Relative survival after hospitalization for hip fracture in older people in New South Wales, Australia.

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Mini Abstract
Survival after hospitalization for hip fracture by age group and sex relative to survival in the general population was assessed in people 65+. Males had double the risk of death of females to 1 year, but age effects lasted only to 3 months. Clinical outcomes need to be improved.

ABSTRACT

INTRODUCTION: We assessed the relative survival of hospitalised fall-related hip fracture patients aged 65+ years separated from hospital in New South Wales, Australia, between July 2000 and December 2003.

METHOD: Population-based study of all hospital separations for NSW residents with a principal diagnosis of hip fracture (ICD-10-AM S72.0 to S72.2) and first external cause of fall (ICD-10-AM codes W00 to W19), linked to NSW death data. A total of 16836 cases were included. Relative survival 3 to 36 months post admission by 10-year age groups and sex was calculated, using NSW life tables for 2002-2004. Relative excess risk was modelled using a generalised linear model with Poisson error structure, using the life table data.

RESULTS: One year cumulative relative survival in 65-74 year olds was 82% (males), 90% (females); in 85+ year olds 65% (males), 80% (females). Males have a relative excess risk of death of 2.2 (95% CI 2.03 – 2.38) times that of females. Only 21% of deaths mention the hip fracture as contributing to death.

CONCLUSION: There is a need to reduce the number of hip fractures and improve clinical outcomes for older people hospitalised with hip fractures.
Key words: hip fractures, mortality, older people, relative survival

Relative Survival after Hip Fractures in Older People in NSW.

Introduction

Hip fracture is a common and debilitating injury in older people. (1) In New South Wales (NSW), the most populous state in Australia (population approximately 6.7 million), there are over 4,800 hospital separations of people aged 65+ years for fall-related hip fractures each year. Hip fractures place a sizable burden on the health system, with an average length of stay of about 14 days (2) and are also associated with considerable morbidity and mortality. The incidence rate of hip fracture increases exponentially after 50 years of age, and in Australia, 91 percent of hip fractures occur in people aged 65 years and older, (3) with the vast majority associated with a fall. Reported one-year mortality rates range from 12-36 percent, (1, 4) and those who survive have generally poorer levels of mobility and reduced ability to function independently. (1) Although age-specific incidence rates appear to have stabilised in Australia, (2) the ageing of the population means that the *number* and associated burden of people aged 65+ years admitted to hospital for a hip fractures will increase annually for the foreseeable future. (2) Given these projections there is a clear imperative to implement strategies designed to reduce hip fracture rates, as well as improved clinical models of care, which reduce the mortality and morbidity associated with a hip fracture.

A number of factors have been shown to influence mortality after fall-related hip fracture in studies involving older people. These include factors intrinsic to the individual such as the presence of co-morbidities, (5-7) (8) frailty, physical and cognitive function prior to the hip fracture, (1, 4, 9-16) gender, (5, 7, 10, 13, 17) and older age. (7, 9, 14, 18-20) Factors external to the individual impacting on mortality rates include prophylactic treatment against infection and thromboembolic disease, (7) delay in the time between diagnosis and surgery, (6, 7, 21) complications after surgery (9, 19, 21) and early ambulation after surgery (7). However, despite improved knowledge on predictors of poor outcome, including potentially modifiable factors, there is evidence to suggest that over the last twenty years there has not been a significant reduction in mortality associated with hip fracture. (22)

Most published studies of survival after a fall-related hip fracture involve matched cohort studies, (13, 20, 23-27) or studies of a consecutive series of hip fracture patients, (5, 9, 12) although there are some larger cohort studies. (10, 28) Some studies use routinely collected data for a defined city, (23, 29-31) a single hospital (4, 10, 20) or group of hospitals, (11, 17, 18, 32) but there are few studies that use routinely collected data for a large geographical area. Several of these studies relate to a unique population group (eg, Veterans), (21, 33) but only consider inpatient deaths. Others include a study using linked hospitalisation death data for hip fracture outcomes in four counties in the Oxford region of England,(22) and Brophy et al carried out a study which included all of Wales, (34) but did not carry out a survival analysis. Part of the reason for this is that a study of survival requires follow-up (as in a cohort study) or the availability of linked hospital and death data. (35)

Because the majority of deaths following hip fracture do not mention the hip fracture as a contributing cause of death, (36) the mortality rate associated with fall-related hip fractures based on cause-specific death will be vastly underestimated. Relative survival is a method for assessing mortality rates when the specific cause of death is unknown but a precipitating event (e.g. a fall-related hip fracture requiring hospitalisation) can be determined.

