

Original Article

Epidemiology of Fractures of the Proximal Femur in Geneva: Incidence, Clinical and Social Aspects

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Abstract. Fracture of the proximal femur (hip fracture) as a consequence of osteoporosis is an important public health problem. Its incidence, which rises with age, varies according to geographical location and race. There is no information concerning hip fracture in Switzerland, which is a Western country with a particularly aged population. During 1987, 361 patients with hip fracture were recorded in the University of Geneva Hospital, which is the main referral center for a population of about 376 000 inhabitants. This represented 94% of all hip fractures occurring in the region. A moderate trauma was reported in 329 cases (91.1%). The overall annual incidence was 96.1 per 100 000 population (146.9 for women and 39.8 for men). When only hip fractures following moderate trauma were considered, the incidence was 87.6 per 100 000 population (138.8 for women and 30.8 for men). Rare under the age of 65, hip fracture incidence increased exponentially in older subjects. The mean age of patients with hip fracture was 82.0 years in women and 75.7 years in men. The ratio of cervical to trochanteric fracture was 1.03 and 1.12 in women and men, respectively. The mean length of stay in the orthopaedic ward was 30.5 days, and the total costs amounted to 8.8 million Swiss francs for hip fracture associated with moderate trauma. Forty-seven percent of subjects were transferred to another hospital for recovery or rehabilitation. During the stay in the orthopaedic ward, the mortality rate was 8.2%. These results emphasize the high incidence and cost of hip fractures in a region of Switzerland where the population is particularly old. The problem could even worsen with the progressive aging of the population.

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Introduction

Fracture of the proximal femur (hip fracture) represents a dramatic consequence of osteoporosis in terms of disability, mortality, long-term institutional care and cost [1,2]. For instance, 17%–19% of the beds in orthopaedic wards are occupied by patients with hip fracture [3,4]. The lifetime risk of undergoing hip fracture is estimated to be 16% in women and 6% in men [5]. The incidence rises exponentially with age and the overall incidence, which has increased over the last few years in many countries, but not in all, is expected to continue to rise with the aging of the Western population [6–11]. Thus, the proportion of the population older than 65 years should increase from 11% to 22% between 1980 and 2050 [2,12].

Studies on the incidence of hip fracture have demonstrated large differences depending on geographical location, race, age and sex distribution of the population evaluated [1–11,13–17]. So far, there is no information concerning Switzerland, which possesses a particularly aged population with a life expectancy among the longest of the Western countries [12,18]. We investigated the incidence of all hip fractures as well as of those most likely ascribable to osteoporosis, and the relevant medical and social conditions, in the region of Geneva, which has the oldest population in Switzerland. Furthermore, Geneva seems to be well suited to such a study since more than 90% of the patients with hip fractures

are referred to one center, allowing a homogeneous evaluation.

Methods

All patients with a fracture of the proximal femur admitted to the University of Geneva Hospital during the whole of 1987 were recorded. Patients were retrospectively identified from the discharge list and basic information on the type of trauma, medical history, previous drug therapy, housing conditions, fracture treatment, length of the stay in the orthopaedic ward and destination at discharge was collected from the medical records by one observer (V.N.). The University of Geneva Hospital constitutes the main referral center for hip fracture for a well-defined geographical area. The number of fracture patients studied represented 94% of all hip fractures in the Geneva area in 1987, as indicated by the number recorded in other local orthopaedic wards. Patients were excluded if the fracture was pathological, or if they were not resident in the Geneva area. Hip fractures comprised fractures at subcapital, cervical (both later designated as cervical), intertrochanteric and subtrochanteric (designated as trochanteric) locations. The diagnosis was taken from the surgical report.

The trauma associated with the fracture was classified into severe (car or bicycle accident, suicide attempt by defenestration), moderate (fall from standing height) or undetermined (unclear circumstances because of loss of consciousness or acute alcohol abuse).

The medical history included information on cardiovascular (coronary disease, heart failure, arrhythmia), neurological (stroke, epilepsy, Parkinson disease, intellectual impairment) and metabolic (diabetes mellitus) diseases, and on previous fractures. Drugs taken during the week preceding the trauma were noted.

