Costs after hip fracture in independently living patients: A randomised comparison of three rehabilitation modalities

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Abstract

Objective: To evaluate costs and cost-effectiveness of physical and geriatric rehabilitation after hip fracture.

Design: Prospective randomised study (mean age 78 years, 105 male, 433 female) in different rehabilitation settings: physically oriented (187 patients), geriatrically oriented (171 patients), and healthcare centre hospital (control, 180 patients).

Main measures: At 12 months post-fracture, we collected data regarding days in rehabilitation, post-rehabilitation hospital treatment, other healthcare service use, number of re-operations, taxi use by patient or relative, and help from relatives.

Results: Control rehabilitation (4945,2€) was significantly less expensive than physical (6609.0€, p=0.002) and geriatric rehabilitation (7034.7€ p<0.001). Total institutional care costs (primary treatment, rehabilitation, and post-rehabilitation hospital care) were lower for control (13,438.4€) than geriatric rehabilitation (17,201.7€, p<0.001), but did not differ between control and physical rehabilitation (15659.1€, p=0.055) or between physical and geriatric rehabilitation (p=0.252). Costs of help from relatives (estimated as 30%, 50% and 100% of a home aid's salary) with physical rehabilitation were lower than control (p=0.016) but higher than geriatric rehabilitation (p=0.041). Total hip fracture treatment costs were lower with physical (36,356€, 51,018€) than control rehabilitation (38,018€, 57,031€) at 50% and 100% of salary (p=0.032, p=0.014, respectively). At one year post-fracture, 15D-score was significantly higher in physical rehabilitation group (0.697) than geriatric rehabilitation group (0.586, p=0.008) and control group (0.594, p=0.009).

Conclusions: Considering total costs one year after hip fracture the treatment including physical rehabilitation is significantly more cost-effective than routine treatment. This effect could not be seen between routine treatment and treatment including geriatric rehabilitation.

Keywords: hospital costs, community costs, cost of rehabilitation, hip fracture, independent living, cost-effect

Introduction

Hip fractures constitute a substantial burden for individuals and society.[1] Most hip fracture patients do not regain their pre-fracture quality of daily life, and up to 20% of such patients face potential institutionalization.[3–9] Many rehabilitation methods have been applied to help hip fracture patients retain independence.[10] However, comparisons between different methods usually focus on the treatment outcomes[11–14] without accounting for the rehabilitation costs. The economic impact of hip fracture has gained more attention in recent years, with direct annual costs of hip fracture estimated as $153.5 billion in 1997 in the United States alone.[2]

Studies reporting hip fracture treatment expenses often concentrate on the short-term costs, including the initial hospitalization and rehabilitation period.[9,11–17] Attempts to reduce hip fracture treatment costs focus on shortening the initial hospital-stay, but such savings do not necessarily represent cost-savings to society, healthcare services and individuals.[2,18–24] On the other hand, programs emphasizing continuity of care by adopting a multidisciplinary approach in addition to accelerated rehabilitation can reportedly reduce the costs after hip fracture.[25] Long-term costs have recently attracted more attention, but comparisons between such studies are limited due to differences in follow-up times,

study designs, and parameters recorded.[13,14,22,25–30] While a wide range of rehabilitation strategies and their costs have been reported,[10] we could not find any report specifically analysing the costs of physically and geriatrically oriented rehabilitations after hip fracture treatment.

In our previous paper we reported the outcomes of prospective randomised study of three different rehabilitation modalities following hip fracture[31]. This paper based on the same study design and setting aimed to report direct cost estimates , total costs of post-hip fracture treatment during one year after fracture and cost-effectiveness of different rehabilitations.

Methods

This study included consecutive non-pathological, independently living hip fracture patients, over 49 years of age, who were surgically treated in 1997–2000. Written informed consents were obtained from the patients, and the study protocols were approved by the Ethical Committee of the University. A total of 538 patients were enrolled (mean age, 78 years; age range, 50–100 years; 105 male and 433 female) (Figure 1). More detailed prefracture characteristics are presented in Table 1. At the time of fracture, all patients were living in either their own home or in some sort of community housing comparable to their own home, including warden-controlled accommodation, a flat, of independent living with some assistance available. The included patients were randomized (by a study nurse using opaque envelopes) to receive one of three different types of rehabilitation: physically oriented, geriatrically oriented, or healthcare centre hospital (control). The great majority of method and clinical details can be found in a previously published paper[31]. Physically orientated rehabilitation took place in the 36-bed rehabilitation unit of a private hospital. The unit was chaired and run by a neurologist with specific training in rehabilitation of disabilities in locomotor function. There was also a general practitioner and a physiatrist who was available part-time. Consultations with a psychiatrist were available daily, and

