Journal of Public Health Medicine

Vol. 20, No. 2, pp. 196–205
Printed in Great Britain

Hip fracture incidence and mortality in an English Region: a study using routine National Health Service data

Alastair McColl, Paul Roderick and Cyrus Cooper

Abstract

Background We investigated the validity of routine hospital and mortality hip fracture data in one English Region and estimated trends in hip fracture between 1978–1981 and 1993–1995.

Methods We identified from Hospital Episode System (HES) data for 1993–1995 all hip fracture episodes relating to individual patients aged over 65 years resident in Wessex. We determined from the discharge method code whether an individual had died during that admission. The number of individual regional and district admissions and deaths were compared with those presented in the Public Health Common Data Set. We compared regional admission rates with data for 1978–1981 from a previous study.

Results National comparative indicators for hip fracture overestimated individual admissions in Wessex by 17 per cent (in health authorities by 1–56 per cent). National comparative indicators for hip fracture mortality underestimated individual deaths in Wessex by 48 per cent. Between 1978–1981 and 1993–1995 the age–sex-standardized hip fracture rates rose from 1.90 to 2.63 per 1000 per year for men and from 5.70 to 7.70 per 1000 per year for women. Rates increased in all age groups except those aged 65–69 years. There was also a small fall in absolute mean annual numbers in this age group. The rates also fell in females aged 70–74.

Conclusions It is possible to adjust routine national HES data to take account of multiple episodes within a single admission. These methods should be applied to national comparative indicators for hip fracture admission and deaths. Hip fracture rates continue to rise in those aged over 70 years. There may be a cohort effect with those born after 1925 showing stable rates which needs further investigation.

Keywords: hip fracture, incidence, mortality

Introduction

Hip fracture is a major cause of mortality and morbidity. It is important to examine trends in hip fracture incidence to contribute to the understanding of aetiology and to assess future demand on health services. Hip fracture admission rates are a good proxy for incidence as virtually all people with hip fracture are admitted to hospital. Variations in hip fracture admission rates could reflect differences in population risk and in the use of prevention measures. Variations in mortality associated with hip fracture could reflect differences in quality of health care as well as incidence. Mortality after hip fracture admission can differ significantly between hospitals even after adjusting for case mix.[1]

The Public Health Common Data Set (PHCDS)[2] provides information each year on the considerable variation in hip fracture admissions and deaths between English Health Authorities. In 1995 hip fracture in England resulted in over 55 000 admissions and was reported as a certified cause of death in over 1600 people.[2] Hip fracture deaths contribute to a *Health of the nation* indicator 'deaths in those aged 65 years and above from accidents'.

However, there are major problems with current routine hip fracture statistics in England. The routine data source for admissions is the Hospital Episode System (HES). During an admission a patient can undergo several finished consultant episodes (FCEs) making it difficult to determine a single independent episode of disease for an individual patient.[3] These and other theoretical constraints in the use and interpretation of national hip fracture indicators have been highlighted.[4] In England it has not been possible to use routine data to examine trends in hip fracture incidence because of the change from pre-1985 Hospital Activity Analysis (HAA) data on hospital discharges to post-1989 FCE based data used in Hospital Episode Statistics (HES). A wide range of data are recorded within each FCE, including date of birth, postcode, discharge destination including death, and the episode order if more than one FCE took place during the admission. The routine data source for hip fracture deaths in the PHCDS is the death certificate. The selection of underlying cause of death is made

Wessex Institute for Health Research and Development, Level B, Southampton General Hospital, Southampton SO16 6YD.

Alastair McColl, Lecturer in Public Health Medicine

Paul Roderick, Senior Lecturer in Public Health Medicine

MRC Environmental Epidemiology Unit, Southampton General Hospital, Southampton SO16 6YD.

Cyrus Cooper, Professor of Rheumatology

Address correspondence to Dr Alastair McColl.

from the condition or conditions mentioned on the certificate. The Office for National Statistics cautions that hip fracture mortality data should be used with great care because 'artefactual local differences result from variations in certification procedures between coroners' and trend analysis is 'affected by changes in certification procedures in 1993'.[5]

This paper presents a study which aimed to: (1) investigate the validity of routine data in describing the epidemiology of hip fracture in one English region by comparing routine admission and mortality indicators with local HES data adjusted after identifying FCEs relating to individual patients; and (2) estimate trends in hip fracture incidence in Wessex using standardized discharge rates from HAA data for 1978–1981 and standardized admission rates for 1993–1995.

Methods

Hip fracture admissions

We obtained local HES data from Postbox, a data company, which until April 1996 collected all local data for the former Wessex region before sending it on to the national co-ordinator of HES. These data included residents of the former Wessex region over the age of 65 years and those residents admitted to hospitals outside the region between 1 April 1994 and 31 March 1995. We used primary and secondary ICD9 diagnostic codes of 820 and 821 (see Table 1) together with additional digits after these codes (i.e. 82009).

