

# Sex effects on short-term complications after hip fracture: a prospective cohort study

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**Objectives:** To evaluate potential sex differences and other factors associated with complications within 4 months after a hip fracture.

**Methods:** A total of 1,915 patients  $\geq 65$  years (480 men) with hip fracture were consecutively included in a prospective multicenter cohort study. A review of medical records and patient interviews according to a study protocol based on the Standardized Audit of Hip Fractures in Europe (SAHFE, RIKSHÖFT) was performed. Sex differences in comorbidity according to the American Society of Anesthesiologists score and complications 4 months after a hip fracture were registered. Multivariate logistic regression analysis was performed to identify factors related to complications.

**Results:** Male sex was associated with worse general health according to the American Society of Anesthesiologists classification ( $P=0.005$ ) and with more comorbidities ( $P<0.001$ ). Male sex emerged as a risk factor for developing pneumonia ( $P<0.001$ ), and additionally, 18% of the men suffered from cardiac complications compared with 13% of the females ( $P=0.018$ ). Female sex was predisposed for urinary tract infections, 30% vs 23% in males ( $P=0.001$ ). Mortality was higher in the male vs female group, both within 30 days (15% vs 10%,  $P=0.001$ ) and at 4 months (24% vs 14%,  $P=0.001$ ). Conditions associated with pneumonia were male sex, pulmonary disease, and cognitive impairment. Cardiac complications were associated with delayed surgery and cardiovascular and pulmonary disease.

**Conclusion:** Before surgery, men with hip fracture already have a poorer health status and higher comorbidity rate than women, thus resulting in a twofold increased risk of pneumonia. Cognitive dysfunction and pulmonary disease contributed to pneumonia in men. Delayed surgery seems to increase the risk for cardiac complications. It is important to consider the sex perspective early on together with cardiopulmonary comorbidity and cognitive dysfunction to be able to counteract serious complications that may lead to death.

**Keywords:** hip fracture, male sex, complications, associated factors

## Introduction

Patients with hip fracture are commonly encountered in orthopedic and geriatric wards.<sup>1</sup> These patients often suffer from several comorbidities<sup>2</sup> and therefore require considerable nursing and medical care, in addition to the specific care needed for the hip fracture. Presence of comorbidities increases the risk of complications and frequently causes increased suffering with prolonged hospital stay<sup>3-5</sup> and increased mortality rate.<sup>6</sup> Few studies have been conducted with large samples to examine sex differences with focus on the effects of specific risk factors for short-term serious complications. It has been found that men more often suffer comorbidities at the time of hip fracture, that they are twice as likely to die after a hip fracture compared to women, and that the cause of death is dominated by infectious diseases such as pneumonia, influenza, and septicemia.<sup>7</sup> Another study has confirmed that men are more likely to die from

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respiratory disease, malignant neoplasm, and circulatory disease compared to women.<sup>8</sup> However, Endo et al<sup>9</sup> found that there was no difference across sex when considering the number of comorbidities prior to surgery, but men had a worse physical status when assessed according to the American Society of Anaesthesiologists (ASA) score. In the same study, men had a higher proportion of one or more post-operative complications, with particular focus on pneumonia, arrhythmia, delirium, and pulmonary embolism.<sup>9</sup>

In 2009, we published a study analyzing sex differences in patients with a hip fracture and found that cognitive function in men was strongly associated with a higher risk of loss of walking ability and mortality.<sup>10</sup> In another report from the same population, we analyzed associated factors for mortality in men and women with a hip fracture and presented a prognostic model including age, sex, ASA, and cognitive function.<sup>11</sup>

Considering the serious complications that could occur after hip fracture surgery, especially in men, it would be of great value to better understand factors related to postoperative complications at admission in order to offer optimal care for patients at high risk.

The aim of the present study was to analyze sex differences and other possible factors associated with short-term complications. In contrast to our previous reports from this cohort, this report focuses on perioperative complications and possible associated factors within 4 months after surgery.

