

## Hip fractures among older people in Iceland between 2008 and 2012

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### ABSTRACT

**Introduction:** Hip fractures are a serious injury especially among older people, mainly caused by falls and women have a higher risk. The authors studied gender differences in hip fractures, marital status, waiting times for surgery and mortality in an older population.

**Methods:** Data was obtained for all 67 years and older admitted with hip fractures to an Emergency Department (ED) in Iceland 2008–2012. The associations of covariates with mortality were analyzed using multivariable logistic regression.

**Results:** The study included 1053 patients; covering 80% of hip fractures in Iceland during the study period, 72% were women. Men were more often married (51% vs. 23%) ( $P < 0.001$ ). Average waiting time was men vs. women 21.5 h/18.9 h ( $p = 0.003$ ). Mortality within 12 months was men 36% vs. women 21% (Odds Ratio (OR); 2.30, 95% Confidence Interval (CI); 1.66–3.18). Higher mortality rates were observed in older age-groups compared to 67–79 years old, i.e. 80–89 years: OR 1.80 (95% CI 1.25–2.60) and 90–109 years: OR 4.52 (95% CI 2.91–7.01). Waiting time was not associated with 12-months mortality risk after adjustment.

**Conclusion:** Although women constitute the majority of elderly with hip fractures, men had higher mortality in our study. Further research that examine factors affecting gender difference will likely be of benefit and associated changes to the care already delivered in the ED may improve mortality.

### Introduction

Hip fractures amongst the elderly are a rising health problem internationally. People are living longer due to better nutrition, improved medical treatments and improved social conditions in many parts of the world (WHO, 2015). Hip fractures have been shown to be two to three times more common among women than men (Guerra et al., 2016; Pincus et al., 2017). Results from health-care register studies have revealed that approximately 90% of such fractures occur among people aged 50 years and older (Mittal and Banerjee, 2012; Saletti-Cuesta et al., 2016). Hip fractures among the elderly are most commonly related to low energy trauma, for example fall from the same height (Langsetmo et al., 2008).

With an increased number of older adults, hip fractures have

already increased the burden on health-care systems and this will increase in the future (Curran et al., 2010). Hip fractures can lead to serious negative outcomes such as permanent disability, long-term hospital care and mortality (Criss and Takacs, 2013). Mortality within three months after hip fracture surgery was 11% in a study at an emergency department in Italy (Rostagno et al., 2016). A cohort study, from Australia, of all residents aged 60 years and older showed that mortality increased in the first year after hip fracture compared to the non-fracture group, both in men and women and was higher among men (Center et al., 1999). Gender and age seem to influence morbidity and mortality after hip fractures; studies indicate that Caucasian women have a one in every six lifetime risk of hip fracture while the risk of developing breast cancer is one in every nine women (Sambrook and Cooper, 2006). Other studies have demonstrated similar results. A

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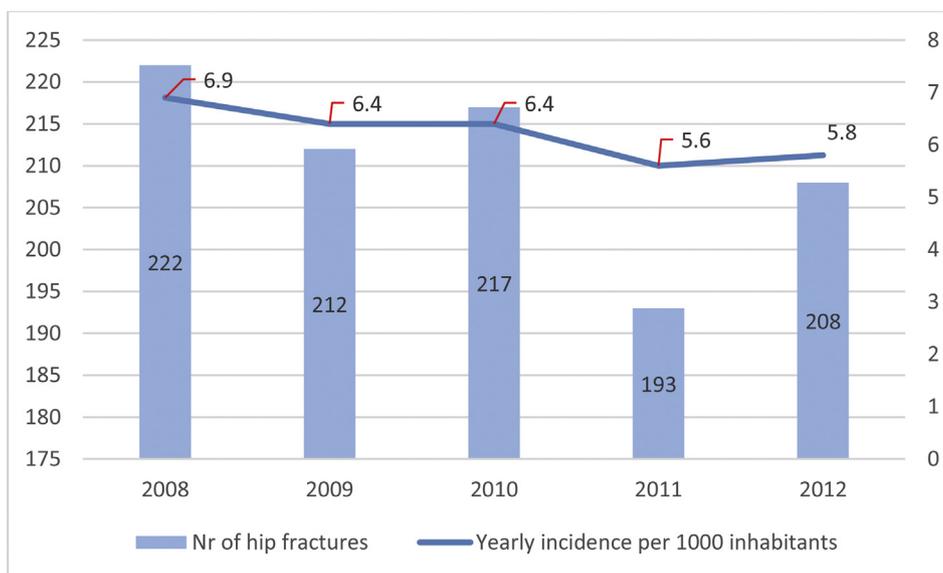


