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## Gender differences and cognitive aspects on functional outcome after hip fracture—a 2 years' follow-up of 2,134 patients

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### Abstract

**Background:** hip fractures as well as cognitive dysfunction become increasingly prevalent in growing ageing populations. Hip fractures are approximately three times more common in elderly women.

**Objective:** we analysed outcome after hip fracture with respect to gender and cognitive function.

**Design:** population-based, prospective cohort study.

**Setting:** four university hospitals in Stockholm, Sweden.

**Subjects:** a total of 2,134 consecutive patients admitted with hip fracture during 2003.

**Methods:** gender differences in residence, walking ability and activity of daily living (ADL) were analysed at baseline, after 4 and 24 months in patients with and without intact cognitive function.

**Results:** women were older, more often living alone and had poorer walking ability ( $P < 0.001$ ). Cognitive dysfunction was equally common by gender. Women were more often treated with a prosthesis ( $P < 0.001$ ) and sent to rehabilitation ( $P < 0.001$ ). In the cognitive dysfunction group, men had more co-morbidity ( $P < 0.001$ ) and total loss of walking ability ( $P = 0.03$ ), but more often resided in own homes ( $P = 0.03$ ). There was no gender difference in ADL.

**Conclusion:** men had a higher risk for loss of walking ability and death only in patients with cognitive dysfunction. Cognitive function was the most important factor for returning to own home and regain pre-fracture function.

**Keywords:** hip fracture, gender differences, cognitive function, living conditions, walking ability, elderly

## Introduction

With ageing populations, the prevalence of hip fractures is expected to increase [1]. Lifetime risk of sustaining a hip fracture among women in Sweden has been estimated to ~20%, and among women reaching the age of 90 years almost 50% have had a hip fracture. The proportion of women versus men has been estimated to be ~3:1 [2]. Although a majority of patients with hip fractures are women, men sustaining this fracture are generally described as more fragile, i.e. their baseline morbidity and post-fracture mortality have been reported to be higher [3, 4]. In a few previous studies, gender differences in functional outcome have been reported, with inconsistent results [5–8].

Hip fractures often cause permanent functional impairment and lead to institutionalisation. Vast economical resources are spent on treatment and rehabilitation [4, 9]. It is therefore important to study a consecutive cohort of all patients, including those younger than 65, and patients with cognitive impairments.

The aim of the present study was to

- (i) describe the total population of patients sustaining a hip fracture in a geographically defined urban area in Sweden during 2003;
- (ii) investigate the potential importance of gender and cognitive function in returning to own home, regaining walking ability and ADL function in this population.

## Patients and methods

### Patients

In this prospective cohort study, all patients who were admitted with an acute non-pathological hip fracture to any of the four university hospitals in Stockholm County from 1 January to 31 December 2003 were included. The total catchments area was about 1.4 million out of the 1.9 million people living in Stockholm. All patients were treated according to the routine protocols of the participating hospitals. Trained research nurses collected data at baseline and after 4 and 24 months. If patients were not able to give informed consent or participate in the interviews, a proxy respondent, i.e. family or caregiver, was interviewed. Experienced orthopaedic surgeons classified the fractures.

The study was conducted in conformity with the Helsinki Declaration and was approved by the local ethics committee.

### Baseline characteristics

Sex, age, type of hip fracture, living situation, walking ability, activities of daily living (ADL) and description of where the fall had occurred were registered. Co-morbidities recorded were cardiovascular disease, stroke, respiratory disease, renal disease, diabetes, rheumatoid disease, Parkinson's disease and malignant disorders. Cognitive function was assessed according to the Short Portable Mental Status Questionnaire (SPMSQ) [10] and general physical health status according to the American Society of Anaesthesiologists' (ASA) classifica-

tion [11]. Mobility was defined according to the use of walking aids, and ADL according to the Katz ADL index [12]. Hip fractures were classified as femoral neck, trochanteric or sub-trochanteric. For the purpose of this study, fractures were categorised as intra-capsular or extra-capsular. The clinical relevance of degree of dislocation will be addressed in other sub-studies.

### Follow-up data

Living conditions, walking ability and ADL were assessed by telephone interviews or by postal questionnaires after 4 and 24 months. Data on mortality were obtained from a proxy or the Hospital Discharge Register.

## Statistical methods

Baseline characteristics and postoperative functional outcome were divided by cognitive function and compared between men and women.

