Home-Based Multicomponent Rehabilitation Program for Older Persons After Hip Fracture: A Randomized Trial

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ABSTRACT. Tinetti ME, Baker DI, Gottschalk M, Williams CS, Pollack D, Garrett P, Gill TG, Marottoli RA, Acampora D. Home-based multicomponent rehabilitation program for older persons after hip fracture: a randomized trial. Arch Phys Med Rehabil 1999;80:916-22.

Objective: To determine whether a home-based systematic multicomponent rehabilitation strategy leads to improved outcomes relative to usual care.

Design: A randomized controlled trial with 12 months of follow-up.

Setting: General community; 27 home care agencies.

Participants: Three hundred four nondemented persons at least 65 years of age who underwent surgical repair of a hip fracture at two hospitals in New Haven, CT, and returned home within 100 days.

Intervention: Systematic multicomponent rehabilitation strategy addressing both modifiable physical impairments (physical therapy) and activities of daily living (ADL) disabilities (functional therapy) versus usual care.

Main Outcome Measures: A battery of self-report and performance-based measures of physical and social function.

Results: There was no significant difference in the proportion of participants in the two groups who recovered to prefracture levels in self-care ADL at 6 months (71% vs 75%) or 12 months (74% in both groups) or in home management ADL at 6 months (35% vs 44%) or 12 months (44% vs 48%). There also was no difference between the two groups in social activity levels, two timed mobility tasks, balance, or lower extremity strength at either 6 or 12 months. Compared with participants who received usual care, those in the multicomponent rehabilitation program showed slightly greater upper extremity strength at 6 months ($p = .04$) and a marginally better gait performance ($p = .08$).

Conclusions: The systematic multicomponent rehabilitation program was no more effective in promoting recovery than usual home-based rehabilitation. Compared with previous cohorts, however, participants randomized to usual care in our study received more rehabilitative and home care services and experienced a higher rate of recovery. This finding is important given the current pressures to reduce home services. The challenge is to determine the composition and duration of rehabilitation and home services that will ensure optimal functional recovery most efficiently in older persons after hip fracture.

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THE INCIDENCE, MORBIDITY, and health care costs associated with hip fracture among older persons are well recognized. Almost 300,000 persons in the United States over the age of 65 years fracture a hip each year.[1] Among community-living survivors, the proportion returning to prefracture ambulatory status has ranged widely from 24% to 70%.[2,3] The rates of recovery in activities of daily living (ADL) within the year following a hip fracture have similarly varied from 25% to 50%.[2-5] Recognized risk factors for poor functional recovery following a hip fracture include older age, postfracture depression, lack of social supports, and poor prefracture physical and cognitive functioning.[2,4-6]

Most previous studies of the effect of rehabilitation on functional recovery after hip fracture have involved acute or subacute rehabilitation facilities; results of these investigations have been inconsistent.[3,7-13] Because the majority of community-living older persons who fracture a hip eventually return home,[14-16] much of postfracture rehabilitation occurs at home, either immediately after acute hospital discharge or after an inpatient rehabilitation stay.[17] Despite its frequency and rapid growth,[18] little is known about the process or outcomes of home-based rehabilitation after hip fracture. In the few such studies reported, programs of enhanced home care services have led to earlier hospital discharge and lower costs, but not to increased functional independence.[19,20]

Home-based rehabilitation after hip fracture typically includes various combinations of muscle strength conditioning, ambulation, transfer, and balance training administered by a physical therapist. The specific components and intensity of training remain largely at the discretion of the individual therapists.[21] Although assistance with self-care ADL often is provided by home care aides, most hip fracture patients receive limited retraining in self-care tasks (eg, dressing, toileting) and almost no retraining in home-management activities by occupational therapists or rehabilitation nurses.[22] A recent meta-analysis suggested that older persons might benefit from rehabilitative therapy aimed at ADL disabilities after acute illnesses or injuries.[23]

The purpose of this randomized controlled clinical trial was to determine whether a comprehensive rehabilitation strategy, addressing both modifiable physical impairments and ADL disabilities, would result in enhanced recovery in physical and social functioning after a hip fracture. The specific aim was to determine whether our systematic multicomponent rehabilita-

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tion (SMR) strategy leads to improved functional outcomes relative to usual care (UC) among nondemented older persons who return to community living after a hip fracture.