Fig. 1. Number of hip fracture among 67 years and older and incidence rate.

study from the USA showed that one-year mortality was 32% for men compared to 18% for women (Bass et al., 2007). Waiting time for surgery may also play a role as one-year mortality after hip fracture surgery was significantly lower when the operation was carried out on the day of admission (Casaletto and Gatt, 2004).

In Iceland, 80% of hip fracture surgery is performed at Landspítali National University Hospital (LUH) and all these patients are admitted through the same emergency department. During the study period, Iceland's population was approximately 318,000 and of that population 10.5% were 67 years and older. LUH is the only academic hospital in Iceland and serves the entire nation as a tertiary hospital. It is the primary hospital as well, for the Reykjavik metropolitan area. The hospital had around 680 in-patient beds and approximately 373,000 emergency visits in the period 2008–2012. The mean admission rate of all ED visits was 15% but 20% for 67 years and older (Gudmundsdottir et al., 2017). In Iceland, no referral is needed for visits to the ED. Using data from all admissions between 2008 and 2012, the aim of the study was to explore the associations of gender, age, marital status, waiting time and number of ICD-10 codes of older people with hip fractures and mortality after surgery during a five-year period between 2008 and 2012.

## Methods

This study was a retrospective cohort study covering 80% of all hip fractures in Iceland amongst older people. Data were collected on all patients above the pension age, 67 years, who presented to the ED at LUH with a collum, pertrochanteric or subtrochanteric fracture (ICD-10 codes S.72.0, 72.1 and 72.2) from 1st of January 2008 to 31st of December 2012. All included patients underwent hip fracture surgery. Data from the Electronic Health Records (EHR) were retrieved through the Clinical-Data Warehouse at Landspítali National University Hospital with ethical approval from the Bioethics Committee at the hospital (nr. 09/2013) and the National Data Protection Authority (nr. 20130202228HGK). In the electronic health records, every hospital visit and admission also have unique identifiers, date and time, which allows the tracking of every patient's "hospital journey" between departments and visits. The following data were retrieved: gender, age, marital status, residence (postal code), ICD-10 diagnoses, admission time, time of surgery and date of death respectively. Data was processed in order to categorize and define the variables for data analysis in Excel.

## Data analysis

After data cleansing procedures and categorizations of the clinical variables, statistical analysis was performed in Excel and SPSS version 20. Data were analyzed descriptively, and gender differences were tested for significance with the chi-square test. Binary logistic regression models were used to calculate (OR) with (95% CI) for differences in mortality within 3 and 12 months from the surgery. Variables were categorized using the lowest categorical value as a referral in age, waiting time for surgery and numbers of diagnoses. Further, women were used as a referral, as well as widowed/living alone. The group was split in two by gender; age was presented in three categories: 67–79 years, 80–89 years and 90 years and older. Marital status was categorized as those who were living alone, widowed or single and those married or living together. Waiting time after surgery was divided into three categories: 24 h or less, more than 24 h–48 h and more than 48 h. Co-morbidity was defined by the number of registered ICD-10 diagnoses and was divided into three groups: one diagnose, two to three diagnoses and four and more diagnoses. Two models were built for calculating the risk of mortality; the first model adjusted for age (as a group variable). The second model adjusted for age, gender, marital status, waiting time after surgery and numbers of diagnoses.

