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Effects of home-based physical exercise on days at home, healthcare utilization and functional independence among patients with hip fractures: a randomized controlled trial

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The study was performed in South Karelia Social and Health Care District (Eksote), Lappeenranta, Finland.

Acknowledgments: We thank Ms. Kaija Paajanen, registered nurse, and Ms. Virpi Äärimaa, practical nurse, for their contribution in participant recruitment and data acquisition. We also thank the personnel of South Karelia Social and Health Care District for their help in recruitment.

Congress presentations: Baseline characteristics of the participants were presented as a poster in the 24th Nordic Congress of Gerontology in Oslo, Norway, on May 2–4, 2018, and in the International Association of Geriatrics and Gerontology – European Region Congress in Gothenburg, Sweden, on May 23–25, 2019.

Financial support: This study was funded by South Karelia Social and Health Care District (Eksote, grant number 1236/00.01.05.01/2013), the Social Insurance Institution of Finland (SII, grant numbers 94/331/2013, and 17/26/2019), and State Research Funding for Academic Health Research (Ministry of Social Affairs and Health, Finland, grant numbers HUS 2016, HUS/2931/2017, HUS/2571/2017, and HUS/2631/2019). The funders had no role in the design, collection, analyses, or interpretation of the data, nor in writing the manuscript or in the decision to submit the article for publication.

Conflicts of interest: None

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Clinical Trial registration number: ClinicalTrials.gov NCT02305433

Reprints are not available.

ABSTRACT

Objective To evaluate the effects of a physical exercise program on days lived at home, the use and costs of healthcare and social services mortality and functional independence among patients with hip fractures.

Design Randomized controlled trial with parallel two-group design, consisting of a 12-month intervention and 12-month registry follow-up.

Setting Home-based intervention.

Participants Patients with operated hip fracture, living at home, aged ≥60 years, randomized into physical-exercise (n=61) or usual-care (n=60) groups.

Intervention Supervised physical exercise twice a week.

Main Outcome Measures The primary outcome was the number of days lived at home over 24 months. Secondary outcomes were the use and costs of healthcare and social services and mortality over 24 months, and Functional Independence Measure (FIM) over 12 months.

Results Over 24 months there was no significant difference between the groups in terms of days lived at home (Incidence Rate Ratio [IRR] 1.01 [95% CI 0.90–1.14]) or mortality (Hazard Ratio [HR] 1.01 [95% CI 0.42–2.43]). The mean total costs of healthcare and social services did not differ between the groups: over 12 months the costs per person-year were 1.26-fold (95% CI 0.87–1.86) and over 24 months 1.08-fold (95% CI 0.77–1.70) greater in the physical-exercise than in the usual-care group. The mean difference between the change in FIM of the groups over 12 months was 4.5 points (95% CI 0.5–8.5, p=0.029) in favor of the physical-exercise group.

Conclusions Long-term home-based physical exercise had no effect on the number of days lived at home over 24 months among patients with hip fractures. The intervention was cost neutral over these 24 months. The FIM scores improved in both groups over 12 months, but significantly more in the physical-exercise group than in the usual-care group.

Key Words: Hip Fractures, Exercise, Rehabilitation, Aged, Functional Status, Health Services, Cost Analysis

List of Abbreviations: ADL (Activities of Daily Living), IADL (Instrumental Activities of Daily Living), FIM (Functional Independence Measure), HR (Hazard Ratio), ICD (International Statistical Classification of Diseases and Related Health Problems), IRR (Incidence Rate Ratio), MMSE (Mini-Mental State Examination), NYHA (New York Heart Association), RR (Risk Ratio)

Hip fractures diminish older peoples´ functional capacity,[1–3] health and quality-of-life,[4, 5] and increase the risk of mortality.[6–8] They pose an economic burden on societies[9, 10] by increasing the use and costs of healthcare and social services,[11–13] especially nursing home (24-hour) care.[3, 14, 15] Increased service use is due to patients' poor pre-fracture functioning[13, 16] and poor recovery of functional capacity after a hip fracture.[1–3] Multicomponent, individual, progressive, supervised and long-term exercise interventions after hospital discharge have prevented the loss of functional capacity of patients with hip fractures.[17–24] However, there is no consensus on optimal exercise content or duration,[19, 25] or the best settings for exercise regimens.[17, 26]

Evidence on the effects of long-term, supervised home-based physical exercise on days lived at home among patients with hip fractures is lacking. Previous studies have mainly focused on the effects of outpatient exercise programs on nursing home admissions[18], re-hospitalization[27] and overall healthcare costs[28]. Regarding healthcare and social service utilization, home-based exercise regimens with relatively short intervention periods and with a few supervised exercise sessions have shown to be cost-neutral[29] and probably cost-effective[30]. Further investigations are needed to clarify whether home-based exercise interventions could increase the number of days at home among patients with hip fractures and also be cost-effective.