consultations with other specialists were available as needed. The ward staff included five physiotherapists, three occupational therapists, one hospital attendant, three rehabilitation attendants, and 18 registered and practical nurses. Rehabilitation duration was restricted to a maximum of about three weeks by the payers for the services. In some cases, rehabilitation ended before the patient was able to return to their original place of living, in which case the patient was discharged to their respective healthcare centre hospital.

Geriatrically orientated rehabilitation focused on both physical training and the associated geriatric problems. The 28-bed geriatrically orientated rehabilitation ward chaired by a geriatrician, and the staff included a general practitioner, one physiotherapist, one hospital attendant, one rehabilitation attendant, and 17 registered and practical nurses. Consultations with a psychiatrist were available daily, and consultations with other specialists were available as needed. If the rehabilitation period was over before the patient could return to their original place of living, the patient was discharged to their respective healthcare centre hospital.

The control group received a routine basic level of rehabilitation. This took place in one of 33 healthcare centre hospitals, which were similar with regard to administrative structure, resources, and treatment protocols. The mean number of beds per ward was 32 (SD, 12). The wards were run by general practitioners and mostly attended by registered and practical nurses. The availability of physiotherapists and consultations with other specialists was minimal and variable. The average ward staff included one physiotherapist (SD, 1), four hospital attendants (SD, 2), 17 registered and practical nurses (SD, 4), and 0.65 of a rehabilitation attendant. In this group, active rehabilitation continued until the patient could be discharged to their pre-fracture place of living, or until the responsible general practitioner decided that the rehabilitation was not having the desired effect in the patient, after which the patient received only basic care at the same hospital.

Data collection

The patients were assessed by a study nurse at admission and at 12 months after admission. The study nurse was aware in which study group patients belonged to. For the cost and cost-effectiveness analyses, we evaluated the baseline equality of the different groups in terms of the numbers of visits to a healthcare centre, visits to a private doctor, days in a hospital (healthcare centre, district hospital, private hospital, or central hospital), drugs used in the six months prior to fracture and 15D-instrument of health-related quality of life (15D-score)[32]. 15D-score was calculated based on questionnaire on 15 different areas of life (mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort and symptoms, depression, distress, vitality and sexual activity), with five ordinal levels on each dimension, and the total score scaled between 0 (being dead) to 1 (no problems in any dimension). To assess the costs of institutional treatment, special forms were used to collect the following data during the hospital stay and rehabilitation: inpatient stay at primary hospital, days in rehabilitation, and days of hospital treatment after rehabilitation. At 12 months, a study nurse collected the following data from the patients: visits to an outpatient clinic, visits to the hospital or a doctor's office, number of re-operations, home medical treatment, number of physiotherapy visits, taxi usage by patient, taxi usage by relatives, hours of home help services, help provided by a relative and 15D-score.

Cost calculations

For the basic cost calculations, we used prices from 2001, which were adjusted to prices of 2012 by multiplying all values by a factor of 1.466, obtained from the Finnish Hospital Cost Index.[33] The cost of the primary hospital treatment—including both the costs of the operation and of treatment in the

surgical ward (emergency room, operating theatre, intensive care unit, nursing care, and medication)—was obtained from the Diagnosis Related Group (DRG) price list for the hospital. This price was 1188€ for a three-day period, and 361€ for each additional day. Rehabilitation costs were 598€/day in the physically oriented rehabilitation unit, and 337€/day in the geriatric department. When calculating the costs of hospital treatment after rehabilitation, the day price was 287€ for patients of Oulu City and 218€ for the surrounding communities (these prices were also used for pre-fracture hospital days). The adjusted DRG prices for reoperations were as follows: implant removal, 1988€; hemi arthroplasty, 2134€; total arthroplasty, 9603€; reosteosynthesis, 7564€; Girdlestone arthroplasty, 7564€; drainage haematoma or infection, 1988€; reduction of dislocation, 1988€.