## Results

This study found 1053 patients with hip fracture were admitted to LUH and underwent surgery in the study period, one patient was excluded because of lack of gender information. The yearly prevalence of hip fracture surgeries (Fig. 1) was similar over the five-year study period, being highest in 2008 (7 per 1000 inhabitants) and lower in later years (6 per 1000 inhabitants). Table 1 shows the basic characteristics of study population. Incidence rate per 1,000 residents was 3.9 for men and 8.3 for women in the study period (Table 1). More women (n = 757) were admitted due to hip fractures than men. The highest age in the study group was 109 years, and the mean age was 82 years (SD ± 7) for men and 83 years (SD ± 7) for women (P = 0.013). The age group of 80–89 years had the highest prevalence of hip fractures, 53% for men and 51% for women. Men were more often married than women (51% vs. 23%) (P < 0.001). There was no gender difference in the number of ICD-10 diagnoses per patient.

Time from arriving at the ED to surgery ranged from 1 h to 54 min up to 331 h and 30 min with an average waiting time of 19.6 h. Average

**Table 1**

Basic characteristics of elderly patients admitted with hip fractures to the National University Hospital in Iceland between 2008 and 2012 (N = 1052).

	Men	Women	P <sup>a</sup>
<b>Admissions, n (%)</b>	295 (28)	757 (72)	
<b>Incidence per 1000 inhabitants</b>	3.9	8.9	
<b>Age M (SD)</b>	82 (7)	83 (7)	0.013
<b>Age categories, n (%)</b>			0.118
67–79 years	97 (33)	228 (30)	
80–89 years	157 (53)	383 (51)	
90–109 years	41 (14)	146 (19)	
<b>Residence in Iceland, n (%)</b>			0.956
Urban (capital area)	230 (78)	589 (78)	
Rural	61 (21)	159 (21)	
Living abroad	4 (1.4)	9 (1.2)	
<b>Marital status, n (%)<sup>b</sup></b>			< 0.001
Married	150 (51)	174 (23)	
Single/divorced	62 (21)	129 (17)	
Widow/-er	79 (27)	446 (59)	
<b>Type of hip fracture, n (%)</b>			0.114
Collum fracture (ICD S72.0)	159 (54)	417 (55)	
Pertrochanteric fracture (ICD S72.1)	119 (40)	288 (38)	
Subtrochanter fracture (ICD S72.2)	17 (6)	52 (7)	
<b>Time from ED admission to hip surgery, n (%)<sup>b</sup></b>			0.379
< 24 h	205 (70)	536 (71)	
24.1–48 h	71 (24)	188 (25)	
48.1–72 h	18 (6)	31 (4)	
<b>Average waiting time</b>	21.5	19.5	0.028
<b>Number of diagnoses (ICD-10), n (%)</b>			0.271
1	163 (55)	416 (55)	
2-3	101 (34)	283 (37)	
≥ 4	31 (11)	58 (8)	

<sup>a</sup> Calculated by Chi-square test.

<sup>b</sup> Numbers may not add up to total because of missing values.

**Table 2**

Mortality within 3 months after hip fracture surgery by demographic factors, waiting time for surgery and number of ICD-10 diagnoses (N = 1052).

	Mortality, n (%)	OR (95% CI) <sup>a</sup>	OR (95% CI) <sup>b</sup>
<b>Mortality &lt; 3 months</b>	150 (14)		
<b>Gender</b>			
Female	86 (11)	1.00	1.00
Male	64 (22)	2.37 (1.64–3.42)	2.28 (1.55–3.38)
<b>Age group</b>			
67–79 y	21 (6)	1.00	1.00
80–89 y	85 (16)	2.71 (1.65–4.47)	2.82 (1.69–4.68)
90–109 y	44 (24)	4.47 (2.56–7.79)	5.28 (2.95–9.43)
<b>Marital status</b>			
Married	46 (14)	1.31 (0.89–1.95)	1.03 (0.68–1.58)
Widow/Living a lone	104 (14)	1.00	1.00
<b>Waiting time for surgery</b>			
< 24 h	102 (14)	1.00	1.00
24.1–48 h	36 (14)	0.99 (0.66–1.51)	0.98 (0.64–1.49)
> 48.1 h	11 (22)	1.80 (0.88–3.68)	1.68 (0.81–3.47)
<b>Number of ICD-10 diagnoses</b>			
1	76 (13)	1.00	1.00
2-3	56 (15)	1.18 (0.81–1.72)	1.24 (0.84–1.82)
> 4	18 (20)	1.88 (1.05–3.37)	1.83 (1.01–3.31)

<sup>a</sup> Adjusted for age.