We identified all FCEs relating to individual patients by examining each FCE after sorting by postcode, date of birth and sex. We recorded an individual admission for hip fracture if there were multiple FCEs within that admission. If there appeared to be more than one admission for an individual we recorded this as a readmission and not as a new case of hip fracture. Hospital numbers were not available.

We compared the number of these individual regional and district admissions with the data presented in the PHCDS for the same period (ICD9 codes 820 and 821).

Hip fracture deaths

We determined whether a patient had died during the admission by examining the discharge method code of all the FCEs relating to an individual patient. We calculated the number of district and regional deaths between April 1994 and March 1995.

We compared the number of these individual regional and district deaths with the data presented in the PHCDS. These data are for the calendar years 1994 and 1995 and so from this we estimated the number of deaths between April 1994 and March 1995.

Table 1 *ICD9 codes for femoral fracture*

820 -	**Fracture of neck of femur**
820.0	transcervical fracture, closed
820.1	transcervical fracture, open
820.2	pertrochanteric fracture, closed
820.3	pertrochanteric fracture, open
820.8	unspecified part, closed
820.9	unspecified part, open
821 -	**Fracture of other and unspecified parts of femur**
821.0	shaft or unspecified part of femur
821.1	shaft or unspecified part of femur

Trends in hip fracture admission in Wessex

We calculated the age-standardized regional admission rates using the individual patient admissions derived from the adjusted 1994–1995 HES data. We obtained 1993–1994 local HES data and calculated individual patient admissions as described above. We examined an additional 12 months data to improve the precision of our estimated rates. We calculated these rates using ICD9 820 alone and ICD9 820 and 821 together. We obtained the 1994 age structure for Wessex from the Wessex Cancer Intelligence Unit. This was calculated using data from the former Office of Population Censuses and Surveys.

Previous studies had used Wessex HAA hip fracture discharge data for 1978–1981 and Wessex mean population age structure for 1978–1982.[6–8] We used these data to derive age- and sex-standardized rates. ICD9 821 was not included in these studies.

We compared directly age–sex-standardized hip fracture rates with 1978–1981 HAA derived rates. Standardization used the 1994 European population using the same methods as described in the PHCDS.[2]

We calculated confidence intervals for the age–sex-standardized and directly standardized rates as described by Gardner and Altman.[9]

Results

Hip fracture admissions

Table 2 shows that 3485 FCEs using Postbox HES data represented 3145 individual patients with hip fracture. There were 3695 admissions presented in the PHCDS for same period. This could be interpreted as a 17 per cent overestimate of the true number of individual admissions; this varied between districts from 1 per cent to 56 per cent.

Other easier methods to estimate the number of individual patients with hip fracture would have been to exclude FCEs not coded as the first episode in that admission. This would have excluded 290, resulting in an estimation of 3195 patients. A length of stay of 0 days was recorded in 35 of these. There were an additional 25 FCEs recorded as the first episode with a length of stay of 0 days.

Hip fracture deaths

Postbox HES data for April 1994–March 1995 presented in Table 3 show that for Wessex residents over the age of 65 years there were 206 deaths in the 3145 patients (7 per cent) during

Table 2 The number of FCEs for Wessex residents over the age of 65 years admitted with fractured neck of femur in 1994–1995 using Postbox HES data and comparison with numbers presented in the PHCDS

District	(A) Number of Postbox FCEs	(B) Multiple FCEs	(C) Further admissions during the year*	(D) Individual patient admissions [A – (B + C)]	(E) Number of FCEs which were not coded as the first episode	(F) PHCDS 1994–1995 data (boundaries at April 1995)	(G) Ratio of PHCDS FCEs representing individual patient admissions (F/D)
Dorset	1068	102	21	945	117	1093	1.16
Portsmouth & SE Hampshire	497	38	12	447	35	507	1.13
Southampton & SW Hampshire	525	37	6	482	42	626	1.30
North & Mid Hampshire	372	60	6	306	54	478	1.56
Wiltshire & Bath	807	29	11	767	35	772	1.01
Isle of Wight	216	16	2	198	7	219	1.11
Wessex	3485	282	58	3145	290	3695	1.17

The 3620 Wessex FCEs obtained from Postbox included 83 which had additional digits after 820 or 821 and six in which hip fracture was coded as a secondary diagnosis. Ninety-two per cent were coded as ICD9 820 and 8 per cent as ICD9 821. Ten patients had separate FCEs for both ICD9 820 and 821. Of the 282 Wessex multiple FCEs six individual patients had four FCEs recorded during their admission, 23 had three FCEs recorded and the rest two FCEs.

