Preliminary Study of the Effect of Low-intensity Home-based Physical Therapy in Chronic Stroke Patients

Jau-Hong Lin, Ching-Lin Hsieh,[1] Sing Kai Lo,[2] Huei-Ming Chai,[3] and Long-Ren Liao[4]
Faculty of Physical Therapy, Kaohsiung Medical University, Kaohsiung; [1]School of Occupational Therapy, College of Medicine, National Taiwan University, Taipei; [3]School and Graduate Institute of Physical Therapy, College of Medicine, National Taiwan University, Taipei; [4]Bureau of Health, Nan-Tou County Government, Nan-Tou, Taiwan; and [2]Institute for International Health, University of Sydney, Australia.

This study was a preliminary examination of the effect of low-intensity home-based physical therapy on the performance of activities of daily living (ADL) and motor function in patients more than 1 year after stroke. Twenty patients were recruited from a community stroke register in Nan-Tou County, Taiwan, to a randomized, crossover trial comparing intervention by a physical therapist immediately after entry into the trial (Group I) or after a delay of 10 weeks (Group II). The intervention consisted of home-based physical therapy once a week for 10 weeks. The Barthel Index (BI) and Stroke Rehabilitation Assessment of Movement (STREAM) were used as standard measures for ADL and motor function. At the first follow-up assessment at 11 weeks, Group I showed greater improvement in lower limb motor function than Group II. At the second follow-up assessment at 22 weeks, Group II showed improvement while Group I had declined. At 22 weeks, the motor function of upper limbs, mobility, and ADL performance in Group II had improved slightly more than in Group I, but the between-group differences were not significant. It appears that low-intensity home-based physical therapy can improve lower limb motor function in chronic stroke survivors. Further studies will be needed to confirm these findings.

Key Words: activities of daily living, home-based physical therapy, stroke
(*Kaohsiung J Med Sci* 2004;20:18–23)

Victims of stroke may suffer from permanent functional disability and become dependent in activities of daily living (ADL) [1–3]. Their need for continuing care and management has a significant impact on family members and society and is a major concern for health care policy makers. Rehabilitation has a moderate effect on stroke patients' functional improvement [4]. Comprehensive multidisciplinary assessment and treatment programs also improve physical and social functioning compared with less organized systems of stroke care [5–7]. Because of the high costs and the large number of patients involved, long-term rehabilitation programs for stroke survivors should be well organized and justified.

Although several reports have documented that little recovery can be expected 6 months or more after a stroke [8, 9], some studies have demonstrated significant functional improvements in weight shift, balance, mobility, and ADL among patients more than 1 year after a stroke [10–13]. The rehabilitation programs used in previous research, however, varied in terms of disciplines (e.g. therapists, treatment times, duration, and intensity). Thus, future research should focus on specific treatment models to increase effectiveness and reduce costs for chronic stroke survivors.

Received: August 8, 2003 Accepted: November 18, 2003
Address correspondence and reprint requests to: Dr. Jau-Hong Lin, Faculty of Physical Therapy, Kaohsiung Medical University, 100 Shih-Chuan 1st Road, Kaohsiung 807, Taiwan.
E-mail: jhlin@kmu.edu.tw

Domiciliary rehabilitation can be a more effective and resource-efficient alternative to hospital-based rehabilitation for patients after stroke [14–16]. Many disabled people and their families prefer home-based treatment to outpatient treatment in terms of familiarity and convenience [17,18]. To ensure both optimum rehabilitation for stroke patients and the best use of resources, it is critical to investigate the effects of specific home-based therapy in chronic stroke survivors. The purpose of this study was to examine the effects of low-intensity home-based physical therapy on the performance of ADL and motor function in patients more than 1 year after stroke.

Patients and Methods

Study design

This was a blinded, randomized, simple crossover trial. Each patient was assessed by an independent (non-treating) physical therapist at baseline, week 11 (first follow-up assessment), and week 22 (second follow-up assessment). After the baseline assessment, patients were randomly assigned to receive home-based physical therapy either immediately (Group I) or after a 10-week delay (Group II). Thus, at the first follow-up assessment at 11 weeks, half the patients had undergone the intervention and half were controls. Assessments and treatments took place at patients' homes, and independent assessors and therapists were not informed of the patients' treatment groups.

