Time trends and demography of mortality after fractured neck of femur in an English population, 1968-98: database study

Stephen E Roberts, Michael J Goldacre

Abstract

Objectives To investigate time trends in mortality after admission to hospital for fractured neck of femur from 1968 to 1998, and to report on the effects of demographic factors on mortality.
Design Analysis of hospital inpatient statistics for fractured neck of femur, incorporating linkage to death certificates.
Setting Four counties in southern England.
Subjects 32 590 people aged 65 years or over admitted to hospital with fractured neck of femur between 1968 and 1998.
Main outcome measures Case fatality rates at 30, 90, and 365 days after admission, and standardised mortality ratios at monthly intervals up to one year after admission.
Results Case fatality rates declined between the 1960s and the early 1980s, but there was no appreciable fall thereafter. They increased sharply with increasing age: for example, fatality rates at 30 days in 1984-98 increased from 4% in men aged 64-69 years to 31% in those aged ≥90. They were higher in men than women, and in social classes IV and V than in classes I and II. In the first month after fracture, standardised mortality ratios in women were 16 times higher, and those in men 12 times higher, than mortality in the same age group in the general population.
Conclusions The high mortality rates, and the fact that they have not fallen over the past 20 years, reinforce the need for measures to prevent osteoporosis and falls and their consequences in elderly people. Whether post-fracture mortality has fallen to an irreducible minimum, or whether further decline is possible, is unclear.

Introduction

Fractured neck of femur is a common cause of morbidity, use of hospital care, and death in elderly people. Age specific incidence rates have increased substantially in most Western populations in recent decades.[1–7] Even if age specific rates remain stable over time, the number of people who have a fracture will increase because of the increasing number of elderly people in the population.

Information about mortality that includes follow up after discharge is not readily available from routine statistics. Clinical follow up studies are usually small scale and do not cover trends over long periods of time. Accordingly, information about secular trends in outcome of fracture is sparse. We have reported briefly on the high risk of death after fracture and on the lack of variation in death rates between hospitals in 1994-8.[8] In the present study we analysed data on hospital admissions over a much longer time period, between 1968 and 1998, to provide information about time trends in case fatality rates in a large defined population. We also report on case fatality rates in relation to age, sex, social class, and marital status.

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Methods

Study population

We used the Oxford record linkage study, which comprises anonymised abstracts of hospital statistics linked to data from death certificates. It covered two health districts and their constituent hospitals in the former Oxford NHS region (population 0.9 million) from 1968 to 1974, six health districts and their hospitals from 1975 to 1986 (population 1.8 million), and eight districts from 1987 to 1999 (population 2.5 million). The Oxford record linkage data have been validated for recording of orthopaedic diagnoses at various times and have been shown to be accurate.[6 9] The reliability of the data linkage has also been validated and has been shown to be of high quality.

The ICD-9 (international classification of diseases, ninth edition) codes used were 820, 821.0, and 821.1, and the ICD-10 codes were S72.0, S72.1, S72.2, and S72.9. These include fractures of the neck of femur and also fractures of "unspecified parts of the femur"; the latter codes are used when the diagnosis is simply recorded as "fractured femur." All admissions for patients under 65 years of age were excluded to eliminate, as far as possible, fractures of the shaft that may have been included in the rubrics for "unspecified parts of femur." The analysis was confined to emergency admissions where the fracture was the principal diagnosis. The study period covered admissions from 1 January 1968 to 31 March 1998, with linkage to death certificates up to 31 March 1999.

Table 1 Age distribution of patients admitted to hospital with fractured neck of femur over time, 1968-98. Values are numbers (percentages)