A visit to the healthcare centre cost 80€, a visit to a private doctor cost 89€, and a visit to the outpatient clinic of the primary hospital cost 256€. The price of physiotherapy visit was 39€. The costs of taxi usage by patients and their relatives were obtained from the patients or the relatives. The cost of home help was 50€ per hour. To provide a fiscal estimation of the usually unreimbursed cost to society, the help provided by a relative was calculated as a different proportions of a home aid's salary (30%, 50% or 100%), as discussed in some papers[34]. The information for these calculations was obtained from a publication of the National Research and Development Centre for Welfare and Health (STAKES).[35]

Statistics

The non-parametric Kruskal-Wallis test and Mann-Whitney U-test were used to analyse continuous variables. A *P* value of <0.05 was considered to indicate statistical significance. Analyses were performed using SPSS for Windows version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

No significant differences were seen between the groups with regards to demographics, background data, use of healthcare services six months prior to fracture, or associated diseases, except for one ADL function – use of toilet (Table 1, Table 2). More detailed prefracture characteristics are presented in our previous paper[31]. During the one-year follow-up, 17 patients died (9%) and one was lost to follow-up in the physical rehabilitation group, 36 patients died (21%) and one was lost to follow-up in the geriatric rehabilitation group, and 34 patients died (19%) and one was lost to follow-up in the control group (Figure 1).

The cost of primary treatment was significantly higher in the physical and geriatric rehabilitation groups, than in the control group (Table 3). This cost was also significantly higher in the geriatric than in the physical rehabilitation group (Table 3). Similarly, the expenditures of rehabilitation were significantly higher in the physical rehabilitation and geriatric rehabilitation compared to control group (Table 3). Costs of institutional care after rehabilitation were significantly higher in the physical rehabilitation group than the control group, but no other differences were observed (Table 3). Total expenditures for institutional treatment (including primary treatment, rehabilitation, and post-rehabilitation treatment in the healthcare center hospital) were higher in the geriatric rehabilitation than in the control group, but no significant differences were seen between physical rehabilitation group and other groups (Table 3).

The non-institutional costs are presented in Table 4. Control group used significantly more resources for doctor visits compared to geriatric rehabilitation group, while the physical rehabilitation group had significantly lower costs compared to geriatric rehabilitation. Outpatient hospital visits cost

significantly less in the control group compared to physical and geriatric rehabilitation groups. The physical rehabilitation group used significantly more physiotherapy than the geriatric rehabilitation group. Taxi usage costs were lowest in the geriatric rehabilitation group compared to physical rehabilitation and the control group. No other significant differences were observed. There were no significant between-group differences regarding the costs of reoperation, home medical treatment, home help services, or travel expenses for a patient's relative. Total costs did not significantly differ between any of the groups.

The cost of help provided by a relative was estimated as a proportion of a home aid's salary (30%, 50%, or 100%, Table 4). Physical rehabilitation was less expensive than control rehabilitation but more costly than geriatric rehabilitation in all proportions of the salary. We found no difference between geriatric rehabilitation and the control group. Total costs of post-rehabilitation healthcare services, including help from a relative, were significantly higher in the physical rehabilitation group than in the geriatric rehabilitation group when using the 30%, 50% and 100% proportions of a home aid's salary (Table 4). When using the 100% proportion, the total cost for the physical rehabilitation group was significantly lower than that of the control group No differences were found between the geriatric rehabilitation group and the control group at any salary percentage (Table 4).

Total treatment costs, when excluding help by a relative, were significantly smaller in the control group than in the physical rehabilitation and geriatric rehabilitation groups (Table 5). There was no significant difference between the physical and geriatric rehabilitation groups. When considering the costs of home help from a relative estimated as 30% of a home aid's salary, the significances of these differences disappeared (Table 5). When the costs of home help from a relative were estimated as 50% and 100% of a home aid's salary, the total costs of hip fracture treatment with physical rehabilitation were significantly lower than in the control group , but no significant difference was observed between

the geriatric rehabilitation (the distribution was very skewed in this group) and physical rehabilitation groups or the geriatric rehabilitation and control groups (Table 5).

