Physical Therapy to Improve Functioning of Older People in Residential Care Facilities

Nancy Harada
Vicki Chiu
Eileen Fowler
Martin Lee
David B Reuben

Background and Purpose. *The purpose of this study was to determine the effectiveness of an individualized physical therapy mobility training program on the gait, balance, and functional performance of elderly individuals living in residential care facilities.* ***Subjects.*** *Twenty-seven elderly individuals with impaired balance and difficulty performing at least one functional activity participated in the study. The subjects ranged in age from 71 to 97 years ($\bar{X}$=87.1, SD=6.7).* ***Methods.*** *Balance and gait speed were assessed at baseline and following physical therapy that consisted of exercises to improve specific functional limitations. Outcomes were reassessed 1 month following completion of the physical therapy.* ***Results.*** *Gait and balance outcomes were analyzed using a one-way repeated-measures analysis of variance. Improvement was obtained in balance, which was maintained at 1 month follow-up. Gait speed did not improve to a level of statistical significance.* ***Conclusion and Discussion.*** *After physical therapy, subjects improved in balance and functional performance. An improvement in gait speed may require a longer duration of treatment. [Harada N, Chiu V, Fowler E, et al. Physical therapy to improve functioning of older people in residential care facilities. Phys Ther. 1995;75:830–839.]*

Key Words: *Balance, Elderly, Gait, Physical therapy.*

Individuals 65 years of age and over currently compose 12% of the total US population.[1] This proportion is expected to rise to almost 13% by the year 2000, and to 20% by the year 2040.[1] This rapid growth of the elderly population has led to an increase in the number of older people who experience functional disability. Estimates are that 17% of noninstitutionalized individuals over the age of 65 years experience some difficulty in the performance of basic activities of daily living (ADLs) and instrumental activities of daily living (IADLs).[2,3] Basic activities of daily living are personal care activities such as eating, toileting, dressing, bathing, transferring, and walking.[2] Instrumental activities of daily living are home management activities such as meal preparation, shopping, money management, telephone use, and housework.[2] The likelihood of having difficulty with ADLs and IADLs increases as an individual ages. Twelve percent of the population 65 to 74 years of age experience difficulty with both ADLs and

N Harada, PhD, PT, is Health Services Research Associate, Geriatric Research, Education, and Clinical Center (11G), Veterans Administration Medical Center-West Los Angeles, and Assistant Professor, School of Medicine, University of California, Los Angeles, Los Angeles, CA 90073 (USA) (1IBKXNDH@MVS.OAC.UCLA.EDU). Address all correspondence to Dr Harada.

V Chiu, is Research Associate, UCLA/VA/RAND MEDTEP Center for Asians and Pacific Islanders.

E Fowler, PhD, PT, is Adjunct Associate Professor, Department of Orthopedics, School of Medicine, University of California, Los Angeles, and Director, Functional Assessment Laboratory, Department of Rehabilitation Services, UCLA Medical Center.

M Lee, PhD, is Lecturer, Department of Biostatistics, School of Public Health, University of California, Los Angeles.

DB Reuben, MD, is Associate Professor, School of Medicine, and Director, Multicampus Program in Geriatric Medicine and Gerontology, University of California, Los Angeles.

This study was approved by the Human Subjects Protection Committee of the School of Medicine, University of California, Los Angeles, and the Veterans Administration Medical Center-West Los Angeles.

This study was supported by the UCLA Older Americans Independence Center, Grant #5 P60 AG10415–02, and the UCLA/VA/RAND MEDTEP Center for Asians and Pacific Islanders, Grant #HS07370.

This article was submitted September 20, 1994, and was accepted June 5, 1995.

IADLs. This incidence rises to 22% in the 75- to 84-year-old age group and to 40% in those individuals 85 years of age and over.[3]

The degree of dependency for ADLs and IADLs is one factor that determines living arrangements for older individuals.[3,4] Community-dwelling elders with limitations in basic life activities may have difficulty maintaining independent households. If so, one of their options is to live in a residential care facility for the elderly, a nonmedical facility that provides room and board, meals, recreational and social activities, protective supervision, and some assistance with daily living.[4,5] Approximately 1 million elderly individuals in the United States reside in almost 70,000 licensed and unlicensed residential care facilities, with an estimated 3.2 million persons at immediate risk for living in one.[4,5] The majority of individuals living in residential care facilities are elderly women with some disability, little family support, and few financial resources.[5]

Due to licensing requirements, residential care facilities must make special provisions for people requiring assistive devices, and therefore many prefer to admit ambulatory individuals who do not use assistive devices such as canes and walkers.[6] Once admitted, however, residents often experience further functional decline due to the aging process.[4] Data from 109 elderly individuals living in residential care facilities indicated that approximately one half used walking aids and 29% needed assistance with one or more ADLs.[7] Interventions administered by physical therapists in residential care facilities may prevent, minimize, or reverse functional decline, thereby enhancing quality of life and possibly preventing further institutionalization in more costly, less home-like environments.

