Osteoporotic fractures of the proximal humerus in elderly Finnish persons

Sharp increase in 1970–1998 and alarming projections for the new millennium

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ABSTRACT – We determined the current trends in the number and incidence of osteoporotic fractures of the proximal humerus in Finland by collecting from the National Hospital Discharge Register all patients 60 years of age or more who were admitted to Finnish hospitals in 1970–1998 for primary treatment of such fractures. The fracture was defined osteoporotic if it was caused by a low-energy trauma only, i.e., a fall from standing height or less.

The number and incidence (per 10^5 persons) of fractures increased sharply from 208 (number) and 32 (incidence) in 1970 to 1,105 and 110 in 1998. Even after the age-adjustment, the incidence of fractures showed a clear increase: in women from 50 in 1970 to 133 in 1998, and in men from 14 in 1970 to 49 in 1998. If this trend continues, there will be three times more osteoporotic fractures of the proximal humerus in Finland in the year 2030 than there were in 1998.

The commonest and best known forms of osteoporotic fractures occur in the distal forearm, spine, and hip (Melton 1988, Jones et al. 1994, Kannus et al. 1999). Nevertheless, a considerable number of osteoporotic fractures also occur in the proximal humerus, pelvis, knee, and ankle, and their treatment is also demanding and expensive and needs special attention (Horak and Nilsson 1975, Melton et al. 1981, Rose et al. 1982, Cummings et al. 1985, Bengnér et al. 1986, Kristiansen et al. 1987, Bengnér et al. 1988, Lind et al. 1989, Obrant et al. 1989, Kelsey et al. 1992, Lauritzen et al. 1993, Nevitt 1994, Johnell 1995).

Epidemiologic information on the latter fractures, however, is scarce and this especially concerns their secular trends (Cummings et al. 1985, Bengnér et al. 1986, 1988, Obrant et al. 1989, Lauritzen et al. 1993, Kannus et al. 1996, Hagino et al. 1999). We assessed the time trends in the absolute number, as well as age-specific and age-adjusted incidence rates of osteoporotic fractures of the proximal humerus in Finland between 1970 and 1998, and predicted the fracture development until the year 2030. This study is an extension of our previous short report of these injuries (Kannus et al. 1996), the database including all follow-up years until 1998, data for every age group, and a precise prediction model for future fractures.

Patients and methods

Database for fractures

In accord with other epidemiologic studies of osteoporotic fractures (Cummings et al. 1985, Melton 1988, Lauritzen et al. 1993, Jones et al. 1994), we defined an osteoporotic fracture of the proximal humerus as a fracture that occurred in persons 60 years of age or more and resulting from low-energy trauma (a fall from standing height or less). Thus, all patients 60 years of age or more

who were admitted to Finnish hospitals during 1970–1998 for primary treatment of the first fracture of the proximal humerus were selected from the National Hospital Discharge Register (NHDR). Injuries caused by a vehicular accident or other high-energy trauma were excluded. Unique personal identification numbers enabled us to focus our analysis on each patient's first admission. The NHDR contains data on age, sex, place of residence, hospital and department, day of admission and discharge, place and cause of injury, and place of further treatment.

The Finnish NHDR (which started in 1967) is one of the oldest nationwide discharge registers in the world, and the data provided by this register are well suited for epidemiologic purposes. This register covers the acute injuries in the population adequately (annual coverage of injuries is 95% or more) and records them accurately (annual accuracy of the NHDR injury diagnoses is also 95% or more), and these percentages are particularly good in severe injuries with clear-cut diagnoses, such as fractures (Salmela and Koistinen 1987, Honkanen 1990, Keskimäki and Aro 1991, Lüthje et al. 1995).

Fractures were recorded by evaluating primary and secondary diagnoses. According to the directives from the Finnish National Board of Health, the first diagnosis describes the main reason for the hospital stay. The second, third and fourth diagnoses indicate other possible diseases or injuries.