The population at risk in 1987 was given by the Office of Population Statistics of Geneva (Bureau des Statistiques). The mean of the populations on 1 January and 31 December was used for the calculation of incidence rates. The data concerning the USA population in 1977

were obtained from the Demographic Directory of the United Nations.

Results

Incidence of Hip Fractures

From a population of 375 733 in Geneva, 361 hip fractures were referred to the University Hospital in 1987. There were 290 women and 71 men, corresponding to a women-to-men ratio of 4.1. This number included 8 patients who suffered bilateral fractures during the same year. Fractures following a fall from standing height (moderate trauma) were recorded in 329 cases. As shown in Table 1, the women-to-men ratio was 5.0. The men were slightly younger than the women. Cervical and trochanteric fractures were equally distributed in women and men (the ratio of cervical to trochanteric fractures was 1.03 and 1.12 in women and men, respectively). The women with a trochanteric fracture were significantly older than those with a cervical one ($p < 0.001$). The left side was affected slightly more frequently (53% of the cases).

Fig. 1 shows the number of hip fractures as a function of age. The fractures following severe trauma occurred over a wide age range. In contrast, hip fractures after moderate trauma were very rare under the age of 60 and peaked in the age-class of 80–84 years. Nearly 50% of the fractures were observed between the ages of 80 and 90 years.

Table 2 shows the crude incidence reported in the Geneva population of 1987. Whereas women slightly predominated in the general population (women-to-men ratio 1.1), the incidence of hip fracture was markedly higher in women. Indeed, the women-to-men ratio was 3.7 when all types of trauma were considered, and 4.5 when only moderate trauma was taken into account. For either condition the incidence was lower when it was standardized to the US population of 1977. Thus, crude incidence, which was 146.9 and 39.9 per 100 000 population in women and men, respectively, became 99.0 and 32.0 per population per year. The

Table 1. Hip fracture after moderate trauma in Geneva (1987)

Fractures	Total number	Women		Men		Women-to-men ratio
		Number	Mean age (years)	Number	Mean age (years)	
All	329	274	82.0 (49–98)	55	75.7 (34–97)	5.0
Cervical	168	139	79.7 (50–98)	29	78.5 (34–97)	4.8
Trochanteric	161	135	84.4 ^a (49–88)	26	72.6 (43–93)	5.2

Only fractures following moderate trauma were considered. The age range is given in parentheses.
^a $p < 0.001$ compared with women with cervical fractures (two-tailed Student's *t*-test).

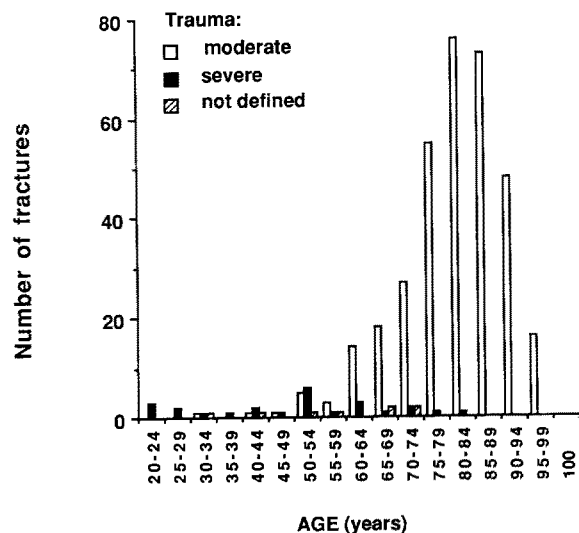


Fig. 1. Total number of hip fractures ($n=361$) as a function of age in Geneva (1987). The type of trauma is defined in the Methods section.

