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Original Article

Incidence and Direct Medical Costs of Hospitalizations due to Osteoporotic Fractures in Switzerland

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Abstract. The objective of this study was to estimate the annual direct medical costs of hospitalizations due to osteoporotic fractures in Switzerland. Days of hospital stay in 1992 were quantified using the casuistic of the medical statistics department of VESKA (Vereinigung Schweizerischer Krankenhäuser, the Swiss Hospital Association), which covers 43% of all hospital beds of that country. Number and incidence of total hospitalizations due to fractures were calculated by extrapolating to 100% the 43% VESKA-selected sample. To estimate number and incidence of hospitalizations due to osteoporotic fractures, internationally accepted age-specific osteoporosis attribution rates were applied. According to the latter the probability of a fracture being caused by osteoporosis increases with age. Mean length of stay for all fractures was calculated (= total hospital days divided by number of cases). By multiplying these mean lengths of stay by the number of osteoporosis-related fracture cases, the number of bed-days due to osteoporotic fractures was calculated. To compare the direct medical costs of hospitalization due to osteoporosis with those due to other frequent diseases, days of hospital stay caused by chronic obstructive pulmonary disease (COPD), stroke, acute myocardial infarction and breast cancer were estimated using the same methodology. A total estimate of 63 170 (f: 33 596, m: 29 574) hospitalizations due to fractures (and other osteoporosis-related diagnoses) was calculated, thus leading to overall annual incidence rates of hospitalizations for fractures of 950/100 000 women and 877/100 000 men. In women, 548 615 hospital days were found to be caused by osteoporosis, 353 654 days by COPD, 352 062 days by stroke, 200 669 days by breast carcinoma and 131 331 days by myocardial infarction. In men, COPD caused more hospitalization days (537 164) than myocardial infarction (196 793), stroke (180 524) or osteoporosis (152 857). Taking a mean price for a hospital day in Switzerland of 845 Swiss francs, the annual costs of acute hospitalizations due to osteoporosis and its complications were approximately 600 million Swiss francs (f: 464, m: 130 million Swiss francs) in 1992. We conclude that there is enough economic evidence to justify wide-scale interventions against osteoporosis in Switzerland.

Keywords: Epidemiology; Fractures; Hospital costs; Incidence; Osteoporosis

Introduction

Osteoporosis, a disease characterized by low bone mass and deterioration of bone architecture, leads to increased susceptibility to fractures [1], and is therefore a major public health problem [2]. Traditionally, only fractures of the hip, vertebrae and distal forearm are counted in statistics under the category of osteoporotic fractures [3]. According to recent studies, however, fractures of the proximal humerus [4] and most pelvic fractures [5] should be included in this category, and the risk of other limb fractures increases with advancing age as well. It has been prospectively demonstrated that appendicular bone mass, measured at the calcaneus, the proximal or the distal radius is directly related to the incidence of fractures of humerus, hip, vertebrae, pelvis, wrist, rib,

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leg, hand, foot, toe and clavicle [6]. Ankle fractures have also been regarded as fragility fractures [7].

Because the prevalence of osteoporosis sharply increases with age [8] and the elderly population in Western countries continues to grow, research on prevention, treatment and costs of osteoporosis has become increasingly important. The decision to implement wide-scale preventive and therapeutic modalities must take cost-benefit and cost-effectiveness into consideration [9]. The first step in calculations of that sort is an estimation on a national level of the costs of medical care for osteoporosis and its clinical manifestations.

The socioeconomic impact of osteoporosis is generally underestimated for the following reasons. Firstly, in most countries a disease is only statistically registered when it leads to hospital admission. Osteoporotic fractures, defined as fractures occurring after minor or moderate trauma, such as a fall from standing height, may or may not lead to hospitalization depending on the kind of fracture: hip fractures do so in almost 100% of cases, whereas fractures of more peripheral sites, such as the distal forearm, are often treated by general practitioners. Secondly, not all hospital admissions due to osteoporosis are recorded as such, but rather as back pain or kyphosis [10]. Even obvious features of osteoporosis, such as peripheral fractures after minor trauma, are often incorrectly coded as 'fracture' in the hospital statistics, instead of 'fracture and osteoporosis', either because of uncertainty about the relevance of the trauma or because the physicians regard osteoporosis as an age-related process rather than a disease. In Europe, studies estimating the impact of fractures on the hospitalization load have been limited to the classical osteoporotic fractures, i.e. hip fractures [11–14], vertebral fractures [15] and forearm fractures [16].

The objectives of this article are: (1) to estimate the overall rate of hospitalizations and the total number of hospitalization days due to fractures as a whole, and especially due to osteoporosis and its complications, in Switzerland, based on statistical data of the Swiss hospital association (VESKA) from 1992; (2) to compare the estimated hospitalization days due to osteoporosis (viewed as above) with those caused by other frequent disorders such as chronic pulmonary disease, stroke, myocardial infarction and breast cancer; (3) to test the awareness of hospital physicians of the causal role of osteoporosis in those fractures. Furthermore, analysis of the patient's status on discharge after hip fracture gives a rough idea of the additional expenses.

Materials and Methods

The Medical Statistics of the Swiss Hospital Association [17,18]

VESKA (Vereinigung Schweizer Krankenhäuser) is the Swiss Hospital Association. The administrative statistics of VESKA comprise data on financial affairs, staff, number of hospital beds and patient admissions of 221 of 237 Swiss public acute general hospitals (only the data from some small institutions are missing). Of the 221 hospitals belonging to the association, 93 transmit their patient data (as further described below) to the VESKA medical statistics department, which thus covers 43% of acute hospital admissions in Switzerland. Coverage includes three of five university hospitals, as well as a balanced mix of non-university hospitals. Table 1 gives the number of hospitals according to their category as well as the respective percentage of admissions registered by VESKA medical statistics. VESKA is the main source for diagnosis and operation statistics in Swiss hospitals. Its membership is voluntary.

The following data are gathered by VESKA: hospital code, patient identification (name, sex, date of birth). Hospital stay is characterized by the number of the patient's record as well as by the date of hospital admission and discharge, respectively. Age of the patient is calculated utilizing date of birth and date of discharge from hospital. Length of stay is calculated utilizing date of hospital admission and discharge (the respective days of entry and discharge are counted as complete days of stay). Specific codes describe admission and discharge status. The latter describes whether the patient was discharged home, transferred to another institution, died

Table 1. VESKA hospitals

Category no.	Hospital category	No. of hospitals in total	VESKA administrative statistics[a]	VESKA medical statistics[b]	Patient admissions/ year[a]	Patient admissions/ year[b]	Admissions[b] (% of[a])
1	University hospitals	5	5	3	142739	52187	36.56%
2	General hospitals with $\geqslant$500 beds	6	6	5	99752	54285	54.42%
3	General hospitals with 250–499 beds	19	19	16	158603	98439	62.07%
4	General hospitals with 125–249 beds	62	61	33	277577	128901	46.44%
5	General hospitals with 75–124 beds	66	61	21	145711	42416	29.11%
6	General hospitals with 1–74 beds	79	69	15	75318	10812	14.36%
Total (categories 1–6)		237	221	93	899700	387040	43.02%

[a]Hospitals covered by VESKA administrative statistics.
[b]Hospitals covered by VESKA medical statistics.

