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Excess mortality after hip fracture among the elderly in Taiwan: A nationwide population-based cohort study ☆

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ABSTRACT

Osteoporotic hip fractures cause high mortality in the elderly population. However, few population studies reported the long-term mortality of hip fracture among the elderly in Asian population. This study assessed the incidence, excess mortality, and risk factors after osteoporotic hip fractures through inpatients aged 60 years or older.
A total of 143,595 patients with hip fracture were selected from Taiwan National Health Insurance database in the years 1999 to 2009 and followed up until the end of 2010. Annual incidence, mortality and SMR, and mortality and SMR at different periods after fracture were measured.
From 1999 to 2005, hip fracture incidence gradually increased and then fluctuated after 2006. From 1999 to 2009, the male-to-female ratio of annual incidence increased from 0.60 to 0.66, annual mortality for hip fracture decreased from 18.10% to 13.98%, male-to-female ratio of annual mortality increased from 1.38 to 1.64, and annual SMR decreased from 13.80 to 2.98. Follow-up SMR at one, two, five, and ten years post-fracture was 9.67, 5.28, 3.31, and 2.89, respectively. Females had higher follow-up SMR in the younger age groups (60–69 yr of age) but lower follow-up SMR in the older age groups (over 80 yr of age) compared with males.
Among the studied patients, incidence is gradually decreasing along with annual mortality and SMR. Hip fracture affects short-term but not long-term mortality.

Introduction

Osteoporotic hip fractures cause high mortality and adverse outcomes in the elderly population [1–15]. Previous studies reported that subjects who survived after hip fracture exhibited decreased mobility, lower quality of life, increased dependence on family, increased requirement for care givers and social services, as well as considerable physical, mental, and financial burden [7,9,15–20].

Previous studies estimated the annual number of hip fractures to reach up to 2.6 million to 4.6 million by 2025 and 4.5 million to 6.26 million by 2050 worldwide, with Asia and Latin America exhibiting the greatest increase [21,22]. The Taiwanese population increased from 15,927,167 in 1964 to 23,224,912 in 2011, and the proportion of the elderly population aged 65 years or older increased from 3% in 1964 to 10.7% in 2011 [23]. As the elderly population increases rapidly in Taiwan, hip fractures will become an important public health issue.

Several studies recently confirmed the association between hip fracture and mortality [4,8,9,24–29], with some exploring this association using nationwide, long-term, follow-up population data from Asia [9,25,27,28]. However, no population study reported on the excess mortality of hip fractures in Taiwan. Therefore, this study aims to assess the incidence and excess mortality among hip fracture patients through inpatients aged 60 years or older from a nationwide population database in Taiwan.

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Methods

Data source and subjects

The National Health Insurance (NHI) database covers the period between 1997 to the present, with data provided annually by the Department of Health of Taiwan. The database covers all patients' medical benefit claims for more than 23 million Taiwanese residents in 2011, with a coverage rate exceeding 99% of the whole population. The completeness and accuracy of the NHI database is guaranteed by the Department of Health and the NHI Bureau of Taiwan.

This study selected subjects aged 60 years or older, who were admitted to hospitals between 1 January 1999 and 31 December 2009. Subjects were identified from the database based on the following criteria: (i) a first discharge diagnosis code of hip fracture (based on International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes 820, 820.0, 820.00, 820.01, 820.02, 820.09, 820.8, 820.03, 820.2, 820.20, and 820.21) and (ii) medical code with surgery of internal fixation or hemiarthroplasty (based on ICD-9-CM codes 79.15, 79.35, 81.52). The first admission date of hip fracture was defined as the index date. The exclusion criteria were inpatients with pathological fractures (ICD-9-CM codes 733.14 and 733.15), open hip fractures (ICD-9-CM codes 820.1, 820.10, 820.11, 820.12, 820.19, 820.9, 820.13, 820.22, 820.3, 820.30, 820.31, and 820.32), or involved in a major traffic accident. Patients who had operations on the pelvis, femur, and hip regions before the index date were excluded to avoid confounding effects. In total, 143,595 subjects with hip fracture were enrolled in the study and followed up until exiting the NHI program, death, or the end of 2010. The completeness and accuracy of the NHI database is guaranteed by the Department of Health and the NHI Bureau of Taiwan. Fracture diagnoses were based on ICD-9 CM Code. On a regular basis, the NHI Bureau randomly assigned senior orthopedic surgeons to inspect the original contents of patients' charts and ICD-9 CM Code to ensure the validity of ICD-9 CM Code. The inspectors do not have any conflict of interest with the patients' hospitals. For these reasons, we infer that the validity of fracture diagnoses is very high.

Outcome measures

This study analyzed two outcomes: (a) annual mortality and standardized mortality ratio (SMR) after hip fractures; as well as (b) mortality and SMR at different time periods after hip fractures, and the effects of risk factors on survival. Time to death was defined as the duration from the index date to death. Subjects alive or lost to follow up were treated as censored. The comorbidities of a subject were retrieved before or at the time of the index date based on the Charlson Comorbidity Index (CCI) [30].

