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Original Article

The Cost of Treating Osteoporotic Fractures in the United Kingdom Female Population

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Abstract. Osteoporotic fractures represent a significant burden to society. The costs of osteoporotic fractures to the UK health care system have not previously been accurately described. In this paper, we quantify the health care and social care costs of fractures occurring in women aged 50 years and over in the UK. We used a variety of data sources. For acute hospital hip fracture costs existing published estimates were used whilst for social care costs a survey of resource use among fracture patients before and after hip fracture was utilized. We undertook a case–control study using the General Practice Research Database to estimate primary care costs. From these data we estimated that the cost of a hip fracture is about £12 000, with non-acute hospital costs representing the larger proportion. The other fractures were less expensive, at £468, £479 and £1338 for wrist, vertebral and other fractures, respectively. For all fractures the annual cost to the UK is £727 million. Assuming each male hip fracture costs the same as a female fracture, including these would increase the total costs to £942 million.

Keywords: Cost of illness; Cost of fracture; Cost of osteoporosis

Introduction

Fractures attributable to osteoporosis are a major source of morbidity and mortality among the elderly female population [1]. There is evidence that the age-specific fracture incidence is rising [2] and, given the aging population, this will combine to increase the numbers of fractures the health services will have to treat. The public health impact of osteoporosis is probably greater than originally assumed as recent evidence suggests that, with the possible exception of skull fractures, most fractures occurring in elderly women are associated with low bone mass [3].

In the past, it was generally assumed that the main method of preventing osteoporotic fractures in women is through the widespread use of hormone replacement therapy (HRT) at the menopause [4]. However, there is some recent evidence suggesting that HRT to prevent fractures must be taken continuously and for life, as any bone benefits are lost shortly after cessation of therapy [5]. As a result, prevention of a significant proportion of osteoporotic fractures has not hitherto been possible.

Recently, however, there has been an increased research effort into non-HRT alternatives for the prevention of osteoporosis. For frail elderly women living in sheltered accommodation, it seems likely that daily dietary supplementation with 800 IU of vitamin D3 and 1000 mg of calcium will prevent about a one-third of hip fractures [6,7]. Furthermore, a more recent study has demonstrated that a combination of calcium and vitamin D is an effective treatment among community-dwelling men and women and can reduce appendicular fractures by about 50% [8]. In addition, it now seems likely that treatment with bisphosphonates can prevent appendicular fractures (although this has been demonstrated only amongst women with low bone density and a prevalent vertebral fracture [9,10]) and two randomized trials have demonstrated that hip protectors help to prevent hip fractures [11,12]. Finally, there are several trials in progress of different bisphosphonates and other new compounds for the prevention of fractures.

An important aspect of the economics of osteoporosis prevention is averted fracture costs, particularly those

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associated with hip fracture. Whilst osteoporotic fractures represent a considerable call on public resources, quantifying this cost is difficult for a number of reasons. First, the total costs of fracture treatment, particularly hip fracture, fall across a number of different budget holders. For example, whilst the immediate treatment costs of hip fracture are almost entirely hospital-based, many survivors of hip fracture will require continuing treatment and support after discharge from hospital. Such support and treatment will involve primary care services, such as the patient's general practitioner, possibly some continuing hospital care such as outpatient appointments, social services support and, for the most badly affected individuals, sheltered or nursing home accommodation.

Second, there are problems associated with fracture ascertainment and cost attribution. This is a particular problem with vertebral fracture. Many such fractures are relatively asymptomatic and may not come to medical attention as a fracture-related condition. But despite some of them having a low level of symptomatology, they may still incur costs.

The most recent estimate of the cost of osteoporotic fractures for England only was contained in the Barlow report [13]. Here the authors estimated that the cost of all hip fractures was in the region of £742 million for people aged 65 years and over. This figure was derived using American estimates of nursing home stay after hip fracture, which may not be applicable to the UK, and does not include the costs of fractures for Scotland, Wales and Northern Ireland. However, this figure is substantially greater than another estimate of £288 million, or £5000 per hip fracture, that was based only on hospital costs [14].