A functionally based physical therapy program may be suitable to guide treatment of these elderly individuals. Sullivan[8] has proposed an intervention model directed by a desired functional outcome, such as improved ambulation or the ability to perform ADLs. This model is based on a variety of theories of exercise including those of Rood,[9] proprioceptive neuromuscular facilitation,[10] and practice models for patients with musculoskeletal[11] or neurologic involvement.[12] The intervention model consists of four stages of control: mobility, stability, controlled mobility, and skill.[8] Each stage of control is characterized by a type of impairment, and treatment techniques are appropriate for the specific impairments. For example, to improve mobility the therapist would use techniques such as stretching, and to improve stability the therapist would instruct the patient in exercises to maintain static balance and control in weight-bearing postures. For controlled mobility, the therapist would instruct the patient in weight-shifting exercises. To improve skill in the performance of functional activities, the patient would practice actual activities such as ambulation and transfers. As a result, the intervention is designed to address specific limitations displayed by the patient.[8]

The few studies that have explored the effectiveness of interventions for people living in residential care facilities have looked at long-term group exercise rather than individualized sessions.[13–15] These exercise programs have included some, but not all, components of Sullivan's exercise model.[13–15] McMurdo and Rennie[14] performed a randomized controlled trial to examine the effectiveness of a 45-minute, twice weekly, 7-month seated group exercise program led by a physical therapist. The exercise program consisted of range of motion (mobility component) and strengthening (stability component) exercises for the upper and lower extremities. The exercise program resulted in greater grip force, better spinal flexion, shorter chair-to-standing time, less self-reported depression, and higher ADL scores in the experimental group as compared with the control group. Judge et al[15] initiated a 12-week exercise program aimed at group flexibility (mobility component), strengthening (stability component), and balance (controlled mobility component) exercise in elderly residents of two life-care communities. These researchers found an improvement in knee extension force and gait speed in the experimental group as compared with the control group. The general nature of these exercise programs meant that exercises could not be included that were specific to each patient's ability level. The program, however, had the benefit of being usable for treating a group of patients at one time.[13] An individualized program of physical therapy can be advantageous because it targets a patient's specific limitations. Exercises can be designed and modified based on the patient's ability level, which can result in improved outcomes. Further study is needed to ascertain whether individualized physical therapy that is conducted over a shorter duration of time and based on a comprehensive model of exercise is feasible for elderly individuals living in a residential care facility and whether this program will lead to improvements in function that can be sustained over time.

The aim of this study was to examine the effect of individualized physical therapy adapted from the Sullivan model on individuals living in residential care facilities. The intervention in our study was directed by the general goal of improving gait speed, balance, and functional level. This goal was selected because deficits in these areas could interfere with an individual's ability to live independently. A secondary aim was to determine the sensitivity of two different measures of balance following physical therapy to determine the most appropriate test to use in future studies. Because no control group was used, definitive statements about changes in balance and gait could not be made. Our study, however, was designed to document treatment and response in a group of subjects.

Method

Overview of Study Design

To test the effects of short-term physical therapy on the function of elderly individuals, a repeated-measures de-

sign was used.[16] Physical therapists who obtained the outcome measurements and those who conducted the intervention were blinded to each other's data. Gait speed and balance were assessed at three points: baseline, immediately postintervention, and 1 month follow-up. To determine the test-retest reliability of the balance measures, one half of the subjects were retested 1 week following the baseline assessment using the same tests. Physical therapy was also assessed through detailed records kept by the treating physical therapists, which contained goals, treatment administered during each session, and patient progression.

Outcome Measures

The outcome measures were (1) scores on the Berg balance scale,[17–20] (2) scores on the balance subscale of the Tinetti Performance-Oriented Mobility Assessment (POMA),[21–24] and (3) gait speed (Tab. 1).[25]

The Berg balance scale measures "functional balance," which has three dimensions: maintenance of a position, postural adjustment to voluntary movements, and reaction to external disturbances.[17–20] Subject performance on each of 14 activities is measured on a five-point ordinal scale ranging from 0 to 4 (0=unable to perform, 4=independent) so that the aggregate score ranges from 0 to 56. Berg et al[18] have found high interrater and intrarater reliabilities (interrater and intrarater reliability intraclass correlation coefficients [ICCs]=.98 and .99, respectively) and high internal consistency (Cronbach's alpha=.96).[18] In a previous study,[26] we found the Berg balance scale to have higher sensitivity and specificity than the Tinetti balance subscale in screening older people for referral to physical therapists. The average time to administer the scale in this study was 10 to 15 minutes.

Tinetti's POMA balance subscale measures an individual's position changes and ability to balance while performing certain activities, and is usually used in conjunction with a gait subscale to derive an aggregate score of gait and balance.[23,24] In our study, only the balance subscale was used. The total score on the Tinetti balance subscale can range from 0 to 16, with a higher score indicating better balance. Tinetti et al[27] have reported both interrater and test-retest reliability of .95 on the gait and balance subscales. Predictive validity is high, as demonstrated by the Tinetti balance subscale's ability to predict falls and fall-related injuries in community-dwelling elderly individuals and intermediate care facility residents.[23,24,28] The Tinetti balance subscale required 5 to 10 minutes to administer.