The aim of this study was to assess relative survival after hospitalised fall-related hip fractures in NSW in people aged 65+ years, accounting for the effects of age and sex. The availability of hospital inpatient data for NSW together with linked death data provides a unique opportunity to undertake such a study on a routinely collected dataset which covers a large geographical area.

Methods

Study population

We selected all hospital admissions for which the date of separation was between 1 July 2000 and 31 December 2003 for NSW residents where the principal diagnosis was hip fracture (ICD-10-AM codes S72.0 to S72.2) associated with an unintentional fall (ICD-10-AM codes W00 to W19) in the first external cause field. Cases were obtained from the NSW Admitted Patient Data Collection (APDC). The APDC is a census of all hospital separations in public and private hospitals in NSW and is based on episodes of care. A hospital separation occurs when a patient is discharged, dies, is transferred to another hospital or has a change in status (for instance from acute to rehabilitation). We also restricted the study to those aged 65+ years at the first hospital separation.

Because there is no unique patient identifier in NSW, we used an internally linked version of the APDC to identify hospital separations for the same person to reduce potential multiple counting of different episodes of care relating to the same person. Deaths in hospital were identified where the mode of separation was recorded as ‘dead’ either in the initial separation for hip fracture or on a subsequent hospital separation. Deaths occurring within NSW as a whole were identified from a second dataset that links the APDC to NSW deaths data provided by the Australian Bureau of Statistics (ABS). Both linked datasets were created using standard probabilistic linkage methods, including the use of multiple passes and clerical review.

The linked datasets are developed and maintained by the Centre for Epidemiology and Research in the NSW Department of Health and are made available to researchers within the state. It was assumed that patients were still alive at the end of December 2003 if they were neither able to be linked to an ABS death record nor had a separation recorded as ‘dead’ in the hospital separation data.

Figure 1 shows examples of how cases were selected and the follow up was defined.
As the hospital separation and death records only gave the month and year of separation or death, the dates of these events were coded to the mid point of the month. The date of admission was then imputed by subtracting the length of stay from the date of separation. Time of follow-up was calculated from the date of admission to the date of death or was censored at 31st December 2003. Use of date of admission as a proxy for the date of the hip fracture has been used elsewhere (37), and is based on the assumption that the first admission for a hip fracture, because of their incapacitating nature, occurs within a short period of time after the occurrence of the hip fracture.

Statistical analysis

We calculated observed survival at three month intervals from 3 to 36 months from date of admission using the life table method (38). Relative survival was calculated as the ratio of observed survival to the survival expected from a population matched on age, sex and calendar period using the Ederer II method. (39)

Relative survival techniques, which have been used in cancer epidemiology since the 1950s, avoid the need to know the specific cause of death. These techniques use all-cause mortality and compare the mortality of the disease/injury group of interest with the mortality of the general population of similar age, sex, and, if necessary, period of time and any other covariates. Two common ways of presenting the results of relative survival are as the excess mortality (the difference between the observed mortality in the cases and the expected mortality for people of the same age and sex in the general population) and as a relative survival ratio (usually called the relative survival rate), which is the ratio of the observed survival rate to the expected survival rate. (39) An interval-specific relative survival rate of unity indicates that the survival in the cases is similar to that of the general population. (39)

The expected mortality data were obtained from published NSW life tables, 2002-2004. (40) Data were analysed according to three broad age groups (65 to 74, 75-84, and 85+ years) and sex. Relative excess risk between 3 and 30 months was modelled using a generalised linear model with Poisson error structure with the analysis based on the collapsed (life table) data. (41) Data were analysed using SAS version 9.1.3. (SAS Institute, Inc., Cary, NC)

Results

During the study period there were 16,836 hospital separations in NSW for patients aged 65 + years with a fall-related primary diagnosis of hip fracture. Twenty-five percent of the patients were males, and 44 percent were aged 85+ years (Table 1). The proportion of patients who died within the study period was higher for males than for females within each age group and overall (Table 1). Mortality was highest among males aged 85 + years.