Table 2. Expert panel attribution of osteoporosis-relevant diagnosis by age group

ICD-9 code	Description	Osteoporosis attribution rate, by age (years)					
		0–44	45–54	55–64	65–74	75–84	85+
	Fractures of the axial skeleton						
805	Fracture of vertebrae	0.0	0.72	0.74	0.75	0.75	0.75
733.1	Pathological fracture (vertebra – spontaneous)	0.0	0.82	0.85	0.88	0.89	0.89
724.1	Pain in thoracic spine	0.0	0.40	0.49	0.58	0.58	0.58
724.5	Backache, unspecified	0.0	0.25	0.38	0.50	0.50	0.50
737.1	Kyphosis (acquired)	0.0	0.85	0.85	0.85	0.85	0.85
807	Fracture of ribs	0.0	0.40	0.45	0.50	0.70	0.70
808.0	Fracture of pelvis (acetabulum, closed)	0.0	0.60	0.68	0.75	0.90	0.90
	Fractures of proximal upper limbs						
812	Fracture of proximal humerus	0.0	0.40	0.45	0.50	0.70	0.70
	Fractures of distal upper limbs						
813	Fracture of forearm	0.0	0.70	0.74	0.78	0.84	0.84
	Fractures of proximal lower limbs						
820	Fracture of femoral neck	0.0	0.51	0.61	0.71	0.91	0.91
821	Fracture of femur (other)	0.0	0.51	0.61	0.71	0.91	0.91
	Fractures of distal lower limbs						
823	Fracture of proximal tibia/fibula	0.0	0.40	0.45	0.50	0.60	0.60
824	Malleolar fracture	0.0	0.40	0.45	0.50	0.60	0.60

Adapted from [10].

or is still hospitalized. Further information deals with place of residence, nationality, marital status and religion of the patient.

Diagnoses at discharge are coded according to ICD-9 (*International Classification of Diseases and Related Health Problems*). In addition to one main diagnosis (usually the cause of admission to the hospital or, if several diagnoses are equally important, the diagnosis which determines the length of stay) nine further diagnoses may be coded. Coding of diagnoses is performed by the physician in charge of the patient at time of discharge from hospital. In the computerized evaluation of diagnostic codes, main diagnosis is analysed separately whereas the sequence of the remaining diagnoses is not relevant. We considered main diagnoses only, with the exception of the code 'osteoporosis per se' (#733.0), which was also counted even when given as a secondary diagnosis.

Procedure with Data-sheets. In participating hospitals, a data-sheet 'medical statistics' is completed for every patient treated. For every hospital stay, a separate form has to be filled out (even if the patient has had several hospital stays for the same main diagnosis). The completed data-sheets are computerized in the statistics centre. At the end of each year the data on discharged patients are evaluated. The following procedure is applied to ascertain the highest possible quality of the data: formal adequacy of the information is checked and plausibility control is routinely performed (e.g. a diagnosis which is only valid for males is not accepted with female gender). Once an error is detected, the corresponding data-sheet is returned to the sender for correction. In addition, every 100th sheet is printed out by the computer, expressing all data in clear text. These sheets are returned to the sender, who has to check the data in detail. By doing so, an overall error rate of the material can be estimated. The latter is in the order of 10%.

Population Structure

We used the Swiss population structure of 1992 (total: 6 907 900; males: 3 373 900; females: 3 534 000). The data source was the statistical directory for Switzerland prepared by the Swiss Federal Office of Statistics [19]. The population was divided into following age groups (years): 0–44, 45–54, 55–64, 65–74, 75–84 and >85.

Attribution Rates for Osteoporotic Fractures (Table 2)

In order to refer an adequate percentage of hospitalization cases to osteoporosis we adapted for age and additional diagnostic codes the age-specific attribution rates defined by an osteoporosis expert panel[1] and published by Phillips et al. in 1988 [10]. For diagnostic code #820 (fracture of femoral neck), for instance, these authors used the following categories: age group 45–59, osteoporosis attribution rate (OAR) 51%; age group 60–

[1]The members of the expert panel were: Charles H. Chesnut, III, MD, University of Washington; Susan Ott, MD, University of Washington; Harry K. Genant, MD, University of California San Francisco; C. Conrad Johnston Jr., MD, Indiana University; Bruce Ettinger, MD, University of California San Francisco.

74, OAR 71%; age group 75+, OAR 91% [10]. To match the age categories from the VESKA statistics we adapted the original OAR according to the following example (code #820): age group 0–44, 0; age group 45–54, 51%; age group 55–64, 61% age group 65–74, 71%; age groups 75–84 and 85+, 91%. We applied the same method to all diagnostic codes studied (Table 2).

As osteoporosis is a systemic skeletal disease [1], we considered three additional fracture types not mentioned by Phillips et al., i.e. malleolar fractures (#824), rib fractures (#807) and femoral fractures other than neck fractures (#821), and applied attribution rates either taken from comparable skeletal sites (i.e. fracture of proximal tibia-fibula (#823) for malleolar fractures, femoral neck fractures (#820) for other fractures of femur) or taken over rates from sites where fractures have a similar age dependence (i.e. proximal humerus fractures (#812) for fractures of ribs).

Data Analysis

1. Based on reported ICD-9 codes for fractures, number and incidence of total hospitalizations due to all fractures, regardless of underlying etiology, were calculated per age group based on the population structure of Switzerland in 1992 by extrapolating the VESKA sample to 100% (Tables 3 and 4, Fig. 1). Then, the age-specific osteoporosis attribution rates were applied to estimate number and incidence of hospitalizations due to 'osteoporotic' fractures (Tables 5 and 6). From all registered cases, outcome status 'transferred within same hospital' and 'transferred to other hospital' were deducted in order to avoid double booking.

2. Mean length of stay for all fracture patients was calculated (= total hospital days according to VESKA statistics 1992 divided by number of cases) per age category. By multiplying the appropriate mean lengths of stay by the number of osteoporosis-related fracture cases (i.e. after applying Phillips' attribution rates) in every age group, the number of bed-days due to osteoporotic fractures was calculated (Tables 5 and 6). Thereby the conservative assumption was made that, within a given age group, the length of stay does not significantly differ according to whether the fracture leading to hospitalization is due to osteoporosis or not.

3. To estimate the costs which are not attributable to hospitalization for acute fracture, hip fracture cases were sorted according to discharge status as indicated by the VESKA discharge codes and the respective percentage of each outcome was calculated (Fig. 2).

4. The number of cases of 1992 in which the diagnosis #820 (hip fracture) was encoded simultaneously with diagnosis #733.0 (osteoporosis) was compared with the number of all cases with code #820 after adjustment for Phillips' attribution rates. Thereby, the awareness of Swiss hospital physicians that osteoporosis is the cause of fracture (i.e. crossing #820 together with #733.0) was estimated using the example of hip fracture.