Age group	1968-73	1974-78	1979-83	1984-88	1989-93	1994-98	1968-98†
Men	(n=338)	(n=741)	(n=976)	(n=994)	(n=1295)	(n=1556)	(n=5900)
65-69	43 (12.7)	108 (14.6)	128 (13.1)	114 (11.5)	124 (9.6)	124 (8.0)	641 (10.9)
70-74	69 (20.4)	133 (17.9)	200 (20.5)	137 (13.8)	182 (14.1)	222 (14.3)	943 (16.0)
75-79	65 (19.2)	155 (20.9)	209 (21.4)	243 (24.4)	274 (21.2)	304 (19.5)	1250 (21.2)
80-84	77 (22.8)	159 (21.5)	208 (21.3)	270 (27.2)	318 (24.6)	412 (26.5)	1444 (24.5)
85-89	51 (15.1)	125 (16.9)	138 (14.1)	159 (16.0)	266 (20.5)	326 (21.0)	1065 (18.1)
≥90	33 (9.8)	61 (8.2)	93 (9.5)	71 (7.1)	131 (10.1)	168 (10.8)	557 (9.4)
Women	(n=1593)	(n=3557)	(n=4678)	(n=4731)	(n=5875)	(n=6253)	(n=26 687)
65-69	117 (7.3)	270 (7.6)	342 (7.3)	284 (6.0)	345 (5.9)	274 (4.4)	1632 (6.1)
70-74	229 (14.4)	453 (12.7)	574 (12.3)	552 (11.7)	560 (9.5)	606 (9.7)	2974 (11.1)
75-79	295 (18.5)	670 (18.8)	950 (20.3)	860 (18.2)	1013 (17.2)	1045 (16.7)	4833 (18.1)
80-84	425 (26.7)	888 (25.0)	1176 (25.1)	1207 (25.5)	1554 (26.5)	1622 (25.9)	6872 (25.8)
85-89	360 (22.6)	776 (21.8)	966 (20.6)	1095 (23.1)	1419 (24.2)	1607 (25.7)	6223 (23.3)
≥90	167 (10.5)	500 (14.1)	670 (14.3)	733 (15.5)	984 (16.7)	1099 (17.6)	4153 (15.6)

†Sex of 3 patients was not known.

Statistical methods

We calculated case fatality rates at 30, 90, and 365 days from the day of admission (day 0), using admissions for fractured neck of femur as the denominator and deaths from any cause after admission as the numerator. We standardised annual case fatality rates by the direct method, using the total population of patients admitted for fractured neck of femur in the region from 1968 to 1998 as the standard population. For presentation of trends, we calculated three-year moving averages of rates by calendar year. We used logistic regression to analyse age and sex adjusted trends in annual case fatality rates over time. To calculate standardised mortality ratios we used the indirect method, applying the age and sex specific mortality rates in five year age strata in the whole population of the region (the "standard" population) to the number of people with fractured neck of femur in the equivalent age and sex stratum, in successive months up to one year after fracture. In calculating standardised mortality ratios at successive months after fracture we removed, from the "special" populations, the number of people who had died in the preceding months in order to take account of the diminishing number of survivors over time. We used logistic regression modelling to analyse age-adjusted sex specific effects of quinquennial time period and marital status, and the age and sex adjusted effects of social class on mortality. During the late 1980s, after changes to information systems in the National Health Service, data on social class stopped being collected, and so analysis of social class was restricted to 1968-88. Social class had been

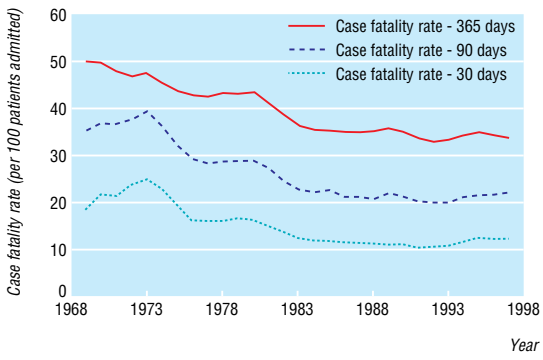

Fig 1 Age and sex adjusted trends in case fatality rates for fractured neck of femur 30, 90, and 365 days after hospital admission, 1968-98