Fewer than two percent of all deaths recorded during follow-up—where cause of death information was available—recorded a fall as the underlying cause of death. For 7.5 percent of deaths, the underlying cause of death was assigned to the external cause ‘exposure to unspecified factors’ (ICD10 code X59). The underlying cause of death in nearly 45 percent of deaths was ‘diseases of the circulatory system’, with 10.8 percent from ‘diseases of the respiratory system’ and 10.7 percent from neoplasms. Twenty-one percent mentioned the hip fracture as a *contributing* cause of death. When deaths were restricted to the period up to 28 days after the first admission for the hip fracture, 53 percent included the hip fracture as a contributing cause of death.

Thirty-five percent of deaths in males and 28 percent of deaths in females within 3 months of admission for fall-related hip fracture occurred on the same episode of care as the first hospitalisation, and another 35 percent (males) and 33 percent (females) of deaths within 3 months of the index admission occurred on a subsequent hospital admission Overall 38% of males and 32% of female deaths occurred in a subsequent period of hospitalisation (compared with 12% and 18% during the first period of hospitalisation).

Observed survival rates decreased with increasing age for both males and females, and the observed and relative survival rates were considerably poorer in males (Figures 2a and 2b). The relative survival of males after 3 years was about 60 percent compared with about 80 percent for females.

Differences between the age groups in interval-specific relative survival rates over time were most pronounced in the first three months after the hip fracture (Figure 3), with relative survival for both males and females aged 85+ years substantially lower than for the younger age groups. After 3 months following the hip fracture, the differences between the age groups narrowed, but there was still a noticeable difference between males and females. After 6 months the interval specific relative survival was approximately 95 percent for males, and even higher for females (Figure 3a).

The Poisson regression model for relative survival showed that the effect of age was dependent on follow-up period, but the effect of sex was independent of both age and follow-up time. The relative excess risk of death following hip fracture for males was 2.2 times that for females (95% CI: 2.03 to 2.38), adjusted for age and follow-up time. In terms of the effect of age (Table 2), the 75-84 year age-group had 1.71 times the relative risk of death in the first three months compared with the 65-74 year age-group, and there was a three-fold increase in risk for those aged 85 years and over relative to the 65-74 year age-group during the first three months after fall-related hip fracture. The significantly greater excess risk did not persist beyond 3 months in the 85+ year age-group, and continued only until 6 months for the 75-84 year age-group, with a 42 percent higher risk than for the 65-74 year age-group (Table 2). After six months there was no significant effect of age on excess risk.

Conclusions

This work is unique in that it is the first time to our knowledge that relative survival rates have been reported (in the Australian context) in people who have had an unintentional fall resulting in a fractured hip. It is also one of the first in the international peer-reviewed literature at the broad geographical level involving both males and females, using large, population-based routinely collected datasets. This study considered all hospitalised fall-related hip fractures in NSW residents aged 65+ years, where separation from hospital occurred between July 2000 and December 2003. There was a distinct difference in survival across age groups within the first three months between men and women. The greatest effect on excess mortality occurred in the period immediately after the admission (and the presumed date of the hip fracture), although there was evidence that excess mortality continued until at least three years post hip fracture except for those aged 85 years or older, for whom it persisted for only 3 months. Other recent studies have suggested that excess mortality only persists for 3 (35) or 6 months.(8)

This study is important because prior studies have argued that falls mortality is underestimated in studies using routine data because of inadequacies of death certification and the allocation of appropriate ICD codes for falls and fall related injury. This study's use of linked data allowed follow-up of the patients over multiple episodes of care, detection of the first fall-related hip fracture within the study period, and follow-up of death records during the study period. It minimized the possibility of multiple counting of events that often occurs when using hospitalisation data based on episodes of care .(2)

The use of relative survival meant that the cause of death did not need to be known, and hence we were able to obtain an estimate of the effect of hip fracture on survival, both as a direct and indirect contributing cause, even when it may not have been mentioned on the death certificate. As expected, mortality due to hip fracture would have been vastly underestimated if we were to only consider deaths where the hip fracture was mentioned as a contributing cause of death. Even when the death occurred within the 28 days of the first recorded hip fracture in the study period, the hip fracture was not mentioned in almost 50 percent of cases. This is consistent with the observation that the deaths tend to be attributed to a ‘natural’ cause of death rather than an ‘external’ cause of death for elderly people (36). Kreisfeld and Newson (3) comment that, in contrast to other types of injury causing death, such as transport accidents, suicides and unintentional poisoning by drugs, most deaths involving hip fractures are certified by a medical practitioner, rather than being referred to the coroner.