The total treatment costs with the cost of home help from a relative estimated as 100% of a home aid's salary minus costs before the fracture significantly differed between the physical rehabilitation group and the control group, but not between the physical and geriatric rehabilitation groups or the geriatric rehabilitation and control groups (Table 6). Pre-fracture 15D scores did not differ between groups. At one year post-fracture, the 15D-score was significantly higher in the physical rehabilitation group than the geriatric rehabilitation group and the control group (Table 6). Post-fracture 15D-score did not significantly differ between the geriatric rehabilitation and the control group. We observed a similar pattern in the in differences between pre-fracture and one-year follow-up scores, with the physical rehabilitation group showing a change in score, which was significantly lower than the changes in the geriatric rehabilitation and control groups. The change in scores did not significantly differ between the geriatric rehabilitation group and the control group.

Discussion

Our present results showed that specialised rehabilitations (physical rehabilitation and geriatric rehabilitation) were significantly more expensive than standard rehabilitation following hip fracture. However, the total costs of the physically oriented rehabilitation group proved to be significantly lower than in the conventional treatment. This means that although physical rehabilitation is relatively expensive, it is a useful investment because it reduces overall costs. Furthermore it could be argued that the savings will accumulate over time as we have only looked at the first year.

The high costs of specialised rehabilitations were expected due the high resource demand in both physical and geriatric rehabilitation. This was reflected in high day prices and the total cost of rehabilitation. It must be considered that the local authorities paid an individual fee that covered a limited period of physical rehabilitation—usually two to three weeks—which influenced the rehabilitation duration in this patient group. Such limitations did not apply to geriatric and standard rehabilitation, which were paid for by public funds. Our present study enabled the separate evaluation of rehabilitation costs, in contrast to many earlier papers in which rehabilitation costs were combined with other hospital costs. While a wide range of rehabilitation strategies have been investigated,[10] few studies have compared the costs between different rehabilitation settings. To our knowledge, no previously published study has used a design similar to our present investigation. In a group of hip fracture and stroke patients, Kramer et al.[15] compared the effectiveness and costs of rehabilitation in three different settings: rehabilitation hospital, subacute nursing home, and a traditional nursing home. As expected, the medicare costs were greater in the rehabilitation hospital setting, which involved more physical, occupational and recreational therapy, compared to the subacute nursing home setting. Moreover, and the costs for subacute nursing home patients were greater than for traditional nursing home patients at the 6-month follow-up. However, it is difficult to compare their results to our present findings due to inflation, exchange rates, and differences in rehabilitation practices and healthcare. In fact, we identified no clear comparisons for our presently examined specialised rehabilitation settings.

We also found that specialised rehabilitation settings were associated with a longer stay in the primary hospital, thus increasing the primary treatment costs. This was because the rehabilitation centres and healthcare centre hospitals have different capacities to admit patients from the primary hospital, which directly affected the initial hospitalization cost. The healthcare centre hospitals are sufficiently well equipped and have a dense enough network to allow patient admission at a very early postoperative

phase and without queuing, which was a problem that particularly affected the geriatric rehabilitation centre. Initial hip fracture treatment costs vary substantially between different countries.[36,25,30] Finnern and Sykes[37] reported primary hip fracture treatment expenses within the EU countries using European Commission cost data. The costs were lowest in Ireland (3714€) and highest in Germany (13,776€). The average cost per patient in the EU was 8125€, while the treatment cost in Finland was 4086€. This great variance in primary hospital costs related to healthcare system differences among different countries. In some countries, rehabilitation occurs in the primary hospitals, whereas early discharge and rehabilitation in other institutions is the routine practice in other countries. Our estimates of the initial hospitalization costs are well within the previously reported range of values when costs are adjusted for present day prices.

The total costs of institutional hip fracture treatment (primary hospital, rehabilitation, and post-rehabilitation healthcare centre hospital costs) were 17% higher in the physically oriented rehabilitation and 28% higher in the geriatrically oriented rehabilitation groups compared to in the control group. In all groups, rehabilitation constituted a major share of the total costs, while post-rehabilitation hospital care was the smallest component of the expenditures. Studies comparing total hip fracture costs between different rehabilitation methods have mainly focused on the effects of early discharge and the costs of the intensified rehabilitation period.[13,38,39] Polder et al.[39] compared costs between patients with early hospital discharge to a nursing home (including rehabilitation facilities) and patients in conventional treatment. They reported that early discharge results in lower initial hospital costs, but a higher rate of later institutionalization, resulting in no overall benefit with regards to total treatment costs. On the other hand, Hollingworth et al.[38] found smaller total costs with the “hospital at home” program in UK, which provided nursing care, social services, and rehabilitation in the patient’s home. However, only 40% of patients benefitted from the “hospital at home” program, and these patients were more mobile and younger prior to hip fracture. Similarly, an Australian study concluded that accelerated rehabilitation

reduced costs by 17% compared to conventional care,[13] but these savings were relatively modest. Again, these results are not fully comparable to our present findings, as the reported rehabilitation methods and study designs were somewhat different from our specialised rehabilitation settings.