Table 2. Incidence of hip fracture in Geneva (1987)

	Total	Women	Men	Women-to-men ratio
Geneva population	375 733	197 446	178 287	1.1
Crude incidence (all types of trauma)	96.1	146.9	39.8	3.7
Crude incidence (moderate trauma only)	87.6	138.8	30.8	4.5
Incidence corrected for USA population ^a (all types of trauma)	66.5	99.0 ^b	32.0 ^c	3.1
Incidence corrected for USA population ^a (moderate trauma only)	59.5	92.4	24.5	3.8

Incidence: fracture rate per 100 000 population per year.

^a The incidence was standardized to the USA population on 1977.

^b 95% confidence interval: 93.0–105.0.

^c 95% confidence interval: 28.3–35.7.

predominance of hip fracture among women was particularly evident, since the women-to-men ratio was 3.8 when only moderate trauma was considered.

Table 3 shows the age-specific incidence of hip fracture after all types of trauma. Whereas fractures were more frequent in men than in women under the age of 50, probably as a consequence of severe trauma, the predominance in women appeared in older age groups. When only hip fractures associated with moderate trauma were analyzed, the age-specific incidence increased exponentially beyond the age of 60, more rapidly in women than in men (Fig. 2). A maximal incidence of 7730 and 2080 per 100 000 population was observed in the 95–99-year-old age group, in women and men, respectively.

Hip fractures were divided into cervical and trochanteric groups (Fig. 3). For both groups the age-specific incidence increased exponentially with age. However,

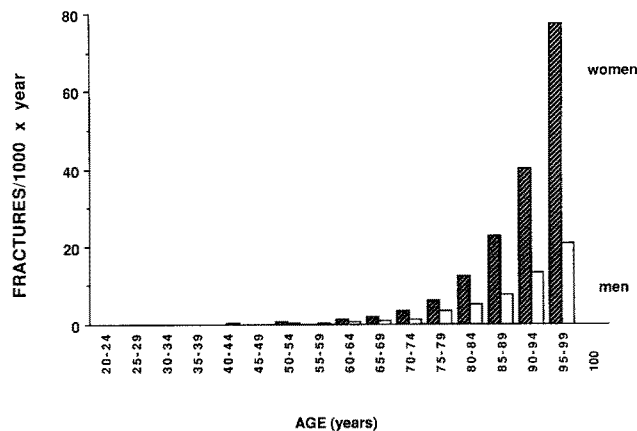


Fig. 2. Age-specific incidence of hip fracture following moderate trauma ($n=329$) in Geneva (1987).

Table 3. Age-specific incidence of hip fracture in Geneva (1987)

Age (years)	Number of cases per 100 000 population per year	
	Women	Men
20–24	–	14
25–29	–	–
30–34	–	14
35–39	–	7
40–44	–	25
45–49	7	–
50–54	56	40
55–59	9	38
60–64	123	48
65–69	178	83
70–74	348	132
75–79	588	348
80–84	1238	498
>85	2979	929

The age- and sex-specific incidence was based on all types of trauma, moderate and severe.

the incidence of trochanteric fracture was significantly higher in women older than 90 years ($p<0.001$). In contrast, cervical fracture appeared to be more frequent in this age-class in men, but the difference did not reach statistical significance, probably because of the relatively small number of events. One-third had suffered a fracture previously. In 52 cases (15.8%) a contralateral hip fracture was reported.

As shown in Fig 4, the majority of hip fractures occurred following falls indoors. Except for a small increase in fractures outdoors in January, there was no significant seasonality in the incidence. A significant proportion of the subjects were taking medication liable to alter equilibrium and to predispose to falls. Indeed, a history of tranquilizer, antipsychotic and/or antidepressant consumption was reported in more than 50% of the cases.