The diagnoses were labeled with a 5-digit code according to the eighth, ninth, and tenth revisions of the International Classification of Diseases (ICD) that indicated the type of fracture. Between 1970 and 1986, we used the eighth revision of ICD and its 2 code-classes for fractures of the proximal humerus (81200 and 81210). Between 1987 and 1995, the ICD-9 code-classes were 8120A and 8121A, and between 1996 and 1998, the corresponding ICD-10 code-class was S42.2. Cases with codes identifying trauma sequelae and orthopedic aftercare were excluded.

Calculation of fracture incidences

Annual mid-year populations figures for each 5-year age group between 1970 and 1998 were taken from the Official Statistics of Finland (Official Statistics of Finland 1999). In this statutory, computer-based register, every Finn is registered by his or her personal identification number and the register is quality-controlled continuously and updated by Statistics Finland, the Central Statistical Office of Finland.

Fracture incidences were calculated for both sexes, expressed as the number of cases per 10^5 persons per year, by sex and age group. To establish age-specific incidences for the selected age groups (60–69, 70–79, 80–), the yearly numbers of fractures of the proximal humerus were divided by the mid-year population for each sex and age group. In calculating the age-adjusted fracture incidence, age adjustment was done by direct standardization, using the mean population between 1970 and 1998 as the standard population.

Prediction of fractures

Finally, the figures for fracture incidences observed in the various age groups during the study (1970–1998) were used to predict the age-specific incidences and absolute number of osteoporotic fractures of the proximal humerus in the population in the years 2010, 2020, and 2030. The prediction was based on a linear trend continuation method, using ordinary least squares as the method of regression and r^2 and standard error of estimate (SEE) as descriptors of the fit of the regression line to the data.

The prediction was made by calculating the incidence regression lines for both sexes and each age group. These regression lines were used to determine the age-specific and sex-specific fracture incidences until the year 2030. Then, within each age and sex group, the predicted absolute number of fractures was obtained by multiplying the above-mentioned incidence by the estimate of the number of inhabitants, the latter being obtained from the Finnish Population Projections 1999–2030 (Official Statistics of Finland 1998).

Results

Overall number and incidence of fractures

The annual total number of osteoporotic fractures of the proximal humerus increased steadily during the study, from 208 (1970) to 1,105 (1998) (Figure

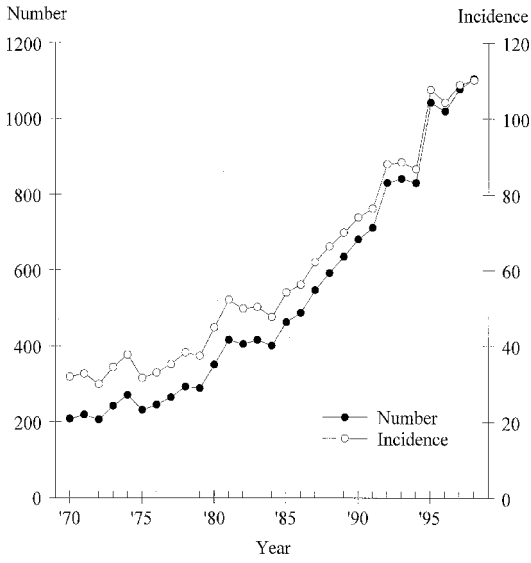

Figure 1. Number and incidence (per 10^5 persons) of osteoporotic fractures of the proximal humerus in Finland in persons at least 60 years old between 1970 and 1998.

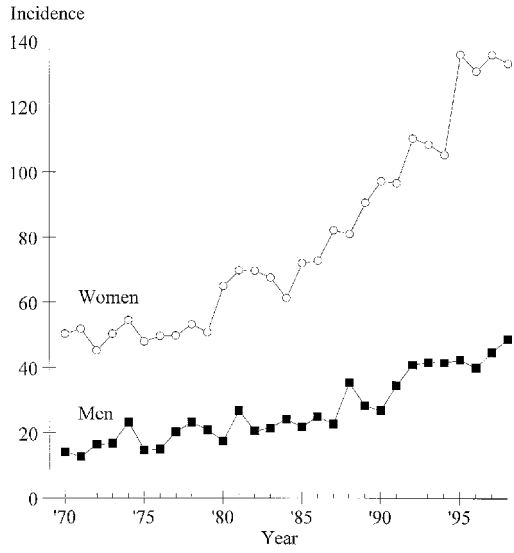

Figure 2. Age-adjusted incidence (per 10^5 persons) of osteoporotic fractures of the proximal humerus in Finland in women and men at least 60 years old between 1970 and 1998.