The aim of this randomized controlled trial was to study the effects of a year-long home-based physical-exercise program among patients with operated hip fractures on the number of days lived at home over 24 months. In addition, we evaluated the effects of the exercise program on the use and costs of healthcare and social services and on mortality over 24 months, and on functional independence over 12 months.

METHODS

Study design

This parallel-group, randomized controlled trial with physical-exercise and usual-care arms was conducted in accordance with the Helsinki declaration in one social and healthcare district (133 000 inhabitants) in Finland between 12/2014 and 12/2019. The study protocol has been reported earlier.[31] The study received ethical approval from the relevant ethics committee in Finland in November 2014 and was registered at ClinicalTrials.gov in December 2014.

Participants

Between 10/2014 and 12/2017, 541 patients with hip fractures were operated on at the district´s main hospital, from which they moved primarily to the adjacent rehabilitation hospital, or in some cases to primary care hospital wards or straight home. Overall, we contacted 338 patients at the rehabilitation hospital for whom discharge was planned. Of these, 144 were interested and granted their permission for our home visit after discharge to assess their eligibility. Of these, 121 were eligible and willing to participate, and signed an informed consent document (Figure 1). The main inclusion criteria were: age of 60 or over, living at home, being able to walk indoors (walking aid allowed), a Mini-Mental State Examination (MMSE)[32] score of ≥12, first-operated femoral-neck (ICD code S72.0), pertrochanteric (S72.1) or subtrochanteric (S72.2) fracture of the femur, and no contraindications as regards physical exercise (e.g. Class III or IV of NYHA [New York Heart Association Functional Classification] or severe neurological disease). Exclusion criteria were living in a nursing home or life expectancy of <2 years. The original inclusion criteria of age (≥65 years), and MMSE (≥17) were lowered in April 2015, in order to increase the number of eligible participants because recruitment rates were low.

After baseline assessments, the participants were randomized into a physical-exercise group (n=61) or a usual-care control group (n=60), using a computer-generated random sequence allocation program with randomly varying block sizes of two to ten without stratification. The program was generated by a statistician who had no other role in the trial. The project manager of the trial used the randomization program and informed the participants of the randomization result.

Outcomes

The main outcome was the number of days lived at home over 24 months (730 days). Days in hospital wards, long-term wards, nursing homes, and days after death up to the end of the 24-month follow-up were counted as days not lived at home. The information on all the randomized participants was gathered from the electronic medical records of the social and healthcare district by a business intelligence analyst blinded to allocation.

We report three secondary outcomes (healthcare and social service utilization, mortality and functional independence) of our trial in this article. Information on all the randomized participant´s healthcare and social service utilization and mortality over 24-months was acquired from medical records. All contacts between the participants and primary care, specialized medical care and home-care, as well as days in hospitals and nursing homes, and the physical exercise sessions of our intervention were included in the analyses. Costs (in euros) were calculated from the social and healthcare provider's perspective, by multiplying the number of service units used by national mean unit costs in 2011,[33] and correcting them to the 2018 level according to the inflation rate based on the cost-of-living index. Pharmaceutical costs incurred outside the hospital were not included. The cost of one physical exercise session in the patients´ homes varied from 60 to 130 euros (€) and included the physiotherapist´s travel expenses. The mean cost of the intervention was calculated by multiplying the mean cost of one session (86.50€) by the number of completed sessions. The used services and their costs were calculated per person-year.

Functional independence was assessed using the Functional Independence Measure (FIM), which includes motor and cognitive components.[34] During the assessment visits to the participant's homes at baseline, and at three, six and 12 months, the study physiotherapist or the study nurse, not blinded to the allocation, interviewed and observed the participant and evaluated 18 tasks using scores from 1 (total assistance) to 7 (complete independence).

Background information on age, sex, and living arrangements were acquired through interviews, and information on illnesses and medications, and the details of the hip-fracture surgery were drawn from medical records. Data on participation in and the adverse effects of the intervention were acquired from the physiotherapists' monthly reports.