*Readmitted at a later date with assumed complication of original hip fracture.

Table 3 The number of deaths for Wessex residents over the age of 65 years admitted with fractured neck of femur in 1994–1995 using Postbox HES data

District	(D) Number of individual patient admissions (from Table 2)	(H) Number of Postbox FCEs with death recorded as discharge method	(I) Number of FCEs recording death as discharge method in same patient	(J) Number of individual deaths (H – I)
Dorset	945	41	1	40
Portsmouth & SE Hampshire	447	34	1	33
Southampton & SW Hampshire	482	38	2	36
North & Mid Hampshire	306	30	4	26
Wiltshire & Bath	767	55	1	54
Isle of Wight	198	20	3	17
Wessex	3145	218	13	206

A total of 324 FCEs had no discharge code recorded and some of the patients represented by these may have died.

their hip fracture admission. The estimated number of deaths for the same period calculated from the PHCDS was 106.5 (Table 4). This could be interpreted as an overall underestimate of 48 per cent which varied considerably between districts.

Trends in hip fracture admission in Wessex

Figure 1 and Table 5 show that the age–sex-specific rates increased overall in both sexes and in all age groups except age group 65–69 years, in which there was also a small fall in absolute mean annual numbers. The rates also fell in females aged 70–74. The greatest rate increases were in the age groups 80–84 for both sexes. The annual mean number of hip fractures rose from 330 men and 1496 women in 1978–1981 to 568.5 men and 2405.5 women in 1993–1995 (Table 5).

There was an overall 11.4 per cent increase for males and a 8.3 per cent increase for females in directly standardized hip fracture rates using ICD9 820 only; if ICD9 820 and 821 were combined in the 1993–1995 data this represented an 18.8 per cent increase for males and a 15.2 per cent increase for females (Table 6).

Discussion

Hip fracture admissions

The PHCDS indicator overestimated individual Wessex admissions by 17 per cent and the overestimation varied between districts. The national indicator should exclude FCEs

Table 4 Comparison of the number of district and regional deaths for Wessex residents over the age of 65 years admitted with fractured neck of femur between April 1994 and March 1995 using number of deaths calculated from Postbox HES data and estimated number of deaths for the same period calculated from the PHCDS

District	(K) PHCDS Number of deaths in 1994	(L) PHCDS Number of deaths in 1995	(M) Estimated number of deaths between April 1994 and March 1995 [(3K + L)/4]	(J) Number of individual deaths (as in Table 3)	Ratio of PHCDS deaths representing individual deaths (M/J)
Dorset	40	42	40.5	40	1.01
Portsmouth & SE Hampshire	16	19	16.75	33	0.51
Southampton & SW Hampshire	12	31	16.75	36	0.47
North & Mid Hampshire	15	20	16.25	26	0.63
Wiltshire and Bath	16	14	15.5	54	0.29
Isle of Wight	1	0	0.75	17	0.04
Wessex	100	126	106.5	206	0.52

The numbers of deaths for 1994 and 1995 are presented in the PHCDS data by district codes and boundaries on 1 April 1996.[5] Southampton & SW Hampshire (QD3) includes some patients previously with North & Mid Hampshire (QD1). Deaths recorded in Bath (08UB) have been combined with those for Wiltshire in the analysis above.

not coded as the first episode in that admission. Our results showed this would be a more appropriate method to estimate the number of individual patients at a district level. Adjusting for zero length of stay did not have much impact. The PHCDS indicator uses all FCEs with a primary diagnosis of hip fracture in the numerator. This is appropriate as we found only an additional six cases in which hip fracture was coded as a secondary diagnosis and in which there clearly had been an operation.

There are other ways to adjust FCE data. The Health Service Indicators have used KP70 adjustments. Because of anticipated shortfalls in data, 'bottom line counts' of the number of FCEs by specialty for each district have been collected.[10] Positive or negative adjustments can be made where FCEs are under- or over-counted. The average 1993–1994 KP70 adjustments for Wessex residents receiving care from the specialty of Trauma and Orthopaedics was only −0.7 per cent.[11] This means that there was an estimated FCE over-counting of less than 1 per cent within Trauma and Orthopaedics. Hip fracture patients represent a proportion of these FCEs.

We are unable to explain the discrepancy between the total Postbox FCEs (3485) and the total PHCDS FCEs (3695). The latter may include patients operated on in two military hospitals in Wessex, which Postbox data did not include. Wherever possible we used data from the Wessex boundaries before April 1995. Our numerators from local Postbox data may be an underestimate. If this is the case, the increased regional hip fracture rate would be an underestimate of the true rate. The discrepancy was unlikely to be due to Wessex residents operated on outside the region (transfer FCEs), as Postbox data included these.