1). The average increase was 15% per year. An increase could be seen in the overall incidence curve, too: the incidence curve of fractures closely followed the absolute number curve despite the fact that the Finnish population aged 60 years or more increased 54% (from 0.65 million to 1.00 million) during this 28-year follow-up (Figure 1). The overall incidence (per 10^5 persons) of fractures was 32 in 1970 and 110 in 1998.

The mean age of patients with an osteoporotic fracture of the proximal humerus also increased during the study period, from 72 years (1970) to 77 years (1998). In women, these numbers were 73 and 78 years, and in men 70 and 73 years. Of all patients, the proportion of women was 84% in 1970 and 82% in 1998.

Age-adjusted incidence of fractures

During the study period, the age-adjusted incidence (per 10^5 persons) of fractures of the proximal humerus increased in people 60 years of age or more; in women, from 50 in 1970 to 133 in 1998, and in men, from 14 in 1970 to 49 in 1998 (Figure 2). The relative increases were 166% and 250%, respectively.

Age-specific incidence of fractures

In women and men, the age-specific incidence (per 10^5 persons) of fractures of the proximal humerus rose in all age groups during the study (Figure 3). The increase in fracture incidence was most pronounced in the older age groups, especially in persons 80 years of age or more.

The future

If the above-noted increase in the incidence of fractures of the proximal humerus continues, the overall incidences of fractures in Finland (per 10^5 inhabitants aged 60 years or more) can be calculated as 126, 155 and 200 in the years 2010, 2020, and 2030. Together with the demographic changes (increase in the size of this elderly population), these incidences mean that in the years 2010, 2020 and 2030, the total number of osteoporotic fractures of the proximal humerus in this country will be about 1,600, 2,400 and 3,400 (Figure 4). Thus the current number of fractures may treble by the year 2030.

Discussion

Osteoporotic fractures among the elderly are a

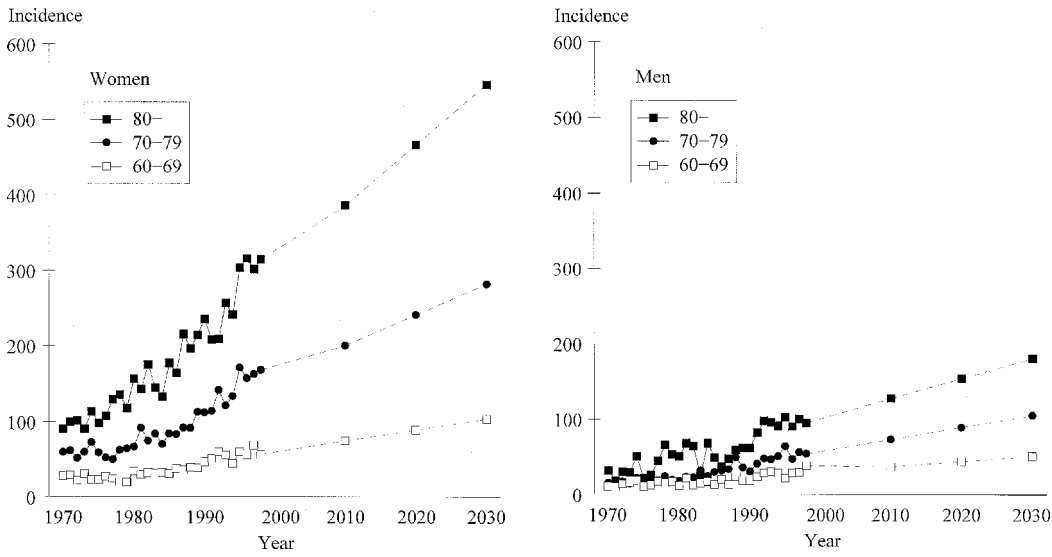

Figure 3. Age-specific incidence (per 10^5 persons) of osteoporotic fractures of the proximal humerus in Finland in women (A) and men (B) at least 60 years old between 1970 and 1998, and prediction of the incidences until the year 2030, calculated with a regression model. In the regression analysis, the r^2 and standard error of estimate (SEE) values in women, from the youngest to oldest age group, were: 0.78 and 6.5, 0.84 and 15.2, and 0.91 and 22.1. In men, the corresponding values were: 0.66 and 4.3, 0.85 and 5.7, and 0.73 and 14.0.