## Materials and methods

All patients admitted with a hip fracture to any of the four university hospitals in Stockholm were consecutively included in a prospective cohort study throughout 2003.<sup>10</sup> The patients were enrolled for 1 year and then followed for 2 years. Patients with pathologic hip fractures, such as metastatic fractures, malign and benign bone cyst, and fracture due to Paget's disease, and patients younger than 65 years were excluded. The overall aim of the initial study was to describe the population with hip fracture in a geographically defined urban area and to evaluate the effect of cognitive function and sex on functional outcome.<sup>10</sup> This study aims to further evaluate the sex effect on complications within 4 months after surgery. Patients were treated according to the Swedish National Guidelines.<sup>12</sup> The guidelines recommend surgery within 24 hours, and encouraged early mobilization, and restricted time for the routine use of perioperative urinary catheter. Data collection was performed by a trained research nurse at each hospital and was then confirmed by the senior orthopedic consultant responsible

for the study. At inclusion, the research nurse made a review of the medical records and carried out a structured interview with each patient according to the study protocol based on the national register RIKSHÖFT—standardized audit of hip fractures in Europe (SAHFE).<sup>13</sup> Data collection was performed at baseline and at 4 months. Proxy respondents were interviewed if the patients were unable to provide reliable answers.

Each patient's physical and mental status on admission to the hospital were regarded as baseline. The index episode was defined as the patient status during the time period from admission to discharge from the hospital. Patient interviews were carried out during the index episode and at follow-up after 4 months.

The patient's current residence status was defined as living in own home or in an institution, which would include nursing homes or other staffed facilities, for example. Activities of daily living (ADL) status was recorded according to the Katz ADL Index.<sup>14</sup> The Katz ADL index status is based on an evaluation of the functional dependence or independence of patients in bathing, dressing, going to the toilet, transferring, continence, and feeding. ADL index A indicates independence in all six functions, index B independence in all but one of the six functions. Indexes C–G indicate dependence in bathing and at least one more function. Presence or absence of concomitant diseases (comorbidity) was based on the medical history obtained from the patient, a proxy, and the medical records. Comorbidities were classified as cardiovascular disease, stroke, pulmonary disease, renal disease, diabetes mellitus, rheumatoid arthritis, Parkinson disease, and malignancy. The patient's smoking status was recorded as "current smoker" or "nonsmoker". Experienced orthopedic surgeons classified the hip fractures according to the SAHFE protocol.<sup>13</sup> The attending anesthesiologist assessed the patient's health status using the ASA score.<sup>15</sup> Cognitive status was assessed during the index period using the Short Portable Mental Status Questionnaire (SPMSQ), which is a 10-item questionnaire. A range of 0–2 correct answers indicates severe cognitive dysfunction, 3–5 moderate dysfunction, 6–7 mild dysfunction, and 8–10 lucid.<sup>16</sup> For the purpose of this study, we dichotomized the answers into two categories: cognitive dysfunction (ie, 0–7 correct answers) or no cognitive dysfunction (8–10 correct answers). In cases where the test was not conducted, patients were classified as having cognitive dysfunction if they had a diagnosis or known history of dementia; otherwise they were recorded as missing. Time to surgery was registered in days from admission to the hospital.

Pressure ulcers were classified as grades I–IV according to the European Ulcer Advisory Panel (EPUAP 1999).<sup>17</sup> The following medical and general complications, as defined in the SAHFE protocol,<sup>13</sup> were used for the purpose of this study: pneumonia, cardiac complications (cardiac failure, arrhythmia, angina), deep venous thrombosis, pulmonary embolism, wound infection (superficial and deep), urinary tract infection (UTI), acute renal failure, gastrointestinal bleeding, myocardial infarction, cerebrovascular lesion, and pressure ulcer.

Complications were identified by collecting information from medical records. Pressure ulcers were recorded on admission, during initial hospital stay, and at the time of discharge. Information on mortality was obtained from each hospital's discharge register or from a proxy.