One limitation of our work was that we were only able to estimate survival to the nearest month rather than to a day. It was for this reason that we used the life table method of survival analysis and that we restricted the length of follow-up to three-month periods. At most, the date of death is 15 days out, and so the earlier conclusion about 28 day mortality is still valid. Data were only available for the specific three-year period, and it is not possible to know whether any of the patients had already been hospitalised before the commencement of the study period with a previous hip fracture or the date of death after this period. Analysis of the number of hip fractures between consecutive 6-month periods did not show that we had any more hip fracture cases in the first six-month period than would occur by random error, so we included all patients, and made the assumption that it was the first hip fracture. An analysis which ignored cases that occurred within the first 6 month period was consistent with the results shown in this paper, so we are confident that any over-enumeration of cases within the first 6 months of the study period has not altered the findings.

There is conflicting evidence in the literature that mortality after hip fracture depends on the type of fracture (intracapsular vs extracapsular). (37) On the other hand most studies combine intra and extracapsular hip fracture data and in addition, it has been found that the proportion of the two types of hip fracture is highly dependent on age.(42) As a consequence we also decided to group all hip fractures together.

Our study used data for all NSW residents hospitalised with fall-related hip fractures over a period of three and a half years. This meant that there were a large number of cases, and that when we split the data by age and sex the sample sizes were sufficiently large to obtain precise estimates of survival to at least three years post-admission.. This study also demonstrates the use of linked, routinely collected databases to understand survival after hip fracture.

Our case selection criteria included all unintentional falls (ICD-10-AM codes W00-W19). While the majority are due to falls from the same level, these codes also includes falls from chairs, beds and from heights, such as ladders and trees, which may be associated with a higher level of trauma than falls on the same level.

Some loss of follow-up may have occurred with people migrating to other states or overseas after the occurrence of the hip fracture. If this has occurred then the death rate for hip fracture patients would have been under-estimated in our study. However, it is likely that the number of people who moved to another state in Australia after a hip fracture is small, and previous work has indicated that migration is uncommon for people who have had a hip fracture (28). In addition, less than two percent of people aged over 65 years in NSW move to another Australian state each year. (43) Because our study used routinely collected data we were unable to measure some aspects found by others to affect survival after hip fracture, such as physical and cognitive function. Other factors known to influence outcome such as the presence of co-morbidities and the time between admission and surgery (and whether or not surgery was undertaken) were beyond the scope of the current paper. However, it is possible that we have overestimated excess mortality by not accounting for pre-existing conditions.

We were able to show that males have an increased risk of death after hip fracture, as observed elsewhere, (10, 17, 29) and that the effect of sex remained after accounting for age, in contrast to findings reported by Aharoff et al.(9)

Our observed mortality rates at three months and one year were consistent with rates reported elsewhere, which range from 6.5 percent(9) to 25 percent(20) for mortality at 3 months and from 12 percent(9) to 33 percent(5) for one year mortality. Mortality rate was highest in the first 3 to 6 months after hip fracture and is consistent with reported rates.(4, 22, 28, 33, 44) Other studies have found excess mortality rates after 1 year, (19) 18 months, (13) and even at 5 to 6 years (28) (except for females aged 85 years and over). However, comparisons with these studies are difficult due to methodological differences in measuring excess mortality. We found that excess mortality continued for at least 2 years, and the rate was not dependent on age after the first period of follow-up time after the hip fracture, but did depend on sex, with a consistently higher level of excess mortality for males. Similar results have been found elsewhere(29).

It is possible that we underestimated mortality immediately after a hip fracture because people who died before being admitted to hospital were not included in our study.

