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Effects of an individually targeted multicomponent counseling and home-based rehabilitation program on physical activity and mobility in community-dwelling older people after discharge from hospital: a randomized controlled trial

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Abstract

Objectives: The aim of this study is to evaluate the effects of multicomponent rehabilitation on physical activity, sedentary behavior, and mobility in older people recently discharged from hospital.
Design: Randomized controlled trial.
Setting: Home and community.
Participants: Community-dwelling people aged ⩾60 years recovering from a lower limb or back musculoskeletal injury, surgery, or disorder were recruited from local health center hospitals and randomly assigned into an intervention ($n=59$) or a control (standard care, $n=58$) group.
Intervention: The six-month intervention consisted of a motivational interview, goal attainment process, guidance for safe walking, a progressive home exercise program, physical activity counseling, and standard care.

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Measurements: Physical activity and sedentary time were assessed using an accelerometer and a single question. Mobility was evaluated with the Short Physical Performance Battery, self-reported use of a walking aid, and ability to negotiate stairs and walk outdoors. Intervention effects were analyzed with generalized estimating equations.
Results: Daily physical activity was 127 ± 78 minutes/day and 121 ± 70 at baseline and 167 ± 81 and 164 ± 72 at six months in the intervention and control group, respectively; mean difference of 3.4 minutes (95% confidence interval (CI) = –20.3 to 27.1). In addition, no significant between-group differences were shown in physical performance.
Conclusion: The rehabilitation program was not superior to standard care for increasing physical activity or improving physical performance. Mobility-limited older people who had recently returned home from hospital would have needed a longer and more frequently monitored comprehensive geriatric intervention.

Keywords
Aging, sedentary behavior, mobility function, accelerometer, intervention

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Introduction

Adequate physical activity is crucial for mobility recovery after hospitalization, maintaining the effects of rehabilitation, and preventing mobility disability in the long term.[1–3] Hospitalization is commonly characterized by bed rest with little physical activity, a situation that can have severe long-term consequences.[4,5] First, following hospitalization, 40% of older adults experience a catastrophic decline in their walking ability.[6,7] Second, many are no longer able to manage in their daily activities on their return home.[8] Third, some have still not regained their former level of physical activity or mobility by the end of the first year after discharge home.[9]

Successful recovery, referring to improvements in mobility and return to the previous level of physical activity, has typically been studied using self-reports rather than accelerometers. However, a few earlier studies have shown that physical activity not only declines after hospitalization but also remains at a very low level for an extended period.[10,11] For example, even at 12 months post-surgery, physical activity among hip fracture patients was only 215 minutes/day.[11] This is below the expected value in this age group and far below the recommended level for older adults.[12,13]

Home-based rehabilitation and counseling programs are important for older people who, because of poor health and mobility limitations, cannot attend supervised training sessions outside the home immediately after hospitalization. In our previous study among older hip fracture patients, a home-based multicomponent rehabilitation program with minimal supervision increased the self-reported level of physical activity[14] and improved mobility[15] recovery over standard care. In a recent secondary analysis of data from a large randomized controlled trial of community-living older persons, a highly supervised physical activity program that began before hospitalization did not enhance accelerometer-derived activity recovery after hospitalization.[10] To the best of our knowledge, no previous randomized controlled trials have utilized accelerometers and reported the effects of a home-based program that emphasizes physical activity counseling and self-directed physical training among older people who have been recently discharged home from hospital.

We investigated the effects of a multicomponent home-based rehabilitation program on physical activity, sedentary behavior and mobility among community-dwelling men, and women aged 60 years or older after hospitalization for a lower limb or back musculoskeletal injury or disorder. We hypothesized that compared to standard care only, an additional physical activity promotion program would increase overall physical activity and restore mobility among older adults recently discharged from hospital.

Methods

A parallel-group randomized controlled trial was conducted from 1 February 2016 to 28 February 2018. The trial was registered prospectively with the ISRCTN registry (ISRCTN13461584) and received ethical approval from the research ethics committee of the Central Finland Health Care District (Dnro 3U/2014). This study was conducted by the GeroCenter Foundation for Aging Research and Development in close collaboration with the Gerontology Research Center at the University of Jyväskylä and the health center hospitals of the Jyväskylä Cooperation Region. Participants gave their written informed consent before entering the study. A detailed description of the study has previously been published.[16]

Recruitment was implemented at two health center hospitals in the city of Jyväskylä, Finland. Briefly, a research nurse reviewed the medical records of community-dwelling men and women aged 60 and older who had been admitted to a health center hospital due to a lower limb or back musculoskeletal injury or disorder, including limb or back surgery (e.g. hip fracture, joint replacement, aggravated arthritis), or a fall-related injury. This target group was chosen, as injury and/or surgery of the lower limb or back typically compromise physical activity and mobility.[4] Patients meeting the inclusion criteria were given information about the study by a researcher. Patients who suffered from severe cognitive deficit (Mini-Mental State Examination[17] (MMSE) < 20), alcoholism, or a severe progressive disease were excluded.

