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# Increasing Age-Adjusted Incidence of Hip Fractures in Finland: The Number and Incidence of Fractures in 1970–1991 and Prediction for the Future

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**Abstract.** Hip fractures in the elderly are a worldwide epidemic, and aging of the populations is increasing the burden of these fractures on the health care systems. To improve the knowledge of whether the number of hip fractures is increasing even more rapidly than can be accounted for by the demographic changes only, all patients who were admitted to Finnish hospitals in 1970, 1975, 1980, 1985, 1988, and 1991 for primary treatment of first hip fracture were selected from the National Hospital Discharge Register. There was a steady, average 7.7% annual increase in the total number of hip fractures in Finland during this period so that the number of fractures was 2239 in 1970 and 6071 in 1991. The proportion of patients aged 60 years or more increased steadily from 75% in 1970 to 91% in 1991. In 1991, 74% of the patients were women. Across the study period, the age-adjusted total incidence of hip fractures also increased in both women and men 50 years of age and over. This increase was more pronounced in men. Thus, the increasing incidence of hip fractures in Finland was not only due to the fact that the population was aging but also due to the increasing age-adjusted incidence. We conclude that the number of hip fractures in Finland is increasing more rapidly than can be accounted for by the demographic changes only and this will seriously challenge the Finnish health care system in the future.

**Key words:** Hip fracture — Incidence — Elderly — Age-adjusted — Age-specific — Future prediction.

Hip fractures are a major public health problem, not only for the economics of medical care [1, 2] but especially for the health of the elderly as hip fractures are one of the most important causes of disability and death among the elderly [3–5]. During recent decades, the incidence of hip fractures has been increasing in the developed countries in Asia [6–8], Europe [2, 7, 9–18], Oceania [10, 19], and North America [1, 7, 10, 20], and is expected to rise dramatically as the populations age.

Most of the recent epidemiologic studies indicate that the age-specific incidence rates of hip fractures have also increased [6–8, 11–13, 17, 18]. Increasing incidence rates in women have been seen in all populations but the rise has slowed in several, but the increase in incidence in men has continued unabated almost everywhere. Naessen et al. [15] found that in the Uppsala, Sweden the age-standardized admission rates for hip fractures increased in men in contrast to mild decrease in women. Melton et al. [20] found in Rochester, Minnesota that the age-adjusted fracture rates have increased in men but in women these fracture rates have been unchanged since the mid-1950s.

Many studies indicate that during the recent decades, the number of the trochanteric fractures, the fractures closely associated with serious osteoporosis [21], has increased more than that of the cervical fractures [6, 11, 15, 17]. In addition, some studies indicate that the increase in the age-specific fracture rates has been mostly attributed to trochanteric fractures in persons 70 years and above [6, 11].

Increasingly tighter control of health care resources makes it important to predict any increases in the number of patients requiring treatment. Such a prediction requires knowledge of whether the number of hip fractures is increasing more rapidly than can be accounted for by the demographic changes only. As understanding of the underlying epidemiologic changes would also allow assessment of efficacy of any preventive measures.

The purpose of this study was to estimate the time trends for the absolute number of hip fractures, and the age-specific and the age-adjusted hip fracture incidence rates in Finland over the period 1970–1991.

## Patients and Methods

All patients who were admitted to Finnish hospitals in 1970, 1975, 1980, 1985, 1988, and 1991 for primary treatment of first hip fracture were selected from the National Hospital Discharge Register (NHDR). The unique personal identification number allowed us to focus our analysis on the first recorded admission. Besides, the NHDR contained data on age, sex, place of residence, hospital number and department, patients admission and discharge days, place and etiology of injury, and the place of secondary treatment. In a patient file-controlled study concerning the accuracy of Finnish hospital discharge data, the NHDR injury diagnosis was found to be completely correct in 96% of the cases [22]. Correspondingly, Lüthje et al. (unpublished data), in their recent study of pelvis fractures, checked 10% of the patient files and found the percentage of the correct NHDR diag-

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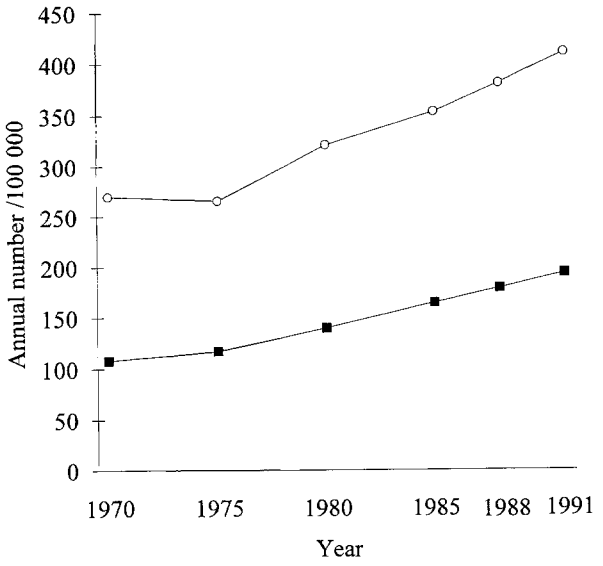


**Fig. 1.** Changes in the age-adjusted incidence of hip fractures in Finland in 50-year-old or older people over the period 1970–1991. (○) women, (■) men.

noses to be 97%. The annual coverage of the Finnish NHDR is, in turn, 95–100% [22, 23]. In hip fractures, the sensitivity of the Finnish NHDR was 98.8% and the specificity 99.9% in 1980 [24].