Subjects

All participants were recruited from Nan-Tou County, Taiwan, in a cohort of community stroke patients enrolled in a handicap databank at the Department of Social Affairs in 2001. Of the 518 people listed on the databank, 40 patients (8%) were ranked as very severely handicapped, 147 (28%) as severely handicapped, 258 (50%) as moderately handicapped, and 73 (14%) as mildly handicapped, based on the handicap accreditation grading. People who did not currently live in Nan-Tou County, had died, or with whom contact had been lost were excluded; 187 patients (36%) were initially contacted by telephone. Among these, 19 (10%) lived independently at home while 168 (90%) still needed assistance from family members or paid caregivers. Of these, 89 subjects were willing to receive follow-up home visits, but only 20 patients met the following inclusion criteria: stroke onset more than 1 year previously; severe to moderate residual disability with Barthel Index (BI) score 5–14 [19,20]; not involved in any kind of rehabilitation program in the past 6 months; ability to follow verbal instructions; and living in the Nan-Tou County area during the period of research. These 20 patients were offered home-based physical therapy. One subject did not complete the intervention because of an unstable medical condition. Nineteen subjects (13 men and 6 women, mean age 62.2 ± 10.0 years) completed the intervention program.

Treatment program and instruments

The home-based physical therapy program was administered by one of four physical therapists who had been serving at local hospitals for more than 2 years. The patients received home-based physical therapy once a week for 10 consecutive weeks, with each treatment session lasting about 50 to 60 minutes. The service mainly consisted of motor facilitation, postural control training, functional ambulation training with gait correction, and ADL training. Daily exercise programs were tailor-made to the patients' individual needs. Primary caregiver counseling was also included to foster treatment compliance.

The BI, ranging from 0 to 20, was used to evaluate the severity of disability for each patient [19,20]. It includes 10 basic ADL items and has been shown to be a reliable and valid measure of ADL [21,22]. Motor function was assessed using the Stroke Rehabilitation Assessment of Movement (STREAM) [23]. STREAM is designed to provide a comprehensive, objective, and quantitative evaluation of motor function for stroke patients; it has high reliability and validity [24]. The STREAM instrument consists of 30 items that are equally distributed among three subscales: upper-limb movements (STREAM-UE; subscale score, 0 to 20), lower-limb movements (STREAM-LE; 0 to 20), and basic mobility items (STREAM-MOB; 0 to 30).

Statistical analysis

Descriptive statistics were used to present the nature of all variables collected, including age, gender, side of hemiplegia, type of stroke, and months from stroke onset to baseline assessment, as well as BI and STREAM scores at baseline and first and second follow-up assessments. Repeated measures analysis of variance (ANOVA), treating time as a within-subject factor and group as a between-subject factor, followed by post hoc multiple comparisons were used to analyze the differences between time periods and between groups. To take into consideration the effect of multiple testing, the Sharpened Bonferroni method was used to adjust for individual alpha level [25], while the overall level of significance was set at 0.05. The SAS statistical software package version 6.12 (SAS Institute Inc, Cary, NC, USA) was used for all analyses.

Results

Baseline characteristics are shown in Table 1. The groups given immediate therapy and delayed therapy were not significantly different at randomization.

Mean BI and STREAM scores are shown in Table 2. The patterns of change in STREAM-LE score from baseline to first and second follow-up were not the same for the two groups (as evident by the significant interaction *p* value). The highest STREAM-LE score was observed at week 11 in Group I but at week 22 in Group II.

