Incidence rates of fragility hip fracture in middle-aged and elderly men and women in southern Norway

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Abstract

Background: Hip fracture contributes to increased morbidity and mortality in the elderly population. As the average age of the population is increasing, the burden of hip fracture on the health-care system is a growing challenge. The highest incidence of hip fracture worldwide has been reported from Scandinavia in fact from Oslo the capital of Norway. During the last decades, efforts have been undertaken to reduce hip fracture risk.
Hip fracture incidence in southern Norway

Objective: to study the incidence of fragility hip fracture in southern Norway.

Design: a validated retrospective epidemiological study.

Setting: population-based study.

Subjects: all patients with fragility hip fractures aged 50 years or older in 2004 and 2005 in southern Norway.

Methods: the hip fracture patients were identified from the four hospitals (Kristiansand, Arendal, Flekkefjord and Mandal) located in the two most southern counties in Norway, Vest-Agder and Aust-Agder County. Age-adjusted and age-specific incidence rates for men and women were calculated. We also explored for seasonal variations and differences between rural and urban areas.

Results: a total of 951 (271 men, 680 women) individuals aged ≥50 years with hip fracture were identified. The age-adjusted incidence rate was 34.6 for men and 75.8 for women per 10,000 person-years. Age specific incidence rates were significantly higher in women than in men but only for age groups between 70 and 90 years.

Conclusion: age-adjusted incidence of hip fracture in men and women in southern Norway is the lowest reported from Scandinavia [2, 4, 5, 7, 8], with Oslo, the capital in Norway, reporting the highest incidence worldwide [3]. The epidemiology of fragility hip fracture has previously not been studied in the most southern part of Norway. Thus our aim was to study incidence of fragility hip fracture in the two most southern counties of Norway the last decade.

Keywords: hip fracture, incidence, osteoporosis, seasonal variations, elderly

Introduction

Hip fracture in elderly individuals is a burden for the society in terms of costs and for the single individual due to subsequent increased morbidity and mortality [1].

The incidence of hip fracture has been shown to rise exponentially with increasing age [1]. With an increasing number of elderly in the Western society, hip fracture in the future will become even more than today a challenge for the health-care systems. The incidence of hip fractures has been reported to differ between countries, between regions in the same country [2–5] and between rural and urban areas [6]. The highest incidence rate of hip fractures has been reported from Scandinavia [2, 4, 5, 7, 8], with Oslo, the capital in Norway, reporting the highest incidence worldwide [3]. The epidemiology of fragility hip fracture has previously not been studied in the most southern part of Norway. Thus our aim was to study incidence of fragility hip fracture in the two most southern counties of Norway the last decade.

Patients and methods

The hip fracture patients were identified from the four hospitals (Kristiansand, Arendal, Flekkefjord and Mandal) located in the two most southern counties in Norway, Vest-Agder and Aust-Agder County. Six per cent of the Norwegian population (4.9 million) lives in this geographic area. The four hospitals are the only referral centres for orthopaedic trauma in the two counties. Individuals over 50 years, who were residents in either of the two counties and sustained a fragility hip fracture between 1 January 2004 and 31 December 2005, were included. High energy fractures, e.g. due to motor vehicle accident, as well as pathological fractures, e.g. tumour related, were excluded by reviewing the medical records and X-ray reports. We also excluded patients with hip fracture living in a small area in Vest-Agder county (Sirdal municipality) as some of these patients may have been referred to the neighbour county hospital (Stavanger University Hospital, Rogaland County located in western Norway).

The hospital electronic diagnosis registers were used to identify all hip fracture patients in the 2-year period coded as S72.0-2 according to the International Classification of Diseases 10th Revision (ICD-10). The identified patients medical records and X-ray records were examined and the diagnosis of fragility hip fracture confirmed before inclusion in the study.

Data on age, gender, date of hip fracture and place of residence were collected in all patients.

In Kristiansand hospital during the same 2-year period (2004–05), a prospective hip fracture study was conducted using the same patient inclusion criteria (S72.0-2) as described above. In this study, the attempt was to prospectively identify all fragility hip fracture patients admitted to Kristiansand hospital during the 2-year period. The patients identified by trained nurses were invited for assessment at the hospital osteoporosis centre and invited for participation in a quality of life and clinical study of hip fracture.