Gait speed was measured using an insole footswitch system called the Stride Analyzer.* As the subject walked a prespecified distance of 6.1 m (20 ft), footswitches recorded foot-floor contact, and gait speed was calculated.[25]

Subject Recruitment and Data-Collection Procedure

Subjects were recruited from three licensed residential care facilities located in the Los Angeles, Calif, area. Prior to initiation of the study, family members and conservators of all residents were informed of study details by the principal investigator (NH). In addition, the principal investigator sent the primary care physician for each resident a letter describing the study and indicating that the resident was being considered for inclusion. The physician was asked to return a form, indicating whether the resident had any medical problems that would preclude participation in the study. Physicians who did not return the form were contacted by phone by the principal investigator.

Subjects were recruited for the study by a team of researchers that included physical therapists. The study was described by the principal investigator, and residents who were interested signed an informed consent form and underwent further screening. Eligibility

Table 1. *Characteristics of Clinical Measures*

Measure	Items	Approximate Time to Complete[a]
Berg balance scale	Sit to stand Standing unsupported Sitting unsupported Standing to sitting Transfers Standing, eyes closed Standing, feet together Reaching forward with outstretched arm Pick up object from floor Turn to look over shoulders Turn 360° Step, touch stool Standing unsupported, one foot in front Standing on one leg	10–15 min
Tinetti POMA[b] balance subscale	Sitting balance Arise Attempt to arise Immediate standing balance Standing balance Nudge Standing, eyes closed Turn 360° Sit down	5–10 min
Stride Analyzer	Gait speed	10 min

[a]Time to complete as determined in this study.

[b]Performance-Oriented Mobility Assessment.

*B&L Engineering, 12309 E Florence Ave, Santa Fe Springs, CA 90670.

criteria included the following: (1) achievement of a minimum score of 20 on the Folstein Mini Mental State Examination (FMMSE)[†29–31]; (2) impairment of balance while walking with or without an assistive device; (3) difficulty in the performance of at least one functional activity, including transfer from a sitting to a standing position, ambulation on ramps and curbs, or ascending and descending stairs; (4) not blind; and (5) not currently receiving physical therapy.

To determine whether residents met these eligibility criteria, they were interviewed using a questionnaire we designed for this study. The interview consisted of questions eliciting residents' demographic information, ability to perform functional activities, and items from the FMMSE. All interviewers were trained in the administration of the questionnaire.

Interviews were followed by measurements of gait speed and balance obtained by physical therapists. Each subject visited two measurement stations where gait speed and balance were evaluated. Balance was assessed using the Berg balance scale and the Tinetti balance subscale. To assess interrater reliability for this study, one half of the subjects were rated concurrently. Interrater reliability was high (Pearson's correlation coefficients ranged between .95 and .98 for the Berg balance scale and between .76 and .90 for the Tinetti balance subscale). To assess test-retest reliability on both balance scales, one half of the subjects were assessed 1 week later. Test-retest reliability on both balance scales was high (ICC=.82 for the Berg balance scale, ICC=.93 for the Tinetti balance subscale). Gait speed was assessed by another physical therapist and research assistant using the Stride Analyzer. Footswitches were inserted into each subject's shoes, and a recorder was strapped around the subject's waist. Gait variables were recorded as the subject walked a distance of 6.1 m. The average of two runs was used for baseline and postintervention measures. As a token of appreciation for participating in these activities, residents received a package of health-related items, such as coupons and oral hygiene products. These items were donated for the study by local medical supply vendors.

To further assess each subject's appropriateness for inclusion based on the criteria as previously described, a physical therapist who was blinded to the results of the outcome measures evaluated each subject 2 weeks following initial testing. This physical therapist's assessment took between 5 to 10 minutes per subject and included an interview followed by observation of the subject's ability to transfer and walk on level surfaces, ramps, stairs, and outdoors. The assessment was tailored to the functional capacity of the subject. For example, subjects who had difficulty walking a short distance indoors were not assessed walking outdoors. Subjects who could not perform any of these transfer or ambulation activities in a safe manner were scheduled for ongoing treatment by a physical therapist.

The physical therapy is described in detail in the next section. Gait and balance were remeasured by the same physical therapist who performed baseline measures within 1 week of completion of the intervention. To determine whether the effects of the intervention were maintained, each subject was remeasured 1 month following completion of the intervention.

Physical Therapy Mobility Training Protocol

Prior to initiation of physical therapy, physical therapists who were not involved with baseline assessment or screening were provided with a general treatment protocol adapted from Sullivan,[8] as depicted in the Figure. These therapists were instructed to devise a treatment program with the aims of improving the subject's gait, balance, and functional activities using this protocol as a guide but individualized based on their own patient evaluation. The therapists received examples of exercises that could be performed, and were told to limit treatments to two to three times per week for 4 to 5 weeks. The frequency and duration guidelines were based on the amount of outpatient physical therapy that is reimbursable under Medicare guidelines,[32] although all treatment costs were covered by research funds. The physical therapists were also instructed to document the patient's remarks, exercises performed during the treatment session, assessment, and goals following each session using their usual documentation techniques.