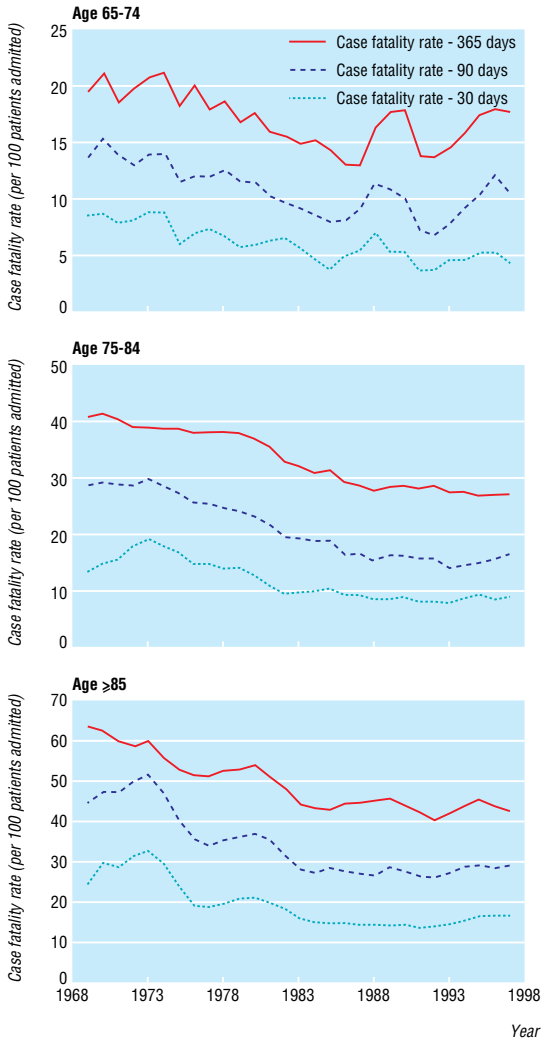

Fig 2 Age and sex adjusted trends in case fatality rates for fractured neck of femur years at 30, 90, and 365 days after hospital admission, 1968-98, (top) in people aged 65-74; (middle) in people aged 75-84; (bottom) in people aged ≥85

Table 2 Age adjusted, sex specific odds ratios for quinquennial time period and marital status, and age and sex adjusted odds ratios for social class, on case fatality rates after hospital admission for fractured neck of femur, 1968-98

Risk factor	No of admissions	Odds ratio (95% CI) for case fatality rates		
		Within 30 days	Within 90 days	Within 365 days
Time period				
Men:				
1968-73	338	1.00	1.00	1.00
1974-78	741	0.88 (0.63 to 1.22)	0.82 (0.61 to 1.09)	0.77 (0.59 to 1.01)
1979-83	976	0.75 (0.54 to 1.04)	0.72 (0.54 to 0.95)	0.80 (0.62 to 1.04)
1984-88	994	0.62 (0.44 to 0.86)	0.63 (0.47 to 0.83)	0.68 (0.52 to 0.88)
1989-93	1 295	0.59 (0.43 to 0.81)	0.59 (0.45 to 0.78)	0.68 (0.53 to 0.88)
1994-98	1 556	0.64 (0.47 to 0.87)	0.60 (0.46 to 0.78)	0.60 (0.47 to 0.77)
Women:				
1968-73	1 593	1.00	1.00	1.00
1974-78	3 557	0.74 (0.63 to 0.87)	0.72 (0.63 to 0.82)	0.84 (0.74 to 0.96)
1979-83	4 678	0.61 (0.52 to 0.72)	0.60 (0.52 to 0.68)	0.73 (0.64 to 0.82)
1984-88	4 731	0.44 (0.37 to 0.52)	0.44 (0.38 to 0.51)	0.56 (0.49 to 0.63)
1989-93	5 875	0.39 (0.33 to 0.46)	0.39 (0.34 to 0.45)	0.52 (0.46 to 0.59)
1994-98	6 253	0.46 (0.39 to 0.54)	0.43 (0.37 to 0.49)	0.55 (0.49 to 0.62)
Marital status				
Men:				
Single	343	1.00	1.00	1.00
Married	2 196	1.01 (0.71 to 1.43)	1.08 (0.80 to 1.45)	1.09 (0.85 to 1.40)
Widowed	1 376	0.97 (0.67 to 1.40)	1.18 (0.87 to 1.59)	1.19 (0.91 to 1.54)
Divorced or separated	66	1.13 (0.50 to 2.56)	0.93 (0.46 to 1.92)	0.77 (0.42 to 1.43)
Women:				
Single	2 383	1.00	1.00	1.00
Married	4 440	0.84 (0.70 to 1.01)	0.78 (0.68 to 0.90)	0.83 (0.74 to 0.94)
Widowed	11 678	1.00 (0.87 to 1.16)	0.98 (0.87 to 1.09)	1.00 (0.91 to 1.11)
Divorced or separated	177	0.70 (0.38 to 1.32)	0.83 (0.53 to 1.29)	0.77 (0.53 to 1.12)
Social class†				
I and II	803	1.00	1.00	1.00
III	591	1.34 (0.98 to 1.83)	1.47 (1.14 to 1.90)	1.31 (1.03 to 1.65)
IV and V	418	2.47 (1.79 to 3.42)	2.04 (1.54 to 2.70)	1.75 (1.34 to 2.27)

†Analyses for social class are for 1968-88 only.

allocated by the Oxford record linkage study staff according to last main employment, although in many cases it was not recorded for the elderly patients.