5. To estimate hospitalization days caused by chronic obstructive pulmonary disease (COPD, defined as chronic bronchitis (ICD9 #491), emphysema (#492) and asthma (#493)), stroke (#434, #436), acute myocardial infarction (#410) and breast cancer (#174), the same methodology was applied as before (Fig. 3).

Results

Overall Fractures

Hospitalization Cases in 1992: Age- and Gender-Specific Incidence. Tables 3 and 4 give, listed by age

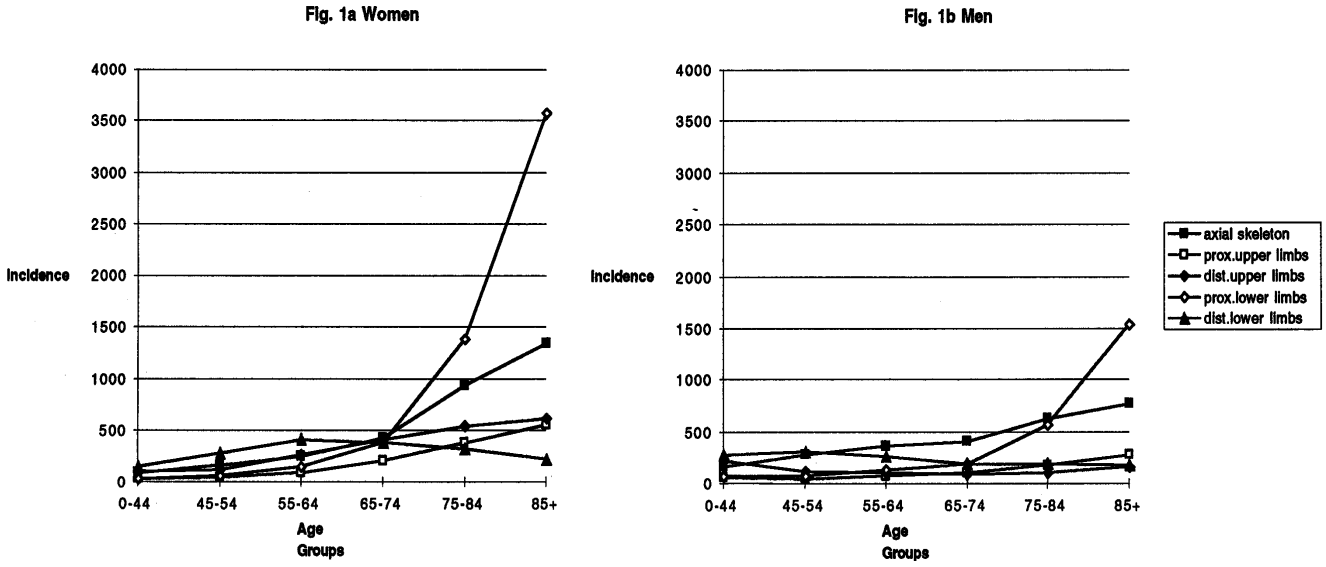

Fig. 1. Incidence rates of hospitalizations due to overall fractures of various skeletal sites per 100 000 inhabitants of the Swiss population in 1992 by age group and gender (**a** women, **b** men) based on extrapolation of 43% VESKA representativity to 100% of Swiss hospitals.

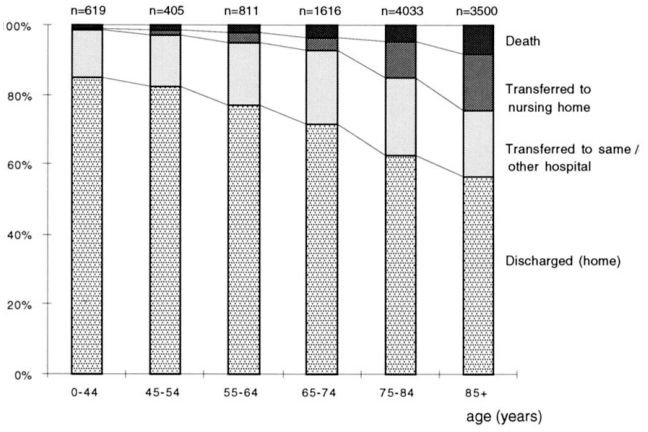

Fig. 2. Percentage of the various outcomes after hip fracture according to age group in Switzerland in 1992 (total of women and men).

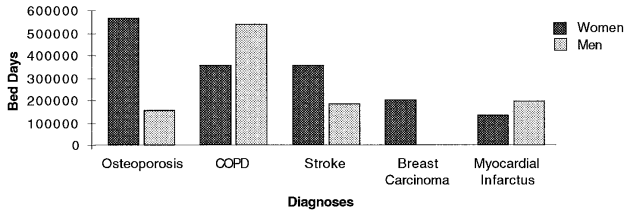

Fig. 3. Comparison of hospital days caused by various frequent diseases compared with osteoporosis and its complications in Switzerland, 1992. COPD, chronic obstructive pulmonary disease.

group and fracture type, the absolute numbers and incidences of hospitalizations due to fractures and other osteoporosis-related diagnoses after extrapolation from the VESKA database in Switzerland in 1992 in women (Table 3) and men (Table 4), respectively. Figure 1 depicts the age-specific incidences of hospitalizations due to overall fractures of the various skeletal sites. In the following, all data are extrapolated to 100% from 43% VESKA representativity.

A *total* of 63 170 (f: 33596, m: 29574) hospitalizations due to fractures was estimated to have occurred in 1992, overall incidence of hospitalizations for fractures being 950/100 000 per year in women and 877/100 000 per year in men.

Fractures of the axial skeleton led to 7780 hospitalizations in women and 7923 in men. The incidence rose exponentially with age, from 81.5/100 000 (0–44 years) to 1344.4/100 000 (85+ years) in women and from 158.2/100 000 to 772.8/100 000 in men. Corresponding figures for all specific axial complications of osteoporosis (#805, #733.1, #724.1, #724.5, #737.1, #807, #808) are given in Tables 3 and 4.

Fractures of the proximal humerus (#812) were age-dependent in both genders. In women, the incidence rose from 32/100 000 per year in age group 0–44 years to 550/100 000 per year in the group 85+ years. In men, the annual incidence was 57/100 000 in group 0–44 years and 48/100 000 in group 45–54 years, respectively. Thereafter it rose exponentially up to 272/100 000 in group 85+ years.

There were 6472 hospitalizations of women and 6028 hospitalizations of men with *fractures of the forearm* (#813) in 1992. Although the total number of fractures was similar in the two genders, the respective relationships between age and incidence differed: in women, only one third of forearm fractures occurred in the first half of life, the incidence strongly increasing with age, whereas in men 78% of these fractures occurred at a young age, i.e. before age 45 years. Age-specific incidences were highest in this category (0–44 years), i.e. 216/100 000 per year, and decreased to 118/100 000 per year in the subsequent age group (45–54 years), remaining stable therafter up to age 75–84 years, and increasing again after age 85 years to 162/100 000.