The main aim of this paper is to provide an estimate of the costs incurred by the most common osteoporotic fractures. Given that public health doctors often require an estimate of the 'cost burden' of a disease to inform spending priorities, the likely total costs of osteoporosis among women aged 50 years and over living in the UK are estimated. The older female population has been selected for this costing exercise as it is the group for whom prevention is likely to be most cost-effective [15].

Methods

Epidemiology

A key factor influencing the total costs of osteoporosis is the fracture incidence. This will be affected by a number of parameters, including the ethnicity of the population (with Caucasians having the highest incidence), diet, latitude and smoking prevalence. Therefore, it is important to use, as far as possible, country-specific incidence or prevalence data. In this study, the most recently published UK estimate of fracture incidence (by Donaldson and colleagues [16]) is used to quantify the annual number of nonvertebral fractures occurring. This study was undertaken in the largest health district in England, where a diagnostic index was developed to identify all fracture patients who were admitted to the accident and emergency department with a suspected fracture. These data were collected within 3 years of the 1981 census and thus could be linked with an accurate estimate of the resident population.

Good vertebral fracture incidence data are not available, so a prevalence survey undertaken within a UK general practice population was used [17]. It was assumed that one-third of prevalent fractures require medical attention and 8% of these require hospital admission [1]. These epidemiologic data were then applied to the 1991 UK over-50 female population. To estimate the proportion of patients with a hip fracture who enter long-term care, are discharged to home, or die, we used a recent 1-year prospective study of hip fracture patients from a large English hospital [18].

Cost Estimation

Before attempting any primary data collection, a literature review was undertaken to identify any published costing studies. Medline was searched for all papers relating to fracture costs in the UK from 1985 using the search terms of 'fracture' and 'cost'. It was decided not to extend the search any further back in time as treatment patterns, particularly for hip fracture, are changing.

Acute Costs

No study was identified that estimated the acute care costs of vertebral or Colles' fracture but two relevant studies were identified that documented the acute hospital costs of hip fracture [19,20]. One study, by Hollingworth et al. [19], estimated that for a length of stay of 42 days the hospital cost of hip fracture was £5606 (1991/2 figures), whilst the other study by French et al. [20] estimated that for a length of stay of 20 days the cost of hip fracture was £4018 (1992/3 figures).

The length of stay in the Hollingsworth study appeared much longer than the UK average. The latest length of stay estimate for England and Wales is an average of 20 days [21]. Therefore, the costs calculated by Hollingsworth et al. were adjusted by subtracting their estimate of the marginal cost per day from their total cost per hip fracture, which yielded an adjusted figure of £4220 (i.e., £5606 = £63 per day multiplied by 22 days[1]). This adjusted figure was similar to the estimate provided by French and colleagues (£4018). Inflating this figure to 1995/6 prices gives a cost of £4808. All costs were inflated to current prices using the Health Services Specific Inflation Index.

[1]The figure of £63 was derived from the average per day cost difference from patients in an early discharge scheme compared with patients still in hospital.

For Colles' fracture, 50 consecutive female patients over the age of 50 years were followed up prospectively recording their resource use; this produced a cost of £328 per patient. For vertebral fractures, we assumed that the fracture resulted in hospital admission for 8% of patients [1] for an average length of stay of 19 days [22]. Finally, for all other fractures we assumed a hospital cost of £1200 each which is a figure for closed upper limb fractures [23].

Social Care Costs

For the hip fracture patients who return to their own homes after fracture, there is likely to be additional use of health and social services. Hitherto, this extra resource use has not been costed, primarily because of difficulties associated with data collection. However, data gathered as part of a wider study into care for older people with a stroke or with fractured neck of femur [24], together with data on the unit costs of health and social care, have enabled the additional health and social service costs associated with hip fracture to be estimated.

The additional use of health and social services has been estimated from responses to questions about the frequency of use of a range of services.[2] The patient's partner was asked at the time of the fracture about their partner's service use in the month prior to fracture. Assuming, in the absence of a fracture, that this service use would not have changed over the next year, it is possible to calculate a 'baseline' of service use.