The physical therapy protocol began with a detailed evaluation to identify physical and functional limitations that should be addressed during treatment. The evaluation consisted of a patient interview followed by tests of range of motion, manual muscle strength, functional ability, posture, sensation, and balance to identify individual limitations that affect patient functioning. Based on these findings, physical therapy was initiated to address the identified limitations with the goal of improving the subject's gait, balance, and functional activity level. Functional activity goals were specified by the physical therapist for each patient based on the initial evaluation findings.

Although the physical therapy program was individualized for each subject, a general characteristic of the

[†]The FMMSE is an instrument used to screen for cognitive impairment in elderly people. Researchers at Rancho Los Amigos Hospital (Downey, Calif) have found that individuals who score below 22 have a poorer potential for rehabilitation. Subjects with an FMMSE score slightly lower than the cutoff were included on a case-by-case basis if they were judged to be able to follow a physical therapist's instruction. This exception was made because some individuals had educational levels of grade 8 or less, and performance on the FMMSE is associated with level of education.

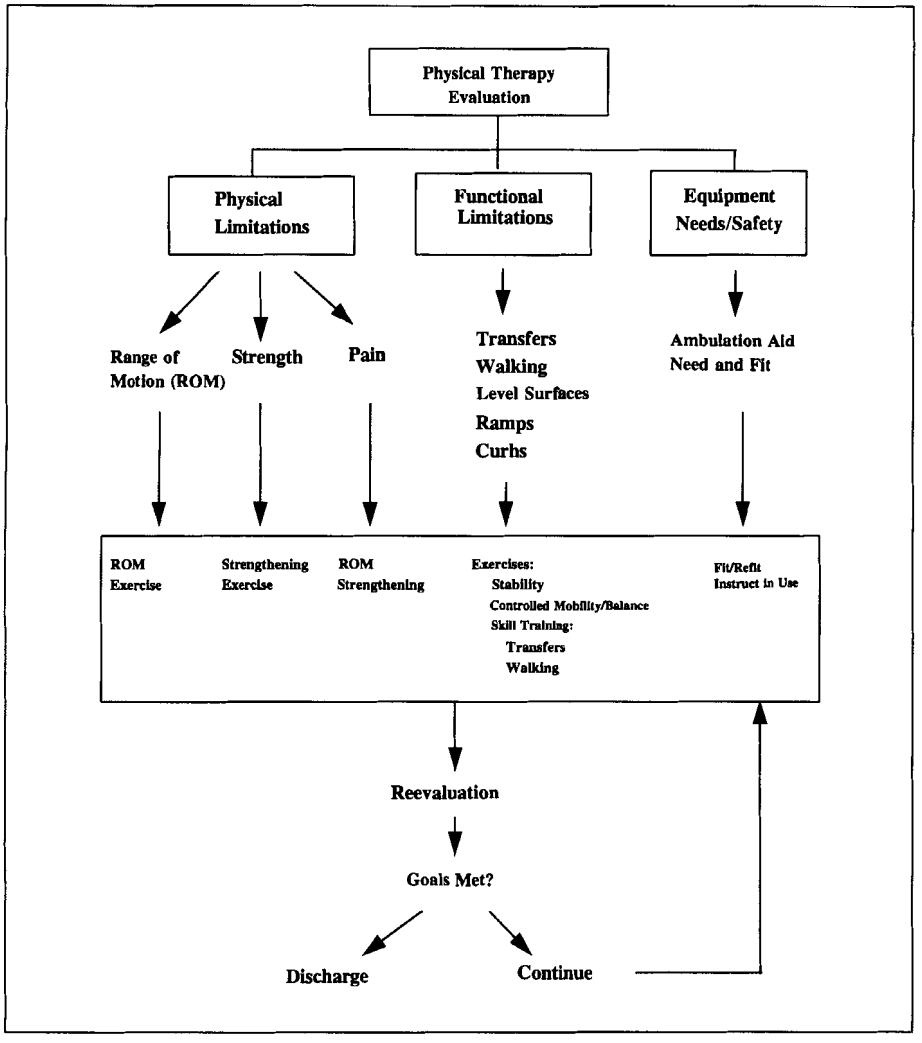

Figure. *Physical therapy mobility training protocol. (Adapted from Sullivan[8])*

exercises is that they addressed mobility, stability, controlled mobility, and skill.[8] Exercises were performed by the subject in one-on-one sessions for 20 to 40 minutes, two to three times per week for 4 to 5 weeks. A typical treatment protocol for a subject in this study is summarized in Table 2.

The exercise program was modified according to the subject's tolerance by increasing repetitions, adding resistance, adding new exercises, and changing positions. The type of functional activity performed during each session was also changed as the subject's abilities changed. For example, a subject who mastered walking on level surfaces was advanced to walking on ramps, curbs, and stairs. Physical limitations (eg, decreased range of motion, strength, or pain) were addressed concurrently with functional limitations if they hindered functional gains. For example, inadequate knee extension that would limit a subject's ability to transfer or walk independently was addressed through targeted strengthening and range of motion exercises.