Fractures of the proximal lower limbs. A total of 6885 hip fractures (#820) were estimated to have occurred in women and 2372 in men (f:m = 2.9:1). In the youngest age group (0–44 years), hip fracture incidence was higher in males than in females, and it was similar in the two genders at age 45–54 years. Thereafter, incidence in females was clearly higher than that in males, reaching rates which were more than twice as high from age 65 years on. The steep rise in hip fracture incidence starts 10 years earlier in women (i.e. after age 64 years) than in men.

A total of 1605 women and 1819 men were hospitalized for femur fractures other than neck fractures (821). As for pelvis fractures, the typical age-incidence relationship was observed in women. In men, however, 1319 femoral fractures, i.e., 72%, occurred in the youngest age group (0–44 years) (reflecting a high incidence of severe trauma), leading to an annual hospitalization rate of 61/100 000 men of that age. After that age the incidence fell, but rose again after age 74 years.

Fractures of the distal lower limbs were estimated to have occurred in 7772 women and 9165 men, respectively. In women, fracture incidence at this skeletal site reached a peak in the age group 55–64 years, remaining high in the group 65–74 years and declining thereafter. In men, the incidence was the highest in the youngest age groups (0–44 and 45–54 years) and declined thereafter. Fracture of proximal tibia/fibula (#823) was a frequent reason for hospitalization in both genders, namely in 3193 women and in 5123 men. However, as indicated before, whereas in women the incidence of this fracture type increased with age, in men it tended to the converse.

In women, hospitalization frequency due to malleolar fractures (#824) rose in the perimenopausal age group compared with group 0–44 years, remaining stable after age 64 and declining after 74 years. In men there was no obvious age–incidence relationship for this type of fracture. In absolute terms, malleolar fractures can be

Table 3. Number (Abs.) and incidence (Inc.) of hospitalizations due to overall fractures of various skeletal sites by age group in Switzerland in 1992: women

Population 1992:	2109600		454400		363100		307900		217400		81600		3534000	
Diagnosis	Age group (years)													
	0–44		45–54		55–64		65–74		75–84		85+		Total	
	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.
Axial skeleton	**1719**	**81.5**	**715**	**157.4**	**901**	**248.1**	**1322**	**429.4**	**2027**	**932.4**	**1097**	**1344.4**	**7780**	**220.1**
Fracture of vertebrae (#805)	633	30.0	163	35.8	202	55.7	344	111.8	526	241.8	258	316.4	2126	60.2
Pathological fracture (#733.1)	21	1.0	28	6.1	49	13.5	107	34.7	170	78.1	67	82.7	442	12.5
Pain in thoracic spine (#724.1)	44	2.1	26	5.6	28	7.7	60	19.6	56	25.7	14	17.1	228	6.5
Backache, unspecified (#724.5)	267	12.7	207	45.6	291	80.1	323	105.0	342	157.3	86	105.5	1516	42.9
Kyphosis (#737.1)	19	0.9	5	1.0	5	1.3	16	5.3	12	5.4	14	17.1	70	2.0
Fracture of ribs (#807)	393	18.6	195	43.0	198	54.4	212	68.7	314	144.4	181	222.3	1493	42.3
Fracture of pelvis (#808.0)	342	16.2	91	20.0	128	35.2	260	84.6	607	279.2	477	584.3	1905	53.9
Proximal upper limbs	**681**	**32.3**	**186**	**40.9**	**340**	**93.5**	**614**	**199.4**	**812**	**373.3**	**449**	**550.1**	**3081**	**87.2**
Fracture of proximal humerus (#812)	681	32.3	186	40.9	340	93.5	614	199.4	812	373.3	449	550.1	3081	87.2
Distal upper limbs	**2079**	**98.6**	**507**	**111.6**	**942**	**259.4**	**1263**	**410.1**	**1184**	**544.5**	**498**	**609.9**	**6472**	**183.1**
Fracture of forearm (#813)	2079	98.6	507	111.6	942	259.4	1263	410.1	1184	544.5	498	609.9	6472	183.1
Proximal lower limbs	**595**	**28.2**	**244**	**53.7**	**542**	**149.2**	**1172**	**380.7**	**3019**	**1388.5**	**2918**	**3576.7**	**8490**	**240.3**
Fracture of femoral neck (#820)	137	6.5	167	36.9	405	111.4	851	308.9	2672	1229.1	2553	3129.3	6885	194.9
Fracture of femur (#821)	458	21.7	77	16.9	137	37.8	221	71.8	347	159.4	365	447.5	1605	45.4
Distal lower limbs	**3019**	**143.1**	**1258**	**276.9**	**1463**	**402.9**	**1170**	**379.9**	**689**	**316.6**	**174**	**213.8**	**7772**	**219.9**
Fracture of proximal tibia/fibula (#823)	1549	73.4	463	101.9	440	121.1	330	107.3	312	143.3	100	122.6	3193	90.4
Malleolar fracture (#824)	1470	69.7	795	175.0	1023	281.8	840	272.7	377	173.3	74	91.2	4579	129.6
Total	**8093**	**383.6**	**2910**	**640.5**	**4188**	**1153.1**	**5541**	**1799.5**	**7731**	**3555.3**	**5136**	**6294.8**	**33595**	**950.7**

Table 4. Number (Abs.) and incidence (Inc.) of hospitalizations due to overall fractures of various skeletal sites by age groups in Switzerland in 1992: men