## Statistical methods

Data were presented as mean  $\pm$  SD (standard deviation) or as indicated. Categorical and nominal data were summarized as percentages (within sex group) and tested for sex differences with the  $\chi^2$  test. The crude association between baseline variables and the most frequent complications is described and presented as odds ratios (ORs), with 95% confidence interval (CI), and *P*-values. Associated variables were entered into logistic regression models using the stepwise selection procedure, one model for each selected complication. All variables in the regression models were tested for interactions. All results are presented as ORs with their respective 95% CIs. All tests were two-sided, with the level of significance set at *P*<0.05. Analyses were performed with IBM SPSS Statistics 19 (IBM Corporation, Armonk, NY, USA).

The study was conducted according to the Helsinki Declaration, and the local ethics committee approved all protocols.

## Results

Of the initial 2,134 patients with a history of hip fracture, 179 patients were younger than 65 years and hence excluded from the study. The study sample consisted of 1,955 elderly patients. Of them, 12 patients died before surgery. Interview data were missing at baseline for an additional 28 patients, leaving just 1,915 patients (1,435 women and 480 men) in the final analysis. Baseline demographics, fracture type, and medical conditions are presented by sex in Table 1.

### Comorbidity – sex differences at baseline

Mean age was higher in the female population, at  $84 \pm 6.8$  vs  $82 \pm 7.4$  years in men (*P*<0.001). Male sex was associated

with a higher percentage ASA 3–4, 69% vs 61% in female (*P*=0.002). Men also had more comorbidities, mean, 1.6 (SD, 1.08) compared to 1.4 (SD, 0.96) in women (*P*<0.001). Cardiovascular disease was found to be 66% among men and 67% among women (*P*=0.824). Significantly more men had a history of stroke (22% men vs 14% women, *P*<0.001), pulmonary disease (20% men vs 15% women, *P*=0.002), Parkinson disease (5% men vs 3% women, *P*=0.017), renal disease (6% men vs 4% women, *P*=0.038), and malignancy (21% men vs 14% women, *P*<0.001). In the male group 14% were suffering from diabetes mellitus vs 11% in the female group (*P*=0.097). Rheumatoid arthritis was found to be 5% among men and 7% among women (*P*=0.169). Fifty-nine percent of males and 58% of females had a cognitive dysfunction, according to the SPMSQ (*P*=0.594) (Table 1).

### Complications – sex differences

The overall complication rate was 59% in the male group vs 56% in the female group (*P*=0.119). About 14% of male patients suffered from pneumonia compared to 6% women (*P*<0.001), and 18% of the men had a cardiac complication compared to 13% of the women (*P*=0.018). Female sex predisposed to UTI, 30% vs 23% in males (*P*=0.001). Mortality was higher in the male group when compared with women, both within 30 days (15% vs 10%, respectively, *P*=0.001) and at 4 month follow-up (24% vs 14%, respectively, *P*=0.001) (Table 2).

### Associations between baseline variables and complications

Sex, age, ASA, time-to-surgery, cardiovascular or pulmonary disease, and cognitive function emerged as significantly associated with complications. In the crude analysis, cognitive dysfunction had a negative association with pressure ulcer, cardiac complication, and pneumonia (Table 3). A history of stroke did not correlate with any of the complications. A similar lack of correlation was found for a history of diabetes mellitus.

Patients with pneumonia had 2.6 times higher odds (OR: 2.6, 95% CI: 1.7–3.9, *P*<0.001) and patients with cardiac complications 3.9 higher odds (OR: 3.9, 95% CI: 2.9–5.4, *P*<0.001) of increased 30-day mortality. At 4 months, the mortality was still 2.2 times more likely in patients with pneumonia (OR: 2.2, 95% CI: 1.5–3.2, *P*<0.001) and 2.5 times more likely in patients with cardiac complication (OR: 2.5, 95% CI: 1.8–3.3, *P*<0.001) (Table 3).