The diagnoses were coded with a five-digit code according to the eighth and ninth revision of the International Classification of Diseases (ICD) indicating the type of the fracture. Between 1970 and 1986, the eighth revision of ICD and its following codes were used: 820.00 and 820.10 for a cervical fracture, and 820.01, 820.11, 820.02, 820.12, 820.03, and 820.13 for a trochanteric fracture. Since 1987, the following five-digit codes were used: 8200A and 8201A for a cervical fracture; and 8202A, 8203A, 8203B, 8203C, 8208X, and 8209X for a trochanteric fracture. In both classifications, the subtrochanteric fractures and the unspecified fractures (so-called NUD diagnoses, codes 820.03, 802.13, 8208X, and 8209X) were included in the group of trochanteric fractures.

The fractures were recorded by both the main (first) and secondary diagnosis. According to the directives given by the Finnish National Board of Health, the first diagnosis described the main reason for the patient's hospital stay. The second, third, and fourth diagnoses indicated other possible diseases or injuries.

The study was based on the whole Finnish population, thus completely covering the intended study population (Finnish nation). In other words, the given absolute numbers and incidences of hip fractures were not cohort-based estimates but true final results.

The age adjustment was performed by means of direct standardization using the mean population between 1970 and 1991 as the standard population. The annual midyear populations in each 5-year age group in the period 1970–1991 were obtained from the official statistics of Finland [25]. The fracture incidences were calculated for both sexes and expressed as the number of cases/100,000 persons/year. To establish age-specific incidences for the selected age groups (50–64, 65–74, 75–84, and 85–), the yearly numbers of hip fractures were divided by the midyear population for each age and sex group. The rates were expressed as the number of cases/100,000 persons/year, by sex and by age group.

The relative hip fracture risk (risk ratio) was established by dividing the yearly incidence number of each age group

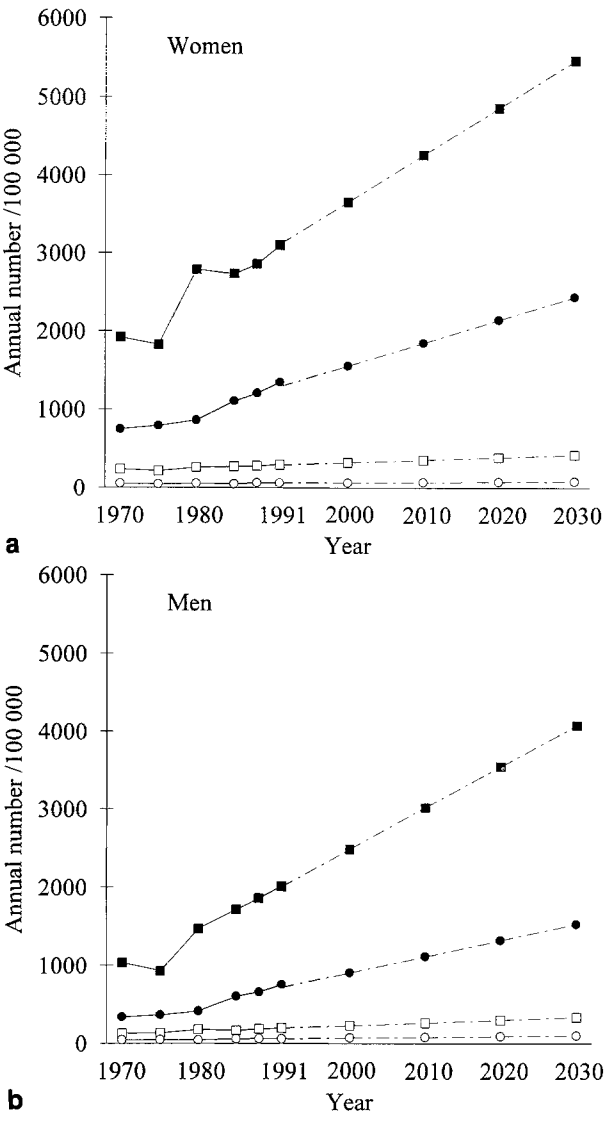


**Fig. 2(a).** The changes in the age-specific incidence of hip fractures in women over the period 1970–1991 and prediction of the incidences until the year 2030, as calculated with a regression model. **(b)** The changes in the age-specific incidence of hip fractures in men over the period 1970–1991 and prediction of the incidences until the year 2030, as calculated with a regression model. (■) 85–, (●) 75–84, (□) 65–74, (○) 50–64.