Statistical analysis

For each cohort year, we calculated the incidence as the number of inpatients with hip fracture divided by the mid-population of that cohort year and stratified them by gender. We calculated the annual mortality as the number of death divided by the number of newly-diagnosed cases of that cohort year and stratified them by gender. We calculated follow-up mortality and SMR at different time periods (one-month to ten-year for mortality and one-year to ten-year for SMR) after fracture, and stratified them by age and gender. Follow-up mortality was estimated by using the Kaplan–Meier method. We compared hip fracture mortality with that of the general population using annual and follow-up SMR. SMR was estimated based on the following definition: the number of deaths among inpatients with hip fracture divided by the expected number of death cases according to age-specific, sex-specific, and calendar-year-specific death rates obtained from the Taiwan national death registry. We compared the effects of risk factors such as age, gender, type of hip fracture, and number of comorbidities on survival using the log-rank test. All analyses were performed using the SAS System (version 9.2; SAS Institute, Cary, NC) and the Statistical Package for the Social Sciences (version 10.0; SPSS Inc, Chicago, IL).

Results

Between 1999 and 2009, 143,595 subjects were admitted for the first time with a primary diagnosis of hip fracture and underwent an operation. Among these patients, 56,403 (39.28%) were male, 87,192 (60.72%) were female, 69,882 had cervical fracture, and 73,713 had trochanteric fracture (Table 1). The annual incidence rate of hip fracture gradually increased from 405/100,000 to 471/100,000 from 1999 to 2005 (Table 2). Incidence then dropped to 446/100,000 in 2006 and fluctuated between 451/100,000 and 476/100,000 after 2006. From 1999 to 2009, the male-to-female ratio of annual incidence increased from 0.60 to 0.66, annual mortality rate of hip fracture gradually decreased from 18.10% to 13.98%, and male-to-female ratio of annual mortality increased from 1.38 to 1.64 (Table 2). We used SMR to compare indirectly the mortality of subjects after hip fracture to that of the general population in Taiwan. The overall annual SMR gradually decreased from 13.80 to 2.98 from 1999 to 2009 (Table 2).

The 1-month, 3-month, 6-month, 1-year, 2-year, 3-year, 5-year and 10-year mortality rates were respectively 2.49%, 6.45%, 10.40%, 16.32%, 25.84%, 33.40%, 44.12%, and 53.50% for the whole cohort (Table 3). Moreover, the 1-month, 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, and 10-year mortality rates were respectively 3.30%, 8.44%, 13.33%, 20.67%, 31.56%, 39.69%, 50.60%, and 59.25% for males and 1.96%, 5.17%, 8.51%, 13.50%, 22.15%, 29.33%, 39.92%, and 49.78% for females (Table 3). Males always exhibited higher mortality rates than females (Table 3, Fig. 1).

We also calculated short- to long-term follow-up SMRs to compare indirectly the mortality of subjects after hip fracture to that of the general population in Taiwan. The overall SMRs at 1-year, 2-year, 3-year, 5-year, and 10-year after hip fracture were 9.67, 5.28, 4.16, 3.31 and 2.89, respectively (Table 4). The overall SMR was higher at the first year after fracture, dropped at the second year, and decreased slowly after the second year to the 10th year after fracture. We also calculated gender-by-age stratified SMRs, which showed that females had a higher SMR in the younger age groups (60 years to 69 years) but lower SMR in the older age groups (greater than or equal to 80 years) compared with males. Overall, the youngest female age group (60 years to 64 years) had the highest SMRs (SMR of 34.75 at the first year and SMR of 4.38 at the tenth year) (Table 4).

Table 1
Baseline characteristics of subjects with a hip fracture by gender.

	Total (N = 143,595)	Male (N = 56,403)	Female (N = 87,192)
Age, mean ± SD (years)	78.13 ± 7.86	77.64 ± 7.73	78.65 ± 7.92
Hip fracture, N(%)			
Cervical fracture	69,882 (48.67)	24,758 (43.89)	45,124 (51.75)
Trochanteric fracture	73,713 (51.33)	31,645 (56.11)	42,068 (48.25)
Operation type, N(%)			
Internal fixation	85,438 (59.50)	36,437 (64.60)	49,001 (56.20)
Hemiarthroplasty	58,157 (40.50)	19,966 (35.40)	19,966 (35.40)
CCI number, N(%)			
0	58,217 (40.54)	20,153 (37.33)	37,164 (42.62)
1	38,218 (26.62)	14,772 (26.19)	23,446 (26.89)
2	23,560 (16.41)	9,904 (17.56)	13,656 (15.66)
3	13,032 (9.08)	5,748 (10.19)	7,284 (8.35)
≥4	10,568 (7.36)	4,926 (8.73)	5,642 (6.73)

CCI: Charlson Comorbidity Index.