The effect of the status at baseline on the four most common complications was analyzed in a stepwise logistic regression

**Table 1** Baseline demographics in 1,915 patients aged >65 years with a hip fracture

	Women		Men		P*
	N	%	N	%	
Age, mean (SD)	84 (6.8)		82 (7.4)	65–101	<0.001
Residence <sup>a</sup>					
Own home	1,077	76	373	80	0.153
Institution	334	24	96	20	
Activities of daily living <sup>b</sup>					
Katz A–B	986	73	312	70	0.138
Katz C–G	357	27	135	30	
Type of fracture <sup>c</sup>					
Cervical	668	48	255	53	0.004
Pertrochanteric	655	46	181	38	
Subtrochanteric	92	6	44	9	
ASA score <sup>d</sup>					
ASA 1–2	557	39	147	31	0.002
ASA 3–4	872	61	328	69	
Number of comorbidities <sup>e</sup>					
Mean, (SD), median	1.4 (0.96)	1	1.6 (1.08)	2	<0.001
0–1	847	60	230	48	
≥2	568	40	247	52	<0.001
Specific comorbidity					
Cardiovascular disease	951	67	317	66	0.824
Stroke	230	14	94	22	<0.001
Pulmonary disease	206	15	97	20	0.002
Renal disease	52	4	28	6	0.038
Diabetes	156	11	66	14	0.097
Rheumatoid arthritis	100	7	25	5	0.169
Parkinson's disease	37	3	23	5	0.017
Malignancy	198	14	100	21	<0.001
Cognitive dysfunction <sup>f</sup>	775	58	262	59	0.594
Pressure ulcer at admission					
Grade I	54	4	14	3	0.392
Grade II–IV	52	4	17	4	0.944
Surgery same day or day after admission	1,092	76	357	74	0.446

**Notes:** \*Chi-square tests (one-way ANOVA for mean age), women vs men. <sup>a</sup>Missing: 35; <sup>b</sup>missing: 125; <sup>c</sup>missing: 20; <sup>d</sup>missing: 11; <sup>e</sup>missing: 23; <sup>f</sup>according to SPMSQ (0–7).

**Abbreviations:** ASA, American Society of Anesthesiologists; SD, standard deviation; SPMSQ, Short Portable Mental Status Questionnaire; ANOVA, analysis of variance.

analysis (Table 4). Female sex posed a higher risk for UTI, whereas male sex was associated with a higher risk of pneumonia. Cardiac complications did not associate with sex. Cognitive dysfunction, present pulmonary disease, and male sex were the strongest factors related to the development of pneumonia. Surgical delay was associated with cardiac complications and increased incidence of developing pressure ulcer.

## Discussion

In this study, we confirm that before surgery, men with hip fracture already have a poorer health status and higher comorbidity rates than do women, resulting in a twofold increased risk of pneumonia and also an increased risk of cardiac complications.

Cognitive dysfunction increased the risk of any kind of complication and was, together with present pulmonary

disease, a dominating factor related to pneumonia in men. Delayed surgery seems to increase the risk for cardiac complications and should be avoided if possible. It is important to consider the sex perspective early on together with cardio-pulmonary comorbidity and cognitive dysfunction to be able to counteract serious complications that may lead to death.

The relatively high complication rate compared to other similar studies may be explained by our approach of including all patients admitted for a hip fracture; in other words, that we also included patients with cognitive dysfunction. Cognitive dysfunction is known to be associated with a negative outcome after a hip fracture. The SPMSQ 10-item questionnaire has been reported to provide relevant information about the cognitive status of patients with hip fractures.<sup>18</sup> We have previously reported the negative impact of severe cognitive dysfunction on mortality.<sup>11</sup> Patients with mild to