Ten days after discharge from hospital, the patient (or partner if, for whatever reason, the patient was unable to answer the question) was asked about their frequency of service use since discharge. Finally, after 6 months, the patient (or partner) was asked about their use of services in the previous month. Assuming that this level of service use had been constant in the previous 5 months,[3] and would remain constant in the next 6 months, it is then possible to estimate the additional service use as a result of fracture. Multiplying the total increase in the use of each service by the average cost per visit and then dividing by the number of people on which the data are based (n = 738), an average additional cost per person has been calculated. This amounts to £1574 at 1995/6 prices.

Non-acute Costs

Data for non-acute costs were taken from the EPIC general practice database. It was decided randomly to sample 100 records of the fracture types of interest per year over 5 years. These were: hip, wrist, vertebral and 'other' (for which 30 records for humerus and rib and 40 records for leg were sampled). Vertebral fractures were assumed to be those that were clinically apparent to a primary care physician. Each of these 500 patients was matched by age and practice with a control. Thus, in total, 4000 anonymized patient records were used. The mean ages of the four fracture groups and their age-matched controls were: 77.52, 69.00, 72.88 and 71.23 years for hip, wrist vertebral and other fractures respectively.

The non-acute health care costs based on this dataset were estimated. This was done by looking at the change in resource use between cases and controls in the year before fracture and the year following fracture. For instance, the referral rates for outpatient appointments were compared for cases and controls before fracture and in the year following fracture and the differences between the groups in the change was attributed to the fracture. The quantities of resources were priced using the local hospital prices for the relevant items of resource use (York Hospital NHS Trust, personal communication), whilst drug costs were estimated using the Monthly Index of Medical Specialties (MIMS).

Results

Using the 1991 population estimates for the female population aged 50 years and over in the UK, and applying the incidence figures from Donaldson and colleagues [16], it was estimated that there are about 51 863 hip fractures, 40 848 wrist fractures, 25 081 clinically apparent vertebral fractures and 50 315 other fractures annually.

Table 1 shows the acute hospital costs by fracture type. For acute treatment of non-admitted Colles' fracture patients, it was assumed that the marginal cost of accident and emergency care was close to zero as such facillities would be available whatever the fracture rate. However, of the 50 patients who presented with a Colles' fracture 20 were admitted for a total of 62 nights, the cost of which was estimated as £200 per night, and these patients required surgical manipulation of their fracture at £300 per person. Hence, the average cost of

Table 1. The estimated annual acute hospital costs of fracture

Fracture type	Cost	No. of patients	Cost
Hip	£4808	51 863	£249 357 304 (51 836 × 4808)
Wrist	£368	40 848	£15 032 064 (40 848 × 368)
Vertebral	£630	25 081	£1 263 780 (25 081 × 0.08 × 630)
Other	£1200	50 315	£60 378 000 (1200 × 50 315)
Total cost			**£324 767 368**

[2]The services were as follows: chiropody, physiotherapy, occupational therapy, social work, health visitor, district nursing, night attendance, laundry, bath attendant, meals, home care, day care, day hospital, respite care, GP domiciliary, GP surgery and outpatient care.
[3]This figure is calculated as 6 months minus the time spent in hospital (about 20 days) minus the number of days after discharge when the previous service use questionnaire had been asked (i.e., at 10 days).

treating a Colles' fracture was estimated as being £368 per patient (i.e. [20 × £300] + [62 × 200]/50).

Table 2 shows the social care costs associated with hip fracture whilst Table 3 shows the number of extra general practitioner (GP) visits for all fracture types. As the latter table illustrates, all fracture types showed a significant increase in the number of GP visits, with women suffering from vertebral fractures showing the largest increase.

Table 4 shows the proportion of patients referred to various hospital specialists in the year before the fracture and the year of the fracture. Before fracture the referral rates to specialists did not materially differ between cases and controls. However, after fracture there is a general increase in hospital referrals among the cases compared with the controls. Unsurprisingly, referrals to orthopedics showed the biggest rise. However, for vertebral fracture patients there was a significant increase in referrals to rheumatologists. Table 5 shows the increase in referrals after adjusting for the slight increase in referrals experienced by the controls and, using prices from the local hospital trust, the total costs of such an increase were calculated.