Changes in mean scores can be calculated easily from the figures in Table 2. From baseline to the first follow-up assessment, there was a greater change in Group I than in Group II in each of the four measures. The difference between the two groups ranged from 1.1 points (STREAM-MOB; effect size, 0.59) to 2.2 points (STREAM-LE; effect size, 0.85). Since at least a medium effect (effect size > 0.5, as suggested by Cohen [26]) was observed, the lack of power was probably responsible for the fact that the scales were not significantly different between the two groups. In fact, if the two groups were not different, then one would expect two of the four scales to be higher in Group I and two to be higher in Group II. The probability that all four scales were higher in Group I was, as derived from the binomial distribution, 0.0625, which was nearly significant at the 0.05 level.

Similarly, when examining the change from the first to the second follow-up assessment, at which Group II had just been given therapy, all four scores were higher in this group. The change ranged from 0.7 points (STREAM-UE; effect size, 0.47) to 4.8 points (STREAM-LE; effect size, 3.7). Once again, only the gain in lower limb motor function was nearly statistically significant (mean change, 1.0 ± 1.3 in

Table 1. Baseline characteristics

	Group I (*n* = 9)	Group II (*n* = 10)
Age (yr)	61.4 ± 11.2	62.8 ± 9.4
Male gender	7 (78)	6 (60)
Onset to baseline assessment (mo)	44.0 ± 29.6	49.2 ± 31.6
Received rehabilitation therapy at hospitalization		
Yes	6 (67)	7 (70)
No	3 (33)	3 (30)
Side of hemiplegia		
Left	3 (33)	2 (20)
Right	6 (67)	8 (80)
Type of stroke		
Hemorrhage	3 (33)	4 (40)
Infarction	6 (67)	6 (60)
Number of attack		
First	6 (67)	6 (60)
Recurrence	3 (33)	4 (40)
Grade of handicap		
Moderate	3 (33)	4 (40)
Severe	6 (67)	6 (60)
Barthel Index (0–20)	10.0 ± 4.0	10.2 ± 3.3
STREAM-UE (0–20)	8.3 ± 6.7	8.0 ± 7.3
STREAM-LE (0–20)	9.8 ± 5.2	7.6 ± 4.3
STREAM-MOB (0–30)	11.3 ± 6.6	9.5 ± 5.0

Values are mean ± standard deviation or *n* (%). STREAM-UE = subscale score of voluntary movement of upper limbs in the Stroke Rehabilitation Assessment of Movement (STREAM) instrument; STREAM-LE = subscale score of voluntary movement of lower limbs in the STREAM instrument; STREAM-MOB = subscale score of basic mobility in the STREAM instrument.

Table 2. Mean scores ± standard deviation for the two assessments at different time periods

Index (total possible score)	Group (*n*)	Baseline	Week 11	Week 22	*p*
Barthel Index (20)	Group I (9)	10.0 (4.0)	12.0 (4.0)	12.4 (4.3)	int = 0.355
	Group II (10)	10.2 (3.3)	10.5 (5.3)	11.8 (5.8)	grp = 0.748
STREAM-UE (20)	Group I (9)	8.3 (6.7)	9.9 (7.0)	10.1 (7.7)	int = 0.267
	Group II (10)	8.0 (7.3)	7.9 (7.5)	8.8 (7.8)	grp = 0.721
STREAM-LE (20)	Group I (9)	9.8 (5.2)	11.9 (4.8)*	10.8 (5.6)	int = 0.001
	Group II (10)	7.6 (4.3)	7.5 (4.5)	11.2 (5.5)†	grp = 0.366
STREAM-MOB (30)	Group I (9)	11.3 (6.6)	12.3 (7.0)	13.6 (7.9)	int = 0.467
	Group II (10)	9.5 (5.0)	9.4 (5.4)	12.0 (5.6)	grp = 0.460

*Significantly different between week 11 and the other two time periods (baseline: $p = 0.011$; week 22: $p = 0.030$) after Sharpened Bonferroni adjustment; †significantly different between week 22 and the other two time periods (baseline: $p = 0.002$; week 11: $p = 0.016$) after Sharpened Bonferroni adjustment. int = interaction; grp = group; STREAM-UE = subscale score of voluntary movement of upper limbs in the Stroke Rehabilitation Assessment of Movement (STREAM) instrument; STREAM-LE = subscale score of voluntary movement of lower limbs in the STREAM instrument; STREAM-MOB = subscale score of basic mobility in the STREAM instrument.