Physical exercise intervention

Our 12-month supervised, structured, and progressive physical exercise program was executed as one-hour sessions twice a week at the participant's home, starting approximately within two weeks of discharge from the rehabilitation hospital.[31] The intervention contained strength, balance, mobility and functional exercises, counselling on physical activity, and brief advice on nutrition. Exercises were individually tailored according to the participant's health status and goals, and their intensity was increased gradually to ensure progression. If acute illnesses or hospitalization led to temporary suspension of the intervention, the program continued after recovery. The participants in the physical-exercise group could also use any necessary healthcare or social services, including rehabilitation, over the 24-month study period. A detailed description of the intervention has been presented earlier.[31]

Usual care

The participants in the usual-care group received no exercise intervention. In accordance with the local guideline on hip fractures, the need for home-based rehabilitation was evaluated at the time of discharge from the rehabilitation hospital. Patients were either instructed to continue exercises by themselves, or received short-term, supervised home-based rehabilitation. Over 24 months, the participants in the usual-care group could use any healthcare or social services they needed.

Statistical analyses

Power calculations were based on data from the PERFECT study,[35] from which data on the proportion of patients living at home one year after the hip fracture were available. A sample size of 182 (91 per research arm) persons was needed to detect the hypothesized difference ($\alpha=0.05$, power=80%) of 180 (SD 431) days in the days lived at home over 24 months of the physical-exercise and usual-care arms. To allow for discontinuation (15%) and death (20%), our target was 300 participants.

The baseline characteristics of the participants in the randomization groups are reported as means with SDs or as frequencies with percentages. The groups were compared using the t-test or bootstrap type t-test, for continuous variables, and Pearson's chi-square test or Fisher's exact test for categorical variables.

The main outcome, the number of days lived at home over 24 months, and the amount of use of healthcare and social services (secondary outcome; visits or days) were analyzed using a generalized linear model with appropriate distribution (Poisson or binomial) and log-link function. The results are reported as days or visits, and incidence rate ratios (IRR) or risk ratios (RR) with 95% confidence intervals (Cls based on a Poisson distribution). Poisson regression is similar to multivariate regression (OLS), in which the number of days and visits is followed using the Poisson distribution and observed as a dependent (count data) variable.[37]

Cost analyses were performed using a generalized linear regression model with log-link and gamma-variance functions. The variance function was selected on the basis of the Park test and Akaike's information criterion. The bootstrapping (bias-corrected) technique was used in connection with the cost analyses (1000 replicates). Changes in FIM scores and differences between the changes in the groups at three, six and 12 months were analyzed using mixed-effects models, with an unstructured covariance matrix (Kenward–Roger method to calculate degrees of freedom). The repeated measurements were taken at different time points, including baseline, three, six and 12 months. Mixed models enabled analyses of unbalanced datasets without imputation; therefore, we analyzed all the available data with the full analysis set. Differences in costs per person-year in relation to baseline FIM scores were analyzed using a four-knot restricted cubic spline generalized linear regression model with log-link and gamma-variance functions. We used the Kaplan–Meier method to estimate cumulative mortality using asymptotic variance confidence intervals. Regarding mortality, we also used the Cox proportional hazards model to calculate adjusted hazard ratios (HRs) with 95% CIs. The normality of the variables was evaluated graphically and using the Shapiro–Wilk W test. The analyses were adjusted for sex and age and carried out according to the intention-to-treat principle. Statistical analyses were performed using the Stata 16.1, StataCorp LP (College Station, TX, USA) statistical package.

RESULTS

At baseline, the participants' mean age was 81.5 and 75% were female. The participants in the physical-exercise group were slightly older than those in the usual-care group (83 [SD 6] years vs. 80 [SD 7] years, and there were slightly more female participants in the physical-exercise group than in the usual-care group (82% vs. 68%), respectively (Table 1). Sixty percent of all the participants lived alone, and 48% received home-care services.

The mean participation rate of the exercise sessions was 82% (mean number of sessions 85, median 96, range 1–104) per participant. No serious adverse effects were observed during the sessions. Seventy-four percent of the participants reported mild transient musculoskeletal problems, of which 24% were related to known illnesses, such as osteoarthritis. Shortness of breath was reported by 41%, and six people experienced a fall during exercise but had no need for medical care.

Main Outcome

The main outcome, the mean number of days lived at home over 24 months, was 625 days (95% CI 578–673) in the physical-exercise group and 616 (95% CI 563–670) in the usual-care group (age- and sex-adjusted IRR 1.01 [95% CI 0.90–1.14]). Twenty-eight people (46%) in the physical-exercise group and 18 people (30%) in the usual-care group lived at home for the full 730 days (age- and sex-adjusted RR 1.53 [95% CI 0.94–2.48], p=0.088).

Two people (3%) in the physical-exercise group and three people (5%) in the usual-care group were permanently placed in nursing homes (p=0.69) during the 24-month period. Five people in the physical-exercise group and six in the usual-care group died over the initial 12-month period, and six and four persons over the next 12 months, respectively (Figure 1). Two-year survival in the physical-exercise group was 82% (95% CI 70–90%) and in the usual-care group 83% (95% CI 71–91%); age- and sex-adjusted HR 1.01 (95% CI 0.42–2.43).

