Trends in hip fracture incidence and mortality in Chinese population from Hong Kong 2001–09

PUI HING CHAU1, MOSES WONG2, ANNA LEE1, MATINA LING3, JEAN WOO2

1Faculty of Social Sciences, The University of Hong Kong, Pokfulam, Hong Kong
2Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Shatin, Hong Kong
3Hong Kong Hospital Authority, Hong Kong

Address correspondence to: P. H. Chau, School of Nursing, The University of Hong Kong, Pokfulam, Hong Kong.
Tel: (+852) 2819 2626; Fax: (+852) 2872 6079. Email: phchau@graduate.hku.hk

Abstract

Background: there is a suggestion that while the age-adjusted incidence of hip fracture in the West may be declining, the incidence may be rising in Asia.

Objective: this study examines the incidence and post-fracture mortality from 2001 to 2009 among the population aged 65 years and over.

Methods: hip fracture incidence rates and case-fatality rates among Hong Kong population aged 65 and over for the period 2001–09 were obtained from the Hong Kong Hospital Authority (HA) database. Rates were adjusted for age. Poisson and logistic regressions were used to examine trends in incidence and post-fracture mortality, respectively.

Results: the age-adjusted incidence rate of hip fracture among the population aged 65 and over in Hong Kong (per 100,000 population) decreased from 381.6 for men and 853.3 for women in 2001 to 341.7 and 703.1, respectively, in 2009. There were no significant changes in post-fracture mortality trends.

Conclusions: there is a downward trend in age-specific hip fracture incidence rates since 2001 among Hong Kong Chinese, but no change in post-fracture mortality trends.

Keywords: hip fracture incidence, post-fracture mortality, Chinese, older population
**Introduction**

With ageing of the population it is particularly pertinent to examine trends in the incidence of hip fractures and post-fracture mortality, to allow estimation of disease burden in order to inform policy relating to service provisions, as well as to evaluate the effectiveness of preventive programmes for osteoporosis. Geographic variations in secular trends in hip fracture incidence may be related to ethnicity, cultural differences, the degree of economic development and use of drugs for osteoporosis such as bisphosphonates [1–9]. Increasing prescription of bisphosphonates may contribute to the decline of hip fracture incidence in the USA [3]; however, a Canadian study noted that the decline in Canada pre-dated the increased screening for osteoporosis and use of drugs [7]. Meanwhile, mortality after hip fracture first decreased and was stabilised in recent years [3, 10], implying longer survival of frail elderly people.

Data from Asia are of particular interest, since there is a suggestion that while the age-adjusted incidence of hip fracture in the West may be declining, the incidence may be rising in Asia [1, 8, 9, 11]. An Asian audit on osteoporosis by the International Osteoporosis Foundation in 2009 noted that the incidence of hip fracture has risen in direct proportion to economic development, and together with the ageing population in Asia, it has been projected that one in two osteoporotic hip fractures will occur in Asia by 2050, with a significant accompanying economic burden [9, 12]. The most recent trends in Hong Kong and Singapore, two economically advanced cities in Asia, suggest that temporal trends may have reached a plateau, while those from Japan suggest a continuing increase [1, 13]. Such data are of importance to the planning of services and for informing preventive policies, among ageing populations that are facing increasing burden from non-communicable diseases.

This study examines the incidence of hip fracture and post-fracture mortality from 2001 to 2009 among the population aged 65 years and over, in order to examine whether the trend is declining, and if so discuss some possible underlying factors such as possible beneficial effects of preventive programmes and/or increasing use of drugs for osteoporosis.

**Methods**

We obtained the hip fracture incidence and subsequent mortality data among Hong Kong population aged 65 years and over during 2001–09 from the Clinical Management System (CMS), a database of the HA recording hospital admission data and death status (as of mid-2010) of the patients. The CMS is a computerised system for all aspects of clinical management implemented by the HA in 1995; and by 1999, it has been adopted by all public hospitals run by the HA. The diagnoses for hospital admission were coded according to ICD-9-CM and verified by experts in the HA. About 98% of all hospital admissions for hip fracture made to public hospitals rather than to private ones [14]; the HA admission data provide a good reflection of the hip fracture cases in Hong Kong. Information on age, sex, principal diagnosis, as well as dates of admission, discharge and death were extracted from the database. However, individual socio-economic status and medication history were unavailable for this study.

Hip fractures were identified by ICD-9-CM codes 820.X in the principal diagnosis. The first admission date of a patient in the study period was defined as the index date for each hip fracture case. As discharged patients might be readmitted for the same fracture, hospital admissions within 180 days following the index date were only counted once (defined as ‘episode’) [3, 15]. Based on the date of death in the database, we analysed mortality outcomes at 30, 180 and 360 days after index hip fracture. The mortality outcomes here refer to the proportion of patients who died from any cause within the aforementioned intervals, for simplicity it is referred to as mortality rates hereafter. For 360-day mortality, only hip fracture cases admitted to hospital on or before 30 June 2009 were included, to allow follow-up for 360 days. Three age groups (65–74, 75–84 and ≥85) were classified.