Use of other healthcare services—including visits to a doctor or outpatient hospital, physiotherapy, home help services, taxi usage, home medical treatment, travel expenses for patients' relatives, reoperations, and help from a relative—and the costs generated following hip fracture were lower in the geriatric rehabilitation group than in the physical rehabilitation group. This was mainly attributed to the costs estimated for home help provided by relatives, as other expenditures had relatively small impacts on the costs. The costs of home help from relatives were estimated as different percentages of a home aid's salary. Even at the lowest proportion (30% of the salary), these costs constituted over half of the total costs during the year after the fracture. The methods for calculating post-rehabilitation costs of hip fracture vary considerably in the literature.[13,22,25,29] We identified only one previous study that accounted for the costs of help provided by a relative.[30] Kondo et al.[30] estimated the loss of salary in cases where a patient's relatives took a leave of absence from work; however, these costs were very low (150 dollars on average) and the use of an elderly care services was the routine practice. A Finnish study by Nurmi et al.[29] reported non-institutional costs of 3013€ during the one-year follow-up after hip fracture. This was significantly lower than in our present results; however, their study didn't account for some of the expenditures we included in our study, such as help from a relative, reoperations, relatives' travel expenses, and physiotherapy. Again, the great variance in methods for cost calculations made it difficult to clearly compare our results to previous findings, with the main difference being the costs of help from a relative.

Intensive physical and geriatric rehabilitation are usually considered to be costly to society. However, our present results showed that the total hip fracture treatment costs over one year following

fracture were similar between rehabilitation groups when accounting for the estimated cost of help given by relatives as 30% of a home aid's salary. When this cost estimate was made using 50% and 100% of the home aid's salary, the mean cost of routine treatment exceeded that of the physical rehabilitation modality. These results suggest that, although routine treatment is viewed as the least costly method, it may actually only serve to shift the costs, such that the expenditures of the hospital are carried by the patients' relatives. This possibility has also been suggested in other studies.[30,22,23,24]

One potential weakness of our study was that the patients' residences influenced their randomization to rehabilitation groups. The physical rehabilitation group had no limitations regarding place of residence. However, the geriatric treatment facility only included patients from the city of Oulu, and the control group only included patients from the surrounding area. Some healthcare services had higher prices in the city than in the surrounding areas (included the healthcare centre hospital prices), which resulted in higher costs in the specialised rehabilitation groups. Additionally, there was sometimes a great difference in the rehabilitation unit capacities. As mentioned earlier, this particularly affected patients undergoing geriatric rehabilitation, who often had to wait in the primary hospital before being admitted to the rehabilitation centre, which increased the costs in this group. However, while these factors influenced the results by increasing the costs of specialised rehabilitation modalities, they highlight rather than diminish our findings, since conventional treatment was still found to be more costly than physical rehabilitation treatment. It should be noted that we chose not to exclude deceased persons from the population, as this could have introduced a selection bias by retaining the healthier patients. Finally, the present study material is quite old, which raises the question of whether the findings reflect the current rehabilitation practices. The publication of our results was delayed because, in Finland, it is economically reasonable to publish all the results as a thesis, and multiple PhD students withdrew during the project.

However, over the passing years since this study, rehabilitation practices have remained largely the same, although the duration of primary hospital stay has been substantially shortened.

Despite the factors that influenced the initial patient randomization and therefore the costs, our data showed that during the one-year post-fracture period, physical rehabilitation proved to be less costly than routine treatment. This difference was mainly attributed to the estimated costs of home help provided by relative, an expenditure that hasn't been taken into account in previous studies. These findings suggest that efforts to save costs should focus on effective rehabilitation, to reducing the need for post-rehabilitation care.

Clinical messages

-Physical rehabilitation after hip fracture is recommendable both economically and with regards to the quality of life.

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Declaration of interest

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Table 1. Prefracture patient characteristics.