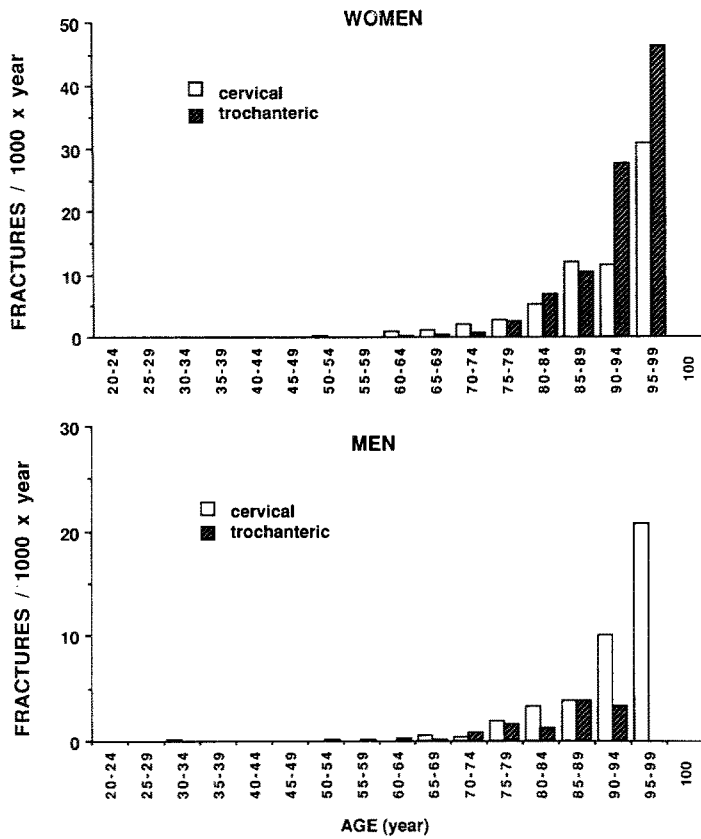


Fig. 3. Age-specific incidence of hip fracture following moderate trauma (n=329) in Geneva (1987) distributed between cervical and trochanteric sites in women and men. Note the different scales on the ordinates.

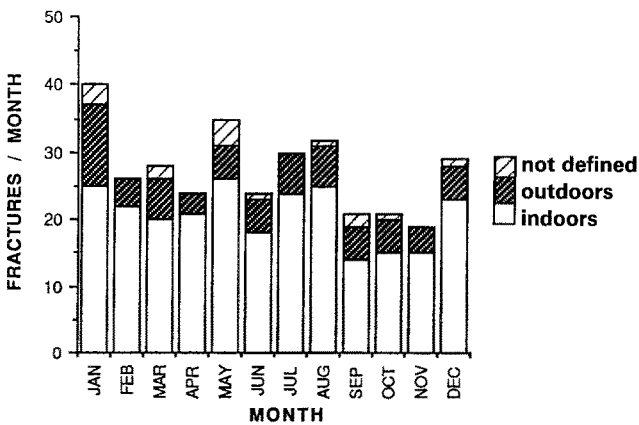


Fig. 4. Month of admission of patients with hip fracture following moderate trauma (n=329) in Geneva (1987).

Outcome in 329 Patients with Hip Fracture Following Moderate Trauma

The treatment of hip fracture was surgical in 94.8% of cases. The mean length of stay in the orthopaedic ward was 30.5 days. Twenty women (7.3%; mean age 87.2 years) died after a mean stay of 30.9 days, and 7 men (12.7%; mean age 79.9 years) after 13.1 days. The

Table 4. Outcome in 329 patients with hip fracture after moderate trauma

	Number of patients	Percent
Discharged to previous accommodation ^a	147	44.7
Transferred to another hospital	155	47.1
Death	27 ^b	8.2

^a Previous accommodation was a nursing home for 38.1% of patients and a private house for 61.9% of patients.
^b 20 (7.3%) women with a mean age of 87.2 years and 7 (12.7%) men with a mean age of 79.9 years.

yearly mortality in Geneva inhabitants older than 70 was 5.5% and 7.1% in women and men, respectively. Table 4 shows the outcome in 329 patients with hip fracture after moderate trauma. Among the 44.7% of patients who were discharged to their previous accommodation, 61.9% went back to their own home and 38.1% to a nursing home. Nearly half the patients (47.1%) had to be transferred to another hospital for recovery and rehabilitation.

Without taking into account the stay in a recovery hospital or the additional care supplement required at home, the total number of days spent in the orthopaedic ward because of a hip fracture after moderate trauma amounted to 10452 for 1987, which represented 8.8 million Swiss francs, based on a mean daily cost of 845 Swiss francs.