METHODS

Participants and Setting

The study was approved by the institutional review board; informed consent was obtained from all participants. Potential participants were the 730 community-living persons at least 65 years of age who underwent surgical repair of a hip fracture at one of the two local hospitals between May 1, 1993 and September 30, 1995. A two-stage screening strategy was used for this trial because final eligibility, including return to the community, could not be determined for patients who were transferred to a subacute rehabilitation facility at the time of hospital discharge. The flow of patients through screening and enrollment is shown in figure 1. Exclusion criteria for the initial, hospital-based, screen included known dementia or failed cognitive screen (Folstein Mini Mental Status Exam (MMSE) score less than 24[24] plus Blessed Dementia Rating less than 4[25]); known terminal illness defined as a life expectancy less than 1 year or died in the hospital; or lived more than 25 miles from the two hospitals (fig 1). The 452 patients who passed the initial screen were randomized to the SMR or UC group, stratified by prefracture functional level (independent in all self-care ADL or not) and by initial discharge location (directly home or to a subacute facility).[26] The 107 patients who were discharged directly home were enrolled at the time of hospital discharge.

Among the 345 patients who were discharged initially to a subacute facility, 26 were unable to undergo the final, subacute facility–based, screen because no study staff were available. The remaining 319 potential participants were screened by nurse assessors blinded to group assignment; 105 proved ineligible on this final screen, for the reasons shown in figure 1. Patients remaining beyond 100 days, the period covered by Medicare, were excluded because the majority of these patients were being treated for comorbidities and most did not return to the community.[1,14,15] Of the 214 patients initially discharged to a subacute facility who met both initial and final eligibility criteria, 197 (92%) agreed to participate and were enrolled. The final number of participants enrolled was 304, of whom 148 were randomized to the SMR group and 156 to the UC group. Compared with the 304 persons included in the trial, the 52 eligible persons who refused to participate (35 from the initial screen and 17 from the final screen) were more likely to be female (92% vs 82%; $p = .062$) and to score slightly lower on the MMSE (26.0 [3.0] vs 26.9 [2.7]; $p = .095$). These two groups did not differ by age, race, type of fracture or repair, or hospital length of stay.

The sample size of 304 was selected to detect a clinically meaningful 33% difference in the proportion of participants attaining complete independence in self-care ADL between the SMR and UC groups, setting α and β set at .05 and .20, respectively, and assuming a 10% loss to follow-up.[27] This sample size provided a power of $>.90$ at $\alpha = .01$ to detect a 33% difference in mean scores between the two groups for all the quantitative outcomes described below.

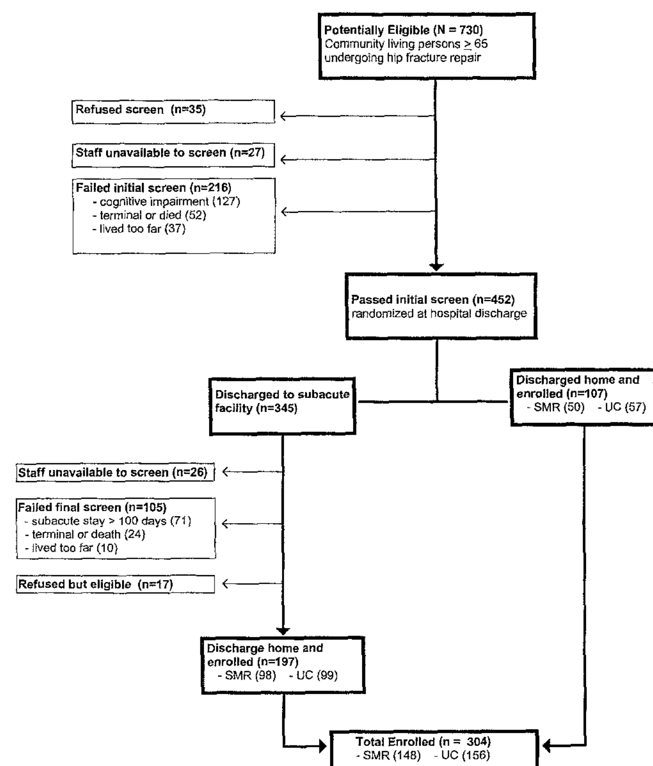

Fig 1. Randomization of patients. SMR, systematic multicomponent rehabilitation; UC, usual care.