**Table 2** Complications 0–4 months after a hip fracture in 1,915 patients aged  $\geq 65$  years

	Women		Men		P*
	N	%	N	%	
Number of complications					
None	613	44	194	42	0.119
One	500	35	156	33	
Two or more	290	21	118	25	
Type of complication					
Pressure ulcer <sup>a</sup>	248	18	96	20	0.200
Urinary tract infection	435	30	109	23	0.001
Cardiac complication	191	13	85	18	0.018
Pneumonia	79	6	65	14	<0.001
Wound infection, superficial	69	5	16	3	0.174
Wound infection, deep	24	2	9	2	0.768
Acute renal failure	32	2	10	2	0.416
Gastrointestinal bleeding	27	2	9	2	0.993
Myocardial infarction	49	3	18	4	0.729
Cerebrovascular lesion	27	2	11	2	0.577
Pulmonary embolism	14	1	5	1	0.899
Deep venous thrombosis	17	1	4	1	0.899
Mortality					
Mortality, 30 days	136	10	74	15	<0.001
Mortality, 0–4 months	207	14	116	24	<0.001

**Notes:** \*All P-values chi-square tests, women vs men. <sup>a</sup>Pressure ulcers grade I–IV developed during hospital stay.

moderate cognitive dysfunction also sustain a high risk of developing complications<sup>19</sup> that are even harder to identify in the clinical setting.<sup>18</sup> In this study, we found that cognitive dysfunction increased the risk for all complications, such as UTI, pressure ulcer, cardiac complication, and pneumonia. We also found that mental impairment was the strongest predictor for pneumonia in men, besides having already present pulmonary disease. We therefore recommend the use of an instrument like the SPMSQ at the time of admission to identify these patients. We found that present pulmonary disease was associated with pneumonia and was also more common among men. It is known from previous studies that chest infection and cardiovascular disease are the most common postoperative complications after hip fracture and may lead to increased mortality.<sup>20–22</sup> This is in accordance with our findings, which also show an increased mortality after a diagnosed pneumonia. Chatterton et al<sup>20</sup> have also shown that male sex together with increasing age and comorbidity were associated with mortality during hospital stay as well as pneumonia and cardiovascular disease. The result from our study highlights further the need to also consider the sex

**Table 3** Crude effect of preoperative variables on pressure ulcer, cardiac complication, and pneumonia

Binary variable	Pressure ulcer			Cardiac complication			Pneumonia		
	OR	(95% CI)	P	OR	(95% CI)	P	OR	(95% CI)	P
<b>Baseline</b>									
Sex, male vs female <sup>a</sup>	1.2	(0.9–1.6)	0.2	1.4	(1.1–1.9)	0.016	2.7	(1.9–3.8)	<0.001*
Age, 85–103 vs 65–84 <sup>a</sup>	1.4	(1.1–1.8)	0.003*	1.3	(1.0–1.6)	0.06	1.2	(0.8–1.7)	0.3
Residence, institutional vs own home <sup>a</sup>	1.4	(1.1–1.8)	0.012	0.8	(0.6–1.6)	0.3	1.2	(0.8–1.8)	0.3
ADL, assisted vs independent <sup>a</sup> (Katz A–B vs C–G)	1.6	(1.2–2.0)	0.001*	0.9	(0.7–1.2)	0.5	1.4	(0.9–2.0)	0.09
Fracture type, extracapsular vs intracapsular <sup>a</sup>	1.2	(1.0–1.5)	0.1	0.9	(0.7–1.1)	0.3	1.1	(0.8–1.5)	0.7
ASA classification, 3–4 vs 1–2 <sup>a</sup>	1.4	(1.1–1.8)	0.013	2.2	(1.6–3.0)	<0.001	2.5	(1.6–3.7)	<0.001
Time to surgery, 0–1 day vs 2 or more days <sup>a</sup>	1.6	(1.3–2.1)	<0.001*	1.7	(1.3–2.3)	<0.001*	1.5	(1.0–2.1)	0.045
<b>Presence vs absence of specific concomitant disease</b>									
Cardiovascular disease	1.1	(0.9–1.4)	0.42	2.6	(1.9–3.5)	<0.001*	1.1	(0.8–1.6)	0.7
Stroke	1.0	(0.8–1.4)	0.9	1.1	(0.8–1.5)	0.7	1.1	(0.7–1.7)	0.7
Pulmonary disease	1.5	(1.1–2.0)	0.006*	2.1	(1.5–2.8)	<0.001	2.7	(1.9–3.9)	<0.001*
Renal disease	1.2	(0.7–2.0)	0.6	1.5	(0.9–2.6)	0.6	1.2	(0.5–2.7)	0.6
Diabetes	0.8	(0.6–1.2)	0.4	1.2	(0.8–1.8)	0.3	1.1	(0.6–1.7)	0.9
Rheumatoid arthritis	0.8	(0.5–1.3)	0.3	1.2	(0.7–2.0)	0.4	1.1	(0.6–2.1)	0.8
Parkinson's disease	1.4	(0.8–2.6)	0.3	0.8	(0.4–1.7)	0.5	1.9	(0.9–4.2)	0.08
Malignancy	1.3	(1.0–1.8)	0.065	1.3	(1.0–1.9)	0.08	1.3	(0.8–2.0)	0.3
Cognitive function,** dysfunction vs normal <sup>a</sup>	1.5	(1.2–2.0)	0.001	1.6	(1.2–2.1)	0.002*	2.4	(1.6–3.6)	<0.001*
<b>Presence of additional complications and mortality</b>									
Number of complications, 2 or more vs 1 <sup>a</sup>	1.6	(1.2–2.0)	<0.001	2.6	(1.8–3.1)	<0.001	3.1	(2.0–4.7)	<0.001
Mortality within 30 days, yes vs no <sup>a</sup>	2.0	(1.5–2.8)	<0.001	3.9	(2.9–5.4)	<0.001	2.6	(1.7–3.9)	<0.001
Mortality 0–4 months, yes vs no <sup>a</sup>	1.6	(1.2–2.2)	0.001	2.5	(1.8–3.3)	<0.001	2.2	(1.5–3.2)	<0.001