Secondary outcomes

The mean total costs of all healthcare and social services per person-year over 12 months were 1.26-fold (95% CI 0.87–1.86) greater in the physical-exercise group (40 722 € [SE 3942]) than in the usual-care group (33 180 € [SE 5808]). Over 24 months, in the physical-exercise group, the mean total costs per person-year (34 159 € [SE 3857]) were 1.08-fold (95% CI 0.77–1.70) greater than in the usual-care group (31 848 € [SE 5663]) (Table 2).

The mean change of total FIM scores over 12 months was 6.0 (95% CI 3.3–8.8) points in the physical-exercise group and 1.6 (95% CI -1.2–4.4) points in the usual-care group (Figure 2). The sex- and age-adjusted mean difference between the changes of total FIM scores of the groups was 4.5 points (95% CI 0.5–8.5, p=0.029). Among the participants in the physical-exercise group who had baseline FIM scores above 100, the total costs of healthcare and social services per person-year over 24 months were 9000 € higher than among those with a baseline FIM score of >100 in the usual-care group (Figure 3).

DISCUSSION

This randomized controlled trial of a year-long, supervised, home-based physical-exercise program for patients with hip fractures revealed no significant differences in the number of days lived at home or in mortality over 24 months between the physical-exercise and usual-care groups.

However, functional independence improved more in the physical-exercise group than in the usual-care group over the 12-month training period. This improvement was gained cost-neutrally in terms of all the healthcare and social services used.

Days lived at home after operated hip fracture has not been a specified outcome in previous home-based exercise studies, but rehabilitation has been reported to have effects on hip-fracture patients' nursing home admittance and mortality. Of our participants, 46% in the physical-exercise group, and 30% in the usual-care group lived at home for the full 24 months without any intermittent inpatient care, while 3% and 5% were permanently admitted to nursing-homes, and 18% and 17% died, respectively. The low rate of nursing home admittance in our trial could be the result of recent policies that favor home-based services in Finland and in other European countries.[38, 39] In contrast to our result, another supervised progressive outpatient resistance-training and multidisciplinary intervention program reduced the odds of requiring admittance to a nursing home and the risk of mortality over 12 months in comparison to standard care.

In our trial, the mean use and costs of all healthcare and social services per person-year of the physical-exercise and the usual-care groups did not differ over 12 or 24 months. A meta-analysis found no effects of home-based rehabilitation on emergency department visits,[24] and 10-week multidisciplinary home rehabilitation did not reduce hospital days [40] over 12 months after a hip fracture. Furthermore, another study with a 12-month home-based exercise program showed no effects on service use or costs after hospital discharge among older adults with falls or joint replacement procedures.[41]

According to our analyses, long-term and progressive home-based exercise programs should focus on patients with hip fractures who have total FIM scores under 100 at the time of discharge. Among these, the costs of rehabilitation were more likely to be balanced by reduced utilization of other healthcare and social services. Rehabilitation (including the physical-exercise intervention) was the main reason for the higher costs in the physical-exercise group than those in the usual-care group over 24 months. Future trials should concentrate on finding new ways to implement home-based rehabilitation; for example, using remote technologies or implementing more exercise training in a more systematic way in home-care services to enhance functional independence and reduce overall rehabilitation costs.

In our trial, functional independence improved more in the physical-exercise group than in the usual-care group over 12 months. This improvement in FIM was gained cost neutrally in terms of all the healthcare and social services used. The 4.5-point mean difference between the changes in total FIM scores of the groups indicates less need for assistance in daily activities and might be considered clinically meaningful.[42] To our knowledge, our trial is the first to report on the effects of home-based rehabilitation on FIM scores among patients with hip fractures. Previous studies have reported contradictory results for ADL (activities of daily living)[21,43] or IADL (instrumental activities of daily living)[21]. Edgren et al. (2015)[21] found that a 12-month home-based physical-exercise program may reduce disability, but Orwig et al. (2011)[43] found no effect on physical functioning among people with hip fractures.

A rigorous randomized design, successful randomization (except for age and sex, which were taken into account in the analyses), and a relatively small loss to follow-up are strengths of our trial. The information on days lived at home and on all use of healthcare and social services was complete as it was gathered from electronic medical records, and the use of private healthcare and social services was rare. Furthermore, adherence to our supervised intervention was good, and no serious adverse events occurred. Supervision enables more individualized and safer training.[44]

Study Limitations

The first limitation is the size of recruited sample (n=121) which is below the power calculations (n=182), as many patients refused to participate due to poor perceived health. Widening the two inclusion criteria (age and MMSE) had no effect on the recruitment rate. Our study could have been underpowered for detecting a 180-day difference between the groups in terms of their days lived at home, as used in the power analysis. Secondly, the hypothesized difference between the groups in our study´s main outcome may have been overestimated. Thirdly, the FIM assessments involve a risk of bias because the assessors were not blinded to the allocation result. Finally, we were unable to study the effects of our intervention on FIM over 24 months, as we had data planned the assessments to cover a 12-month period.