Population 1992:	2175800		461000		336600		239100		129800		31600		3373900	
Diagnosis	Age group (years)													
	0–44		45–54		55–64		65–74		75–84		85+		Total	
	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.	Abs.	Inc.
Axial skeleton	**3441**	**158.2**	**1242**	**269.4**	**1202**	**357.2**	**978**	**409.5**	**813**	**627.1**	**244**	**772.8**	**7923**	**234.8**
Fracture of vertebrae (#805)	1274	58.6	358	77.7	253	75.3	235	98.2	200	154.1	56	176.6	2377	70.5
Pathological fracture (#733.1)	28	1.3	14	3.0	26	7.6	60	25.3	67	52.0	5	14.7	200	5.9
Pain in thoracic spine (#724.1)	63	2.9	26	5.6	44	13.1	12	4.9	16	12.5	9	29.4	170	5.0
Backache, unspecified (#724.5)	321	14.8	214	46.4	200	59.4	167	70.0	58	44.8	33	103.0	993	29.4
Kyphosis (#737.1)	30	1.4	2	0.5	5	1.4	16	6.8	5	3.6	2	7.4	60	1.8
Fracture of ribs (#807)	1072	49.3	463	100.4	516	153.4	344	144.0	323	249.0	88	279.7	2807	83.2
Fracture of pelvis (#808.0)	653	30.0	165	35.8	158	47.0	144	60.3	144	111.1	51	161.9	1316	39.0
Proximal upper limbs	**1260**	**57.9**	**223**	**48.4**	**230**	**68.4**	**249**	**104.1**	**219**	**168.4**	**86**	**272.3**	**2267**	**67.2**
Fracture of proximal humerus (#812)	1260	57.9	223	48.4	230	68.4	249	104.1	219	168.4	86	272.3	2267	67.2
Distal upper limbs	**4700**	**216.0**	**547**	**118.6**	**365**	**108.5**	**226**	**94.4**	**140**	**107.5**	**51**	**161.9**	**6028**	178.7
Fracture of forearm (#813)	4700	216.0	547	118.6	365	108.5	226	94.4	140	107.5	51	161.9	6028	178.7
Proximal lower limbs	**1740**	**80.0**	**326**	**70.6**	**444**	**132.0**	**458**	**191.6**	**735**	**566.2**	**488**	**1545.5**	**4191**	**124.2**
Fracture of femoral neck (#820)	421	19.4	198	42.9	293	87.1	365	152.7	651	501.7	444	1405.7	2372	70.3
Fracture of femur (#821)	1319	60.6	128	27.8	151	44.9	93	38.9	84	64.5	44	139.8	1819	53.9
Distal lower limbs	**6095**	**280.1**	**1438**	**311.8**	**875**	**259.8**	**463**	**193.6**	**242**	**186.3**	**54**	**169.3**	**9165**	**271.7**
Fracture of proximal tibia/fibula (#823)	3558	163.5	726	157.4	449	133.3	242	101.2	123	95.0	26	81.0	5123	151.9
Malleolar fracture (#824)	2537	116.6	712	154.4	426	126.4	221	92.4	119	91.4	28	88.3	4042	119.80
Total	**17236**	**792.2**	**3776**	**818.8**	**3116**	**925.8**	**2374**	**933.1**	**2149**	1655.5	**923**	**2921.7**	**29574**	**876.6**

Table 5. Number of hospitalizations, hospital days and mean length of stay due to overall and osteoporotic fractures: women

Diagnosis of all age groups	Overall fractures			Due to osteoporosis[a]		
	No. of hospitalizations	Mean length of stay (days)	Total days	No. of hospitalizations	Mean length of stay (days)	Total days
Axial skeleton	**7780**	**20.9**	**162321 (24.6%)**	**4092**	**24.5**	**100389 (22.5%)**
Fracture of vertebrae (#805)	2126	17.8	37856 (5.75%)	1113	20.7	23006 (5.16%)
Pathological fracture (#733.1)	442	43.7	19319 (2.93%)	369	45.7	16854 (3.78%)
Pain in thoracic spine (#724.1)	228	14.9	3395 (0.51%)	99	16.8	1666 (0.37%)
Backache, unspecified (#724.5)	1516	18.3	27779 (4.22%)	536	19.6	10523 (2.36%)
Kyphosis (#737.1)	70	85.4	5956 (0.91%)	43	114.0	4956 (1.11%)
Fracture of ribs (#807)	1493	15.4	23014 (3.49%)	620	17.9	11062 (2.48%)
Fracture of pelvis (#808.0)	1905	23.6	45002 (6.83%)	1312	24.6	32322 (7.25%)
Proximal upper limbs	**3081**	**24.1**	**74135 (11.25%)**	**1885**	**30.5**	**57541 (12.90%)**
Fracture of proximal humerus (#812)	3081	24.1	74135 (11.25%)	1885	30.5	57541 (12.90%)
Distal upper limbs	**6472**	**8.3**	**53451 (8.11%)**	**3449**	**11.0**	**37824 (8.48%)**
Fracture of forearm (#813)	6472	8.3	53451 (8.11%)	3449	11.0	37824 (8.48%)
Proximal lower limbs	**8490**	**29.6**	**251040 (38.1%)**	**6690**	**30.8**	**205957 (46.2%)**
Fracture of femoral neck (#820)	6885	29.1	200305 (30.41%)	5763	29.8	171696 (38.49%)
Fracture of femur (#821)	1605	31.6	50735 (7.70%)	927	36.9	34261 (7.68%)
Distal lower limbs	**7772**	**15.2**	**117812 (17.9%)**	**2264**	**19.6**	**44353 (9.9%)**
Fracture of proximal tibia/fibula (#823)	3193	17.0	54240 (8.23%)	795	24.8	19740 (4.43%)
Malleolar fracture (#824)	4579	13.9	63572 (9.65%)	1469	16.8	24613 (5.51%)
Total	**33595**	**19.6**	**658759 (100%)**	**18380**	24.3	**446064 (100%)**
Osteoporosis (#733.0)				**3385**	**30.3**	**102551**

[a]i.e. after applying osteoporosis attribution rates to overall number of fractures.

Table 6. Number of hospitalizations, hospital days and mean length of stay due to overall and osteoporotic fracture: men

Diagnosis of all age groups	Overall fractures			Due to osteoporosis[a]		
	No. of hospitalizations	Mean length of stay (days)	Total days	No. of hospitalizations	Mean length of stay (days)	Total days
Axial skeleton	**7923**	**15.1**	**119865 (30.5%)**	**2669**	**17.4**	**46507 (33.5%)**
Fracture of vertebrae (#805)	2377	12.9	30758 (7.83%)	813	14.4	11695 (8.43%)
Pathological fracture (#733.1)	200	22.0	4395 (1.12%)	150	23.1	3475 (2.50%)
Pain in thoracic spine (#724.1)	170	12.2	2072 (0.53%)	53	15.1	807 (0.58%)
Backache, unspecified (#724.5)	993	19.4	19249 (4.90%)	258	23.5	6043 (4.35%)
Kyphosis (#737.1)	60	36.2	2191 (0.56%)	26	57.8	1485 (1.07%)
Fracture of ribs (#807)	2807	11.4	32079 (8.17%)	878	13.3	11670 (8.41%)
Fracture of pelvis (#808.0)	1316	22.1	29151 (7.42%)	491	23.1	11332 (8.17%)
Proximal upper limbs	**2267**	**12.7**	**28858 (7.36%)**	**708**	**18.8**	**13335 (9.61%)**
Fracture of proximal humerus (#812)	2267	12.7	28858 (7.36%)	708	18.8	13335 (9.61%)
Distal upper limbs	**6028**	**5.8**	**35223 (8.97%)**	**989**	**9.9**	**9787 (7.05%)**
Fracture of forearm (#813)	6028	5.8	35223 (8.97%)	989	9.9	9787 (7.05%)
Proximal lower limbs	**4191**	**21.9**	**91723 (23.4%)**	**1876**	**24.5**	**45967 (33.1%)**
Fracture of femoral neck (#820)	2372	22.2	52544 (13.38%)	1536	24.1	36964 (26.64%)
Fracture of femur (#821)	1819	21.5	39179 (9.98%)	340	26.5	9003 (6.49%)
Distal lower limbs	**9165**	**12.7**	**116874 (29.8%)**	**1377**	**16.8**	**23164 (16.7%)**
Fracture of proximal tibia/fibula (#823)	5123	14.0	71614 (18.24%)	702	19.9	14009 (10.10%)
Malleolar fracture (#824)	4042	11.2	45260 (11.54%)	675	13.6	9155 (6.60%)
Total	**29574**	**13.3**	**392573 (100%)**	**7619**	**18.2**	**138760 (100%)**
Osteoporosis (#733.0)				**650**	**21.7**	**14097**

[a]i.e. after applying osteoporosis attribution rates to overall number of fractures.

regarded as very important, accounting for as many as 4579 fractures in females and 4042 in males.