Random allocation to either the intervention (standard care plus the six-month rehabilitation program) or control (standard care only) group took place immediately following the baseline assessments. Randomization was completed by a statistician, not involved in the trial, using a computer-generated random number sequence and concealed opaque envelopes. Randomization was stratified by gender, age (60–84 or $\geqslant 85$ years), and baseline gait speed (<0.4 or $\geqslant 0.4$ m/s) and executed in blocks of 10.

The baseline assessments were started during hospital stay and were finalized at the participant's home within two weeks of discharge from hospital, including questionnaires/interview, performance tests, and six-day accelerometer recordings. The assessments were repeated at three and six months thereafter. Moreover, participants were followed up for a further six months to collect self-reports on physical activity, mobility limitations, and use of healthcare services.

The primary outcome was total activity per day in minutes using a three-dimensional accelerometer (Hookie AM20 Activity Meter, Hookie Technologies Ltd., Espoo, Finland and UKK RM42, UKK Institute, Tampere, Finland). An accelerometer was attached to the non-affected anterior thigh with transparent, adhesive film (Opsite Flexigrid, Smith & Nephew, United Kingdom) for six consecutive days to measure acceleration at baseline and at three and six months thereafter. We also classified physical activity into light, moderate, and vigorous intensity for the secondary analyses. Intensity of physical activity was estimated using the mean amplitude deviation (MAD) of acceleration analyzed in five-second epochs.[18] The data at each intensity were analyzed in minutes, and hence, time spent in physical activity at different intensities was reported in minutes per day. MAD-based cut-points for light ($0.0605 >$ Mean Amplitude Deviation $\geqslant 0.0167$ g), moderate ($0.5827 \geqslant$ Mean Amplitude Deviation $\geqslant 0.0605$ g), and vigorous (Mean Amplitude Deviation > 0.5827 g) activity plotted against oxygen uptake across a range of walking speeds among older adults have previously been validated in our treadmill tests. Time spent in moderate and vigorous physical activities were combined in the analyses due to participants' very low levels of vigorous physical activity. The primary outcome, total physical activity (including light, moderate, and vigorous activity) is reported using a minimum of three 24-hour epochs.[19] In addition, as secondary outcomes, the average daily time spent in light and moderate to vigorous physical activity, the average number of activity bouts, the average time accumulated in active bouts, the average number of sedentary bouts, and total time of sedentary behavior per day are reported.

Other secondary outcomes were self-reported physical activity, the Short Physical Performance Battery (SPPB),[20] perceived difficulties in mobility, and use of mobility aids. Self-reported level of physical activity over the previous month was assessed with a single question with seven response categories.[21] Information on self-reported physical activity before hospitalization was collected during hospital stay, at baseline and at 3, 6, and 12 months thereafter.

Mobility function was measured using the Short Physical Performance Battery and a questionnaire on perceived difficulties in walking outdoors, in walking 500 m and 2 km, and in ascending one flight of stairs. The Short Physical Performance Battery was administered at baseline, and at three and six months thereafter. Perceived difficulties in mobility prior to hospitalization were elicited in the hospital, at baseline and at 3, 6, and 12 months thereafter. The use of mobility aids was also asked by a questionnaire and rated as no, yes, only indoors, only outdoors, and both indoors and outdoors.

Data on age, gender, living arrangements, and education were collected by a questionnaire at baseline. Information on body height, weight, chronic conditions, and length of hospital stay were collected from patient medical records. Safety was assessed by evaluating rates of adverse events in the intervention group, hospital readmissions, and emergency room visits in both study groups. Information on the use of emergency room and home care services and need for hospital readmissions was collected by questionnaire at baseline, after the first two weeks following discharge home and at 3, 6, and 12 months. Information on rehabilitation practices was collected by interview at three months. Baseline cognitive status was assessed with the MMSE.[17] The impact of pain on daily function was assessed using the Pain Interference Subscale from the Brief Pain Inventory (BPI) questionnaire[22] and depressive symptoms by the Center for Epidemiological Studies Depression Scale (CES-D).[23] Life-space mobility was measured using the University of Alabama at Birmingham Study of Aging Life-Space Assessment (LSA).[24] Fear of falling was assessed by the Fall Efficacy Scale–International (FES-I).[25]

All participants received rehabilitation and healthcare services according to usual practice (standard care) including medical management of health conditions, assessment of care needs, and provision of care and rehabilitation after hospital discharge. In addition to standard care, the intervention group received a home-based individually targeted multicomponent rehabilitation program aiming to promote physical activity and restore mobility. A detailed description of the program has been published elsewhere.[16] Briefly, the six-month rehabilitation began in the participant's home within two weeks of randomization and included seven home visits and three phone calls by the physiotherapist, setting physical activity-related goals with the Goal Attainment Scaling method,[26] a face-to-face physical activity counseling session, and a home exercise program according to the OTAGO protocol.[27] In addition, frail participants unable to go outdoors alone were offered support from volunteer students of health sciences recruited from the local University or University of Applied Sciences.