Data Analysis

Gait and balance outcome variables were analyzed using a one-way repeated-measures analysis of variance to determine whether there were significant differences in measures across time.[33] A *post hoc* analysis, the Student-Newman-Keuls multiple-comparisons procedure, was used as a means of subanalyzing individual time-point differences. The Student-Newman-Keuls procedure controls for a global significance level of 5%.[34] Functional activity data were abstracted from the physical therapists' documentation of each treatment session, and frequencies were calculated.

Results

Sample Characteristics

A total of 27 elderly individuals received physical therapy. Characteristics of these subjects are presented in Table 3. Ninety-three percent of the participants were female, with a mean age of 87.1 years. The majority of participants had at least a high-school education. The mean length of stay in the residential care facility was 3.0 years. Eighty-five percent of the participants used a cane or walker. The mean score on the FMMSE was 23. There were an average of 2.3 diagnoses listed per subject. These diagnoses were categorized as cardiorespiratory (n=13), musculoskeletal (n=6), neurologic (n=3), mental (n=3), and other medical (n=2). Cardiorespiratory diagnoses included asthma, hypertension, and arteriosclerotic cardiovascular disease. Musculoskeletal diagnoses included lumbar disk disease, osteoarthritis, spondylolisthesis, osteoporosis, spinal stenosis, vertebral compression fracture, and status post-hip fracture. Neurologic conditions included status post-cerebrovascular accident, and mental conditions included paranoid behavior, schizophrenia, dementia, and depression. Other medical diagnoses included cholecystitis, diabetes, hypothyroidism and hyperthyroidism, glaucoma, abdominal hernia, and anemia.

Gait and Balance Outcomes

After physical therapy, there was improvement in balance over time, as measured by the Berg balance scale (P=.0003) and the Tinetti balance subscale (P=.01). Subjects improved by a mean of 5.6 points on the Berg balance scale, indicating that a subject was able to perform several activities better, or one additional activity. Sub-

Table 2. *Typical Treatment Protocol*

Week	Session	Treatment[a]
1	1	Initial evaluation
	2	M: Knee extension
		S: Straight leg raises, standing hip abduction
		CM: Step-ups
		Sk: Ambulation with walker in hallway
2	1	M: Heel-cord stretch
		S: Sidestepping
		CM: Standing squats, standing on one leg, static balance
		Sk: Ambulation indoors with walker emphasizing gait pattern
	2	CM: Challenge balance-eyes closed, tandem position
		Sk: Ambulation with cane emphasizing gait pattern ×61 m (200 ft)
	3	CM: Dynamic standing balance-reaching forward
		Marching in place
		Sk: Ambulation with cane assistance ×91.4 m (300 ft)
		Sit-to-stand transfer
3	1	Treatment to include activities listed above
	2	Sk: Ambulation ×121.9 m (400 ft) with cane
		Sit-to-stand transfer ×10
4	1	Sk: Ramps and stairs
	2	Sk: Sit-to-stand transfer with focus on speed
	3	Treatment to include activities listed above
5	1	Sk: Ambulation with cane across street
	2	Treatment to include activities listed above
	3	Reevaluation and discharge from physical therapy

[a]Treatment sessions could include exercises from previous sessions. Only new exercises for each session are listed. (M=mobility, S=stability, CM=controlled mobility, Sk=skill.)

jects improved by a mean of 1.1 points on the Tinetti balance subscale. Improvement in gait speed over time was not significant (P=.10), although subjects improved by a mean of 0.06 m/s. The Student-Newman-Keuls multiple-comparison procedure indicated that baseline means for both balance scales were lower than the other two time points at a joint significance level of 5%. These results are reported in Table 4.

Five subjects did not complete the 1-month follow-up due to refusal (n=3), pneumonia (n=1), and a move to another facility (n=1). One subject refused to complete the balance test because of injury.

The adherence rate for the physical therapy program was 91%. The adherence rate was defined as the number of visits in which the subject participated in physical therapy divided by the total number of scheduled sessions. Reasons for refusal were not always documented by the therapist; however, some of the documented reasons included lack of motivation, feeling tired, time conflicts with other activities such as bathing or meals, or feeling ill with a cold or asthma. No injuries were reported during any of the treatment sessions.

Table 3. *Characteristics of Participants (N=27)*[a]

Age (y)	
$\bar{X}$	87.1
SD	6.7
Range	71–97
Gender	
Female	93% (25)
Male	7% (2)
Education	
High school or less	74% (20)
Some college or graduated from college	22% (6)
Some graduate school or completed graduate school	4% (1)
Length of stay (y)	
$\bar{X}$	3.0
SD	2.3
Range	1–10
Walking aids	
No aid	11% (3)
Cane	33% (9)
Walker	52% (14)
Other	4% (1)
Folstein Mini Mental State Examination score	
$\bar{X}$	24
SD	3.7
Range	14–30
ADL[b]—percentage needing assistance	
Bathing	44% (12)
Dressing	4% (1)
Feeding	7% (2)
Diagnoses	
Musculoskeletal	22% (6)
Cardiorespiratory	48% (13)
Neurologic	11% (3)
Mental	11% (3)
Other medical	8% (2)

[a]Number of subjects shown in parentheses.