Group I vs 3.6 ± 3.9 in Group II; $p = 0.070$). The changes in upper limb motor function, mobility, and ADL were far from statistical significance, indicating that the treatment effect was apparently more specific to the motor function of lower limbs.

Discussion

The purposes of physical therapy in stroke patients are to restore motor function, improve independence in ADL, and reduce stroke-related complications. In this blinded, randomized crossover trial, after 10 weeks of low-intensity home-based physical therapy, patients demonstrated more substantial and significant improvements in lower limb motor function. The lack of improvement in upper limb motor function, mobility, and ADL performance could be attributed to an inadequate number of subjects. These results indicate that specific improvement in lower limb motor function after low-intensity home-based physical therapy is possible in chronic stroke patients more than 1 year post-stroke.

Each year, at least 35,000 people in Taiwan suffer from a stroke [27]. The 1-year survival rate is 74.3% [28]. Among survivors, one-third with dependence in ADL are still strongly affected by complications such as handicaps, unclear consciousness, aphasia, dementia, or psychologic abnormality. Physical therapy services for stroke patients are related to the availability of medical resources in the community. Compared with metropolitan areas, county governments in rural areas commonly have large discrepancies in service availabilities and, hence, have a need to develop more cost-effective strategies. In this study, 10 weeks of low-intensity home-based physical therapy in a program supervised by a physical therapist resulted in some improvement in motor function in the lower limbs. This is consistent with the report by Wade and colleagues [11], which indicated that intervention by an experienced physical therapist late after stroke improves gait speed. Similarly, Young and Forster found that home physiotherapy seemed to be slightly more effective and resource-efficient than day hospital-based rehabilitation [14]. These investigators reported that home physical therapy was as beneficial as hospital-based rehabilitation.

In this study, the main improvement in motor function in lower limbs might be explained by the fact that the low-intensity physical therapy program emphasized lower-limb motor facilitation, standing balance training, and functional ambulation training. However, apart from low statistical power, the lack of significant gains in ADL performance, upper limb motor function, and mobility may be attributable to various reasons. In contrast to the results of previous studies [10,12], the patients' daily function measured by BI after the program improved slightly, but the changes were not statistically significant in either group. We believe that a low-intensity physical therapy program with only a physical therapist and 1-hour weekly home visits may not be sufficient to generate substantial improve-

ments. A statistically significant intensity effect relationship in stroke rehabilitation has been reported [29]. Moreover, previous studies have reported that multidisciplinary home-based rehabilitation efforts provide more beneficial outcomes for stroke patients [15,16]. We also believe that our home-based physical therapy patients would have had better outcomes if they had been provided with professional rehabilitation team services.

In summary, low-intensity home-based physical therapy specifically improves motor function in lower limbs in chronic stroke survivors. However, there are non-significant improvements in motor function in upper limbs, mobility, and ADL performance. Further studies are needed involving larger samples of mild or very severe stroke patients selected at early discharge from multiple district hospitals and medical centers.

Acknowledgments

This study was supported by a grant from the National Science Council (NSC 91-2314-B-037-331), Taiwan, and the "Nan-Tou County community-based rehabilitation program for the survivors from 921 earthquake".