Patients with diagnosed vertebral fractures were the only fracture group to show a significant increase in the amount of prescriptions for drugs affecting bone metabolism with 38.1% taking a drug affecting bone metabolism, compared with 2% of the controls. This resulted in an average drug cost of £61.68 (SD 87.2) and £0.93 (SD 6.73) for cases and controls respectively (t = 48.19, $p < 0.001$).

Table 6 shows the aggregated costs per patient and total costs for the UK, which amount to £727 million. Hip fracture, unsurprisingly, is the most expensive fracture at about £12 000 per patient and comprises 87% of the total costs of fractures.

Table 2. The estimated social care costs of hip fracture

Cost description	No. of patients (proportion taken from [18])	Cost
Long-stay hospital care for 1 year	2593 (5%)	£101 982 690 (2593 × [114 × 345][a])
Long-stay hospital followed by death, median length of stay 52 days[b]	7779 (15%)	£46 113 912 (7779 × [114[c] × 52])
Long-stay residential care after discharge from hospital	10 373 (20%)	£186 091 620 (10 373 × [52[c] × 345][a])
Discharged to home	23 339 (45%)	£36 735 586 (23 339 × 1574)
Died within 20 days	7779 (15%)	£0[d]
Total cost		**£370 923 808**

[a]The first 20 days are included in the surgical treatment cost.
[b]This is in addition to the initial 20 days.
[c]Taken from reference [29].
[d]It is assumed that 15% of patients die due to hip fracture within the acute treatment phase and thus only incur the costs of fracture repair and subsequent (20 day) hospital stay.

Table 3. Mean change in number of GP visits after fracture and their cost

Fracture type	Cases	Controls	Difference (significance of difference)	Cost per patient[a]
Hip	10.75	1.62	9.13 $p < 0.0001$	£146
Wrist	5.36	1.34	4.02 $p < 0.001$	£64
Vertebral	14.69	0.88	13.81 $p < 0.0001$	£221
Other	7.28	1.5	5.78 $p < 0.003$	£92

[a]Assuming £16 per visit [29].

Table 4. Comparison of the number of outpatient visits per woman before and after fracture, by speciality

Outpatient speciality		Cases	Controls
Hip fracture patients			
Geriatric	Before	2.6	1.2
	After	7.0	2.8*
Orthopedic	Before	3.0	3.2
	After	32.0	3.6*
Medical	Before	3.4	4.2
	After	11.6	4.4*
Rheumatology	Before	0.4	0.4
	After	0.6	0.4
Radiology	Before	4.0	5.0
	After	9.0	5.2[a]
Wrist fracture patients			
Orthopedic	Before	2.0	2.8
	After	23.2	3.2*
Medical	Before	3.4	3.2
	After	5.8	4.6
Rheumatology	Before	0.2	0.4
	After	0.4	0.2
Radiology	Before	5.8	6.2
	After	12.4	8.8
Vertebral fracture patients			
Orthopedic	Before	4.6	2.8
	After	22.2	3.6*
Medical	Before	6.0	4.6
	After	17.6	5.4*
Rheumatology	Before	0.4	0.2
	After	4.2	0.6*
Radiology	Before	9.4	4.6
	After	33.6	5.4*
Other fracture patients			
Orthopaedic	Before	2.4	2.6
	After	23.2	3.8*
Medical	Before	4.8	2.6
	After	9.4	4.6*
Rheumatology	Before	0.4	1.0
	After	1.4	1.8
Radiology	Before	5.4	6.0
	After	15.2	7.6*