Home-Based Rehabilitation

All home health and home-based rehabilitative services were provided through one of 27 Medicare-certified home care agencies in the southern Connecticut area. Participants randomized to SMR received their physical therapy (PT) and functional therapy (FT) from our study PT and rehabilitation nursing staff. Participants randomized to UC received their PT through staff employed by the home care agencies. All other home care services, including home care nursing and home health aides, were provided by the home care agencies without regard to treatment group.

The SMR strategy, which linked assessment results to specific intervention recommendations, has been described in detail previously.[28] Briefly, the PT component of the intervention was designed to identify and ameliorate impairments in upper and lower extremity strength, balance, transfers, gait, and stair climbing. Interventions for gait, transfers, and bed mobility involved instruction in safer, more effective techniques, procurement of and training in use of assistive devices, and environmental modifications. Participants were instructed in the performance of progressive, competency-based exercises for balance (five levels), for upper and lower extremity conditioning (using four levels of color-coded resistive bands) and, if indicated by the baseline assessment, for specific muscle and joint groups. Participants then were asked to complete their exercise programs by themselves once each day. To enhance and monitor adherence to the daily exercise programs, participants completed an exercise checklist each day.

The FT component of the intervention, based on the principles of occupational therapy, was designed to identify and improve inefficient and/or unsafe performance of tasks of daily life. A rehabilitation nurse, in consultation with an occupational therapist, administered the FT program. The assessment component, based on Occupational Therapy Functional Assessment Compilation (OTFACT),[29] involved observed performance of medication management, oral care, eating, toileting, grooming, bathing, dressing, meal preparation, laundry, dishwashing, housekeeping, and shopping. Each of these activities was broken down into prespecified tasks. For tasks performed

unsafely or ineffectively, the rehabilitation nurse determined which of 12 impediments (memory, problem-solving, decreased motivation, low confidence [fear], pain, decreased activity tolerance [endurance], vision, hearing, coordination [fine motor], strength, range of motion, or balance) she felt contributed to this unsafe or ineffective performance. Interventions targeted task performance based on the identified impediments and included: (1) task modification; (2) use of adaptive equipment; (3) environmental modifications; (4) psychological interventions (to enhance confidence or motivation); (5) caregiver (usually family) education and involvement; and (6) referral to other healthcare providers (eg, to physician for treatment of depression or pain).

For both PT and FT, the number of visits was tapered over time. Specific criteria and decision rules that linked assessment results with the appropriate interventions were developed for PT and FT. Criteria for progression in each area were also articulated. These rules and criteria were reported previously[29] and were included in a detailed procedure manual. The SMR intervention continued for up to 6 months.

The UC intervention consisted of traditional PT provided by physical therapists employed by the home care agencies. Only a few of the participants received occupational therapy from the home care agency. As is typical in home care, the specific content and duration of the therapy training program for UC patients was left to the discretion of the individual therapists. The usual home care physical therapists noted that they instructed their patients in gait and transfer training and provided strengthening and range of motion exercises, usually without resistive bands or weights. No usual care patients received FT.

Descriptive and Outcome Data Collection

A nurse researcher, not involved in treatment and blinded to participants' treatment group, performed the baseline and follow-up assessments. During the baseline assessment, which took place prior to hospital or subacute facility discharge, the nurse researcher ascertained age, gender, race, educational level, prefracture living situation, depressive symptoms using the 10-item Center for Epidemiologic Studies–Depression Scale (CES-D),[30] social supports using the MacArthur Battery,[31] body mass index, vision,[32] and hearing.[33] Medical records were reviewed to ascertain type of fracture and repair; presence of chronic conditions; and postfracture complications, defined as deep venous thromboses, pulmonary emboli, pneumonia, urinary sepsis, myocardial infarction, or congestive heart failure.