	Physical rehabilitation group (N=187)	**Geriatric rehabilitation group** (N=171)	**Control group** (N=180)	p-value
Age				p=0,226
Mean (SD)	77,5 (9,4)	79,1 (9,4)	77.7(9,1)	

Range	53,1-94,5			50,0-99,6			53,7-53.7-98,2		
Sex									p=0,560
Males	41	21,9	%	30	17,5	%	34	18,9	%
Females	146	78,1	%	141	82,5	%	146	81,1	%
Side of fracture									p=0,454
Right	86	46,0	%	90	52,6	%	88	48,9	%
Left	101	54,0	%	81	47,4	%	92	51,1	%
Type of fracture									p=0,733
Undisplaced intracapsular	25	13,4	%	25	14,6	%	23	12,8	%
Displaced intracapsular	99	52,9	%	75	43,9	%	99	55,0	%
Basocervical	3	1,6	%	2	1,2	%	2	1,1	%
Trochanteric two-fragment	26	13,9	%	30	17,5	%	22	12,2	%
Trochanteric multi-fragment	27	14,4	%	34	19,9	%	30	16,7	%
Subtrochanteric	7	3,7	%	5	2,9	%	4	2,2	%
Primary operation									p=0,358
Three screws	42	22,5	%	38	22,3	%	39	21,6	%
Single screw with slide plate	25	13,3	%	24	14,0	%	21	11,7	%
Intramedullary nail	41	21,9	%	50	29,2	%	42	23,4	%
Hemiarthroplasty	70	37,4	%	56	32,7	%	65	36,1	%
Total hip arthroplasty	9	4,8	%	3	1,8	%	13	7,2	%
ASA grade									p=0,825
I	3	1,6	%	5	2,9	%	5	2,8	%
II	39	21,1	%	32	18,7	%	29	16,3	%
III	117	63,2	%	113	66,1	%	113	63,5	%
IV	25	13,5	%	21	12,3	%	30	16,9	%
V	1	0,5	%				1	0,6	%
Discharged to									
Own home	9	4,8	%	20	11,7	%	9	5,0	%
Institutional care			%	1	0,6	%			%
Permanent hospital inpatient			%			%			%
Rehabilitation unit	175	93,6	%	145	84,8	%	2	1,1	%
Health centre hospital	2	1,1	%	4	2,3	%	168	93,3	%
Died	1	0,5	%	1	0,6	%	1	0,6	%
P-value for discharged to rehabilitation unit which meant to be: p=0.004									
Associated deceases									
Cardiovascular diseases									p=0,197
Yes	136	72,7	%	125	73,1	%	144	80,0	%
No	51	27,3	%	46	26,9	%	36	20,0	%

Paralysis									p=0,446
Yes	27	14,4	%	30	17,5	%	23	12,8	%
No	160	85,6	%	141	82,5	%	157	87,2	%
Respiratory organ diseases									p=0,329
Yes	31	16,6	%	37	21,6	%	29	16,1	%
No	156	83,4	%	134	78,4	%	151	83,9	%
Urinary organ diseases									p=0,897
Yes	45	24,1	%	41	24,0	%	40	22,2	%
No	142	75,9	%	130	76,0	%	140	77,8	%
Diabetes mellitus									p=0,783
Yes	36	19,3	%	37	21,6	%	34	18,9	%
No	151	80,7	%	134	78,4	%	146	81,1	%
Rheumatism									p=0,848
Yes	23	12,3	%	24	14,0	%	22	12,2	%
No	164	87,7	%	147	86,0	%	158	87,8	%
Parkinson's disease									p=0,374
Yes	9	4,8	%	4	2,3	%	9	5,0	%
No	178	95,2	%	167	97,7	%	171	95,0	%
Malignant tumour or haemopathy									p=0,791
Yes	25	13,4	%	22	12,9	%	20	11,1	%
No	162	86,6	%	149	87,1	%	160	88,9	%

Table 2. Use of healthcare services prior to fracture.