Multiple FCEs within an admission could be a marker of case severity or imply good multidisciplinary co-operation or rehabilitation. The most appropriate method to determine hip fracture incidence and also validate HES data and interpret multiple FCEs would be through a prospective study. Such a study could include a comparison of the management of individual patients against their HES record.

It is possible to adjust national routine HES data to take account of multiple FCEs within a single admission. These methods should be applied to national comparative indicators for hip fracture admission.

Hip fracture deaths

The difference in district hip fracture mortality rates used in the PHCDS and those using HES could be explained by hip fracture not being recorded on a death certificate. A retrospective cohort study using record linked data suggested that hip fracture appeared on a death certificate in only 25 per cent of those dying within four weeks of operation.[12] Even if hip fracture does appear, it may not be classified as the underlying cause. Another study found a similar proportion and suggested that the

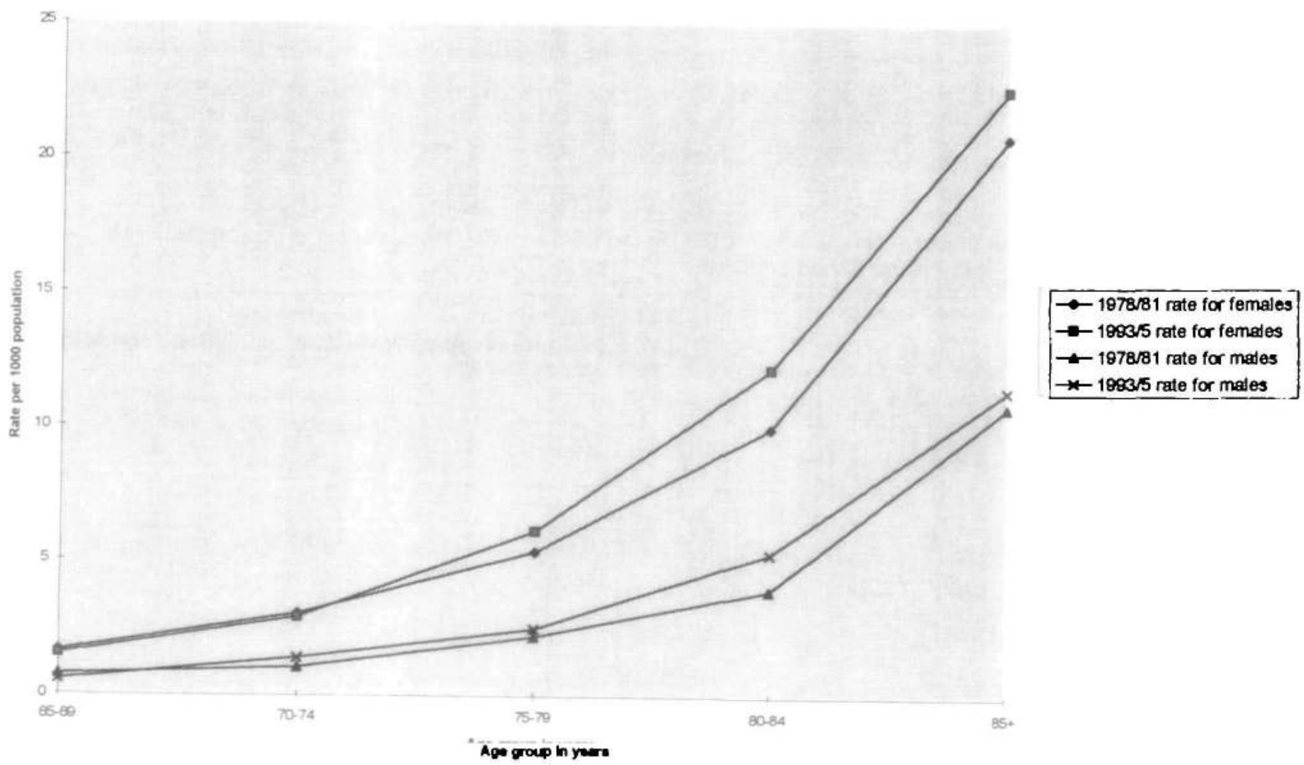

Figure 1 Age–sex-specific hip fracture rates in Wessex; ICD9 820 only; 1978–1981 HAA discharge data; 1993–1995 adjusted HES admission data.

