Years of potential life lost after hip fracture among postmenopausal women

Søren Eiskjær, Svend E. Østgård, Bent W. Jakobsen, Jørn Jensen and Ulf Lucht

From January 1987 and onwards all cases of hip fracture in Århus County, Denmark, were registered in a prospective multicenter investigation. Until December 1990, 2273 postmenopausal women (> 50 years) with first hip fractures were registered. Of these 643 sustained a hip fracture in 1988. Lifetables were constructed for different age groups; the excess mortality (in comparison with the reference population) for each age group ranged from 10 to 20 percent. The years of potential life lost (YPLL) (life expectancy method) were calculated for the 1988 cohort and compared with the YPLL due to other selected conditions calculated from official vital statistics. The YPLL rates (per 1000 persons) were as follows: hip fracture 9.2, ischemic heart disease 73, cerebrovascular disease 29, breast cancer 20 and cancer of the uterus 6.7. We propose that hip fracture mortality data should be continuously registered and evaluated using the YPLL method to detect changes caused by the expected increase in the number of hip fractures.

The Accident Analysis Center, Århus University Hospital, Department of Orthopedics E, Århus, Denmark
Correspondence: Dr. Søren Eiskjær, Flintebakken 22, DK-8240 Risskov, Denmark. Tel +45–86 219020
Submitted 91-08-06. Accepted 92-01-11

Approximately 5 to 20 percent more patients with hip fracture die within the first year after the fracture than would be expected on the basis of their age and sex (Cummings et al. 1989).

Years of potential life lost (YPLL) per death is calculated by taking the difference between the midpoint of the age range and the remaining life expectancy at that age from a lifetable (Haenzel 1950, Center for Disease Control 1986). YPLL can assist in the performance of three basic public health functions: the establishment of research and resource priorities, the surveillance of temporal trends in mortality, and the evaluation of the effectiveness of program interventions (Center for Disease Control 1986).

We have studied YPLL after fracture of the hip in postmenopausal women (> 50 years) and compared these data with YPLL after ischemic heart disease, cerebrovacular disease, breast cancer and cancer of the uterus.

Patients and methods

Since January 1987 a prospective registration of all hip fractures in Århus County has been undertaken at all the hospitals admitting patients with hip fractures. The following variables were registered for each patient: the date of birth, the date and hour of fracture, the date and hour of admission, prefracture social setting and ADL level, walking ability, fracture type, date and hour of surgery, treatment, date of discharge, postfracture social setting and the date of death. As of December 1990 a total of 2273 hip fractures (first fractures) in postmenopausal women (age ≥ 50 years) were registrered. Cervical, trochanteric and subtrochanteric fractures were included. Pathological fractures and patients not residing in Århus County were excluded. Lifetables (Benedetti 1988) were constructed for the following age groups: 50–69 years (334 fractures), 70–79 years (594 fractures), 80–89 years (1039 fractures) and ≥ 90 years (306 fractures). These life-tables were compared to the life-tables for the standard population in Århus County. The excess mortality in each age group was calculated by subtracting the cumulative survival proportion for the standard population and the hip fracture population at one year. The number of deaths caused solely by hip fracture was calculated by multiplying the number of hip fractures in the year 1988 (separately for each age group) with the excess mortality in that particular age group. Table 1 shows the distribution of fractures by age (1988 cohort) and the number of deaths in each age group (first year postfracture). The YPLL rate per 1000 persons was calculated according to the life expectancy method:

$$\text{YPLL rate} = (\sum d_i \times l_i) \times 1000/N$$

where d_i = number of deaths in age group i, l_i = life expectancy at the midpoint of age group i in years, N = number of persons in the actual population. Information about the remaining life expectancy at the midpoint of each age group was obtained from a life-table

Table 1. Number of hip fractures and deaths during the first year postfracture (1988 cohort)

Age group	Number of hip fractures	Number of deaths
50–54	10	1
55–69	14	1
60–64	29	3
65–69	46	4
70–74	62	12
75–79	111	20
80–84	141	35
85–89	153	55
90+	77	35

Table 2. Excess mortality by age

Age group	Excess mortality (percent)	95-percent confidence interval
50–69	9.8	6.4–13
70–79	15	12–19
80–89	20	17–23
90+	14	8.1–20

Table 3. YPLL rates for hip fracture and some selected disease entities

Disease entity	ICD number	YPLL rate
Ischemic heart disease	410–414	73
Cerebrovascular disease	430–438	29
Cancer of the breast	174	20
Hip fracture	820	9.2
Cancer of the uterus	180–182	6.7

published every year by the Danish Central Bureau of Statistics (Danmarks Statistik 1990). The life expectancy for a 100-year-old woman is 2.1 years and this value was chosen as the life expectancy in patients aged ≥ 90 years. The YPLL rate was adjusted to the age distribution of the female Danish population according to the direct method (Romeder and McWhinnie 1977). Information about the number of deaths from other common causes by age and sex was obtained from the National Board of Health (Sundhedsstyrelsen 1990) and the YPLL rate was calculated for each of these causes. The last age interval in these tables is the interval ≥ 85 years. We chose to select the life expectancy in this interval as 5.0 (life expectancy for an 87-year-old woman, midpoint of the interval 85–89 years). This choice tends to underestimate the YPLL caused by hip fracture, as compared to other causes.