CONCLUSION

Our 12-month, physiotherapist-supervised, home-based physical exercise trial had no effect on the number of days lived at home or on mortality over 24 months among patients with hip fractures. The intervention was cost neutral, and there was no difference between the groups´ total public healthcare and social service costs over 12 or over 24 months. Our intervention improved functional independence to a greater extent in the physical-exercise group than in the usual-care group over 12 months.

Table 1. Baseline characteristics of the participants in the physical-exercise and usual-care groups. Frequencies (%) or means (SD) are shown.

Characteristics	**Physical-exercise n=61**	**Usual-care n=60**
Age, mean (SD)	83 (6)	80 (7)
Women, n (%)	50 (82)	41 (68)
Education <9 years, n (%)	38 (62)	39 (65)
Living, n (%)		
Alone	37 (61)	35 (58)
With spouse	16 (26)	19 (32)
With another person	8 (13)	6 (10)
Home-care services, n (%)		
0 times/week	28 (46)	35 (58)
1–7 times/week	13 (21)	13 (22)
>7 times/week	20 (33)	12 (20)
Number of regular medications, mean (SD)	8.8 (3.4)	8.7 (3.0)
Physician-diagnosed diseases or disorders, n (%)		
Coronary heart disease	27 (44)	27 (45)
Stroke or Transient Ischemic Attack (TIA)	14 (23)	19 (32)
Hypertension	44 (72)	43 (72)
Diabetes	16 (26)	12 (20)
Osteoporosis	27 (44)	24 (40)
Alzheimer's disease	11 (18)	10 (17)

Body Mass Index (BMI) (kg/m^2), mean (SD)	26.4 (4.4)	25.9 (4.4)
MMSE, mean (SD)	23.1 (4.7)	22.7 (4.2)
Fracture type (ICD code), n (%)		
Femoral-neck (S72.0)	39 (64)	35 (58)
Pertrochanteric (S72.1)	17 (28)	21 (35)
Subtrochanteric (S72.2)	5 (8)	4 (7)
Type of surgery (NOMESCO* codes)[36]		
Total hip arthroplasty†	2 (3)	0 (0)
Hemiarthroplasty‡	31 (52)	36 (59)
Internal fixation§	27 (45)	25 (41)
Hospital care, days, mean (SD)		
From the fracture event to surgery	1.4 (1.5)	1.1 (1.4)
Stay in the surgical ward	4.9 (2.5)	4.7 (2.6)
Stay in the rehabilitation hospital	23.2 (12.4)	25.3 (16.5)
From hospital admission to discharge	28.1 (12.1)	30.0 (17.1)
FIM, mean (SD)		
Total	97.2 (13.1)	98.0 (15.0)
Motor	67.4 (10.3)	68.1 (11.2)
Cognition	29.6 (4.2)	29.1 (5.0)

* NOMESCO (Nordic Medico-Statistical Committee Classification of Surgical Procedures)[36]

† including hybrid total hip arthroplasty and cemented primary total hip arthroplasty

‡ including cemented hemiarthroplasty

§ including internal fixation of fracture of neck of femur with nail or screw, internal fixation of fracture of upper femur with screws and side plate, internal fixation of fracture of upper femur with intramedullary nail, and other internal fixation of other parts of femur

Table 2. Use (visits or days) and costs (€) of healthcare and social services per person-year in physical-exercise and usual-care groups over 0—12 and 0—24 months.