During the first visit, the physiotherapist introduced participants to the Goal Attainment Scaling method. The aim was to encourage participants to change their physical activity behavior. The participants' own wishes were discussed first, and the agreed goals are then written down together with the physiotherapist. The criteria for goal achievement were set and rated on a 5-point scale before the intervention started.

Three months after the first visit, individual face-to-face physical activity counseling, including an individualized plan, was conducted. The physiotherapist used a motivational interviewing technique during the counseling sessions to help participants find their intrinsic motivation for adopting an active lifestyle, overcome barriers, and detect sedentary behavior patterns. The topics covered during the session included the participant's earlier and current physical activity level, the participant's interest in returning to his or her previous activities, the possibility to start a new type of activity or exercise, and guidance on how to be active in performing everyday chores. Participants received information on physical activity courses and facilities offered by the municipality. To promote physical activity, they were given an opportunity to visit a gym or swimming facility with the physiotherapist. Both the participant and the physiotherapist signed the written plan and evaluated its execution during the final home visit.

A physiotherapist both taught and gave participants a written home exercise program designed by PhysioTools (PhysioTools, Tampere, Finland). During home visits, the exercise program was supervised and updated by the physiotherapist; otherwise, most exercises were performed alone. The exercises targeted muscle strength of the lower limbs, balance, and fluent walking. Participants were expected to exercise three times a week. The exercise program was checked for exercise type and intensity during each home visit to ensure that the intervention remained appropriate and sufficiently challenging throughout the rehabilitation period. Resistance bands of three different strengths were utilized to progress training. Participants kept a daily exercise diary during the intervention period. Training adherence was calculated based on the diary and confirmed based on the physiotherapist's evaluation.

Pretrial power calculation was based on the amount of accelerometer-based daily upright activity (mean time per day 250 ± 103 minutes) among community-dwelling people aged 80 years.[12] We expected a 20% clinically meaningful increase in physical activity in the intervention group compared to control group. For this effect size at $a = 0.05$ and a power of 80%, the required sample size was 53 participants per group. A dropout rate of 15% was expected, and hence, the target size for each group was 60 participants.

The effect of the intervention on objectively measured physical activity and mobility outcomes was analyzed by generalized estimating equation (GEE) linear models with normal distribution, unstructured working correlation, and a group × time interaction term. The differences in model-predicted means between the intervention and control groups were assessed using pairwise comparisons. GEE models with multinomial distribution and cumulative logit link were used for categorical self-reported physical activity and mobility outcomes and with binary logistic model for the use of healthcare services and a walking aid. The analyses were performed with IBM SPSS Statistic Software Version 24 (Chicago, IL). In additive analysis, odds ratios (ORs) and 95% confidence intervals for average changes in negotiating stairs at each time point relative to baseline were computed and the change over time in the study groups was compared using a chi-square distributed Wald test in a custom script for R (The R Statistical Computing Environment, Vienna, Austria). All available data were analyzed as per group allocation in accordance with intention-to-treat principles.

Results

In total, 117 people, eligible for the study, provided an informed consent and were randomized into the intervention group ($n = 59$) or control group ($n = 58$) (Figure 1). No significant differences in baseline characteristics were observed between the rehabilitation and standard care control group (Table 1). Fifty-nine percentage ($n = 69$) of the participants had been admitted to hospital due to trauma. Mean length of hospital stay was 16.1 (SD, 15.2) days, ranging between 1 and 92 days. The participants had severe mobility limitations (average SPPB score of 4.7 ± 2.5) and high fear of falling (average FES-I score of 39.1 ± 11.2) at baseline.

During the six-month trial, eight participants (7%) withdrew or were lost to follow-up due to personal reasons, non-intervention-related death, or re-hospitalization. Those who withdrew from or died during the trial had longer hospital stay (32.6 ± 31.3 vs. 14.9 ± 12.7 days, $P = 0.001$), higher fear of falling (47.4 ± 14.5 vs. 38.5 ± 10.7, $P = 0.03$), less education (6.9 ± 2.7 vs. 9.8 ± 4.0 years, $P = 0.04$), and higher probability of hospital admission due to acute trauma, for example, a fall-induced fracture (100%, $n = 8$ vs. 55%, $n = 60$, $P = 0.01$), than those who completed the six-month trial. In addition, the rehabilitation program was interrupted temporarily for 21 participants for non-intervention-related medical reasons. All 21 later returned to the intervention (for more detail, see