Results

A total of 32 590 people aged 65 years and over were admitted to hospital as emergencies with fractured neck of femur between 1968 and 1998, of whom 26 687 (81.9%) were women. The mean age of the patients was 81.5 (SD 7.4) years (men 79.6 (7.5) years, women 82.0 (7.4) years).

The age distribution of patients admitted with fractured neck of femur increased significantly over the study period (χ^2 test for trend = 60.7, df = 1, $P < 0.001$ for men; χ^2 test for trend = 193.6, df = 1, $P < 0.001$ for women; table 1). For example, 611 (31.6%) of the patients admitted in 1968-73 were aged 85 years or over, compared with 3200 (41.0%) in 1994-8.

For both men and women, case fatality rates declined during the early part of the study period and then levelled off from the early 1980s (figs 1 and 2). Because the study population had expanded from six to eight districts in 1987, we analysed the trends separately for the populations covered by the six and eight districts; the trends in both populations were similar, and the increase in deaths in the late 1980s was still evident.

Logistic regression modelling showed that, between 1968-73 and 1979-83, significant downward trends occurred in the annual age adjusted case fatality rates for women at 30, 90, and 365 days (all $P < 0.001$), and for men at 90 days ($P < 0.05$). The study of rates had less statistical power in men than women because of lower incidence of fracture, and downward trends did not reach significance for the rates at 30 and 365 days for men in the earlier years (table 2). From the 1984 onwards, annual rates did not decline further.

Mortality was significantly higher ($P < 0.001$) in social classes IV and V than in classes I and II (table 2). The odds ratio for IV and V to I and II was 2.47 at 30 days (95% confidence interval 1.79 to 3.42) and declined to 1.75 (1.34 to 2.27) at one year. Mortality was also higher in class III, relative to classes I and II, for the case fatality rate at 90 days ($P < 0.01$) and at one year ($P < 0.05$). After adjustment for age group, marital status had no significant effect on survival in men, but mortality was significantly lower in married women than in single women at 90 days ($P < 0.01$) and at one year ($P < 0.001$).

For both men and women, case fatality rates increased greatly with increasing age (table 3). For example, in the period 1984-98 at 30 days after admission, they rose with age in men from 4.4% (2.3% to 6.5%) at age 65-69 to 18.6% (15.9% to 21.4%) at age 85-89 and 31.4% (26.6% to 36.1%) at age 90 or over. In each age group, the rates were consistently higher in men than in women. The rates were also significantly higher in 1968-83 than in 1984-98 for most individual age-sex groups.

Figure 3 shows standardised mortality ratios for men and women separately during the 31 year period 1968-98. These calculations compare mortality in

Table 3 Age and sex specific case fatality rates (95% confidence intervals) after hospital admission for fractured neck of femur, 1968-83 and 1984-98