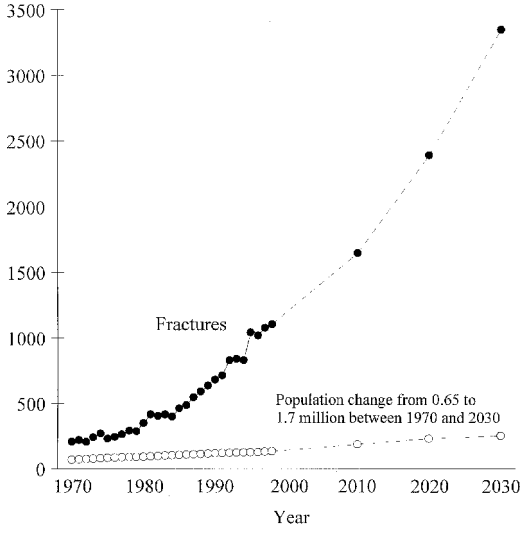

Figure 4. Prediction of the number of Finnish persons aged 60 years or more and the number of their osteoporotic fractures of the proximal humerus in the future, calculated with a regression model.

worldwide epidemic and increasingly tight control of health care resources makes it necessary to predict the fracture increase with time (Melton 1988, 1996, Obrant et al. 1989, Jones et al. 1994, Johnell 1995, Kannus et al. 1999). Such a prediction requires knowledge of whether the number of fractures is increasing more rapidly than can be accounted for by the demographic changes alone. An understanding of the underlying epidemiologic changes also permits assessment of the efficacy of preventive measures.

We studied the entire Finnish population 60 years of age or more to describe the trends for the absolute number and the incidence of osteoporotic fractures of the proximal humerus during 1970–1998. Using the National Hospital Discharge Register and the unique personal identification numbers, we eliminated multiple admissions caused by transfers between hospitals or hospital departments and readmissions, due to complications. During the relatively long study period (1970–1998), the ICD codes for fractures of the proximal humerus changed twice (1987 and 1996), but since these codes have always been simple and self-evident in the Finnish NHDR, such changes had no effect on the numbers and incidences of proximal humerus fractures (Figures 1–4).

In Malmö, Sweden, the incidence of proximal humeral fractures doubled in elderly women between 1950 and 1982 (Bengnér et al. 1988). In a study between 1976 and 1984, Lauritzen et al.

(1993) observed no significant change in the total and age-specific incidence of fractures of the proximal humerus in one hospital area in Denmark, while in a small Japanese study in 1986–1995, Hagino et al. (1999) found a significant rise in the incidence of these fractures in persons 35 years of age or more. In our study, the incidence of osteoporotic fractures of the proximal humerus in Finnish people aged 60 years or more tripled during 1970–1998.

This development is alarming for two reasons. First, not only is the fracture incidence increasing, but the population at risk is constantly expanding and will do so more rapidly in the near future (Figure 4). As a result, the largest Finnish age group (the 15-year cohort born after World War II) will reach the average age of patients with an osteoporotic fracture of the proximal humerus between the years 2020 and 2030. Secondly, the increasing mean age of these patients will probably cause more difficulties in the treatment of these fractures (longer time for fracture healing, longer rehabilitation period, and an increasing number of treatment complications, such as nonunions) as well as increasing rates of general morbid conditions and, indirectly, death of the patients. For these reasons, vigorous preventive measures, such as prevention of osteoporosis and falls of older adults and protection of critical anatomic sites of the body when a fall occurs, should be urgently adopted to reduce the increasing burden of these age-related fractures.

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