Number of co-morbidities was dichotomised into either 0–1 or >1, cognitive function level into 'no cognitive dysfunction' (SPMSQ 8–10), or 'cognitive dysfunction' (SPMSQ 0–7), and patients' residence as own home or institutional living (group-living for demented patients or nursing home). Mobility was categorised as independent walking (without any walking aid or one cane), dependent on walking aids (two canes or walking frame) or as non-walking (wheelchair or bedridden) and ADL status dichotomised into independent (Katz A–B), or dependent (Katz C–G) [13].

For statistical analyses, SPSS 15.0 for Windows was used. The independent samples *t*-test was used for testing scale variables between independent groups. Nominal variables were tested by the chi-square test. All tests were two-sided. All *P*-values are given in tables.

As possible predictors of returning to own home after 4 months, the following variables were considered: sex, cognitive function, living situation, age, type of fracture, pre-fracture walking ability, pre-fracture ADL status, co-morbidity and ASA. Variables that were significantly univariately associated with the site of residence after 4 months were retained for multivariate analysis. The same procedures were performed for prediction of regaining walking ability and independence in ADL.

## Results

Baseline and outcome data are displayed in three groups, the total study population ( $n = 2,134$ ), patients with intact cognitive function ( $n = 873$ ) and with cognitive dysfunction ( $n = 1,078$ ), and compared between women and men as shown in Tables 1 and 2.

In the total population, women were in majority (73%), but in patients <70 years the gender distribution was equal. Women were older (83 years vs. 77), but no gender differences were found in ASA grade, cognitive function or fracture type

Table 1. Baseline characteristics and surgical procedures (intracapsular fractures)

	Total study population <sup>a</sup>					No cognitive dysfunction <sup>b</sup>					Cognitive dysfunction <sup>b</sup>				
	Women		Men		P	Women		Men		P	Women		Men		P
	n	%	n	%		n	%	n	%		n	%	n	%	
Number of patients at baseline	1,549	73	585	27	<0.001	628	72	245	28	<0.001	793	74	285	26	<0.001
Age mean (SD)	83	(9.4)	77	(12.4)	<0.001	79	(10.5)	73	(13.9)	<0.001	85	(7.2)	81	(10.2)	<0.001
25–69 years	131	8	126	21		96	15	87	36		18	2	26	9	
70–84 years	685	44	273	47		326	52	104	42		312	39	147	52	
85–103 years	733	47	186	32		206	33	54	22		463	58	112	39	
Residence															
Institution	345	23	106	18		17	3	6	2		304	40	88	32	
Own home	1,176	77	466	82	0.04	609	97	239	98	0.8	468	60	188	68	0.03
<i>Living alone<sup>c</sup></i>	823	70	200	43		424	68	91	37		342	73	92	50	
<i>Living with spouse/or other<sup>c</sup></i>	299	26	253	55	<0.001	173	28	144	60	<0.001	84	18	82	44	<0.001
Walking ability															
Independent/one stick	751	49	326	57		405	64	190	78		290	37	112	40	
Two sticks/frame	736	48	215	37		218	35	45	18		457	59	148	53	
Non-walker	42	3	34	6	<0.001	5	1	9	4	<0.001	33	4	21	7	0.05
ADL															
Independent (Katz A or B)	1,063	74	394	74		593	95	231	95		398	56	143	56	
Dependent (Katz >B)	367	26	140	26	0.8	31	5	12	5	1	318	44	112	44	0.9
Co-morbidity (mean sum)		1.3		1.6	0.002	1.3		1.3		0.8	1.4		1.6		<0.001
0–1 Condition of comorbidity	914	60	302	53		382	61	155	64		467	60	127	45	
>1 Conditions of comorbidity	595	40	268	47	0.002	242	39	88	36	0.3	312	40	155	55	<0.001
ASA															
1 or 2	628	41	212	37		336	54	116	48		244	31	78	28	
3 or above	906	59	362	63	0.1	289	46	127	52	0.1	544	69	201	72	0.3
The fall accident occurred outdoors	224	15	128	23	<0.001	165	27	97	41	<0.001	48	6	28	10	0.03
Type of fracture															
Extra-capsular	786	50	275	47		285	42	104	42		384	56	124	50	
Intra-capsular	763	50	310	53	0.1	343	55	141	58	0.4	307	44	126	50	0.1
<i>Internal fixation</i>	393	52	219	71		177	52	101	72		143	47	82	65	
<i>Prosthesis</i>	370	48	91	29	<0.001	164	48	38	27	<0.001	157	51	41	32	0.004

<sup>a</sup>Includes all patients, also those where cognitive function was not reported (*n* = 183).