The nurse assessor also administered a battery of self-report and performance measures at baseline and again 6 and 12 months after hip fracture in participants' homes. The primary outcome was self-reported function in seven self-care (basic) ADL (eating, grooming, toileting, bathing, dressing, getting from bed to chair, and walking across a small room) and in seven home management ADL (handling medications, using the telephone, preparing simple meals, doing light and heavy housework, doing laundry, shopping, and using transportation).[34,35] Each self-care and home management ADL was scored 0 (does not do), 1 (does with human help), or 2 (does without human help). These scores were aggregated into a composite self-care ADL score that ranged from 0 to 14, and a home management ADL score that also ranged from 0 to 14. For both of these outcomes, we calculated the proportion of participants who performed all activities without human help (complete independence) and the proportion who scored at least as well at follow-up as before the fracture (recovery). A secondary outcome, social activity, was ascertained using a scale adapted from the Established Populations for Epidemiologic Studies of the Elderly (EPESE) interview.[36] The frequency of 10 groups of social activities (attending events; shopping at malls; trips; volunteer work; paid work; visiting at friends or relatives' homes; attending religious services; participating in groups; caring for or helping a friend or relative; and talking on the telephone with friends, neighbors, and relatives) was summed into a scale based on the frequency for each activity. Categories included less than once a month (0), 1 to 4 times per month (1), and more than four times per month (2). Social activity score was the aggregate of frequency ratings for each of these 10 groups of activities. The range of possible social activity scores was 0 to 20.

The battery of performance-based measures was administered to assess mobility tasks, balance, gait, and strength. The timed mobility measures included the time required to stand from a chair three times,[37] to walk 10 feet, turn, and walk back,[36,37] and to climb a flight of stairs. The Berg Balance Scale was used to assess balance.[38] The items, each scored 0 to 4 based on qualitative assessment, included sitting unsupported, transferring sit-to-stand, standing unsupported with feet together with eyes opened then closed, standing on one leg, transferring stand-to-sit, transferring chair to chair, reaching forward with outstretched arm, looking behind shoulder, standing tandem, stepping up, picking up a pencil from the floor, and turning 360°. A higher score reflected better performance; the possible range was 0 to 52. Because several items are unsafe or contraindicated after hip fracture or in posthemiarthroplasty patients, only sitting unsupported, transferring sit-to-stand, standing unsupported with feet together, standing with eyes closed, transferring stand-to-sit, standing on one leg, transferring chair to chair, and turning 360° were tested at baseline. The qualitative assessment of gait included five items from the gait component of the Performance-Oriented Mobility Assessment (POMA), namely step continuity and symmetry, path deviation, turning, and missed steps.[39] Possible scores ranged from 0 to 8. One repetition maximum (1 RM) of the triceps and knee extensors, using lead shot pouches, was used to measure upper and lower extremity strength, respectively. The nondominant arm and nonfractured leg were tested. To accommodate modifications required because of the fracture, all strength testing was performed in a supine position with a flexion (quad) board used for lower extremity testing. One RM was defined as the maximum amount of weight in pounds a participant could lift through a full range of motion.

Adverse events, including falls, musculoskeletal pain or injuries, and hospitalization were ascertained at 3 months (by telephone) and 6 months (during the home interview) on all participants by an assessor blinded to treatment group.

Statistical Analysis

Baseline clinical and demographic characteristics of the SMR and UC groups were compared by t tests for continuous measures or chi-square tests for categorical variables. These comparisons were also stratified by initial discharge location to ensure that the treatment groups were similar among both those discharged directly home and those with a subacute stay.

For the primary functional endpoints of self-care and home management ADL at 6 and 12 months after fracture, the SMR and UC groups were compared in two ways. First, the two groups were compared with respect to the proportion of participants recovering to their prefracture level of functioning. Second, the proportions of the two groups reaching complete independence (ie, a score of 14 on each scale) at each time point were compared. These differences were assessed via Cochran-Mantel-Haenszel chi-square,[40] adjusted for initial posthospital

discharge location (home or subacute facility). There was no evidence of heterogeneity between the two discharge groups.