**Notes:** All P-values chi-square tests. \*Variables still significant after adjusting for associated baseline variables. \*\*According to the Short Portable Mental Status Questionnaire (0–7 vs 8–10). <sup>a</sup>Reference group.

**Abbreviations:** ASA, American Society of Anesthesiologists; ADL, activities of daily living; CI, confidence interval; OR, odds ratio.

**Table 4** Logistic regression models of baseline variables associated with the most frequent complications

	Urinary tract infection			Pressure ulcer			Cardiac complication			Pneumonia		
	OR	(95% CI)	P	OR	(95% CI)	P	OR	(95% CI)	P	OR	(95% CI)	P
Sex												
Female <sup>b</sup>	1									1		
Male	0.7	(0.5–0.9)	0.003							2.4	(1.7–3.6)	<0.001
Age												
65–84 <sup>b</sup>	1			1								
>85	1.2	(0.0–1.5)	0.034	1.4	(1.1–1.8)	0.008						
ADL												
Independent <sup>b</sup> (Katz A–B)				1								
Dependent (Katz C–G)				1.6	(1.2–2.1)	0.001						
Time-to-surgery												
0–1 day <sup>b</sup>				1			1					
1 days				1.6	(1.2–2.1)	<0.001	1.6	(1.2–2.2)	0.001			
Cardiovascular disease												
No <sup>b</sup>							1					
Yes							2.2	(1.5–3.0)	<0.001			
Pulmonary disease												
No <sup>b</sup>				1			1			1		
Yes				1.6	(1.2–2.2)	0.003	2.0	(1.4–2.8)	<0.001	2.8	(1.8–4.2)	<0.001
Cognitive function												
Normal (SPMSQ <sup>a</sup> 8–10) <sup>b</sup>							1			1		
Dysfunction (SPMSQ 0–7)							1.5	(1.1–2.0)	0.006	2.5	(1.6–3.8)	<0.001

**Notes:** <sup>a</sup>The SPMSQ. <sup>b</sup>Reference variable.

**Abbreviations:** ADL, activities of daily living; CI, confidence interval; OR, odds ratio; SPMSQ, Short Portable Mental Status Questionnaire.