	Use of healthcare and social services			**Costs (€) of healthcare and social services**		
	Physical-exercise (n=61) Mean (SE)*	**Usual-care (n=60) Mean (SE)***	**IRR[†] (95% CI)**	**Physical-exercise (n=61) Mean (SE)[‡]**	**Usual-care (n=60) Mean (SE)[‡]**	**Mean ratio[§] (95% CI)**
0—12 months						
Home care, visits	234.0 (45.8)	212.5 (53.9)	1.02 (0.57 to 1.83)	10 560 (2 018)	9 777 (2 403)	1.00 (0.31 to 1.69)
Primary care						
General practitioner, visits	12.7 (2.0)	9.4 (1.1)	1.32 (0.91 to 1.92)	1 637 (273)	1 135 (126)	1.45 (0.93 to 2.22)
Nurse, visits	21.8 (2.9)	22.9 (2.7)	0.93 (0.64 to 1.36)	1 112 (148)	1 245 (157)	0.89 (0.60 to 1.27)
Rehabilitation[||], visits	94.8 (2.6)	18.2 (2.7)	5.32 (3.94 to 7.19)	8 812 (252)	3 568 (524)	2.55 (1.88 to 3.39)
Hospital wards, days	8.4 (3.6)	6.5 (2.3)	1.20 (0.44 to 3.22)	2 959 (1 299)	2 260 (812)	1.20 (0.31 to 3.55)
Home healthcare, visits	3.9 (0.9)	3.5 (0.6)	1.09 (0.58 to 2.06)	470 (102)	412 (73)	1.15 (0.63 to 2.29)
Specialized medical care						
Physician, visits	2.0 (0.4)	2.9 (0.5)	0.80 (0.50 to 1.30)	631 (137)	946 (186)	0.77 (0.45 to 1.30)

Nurse, visits	0.8 (0.3)	1.2 (0.3)	0.77 (0.35 to 1.71)	51 (20)	56 (13)	0.99 (0.36 to 2.56)
Emergency department, visits	1.8 (0.4)	1.7 (0.3)	1.18 (0.65 to 2.13)	626 (154)	676 (174)	1.04 (0.53 to 2.09)
Hospital wards, days	2.1 (0.7)	4.3 (0.9)	0.55 (0.23 to 1.28)	2 093 (820)	7 047 (3 652)	0.40 (0.14 to 1.25)
Nursing home, days	16.1 (8.6)	13.8 (9.1)	1.29 (0.25 to 6.68)	2 960 (1 515)	2 490 (1 532)	1.36 (0.05 to 15.55)
Total costs				**40 722 (3 947)**	**33 180 (5 808)**	**1.26 (0.87 to 1.86)**
0—24 months						
Home care, visits	201.3 (41.5)	248.0 (64.3)	0.73 (0.39 to 1.37)	9 354 (1858)	11 472 (2846)	0.73 (0.38 to 1.43)
Primary care						
General practitioner, visits	11.0 (1.4)	9.5 (1.0)	1.12 (0.80 to 1.57)	1 540 (263)	1 151 (120)	1.34 (0.89 to 1.90)
Nurse, visits	21.4 (2.7)	20.8 (2.5)	1.02 (0.69 to 1.50)	1 074 (131)	1 130 (149)	0.97 (0.65 to 1.38)
Rehabilitation[||], visits	53.0 (1.8)	11.7 (1.5)	4.59 (3.51 to 5.99)	5 547 (290)	2 556 (401)	2.23 (1.61 to 3.13)
Hospital wards, days	7.9 (2.6)	4.6 (1.3)	1.54 (0.68 to 3.51)	3 531 (1 354)	1 761 (625)	1.74 (0.61 to 4.39)
Home healthcare, visits	3.6 (0.7)	3.9 (0.6)	0.96 (0.56 to 1.63)	452 (85)	454 (70)	1.05 (0.66 to 1.85)
Specialized medical care						
Physician, visits	1.9 (0.3)	2.2 (0.3)	0.97 (0.64 to 1.48)	643 (132)	777 (165)	0.94 (0.56 to 1.63)
Nurse, visits	0.9 (0.3)	1.4 (0.4)	0.72 (0.30 to 1.72)	60 (22)	65 (18)	1.01 (0.36 to 2.58)

Emergency department, visits	1.3 (0.3)	1.2 (0.2)	1.11 (0.65 to 1.91)	545 (140)	558 (159)	1.11 (0.57 to 2.34)
Hospital wards, days	3.3 (0.8)	4.4 (0.9)	0.76 (0.40 to 1.47)	3 430 (895)	7 314 (3 643)	0.56 (0.23 to 1.40)
Nursing home, days	12.9 (5.9)	11.3 (7.1)	1.30 (0.30 to 5.58)	2 434 (1 035)	2 053 (1 167)	1.45 (0.32 to 14.30
Total costs				**34 159 (3 857)**	**31 848 (5 663)**	**1.08 (0.77 to 1.70)**

* use of healthcare and social services (Poisson rates per person-year)

† adjusted (age and sex) Incidence Rate Ratio, the physical-exercise group over the usual-care group

‡ costs of healthcare and social services (mean costs per person-year)

§ adjusted (age and sex) mean ratio, the physical-exercise group over the usual-care group, bootstrap (bias-corrected) with 95% confidence intervals

|| including physiotherapy, occupational therapy, speech therapy and trial intervention (physiotherapist-supervised, home-based physical exercise)

Figure 1. Flowchart of the study.