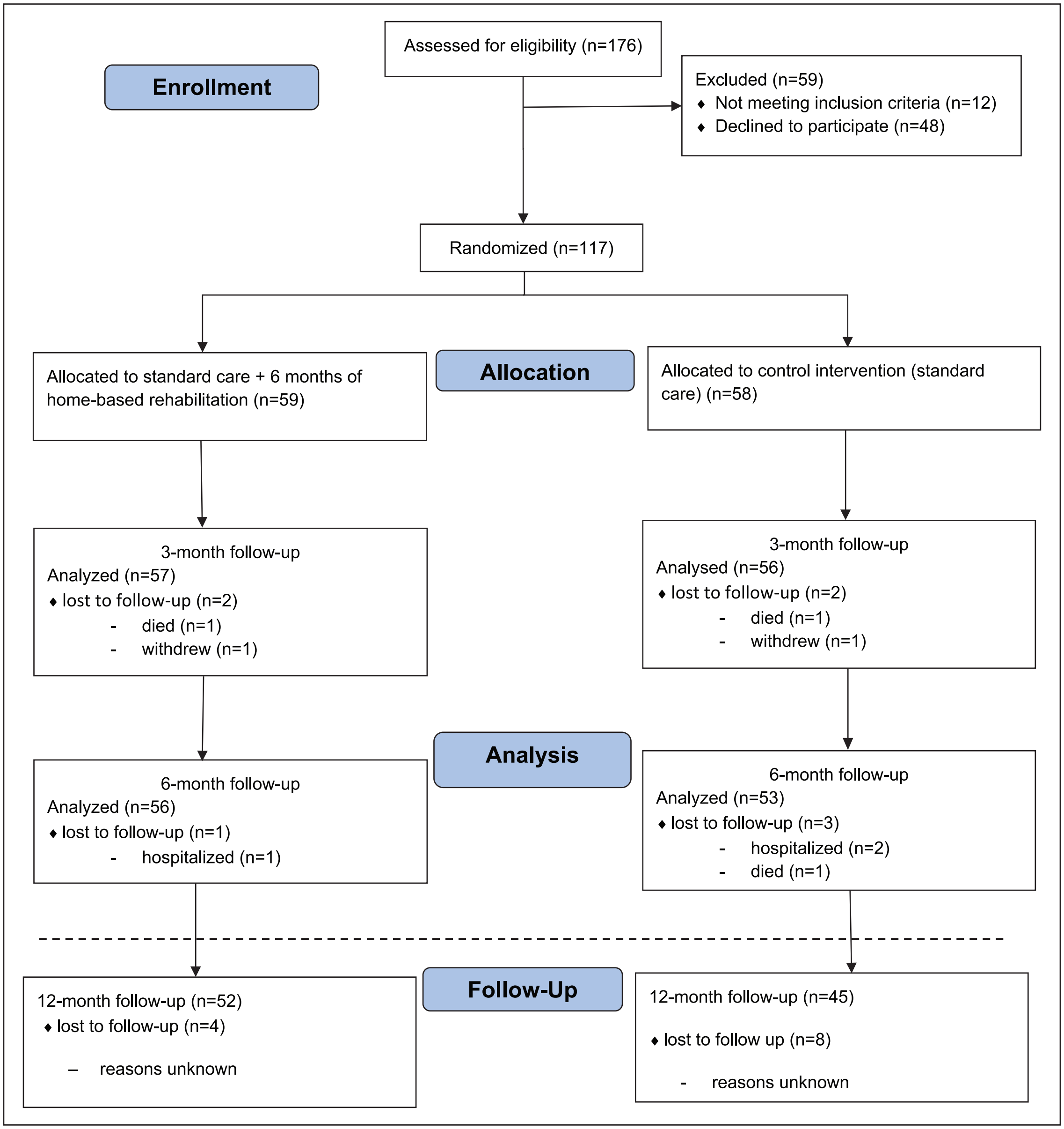

Figure 1. Flow chart of the study.

Supplementary File 1). No severe adverse events related to the intervention occurred.

Training adherence and standard care

Our supervised rehabilitation program lasted on average of 20 ± 3 weeks. All but three participants had seven meetings with the physiotherapist, attended the face-to-face physical activity counseling session, and signed a personal plan. The plan was checked and updated in all cases except one (who moved permanently to a nursing home before the final visit). Of the three who withdrew from the intervention, two were visited three

Table 1. Baseline characteristics of the participants.