Population statistics were obtained from the Hong Kong Census and Statistics Department [16].

**Statistical analysis**

The annual numbers of hip fracture episodes and those who died within 30, 180 and 360 days after index hip fracture between 2000 and 2009 were recorded. Fracture that occurred in early 2000 might be within 180 days of the index date in 1999. To allow for a clearance period, year 2000 was excluded from the analysis. Age-sex-specific hip fracture incidence rates were calculated by dividing age-sex-specific hip fracture episodes by the corresponding populations. The mortality rates at 30, 180 and 360 days after the index date for each age-sex-specific group were calculated by dividing the numbers of deaths by the numbers of hip fracture episodes of the corresponding age-sex-specific groups. Age-adjusted incidence rates were calculated by a direct method using the 2006 Hong Kong By-Census population. Age-adjusted mortality rates were calculated by an indirect method using the rates in 2006 as standard. As the numbers of cases and deaths were large, the confidence intervals (CIs) were constructed based on normal assumption.

Poisson and logistic regression models were used to examine the trends in the hip fracture incidence and mortality, respectively. Year of occurrence, gender and age group were used as independent variables. In the Poisson model, the age-sex-specific population was used as offset population. To assess the heterogeneity in the effect of these factors on trends, all pair-wise interaction terms between them were included in the model. Insignificant interaction terms were removed to obtain the final model. Data analysis was performed using SPSS version 17.0 (SPSS, Inc., Chicago, IL, USA). A significance level of 5% was adopted.
Results

During 2001–09, 42,717 episodes of hip fractures among population aged 65 and over (12,354 men and 30,363 women) were identified for analysis. Among them, 1,446 and 5,246 people died within 30 and 180 days after hip fracture, respectively. Up to mid-2009, 7,221 people (out of 40,219 hip fracture episodes) died within 360 days after hip fracture. The age-adjusted incidence rate of hip fracture among the older population in Hong Kong (per 100,000 population) decreased from 381.6 (95% CI: 359.7–403.5) for men and 853.3 (95% CI: 822.9–883.7) for women in 2001 to 341.7 (95% CI: 324.5–358.9) and 703.1 (95% CI: 680.2–725.9), respectively, in 2009 (Figure 1). Poisson regression model showed significant decreasing trend of the incidence rate of hip fracture (an annual reduction in 2%, P-value < 0.001). The rate of decline was statistically indifferent between age groups (age-year interaction with P-value 0.379), but significantly larger in women than men (sex-year interaction with P-value 0.003).

The age-adjusted mortality rates were stable from 2001 to 2009 (Figure 2). In 2001, 4.3% (95% CI: 3.1–5.5%) of men and 2.7% (95% CI: 2.1–3.3%) of women aged 65 and over died within 30 days after hip fracture. In 2009, these rates were 5.4% (95% CI: 4.3–6.6%) and 2.8% (95% CI: 2.3–3.3%), respectively. Age-adjusted 180-day mortality following hip fracture varied, respectively, from 17.8% (95% CI: 15.3–20.2%) and 9.5% (95% CI: 8.4–10.7%) among older men and women in 2001, to 16.3% (95% CI: 14.3–18.3%) and 10.7% (95% CI: 9.7–11.8%), respectively, in 2009. Age-adjusted 360-day mortality rates were 26.2% (95% CI: 23.2–29.2%) and 15.0% (95% CI: 13.6–16.4%) for older men and women in 2001, and these rates were 22.4% (95% CI: 19.1–25.7%) and 16.4% (95% CI: 14.6–18.1%), respectively, in 2009. Logistic regression did not show significant trend in the (30/180/360-day) mortality rates (P-values were 0.113, 0.514 and 0.844, respectively) for all three age groups and both sexes.