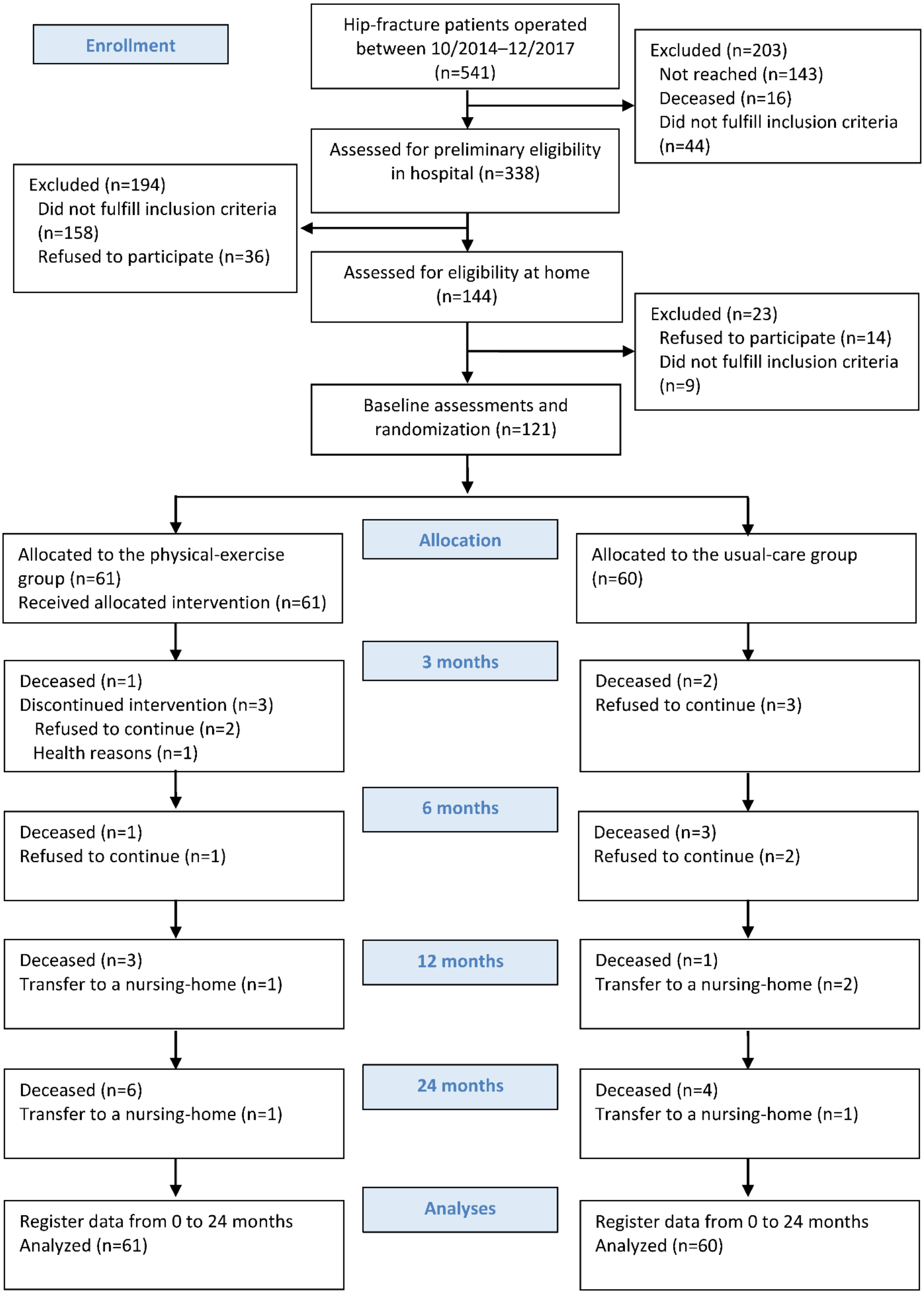

Enrollment
Hip-fracture patients operated between 10/2014–12/2017 (n=541)
Excluded (n=203)
Not reached (n=143)
Deceased (n=16)
Did not fulfill inclusion criteria (n=44)
Assessed for preliminary eligibility in hospital (n=338)
Excluded (n=194)
Did not fulfill inclusion criteria (n=158)
Refused to participate (n=36)
Assessed for eligibility at home (n=144)
Excluded (n=23)
Refused to participate (n=14)
Did not fulfill inclusion criteria (n=9)
Baseline assessments and randomization (n=121)
Allocation
Allocated to the physical-exercise group (n=61)
Received allocated intervention (n=61)
Allocated to the usual-care group (n=60)
3 months
Deceased (n=1)
Discontinued intervention (n=3)
Refused to continue (n=2)
Health reasons (n=1)
Deceased (n=2)
Refused to continue (n=3)
6 months
Deceased (n=1)
Refused to continue (n=1)
Deceased (n=3)
Refused to continue (n=2)
12 months
Deceased (n=3)