<sup>b</sup>Cognitive function according to SPMSQ. No dysfunction = SPMSQ 8–10, dysfunction = SPMSQ 0–7 or diagnosed dementia.

<sup>c</sup>Due to missing information in some cases, the number and percentages do not exactly end up to total.

All tests women versus men,  $\chi^2$  (*t*-test for mean age). The total number of patients not treated with surgery was 12. In 25 patients ASA was not assessed, of whom nine patients died before surgery. Only one patient included in the study was classified as ASA 5, this patient was merged to the group ASA 3–4.

(intra- or extra capsular). Women with intra-capsular fractures were significantly more often treated with a hip replacement.

Among patients with cognitive dysfunction, women had a lower rate of co-morbidity, while in the intact cognitive function group, there were no gender differences (Table 1).

## Gender differences in living condition and physical function at baseline

### Intact cognitive function

Most patients with intact cognitive function were admitted from own home, living alone more common among women. Women in this group had poorer walking ability than men, but more men could not walk at all. Ninety-five per cent of the patients with intact cognitive function were independent in ADL (Katz A–B) at baseline, with no gender difference (Table 1).

### Cognitive dysfunction

In the group with cognitive dysfunction, 60% of the women and 68% of the men were admitted from own home, and living alone was more common among women. Walking ability was poor in patients with cognitive dysfunction, with a slight gender difference in favour of men. In this group, 7% of the men and 4% of the women could not walk at all. Approximately 50% were independent in ADL function (Katz A–B), with no gender difference (Table 1).

## Gender differences in outcome, after 4 and 24 months

Mortality was higher among men in the cognitive dysfunction group, but in the intact cognitive function group there were no gender differences. A total of 336 (15%) had died after 4 months, and after 24 months the number was 700 (32%) (Table 2, Figure 1).

Table 2. Residence and physical function at 4 and 24 months' follow-up

	Total study population					No cognitive dysfunction <sup>a</sup>					Cognitive dysfunction <sup>a</sup>				
	Women		Men		<i>p</i> <sup>b</sup>	Women		Men		<i>p</i> <sup>b</sup>	Women		Men		<i>p</i> <sup>b</sup>
	<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%	
Residence in own home															
4 months	788	79	284	86	0.07	514	95	191	97	0.3	228	36	83	42	0.1
24 months	589	63	216	75	<0.001	417	<89	159	93	0.3	141	34	53	49	0.003
Discharged to rehab unit	851	55	293	50	<0.001	419	67	131	54	<0.001	375	47	137	48	0.8
Walking ability															
Independent/one stick															
4 months	283	23	128	31	<0.001	198	35	105	49	<0.001	70	12	21	11	0.6
24 months	244	26	102	35	0.001	189	40	86	49	0.003	45	11	14	14	0.7
Two sticks/frame															
4 months	799	64	211	51	<0.001	345	60	91	43	<0.001	408	67	110	60	0.06
24 months	520	56	134	46	0.001	250	53	70	40	0.003	241	59	59	57	0.7
Non-walker															
4 months	166	13	77	18	<0.001	28	5	17	8	0.1	128	21	53	29	0.03
24 months	166	18	52	18	0.9	31	7	18	10	0.1	123	30	31	30	1.0
ADL-independent (Katz A–B)															
4 months	701	58	237	58	0.9	349	62	145	69	0.06	76	13	26	14	0.6
24 months	529	57	179	64	0.06	296	64	123	72	0.04	55	14	15	15	0.7
Mortality															
0–4 months	213	14	123	21	<0.001	36	6	15	6	0.8	152	19	88	31	<0.001
0–24 months	465	30	235	40	<0.001	109	17	49	20	0.4	315	40	159	56	<0.001

<sup>a</sup>Cognitive function according to the Short Portable Mental Status Questionnaire (SPMSQ, 0–10), where SPMSQ 8–10 = no dysfunction and SPMSQ 0–7 = dysfunction or diagnosed dementia.

<sup>b</sup>Chi-squared tests, women versus men.

Note the large amount of lost patients for 24 months follow-up in the cognitive dysfunction group. The amount of missing varies, being most frequent in the cognitive dysfunction group (see Figure 1).

### Intact cognitive function

No gender differences in residence were found after 4 and 24 months. After 2 years, about 90% were still residing in their own homes. Men had a better walking ability, but the percentage of non-walkers had increased in both gender groups after 4 and 24 months. Dependence in ADL increased (Table 2).