Age group	No of admissions	Case fatality rates: Within 30 days Deaths	Within 30 days Rate (95% CI)	Within 90 days Deaths	Within 90 days Rate (95% CI)	Within 365 days Deaths	Within 365 days Rate (95% CI)
1968-83	11 883	1604	13.5 (12.9 to 14.1)	2857	24.0 (23.3 to 24.8)	4 306	36.2 (35.4 to 37.1)
Men:							
65-69	279	20	7.2 (4.1 to 10.2)	33	11.8 (8.0 to 15.6)	57	20.4 (15.7 to 25.2)
70-74	402	37	9.2 (6.4 to 12.0)	61	15.2 (11.7 to 18.7)	103	25.6 (21.4 to 29.9)
75-79	429	71	16.6 (13.0 to 20.1)	105	24.5 (20.4 to 28.5)	162	37.8 (33.2 to 42.3)
80-84	444	80	18.0 (14.4 to 21.6)	152	34.2 (29.8 to 38.6)	234	52.7 (48.1 to 57.3)
85-89	314	85	27.1 (22.2 to 32.0)	142	45.2 (39.7 to 50.7)	205	65.3 (60.0 to 70.6)
≥90	187	63	33.7 (26.9 to 40.5)	102	54.5 (47.4 to 61.7)	130	69.5 (62.9 to 76.1)
Total	2 055	356	17.3 (15.7 to 19.0)	595	29.0 (27.0 to 30.9)	891	43.4 (41.2 to 45.5)
Women:							
65-69	729	20	2.7 (1.6 to 3.9)	44	6.0 (4.3 to 7.8)	100	13.7 (11.2 to 16.2)
70-74	1 256	87	6.9 (5.5 to 8.3)	147	11.7 (9.9 to 13.5)	248	19.7 (17.5 to 21.9)
75-79	1 915	162	8.5 (7.2 to 9.7)	295	15.4 (13.8 to 17.0)	489	25.5 (23.6 to 27.5)
80-84	2 489	336	13.5 (12.2 to 14.8)	630	25.3 (23.6 to 27.0)	921	37.0 (35.1 to 38.9)
85-89	2 102	347	16.5 (14.9 to 18.1)	627	29.8 (27.9 to 31.8)	906	43.1 (41.0 to 45.2)
≥90	1 337	296	22.1 (19.9 to 24.4)	519	38.8 (36.2 to 41.4)	751	56.2 (53.5 to 58.8)
Total	9 828	1248	12.7 (12.0 to 13.4)	2262	23.0 (22.2 to 23.8)	3 415	34.7 (33.8 to 35.7)
1984-98	20 704	2029	9.8 (9.4 to 10.2)	3791	18.3 (17.8 to 18.8)	6 362	30.7 (30.1 to 31.4)
Men:							
65-69	362	16	4.4 (2.3 to 6.5)	32	8.8 (5.9 to 11.8)	70	19.3 (15.3 to 23.4)
70-74	541	41	7.6 (5.3 to 9.8)	81	15.0 (12.0 to 18.0)	148	27.4 (23.6 to 31.1)
75-79	821	93	11.3 (9.2 to 13.5)	153	18.6 (16.0 to 21.3)	279	34.0 (30.7 to 37.2)
80-84	1 000	160	16.0 (13.7 to 18.3)	280	28.0 (25.2 to 30.8)	432	43.2 (40.1 to 46.3)
85-89	751	140	18.6 (15.9 to 21.4)	260	34.6 (31.2 to 38.0)	393	52.3 (48.8 to 55.9)
≥90	370	116	31.4 (26.6 to 36.1)	193	52.2 (47.1 to 57.3)	249	67.3 (62.5 to 72.1)
Total	3 845	566	14.7 (13.6 to 15.8)	999	26.0 (24.6 to 27.4)	1 571	40.9 (39.3 to 42.4)
Women:							
65-69	903	20	2.2 (1.3 to 3.2)	49	5.4 (3.9 to 6.9)	107	11.8 (9.7 to 14.0)
70-74	1 718	78	4.5 (3.6 to 5.5)	148	8.6 (7.3 to 9.9)	266	15.5 (13.8 to 17.2)
75-79	2 918	160	5.5 (4.7 to 6.3)	301	10.3 (9.2 to 11.4)	570	19.5 (18.1 to 21.0)
80-84	4 383	323	7.4 (6.6 to 8.1)	626	14.3 (13.2 to 15.3)	1 153	26.3 (25.0 to 27.6)
85-89	4 121	434	10.5 (9.6 to 11.5)	830	20.1 (18.9 to 21.4)	1 407	34.1 (32.7 to 35.6)
≥90	2 816	448	15.9 (14.6 to 17.3)	838	29.8 (28.1 to 31.4)	1 288	45.7 (43.9 to 47.6)
Total	16 859	1463	8.7 (8.3 to 9.1)	2792	16.6 (16.0 to 17.1)	4 791	28.4 (27.7 to 29.1)
Total, 1968-98	32 587†	3633	11.1 (10.8 to 11.5)	6648	20.4 (20.0 to 20.8)	10 668	32.7 (32.2 to 33.2)

†Sex of 3 patients was not known.

people with fractures with mortality in the general populations of men and women of the same age. At one month after hospital admission, mortality was 16 times higher in men and 12 times higher in women than in the general populations of men and women of similar age. By month 2, the standardised mortality ratios had declined substantially, but they were significantly higher in men than women in four of the first five months after admission. The ratios for both men and women remained higher than those in the general population throughout the full year after admission, but differences between men and women were not significantly different in months 6-12.