<sup>b</sup> Additional adjustments were made for gender, marital status, waiting time for surgery and number of diagnoses.

waiting time for men was 21.5 h and 19.5 h for women (P < 0.028). Patients living in the Reykjavik capital area were 72% of the patient group, they had surgery within 19.5 h while others waited 20.0 h on average (P < 0.025). Most patients had surgery within 24 h, 70% of men and 71% of women. Mortality risk within three months after surgery was calculated and shown in Table 2 (n = 150). After adjustment men were more than two times more likely than women OR 2.28 (95% CI 1.55 to 3.38) to die within three months after surgery and

**Table 3**

Mortality within 12 months after hip fracture surgery by demographic factors, waiting time for surgery and number of ICD-10 diagnosis (N = 1052).

	Mortality 0–12M, n (%)	OR (95% CI) <sup>a</sup>	OR (95% CI) <sup>b</sup>
<b>Mortality &lt; 12 months</b>	263 (25)		
<b>Gender</b>			
Female	158 (21)	1.00	1.00
Male	105 (36)	2.65 (1.75–3.19)	2.30 (1.66–3.18)
<b>Age</b>			
67–79 y	51 (16)	1.00	1.00
80–89 y	133 (25)	1.76 (1.23–2.52)	1.80 (1.25–2.60)
90–109 y	79 (42)	3.99 (2.61–5.98)	4.52 (2.91–7.01)
<b>Marital status</b>			
Married	81 (25)	1.32 (0.96–1.81)	1.05 (0.74–1.47)
Widow/Living a lone	182 (25)	1.00	1.00
<b>Waiting time for surgery</b>			
< 24 h	182 (25)	1.00	1.00
24.1–48 h	66 (25)	1.04 (0.75–1.45)	1.04 (0.74–1.45)
> 48.1 h	12 (24)	0.99 (0.50–1.96)	0.91 (0.45–1.82)
<b>Number of ICD-10 diagnoses</b>			
1	141 (24)	1.00	1.00
2-3	93 (24)	1.03 (0.76–1.40)	1.04 (0.76–1.43)
> 4	29 (33)	1.68 (1.02–2.75)	1.63 (0.99–2.70)

<sup>a</sup> Adjusted for age.

<sup>b</sup> Additional adjustments were made for gender, age, marital status, waiting time for surgery and number of diagnoses.

patients aged 80–89 years were almost three times more likely to die than the reference group of 67–79 years old OR 2.82 (95% CI 1.69 to 4.68). The oldest group (90–109 y) had four times higher mortality than the reference group OR 4.47 (95% CI 2.56 to 7.80). Marital status did not statistically significantly affect the mortality within three months, neither did waiting time for surgery. Patients with four or more ICD diagnoses had higher mortality risk within three months OR 1.83 (95% CI 1.01 to 3.31).

Out of 1052 patients, 263 died (25%) within 12 months of surgery. The adjusted model showed that men were two times more likely to die within 12 months than women OR 2.30 (95% CI 1.66 to 3.18) (Table 3). After adjustment, patients aged 80–89 years had 80% higher odds for mortality within 12 months from surgery compared to the 67–79 years old OR 1.80 (95% CI 1.25 to 2.60). Patients in the oldest group 90–109 years old, had almost four times higher odds than reference group OR 4.52 (95% CI 2.91 to 7.01). Compared with one ICD-10 diagnosis, patients with more than four ICD-10 diagnosis were more likely to die within 3 months after surgery OR 1.83(95% CI 1.01–3.31) and had borderline increased mortality risk within 12 months after surgery OR 1.63 (95% CI 0.99–2.70) when adjusting for all possible confounders.

## Discussions

This study examined mortality risk among older people with hip fractures in Iceland by gender, age, marital status, number of coexisting diseases, and waiting time for surgery during a five-year period. In this study, hip fracture occurrence was more than two times more likely in women than men, which aligns with studies in other populations (Guerra et al., 2016; Pincus et al., 2017; Siggeirsdottir et al., 2014). The mean age at hip fracture was one year lower among men than women (82 ± 7 vs 83 ± 7 yr) which is also similar to other studies (Chesser et al., 2016; Johansen et al., 2017). It appears that once people have reached 80 years of age the risk of having health problems multiplies (Khan et al., 2018) Further, women were more likely to be widowed, while the men were more likely to be living with a spouse (51% v 23%). Similar trends were detected in a 25-years review on gender and hip fractures (Saletti-Cuesta et al., 2016) and may indicate some kind of protection in living with a partner at home(Hansson et al., 1982).