Table 5 *The age–sex-specific and standardized hip fracture rates (per 1000 population) in Wessex residents over the age of 65 years using 1978–1981 HAA age–sex-specific and standardized rates and 1993–1995 individual patient admissions rates derived from Postbox HES data; ICD9 820 and 820 together with 821*

	Male						Female					
Age group	**65–69**	**70–74**	**75–79**	**80–84**	**85+**	**Total**	**65–69**	**70–74**	**75–79**	**80–84**	**85+**	**Total**
(i) Average annual HAA rates 1978–1981*	0.74 (0.55–0.99)	1.04 (0.78–1.35)	2 20 (1.73–2.76)	3 94 (3.04–5.04)	10 79 (8.69–13.26)	1 90 (1.70–2 12)	1.62 (1.36–1 93)	3.04 (2.64–3 47)	5.35 (4.75–6.00)	9.99 (8.96–11.10)	20.78 (14.03–22.65)	5.70 (5.41–5.99)
(ii) Mean annual HAA numbers 1978–1981	47	54	74	64	91	330	126	215	291	345	518	1496
(iii) Average annual combined 1993–1995 admission rates; ICD9 820 only*	0.54 (0.37–0.74)	1.40 (1.13–1.73)	2 50 (2.04–3.03)	5 31 (4 50–6.23)	11 40 (9.83–13 14)	2.63 (2.42–2 85)	1.51 (1 24–1 83)	2.91 (2 55–3 31)	6.13 (5.53–6.78)	12.19 (11 25–13.18)	22.54 (21.20–23.94)	7.70 (7.40–8.02)
(iv) Average annual combined 1993–1995 admission rates; ICD9 820 + 821*	0 60 (0.43–0.82)	1.53 (1.24–1.87)	2 6 (2.20–3.23)	5 69 (4.85–6.64)	11 84 (10.25–13 62)	2 81 (2.59–3.04)	1.65 (1.37–1.98)	3.10 (2 72–3.50)	6.51 (5.88–7.18)	12.91 (11.94–13.93)	23.95 (22.57–25 39)	8.19 (7.87–8.51)
(v) Mean annual numbers 1993–1995; ICD9 820 (820 and 821 in parentheses)	36 (40.5)	88 (96)	103 (110 5)	151 (162)	190 5 (198)	568.5 (607)	108.5 (118.5)	235.5 (250.5)	376.5 (399 5)	627 (664)	1058 (1124)	2405.5 (2556 5)
(vi) Relative increase from 1978–81 to 1993–1995 (iii/i), ICD9 820 (820 and 821 in parentheses iv/i)	0.73 (0.81)	1.35 (1.47)	1.14 (1 22)	1.35 (1.44)	1.06 (1.10)	1.38 (1.48)	0.93 (1 01)	0 96 (1 02)	1 15 (1.22)	1.22 (1.29)	1.08 (1.15)	1.35 (1.44)
(vi) Absolute difference in rates (iii – i), ICD9 820cb (820 and 821 in parentheses iv – i)	–0.2 (–0.14)	0.36 (0.49)	0.3 (0.48)	1.37 (1.75)	0.61 (1 05)	0 73 (0.91)	–0.11 (0 03)	–0.13 (0.06)	0.78 (1.16)	2.2 (2.92)	1.76 (3.17)	2.0 (2.49)

*Values in parentheses are 95% confidence intervals.

need for an inquest could act as a barrier to junior doctors recording fractures on the death certificate.[13] Osteoporosis can be coded as the underlying cause of death (ICD9 733) even if hip fracture is mentioned on the death certificate. In England over a thousand deaths are annually recorded this way.[14] We did not attempt to obtain local data for ICD9 733. Local deaths may have occurred some time after the hip operation and the doctor completing the death certificate may have decided that other factors were more important causes of death.

We have not presented district mortality and case fatality rates. The small numbers involved and differences in case mix could make interpretation misleading. In the East Anglia hip fracture audit 90 day mortality was 18 per cent, differing significantly between hospitals (5–24 per cent).[1] A proportion of deaths would have occurred after discharge from hospital. This audit emphasized the importance of taking case mix and other potential confounders into account when examining differences in health outcome, including case fatality, between provider units.[15] In our study the local HES data suggested that mortality during admission was at least 7 per cent. Complete discharge data and a longer period of follow-up, including those patients transferred for rehabilitation, could increase this percentage. The absence of data on what happens to patients after they leave hospital is a well-recognized problem.[16] A routine data indicator based on mortality after hip fracture would depend on record linkage. The UK Government has recently proposed hospital mortality within 30 days of admission following hip fracture as a clinical indicator for health authorities and trusts in England.[17] This indicator will use HES data and account for multiple FCEs within a single admission. This study suggests that HES data are a more appropriate source for a national hip fracture hospital mortality indicator than information on underlying cause from death certificates. (Plans for multiple cause coding of death certificates may make death certificate analysis more useful.[18,19]) However, HES data would have to be evaluated in a prospective study. The proposed indicator will only use ICD9 820, and the proportion of deaths occurring outside hospital 'will be investigated using the Oxford Record Linkage Data'.[17]

For some clinical conditions, process measures based on the results of randomized controlled trials can detect relevant differences between hospitals that would not be identified by comparing hospital-specific mortality.[20] Relevant process measures for hip fracture, which would require additional data collection, could include thromboembolic and antibiotic prophylaxis and early mobilization.[15] HES data could be used to examine process measures such as the length of time between admission and operation[21] or whether an operation was performed.