For social activities and the physical performance outcomes, the primary analytic strategy was analysis of covariance (ANCOVA)[41] to test for differences in the amount of improvement in performance between the two groups from baseline to 6 months and baseline to 12 months. In ANCOVA, between-participant variation in baseline measurements is taken into account by using each participant's baseline value as a covariate in a linear model for treatment comparisons of posttreatment (6 and 12 month) means. Because initial discharge location (home or subacute facility) was a stratification factor in the randomization procedure, a variable indicating discharge stratum was included in all models.

We did not use repeated measures methods for analysis because we were interested in examining both the shorter-term (6 month) and longer-term (12 month) effects of the intervention.

RESULTS

Participants randomized to the two groups were well matched on baseline demographic, health, and functional characteristics; type of fracture and repair; and the occurrence of postoperative complications (table 1). A similar proportion (66% of SMR versus 63% of UC participants) experienced a subacute facility stay before returning home. There were no differences in prefracture or fracture-related characteristics between SMR and UC participants in either the subgroup who returned directly home or the subgroup who experienced an initial subacute facility stay.

Table 1: Baseline Characteristics According to Treatment Group

Characteristic	SMR (*n* = 148)	UC (*n* = 156)
Age (yrs)	80.5 ± 7.0	79.4 ± 7.8
Female	123 (83)	126 (81)
White	146 (99)	153 (98)
Education (yrs)	11.3 ± 3.1	11.8 ± 3.0
Lived alone prefracture	77 (52)	73 (47)
Folstein MMSE	26.7 ± 2.7	26.9 ± 3.0
Depressive Symptoms (CES-D)	6.6 ± 3.6	7.0 ± 4.1
No. chronic conditions	1.8 ± 1.5	1.8 ± 1.4
No. medications	3.2 ± 3.1	3.0 ± 3.1
Hospitalization in the year prior to fracture	13 (9)	20 (13)
Prefracture functioning		
Self-care ADL*	13.8 ± 0.7	13.7 ± 0.9
Independent in all self-care ADL	131 (89)	136 (87)
Home management ADL*	10.8 ± 2.9	10.6 ± 3.0
Independent in all home management ADL	30 (20)	35 (22)
Social activities*	6.9 ± 3.2	6.7 ± 3.6
Type of fracture-femoral neck	84 (57)	78 (50)
Type of surgery-arthroplasty	36 (24)	44 (28)
Postoperative complications†	24 (16)	19 (12)
Hospital length of stay (days)	12.2 ± 9.3	12.0 ± 7.1
Weight-bearing status at hospital discharge		
Full	26 (18)	23 (15)
As tolerated	59 (40)	67 (43)
Partial	38 (26)	51 (33)
Toe-touch	23 (16)	11 (7)
Non–weight bearing	2 (1.4)	4 (3)
Initial subacute rehabilitation stay	98 (66)	99 (63)

Data reported as mean ± standard deviation for continuous variables and number (%) for categorical variables. None of the *p* values for between-group comparisons was <.10.
Abbreviations: SMR, systematic multicomponent rehabilitation; UC, usual care.
* Refers to month prior to fracture. See Methods for definition.
† Includes deep venous thrombosis, pulmonary embolus, pneumonia, myocardial infarction, congestive heart failure, sepsis.

Table 2: Activities of Daily Living Outcomes at 6 and 12 Months After Hip Fracture According to Treatment Group

Outcome*	SMR *n* (%)	UC *n* (%)	χ^2 †	*p* Value
Self Care ADL				
Recovery				
6mo	98 (71)	107 (75)	.722	.40
12mo	101 (74)	102 (74)	.019	.89
Complete independence				
6mo	93 (67)	101 (71)	.482	.49
12mo	98 (73)	95 (69)	.471	.49
Home Management ADL				
Recovery				
6mo	48 (35)	62 (44)	2.097	.15
12mo	60 (44)	66 (48)	.289	.59
Complete independence				
6mo	12 (9)	23 (16)	3.389	.07
12mo	25 (19)	34 (25)	1.458	.23

Abbreviations: SMR, systematic multicomponent rehabilitation; UC, usual care; ADL, activities of daily living.
* The denominator for the 6-month outcomes was 281 and for the 12-month outcomes was 272. Recovery was defined as a score at follow-up at least as high as before the fracture.
† Cochran-Mantel-Haenszel χ^2 adjusted for initial posthospital discharge location (home or subacute facility).