	Intervention group, *n* = 59	Control group, *n* = 58
Age, years, mean (SD)	79.9 (8.4)	79.7 (8.1)
Women, *n* (%)	50 (85)	50 (86)
Years of education, mean (SD)	10.2 (4.6)	8.9 (3.1)
MMSE points, mean (SD)	26.3 (2.6)	25.5 (2.6)
Living alone, *n* (%)	38 (64)	40 (69)
Body mass index, mean (SD), kg/m^2	27.1 (4.7)	27.7 (5.3)
Height, mean (SD), cm	163.9 (7.7)	163.1 (7.1)
Weight, mean (SD), kg	72.9 (14.4)	74.0 (15.0)
Number of chronic diseases, mean (SD)	3 (2)	3 (2)
Reasons for hospitalization, *n* (%)		
Traumatic fracture	23 (39)	24 (41)
Intensified pain in back or lower extremity (i.e. following falling)	10 (17)	12 (21)
Intended joint replacement	23 (39)	18 (31)
Intended back surgery	3 (5)	4 (7)
Length of hospital stay, days, mean (SD)	14 (12)	18 (17)
Interference of pain, mean (SD)	4.4 (2.6)	3.9 (2.9)
Mood, CES-D points, mean (SD)	14.2 (10.2)	14.3 (10.7)
Fear of falling, FES-I score, mean (SD)	39.4 (11.3)	38.8 (11.1)
SPPB, score, mean (SD)	4.7 (2.5)	4.6 (2.5)
Mobility prior to hospitalization		
Walking aid, indoors, *n* (%)	22 (37)	21 (36)
Walking aid, outdoors, *n* (%)	41 (68)	40 (69)
Stair negotiation, *n* (%)		
No difficulties	15 (25)	14 (24)
Minor difficulties	14 (24)	20 (35)
Major difficulties	18 (31)	14 (25)
Manage only with help	4 (7)	4 (7)
Unable to manage even with help	8 (14)	6 (11)
Self-reported level of physical activity prior to hospitalization, *n* (%)		
Inactivity	9 (15)	5 (9)
Low-level activity	38 (65)	41 (71)
Medium- to high-level activity	12 (20)	12 (20)
Life-space mobility, LSA score, mean (SD)	48.1 (21.9)	50.2 (20.8)

MMSE: Mini-Mental State Examination; CES-D: Center for Epidemiologic Studies Depression Scale; FES-I: Fall Efficacy Scale–International; SPPB: Short Physical Performance Battery; LSA: Life-Space Assessment.

times and one six times, but none of them signed the personal plan.

On average, the participants together with the physiotherapist set two physical activity-related goals at the start of the intervention. Ninety-five percentage (*n* = 53) of the participants achieved at least the expected level of their first goal and the majority (54%, *n* = 32) performed better than they had expected. Adherence to the six-month home-based physical exercise intervention was fair, with 58% (*n* = 34) of rehabilitees performing all the strengthening, 53% (*n* = 31) balance, and 68% (*n* = 40) walking exercises. Nine (15%) participants in the intervention group visited a gym and four (7%) a swimming facility with the physiotherapist. Twenty-four participants (41%) returned to their previous exercise activity or started a new type of exercise during the intervention period. Twelve (20%)

participants in the intervention group received additional support from a volunteer student.

Prior to discharge from hospital to home, 60% of participants (61% vs. 64%, $P=0.83$ of the intervention and control groups, respectively) received written information on home exercises and safe walking and instructions from a physiotherapist on how to rise from a chair. For the majority (54% vs. 66%, $P=0.33$ of the intervention and control group, respectively), the exercise program was not updated after discharge from hospital. The proportion of those who received physiotherapy as part of their standard care in both groups is shown in Supplementary File 2. Sixty-three percent of participants (both groups) did not receive any other rehabilitation.

Effect of the intervention on physical activity and sedentary behavior

The results for all the physical activity and sedentary behavior variables at six months are shown in Table 2. Both groups showed a similar increase in the total time spent physically active (Supplemental Figure 2). No between-group differences were observed in total daily time in physical activity (intervention 127 ± 78 minutes/day at baseline and 167 ± 81 at six months vs. control 121 ± 70 and 164 ± 72; group $\times$ time interaction, $P=0.97$).

Of the secondary outcomes, neither sedentary behavior (intervention 1313 ± 78 minutes/day at baseline and 1273 ± 81 at six months vs. control 1319 ± 70 and 1276 ± 72; group $\times$ time interaction, $P=0.97$) nor any of the other physical activity measures differed between the study groups (Table 2). However, a non-significant trend ($P=0.08$) toward an increase in self-reported physical activity was observed in the intervention group compared to the control group (Table 3).

The mean SPPB score did not change in the intervention group compared to controls ($P=0.37$, Table 2, Supplemental Figure 2). However, the intervention reduced perceived difficulties in negotiating stairs compared to controls at six months post-intervention (Table 3, Supplementary File 3, $P=0.04$). Fifteen participants in the intervention group and 14 participants in the control group reported no difficulties prior to hospitalization whereas at six months after the intervention, 23 and 9 participants reported no difficulties, respectively (Table 3). The intervention was not superior to standard care in perceived ability to walk outdoors, 500 m or 2 km. Moreover, the intervention had no effect on the use of assistive devices when walking indoors and outdoors (Table 3). Self-reported use of healthcare services was similar in both groups across the six-month intervention. However, there was a trend across the intervention toward a reduction in the need for emergency room services in the intervention group ($P=0.07$).