Importance of the Various Types of Fractures: Frequency Versus Bed-Days According to Gender. Tables 5 and 6 give an overview of the number of hospitalizations, the resulting number of hospital days and the mean length of stay caused by overall and osteoporotic (i.e. after applying Phillips' rates) fractures in women (Table 5) and men (Table 6) after extrapolation of the VESKA representativity to 100%.

In women, a total of 33596 hospitalizations were estimated to be due to fractures, backache and acquired kyphosis in 1992, with a mean length of stay of 19.6 days, accounting for 658759 hospital days. Out of all fracture types, hip fractures were the primary cause for hospitalizations (n = 6885), leading to 200305 bed-days per year. We estimated as many as 6472 forearm fractures. Since the average length of stay was relatively short, i.e. 8.3 days, the total number of bed-days caused by this fracture type turned out to be smaller (53451). However, complications of forearm fractures, such as algodystrophy, were not taken into account. There was an extrapolated number of 4579 hospitalizations for malleolar fractures; average length of stay being 13.9 days a total of 63572 bed-days ensued. There were 3193 hospitalizations for fractures of the proximal tibia/fibula (mean length of stay 17.0 days, total bed-days = 54240) and 3081 hospitalizations for fractures of proximal humerus; however, due to the long mean length of stay of 24.1 days for the latter, the total number of bed-days caused by proximal humerus fractures took second place after hip fractures (74135 bed-days). There were 2126 hospitalizations for vertebral fractures (mean length of stay 17.8 days, total bed-days = 37856) and 1905 for pelvis fractures (mean length of stay 23.6 days, 45002 bed-days). Femoral fractures (other than neck fractures), although not very frequent (n = 1605), were much more relevant in terms of bed-days than pelvis fractures because of their longer length of stay (31.6 days), accounting for a total of 50735 hospital days in that year. Pathological vertebral fractures alone (#733.1), kyphosis (#737.1), and the pain syndromes of the spine (#724.1 and #724.5) were much less important in terms of hospitalization cases and total bed-days, and the same held true for rib fractures.

In men, the corresponding number of hospitalizations due to all fractures, backache and acquired kyphosis in 1992 was 29574, with a mean length of stay of 13.3 days, i.e. 6.3 days less than in women. These cases accounted for 392573 hospital days, i.e. 266186 days less than in women.

The diagnosis 'forearm fracture' was frequent in men. It was coded 2592 times, which means that after extrapolation, 6028 hospitalizations per year (20% of total hospitalizations for fractures in men) may be due to this fracture. Because of the very short length of stay these cases accounted for only 9% of all bed-days calculated for overall fractures in males (35223 days). There were 5123 fractures of proximal tibia/fibula which accounted for 71614 bed-days, i.e. 18% of the total. There were 4042 malleolar fractures, accounting for 45260 bed-days, i.e. 11.5%. Fractures of the ribs were more frequent than hip fractures (2807 vs 2372 cases) but accounted for fewer bed-days than the latter (32079 days (8.1%) vs 52544 days (13%)) or than femur fractures (1819 cases, 39179 days, 10%). The 2377 hospitalizations for vertebral fractures led to 30758 hospital days (7.8% of the total of bed-days) and 1316 pelvis fractures led to 29151 days (7.4%). A rather modest part of the total hospital bed-days in men was taken up by proximal humerus fractures, i.e. 28858 days (7.4%) for 2267 hospitalizations.

Osteoporotic Fractures: Differential Impact on Bed-Days According to Gender

After application of Phillips' OAR, 18380 hospitalizations have been estimated to be due to osteoporotic fractures (and other complications of osteoporosis) in women in 1992. These hospitalizations accounted for a total of 446064 days of hospital stay, i.e. 68% of bed-days caused by overall fractures.

The sequence of importance of the various fracture sites after applying osteoporosis attribution rates is different from that for all fractures taken together. In the following, we sorted the fracture types according to their impact on the total number of hospital bed-days.

In women, hip fractures accounted for 171696 days (38.5% of all bed-days for osteoporotic fractures) per year. Proximal humerus fracture (57541 days) was the second most important osteoporotic fracture type (12.9%) followed by forearm fracture (37824 days, 8.5%). Because of their extensive length of stay (36.9 days), femoral fractures other than neck fractures led to 34261 hospital days (7.7%), whereas pelvis fractures accounted for 32322 days in hospital (7.2%). Osteoporosis-related malleolar fractures led to 24613 hospital days (5.5%), whereas vertebral fractures (#805) led to 23006 bed-days (5.2%). However, if subgroups and complications of vertebral fractures (i.e. pathological fracture #733.1, kyphosis #737.1, pain in thoracic spine #724.1 and unspecified backache #724.5) were included, a total of 57005 hospital days (12.8%) was accounted for by vertebral pathology, making complications of vertebral osteoporosis the third most important category in terms of hospital costs in women.

'Osteoporosis' (#733.0) as main and secondary diagnosis was responsible for an additional 102551 hospital days in women, after deduction of cases in which osteoporosis was attributed as a secondary diagnosis to patients with one of the aforementioned fractures, and after applying Phillips' attribution rate of 0.88 [10].

In men, we estimated a total of 7619 hospitalizations to be due to complications of osteoporosis, accounting for 138760 annual bed-days.

As in women, hip fractures were the most important fractures in terms of hospital days (36964 hospital

days, i.e. 26.6%). Second came proximal tibia/fibula fractures (14009 days, 10.1%) and third proximal humerus fractures (13335 days, 9.6%), followed by vertebral fractures (11695 days, 8.4%). Again, after adding related diagnoses to vertebral fractures (#733.1, #737.1, #724.1, #724.5), the number of bed-days for vertebral pathology was as high as 23505 (17%), which ranks it second after hip fractures. Rib fractures (11670 days, 8.4%) and pelvis fractures (11332 days, 8.2%) came next. Fractures of the forearm (9787 days) accounted for 7% of total bed-days for osteoporosis, as in women (8%). Malleolar fractures accounted for 9155 days (6.6%) and femur fractures other than hip fractures for 9003 days (6.5%).

'Osteoporosis' (#733.0) accounted for an additional 14097 hospital days in men, after deduction of cases in which osteoporosis was attributed as a secondary diagnosis to patients with one of the aforementioned fractures, and after applying Phillips' attribution rate of 0.88 [10].

By multiplying these figures by a mean daily cost of 845 Swiss francs [20] the annual direct costs of acute hospitalizations for osteoporosis and its complications (not taking into account ambulatory treated patients, patients transferred to nursing homes, medical homes, etc.) are approximately 464 million Swiss francs for women and 130 million Swiss francs for men; the total is 594 million Swiss francs for the year 1992.