### Cognitive dysfunction

After 4 months, fewer of the remaining population followed up were residing in own home, and after 24 months, the proportion was 34% of the women and 49% of the men. In both women and men, the proportion of independent walkers decreased after 4 and 24 months. After 24 months, 30% could not walk at all (Table 2).

### Logistic regression analysis

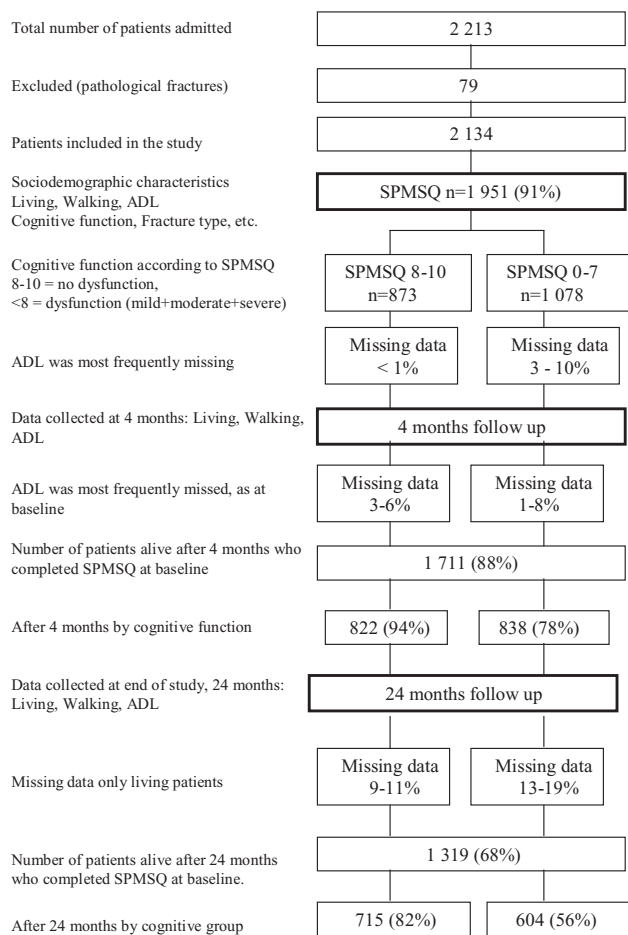
Of the variables tested for multivariate analyses, gender, type of fracture and co-morbidity had no influence on ability to return to pre-own home, regaining walking ability or regaining independence in ADL. Of the significant variables retained from the univariate analyses, cognitive function was found to be the most powerful in all models, except for 'regaining walking ability', where the use of walking aids prior to fracture had greater influence (data not shown) (Table 3, appendices available at *Age and Ageing* online).

### Discussion

In order to reflect a real life situation, we included all patients (*n* = 2,134) admitted with a hip fracture to four hospitals in an urban area in Sweden during 2003. More than half of the population had a cognitive dysfunction, equally common in women and men. Women were older, more often lived alone and had poorer walking ability. Women received a hip prosthesis more often than men with same fracture type.

Living alone is one of the variables usually associated with not being able to return to own home after a hip fracture [14]. It has also been reported that men are more likely to move into nursing homes after being treated for a hip fracture [8, 14]. We found no gender difference in the ability to return to own home after 4 months. This discrepancy may be explained by differences in health care systems, for example multi-professional home care teams as an alternative to nursing homes.

Women in this study had poorer walking ability, which may indicate that living alone may influence walking ability in a negative way. Older women experience more economic strains compared to men and more often live in block of flats with heavy doors or stairs to climb, which may impede on possibilities for outdoor activities [15]. Women may also be afraid of walking outdoors due to increased fear of falling [16]. Men more often live in houses with better possibilities to get outdoors, i.e. having a better convenience in this respect



**Figure 1.** Flow-chart showing patients included and followed up, by cognitive function. Of the 2,134 patients included, the SPMSQ test was not conducted in 320. Those who had a history of diagnosed or recognised dementia ( $n = 137$ ) were merged into the cognitive dysfunction group. Missing is defined as living patients lost for follow-up.

[17]. This could explain why men in this study more often fractured their hips while outdoors. However, most fracture incidences in both gender groups occurred in the patients' own homes (women 76%, men 64%).