Self-care and home management ADL outcomes are shown in table 2. Eleven participants (5 SMR; 6 UC) died before the 6-month assessment as did eight participants (3 SMR; 5 UC) between the 6- and 12-month assessment. An additional 12 persons (4 SMR; 8 UC) refused each of the 6-month and the 12-month assessments. There were no significant differences in functional outcomes between SMR and UC participants. A high proportion of both groups reported recovery and complete independence in self care ADL at 6 and 12 months. There was a trend ($p = .07$) toward a higher proportion of UC participants reporting complete independence in home management ADL at 6 months compared with SMR participants. In stratified analyses, there were no differences in functional outcomes by treatment group between persons discharged directly home or to a subacute facility or between persons who were completely independent in self-care ADL before the fracture and those who were not.

Participation in social activities was compared between the SMR and UC groups at 6 and 12 months. The mean (SE) social activity scores at 6 months, adjusted for discharge location and prefracture social activity score, for the SMR and UC groups were 6.17 (.24) and 6.71 (.23) ($p = .10$), respectively. The comparable scores at 12 months were 6.77 (.29) and 7.22 (.28), ($p = .25$).

The physical performance outcome measures are shown in table 3. The only measure significantly different between the two treatment groups was upper extremity strength at 6 months; the qualitative gait measure was marginally better at 6 months in the SMR than UC group. Again, stratified analyses did not reveal differences by treatment group according to whether participants were discharged directly home or to a subacute facility or whether or not participants were completely independent in self-care ADL prior to the fracture.

Participants randomized to SMR were slightly more likely

Table 3: Physical Performance at 6 and 12 Months After Hip Fracture According to Treatment Group

Outcome*	SMR	UC	*p* Value
Chair stand time (sec)			
6mo	13.98 (.68)	14.36 (.66)	.68
12mo	15.51 (.71)	15.17 (.69)	.72
Stair climb time (sec)			
6mo	23.63 (2.14)	26.41 (2.16)	.35
12mo	26.32 (2.38)	23.30 (2.22)	.35
Modified Berg balance			
6mo	31.48 (.94)	31.27 (.91)	.87
12mo	31.25 (.98)	30.89 (.94)	.79
Qualitative gait			
6mo	6.09 (.15)	5.75 (.14)	.08
12mo	6.05 (.16)	5.97 (.15)	.51
Quantitative gait (m/sec)			
6mo	.44 (.01)	.42 (.01)	.54
12mo	.47 (.01)	.47 (.01)	.79
Upper extremity strength (pounds)			
6mo†	7.70 (.28)	6.91 (.27)	.04
12mo	7.08 (.26)	7.34 (.25)	.46
Lower extremity strength (pounds)			
6mo	12.17 (.49)	12.56 (.44)	.55
12mo	13.65 (.42)	13.66 (.38)	.99

Values reported as mean (SE). Means and standard errors are adjusted for discharge location and baseline score (except for chair stand time and stair climb time, which were not assessed at baseline).
* See Methods for full definitions of outcome measures.
† Indicates that treatment X baseline interaction term was significant ($p < .05$); model was additionally adjusted for this term.

than UC participants to report musculoskeletal pain related to exercise (59% vs 48%; $p < .07$) and to stop exercising because of pain (19% vs 11%; $p < .06$). No participant withdrew from the SMR because of pain or discomfort. There was no difference between SMR and UC groups in the proportion reporting falls (19% vs 17%) or hospitalizations (11% vs 13%) during the 6 months after hip fracture. A similar proportion of SMR and UC participants reported using a walker at 6 months (36% versus 38%); SMR participants were more likely than UC participants to use a cane at 6 months (64% vs 49%; $p = .013$). Eleven percent of SMR and 24% of UC participants were using no assistive device at 6 months ($p = .004$).