(50–64, 65–74, 75–84, and 85–) by the incidence in the corresponding group in 1970. These annual risk ratios were expressed for each fracture type (cervical or trochanteric) and age group.

The figures of fracture incidences observed in the different age groups over the study period (1970–1991) were used to predict the absolute number of hip fractures and their age-specific incidences in the population in the years 2000, 2010, and 2030. The regression lines were calculated for both sexes and for each age group (50–64, 65–74, 75–84, 85–) and were then used to determine the age- and sex-specific fracture incidences in women and men 50 years of age and over till the year 2030. Then, within each age and sex group, the estimated absolute number of fractures was obtained by multiplying the above-mentioned incidence by the estimation of the number of inhabitants, the latter being obtained from the "Population projections in Finland in 1993–2030" [26].

**Table 1.** The relative risk factor of cervical and trochanteric hip fractures in Finnish women and men between 1970 and 1991

| | Cervical | | | | Trochanteric | | | |
|---|---|---|---|---|---|---|---|---|
| | Age group | | | | Age group | | | |
| Year | 50–64 | 65–74 | 75–84 | 85– | 50–64 | 65–74 | 75–84 | 85– |
| 1970 | 1 | 1 | 1 | 1[a] | 1 | 1 | 1 | 1 |
| 1975 | 0.88 | 0.92 | 1.07 | 0.95 | 1.04 | 1.07 | 1.05 | 0.95 |
| 1980 | 0.99 | 1.15 | 1.17 | 1.41 | 1.03 | 1.34 | 1.19 | 1.60 |
| 1985 | 1.09 | 1.21 | 1.59 | 1.43 | 1.01 | 1.23 | 1.43 | 1.63 |
| 1988 | 0.97 | 0.93 | 1.21 | 1.11 | 1.85 | 2.31 | 2.91 | 2.66 |
| 1991 | 0.95 | 1.02 | 1.40 | 1.17 | 1.96 | 2.38 | 3.16 | 2.96 |

[a] In 1970, there was a risk factor of 1

## Results

### *Absolute Number and Incidences of Hip Fractures*

There was a steady increase in the total number of hip fractures in Finland between 1970 and 1991. The average increase was 7.7% per year. The whole population incidence curve of fractures closely followed the absolute number curve as the Finnish population increased only 8% (from 4.6 to 5.0 million) during this 22-year period. The number of all admissions (first admissions plus repeated admissions for the same fracture) to hospitals for the hip fracture increased even faster (i.e., increased problems in further treatment), the average increase being 10.7% per year. The proportion of first admissions of all hospital admissions for a hip fracture was 80% in 1970 and 1975, 75% in 1980, 73% in 1985, 68% in 1988, and 65% in 1991.

In men, the increase in cervical and trochanteric fractures was about the same over the study period (the proportion of trochanteric fractures was 49% in 1970 and 50% in 1991) and in women, the number of trochanteric fractures increased faster than that of cervical fractures: the proportion of trochanteric fractures was 26% in 1970 and 47% in 1991.

The mean age of all hip fracture patients increased significantly and steadily from 65.5 years (1970) to 76.3 years (1991). The corresponding figures for men and women were 52.9 and 69.0 years, and 71.6 and 78.9 years, respectively. During the same time, the mean age of the population increased from 33.3 years to 37.7 years. The proportion of hip fracture patients aged 60 years or more increased steadily from 75% in 1970 to 91% in 1991. During the same period, the proportion of Finnish people aged 60 years or more increased from 14% to 19%.

### *Age-Adjusted Incidences of Hip Fractures*

The age-adjusted total incidence of hip fractures increased in both women and men 50 years of age and over. In women, this age-adjusted incidence increased from 273/100,000 in 1970 to 412/100,000 in 1991 (Fig. 1). In men, the corresponding figures were 108/100,000 in 1970 and 194/100,000 in 1991 (Fig. 1). Despite the greater relative increase in the age-adjusted hip fracture incidence in men (80%) compared with women (51%) over this period, the age-adjusted incidence was still 2.1 times higher in women in 1991.

### *Age-Specific Incidences of Hip Fractures*

In women as well as men, the age-specific incidence of hip fractures increased in all age groups over the study period (Fig. 2a,b.) This increase was most pronounced in the older age groups. For example, the age-specific incidence (per 100,000 inhabitants) was 750 in 75–84-year-old women in 1970, 864 in 1980, and 1347 in 1991. In men, the corresponding figures were 338, 415 and 753.