Trends in hip fracture admission in Wessex

Evidence from several countries suggests that the age-standardized incidence of hip fracture has been increasing over the last three decades,[22–27] although one paper has suggested that it has started to decrease[27] (see Table 7). An increasing age-standardized incidence would have a major impact on the use of resources.[28,29] Spector *et al.* published the last study to examine trends in England and Wales.[30] They found a dramatic increase from 1968 to 1978 and then a levelling off with a relatively constant standardized admission ratio from 1980 to 1985.

The overall 11.4 per cent increase in hip fracture for males and 8.3 per cent for females using directly standardized methods (Table 6) contrasts with the 38 per cent increase for males and 35 per cent increase for females in comparative age-standardized rates [Row (vi) in Table 5]. The increases in Table 5 are equivalent to indirectly standardized admission ratios using age-standardized rates for 1978–1981 as the reference. It is preferable to use direct standardization when comparing trends for hip fracture incidence or admissions. The differing proportions of very elderly people among the population being compared could result in differing standardized admission ratios even if the age-standardized mortalities were the same.[31] Because the age group 85+ in Tables 5 and 6 is 'open' and there are increasing numbers surviving to greater ages in this group it may be more appropriate to make comparisons over time for the 'closed' age group of 65–84 years.

Changes in the proportion of true fractured neck of femur classified as either ICD9 820 or 821 could have an effect on the

Table 6 Directly standardized hip fracture rates in Wessex residents aged over 65 years using the 1978–1981 HAA data and the 1993–1995 individual patient admissions from Postbox HES data

	Directly standardized admission rates	
	Males	Females
(i) HAA 1978–1981*	2.29 (1.79–2.89)	5.19 (4.62–5.81)
(ii) Individual patient admissions April 1993–March 1995; ICD9 820 only*	2.55 (2.12–3.05)	5.62 (5.10–6.18)
(iii) Per cent increase between these periods (ii/i)	11.4	8.3
(iv) Individual patient admissions April 1993–March 1995; ICD9 820 + 821*	2 72 (2.27–3.24)	5.98 (5.45–6.56)
(vi) Per cent increase between these periods (iv/i)	18.8	15.2

Direct standardization used the 1994 European population.
*Values in parentheses are 95% confidence intervals.

Table 7 Some studies examining changes in age–sex-specific and standardized hip fracture rates

Place and study reference	Period studied	Age group studied	Changes in age-standardized rates per 1000	Source of data
Rochester Minnesota, USA (Melton *et al.*[27])	1928 to 1992	All ages	Between 1928 and 1950 rates rose in women, and rose in men between 1928 and 1980. Rates fell thereafter. Between 1983 and 1992 the rates in men showed a slight fall from approximately 16 for those over 85 and 2 for those aged 65–74. In those aged 75–84 the rate was steady at 5.5. Between 1983 and 1992 in women the rates fell from about 24 to 21 in those aged over 85, from 12 to 10 in those aged 57–84 and from 3 to 2.5 in those aged 65–74	Used the Rochester Epidemiology Project medical records linkage system. Excluded sub-trochanteric fractures and those more distal on the femur
Malmo, Sweden (Gullberg *et al.*[22])	1950 to 1991	50 years and over	Males from approximately 1.0 to 3.3. Females from approximately 3.6 to 5.4. In men, all age classes experienced a significant yearly increase (1.6% in the 50–59 age group, 3.9% over the age of 80). In women, only the 70–79 and 80+ age groups showed a significant increase (1.4%, 2.3%). A levelling off occurred during the mid-1980s	Data from Dept of Diagnostic Radiology in the single hospital
Unites States (Bacon[34])	1965 to 1993	White population 50 years and over	Rates increased significantly for males in age groups 80–84 years and 85 years and older, but not for younger males. For females, age-standardized rates did not change significantly	Used the National Hospital Discharge Survey. Used ICD9 820
Netherlands (Boereboom *et al.*[35])	1972 to 1987	65 years and over	Males from 1.98 to 3.08. Females from 4.79 to 6.69	Hospital admissions coded as ICD9 820
Norway (Falch *et al.*[23])	1978–1979 to 1988–1989	50 years and over	Rates rose in all groups except women aged 50–59 years. Rates rose for males to 4.5 in Oslo and to 3.7 in rural population (27% for those 70–79 years and 42% for those over 80 years). Rates rose for females to 11.9 in Oslo and to 7.5 in rural populations (14% for those 70–79 years and 31% for those over 80 years)	Data from hospital admission records
Siena, Italy (Agnusdei *et al.*[33])	1980 to 1991	50 years and over	Males from 0.57 to 1.1 with annual increasing rate of 0.04. Females from 1.2 to 1 9 with no significant trend	Review of hospital notes
New South Wales, Australia (Lau[25])	1981 to 1989–1990	all ages	Males from 1.48 to 1.82 Females from 4 37 to 5.00	Hospital discharge data using ICD9 820
Oxfordshire and West Berkshire, UK (Evans *et al.*[32])	1968 to 1985	65 years and over	Males from approximately 1.3 to 1.8. Females from approximately 4.9 to 6.3	Using record linked population data ICD9 820 separately and combined with 821
This study Wessex region, UK	1978–1981 to 1993–1995	65 years and over	Males from 1.90 to 2.63 Females from 5 70 to 7.70. Rates increased in all age groups except those aged 65–69 years and females aged 70–74 years	Used ICD9 820 separately and combined with 821