The number of rehabilitative and home care service visits received by participants in the 6 months after hip fracture are shown in table 4. A total of 146 (99%) of the 148 SMR and 143 of the 156 (92%) of UC participants received at least one rehabilitation visit after returning home. SMR participants received a greater number of physical therapy visits than UC participants. Both groups received a similar number of occupational therapy and home health nurse services. While a similar proportion of SMR and UC participants received home health aide services, SMR participants received a slightly greater number of visits than participants in the UC group (table 4).

In the SMR group, 104 participants (70%) completed the PT and FT program, 4 completed PT but refused FT, and 6 refused PT and FT after the initial visit, the same number as refused PT in the UC group. Two SMR participants were admitted to nursing homes before home therapy could begin. The proportion of SMR participants receiving various components of the PT intervention were as follows: upper extremity strengthening exercises, 73%; lower extremity strengthening exercises, 84%; balance exercises, 94%; transfer training, 84%; gait training, 94%; and stair training, 84%. More than half of the 148 participants (56%) reported performing at least 70% of the prescribed daily strengthening and balance exercises; 77% reported completing the exercises more than half the time (at least three times per week). For the FT component, the number and proportion of SMR participants meeting criteria who received interventions for activities included: eating, 10 of 14 (71%); oral hygiene, 10 of 11 (91%); grooming, 19 of 30 (63%); toileting, 37 of 37 (100%); bathing, 106 of 106 (100%); dressing, 92 of 92 (100%); meal preparation, 74 of 74 (100%); laundry, 21 of 41 (51%); housekeeping, 10 of 31 (32%); and shopping, 8 of 59 (14%). Other than the number of visits and duration of services (length of stay) no data on details of home care or rehabilitative services or adherence to prescribed exercise programs are available for UC participants, as this was left to the discretion of the UC therapists.

DISCUSSION

In this randomized controlled trial, no self-reported functional, and only two physical performance, outcomes were even marginally better among participants who received the more SMR program than among those who received usual based rehabilitation. In fact, a slightly greater proportion of participants who received UC, compared with SMR, reported independence in their home management ADL by 6 months postfracture. The only physical performance measure significantly better in the SMR than UC group was upper extremity strength at 6 months. In addition, the SMR group manifested marginally better qualitative gait performance than the usual care group at 6 months. Stratified analyses did not identify subgroups of SMR participants, based on either initial discharge location (home or

Table 4: Rehabilitative and Home Care Services Received by SMR and UC Participants Within the 6 Months After Hip Fracture

Service	SMR (*n* = 148)	UC (*n* = 156)
Physical therapy*		
No. (%) receiving	146 (99)‡	143 (92)
No. visits for those receiving: median (range†)	25 (19-32)‡	13 (7-20)
Functional therapy*		
No. (%) receiving	136 (92)‡	—
No. visits for those receiving: median (range†)	12 (10-15)‡	—
Occupational therapy		
No. (%) receiving	16 (11)	13 (9)
No. visits for those receiving: median (range†)	8 (5-13)	3 (1-9)
Home health nurse		
No. (%) receiving	124 (84)	120 (77)
No. visits for those receiving: median (range†)	7 (3-13)	8 (4-14)
Home health aide		
No. (%) receiving	108 (73)	105 (67)
No. visits for those receiving: median (range†)	32 (18-52)	24 (12-46)

Abbreviations: SMR, systematic multicomponent rehabilitation; UC, usual care.
* SMR participants who had an initial subacute stay received a median of 23 physical therapy and 13 functional therapy visits. The comparable number for SMR participants discharged directly home were 28 and 11. UC participants with an initial subacute stay received a median of 11 physical therapy visits versus 15 visits for UC participants discharged directly home.
† Interquartile range.
‡ Physical and functional therapies were provided by the study team. All other rehabilitative and home services were provided by the home care agencies.

subacute facility) or prefracture level of independence in self-care ADL, who did significantly better on either self-report or performance measures than comparable UC participants.