We used the official population numbers of the two counties published online by Statistics Norway [9], excluding the population of Sirdal municipality, to calculate the annual incidence of fragility hip fracture in individuals ≥50 years. The mean number of fragility hip fractures in 2004 and 2005 was used as numerator and the mean of the population in 2004 and in 2005 as the denominator for annual incidence calculation. Sex-specific age-adjusted fracture rates were calculated. We also searched for differences in sex-specific age-adjusted fracture rates between rural and urban areas and for seasonal differences. Urban areas were defined as municipalities with more than 5,000 citizens and with areas more than 50% densely populated a definition used by the official statistics bureau in Norway. The period from December to February was defined as winter, March to May as spring, June to August as summer and September to November as autumn.
The annual age-adjusted hip fracture incidence rates were calculated standardised to the mean population of the examined geographic area in 2004 and 2005 in southern Norway. This standardised calculation of annual incidence rates were also applied on populations from previous reports from Norway and other countries as listed in Table 2.

### Statistical analysis

Calculations were performed with SPSS version 16.0 (SPSS, Inc., Chicago IL, USA). Hip fracture rates (number of fractures per 10,000 person-years) were defined by 5-year intervals for the whole population of patients and for each sex separately. The incidence in different age groups was calculated as the number of hip fractures divided by the mean population. The 95% confidence intervals (CIs) for the incidence rates were calculated using the equation for binomial distribution [10]. For group comparison, we used the \( z \)-test. These statistical analyses were performed with the StatCalc 2.6 program (AcaStat Software Leesburg, VA, USA). \( P \)-values less than 0.05 were considered to be significant.

### Ethics

The study was approved by the Regional Committee for Medical Research Ethics and the National Data Inspectorate.

### Results

In the 2-year period, 984 fragility hip fracture patients age ≥50 years (279 men and 705 women) were identified at the four hospitals. Among them, six patients were living in the Sirdal municipality and 19 individuals were non-residents in the two counties. Eight identified patients were excluded due to other kinds of fractures than hip fracture (e.g., femur shaft). The final number of fragility hip fractures resident in the geographic area included in this study was 951 (271 men and 680 women), Kristiansand hospital 466 (140 men, 326 women), Arendal hospital 365 (100 men, 265 women), Flekkefjord hospital 108 (29 men, 79 women) and Mandal hospital 12 (2 men, 10 women).

All prospectively identified hip fracture patients in Kristiansand were also identified retrospectively; however, 32 patients were only identified by using the ICD-10 diagnosis code system and were not identified prospectively.

Mean age for all included patients was 81.2 years (men 80.0 years and women 81.8 years).

### Age-adjusted and age-specific hip fracture incidence rates

The age-adjusted crude annual incidence rate per 10,000 person-years was for men 34.6 and for women 75.8.

The age-specific incidence of hip fracture increased exponentially after the age of 50 years for both sexes as shown in Table 1. A statistically significant difference in age-specific incidence rates between the two genders was seen for age groups between 70 and 90 years (70–74 years \( P < 0.013, 75–79 \) years \( P < 0.0003, 80–84 \) years \( P < 0.0002 \) and 85–90 years \( P < 0.035 \)).

### Rural and urban areas

No statistically significant difference in mean (95% CI) age-adjusted hip fracture incidence rates was found between urban and rural areas, neither for men [33.5 (34–37) versus 31.7 (29.2–34.2), \( P < 0.88 \)] nor for women [(72.4 (68.8–76.0) versus 76.7 (74.7–78.7), \( P < 0.84 \)].

### Seasonal variation

The mean (95% CI) proportion of hip fractures during the 2-year period was significantly \( P < 0.001 \) higher in winter months [29.4% (29.4 (27.4–33.4)] compared with the other seasons, spring [24.0% (21.1–26.6)], summer [24.0% (21.1–26.6)] and autumn [22.9% (20.4–25.2)]. No statistically significant differences in fracture rates were seen between spring, summer and autumn.