[b]ADL=activity of daily living.

Treatment Goals Documented by Physical Therapists

Physical therapists established an average of 3.4 treatment goals per subject. These goals addressed impairment and disability. Table 5 outlines treat-

Table 4. *Balance and Gait Speed Outcomes (N=27)*

	Baseline (N=27)	Postintervention (N=27)	1-Month Follow-up (N=21)	P
Berg balance scale				
$\bar{X}$	39.0	44.6	45.0	.0003[a]
SD	10.9	7.2	6.8	
Range	0–52	28–55	32–54	
Tinetti balance subscale				
$\bar{X}$	11.6	12.7	13.1	.01[a]
SD	2.4	2.4	2.3	
Range	7–15	8–16	9–16	
Gait speed (m/s)				
$\bar{X}$	0.40	0.46	0.46	.10
SD	0.14	0.18	0.19	
Range	0.15–0.70	0.14–0.86	0.11–0.95	

[a]Significant at .05 level.

ment goals and the frequency and proportion with which these goals were established for this group of elderly persons.

Treatment goals addressed both impairment and disability. One additional goal addressed performance in a home exercise program. Four goals were established more frequently than others. The goal most often set to address impairment was improved hip, knee, or ankle force in 11 (42%) of the subjects. Four of these subjects (36%) met this goal, as determined by the physical therapist. The goals most frequently established to address disability were improvement in walking with an assistive device (n=20, 77% of all subjects) and independent transfers (n=8, 31% of all subjects). Eighteen of these subjects (90%) improved in walking on level surfaces, with a decrease in the amount of assistance required, and 7 of these subjects (88%) improved in transfers, as determined by the physical therapist. Fewer subjects had additional treatment goals of independent ambulation on ramps (n =2, 8% of all subjects), stairs (n=3, 12% of all subjects), or walking across a street (n=3, 12% of all subjects). These specific goals may have been encompassed in the more general goal of improved walking. Eight percent of subjects had the goal of improving bed mobility, and 4% of subjects had the goal of independent dressing. Finally, 8 subjects (31%) had the goal of achieving independence in the performance of a home exercise program. Five of these subjects (63%) achieved this goal.

Discussion

Outcomes of the Intervention

This study demonstrated an improvement in balance following the intervention over time as measured by the Berg balance scale and the Tinetti balance subscale. This improvement in balance appears to be clinically meaningful because the mean change in the Berg balance score indicated that subjects were able to perform several activities better or one additional activity on the Berg test. Subjects also improved in functional ability, as demonstrated by the proportion of subjects who achieved treatment goals concerning functional performance. The ability of physical therapy to improve balance and functional performance is important as poor balance and limited functional performance are risk factors for falls and further institutionalization.[35,36]

Although subjects tended to improve in gait speed, the physical therapy did not result in a statistically significant improvement in this measure. The variation in baseline gait speed, however, was great, ranging from 0.15 to 0.70 m/s. Given the wide range, an increase of 0.06 m/s could equal improvement ranging from 7% to 43%. Given the short duration of treatment and the subjects' baseline level of functioning, physical therapists focused their treatment to improve balance, stability, and safety, and the improvement of gait speed may not have been a primary goal. Gait speed may be more important for a person at a higher level of functioning, such as a community ambulator, for whom studies have indicated that the minimum speed needed to cross a street safely is 0.81 m/s.[37]

The finding that subjects did not improve in gait speed differs from the findings of Judge and colleagues,[15] who found improvement in gait speed following a 12-week group exercise program. For our population of elderly persons in residential care facilities, the improvement of gait speed may require a longer duration of exercise. The reimbursement for physical therapy services, however, is often limited by insurers such as Medicare.[33] The high costs of individual physical therapy may justify continuation of the exercise program at a lower level of supervision, such as a group physical therapy program or a standardized maintenance program administered by trained staff at the residential care facility with periodic reevaluation by a physical therapist to determine the need for individualized intervention.

Treatment goals were focused on improving lower-extremity force, ambulation with an assistive device, and transfers. Fewer goals focused on the improvement of lower-level skills such as bed mobility. Elderly people needing assistance with bed mobility are more likely to live in a skilled nursing facility where they can receive constant supervision. Physical therapy for

Table 5. *Treatment Goals Established by Physical Therapists at the Initial Session (N=26)*

Treatment Goal	Goal Established		Goal Met	
	n[a]	%[b]	n[c]	%[d]
Impairment				
Improve strength	11	42	4	36
Decrease pain	5	19	1	20
Improve endurance	5	19	3	60
Increase lower-extremity range of motion	4	15	2	50
Decrease lower-extremity swelling	2	8	0	0
Improve posture	1	4	1	100
Disability				
Improve walking with assistive device	20	77	18	90
Independent ambulating on ramps	2	8	2	100
Independent ascending/ descending stairs	3	12	2	67
Independent walking across street	3	12	2	67
Independent transfers	8	31	7	88
Improve bed mobility	2	8	2	100
Independent dressing	1	4	1	100
Other				
Independent in home exercise program	8	31	5	63

[a]The number of subjects for whom the goal was established.