Transfer to a nursing-home (n=1)
Deceased (n=1)
Transfer to a nursing-home (n=2)
24 months
Deceased (n=6)
Transfer to a nursing-home (n=1)
Deceased (n=4)
Transfer to a nursing-home (n=1)
Analyses
Register data from 0 to 24 months
Analyzed (n=61)
Register data from 0 to 24 months
Analyzed (n=60)

Figure 2. Changes from baseline in total FIM scores over 12 months in the physical-exercise group and the usual-care group. Means and 95% CI; age and sex adjusted.

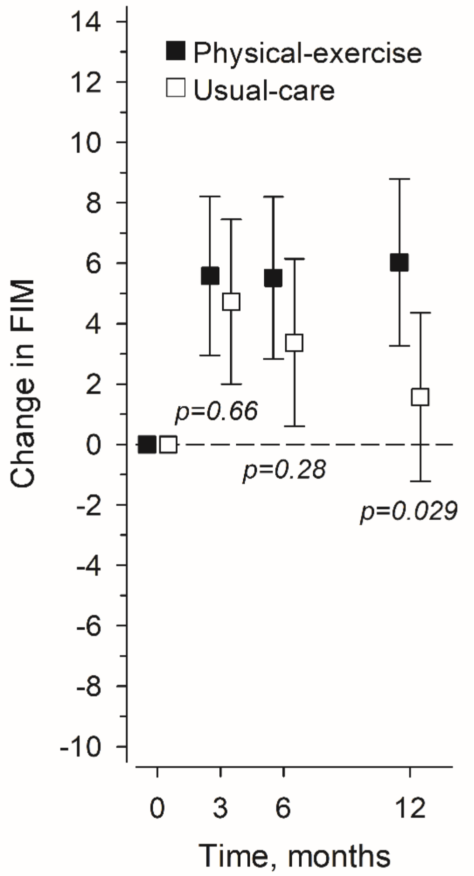
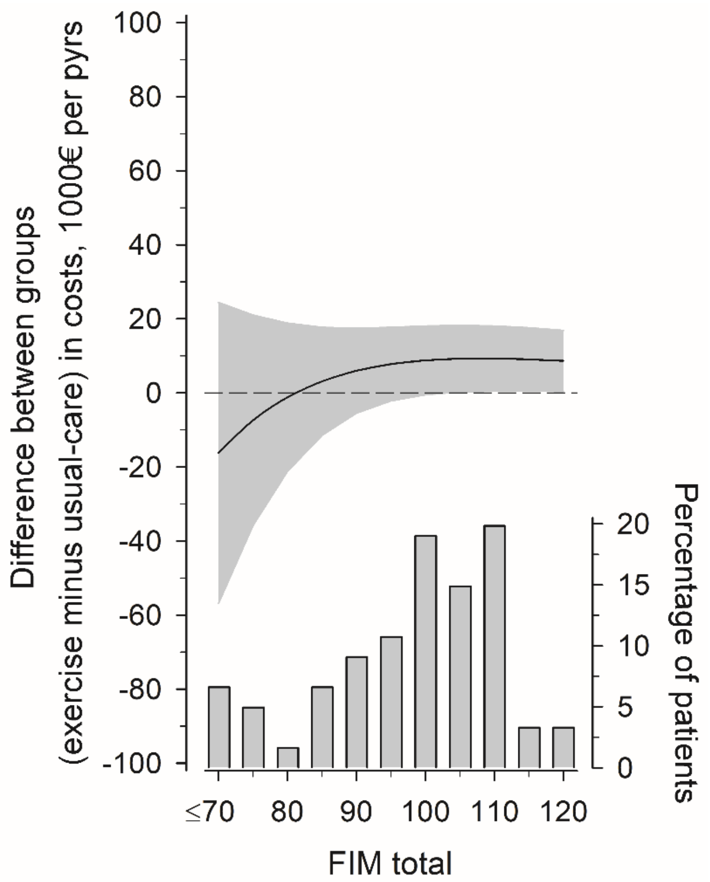


Figure 3. Differences between the costs per person-year (pyrs) over 24 months in the physical-exercise and usual-care groups according to total FIM scores at baseline. The grey area represents the 95% confidence interval. The curve was derived from a four-knot restricted cubic spline generalized linear regression model adjusted for age and sex.



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