### Table 1. Mean annual incidence of hip fracture with 95% confidence interval (CI) for different age groups in men and women in southern Norway (January 2004–December 2005)

<table>
<thead>
<tr>
<th>Age groups (years)</th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Person-years</td>
<td>Number of fractures</td>
<td>Annual incidence per 10,000 person-years (95% CI)</td>
<td>Person-years</td>
<td>Number of fractures</td>
<td>Annual incidence per 10,000 person-years (95% CI)</td>
</tr>
<tr>
<td>50–54</td>
<td>17,169</td>
<td>9</td>
<td>5.2 (2–8)</td>
<td>16,778</td>
<td>10</td>
<td>6.0 (2–10)</td>
</tr>
<tr>
<td>55–59</td>
<td>16,952</td>
<td>10</td>
<td>5.9 (2–10)</td>
<td>16,413</td>
<td>9</td>
<td>5.5 (2–8)</td>
</tr>
<tr>
<td>60–64</td>
<td>12,041</td>
<td>6</td>
<td>4.9 (1–9)</td>
<td>12,562</td>
<td>19</td>
<td>15.1 (8–22)</td>
</tr>
<tr>
<td>65–69</td>
<td>9,466</td>
<td>20</td>
<td>21.1 (12–30)</td>
<td>9,972</td>
<td>32</td>
<td>32.0 (21–43)</td>
</tr>
<tr>
<td>70–74</td>
<td>8,048</td>
<td>34</td>
<td>42.2 (28–56)</td>
<td>9,209</td>
<td>65</td>
<td>70.5 (53–87)</td>
</tr>
<tr>
<td>75–79</td>
<td>6,486</td>
<td>40</td>
<td>61.7 (43–81)</td>
<td>9,088</td>
<td>108</td>
<td>118.8 (96–140)</td>
</tr>
<tr>
<td>80–84</td>
<td>4,882</td>
<td>60</td>
<td>122.9 (92–154)</td>
<td>8,264</td>
<td>170</td>
<td>205.7 (174–236)</td>
</tr>
<tr>
<td>85–89</td>
<td>2,320</td>
<td>52</td>
<td>224.1 (164–284)</td>
<td>4,926</td>
<td>156</td>
<td>316.6 (267–365)</td>
</tr>
<tr>
<td>90+</td>
<td>857</td>
<td>40</td>
<td>466.7 (325–607)</td>
<td>2,526</td>
<td>111</td>
<td>439.4 (359–519)</td>
</tr>
</tbody>
</table>
Central Finland 2002

Cantabria, Spain 2002 [27] 103,976 189,337 86 404 10.1 (8.8–11.4)

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Cantabria, Spain 2002 [27] 103,976 189,337 86 404 10.1 (8.8–11.4)

Canada 2001–05 [14] Whole Canadian population Whole Canadian population 41,741 106,241 22.3 56.8

Comparing age-specific and age-adjusted hip fracture incidence rates with previous reports

In comparison with previous reports from Norway, as shown in Figure 1, our age-specific incidence rates for women were lower than reported from Oslo [3] for age 80 years and older and were more in accordance with reports from south eastern [4], central [5] and northern [11] Norway. For men, only minor differences in age-specific incidence rates were seen between our data from southern Norway and previous reports from Oslo [3], south eastern [4], central [5] and northern [11] Norway. As shown in Table 2, the age-adjusted incidence rates of fragility hip fracture from southern Norway are among the lowest reported from Norway and Denmark. However, compared with other reports from non-Nordic countries, the age-adjusted incidence rates for hip fracture continue to be one of the highest in the world both in men and women.

As shown in Table 2, the age-adjusted incidence rates of fragility hip fracture from southern Norway are among the lowest reported from Norway and Denmark. However, compared with other reports from non-Nordic countries, the age-adjusted incidence rates for hip fracture continue to be one of the highest in the world both in men and women.