Discussion

Among Western countries the population of Switzerland has one of the longest life expectancies [18]. The incidence of hip fracture is known to increase with age, suggesting that this type of osteoporotic fracture may constitute a major health problem during the coming decades. To establish preventive strategies, the identification of epidemiological characteristics is required. We retrospectively evaluated the incidence of hip fracture in Geneva, as well as the outcome and the associated cost. The population studied was mainly urban and the oldest in Switzerland.

Most of the hip fractures occurring in Geneva are usually referred to the University Hospital. The admission rate in this hospital is thus a direct reflection of the real prevalence. Furthermore, accurate census of the resident population allowed the calculation of the true incidence rate. The information concerning hip fracture was recorded and analyzed by one observer in the same way for all patients. From the medical records those fractures resulting from moderate trauma, defined as a fall from standing height [13], could be clearly established. Ninety-one percent of hip fractures were caused by such a fall and can most probably be ascribed to osteoporosis.

Our results indicate that hip fracture is rare under the

age of 50, and that when it occurs in this age group it results mainly from an accident. As already reported, men predominated in cases under the age of 50, most probably because of higher exposure to accident risk. After 50 there was an exponential rise in incidence with age, with a marked predominance of women. This could be related to the lower bone mineral density of the femoral neck found in elderly women as compared with men [19]. Overall, the number of cervical and trochanteric fractures was equal, with a slight predominance of trochanteric fracture in very elderly. Confirming previous observations, the left hip tended to be more frequently affected [13,14]. This could be related to falling more frequently on the non-dominant side. Except for an apparent peak of incidence in January, mainly due to an increase in fractures occurring outdoors, there was no clear seasonal variation. Contradictory results have been reported with respect to the seasonality of hip fractures [2,15,16,20]. However, the fact that in our survey most of the fractures occurred indoors could well account for the lack of seasonality.

There was an exponential increase in age-adjusted incidence similar to that in most of the published studies [1,2,4,6–10,13–17]. When standardized for the 1977 population of the USA, the age-adjusted incidence varied considerably between the countries [2,14,15]. Hip fracture seems to be particularly frequent in Scandinavia and the USA. The large difference among the various studies could be related to an increased number of fractures as a consequence of severe trauma, when all types of trauma are taken into account. When results are collected from the discharge summaries of different hospitals, multiple reports caused by transfers between hospitals or readmissions following complications might overestimate fracture incidence. In the present study, only the first hospitalization was recorded and we were able to distinguish between moderate and other types of trauma. The survey undertaken in the Picardy area of France for the same year (1987) has provided slightly lower values, which could be related to a higher incidence in the mostly urban population of Geneva compared with the more rural population of Picardy [16,17].

The mean length of stay in the orthopaedic ward was 30.5 days. This represented in 1987 a cost of about 8.8 million Swiss francs when only fractures resulting from moderate trauma (and most probably ascribable to osteoporosis) were taken into account. Furthermore, not only increased mortality, which amounted to 8.3% during the first month after injury, should be considered but also the need for long-term care or rehabilitation; this was relevant to a large proportion of patients, 47% of whom had to be transferred to another hospital for recovery. Therefore, the overall cost in 1987 must have exceeded 10 million Swiss francs.

Fractures are caused by a combination of low bone mass and a fall. Concerning the former, we have recently reported a lower bone mineral density in patients with a recent hip fracture compared with age-matched non-fractured subjects (19). On the other

hand, the propensity to fall is higher in the elderly. The high prevalence of drugs likely to alter equilibrium has probably played a role in the occurrence of fracture [21]. In our survey, nearly 50% of the patients were taking such drugs during the week before injury. Moreover, malnutrition may also contribute to the high incidence and complication of hip fracture in our urban population [22].

In conclusion, we have determined the incidence of hip fracture in the Geneva area for 1987. The high incidence and cost, as well as the need for long-term care, justify the design of preventive strategies, particularly in view of the increased number of hip fractures which could result from the progressive aging of the population during the next few decades [23].

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