Gender differences in functional outcome (ADL) after hip fracture have been studied previously, with inconsistent results. Several studies have shown no gender difference among survivors in selected hip fracture populations [5–7, 18], whereas in other studies male gender emerged as a risk factor for poor functional outcome [8, 19]. In the current study, the only gender difference found was that men with intact cognitive function had better ADL function after 24 months. In all patient who could manage their ADL at baseline (Katz A–B), we found that intact cognitive function was the strongest predictor for regaining pre-fracture ADL function, which is in line with earlier reports [20, 21]. Besides gender differences in age and health status, factors such as socio-cultural differences, different measurements of ADL and time to follow-up may interact and contribute to the discrepancy in results.

Using different instruments for measuring cognitive function, others have reported that dysfunction and dementia are more common among women in a general population [22]. In the current study, using the SPMSQ instrument, we found that more than half of the patients had a cognitive dysfunction, equally frequent among women and men. Apart from the fact that different outcome measurements could give different results, this could confirm that men with a hip fracture are more fragile compared with men in a general population, as previously reported [4, 5]. As men were younger, this could indicate a biological higher age, which also has been reported [8, 23]. However, gender differences in morbidity and mortality were only found in the subpopulation of patients with cognitive dysfunction.

Cognitive dysfunction at baseline was strongly associated with a decline in physical function in both women and men, which is in line with previous knowledge [24–27].

Although the high mortality and amount of missing for follow-up in the cognitive dysfunction group might give concerns about the power to detect gender differences, men with cognitive dysfunction more often had a total loss of walking ability. The same pattern of unfavourable recovery in men has been reported after stroke [28]. The reasons for the recovery effect are unclear, but it has been suggested that men and women have different coping strategies, with male coping strategies being less suitable for a situation of functional dependence [28].

The high proportion of non-walkers among both women and men with cognitive dysfunction might indicate that ambitions differ regarding rehabilitation of these patients. Many patients with cognitive dysfunction live in nursing homes and are discharged early from the hospital and consequently receive less specific walking instructions and training by a physiotherapist in-hospital. Also, staffing and environmental circumstances in nursing homes have been reported to be sub-optimal for rehabilitation after hip fractures [29]. This may partly be due to the efforts made to prevent falls, e.g. patients who have a high risk for falling have been reported to be belted into wheelchairs [30]. However, Rolland showed that patients with cognitive dysfunction could regain their pre-fracture function after rehabilitation [26].

The finding that women were more often treated with a hip prosthesis could not be explained by differences in preoperative co-morbidity or fracture dislocation differences (data not shown). One explanation could possibly be that surgeons considered male patients in a worse condition when admitted, and therefore choose a simpler and quicker surgical technique. Another explanation could be the more abundant bone stock in men, which might have made osteosynthesis more attractive (reference, appendices available at *Age and Ageing* online). However, little attention has been paid to gender differences in choice of surgical methods.

A potential limitation of this study is that cognitive function according to SPMSQ was assessed when practically possible, i.e. at any time during the hospital stay. Moreover, not all patients could be interviewed during the hospital stay. In

order to adjust for missing information, we included patients with documented or diagnosed dementia in the cognitive dysfunction group. Fifty-five per cent of the 2,134 participants had a cognitive dysfunction according to these criteria, with no gender difference. The proportion of non-lucid patients varies in different hip fracture studies, probably due to the fact that subgroups of the populations vary, but it cannot be excluded that the proportion could have been different if the SPMSQ had been performed at the time of admission in all cases, as it is well known that cognitive function fluctuates in individuals during hospital stay [13]. However, the SPMSQ may only be used as a screening instrument for finding out about a patient's cognitive function, it does not differentiate dementia or delirium.

Using proxies in some cases is sub-optimal, and could be a limitation, but unavoidable in a study with this design. The amount of proxy answers was equally common among women and men and most frequent in the cognitive dysfunction group.

### Conclusion

Women were older, more often lived alone and had poorer walking ability than men. Women were more often treated with prosthesis and sent to rehabilitation units. Among patients with normal cognitive function, there were no gender differences in independent living, ADL, morbidity or mortality. Cognitive dysfunction was equally common in women and men and cognitive function *per se* was the single most important factor for returning to own home and regaining physical function. Male gender was associated with a higher risk for loss of walking ability and death, but only in patients with cognitive dysfunction.

### Key points

- More than half of the patients with a hip fracture had a cognitive dysfunction according to the SPMSQ.
- Cognitive dysfunction was equally common among women and men.
- Cognitive dysfunction was associated with higher risk for lost physical function and death.
- It is advocated that cognitive function is assessed in patients admitted with hip fracture.

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### Conflicts of interests

The authors have no conflict of interest to declare.

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### Supplementary data

Supplementary data are available at *Age and Ageing* online.

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