Discussion

The present individually tailored and home-based counseling and rehabilitation program did not increase physical activity or mobility in older adults recovering from a musculoskeletal disorder when compared to standard care. Natural healing and improved physical activity and mobility during the first few months after hospitalization occurred in all participants regardless of study group; however, full recovery is often a protracted process. Following a hip fracture, the recovery of walking ability can take a year or more.[9] Our sample included participants who had undergone a hip or knee operation and even revision surgery. It is thus possible that to improve physical activity and mobility, our sample of mobility-limited older people who had recently returned home from hospital would have benefited more from a longer and more frequently monitored comprehensive geriatric intervention.

Mean length of hospital stay was 16 days, which is double the average of 8.3 days,[28] and participants' need for healthcare services remained high over the study, indicating that our sample comprised vulnerable older people with multiple health issues. High morbidity and the need for readmissions potentially influenced our participants' physical activity and mobility. A positive impact was that the participants who needed to suspend the training program were later able to resume it. However, they would have needed more time to recover and train before the post-intervention

Table 2. Intention-to-treat analysis of intervention effects (baseline to post-intervention) on accelerometer-derived physical activity, sedentary behavior, and physical performance (SPPB).

Outcome	Intervention Mean ± SD			Control Mean ± SD			Difference between groups at six months, intervention minus control	Group × time interaction *P*-value from GEE analysis
	Baseline	Three months	Six months	Baseline	Three months	Six months		
Total physical activity (minutes/day)	127 ± 78	161 ± 75	167 ± 81	121 ± 70	166 ± 83	164 ± 72	3.38 (–20.3 to 27.1)	0.970
Light activity (minutes/day)	106 ± 55	115 ± 45	118 ± 46	102 ± 52	116 ± 46	114 ± 43	2.17 (–12.3 to 16.6)	0.957
Moderate to vigorous activity (minutes/day)	21 ± 36	46 ± 39	49 ± 43	19 ± 26	50 ± 48	50 ± 43	–0.80 (–13.4 to 11.9)	0.875
Mean number of active bouts per day (times/day)	1 ± 1	2 ± 2	2 ± 2	1 ± 1	2 ± 2	2 ± 2	–0.02 (–0.6 to 0.5)	0.901
Total time accumulated in moderate/vigorous active bouts per day (minutes)	4 ± 12	15 ± 20	14 ± 15	6 ± 17	16 ± 20	17 ± 19	–1.61 (–6.7 to 3.5)	0.953
Mean number of sedentary bouts per day	30 ± 9	28 ± 7	29 ± 6	30 ± 9	28 ± 6	28 ± 5	0.53 (–1.5 to 2.6)	0.915
Sedentary time (minutes/day)	1313 ± 78	1282 ± 77	1273 ± 81	1319 ± 70	1274 ± 83	1276 ± 72	–0.72 (–24.8 to 23.4)	0.971
SPPB (score)	4.7 ± 2.5	6.8 ± 2.6	7.3 ± 3.1	4.6 ± 2.5	6.2 ± 3.1	6.9 ± 3.5	0.34 (–0.7 to 1.3)	0.370

GEE: generalized estimating equation linear models; SPPB: Short Physical Performance Battery.

Table 3. Changes in self-reported level of physical activity, perceived difficulties in negotiating stairs, walking outside, walking 500 m and 2 km, use of walking aid, and need for healthcare services; proportion of participants and response categories for the intervention and control groups at pre-hospitalization, baseline and 3, 6, and 12 months post-intervention.