aspect when assessing the patients' risk for serious complications such as pneumonia or cardiac complications. Despite this knowledge, it seems that the care of these patients needs to be improved, for example, by taking into account male sex as a strong risk factor, considering a more active pre- and postoperative physiotherapeutic treatment, and starting antibiotic treatment sooner. Patients with cardiac disease need to be identified early to be able to consider a more active pre- and postoperative treatment. Under optimum conditions, there is a clear treatment algorithm that includes cardiac evaluation such as adjustment of fluid balance, hemoglobin, and saturation. Assessment by a cardiologist already at the emergency ward should be considered, also including a plan for follow-up during the hospital stay. In certain orthopedic clinics in Sweden, there is now a staff geriatrician, and this has been a valuable contribution to optimize the medical treatment of hip fracture patients.

Somewhat surprising, a previous history of stroke did not correlate with any complication, but identical results have also been reported previously.<sup>23</sup> In the current study, UTI was identified if antibiotics were provided for this condition. UTI was found to be the most common complication, which is in line with several other studies.<sup>3,5,24</sup> Still, the present incidence was even higher than reported by others.<sup>25,26</sup> This may be explained by the fact that we followed all patients up to

4 months after the fracture. Time to surgery was associated with an increased incidence of pressure ulcers, which is consistent with prior findings.<sup>27–29</sup> Furthermore, cardiac complications were associated with delayed time to surgery. Previous studies have shown the importance of reduced waiting time to surgery to increase the patients possibility to return to independent living,<sup>29</sup> to reduce hospital stay, and possibly decrease complication rate and mortality.<sup>30</sup> The Swedish Board has placed a major focus on this issue and demands an annual account of the number of patients with hip fracture who have had surgery within 24 hours. This time limit is also linked to economic compensation, and this could be one way to raise the awareness of the importance of providing a fast track to surgery for patients with hip fracture.<sup>12</sup> More than half the number of patients in our study had a cardiovascular disease. This comorbidity could require optimization of the patients' health condition before surgery, which in turn could lead to a delay. The question is how to balance these two demands. In a recent review article, it was suggested that we need a more active approach in the preoperative risk assessment, medical and orthopedic comanagement, and perioperative monitoring to be able to operate on the patient within time limits and as safe as possible.<sup>31</sup> We agree that the preoperative risk assessment is of importance and that it should be carried out systematically using a validated and

manageable instrument. In a study evaluating the impact of surgical timing on surgical outcomes, the orthopedic Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM) was used. The study showed a small improvement of the physiological score from admittance to before surgery and that the POSSUM may be used to identify patients with a higher risk for morbidity if surgery was delayed over 24 hours.<sup>32</sup>

The strengths of this study are the large number of patients as well as the inclusion of patients with cognitive dysfunction. Cognitive dysfunction is often an exclusion criterion in prospective studies of hip fracture patients. The other strengths of the study are the use of validated instruments and protocols, for example, as in our use of the SAFHE, as well as the thorough review of all the charts. These were performed by specially trained research nurses who also interviewed all the patients. There are several limitations of the study. The study did not include current medications, laboratory parameters, or secondary causes of osteoporosis that could have further contributed to the assessment of the patients' risk of mortality. A possible limitation was the missing data which, however, only comprised 1.4% of the patients and therefore is unlikely to affect the outcome.

## Conclusion

Before surgery, men with hip fracture already have a poorer health status and higher comorbidity rate than women, resulting in a twofold increased risk of pneumonia and also an increased risk of cardiac complications. Cognitive dysfunction and present pulmonary disease were related to pneumonia in men. Delayed surgery seems to increase the risk for cardiac complications. It is important to consider the sex perspective early on together with cardiopulmonary comorbidity and cognitive dysfunction to be able to counteract serious complications that may lead to death.

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## Disclosure

The authors report no conflicts of interest in this work.

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