	Physical rehabilitation (*n* = 187)		**Geriatric rehabilitation (*n* = 171)**		**Control group (*n* = 180)**	
	Mean times (SEM)	Euros	Mean times (SEM)	Euros	Mean times (SEM)	Euros
Visits to healthcare centre	0.99 (0.19)	110.4	0.62 (0.10)	68.8	0.93 (0.15)	103.4
Visits to private doctor	0.08 (0.03)	6.1	0.10 (0.03)	7.6	0.01 (0.01)	1.0
Hospital treatment	Days	Euros	Days	Euros	Days	Euros
- Healthcare centre hospital	1.44 (0.33)	286.6	1.44 (0.60)	286.6	2.39 (0.51)	476.3
- District hospital	0.44 (0.28)	87.4	0.94 (0.47)	187.6	0.36 (0.21)	72.5
- Private hospital	0.01 (0.00)	1.1	0.04 (0.03)	7.0	-	-
- Central hospital	1.84 (0.41)	367.6	3.64 (0.69)	724.7	1.44 (0.38)	287.1
Number of drugs	5.25 (0.24)		5.73 (0.30)		5.49 (0.24)	
Total		859.1 (122.0)		1282.3 (214.8)		940.3 (149.7)

	***p* value**
Physical rehabilitation vs. geriatric rehabilitation	$p = 0.424$
Physical rehabilitation vs. control	$p = 0.638$
Geriatric rehabilitation vs. control	$p = 0.197$

Table 3. Costs of primary treatment, rehabilitation, and post-rehabilitation treatment at the healthcare centre hospital.

	Physical rehabilitation (*n* = 187)		**Geriatric rehabilitation (*n* = 171)**	
	Mean days (SEM)	Mean euros (SEM)	Mean days (SEM)	Mean euros (SEM)
Primary treatment and in-patient days in primary hospital	7.4 (0.3)	5105.1 (94.4)	8.9 (0.4)	5597.9 (129.1)
Rehabilitation	19.6 (1.3)	6609.0 (272.1)	26.6 (1.7)	7034.7 (439.1)
Post-rehabilitation treatment at healthcare centre hospital	19.6 (2.3)	3944.9 (486.4)	20.6 (3.0)	4569.1 (655.7)
Total	46.5 (2.7)	15,659.1 (561.2)	56.1 (3.6)	17,201.7 (826.2)

	p value	**Physical rehabilitation vs. geriatric rehabilitation**	**Physical rehabilitation vs. control**
Primary treatment and in-patient days in primary hospital	$p < 0.001$	$p = 0.047$	$p = 0.001$
Rehabilitation	$p < 0.006$	$p = 0.666$	$p = 0.002$
Post-rehabilitation treatment at healthcare centre hospital	$p = 0.068$	$p = 0.058$	$p = 0.043$
Total	$p < 0.001$	$p = 0.252$	$p = 0.055$

Table 4. Use of healthcare services after rehabilitation.

	Physical rehabilitation (*n* = 187)		**Geriatric rehabilitation (*n* = 171)**		**Control group (*n* = 180)**					
	Mean times (SEM)	Mean euros (SEM)	Mean times (SEM)	Mean euros (SEM)	Mean times (SEM)	Mean euros (SEM)		Physical rehabilitation vs. geriatric rehabilitation	Physical rehabilitation vs. control	Geriatric rehabilitation vs. control
Visits to a doctor	1.1 (0.2)	116.7 (17.3)	1.3 (0.4)	122.9 (39.9)	1.7 (0.6)	194.8 (73.8)	$p = 0.001$	$p = 0.010$	$p = 0.288$	$p = 0.001$
Outpatient visits to the hospital	1.2 (0.1)	128.4 (14.2)	1.6 (0.2)	156.3 (23.8)	0.9 (0.1)	87.9 (16.2)	$p = 0.016$	$p = 0.591$	$p = 0.021$	$p = 0.007$
Physiotherapy	5.8 (1.1) times	467.8 (89.1)	3.3 (0.8) times	263.5 (62.6)	4.1 (1.0)	366.9 (95.8)	$p = 0.028$	$p = 0.017$	$p = 0.087$	$p = 0.458$
Home help services	92.1 (16.3) hours	4522.1 (789.3)	86.9 (16.8) hours	4219.0 (816.0)	90.8 (14.5) hours	3821.0 (726.7)	$p = 0.522$			
Taxi usage		51.6 (10.2)		17.9 (5.6)		50.7 (13.1)	$p = 0.023$	$p = 0.002$	$p = 0.428$	$p = 0.029$
Home medical treatment	0.14 (0.03) h/week	437.6 (82.6)	0.14 (0.04) h/week	417.4 (111.2)	0.26 (0.06) h/week	971.8 (216.4)	$p = 0.077$			
Travel expenses of patient's relatives		132.2 (46.7)		104.1 (39.1)		59.4 (16.7)	$p = 0.257$			
Re-operations		642.1 (155.5)		1082.7 (235.5)		1000.9 (215.9)	$p = 0.458$			
Home help provided by relatives (30%)	10.0 (2.0) h/week	8785.2	8.4 (2.0) h/week	6238.0	13.0 (2.5) h/week	11,392.0	$p = 0.028$	$p = 0.041$	$p = 0.016$	$p = 0.520$
Home help provided by relatives (50%)		14,662.5		10411.2		19,013.2	$p = 0.028$	$p = 0.041$	$p = 0.016$	$p = 0.520$
Home help provided by relatives (100%)		29,325.1		20822.3		38,026.4	$p = 0.028$	$p = 0.041$	$p = 0.016$	$p = 0.520$
Total (0%)		6034.1 (776.7)		5393.2 (756.7)		5566.5 (724.9)	$p = 0.150$	$p = 0.098$	$p = 0.090$	$p = 0.990$
Total (30%)		14,819.3 (1884.8)		11,631.2 (1628.9)		16,958.5 (2401.5)	$p = 0.102$	$p = 0.042$	$p = 0.120$	$p = 0.612$
Total (50%)		20,696.6 (2934.2)		15,804.4 (2546.3)		24,579.7 (3895.3)	$p = 0.068$	$p = 0.030$	$p = 0.078$	$p = 0.708$
Total (100%)		35,359.1 (5657.0)		26,215.5 (4955.8)		43,592.9 (7698.0)	$p = 0.036$	$p = 0.018$	$p = 0.041$	$p = 0.839$