[b]The proportion of all subjects for whom the goal was established.

[c]The number of subjects who met the goal.

[d]The proportion of subjects for whom the goal was established who met the goal.

this frail population would consist of lower-level exercises and skill activities.[38] The effectiveness of physical therapy for a frailer nursing home population is being considered in other studies.[39]

Our results showed that the Berg balance scale was more sensitive than the Tinetti POMA balance subscale in measuring change after the physical therapy program. The strength of the Berg balance scale lies in its detailed five-point grading scale, which appears to be better at detecting balance impairment than a dichotomous grading scale as used in the POMA balance subscale. Topper et al[40] also describe this limitation of the POMA in identifying individuals who are at risk for falling. In addition, the Berg balance scale contains more activities on which to grade the subject. A limitation of the Berg balance scale, however, is that it takes longer to administer than the POMA balance subscale (15 minutes versus 10 minutes). Several subjects did not like being tested on the more difficult items (eg, touching a stool with alternating feet and standing on one leg). The Tinetti balance subscale was able to detect gross differences between normal and impaired balance, and was not as challenging to the subject. An advantage of the Tinetti balance subscale was its higher test-retest reliability as compared with the Berg balance scale.

A limitation of our study was the lack of a control group to ascertain true treatment effects from changes due to other factors such as inherent change over time or learning. One-week test-retest reliability coefficients on a subgroup of subjects for the Berg balance scale and the Tinetti balance subscale were high, suggesting a small chance of improvement due to learning. A factor that cannot be ruled out, however, is an effect due to increasing socialization, which would require a control group. A second limitation of the study was the time lag between initial assessment and initiation of physical therapy due to the logistics of scheduling treatment sessions with physical therapists. This time lag, however, would serve to minimize the treatment effect, resulting in a conservative estimate of our results.

Conclusions

The effectiveness of this physical therapy for older people living in residential care facilities has important implications. Physical therapy that can prevent, delay, or reverse functional decline can serve to prolong the independence of older people, so that they can remain in an independent living arrangement for a longer period of time. An independent living arrangement usually promotes a higher quality of life and is less costly than an institutionalized setting, such as a nursing home.

The results of this study justify further studies to test the effectiveness of physical therapy for improving functional performance in elderly individuals. Areas of further study include determining the types of elderly patients who are most likely to benefit from physical therapy, determining the optimal combination of exercises for functional gains according to Sullivan's model, determining the trade-offs between individualized versus group physical therapy in terms of functional outcome, and determining appropriate activities to maintain functional gains once individualized physical therapy has been discontinued. Other areas of study should address psychosocial factors that will improve a subject's motivation and compliance with physical therapy. Finally, a randomized clinical trial is needed to demonstrate the effectiveness of physical therapy for improving gait, balance, and functional performance.

Acknowledgments

We thank JoAnn Damron-Rodriguez, PhD, for her expertise in working with older adults living in residential care facilities. We also thank the physical therapy departments at the Veterans Administration Medical Center-West Los Angeles and Mount Saint Mary's College for their participation in this study. Susie Mais, PT, provided expertise and enthusiasm in working with older adults. We also thank Al Siu, MD, Laurence Rubenstein, MD, and Theodore Hahn, MD, for their thoughtful comments during the preparation of this manuscript.

References

1 Guccione AA. Implications of an aging population for rehabilitation: demography, mortality, and morbidity in the elderly. In: Guccione AA, ed. *Geriatric Physical Therapy*. St Louis, Mo: CV Mosby Co; 1993:4.

2 *Disability Statistics Program, University of California, San Francisco—People With Disabilities in Basic Life Activities in the United States: Disability Statistics Abstract*. Washington, DC: US Department of Education, National Institute on Disability and Rehabilitation Research; 1992.

3 Prohaska T, Mermelstein R, Miller B, Jack S. Functional status and living arrangements—health data on older americans: United States, 1992. *Vital Health Stat 3*. 1993;27:23–39.

4 Monk A, Kaye L. Congregate housing for the elderly: its need, function, and perspectives. In: Kaye LW, Monk A, eds. *Congregate Housing for the Elderly: Theoretical, Policy, and Programmatic Perspectives*. New York, NY: The Haworth Press Inc; 1991.

5 McCoy JL, Conley RW. Surveying board and care homes: issues and data collection problems. *Gerontologist*. 1990;30:147–153.

6 State of California, Health and Welfare Agency, Department of Social Services. *Manual of Policies and Procedures: Residential Facilities for the Elderly*. November 1991.

7 Damron-Rodriguez JA, Harada N. Residential care facilities for the elderly: a level of long-term care? *Gerontologist*. 1994;34:198.

8 Sullivan PE. Ambulation: an integrated framework to achieve a functional outcome. In: Guccione AA, ed. *Geriatric Physical Therapy*. St Louis, Mo: CV Mosby Co; 1993:253–268.