Table 2. Age-adjusted hip fracture rates in men and women older than 50 years in southern Norway compared with previous reports from Norway, Scandinavia and other selected countries standardised to the population of southern Norway

<table>
<thead>
<tr>
<th>Region, country and time period (reference)</th>
<th>Study population</th>
<th>Number of fractures</th>
<th>Age-adjusted incidence rates (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-years men</td>
<td>Person-years women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Cantabria, Spain 2002 [27]</td>
<td>103,976</td>
<td>189,337</td>
<td>86</td>
</tr>
<tr>
<td>Germany 2004 [25]</td>
<td>Whole German population</td>
<td>Whole German population</td>
<td>NA</td>
</tr>
<tr>
<td>Canada 2001–05 [14]</td>
<td>Whole Canadian population</td>
<td>Whole Canadian population</td>
<td>41,741</td>
</tr>
<tr>
<td>Southern Norway 2004-05 (present study)</td>
<td>78,222</td>
<td>89,740</td>
<td>271</td>
</tr>
<tr>
<td>Funen Denmark 2000–03 [8]</td>
<td>79,495</td>
<td>90,504</td>
<td>200</td>
</tr>
<tr>
<td>Central Norway, 1997–98 [5]</td>
<td>48,965</td>
<td>57,036</td>
<td>373</td>
</tr>
</tbody>
</table>

The rates are per 10,000 person-years.

The Canadian incidence rates are calculated for men and women older than 55 years, NA, not available.

Discussion

The main finding in our study is that the age-adjusted incidence of hip fracture in women older than 50 years in southern Norway is significantly lower than reported from Oslo, the capital of Norway, with the highest hip fracture rate reported in the world [3], and among the lowest reported compared with the two other Scandinavian countries, Denmark and Sweden [8, 12, 13]. These first data reported on incidence of hip fracture in southern Norway should be interpreted with caution as our study was conducted 7 years later than the Oslo study and only contained data from a 2-year period (2004 and 2005). The differences thus may reflect temporal trends and no true geographic differences.

In comparison with previous reports from Norway, the age-specific incidence rates for women were lower than reported from Oslo [3] for age 80 years and older and were more similar to reports from south eastern [4], central [5] and northern [11] Norway. For men, only minor differences in age-adjusted (Table 2) and age-specific incidence rates (Figure 1) were seen between our data from southern Norway and previous reports from Oslo [3], south eastern [4], central [5] and northern [11] Norway.

Recent data has shown a declining tendency of osteoporotic hip fracture the last decade in the Western society [8, 12, 14]. This decline in fracture risk may be explained by the introduction of both non-pharmacological and pharmacological initiatives (e.g. bisphosphonates) [12, 14, 15]. Several specific factors have been reported to be associated with a lower fracture risk including the use of calcium and vitamin D supplements, vitamin K supplementation [16], unexpected beneficial effects of other medications including statins [17], reduction in comorbid conditions [18], preventive efforts among elderly (home visits, exercising programmes, nutrition) [19] and the temporal increases in body mass index in developed countries may reduce the hip fracture risk through a direct effect on bone strength [increasing bone mineral density (BMD)] and by reducing force from the fall (increased padding over the trochanter) [20]. However, differences in hip fracture incidence rates may also be reflected by differences in BMD between populations. In a recent published Norwegian study, significant differences in hip BMD were reported between Tromsø city located in the northern and Bergen city located in the western part of Norway [21]. Differences in demographics between areas may be another explanation; indeed, the number of women is higher in all age groups in Oslo than rest of Norway [22].

In our study, approximately one-third to one-fourth of the fragility hip fractures occurred in men, this is in
accordance with previous studies [23]. The high incidence of hip fracture in men emphasises that both pharmacologic and non-pharmacological initiative to reduce fracture risk should also include men. In the USA and also in Norway, several bisphosphonates and teriparatide have been approved for the treatment of male osteoporosis [24].

Cold climate, low vitamin D intake and lower body mass index are factors which may explain the high incidence rate of hip fracture in Scandinavia. However, the incidence rate of hip fracture that is significantly lower in Finland, a country that is in the same latitude as Norway and Sweden with a common climate and lifestyle (Table 2). This indicates that genetic factors may also be of significant importance.

We found no statistically significant difference in hip fracture incidence between urban and rural areas as previously reported by others [6]. The reason may be that the urban areas in southern Norway lack the typical structure of large cities and the spreading of population resembles more the structure of semi-rural or rural areas. This may also partly explain differences observed in incidence rates between our study and the data from Oslo defined as a pure urban area.

