recovery (Duncan et al. 1999). For this study, we use the social participation domain.

Statistical analysis

Statistical analyses were performed using SPSS, version 18.0. Descriptive statistics were used to describe patient characteristics. The Shapiro-Wilk test was used to confirm that all outcome variables were normally distributed. The independent t-test (for continuous variables), Mann-Whitney U-test, (for ordinal variables) and chi-square test (for categorical variables) were used to compare baseline characteristics in both groups. The paired t-test was used to compare dependent variables within groups after interventions. The independent t-test was used to compare dependent variables between groups after interventions. A significance level of 0.05 was used in all measurements.

Results

General characteristics of the subjects are shown in

Fig. 1. Community walking training program (CWTP). CWTP was composed of various real community environments, including walking near the hospital setting, walking outside of the hospital setting on uneven ground, walking outside of the hospital setting on uneven ground with obstacles, and visiting a shopping center.

Table 1. No significant differences in general characteristics and dependent variables were observed between the CWTP and control groups. Changes in walking function and social participation are shown in Table 2. Walking function (10-m walk test, 6-min walk test, and community walk test) and social participation (SIS social participation domain) were similar between the two groups before training. After four weeks of intervention, both groups showed significant improvements in walking function and social participation ($P < 0.05$), except the community walk test in the control group. However, the CWTP group showed significantly greater improvement than the control group in walking function and social participation ($P < 0.05$).

Discussion

The current study investigated the effect of a CWTP on walking function and social participation of post-stroke patients. After four weeks of the CWTP, significant improvements in walking function and social participation were observed between the CWTP compared to the control group.

Recovery of walking function is an essential factor to achieve independent activities of daily living and increase quality of life and social participation (Kelly-Hayes et al.

Table 1. Homogeneity test for general characteristics and dependent variables of the subjects.

	CWTP group (n = 11)	Control group (n = 11)	X^2/t (P) values
General characteristics			
Gender			
Male/Female (%)	6/5 (54.5/45.5)	7/4 (63.6/36.4)	.727 (.394)
Paretic side			
Right/Left (%)	7/4 (63.6/36.4)	6/5 (54.5/45.5)	.727 (.394)
Etiology			
Infarction/Hemorrhage (%)	5/6 (45.5/54.5)	6/5 (54.5/45.5)	.000 (1.000)
Age, *years*	50.18 ± 10.29	50.73 ± 7.24	−.330 (.974)
Height, *cm*	165.09 ± 5.16	168.27 ± 8.47	−1.152 (.249)
Mass, *kg*	62.64 ± 8.23	69.09 ± 9.44	−1.614 (.107)
Post stroke duration, *days*	190.45 ± 108.46	272.82 ± 107.71	−1.905 (.057)
MMSE-K, *score*	27.36 ± 1.68	27.18 ± 1.77	−.302 (.763)
Dependent variables			
10-meter walk test, *m/s*	0.51 ± 0.16	0.48 ± 0.18	−.490 (.645)
6-minute walk test, *m*	162.59 ± 42.43	174.93 ± 64.17	−.460 (.646)
Community walk test, *min*	41.07 ± 33.44	46.41 ± 38.42	−.591 (.554)
SIS social participation, *score*	42.34 ± 20.79	38.36 ± 18.00	−.625 (.532)

Values are expressed as n (%) or Mean ± S.D.

CWTP, community walking training program; MMSE-K, Mini Mental State Examination-Korea; SIS, stroke impact scale.

No significant differences in general characteristics and dependent variables were observed between the CWTP and control groups.