Table 5. Total costs of hip fracture treatment and use of healthcare services after rehabilitation.

	Physical rehabilitation (*n* = 187)		**Geriatric rehabilitation (*n* = 171)**		**Control group (*n* = 180)**					
	Mean euros	SEM	Mean euros	SEM	Mean euros	SEM		Physical rehabilitation vs. Geriatric rehabilitation	Physical rehabilitation vs. control	Geriatric rehabilitation vs. control
Total costs excluding home help by relatives	21,693	1028.2	22,595	1162.0	19,005	984.0	$p = 0.012$	$p = 0.971$	$p = 0.009$	$p = 0.011$
Total costs including home help by relatives (30% of a home aid's salary)	30,478	1994.7	28,833	1813.6	30,397	2494.9	$p = 0.137$			
Total costs including home help by relatives (50% of a home aid's salary)	36,356	3002.8	33,006	2650.3	38,018	3954.8	$p = 0.088$	$p = 0.476$	$p = 0.032$	$p = 0.144$
Total costs including home help by relatives (100% of a home aid's salary)	51,018	5688.8	43,417	4986.4	57,031	7729.9	$p = 0.041$	$p = 0.324$	$p = 0.014$	$p = 0.115$

Table 6. Incremental cost-effectiveness analysis.

	Physical rehabilitation		**Geriatric rehabilitation**		**Control group**					
	(*n* = 187)		**(*n* = 171)**		**(*n* = 180)**		*p* value	Physical rehabilitation vs. Geriatric rehabilitation	Physical rehabilitation vs. control group	Geriatric rehabilitation vs. control group
	Mean	SEM	Mean	SEM	Mean	SEM				
Costs before fracture	859	122.0	1282	214.8	940	149.7		*p* = 0.424	*p* = 0.638	*p* = 0.197
Costs after fracture	51,018	5688.8	43,417	4986.4	57,031	7729.9	*p* = 0.041	*p* = 0.324	*p* = 0.014	*p* = 0.115
Difference in cost	50,159	5691.4	42,135	4916.2	55,965	7725.4	*p* = 0.055	*p* = 0.305	*p* = 0.018	*p* = 0.161
	***n* = 166**		***n* = 153**		***n* = 149**					
15D-score* before fracture	0.780	0.010	0.790	0.032	0.755	0.010	0.296			
15D-score* 1 year after fracture	0.697	0.018	0.586	0.025	0.594	0.025	0.009	*p* = 0.008	*p* =0.009	*p* = 0.938
Difference in 15D-score*	0.083	0.015	0.205	0.037	0.161	0.021	0.018	*p* = 0.009	*p* =0.028	*p* = 0.667

*15D-instrument of health-related quality of life