9 Stockmeyer SA. An interpretation of the approach of Rood to the treatment of neuromuscular dysfunction. *Am J Phys Med*. 1967;46:900–954.

10 Sullivan PE, Markos PD. *Clinical Procedures in Therapeutic Exercise*. East Norwalk, Conn: Appleton & Lange; 1986.

11 Harris BA, Dyreck DA. A model of orthopedic dysfunction for clinical decision making in physical therapy practice. *Phys Ther*. 1989;69:548–553.

12 Schenkman M, Butler RB. A model for multisystem evaluation, interpretation, and treatment of individuals with neurologic dysfunction. *Phys Ther*. 1989;69:538–547.

13 O'Hagan CM, Smith DM, Pileggi KL. Exercise classes in rest homes: effect on physical function. *NZ Med J*. 1994;107:39–40.

14 McMurdo ME, Rennie L. A controlled trial of exercise by residents of old people's homes. *Age Ageing*. 1993;22:11–15.

15 Judge JO, Underwood M, Gennosa T. Exercise to improve gait velocity in older persons. *Arch Phys Med Rehabil*. 1993;74:400–406.

16 Hulley SB, Feigal D, Martin M, Cummings SR. Designing a new study, IV: experiments. In: Hulley SB, Cummings SR, eds. *Designing Clinical Research*. Baltimore, Md: Williams & Wilkins; 1988.

17 Berg K. Balance and its measure in the elderly: a review. *Physiotherapy Canada*. 1989;41:240–246.

18 Berg K, Wood-Dauphinee S, Williams JI, Gayton D. Measuring balance in the elderly: preliminary development of an instrument. *Physiotherapy Canada*. 1989;41:304–311.

19 Berg K, Wood-Dauphinee S, Williams JI, Maki B. Measuring balance in the elderly: validation of an instrument. *Can J Public Health*. 1992;83:S7–S11.

20 Berg K, Maki B, Williams JI, Holliday PJ, Wood-Dauphinee SL. Clinical and laboratory measures of postural balance in an elderly population. *Arch Phys Med Rehabil*. 1992;73:1073–1080.

21 Tinetti ME. Performance-oriented assessment of mobility problems in the elderly. *J Am Geriatr Soc*. 1986;34:119–126.

22 Tinetti ME, Ginter SF. Identifying mobility dysfunction in the elderly. *JAMA*. 1988;259:1190–1193.

23 Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med*. 1988;319:1701–1707.

24 Tinetti ME, Williams TF, Mayewski R. Fall risk index for elderly patients based on number of chronic disabilities. *Am J Med*. 1986;80:429–434.

25 Perry J. *Gait Analysis: Normal and Pathological Function*. Thorofare, NJ: Slack Inc; 1992:431.

26 Harada N, Chiu V, Damron-Rodriguez J, et al. Screening for balance and mobility impairment in elderly individuals living in residential care facilities. *Phys Ther*. 1995;75:462–469.

27 Tinetti ME, Baker DI, Garrett PA, et al. Yale FICSIT: risk factor abatement strategy for fall prevention. *J Am Geriatr Soc*. 1993;41:315–320.

28 Robbins AS, Rubenstein LZ, Josephson KR, et al. Predictors of falls among elderly people: results of two population-based studies. *Arch Intern Med*. 1989;149:1628–1633.

29 Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189–198.

30 Kemp B. The psychosocial context of geriatric rehabilitation. In: Kemp B, Brummel-Smith K, Ramsdell JW, eds. *Geriatric Rehabilitation*. Austin, Tex: Pro-ed; 1990:53.

31 Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriatr Soc*. 1992;40:922–935.

32 *Medicare and Medicaid Guide*, Section 1833, October 21, 1993.

33 Hand DJ, Taylor CC. *Multivariate Analysis of Variance and Repeated Measures: A Practical Approach for Behavioural Scientists*. New York, NY: Chapman and Hall; 1987.

34 Glantz SA, Slinker BK. *Primer of Applied Regression and Analysis of Variance*. New York, NY: McGraw-Hill Inc; 1990:300–302.

35 Guimaraes RM, Issacs B. Characteristics of the gait in old people who fall. *Int Rehab Med*. 1980;2:177–180.

36 Gehlsen GM, Whaley MH. Falls in the elderly, part II: balance, strength, and flexibility. *Arch Phys Med Rehabil*. 1990;71:739–741.

37 Hoxie RE, Rubenstein LZ. Are older pedestrians allowed enough time to cross intersections safely? *J Am Geriatr Soc*. 1994;42:241–244.

38 O'Neil MB, Woodard M, Sosa V, et al. Physical therapy assessment and treatment protocol for nursing home residents. *Phys Ther*. 1992;72:596–604.

39 Mulrow CD, Gerety MB, Kanten D, et al. A randomized trial of physical rehabilitation for very frail nursing home residents. *JAMA*. 1994;271:519–524.

40 Topper AK, Maki BE, Holliday PJ. Are activity-based assessments of balance and gait in the elderly predictive of risk of falling and/or type of fall? *J Am Geriatr Soc*. 1993;41:479–487.