Dismissal Status after Hip Fracture

Figure 2 depicts the relative importance (percentage) of the various discharge status options after hip fracture in 1992. In the age groups younger than 65 years, the percentage of patients discharged home was higher than 74%, whereas it was as low as 54% in patients older than 85 years. Concomitantly the percentage of patients transferred to nursing homes increased with age, i.e. from 0.9% in the age group 45–54 years to 15.4% in the group over 85 years. The same holds true for death rate during hospitalization: it was at 1.8% in the group 45–54 years versus 8% in the oldest age group, and was higher in older men (age 85+) than in older women (13.6% vs 7.0%, respectively).

Awareness of Diagnosis 'Osteoporosis' in Hip Fracture Cases

The VESKA cases with the diagnosis 'hip fracture' (ICD #820) combined with diagnostic code 733.0 (osteoporosis) accounted for only 122 cases (112 women, 10 men). Mean length of stay in these patients was 43.7 days – obviously longer than in the population described above. An aberrant estimate of hospital days caused by osteoporotic hip fracture would have ensued, namely 5332 days in total (5087 in women, 245 in men), i.e. 50-fold less than described above, after application of osteoporosis attribution rates to all hip fractures.

Comparison of Hospitalization Days Due to Osteoporosis with Bed-Days Due to Other Frequent Diseases

In Fig. 3 the number of hospital days caused in 1992 by osteoporosis were compared with those caused in that year by chronic obstructive pulmonary diseases (COPD; ICD9 codes #491, #492, #493), stroke (#434, #436), breast carcinoma (#174) and myocardial infarction (#410) in both women and men.

In women, osteoporosis led to 548615 hospital days (21765 cases) as compared with 353654 days (11920 cases) for COPD, 352062 days (5219 cases) for stroke, 200669 days (7793 cases) for breast carcinoma and 131331 days (5416 cases) for myocardial infarction.

In men, however, COPD (26354 cases) caused the highest number of hospital days (537164 days). Myocardial infarction (11547 cases; 196793 days) and stroke (5223 cases; 180524 days) accounted for fewer hospital days, as did osteoporosis (8269 cases; 152857 days).

Discussion

The present article provides absolute numbers and incidence rates of hospitalizations due to fractures in Switzerland in 1992, reported in the registration system for Swiss hospitals, VESKA (which includes 43% of Swiss hospitals), and extrapolated to 100% of Swiss hospitals. A total of 63170 hospitalizations due to fractures were noted, 53% of which were in women and 47% in men, leading to overall annual incidence rates of 950/100000 women and 877/100000 men.

Whereas hip fractures lead to hospitalization in almost 100% of cases, only a minority of other fractures do so. Knowelden et al. [21] estimated the percentage of hospitalized patients to be in the order of 95% for hip fractures, 39% for vertebral fractures, 8% for forearm, 14% for humerus, 20% for other sites (pelvis, hand and phalanges, femoral fractures excluding the neck, distal lower extremity) and 24% for any site.

Thus, there is a 'black box' in the study, namely the pool of outpatients with fractures who bypass our statistical system although they cause a major socio-economic burden. For example the study does not include the other limb fractures such as hand, foot, toe and clavicle which rarely lead to hospital admission; their incidence also increases with advancing age [6]. In other words the number of fractures leading to medical intervention in an outpatient setting remains unknown.

Total hospitalization rates for fractures were similar in women and men. However, there were large differences regarding the age at which fractures occurred: in Swiss men, 58% of all fractures occurred before the age of 45 years, whereas in women 76% occurred after this age.

This finding is in accordance with a study recently carried out in Trent, UK [22], which revealed that in males three quarters of all fractures occur before the age of 45 years whereas in women three quarters occur after that age, emphasizing the importance of postmenopausal bone loss in the pathogenesis of these fractures. Also the site of fractures differs markedly between genders. For instance, in women up to the age group 55–64 years, distal upper and lower limbs seem to be more prone to fracture than the axial skeleton and the proximal limbs. After that age incidence rates of axial skeleton and hip fractures exponentially catch up and overtake the former fracture groups, whereas the incidence rate of proximal upper limb fractures steadily increases with advancing age. Conversely, incidence of hospitalization for distal lower limb fractures in women peaks in the age group 55–64 years and declines thereafter. This decline in ankle fractures coincides with the exponential rise in hip fractures, possibly as a result of a change in motion pattern.

In men, compared with women, the incidence of hospitalizations for fractures of the axial skeleton was higher up to age 64 years and lower thereafter, although it still rose with age. This may reflect the higher rate of vertebral and pelvic fractures due to high-velocity trauma in younger males. A steep increase in the incidence of vertebral fractures occurs 10 years later in men than in women, a fact which may partly be due to the lack of a menopause equivalent in men. On the other hand kyphosis is more frequently encountered in young males, as a manifestation of Scheuermann's disease. Whereas proximal upper and lower limb fractures increased with age in men, distal limb fractures did not: they frequently occur at a young age already, as a result of trauma.

This is the first European report attempting to assess in inpatients the overall incidence rate of fractures and bed-days caused by fractures, based on a statistical system covering an entire country. Kanis and Pitt [22], for instance, reviewed the inpatient admission rates due to fractures of various skeletal sites in the UK between 1989 and 1990, but only for the Trent region, and no information was available about the bed-days caused by each fracture type; instead, an estimate of fracture-specific days in hospital was taken from an earlier study [21]. Other European reports are confined to hip fractures. For example, comparing age-adjusted hip fracture incidences of 12 European countries between 1983 and 1985, Johnell et al. [23] found a north–south gradient, with the highest incidence rate in Sweden (f: 504/100 000, m: 195/100 000) and lowest in Malta (67 and 28/100 000, respectively), while values for Switzerland were between those two extremes (173 and 70/100 000, respectively). Although environmental and lifestyle factors may account at least in part for such geographic variations in fracture rates across Europe [24], biases introduced by the use of the ICD code, because of overreporting (i.e. multiple counting of the same patient [23]) and extrapolation from small, unbalanced population samples may also be involved. In our study, we avoided double reporting by deleting all cases where outcome status was a transfer within the same or to another hospital, and the type of extrapolation we performed was different.

There are few published data about fracture rates in Switzerland and they only deal with hip fractures: in a retrospective analysis performed in the city of Geneva in 1987 [20], 361 patients with hip fractures were registered in the University Hospital of Geneva, which is the main referral center for a population of about 376 000 inhabitants. The overall annual incidence found by these authors was 96/100 000 population (147 for women, 40 for men), slightly below what has been found here for the whole country. In the canton of Vaud with a total population of 584 000 inhabitants (i.e. about 8% of the entire Swiss population), the incidence rate of hip fractures over the period 1986–1991 was estimated at 167/100 000 per year in persons aged 20 or older (241 for women, 84 for men) [35], i.e. slightly above our values. However, as stated by the authors themselves, the regional statistical system used in their study overestimates the number of new hip fractures by about 16%, due to double counting of cases after interhospital transfers or readmissions for early and late complications. Inter-regional variations within the same country have been previously reported, especially between urban and rural populations [26], and therefore the analysis of a large and well-balanced sample of the population is indispensable for precisely estimating the actual hospitalization costs due to osteoporosis within a single country.