Table 2. Comparison of balance and gait ability within groups and between groups.

parameters	CWTP group (n = 11)			Control group (n = 11)			t (P) values
	Pre-test	Post-test	Changes	Pre-test	Post-test	Changes	
walking function							
10-meter walk test, *m/s*	0.51 ± 0.16	0.71 ± 0.25	0.19 ± 0.17*+	0.48 ± 0.18	0.55 ± 0.22	0.07 ± 0.07*	−2.006 (.045)
6-minute walk test, *m*	162.59 ± 42.43	227.80 ± 75.12	65.20 ± 51.35*+	174.93 ± 64.17	192.92 ± 68.64	17.98 ± 15.72*	−2.890 (.004)
Community walk test, *min*	41.07 ± 33.44	27.61 ± 28.51	−13.46 ± 3.79*+	46.41 ± 38.42	44.79 ± 35.35	−2.92 ± 4.78	−2.463 (.014)
Social participation							
SIS social participation, *score*	42.34 ± 20.79	54.83 ± 17.70	12.49 ± 10.17*+	38.36 ± 18.00	42.61 ± 15.13	4.25 ± 3.77*	−2.271 (.023)

Values are expressed as Mean ± S.D.
CWTP, community walking training program; SIS, stroke impact scale.
*Significant differences between pre and post-test, paired t-test, $P < 0.05$.
+Significant differences between CWTP group and control group, independent t-test, $P < 0.05$.
CWTP group showed significantly greater improvement than the control group in walking function and social participation.

2003). Although many stroke patients improve walking function through rehabilitation, it has been reported that only a few stroke patients can walk independently within real community environments (Perry et al. 1995; Goldie et al. 1996). Because the limited community ambulation can reduce the quality of life of stroke patients through social isolation (Ada et al. 2003), recent advances in stroke rehabilitation emphasize the recovery of independent community ambulation.

Previous studies have emphasized that distances of 150 to 300 m, obstacles, and an uneven surface are prerequisites for constructing a community ambulation training program (Hill et al. 1997; Shumway-Cook et al. 2003). However, most stroke rehabilitation programs for improving walking function are conducted in clinical or hospital settings; it cannot be assumed that these settings will suffice for providing outdoor environmental situations (Lord and Rochester 2005). Thus, this study conducted a CWTP with stroke patients consisting of a real community environment, and we observed significant improvements in walking function.

Findings of the current study are supported by previous studies on community walking training involving environmental situations. For instance, Park et al. (2011) demonstrated that four weeks of community-based ambulation training consisting of various community situations helped improve walking ability of stroke patients. In addition, Stuart et al. (2009) reported that community-based physical therapy involving environmental options was effective for improving ambulation in stroke patients. The current and previous studies were based on eight environmental dimensions (Shumway-Cook et al. 2002), including distance, temporal factors, ambient conditions, physical load, terrain, attentional demands, postural transitions, and traffic density. In the community walking training, environmental dimensions are an important factor determining the level of community walking (Shumway-Cook et al. 2002, 2003; Park et al. 2011). Thus, we believe that active participation and voluntary movement during various real community environmental situations improved walking function.

The ability to independently participate in social activities indicates recovery from stroke and reincorporation into community life (Zhang et al. 2002). Although 64% of stroke patients have limited social participation in employment, activities of daily living, and leisure activities (Hardie et al. 2004), most stroke rehabilitation approaches have mainly considered functional or activity-related evaluations (Salter et al. 2007). Crawford et al. (2008) reported that evaluating social participation is important in stroke rehabilitation; in particular, the evaluation should be included as a routine part of stroke rehabilitation. Thus, current study evaluated social participation after four weeks of a CWTP, and significant improvement in social participation was observed in the CWTP group compared to the control group. Independent walking ability is an essential factor for reincorporation of stroke patients into community life (Lord and Rochester 2005; Salter et al. 2007). The current CWTP, which consisted of a real community environment, may motivate subjects to actively participate in training program, thereby increasing walking function and confidence in community participation. Thus, we suggest that community walking training within a real environment may be an effective method for improving walking function and social participation of chronic stroke patients when added to standard rehabilitation.

Although the CWTP was effective in improving walking function and social participation of chronic stroke patients, this study has some limitations. In this study, because only experimental group received additional CWTP, it was difficult to identify the effective of CWTP compared with other walking training program. To clarify this, further study comparing CWTP and other walking training program is needed.

In addition, only a small number of subjects were recruited. Therefore, the results cannot be generalized to all stroke patients. Another limitation of this study was that long-term follow-up of the CWTP was not considered. Therefore, we suggest that further studies include long-term follow-up to examine the long-term effect of a CWPT.

Conflict of Interest

The authors declare no conflict of interest.

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