Our results on waiting time from admission to surgery indicate that our hospital met quality guidelines during the study period (NICE,

2017). Measurements showed that 70% of men and 71% of women were operated within 24 h from admission and 94% of men and 96% of women within 48 h. According to the guidelines from the US National Institute of Health and Caring Excellence, surgery for hip fractures should be performed on the same day, or the day after admission (NICE, 2017). In a Australian study 64% of had surgery within 48 h from admission (Zeltzer et al., 2014) and 88% in a study from India (Rai et al., 2018).

In this study, the number of coexisting ICD-10 diagnosis were used to indicate disease burden but it was of interest that half of the study group had just one diagnosis. Higher risk of mortality after surgery was first seen among those with more than four ICD-10 diagnosis but men were two times more likely to die after surgery both within three and 12 months after surgery. These results are in accordance with an older cohort study from Australia, showing higher death rate among men than women within one year from major fracture (Center et al., 1999) and a study from USA (32% v 18%) (Bass et al., 2007). A recent systematic review also reported higher mortality among men than women, suggesting that this could be due to higher age and worse condition of the male patients (Smith et al., 2014). In our statistical models, we adjusted for age at fracture and number of coexisting diagnoses and still we observed higher mortality risk among men. We do not have an explanation for this gender difference in mortality risk after surgery, but special consideration could be taken for men in this population knowing that the mortality risk is higher.

#### Strengths and limitations

One of the strength of the study was the sample, the data covered 80% of all hip fractures amongst older people in Iceland over a five-year period, it was taken from the nation's single tertiary hospital and may be regarded to represent a significant proportion of the total population well. This offers a relatively unique opportunity to study a specific population of the majority of a single country to identify factors that influence mortality post hip fracture. Further, all covariates from the sample were collected at the same time as the patients that had surgery. Other strengths of the study design, was that the participants had already been registered by health-care personnel in accessible electronic medical records. The limitations of the study were included in the lack of information on some demographic- and lifestyle factors affecting survival after surgery.

#### Conclusion

The mortality risk among older people after hip fracture surgery in Iceland seems similar to other countries (Saletti-Cuesta et al., 2016). The NICE recommendations are to “perform the surgery on the day of, or the day after, admission” (NICE, 2017) and our study shows that these recommendations were fulfilled in 70% of cases at our hospital, LUH, during this five-year period. Studies have shown decreased mortality rates if clinical pathways for hip fractures were used (Leigheb et al., 2012). Such pathways have been implemented at the emergency department at LUH as in many other hospitals around the world. Present study calls for more focus on men in the existing clinical pathway at LUH. Systematically screening for fall risk amongst older people and working on preventions could be a positive step in decreasing this problem. One way could be screening for risk of osteoporosis, dizziness and ask about falls at home, on a regular basis in primary health-care, in the quest of trying to find the vulnerable group before they fall with serious consequences. Further, increasing the use of bone mineral density measurements among older people to identify those at risk as well as with vigorous education and increased research on the subject. Awareness of the factors that influence mortality in this study provides an opportunity to improve care of the elderly after hip fracture to lower mortality such as pre-operative preparations with nutritional interventions and by making mobilization easier for example under femoral

block, while waiting for surgery. Further, post-operative care and discharge planning may be considered; are the men more reluctant to receive professional rehabilitation than women?

#### Ethical statement from the authors

The study design and procedures were approved by the Bioethics Committee at the hospital (nr. 09/2013) and the National Data Protection Authority of Iceland (nr. 20130202228HGK).

#### Financial statement from the authors

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#### Conflicts of interests – statement from the authors

None of the authors have any direct or indirect commercial or financial incentive associated with the publishing of the manuscript. The authors alone are responsible for the content and writing of the manuscript. Extra institutional financial support is indicated on the title page as requested.

#### Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.ijotn.2018.06.001>.

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