There are several possible explanations for the lack of greater effect of the longer, more comprehensive intervention strategy offered to the SMR participants compared with UC. First, although lack of adherence to the recommended protocols might have diluted the potential benefit, the vast majority of SMR participants who met criteria for an intervention received it from the physical therapist or rehabilitation nurse unless there was a clear contraindication. Self-reported adherence to the balance and strength training exercise programs by SMR participants was good to excellent. Similarly, with the exception of three home management activities (housekeeping, laundry, and shopping) as discussed below, participants participated in the indicated FT interventions.

Second, the lack of added benefit of the SMR strategy was particularly obvious in the home-management ADL. As we reported previously, many participants were reluctant to engage in home management tasks such as housekeeping, shopping, and laundry for various reasons, including concerns about safety.[28] The heightened awareness to deficits in performance of these household tasks may have led SMR participants and their families to set up alternative strategies (eg, increased family participation or hiring housekeepers) for carrying out these tasks. Furthermore, several participants in the SMR group raised concerns about losing their home health aides if they became more independent.[28] Of note, participants in the SMR group received a greater number of home health aide visits than participants in the UC group even though their impairment and disability levels were similar at baseline. While it is not possible to determine whether there was any causal relationship between FT and the increased use of home health aides as ordered by the home care staff separate from the project staff, this finding does suggest the importance of determining which strategies might support, rather than impede, optimal functional independence and recovery. As is often the case when variations are seen among comparable patients, it is difficult to determine what level of health services is optimal.[17,42-44] For example, did the increased attention from the rehabilitation nurse result in increased home services and family participation, thus allowing participants appropriately to curtail unsafe behaviors, or did it foster greater dependence unnecessarily? Although this important question cannot be answered by the data available in our study, the UC group, while receiving fewer home health aide visits, did not experience more adverse events such as falls or hospitalizations.

Third, it is important to note that participants in both the SMR and UC groups experienced greater recovery in self-care ADL and gait than has been reported in previous observational studies of hip fracture patients.[2,4-6] Indeed, it was the greater than expected improvement in the UC participants that largely explained the lack of effect of the SMR on self-care ADL. For example, the 70% of participants in both groups who reported complete independence in self-care ADLs at 6 and 12 months contrasts with the 25% to 50% reported in earlier studies.[2,4-6] When compared with the general population of individuals with a disease, persons willing to participate in randomized controlled trials often have a better prognosis, an entity referred as "volunteer effect." Because we enrolled more than 85% of eligible participants, however, it is unlikely that volunteer effect alone was responsible for the better than expected outcomes among UC participants. Rather, the exclusion of cognitively impaired persons, necessary because of the unsupervised nature of the home-based exercise programs, likely explains much of the discrepancy in recovery seen in this versus earlier studies. This finding would suggest that cognitive impairment, rather than the hip fracture per se, may explain much of the previously reported poor recovery after hip fracture.[4,5]

Fourth, another probable explanation for the greater recoveries seen in our study was the increase in rehabilitative services provided to both UC and SMR participants relative to the period covered in earlier studies. The conduct of this intervention trial coincided with an increase in Medicare-covered subacute facility use for rehabilitation and with a marked increase in utilization of Medicare-covered home services. Connecticut was one of the states with the highest utilization of Medicare-covered home services, including physical therapy.[18] This increase is evidenced by the fact that the median duration of home services for hip fracture patients by one of the participating home care agencies during a pilot phase in 1990 was 34 days versus the average duration of home services of 68.5 days (median 59 days) during our trial in the mid 1990s. Our findings do at least raise the possibility that the high utilization seen in usual care during this trial may have accounted for the better than expected outcomes in the UC group. This possibility is particularly important to consider because of the emphasis in the Balanced Budget Act of 1997 on reducing the intensity and duration of home services.[45]

A final consideration is whether 6 months of intervention was a sufficient period of time to see the maximal benefit of our SMR intervention. There was little improvement noted in SMR or UC participants between 6 and 12 months. This may be because either participants had reached their maximum level of recovery or the intervention had ended before participants reached their full potential. The challenge that remains is to determine the composition and duration of rehabilitation and home services that ensures optimal functional recovery most efficiently in older persons who fracture a hip.[17]

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