monitoring of trends. A validation exercise by Evans *et al.*[32] found that nearly half of the true cases of fracture of neck of femur (ICD9 820) had been coded as fractures of other and unspecified parts of femur (ICD9 821). Seven per cent of cases coded as fracture of neck of femur (820) should have been coded as other and unspecified parts of femur (821). Evans *et al.* concluded that the two categories should be combined in an examination of secular changes. ICD9 821 accounted for 8 per cent of our 1993–1995 hip fracture admission data and our results are presented for ICD9 820 alone and combined with 821. The previous studies[6–8] using HAA data had used only ICD9 820 because at that time these data were considered comprehensive (C. Cooper, personal communication, 1997). The 1978–1981 age–sex-specific rates in this study are similar to those for the same period in the study by Evans *et al.*,[32] which used ICD9 820 and 821 combined. In England, hospital data coders do not need a formal qualification, unlike their contemporaries in the United States. There may have been variation in the coding of hip fracture between and within the Wessex hospitals. Other studies examining trends in hip fracture incidence have used only ICD9 820 (see Table 7); these include one study examining trends in England and Wales.[30] All hip fractures are now coded under the new ICD10 classification as S72 – fracture of femur. There are different subgroups for fractures at varying femoral sites.

We have shown an increase in hip fracture rates in both sexes and in all age groups except age group 65–69 years and females aged 70–74 years. This contrasts with the last trend study in England and Wales with a levelling off between 1980 and 1985.[30] The changes in age-standardized admission rates over the period studied are similar to reports from other countries (see Table 7). We have corrected for a potential overestimation because of the use of FCEs. A possible cohort effect in hip fracture patients with reduced rates in those born after 1925 needs further investigation. Other studies have reported reduced or steady rates in women born in the 1920s and early 1930s[22,23] and in both sexes.[33] However, the continuing increased hip fracture rates in those born before this date could have a major impact on future NHS resources.

This study has implications for using routine data to examine the epidemiology of hip fracture and to monitor the quality of hip fracture care. Changes in methods of data collection, in health authority and regional boundaries, and in the use of ICD codes make the analysis of routine data complex. This study has shown that it is possible to examine hip fracture incidence, mortality, and trends by using routine NHS data adjusted to take account of multiple episodes within a single admission.

Acknowledgements

We thank Veena Soni Raleigh and Victor Kiri for provision of statistical data. We thank Gill Ferris for obtaining Postbox data.

References

1 Todd CJ, Freeman CJ, Camilleri Ferrante C, *et al.* Differences in mortality after fracture of hip: the East Anglian audit. *Br Med J* 1995; **310:** 904–908.

2 Department of Health. *Public Health Common Data Set 1995. Incorporating population health outcome indicators for the NHS. Data definitions and user guide for computer files*. Guildford: Institute of Public Health, University of Surrey, 1995.

3 Clarke A, McKee M. The consultant episode: an unhelpful measure. *Br Med J* 1992; **305:** 1307–1308.

4 McColl AJ, Gulliford MC. *Population health outcome indicators for the NHS. A feasibility study*. London: Faculty of Public Health Medicine and the Department of Public Health Medicine, United Medical and Dental Schools of Guy's and St Thomas' Hospitals, 1993.

5 Department of Health. *Public Health Common Data Set 1996 – supplementary data*. Guildford: National Institute of Epidemiology, University of Surrey, 1997.

6 Cooper C. *The epidemiology of hip fracture in the elderly*. DM thesis, University of Southampton, 1989.

7 Cooper C. Epidemiology and public health impact of osteoporosis. *Balliere's Clin Rheumatol* 1993; **7:** 459–477.

8 Cooper C, Wickham C, Lacey R, Barker DJP. Water fluoride content and fracture of the proximal femur. *J Epidemiol Commun Hlth* 1990; **44:** 17–19.