Outcomes	Intervention					Control					Group × time interaction *P*-value
	Pre-hospitalization, *n* = 59	BL, *n* = 59	3 Months, *n* = 57	6 Months, *n* = 56	12 Months, *n* = 52	Pre-hospitalization, *n* = 58	BL, *n* = 58	3 Months, *n* = 53	6 Months, *n* = 53	12 Months, *n* = 45	
Self-reported physical activity, *n* (%)											0.084[a]
Mostly lying down	1 (2)	6 (10)	2 (3)	0	0	0	6 (10)	1 (2)	3 (6)	3 (7)	
Mostly sitting	8 (14)	19 (32)	6 (11)	4 (7)	11 (22)	5 (9)	20 (34)	6 (11)	2 (4)	6 (14)	
Low-level activity	22 (37)	34 (58)	25 (44)	24 (43)	19 (38)	23 (40)	30 (52)	21 (40)	22 (42)	19 (45)	
Medium-level activity, ⩾3 hours/week	16 (27)	0	11 (19)	11 (20)	6 (12)	18 (31)	1 (2)	10 (19)	11 (21)	9 (21)	
Medium-level activity, ⩾4 hours/week	9 (15)	0	9 (16)	9 (16)	9 (18)	9 (15)	1 (2)	14 (26)	10 (19)	4 (10)	
High-level activity, exercise	3 (5)	0	2 (3)	8 (14)	5 (10)	3 (5)	0	1 (2)	5 (9)	1 (2)	
Negotiating stairs, *n* (%)											0.038[a]
No difficulties	15 (26)	3 (5)	21 (37)	23 (41)	18 (36)	14 (25)	10 (17)	18 (34)	9 (17)	13 (29)	
Minor difficulties	14 (24)	19 (32)	23 (40)	16 (29)	18 (36)	20 (33)	12 (21)	18 (34)	27 (51)	13 (29)	
Major difficulties	18 (30)	6 (10)	5 (8)	9 (16)	5 (9)	14 (25)	10 (17)	5 (9)	7 (13)	9 (20)	
Only with help of another person	4 (6)	14 (24)	4 (7)	3 (5)	7 (13)	4 (7)	14 (25)	5 (9)	4 (8)	5 (11)	
Unable even with help	8 (14)	17 (29)	5 (8)	5 (9)	3 (6)	6 (10)	12 (20)	7 (14)	6 (11)	5 (11)	
Walking outside, *n* (%)											0.683[a]
No difficulties	15 (26)	2 (3)	12 (21)	17 (30)	14 (27)	16 (28)	6 (10)	14 (26)	15 (28)	11 (24)	
Minor difficulties	22 (37)	23 (39)	33 (58)	28 (50)	26 (50)	23 (40)	15 (26)	28 (53)	28 (53)	22 (49)	
Major difficulties	16 (27)	10 (17)	6 (11)	5 (9)	8 (15)	14 (25)	15 (26)	5 (9)	4 (8)	8 (18)	
Only with help of another person	3 (5)	19 (32)	5 (9)	6 (11)	4 (8)	4 (7)	21 (36)	6 (11)	5 (9)	3 (7)	
Unable even with help	3 (5)	5 (9)	1 (2)	0	0	0	1 (2)	0	1 (2)	1 (2)	
Walking 500 m, *n* (%)											0.378[a]
No difficulties	15 (25)	2 (3)	14 (25)	18 (32)	16 (33)	14 (25)	6 (10)	17 (32)	18 (34)	15 (33)	
Minor difficulties	18 (31)	10 (17)	28 (49)	21 (38)	17 (33)	16 (28)	10 (17)	18 (34)	22 (42)	14 (31)	
Major difficulties	10 (17)	11 (19)	7 (12)	7 (13)	6 (12)	12 (21)	10 (17)	7 (13)	2 (4)	6 (13)	
Only with help of another person	3 (5)	1 (2)	3 (5)	4 (7)	4 (8)	2 (4)	4 (7)	3 (6)	3 (6)	3 (7)	
Unable even with help	13 (22)	25 (59)	5 (9)	6 (11)	8 (16)	13 (22)	28 (48)	8 (15)	8 (15)	7 (16)	
Walking 2 km											0.548[a]
No difficulties	9 (15)	0	3 (5)	9 (18)	7 (14)	9 (16)	1 (2)	8 (15)	10 (22)	7 (16)	
Minor difficulties	4 (7)	2 (3)	16 (28)	9 (16)	11 (22)	5 (9)	2 (3)	9 (17)	10 (22)	11 (25)	
Major difficulties	19 (17)	2 (3)	7 (12)	9 (18)	10 (20)	11 (19)	2 (3)	2 (4)	8 (15)	7 (16)	
Only with help of another person	3 (5)	0	5 (9)	2 (4)	4 (8)	1 (2)	3 (5)	3 (6)	2 (4)	2 (5)	
Unable even with help	33 (56)	55 (94)	26 (46)	27 (48)	19 (37)	31 (54)	50 (86)	30 (58)	23 (43)	17 (39)	
Use of walking aid, indoors, *n* (%)	21 (36)	49 (83)	29 (51)	24 (43)	22 (42)	23 (40)	51 (88)	29 (52)	22 (42)	22 (46)	0.784[b]
Use of walking aid, outdoors, *n* (%)	41 (70)	56 (95)	42 (74)	41 (73)	38 (73)	40 (69)	53 (91)	44 (79)	37 (71)	31 (69)	0.550[b]
Need for emergency room service	–	7 (12)	9 (16)	5 (9)	7 (14)	–	5 (9)	7 (13)	13 (25)	10 (24)	0.072[b]
Need for healthcare services	–	27 (46)	27 (47)	22 (39)	22 (46)	–	27 (47)	29 (52)	28 (51)	21 (53)	0.272[b]

BL: baseline.
P-value for group × time interaction at six months from generalized estimating equation with multinomial[a] and binary logistic models[b].

measurement. Although our rehabilitation program included strategies to promote long-term behavior change, this would have required a longer follow-up, possibly in excess of 12 months.