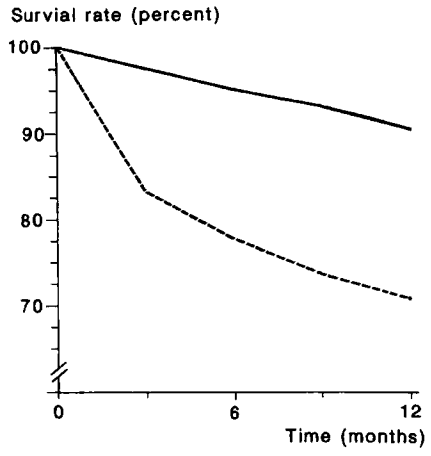

Figure 1. Cumulative survival rates for the reference (upper curve) and hip fracture populations, age range 80–89 years.

Results

The relative survival rate approximated 100 percent after 6–12 months (all age groups) and in addition it was demonstrated graphically that the survival curves for the reference and standard population run parallel after 6–12 months (Figure 1). The excess mortality was most pronounced in the age group 80–89 years (Table 2). The cumulative proportion surviving at one year in the age group 50–69 years was 0.99/0.89 (reference population/hip fracture population), 0.96/0.81 (70–79 years), 0.90/0.71 (80–89 years) and 0.74/0.60 (≥ 90 years). The leading cause of YPLL was ischemic heart disease, followed by cerebrovascular disease, cancer of the breast, hip fracture and cancer of the uterus (Table 3). The lower confidence limits (Table 2) resulted in a YPLL rate of 7.2 per 1000 persons and using the upper confidence limits resulted in a YPLL rate of 12. We chose to calculate the YPLL rate on the basis of the number of hip fractures and the excess mortality in each age group. This facilitated the calculation of confidence limits. The YPLL rate could also have been calculated by using the actual number of deaths and the relative risk of dying (during the first year postfracture) in each age group. Not surprisingly, this too resulted in a YPLL rate of 9.2 per 1000 persons.

Discussion

The present study has demonstrated that YPLL after hip fracture amounts to approximately half of the YPLL after cancer of the breast, but one and a half times the YPLL after cancer of the uterus.

An extensive literature research has revealed only a single study quantifying and comparing deaths associated with hip fracture with deaths due to other common causes (Cummings et al. 1989). In that particular study the lifetime risk (the probability of dying due to a certain condition) of death due to hip fracture was calculated at 2.8 percent, the lifetime risk of death due to breast cancer was likewise 2.8 percent, and the lifetime risk of death due to cancer of the uterus 0.7 percent. The concept of lifetime risk does not take account of the age at onset of the disease. Breast cancer and uterus cancer usually occur at a younger age than hip fracture and cause a loss of more years of life.

The excess mortality calculated by Cummings et al. (1989) differs somewhat from the excess mortality calculated in the current study, which was based on the same population data as it was applied to. Other Scandinavian studies list excess mortality at one year in the range of 14–19 percent (Jensen and Tøndevold 1979, Dahl 1980, Holmberg et al. 1986, Elmerson et al. 1988). However, these studies have primarily been conducted to find factors contributing to the excess mortality after hip fracture. None of these researchers have tried to quantitate and compare the mortality after hip fracture with the mortality after other common conditions.

YPLL can also be calculated by using a designated end point, most commonly 65 or 70 years. This is not feasible for hip fracture data since the incidence rises exponentially with increasing age and since hip fracture is almost nonexistent below 40–50 years of age. Both the total YPLL and the relative ranking changes substantially according to which method is used. Nevertheless, the YPLL index compares favorably with other mortality indexes (Kleinman 1977) and it can communicate a message that is not complicated by a large array of statistics (Shapiro 1977).

The list of causes of death published by the National Board of Health (1990) includes hip fracture. The YPLL rate per 1000 persons calculated from these data was 3.8. This list is based on the death certificates. Hip fracture is probably grossly "undercertificated" as a cause of death. Only 5–20 percent of deaths after hip fracture are certified as caused by that fracture (Donaldson et al. 1989). Only if a hip fracture is listed as the underlying cause of death (not a contributory cause) does it contribute to the YPLL caused by hip fracture.

Patients with hip fracture have a greater prevalence of other more or less serious medical conditions than other people of similar age (Johnell and Sernbo 1986). Because of this it is likely that we have overestimated the YPLL after hip fracture. Medical conditions are probably the most important determinants of survival after hip fracture (Kenzora et al. 1984, Ions and Stevens 1987, Eiskjær and Østgård 1991). The concept of YPLL does not allow us to weigh or differentiate the causes contributing to death, which is a limitation. However, this limitation is valid for all disease entities and will also be valid if temporal trends for a single disease entity are surveilled (e.g. hip fracture). Moreover, it can be debated whether it is not the hip fracture, which triggers the events leading to death. Comparing death rates after hip and forearm fractures, Weiss et al. (1983) conclude that it is the hip fracture and its consequences that lead to an increased death rate, rather than the factors that predispose to a fracture.