9 Gardner MJ, Altman DG. *Statistics with confidence – confidence intervals and statistical guidelines*. London: British Medical Journal, 1989.

10 NHS Management Executive. *Health Service Indicators – dictionary*. London: NHS Management Executive, 1991.

11 Raftery J. *Comparative analysis for Health Commissions and Trusts in the South and West Region*. Southampton: Wessex Institute for Health Research and Development, 1996.

12 Goldacre MJ. Cause-specific mortality: understanding uncertain tips of the disease iceberg. *J Epidemiol Commun Hlth* 1993; **47:** 491–496.

13 Calder SJ, Anderson GH, Gregg PJ. Certification of cause of death in patients dying soon after proximal femoral fracture. *Br Med J* 1996; **312:** 1515.

14 McKee M. Indicators of clinical performance. *Br Med J* 1997; **315:** 142.

15 Todd CJ, Freeman C. East Anglia audit of hip fracture. In: McColl AJ, Roderick P, Gabbay J, eds. *Improving health outcomes – case studies on how English health authorities use population based health outcome assessments*. Southampton: Wessex Institute for Health Research and

Development, 1997 (available on http://www.soton.ac.uk/~wi/projx/outcomes/iho1.htm).

16 McKee M, Hunter D. Mortality league tables: do they inform or mislead? *Qual Hlth Care* 1995; **4:** 5–12.

17 NHS Executive. *Clinical indicators for the NHS (1994–5) – a consultation document*. London: Department of Health, 1997.

18 Ashley J, Devis T. Death certification from the point of view of the epidemiologist. *Population Trends* 1992; **67:** 22–28.

19 Birch D. Automatic coding of causes of death. *Population Trends* 1993; **73:** 36–38.

20 Mant J, Hicks N. Detecting differences in quality of care: the sensitivity of measures of process and outcome in treating acute myocardial infarction. *Br Med J* 1995; **311:** 793–796.

21 Kisely S, Garnet S. Hip fracture in South Lancashire. In: McColl AJ, Roderick P, Gabbay J, eds. *Improving health outcomes – case studies on how English health authorities use population based health outcome assessments*. Southampton: Wessex Institute for Health Research and Development, 1997 (available on http://www.soton.ac.uk/~wi/projx/outcomes/iho1.htm).

22 Gullberg B, Duppe H, Nilsson B, *et al.* Incidence of hip fractures in Malmo, Sweden (1950–1991). *Bone* 1993; **14**(Suppl 1): S23–S29.

23 Falch JA, Kaastad TS, Bohler G, Espeland J, Sundsvold OJ. Secular increase and geographical differences in hip fracture incidence in Norway. *Bone* 1993; **14:** 643–645.

24 Lee CM, Sidhu JS, Pan KL. Hip fracture incidence in Malaysia 1981–1989. *Acta Orthop Scand* 1993; **64:** 178–180.

25 Lau EM. Admission rates for hip fracture in Australia in the last decade. The New South Wales scene in a world perspective. *Med J Aust* 1993; **158:** 604–606.

26 Fisher ES, Baron JA, Malenka DJ, *et al.* Hip fracture incidence and mortality in New England. *Epidemiology* 1991; **2:** 116–122.

27 Melton LJ, Atkinson EJ, Madhok R, Robbins J. Downturn in hip fracture incidence. *Public Hlth Rep* 1996; **111:** 146–151.

28 Hollingworth W, Todd CJ, Parker MJ. The cost of treating hip fractures in the twenty-first century. *J Publ Hlth Med* 1995; **17:** 269–276.

29 Royal College of Physicians. *Fractured neck of femur: prevention and management*. London: Royal College of Physicians, 1989.

30 Spector TD, Cooper C, Lewis AF. Trends in admissions for hip fracture in England and Wales, 1968–85. *Br Med J* 1990; **300:** 1173–1174.

31 Rothman KJ. *Modern epidemiology*. Boston, MA: Little, Brown, 1986: 46–48.

32 Evans JG, Seagroatt V, Goldacre MJ. Secular trends in proximal femoral fracture, Oxford Record Linkage Study area and England 1968–86. *J Epidemiol Commun Hlth* 1997; **51:** 424–429.

33 Agnusdei D, Camporeale A, Gerardi D, *et al.* Trends in the incidence of hip fracture in Siena, Italy, from 1980 to 1991. *Bone* 1993; **14**(Suppl 1): S31–S34.

34 Bacon WE. Secular trends in hip fracture occurrence and survival: age and sex differences. *J Aging Hlth* 1996; **8:** 538–553.

35 Boereboom FT, de Groot RR, Raymakers JA, Duursma SA. The incidence of hip fractures in The Netherlands. *Neth J Med* 1991; **38:** 51–58.

Accepted on 7 January 1998