### *Risk Ratios of Hip Fractures*

The changes in the risk ratios of the hip fractures in the fracture type-stratified subgroups are represented in Table 1. In neither women nor men did the risk ratios of cervical hip fractures show consistent changes. However, the risk ratios of trochanteric fractures increased in both sexes in all age groups. For example, in women and men aged 75–84 years, the relative risk was over three times higher in 1991 than in 1970.

### *Hip Fractures in the Future*

The predicted incidences of hip fractures by age and sex are shown in Figures 2a,b. In 2000, 2010 and 2030, the total incidences (per 100,000 inhabitants) are calculated to be 600, 681, and 1097 in women and 260, 330, and 622 in men. In the older age groups, these figures are expected to be remarkably higher (see Fig 2a,b.). In the year 2000, the total number of hip fractures in Finland will be about 7800, and correspondingly, 10,500 and 18,800 in the years 2010 and 2030.

## Discussion

In this study we used the whole Finnish population to describe the time trends for the absolute numbers and the incidences of first hip fractures. Using the National Hospital Discharge Register and the unique personal identification number we were able to eliminate multiple admissions caused by transfers between hospitals or hospital departments and readmissions due to complications. Our results represent almost all incidents of first hip fractures in Finland as, almost without exception, all patients with a hip fracture are likely to be hospitalized, and the accuracy and coverage of the Finnish Hospital Discharge Register have been shown to be very good concerning severe injuries such as hip fractures [22–24] and (Lüthje et al., unpublished data).

It seems to be generally agreed that the crude incidence of hip fractures is rising in conjunction with aging of the underlying population. In accordance with most of the recent studies [6–8, 11–13, 17, 18] we found that the age-specific incidence is also increasing in both sexes. This increase was mostly attributed to trochanteric fractures, i.e., the fractures closely associated with a serious osteoporosis

[21]. A similar proportional increase in trochanteric fractures has also been reported in several other recent studies [6, 11, 15, 17].

In some populations, the increase in hip fracture incidences has either slowed, leveled off, or even decreased. In Denmark Lauritzen et al. [14] observed a significantly decreasing incidence of cervical hip fractures in women aged 60–89 years and no significant changes in the incidences of women's trochanteric fractures or men's fractures. In Sweden Naessen et al. [15] also found similar decreasing incidence of women's cervical fractures. In their study, however, men's age-adjusted fracture incidence increased in both cervical and trochanteric fractures. In Rochester, Minnesota [20] the age-adjusted incidence increased in men over time whereas the fracture rates in women leveled off in the mid-1950s. In our study, the age-adjusted incidence increased in both sexes. A similar, linearly increasing trend of age-adjusted fracture incidences in both sexes was found in the Netherlands over the period 1972–1987 [13].

There are some limitations in our study. First, we included the unspecified hip fractures [the non-ultra descriptus (NUD) diagnosis codes] in the group of trochanteric fractures. Thus, in this group there might have been some cervical fractures that occurred in the very distal part of the femoral neck. Also, the change of the revision of the International Classification of Diseases (ICD) between 1986 and 1987 somewhat increased the proportion of the NUD diagnoses: the proportion of the NUD diagnoses of first hip fractures was 3.2% in 1970 and 6.3% in 1991. This variation may to some extent distort the comparison of the proportions of cervical and trochanteric fractures across time. Second, despite using the 5-year age range, an increase in life expectancy during the study period may falsely increase the estimated incidence rates over time to some extent. In other words, average ages may be increasing even within 5-year age groups so that the age-adjustment procedure does not completely control the demographic changes over time. However, the retention in population denominators of those no longer at risk for such fractures because they had already had one may partly counterbalance this influence [15]. Third, we want to emphasize that there can be natural annual variation in hip fracture incidences, and this limitation in the representativity of the selected study years may have had some effect on the presented time trends of the hip fractures. Fourth, the system we used to collect the data allowed us to only recognize the "first" admissions of hip fractures in the years for which we had data, e.g., a patient admitted in December 1990 and readmitted in January 1991 would look like a new case. However, the problem is the same for every year so it would have little influence on the trends but could slightly inflate the number of fractures seen annually.

In the year 2000 and 2010, the annual number of first hip fractures in the population aged 50 and over was calculated to be 7800 and 10,500, respectively. The corresponding incidences (per 100,000 inhabitants) will be 448 and 518. In Finland, however, the largest age groups (the 10-year cohort born after the World War II) will reach the highest risk (age 75 years and over) for hip fractures between the years 2020 and 2030, and, thus, the number of these fractures are expected to increase exponentially during this period.

We conclude that the number of hip fractures in Finland is increasing more rapidly than can be accounted for by the demographic changes only. These findings indicate that vigorous preventive measures are imperative to control the increasing burden of the hip fractures on our society.

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