References

1. Corr S, Bayer A. Poor functional status of stroke patients after hospital discharge: scope for intervention? *Br J Occup Ther* 1992;55:383–5.
2. Lin SH. Home health care and social supports for community-dwelling stroke patients. *J Formos Med Assoc* 1993;92:S177–83. [Chinese]
3. Clarke PJ, Black SE, Badley EM, et al. Handicap in stroke survivors. *Disabil Rehabil* 1999;21:116–23.
4. Ottenbacher KJ, Jannell S. The results of clinical trials in stroke rehabilitation research. *Arch Neurol* 1993;50:37–44.
5. Kalra L, Dale P, Crome P. Improving stroke rehabilitation: a controlled study. *Stroke* 1993;24:1462–7.
6. Dam M, Tonin P, Casson S, et al. The effects of long-term rehabilitation therapy on poststroke hemiplegic patients. *Stroke* 1993;24:1186–91.
7. Indredavik B, Bakke F, Slordahl SA, et al. Stroke unit treatment improves long-term quality of life: a randomized controlled trial. *Stroke* 1998;29:895–9.
8. Wade DT, Hewer RL, Skibeck CE, David RM. *Stroke: A Critical Approach to Diagnosis, Treatment, and Management.* Chicago: Year Book Medical Publishers, 1985.
9. Jeffery DR, Good DC. Rehabilitation of the stroke patient. *Curr Opin Neurol* 1995;8:62–8.
10. Tangeman PT, Banaitis DA, Williams AK. Rehabilitation of chronic stroke patients: changes in functional performance. *Arch Phys Med Rehabil* 1990;71:876–80.
11. Wade DT, Collen FM, Robb GF, Warlow CP. Physiotherapy intervention late after stroke and mobility. *BMJ* 1992;304: 609–13.
12. Werner RA, Kessler S. Effectiveness of an intensive outpatient rehabilitation program for postacute stroke patients. *Am J Phys Med Rehabil* 1996;75:114–20.
13. Rodriquez AA, Black PO, Kile KA, et al. Gait training efficacy using a home-based practice model in chronic hemiplegia. *Arch Phys Med Rehabil* 1996;77:801–5.
14. Young JB, Forster A. The Bradford community stroke trial: results at six months. *BMJ* 1992;304:1085–9.
15. Roderick P, Low J, Day R, et al. Stroke rehabilitation after hospital discharge: a randomized trial comparing domiciliary and day-hospital care. *Age Ageing* 2001;30:303–10.
16. von Koch L, de Pedro-Cuesta J, Kostulas V, et al. Randomized controlled trial of rehabilitation at home after stroke: one-year follow-up of patient outcome, resource use and cost. *Cerebrovasc Dis* 2001;12:131–8.
17. Hedrick SC, Koepsell TD. Meta-analysis of home-care effects on mortality and nursing-home placement. *Med Care* 1989;27: 1015–26.
18. von Koch L, Holmqvist LW, Wottvich AW, et al. Rehabilitation at home after stroke: a descriptive study of an individualized intervention. *Clin Rehabil* 2000;14:574–83.
19. Wade DT, Langton-Hewer R. Functional abilities after stroke: measurement, natural history and prognosis. *J Neurol Neurosurg Psychiatry* 1987;50:177–82.
20. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. *Md State Med J* 1965;15:61–5.
21. Hsueh IP, Lee MM, Hsieh CL. The psychometric characteristics of Barthel ADL index in patients with stroke. *J Formos Med Assoc* 2001;100:526–32.
22. Gosman-Hedstrom G, Svensson E. Parallel reliability of the functional independence measure and the Barthel ADL Index. *Disabil Rehabil* 2000;22:702–15.
23. Daley K, Mayo N, Wood-Dauphinee S. Reliability of scores on the stroke rehabilitation assessment of movement (STREAM) measure. *Phys Ther* 1999;79:8–23.
24. Wang CH, Hsieh CL, Dai MH, et al. Inter-rater reliability and validity of the Stroke Rehabilitation Assessment of Movement (STREAM) instrument. *J Rehabil Med* 2002;34:20–4.
25. Hochberg Y, Benjamini Y. More powerful procedure for multiple significance testing. *Stat Med* 1990;9:811–8.
26. Cohen J. *Statistical Power Analysis for the Behavioural Sciences.* New York: Academic Press, 1977.
27. Hu HH, Sheng WY, Chu FL, et al. Incidence of stroke in Taiwan. *Stroke* 1992;23:1237–41.
28. Hung TP. *Prospective Survey and Registry of Stroke in Taiwan area: The Fourth Annual Report (DOH81-TD-026).* Taipei: Department of Health, 1992.
29. Kwakkel G, Wagenaar RC, Koelman TW, et al. Effects of rehabilitation after stroke. A research synthesis. *Stroke* 1997; 28:1550–6.