Discussion

The main strengths of this study are that it is a large, population based study of more than 32 000 patients; it covers a long time span to enable investigation of long term trends in mortality; and it uses a database that had incorporated systematic follow up through record linkage to data from death certificates. The main limitations of the study are that the clinical information recorded about individual patients was confined to basic diagnostic and demographic data, and no information on treatment or on the functional status of the patients who survived was included.

Our findings on mortality are broadly comparable with those found in other studies of mortality after fractured neck of femur in defined Western populations.[10–16] For example, our mortality rate at 90 days was 18.3% in 1984-98 compared with 17.9% in the East Anglian hip fracture audit, which used clinical follow up in the early

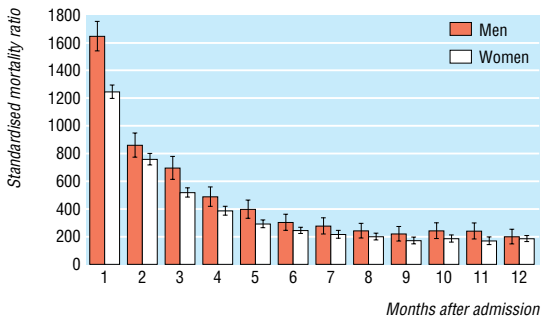

Fig 3 Standardised mortality ratios after hospital admission for fractured neck of femur in men and women, 1968-98. Bars are 95% confidence intervals

1990s.[10] Thus our finding from routine linked data is almost the same as that in an intensively followed clinical population in an adjacent English health region. Our case fatality rate at one year in 1984-98, 30.7%, compares with rates in studies of other Western populations, ranging from 25% to 38%.[11–16]

The incidence of fractured neck of femur has increased in recent decades.[6 17] Incidence rates are higher in women than men but, as we show, case fatality rates and standardised mortality ratios after fracture were substantially higher in men than women. This contrasts with findings in illnesses such as coronary heart disease and stroke, which tend to have a higher incidence in men than women but higher fatality rates in women than men.[18–21]

We found that mortality after fracture was higher in social classes IV and V (lower socioeconomic status) than in I and II (higher status). Little is known about social class and post-fracture mortality: one study reported no association,[22] and another reported higher mortality in lower social classes.[23] Population based all cause mortality is higher in social classes IV and V than in classes I and II. However, our findings probably reflect more than just the general health related disadvantages of classes IV and V. The fact that the mortality differential was greatest within 30 days indicates an effect that was specific to the outcome of the fracture. Social class data were collected by the Oxford record linkage study up to the late 1980s. Unfortunately, the Department of Health's reforms to NHS information systems in the 1980s caused this to stop.

Mortality rates after fracture fell significantly from the late 1960s to the early 1980s but have not declined further in the past 20 years. It is unclear whether mortality after fractured neck of femur has declined to an irreducible minimum or whether there is still scope for further reduction. We suggest that investigators with access to longstanding, linked databases in other countries might determine whether post-fracture mortality rates have levelled off in their populations in recent years. For this and other conditions, more should be done than is current practice to compare outcomes in the NHS with outcomes in other countries and health care systems.[24] The lack of recent decline in mortality, coupled with the fact that mortality after fracture is so high, mean that preventive programmes aimed at osteoporosis and at falls and their consequences in elderly people are particularly important.

Leicester Gill, Glenys Bettley and Myfanwy Griffith built the linked files. We thank David Yeates for extraction of data for analysis.

Contributors: SER contributed to study design, reviewed the literature, undertook the analyses and co-wrote the manuscript. MJG designed the study and co-wrote the manuscript. SER and MJG are guarantors.

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Conflict of interest: None declared.

Ethical approval: Approval for building of historical data files was given by Oxford Region Data Protection Steering Group and health authorities' Caldicott guardians. Ethical approval was not needed for analysis of anonymised statistical dataset.

What is already known on this topic

Numbers of elderly people with fractured neck of femur are increasing in most Western populations

Case fatality rates increase sharply with age

What this study adds

Case fatality rates after fractured neck of femur have not declined appreciably during the past 20 years

Although the incidence of fractured neck of femur is much higher in women than men, case fatality rates are higher in men than women

High death rates, and the fact that they have not declined, reinforce the need for prevention of osteoporosis, falls, and fractures

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