Participants who lived alone and were unable to go outdoors independently reported a high fear of falling, a situation that might have needed more attention. Many of our participants did not walk outdoors at the beginning of the intervention, that is, immediately after returning home from hospital. Obviously, the inability to go outdoors limits the potential for increasing physical activity. Clarke et al.[29] recommended complementing traditional physical activity interventions with strategies that enhance social support and target individuals with low mood and other mental health issues. We aimed to complete our rehabilitation program with the support of student volunteers tasked to promote older adult's activities outdoors. However, finding, matching, and placing volunteers with the older adults presented a major challenge. Hence, new volunteer recruitment strategies to boost volunteer numbers are needed, especially in countries such as Finland where the norm of helping family members, friends, and neighbors is stronger than that of helping strangers.

In line with earlier studies,[10,30] we found that the rehabilitation program did not restore physical activity; instead, it may have promoted the ability to negotiate stairs. The participants of the Losartan Intervention for Endpoint Reduction (LIFE) trial[10,31] were recruited from the community and thus showed much better physical performance at baseline than our participants (The SPPB LIFE score of 7.4 vs. 4.7 in this study). Interestingly, although periods of acute hospitalization during the LIFE trial led to major mobility problems and a decrease in total physical activity time, it did not diminish the benefit of the physical activity program in promoting independent walking after discharge from hospital.[31] Similar to our results, the improvement in the amount of physical activity in the intervention group was not greater than that in the control group after hospitalization.[10] The broader real-life approach of this study, which included patients with a variety of diagnoses, replicated our previous findings among hip fracture patients on perceived ability to negotiate stairs.[15] Improved ability to negotiate stairs may reflect increased self-efficacy that is related to overall mobility and can thus support everyday life.[32] Importantly, restoring mobility may be positively linked to the need for health-related services; a non-significant trend suggested that the control group was five times more likely to use emergency room services than the intervention group.

Validated and widely used methods were chosen to measure the outcomes of this study. We were unable to identify all the physical and mental conditions that could render individuals unsuitable for the rehabilitation intervention. Hence, some participants were recruited who were too frail to participate in the intervention and who required several readmissions to hospital. These participants were more likely to be lost to follow-up, thereby limiting the generalizability of the results. The study population included older people with a wide range of functional abilities, thereby resulting in a larger between-subjects variance than in studies with relatively homogeneous participants and limiting comparability. The number of participants recruited was relatively small but exceeded the predetermined estimate of sample size. A limitation is that the examiners were not blinded to group assignment, thereby allowing the possibility of bias. A further limitation is that the analysis of multiple outcomes and multiple analyses on the same outcome at different time points increases the overall type I error rate, and thus, the findings for improved ability to negotiate stairs should be considered exploratory rather than confirmatory, and further investigation is needed.

We conclude, from the adherence to the intervention protocol, that implementing the home-based multicomponent rehabilitation program with a vulnerable group of older people recently discharged from hospital seems feasible. In addition, no intervention-related adverse events occurred. Given the absence of benefits of the intervention on physical activity or physical performance, further research with larger sample sizes and longer post-intervention follow-up among older people recently discharged from hospital is needed. In addition, repeated measurements of outcomes using shorter assessment intervals such as one month following acute hospitalization may better help to reveal differential patterns of recovery between groups. It is also important to conduct formal economic evaluation in future trials in order to find out whether the increased costs of providing a home-based rehabilitation are offset by potential savings related to further hospital admissions and need for home care.

Clinical messages

- The physical activity intervention program with seven home visits and three phone calls by a physiotherapist was safe and easy to implement but not superior to standard care in increasing physical activity or improving physical performance.
- Physical activity promotion program may have reduced perceived difficulties in negotiating stairs, but this tentative finding should be confirmed in further studies.

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Author contributions

R.N. (principal investigator) conceived the trial, developed the trial design, administered the research funding, and wrote the manuscript. S.S. (co-principal investigator) conceived the trial, developed the trial design, and wrote the manuscript. K.M.T. was responsible for participant recruitment and data collection and wrote the manuscript. L.A.-M. conducted the home rehabilitation program and wrote the manuscript. T.T. participated in data analysis and interpretation and critically revised the manuscript. T.R. developed the methods of analyzing the accelerometer data and wrote and critically revised the manuscript. E.P., M.-L.K., S.K., and T.F. made substantial contributions to the conception and design of the study and to writing and critically revising the manuscript. All authors read and approved the final manuscript.

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Supplemental material

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