* $p < 0.01$
[a] $p = 0.02$

Table 5. Cost per patient and total costs of extra referrals due to fracture

Outpatient speciality	Price per patient	Proportional increase	Total no of patients referred[a]	Cost per patient[b] (total cost)
Hip fracture patients				
Geriatric	£675	2.8%	944	£12.30 (£637 875)
Orthopaedic	£174	28.6%	9641	£32.35 (£1 677 594)
Medical	£463	8.0%	2697	£24.08 (£1 248 655)
Radiology	£20	4.8%	1618	£0.62 (£32 360)
Total cost				**£69.35 (£3 596 484)**
Wrist fracture patients				
Orthopaedic	£174	20.8%	8496	£36.19 (£1 478 478)
Total cost				**£36.19 (£1 478 478)**
Vertebral fracture patients				
Orthopaedic	£174	16.8%	4214	£29.23 (£733 236)
Medical	£463	10.8%	2709	£50.00 (£1 254 267)
Rheumatology	£483	3.4%	853	£16.43 (£411 999)
Radiology	£20	23.4%	5869	£4.68 (£117 380)
Total cost				**£100.35 (£2 516 882)**
Other fracture patients				
Orthopaedic	£174	20.0%	10 063	£34.80 (£1 750 962)
Medical	£463	2.6%	1308	£12.04 (£605 604)
Radiology	£20	8.2%	4126	£1.64 (£82 520)
Total cost				**£46.48 (£2 439 086)**

[a]As a proportion of hip fracture patients die or never leave long-stay hospital care this is based on the 65% (i.e. 33 712) of patients who are discharged from hospital (see Table 2).
[b]Denominator is total number of hip fracture patients (i.e. 51 863).

Table 6. Total costs of fractures and cost per fracture

Fracture Type	Acute costs per patient (total costs)	Social care and long stay hospital costs per patient (total costs)	Follow-up costs per patient (total costs)	Drug costs per patient (total costs)	Cost per fracture
Hip	£4808 (£249 357 304)	£7152 (£370 923 808)	£164[a] (£8 505 532)	£0	£12 124 (£628 786 644)
Wrist	£368 (£15 032 064)	£0	£100 (£4 092 661)	£0	£468 (£19 117 292)
Vertebral	£96 (£2 401 182)	£0	£321 (£8 051 001))	£62 (£1 555 022)	£479 (£12 007 205)
Other	£1200[b] (£60 378 000)	£0	£138 (£6 943 470)	£0	£1338 (£67 321 470)
Total					**£4326 per any fracture (£727 232 611)**

[a]GP costs only £95 per patient not £146 as the denominator is the total number of fractures.
[b]Taken from CHKS costings for closed upper limb fracture [23].

Discussion

In this paper, the costs induced by fractures for women aged 50 years and over in the UK have been estimated. Unsurprisingly, hip fractures were the most expensive fracture, comprising some 87% of the total cost of osteoporotic fractures. The estimate for women alone is similar to that of Barlow [13]; their estimate also included the cost of hip fracture in men but only considered the costs to the English health care system. Given the estimate of 51 863 female hip fractures for the UK and assuming a ratio of 2.9 female hip fractures to each male hip fractures [25], it is estimated that there would be approximately 18 000 hip fractures in men. If each such fracture costs the same as a female hip fracture this would increase the total cost estimate to £942 million.

Although the total cost of fractures is large, of more interest to health economists is the cost per fracture, which can be used to estimate the cost-effectiveness of various compounds for the prevention of osteoporosis. The hospital cost of a hip fracture in our study is similar to the estimates of the hospital cost of other major European countries [26]. Indeed, the hospital cost of a hip fracture of $7000 when converted to $US using purchasing power parities is not widely different from the uprated $9026 1987 Medicare cost estimate of a hip fracture in the United States [27].

Furthermore, a recent Swedish study that appeared to use a similar methodology to ours has estimated that in 1994 the hospital costs of a hip fracture were $7026, with the total hip fracture costs for a year being $17704 [28]. Interestingly, the ratio of these two figures (2.52) is identical to the corresponding ratio for our total hip fracture costs and hospital costs, namely £12 124/£4808.

Despite detailed cost analyses, there will be some costs due to osteoporosis that have not been quantified. Some of these are relatively trivial and are of little significance. The use of pain-relieving drugs, for example, was not included in the analysis. However, even the most expensive analgesic is relatively cheap compared with drugs affecting bone metabolism. Another cost underestimate that is likely to be more significant is undiagnosed vertebral fractures. It is likely that a proportion of vertebral fractures are symptomatic and do generate costs to society; however, because they remain undiagnosed or misdiagnosed they were therefore not identified in the data set.

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