The question arises now of how many of the cases of hip fracture registered in Switzerland are really due to osteoporosis and, therefore, are a target for future preventive and curative strategies. This is why we applied attribution rates [10]: to attribute to osteoporosis the appropriate percentage of overall fractures as a function of age and site. These rates, however, are not gold standards, and they were originally generated for women only. Therefore a degree of overestimation of osteoporosis as the cause of fractures cannot be excluded in men. Recently, however, a panel of US experts also calculated osteoporosis attribution probabilities: they are even higher than those used here for hip and spine fractures in women and similar to ours for fractures in men [27]. The respective median attribution probabilities for hip fractures in that study were 0.80 (women) and 0.60 (men) for age group 45–64 years, 0.90 and 0.80 for age group 65–84 years, and 0.95 and 0.85 for people older than 85 years [27]. Although there are no data to confirm that the trauma to fragility ratio is similar in the USA and Switzerland, the adoption of the osteoporosis attribution rates from white Americans seems to be justified given the similar lifestyles and comparable stature of the two populations.

According to Melton [3], the epidemiological characteristics of osteoporotic fractures are: (1) incidence rates which increase with age, (2) higher rates among women than men, (3) association with moderate trauma at sites containing substantial amounts of trabecular

bone. We confirm the first two criteria for most fractures, at least from a certain age on (after 65 years), although in men, for obvious reasons (i.e. prevalence of trauma in younger age groups) not all incidences rose with age. Fractures at the distal lower extremity are an exception because after a certain age and in both sexes they seem to occur at declining rates. In women the exponential rise in hip fractures might in some way be related to that phenomenon, whereas in men reduced exposure to major trauma with increasing age may play a similar role. The relatively lower osteoporosis attribution rates for this fracture type compared with other fractures thus appear to be justified. Our study design did not, however, allow the degree of trauma to be taken into account.

In postmenopausal women, distal forearm fractures and vertebral crush fractures seem to be closely related to osteoporosis [28]. Hip fractures, on the other hand, are associated with osteoporosis in the more elderly population, as are fractures of the pelvis, proximal humerus, proximal tibia, and vertebral wedge fractures. Although we give no data on overall incidence rates of fractures but only on hospitalization frequencies, our data support this view, in that we also detected a rise in hospitalizations for fractures of the axial skeleton which occurs earlier than that for hip fractures.

We estimated there were 18 380 and 7619 hospitalizations due to specified features (Table 4) of osteoporosis in women (71%) and men (29%), respectively, leading to 446 064 (f: 76%) and 138 760 (m: 24%) hospital days in 1992. After adding the unspecified diagnosis 'osteoporosis' (f: 102 551, m: 14 097 days) the total of hospital days was as high as 701 472 days. In women the relative importance in terms of number of patients affected and bed-days caused was greatest for fractures of the proximal lower limbs (especially hip fractures), which accounted for 46% of bed-days, followed by osteoporotic complications of the axial skeleton (22.5% of bed-days), and fractures of the humerus (13% of bed days). Distal lower limb fractures took fourth place (9.9%), followed by distal forearm fractures (8.5%). This is a new finding, because fractures of the spine, hip and forearm are generally considered to be the most important osteoporotic fractures [3]; the prevalence of humerus fractures appears thus to be either underestimated in the literature (these studies are based on fracture incidences and not on bed-days caused by fractures) or overestimated in our study. Indeed, one explanation for this discrepancy might be the much longer average length of stay in hospital for a humerus fracture (30 days if at all) compared with a distal forearm fracture (11 days if at all); the percentage of patients hospitalized is also higher for humerus (14%) than for distal forearm fractures (8%) [21].

In men the relative importance of the various osteoporotic fractures in terms of hospital days is different from that found in women: axial skeleton fractures (33.5% of bed-days) are as important as proximal lower limb fractures (33.1%), followed by distal lower limb fractures (16.7%, humerus fractures (9.6%) and distal forearm fractures (7%). In terms of number of patients affected, axial fractures are even more important (2669 cases) than proximal lower limb fractures (1876 cases).

Taken together, these results point to the fact that complications of osteoporosis affecting the axial skeleton as well as peripheral sites other than the hip, e.g. the proximal humerus, often require hospitalization and therefore have a great impact on the socio-economic burden of this disease. We estimated a total of 701 472 hospital days due to osteoporosis and its complications. If we multiply thse figures by a mean daily cost of 845 Swiss francs [20], the socio-economic burden in 1992 turns out to be 594 million Swiss francs, based on inpatient service alone.

It is generally accepted that hospital stay accounts for the largest part of the medical care costs in patients with hip fracture [29]. Praemer et al. [30] estimated that inpatient care accounted for 44% of direct health care costs for hip fracture in the USA. However, nursing home care is also very expensive and corresponds in the USA to about half of the amount spent on inpatient care [30]. Indeed, it has been stated that 30% of patients with hip fractures remain totally dependent [31]. For Switzerland, unfortunately, no such data are presently available.

We have shown (Fig. 2) that in both genders the percentage of patients who are discharged home after hip fracture declines as a function of age, whereas the percentage of those transferred within the same or to another hospital, or to a nursing home, as well as of those who die, increases. Taking all age groups together, 4.6% of female patients and 8.5% of male patients of our study died during their hospital stay after osteoporotic hip fracture. In patients over age 74 years this percentage was even higher. Mortality rate after hip fracture has been reported to be around 20% within 1 year [32] and seems to be higher in men than in women [33].

It is noteworthy that the following assumptions made for our calculations may lead to underestimation of the hospital costs:

1. It may not be entirely correct that length of stay after a fracture does not differ according to whether osteoporosis is involved or not, as longer duration of hospitalization after osteoporotic hip fracture has been observed by others [34].

2. Ignoring rehabilitation hospitalizations in our calculations leads to underestimation of the average length of stay, as supported by a recent study in which the rehabilitation phase was found to be threefold longer than the stay at the acute hospital [16].

3. As we only tracked fractures which were coded as the main diagnosis, we may have missed those fractures that were accompanying other diseases or which had occurred during a hospital stay and therefore may have lengthened a hospital stay originally due to disease other than fracture.

In the context of hip fracture, the awareness of 'osteoporosis' of the hospital physicians in Switzerland was extremely low, as demonstrated by the few cases in which the codes 'osteoporosis' and 'hip fracture' had

been concurrently checked (112 women and 10 men). This fact unmasks a weakness in the education system of our physicians, who obviously were not taught to recognize osteoporosis as a disease but rather as a manifestation of aging.

Finally, comparison of the number of bed-days caused by osteoporosis with that caused by other frequent diseases is illuminating: 701 472 days caused by osteoporosis versus 890 818 days caused by COPD, 532 586 by stroke, 328 124 by myocardial infarction and 200 669 by breast cancer, osteoporosis being number one in women. This underlines the fact that nationwide targeted interventions in the field of osteoporosis are mandatory.

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