This analysis of relative survival following a hip fracture confirms that estimates of fall-related mortality based solely on the underlying cause of death statistics clearly underestimate the impact of falls on the health of older people. The direct impact is that population-based estimates of the burden of falls are grossly underestimated even in a sentinel event such as a hip fracture. If there is an apparent failure to link a defining event such as a hip fracture to subsequent mortality, one can reasonably assume that the consequences of other common fall related injuries including pelvic, humeral and wrist fractures are also grossly underestimated. Failure to quantify the true size and impact of fall related mortality and morbidity will inevitably lead to an underplanning and under-resourcing of services both to prevent and manage falls and fall related injury.

The relative excess in mortality seen in the immediate fracture period might suggest that enhanced models of medical care could possibly alter outcome. There is evidence from the UK to suggest that differences in mortality rates across different hospitals are not purely related to casemix and that variation in practice is likely to contribute to outcome.(32, 45)

In a recent mortality analysis of hip fracture undertaken in Denmark, it was reported that 57 percent of deaths occurring in the 30 days post fracture were potentially avoidable.(46) There is also an implication that a significant number of deaths are unavoidable leading one to conclude that effective strategies to prevent falls and hip fractures are required if one is to have an impact on fall related mortality.

Studies reported in the literature have found substantial variation between hospitals or regions in terms of survival after hip fracture.(32, 45) This was beyond the scope of this current study but given the likelihood that variations probably do exist within NSW, analysis at an administrative health area or individual hospital level should be encouraged. On-going real time audit of hip fracture care already exists in some countries (Scotland) where clinicians have access to their own and neighbouring hospital data. More research is clearly required to determine the optimal model of care for a person with a hip fracture.

The full impact of falls in older people on mortality rates is underestimated in studies based on the underlying cause of death alone. This study has demonstrated variation in survival after hip fracture, with males having relatively greater risk of death after hip fracture, independent of age. The majority of excess deaths occurred within three months of admission for the fall-related hip fracture, and within this period the higher the age the greater the number of excess deaths. After three months, the relative risk of death was similar between ages; however the excess risk of death for males persisted. There is a clear need to reduce the number of hip fractures in older people that occur by implementing fall prevention strategies for older people and by improving the clinical outcomes of those hospitalised with hip fractures.

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Tables

Table 1 Number of Fall-Related Hip Fracture Hospital Separations and Subsequent Deaths, in People Aged 65+ Years, NSW, July 2000–Dec

	Total cases			Deaths							
				Male				Female			
Age group (years)	Male	Female	Total	In hospital deaths*	Post-discharge deaths: In hospital	Post-discharge deaths: Other	Overall % deaths	In hospital deaths*	Post-discharge deaths: In hospital	Post-discharge deaths: Other	Overall % deaths
65-74	754	1494	2248	25	113	68	27.3%	20	94	113	15.2%
75-84	1906	5187	7093	111	297	331	38.8%	138	465	629	23.8%
85+	1560	5935	7495	177	267	392	53.6%	271	603	1328	37.1%
Overall	4220	12616	16836	313	677	791	42.2%	429	1162	2070	29.0%

* Deaths which occurred on same episode of care as original hospitalisation for fall-related hip fracture.

Table 2. Relative Excess Risk of Death after Hospitalisation for Hip Fracture (95% CI) (Comparison Group 65-74 Years)

Follow-up time (months)	75-84 years			85+ years		
0–3	1.71*	(1.42,	2.06)	3.17*	(2.65,	3.79)
3–6	1.42*	(1.02,	1.98)	1.25	(0.87,	1.80)
6–9	1.02	(0.66,	1.57)	0.89	(0.53,	1.51)
9–12	1.33	(0.79,	2.23)	0.93	(0.47,	1.84)
12–15	0.70	(0.39,	1.27)	0.49	(0.19,	1.26)
15–18	1.27	(0.65,	2.48)	0.61	(0.19,	1.92)
18–21	0.85	(0.43,	1.68)	0.81	(0.34,	1.94)
21–24	1.65	(0.71,	3.86)	0.49	(0.07,	3.65)
24–27	0.86	(0.41,	1.78)	0.42	(0.10,	1.82)
27–30	1.17	(0.47,	2.91)	1.07	(0.34,	3.41)

* Indicates significant relative excess risk at 5% level of significance

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