The number of hip fractures has increased dramatically during the last 30–40 years, owing to an increase in the population at risk and a change in specific incidence in various age and sex groups (Frandsen and Kruse 1983, Schrøder et al. 1987, Jarnlo et al. 1989). If the number of hip fractures continues to increase, the total number of YPLL due to hip fracture will increase. Changes in specific incidences may change the ranking of YPLL due to hip fracture, perhaps equalizing the YPLL rates for hip fracture and the most serious cancer (breast cancer) during the next two or three decades. Recent evidence suggests that breast cancer mortality rates will remain stable (Ewertz and Carstensen 1988, Lund 1989). Death represents the most serious consequence of a hip fracture. We propose using the YPLL method to monitor changes in hip fracture mortality.

References

Benedetti J, Yuen K, Young L. Life tables and survivor functions. In: BMDP Statistical Software Manual (Ed. Dixon, W. J.) University of California Press 1988; 2, P. 690–718.

Center for Disease Control. Premature mortality in the United States: public health issues in the use of years of potential life lost. MMWR (Suppl 2) 1986; 35: 1S–11S.

Cummings S R, Black D M, Rubin S M. Lifetime risks of hip, Colles', or vertebral fracture and coronary heart disease among white postmenopausal women. Arch Intern Med 1989; 149 (11): 2445–8.

Dahl E. Mortality and life expectancy after hip fractures. Acta Orthop Scand 1980; 51 (1): 163–70.

Danmarks Statistik. Statistical Yearbook 1990. Danmarks Statistik, Copenhagen 1990.

Donaldson L J, Parsons L, Cook A J. Death certification in fractured neck of femur. Public Health 1989; 103 (4): 237–43.

Eiskjær S, Østgård S E. Risk factors influencing mortality after bipolar hemiarthroplasty in the treatment of fracture of the femoral neck. Clin Orthop 1991; 270: 295–300.

Elmerson S, Zetterberg C, Andersson G B. Ten year survival after fractures of the proximal end of the femur. Gerontology 1988; 34 (4): 186–91.

Ewertz M, Carstensen B. Trends in breast cancer incidence and mortality in Denmark, 1943–1982. Int J Cancer 1988; 41 (1): 46–51.

Frandsen P A, Kruse T. Hip fractures in the county of Funen, Denmark. Implications of demographic aging and changes in incidence rates. Acta Orthop Scand 1983; 54 (5): 681–6.

Haenzel W. A standardized rate for mortality defined in units of lost years of life. Am J Public Health 1950; 40: 17–26.

Holmberg S, Conradi P, Kalén R, Thorngren K G. Mortality after cervical hip fracture. 3002 patients followed for 6 years. Acta Orthop Scand 1986; 57 (1): 8–11.

Ions G K, Stevens J. Prediction of survival in patients with femoral neck fractures. J Bone Joint Surg (Br) 1987; 69 (3): 384–7.

Jarnlo G B, Jakobsson B, Ceder L, Thorngren K G. Hip fracture incidence in Lund, Sweden, 1966–1986. Acta Orthop Scand 1989; 60 (3): 278–82.

Jensen J S, Tøndevold E. Mortality after hip fractures. Acta Orthop Scand 1979; 50 (2): 161–7.

Johnell O, Sernbo I. Health and social status in patients with hip fractures and controls. Age Ageing 1986; 15: 285–91.

Kenzora J E, McCarthy R E, Lowell J D, Sledge C B. Hip fracture mortality. Relation to age, treatment, preoperative illness, time of surgery, and complications. Clin Orthop 1984; 186: 45–56.

Kleinman J C. Age adjusted mortality indexes for small areas: applications to health planning. Am J Public Health 1977; 67 (9): 834–40.

Lund E. Insidens og dodelighet av brystkreft i Norge. Kan tidlig diagnostikk forklare ulike utviklingstrekk?. Tidsskr Nor Laegeforen 1989; 109 (10): 1073–5.

Romeder J M, McWhinnie J R. Potential years of life lost between ages 1 and 70: an indicator of premature mortality for health planning. Int J Epidemiol 1977; 6 (2): 143–51.

Schrøder H M, Andreassen M, Villadsen I, Sørensen J G. Hip fractures in the municipality of Århus 1970–85. Acta Orthop Scand 1987; 58: 706.

Shapiro S. A tool for health planners (letter). Am J Public Health 1977; 67 (9): 816–7.

Sundhedsstyrelsen. Causes of death in Denmark 1988. Vital Statistics Copenhagen 1990; 1: 26.

Weiss N S, Liff J M, Ure C L, Ballard J H, Abbott G H, Daling J R. Mortality in women following hip fracture. J Chronic Dis 1983; 36 (12): 879–82.