In our study, a statistically significant higher incidence of hip fracture was seen in winter compared with the other seasons. Contradictory reports on seasonal variation on hip fracture risk have been reported with some reporting no differences [3] and others reporting a higher risk in winter [11, 13, 25]. The higher prevalence of hip fracture in winter months may partly be explained by an increased risk of falling caused by slippery condition on snow and ice and decreased vitamin D levels in winter months [26].

The use of retrospective study design and data collection may be considered as a limitation of our study as prospective study design and data collection in general is considered to be of a higher reliability. Hip fracture patients may have been missed because they have been misdiagnosed or they may have been coded with a wrong ICD-10 code. However, we believe this is not a crucial limitation for our study. In our study, the retrospective data collection on fragility hip fracture patients seems to be more reliable than the prospective. This has also recently been confirmed by others [11]. Anyway, the differences were minor and did not alter significantly the hip fracture incidence rates. The diagnoses of fragility hip fracture were also validated by thoroughly examining all medical records and X-ray reports. Thus, it is likely that the vast majority of individuals suffering a fragility hip fracture in southern Norway in our study were identified. Further we also excluded from our retrospective analysis readmissions due to complications or revisions. Our study may thus also be considered as a validation study of the retrospective method using the hospital diagnosis code system to identify hip fracture patients, a method which has been used in the vast majority of epidemiological hip fracture studies [3–5, 8, 13, 25, 27–29].

Conclusions

The present study reveals one of the lowest age-adjusted incidence rates of hip fractures seen in Norway and Scandinavia in both males and females; however, the incidence rates are still among the highest in the world. A significant higher incidence hip fracture rate was found in winter but no significant difference was seen between urban and rural areas in southern Norway. There is an urgent need to improve preventive strategies to reduce the risk of hip fracture in elderly men and women as the number of fracture in the future will increase with an ageing population.

Figure 1. Comparing the annual age-specific incidence rates of hip fracture among individuals per 10,000 person-years in southern Norway with previous reports from other regions, Oslo [3], south eastern [4], central [5] and northern (Harstad) [11] Norway in men and women.
Key points

- Hip fracture incidence rates are lower in southern Norway than in Oslo, the capital of Norway.
- No differences in hip fracture incidence rates were seen between rural and urban areas in southern Norway.
- A significantly higher number of fractures occurred during winter compared with the other seasons.
- Retrospective identification of hip fracture patients based on the ICD-10 diagnosis codes is a valid method.
- Further initiatives are needed to reduce future hip fracture risk.

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Conflicts of interest

None declared.

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References

Markers of inflammatory status are associated with hearing threshold in older people: findings from the Hertfordshire ageing study

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Abstract

Background: age-related hearing loss is a common disabling condition but its causes are not well understood and the role of inflammation as an influencing factor has received little consideration in the literature.

Objective: to investigate the association between inflammatory markers and hearing in community-dwelling older men and women.

Design: cross-sectional analysis within a cohort study.

Setting: the Hertfordshire Ageing Study.

Participants: a total of 343 men and 268 women aged 63–74 years on whom data on audiometric testing, inflammatory markers and covariates were available at follow-up in 1995.

Main outcome measures: average hearing threshold level (across 500–4,000 Hz) of the worst hearing ear and audiometric slope in dB/octave from 500 to 4,000 Hz.

Results: older age, smoking, history of noise exposure and male gender (all \( P < 0.001 \)) were associated with higher mean hearing threshold in the worse ear in univariate analysis. After adjustment for these factors in multiple regression models, four measures of immune or inflammatory status were significantly associated with hearing threshold, namely white blood cell count \( (r = 0.13, P = 0.001) \), neutrophil count \( (r = 0.13, P = 0.002) \), IL-6 \( (r = 0.10, P = 0.05) \) and C-reactive protein \( (r = 0.11, P = 0.01) \). None of the inflammatory markers was associated with maximum audiometric slope in adjusted analyses.

Conclusions: markers of inflammatory status were significantly associated with degree of hearing loss in older people. The findings are consistent with the possibility that inflammatory changes occurring with ageing may be involved in age-related hearing loss. Longitudinal data would enable this hypothesis to be explored further.

Keywords: hearing, age-related hearing loss, presbycusis, inflammation, ageing, older people, elderly