Discussions

The findings suggest that hip fracture incidence in the Chinese population in Hong Kong is following the declining pattern observed in Western countries in the past decade from a plateau observed around the year 2000, this trajectory lagging behind the West by a few years. The findings provide further evidence that the rise in incidence in hip fractures in Asia may have reached a plateau followed by decline, similar to findings in Western countries, the time lag reflecting the pace of economic development of Asian countries. The trend in Hong Kong may be replicated by other Asian countries a few years later. The International Osteoporosis Foundation carried out an Asian Audit and concluded that rising incidence in Asia and population ageing may result in steep increases in the number of osteoporosis fractures. If the trend in Hong Kong is an indicator of future trends in other Asian countries, the predicted absolute numbers of fragility fractures in Asia may be overestimated using data for past trends. It is interesting that the rate of decline is similar even among the very old age groups. A New Zealand study pointed out that there may be an age period cohort effect, in that incidence trends may be different for different cohorts of elderly, with a rising trend in older cohorts and a falling trend in more recent cohorts [6]. The overall burden then depended on the increasing survival of the frail, giving rise to increasing absolute numbers of people with fractures even though the incidence is falling. However, mortality trend was unchanged over this period, consistent with the recent trends in the West [3, 10]. The combination of falling incidence and unchanged mortality would be expected to result in a decrease on the pool of people with hip fracture, if the rate of population ageing remains unchanged. In reality it is likely that the rate of decline in mortality will be greater than that in hip fracture incidence, resulting in increasing numbers of people with hip fracture, although the numbers may be less than that extrapolated simply from the increase in the number of older people.

Identification of the underlying factors accounting for these trends is of importance, since it is an indirect evaluation of public health efforts in prevention and treatment of osteoporosis. One study in the USA suggested that the prescription of drugs for osteoporosis may have accounted for this trend [3]. However, in Canada, the decline in incidence pre-dated that for the increase in prescription of drugs [7]. In Hong Kong, based on local data on prescriptions of osteoporosis drugs by the outpatient departments of public hospitals, the age-adjusted prescription rate of bisphosphonates among older men and women increased since 2000, with faster rates from 2004, being much higher among women. The local situation is similar to the USA, where there is a rise in the prescription of bisphosphonates since 2003, being greater for women. It is possible that use of bisphosphonates contributed partly to the decline [3]. However, our data could not test this hypothesis since the proportion, age and duration of the population being
treated is not captured by any existing databases. It has been estimated that drug utilisation accounted for 40% of decline in hip fracture incidence [1]. However, the local data showed that the decline in hip fracture incidence occurred before the increase in bisphosphonate prescriptions, suggesting that there are other contributory factors.

Other measures that contribute to a declining trend include establishment of falls services, promotion of physical exercise or Tai Chi. In Hong Kong, the HA launched the Falls Prevention Community Programme in 2005 to enhance public understanding of falls prevention and to encourage older people to attend the ‘Tai Chi 10 Learning Classes’. This territory-wide programme gained the support from various government departments, as well as >100 voluntary organisations and doctors’ associations. In 2006, the HA continued to enhance its fall prevention programmes by conducting district-based ‘fall risk’ home assessment in collaboration with NGOs and organising Tai Chi classes for older people with over 100 community organisations. Again, the decline in incidence pre-dates the implementation of these programmes. In 2000, the Leisure and Cultural Services Department and the Department of Health of Hong Kong jointly launched the territory-wide campaign ‘Healthy Exercise for All Campaign’. The campaign aims at raising the public’s interest in exercising and encouraging them to exercise regularly, preferably daily, so that they can understand the benefits of exercising to health. Local statistics on behavioural risk factors showed that the proportion of the community-dwelling population aged 15–64 engaged in vigorous physical activities for at least 1 day in the week prior to the survey increased from 33.9% in 2004 to 38.4% in 2010, whereas there was no obvious trend in moderate physical activities. On the other hand, the proportion of population who walked for at least 10 min everyday decreased from 76.6% in 2004 to 67.4% in 2010 [17]. Since the data are on a younger population and there are contrasting trends in different physical activities, it is uncertain if the decline in hip fracture incidence is related to the promotion of physical exercises.

Apart from the health promoting factors, such as falls services, physical exercise or Tai Chi, and calcium intake, the rate of decline in hip fracture incidence may be a result of reduced exposure to unfavourable early life environments with subsequent adverse effects on bone health [18], low income [19], as well as unhealthy lifestyle factors such as smoking and inactivity.

From the planning of clinical services point of view, the management of a frail patient with hip fracture and multimorbidity is complex, with health and social service needs. Therefore although the trend for hip fracture may be decreasing, it is possible that those who fracture are increasingly frail, with greater service needs from many disciplines. For example, hip fractures frequently occur among people with dementia, stroke or Parkinson’s disease, and in the long-term care institutional setting. It is also one of the causes for the transition from living at home to long-term institutional care [20]. Future studies should include the frailty status of patients with hip fracture to provide a more accurate picture for the planning of service provisions.

There are limitations in this study. The HA database does not capture 100% of hip fractures in Hong Kong, since some patients will have been treated in the private sector. Nevertheless, one can assume that the proportion of hip fractures admitted to HA hospitals is unlikely to be less than the overall figure >90% of patients requiring hospital admission being treated in the public sector. Fracture trends of other sites such as spine differ from that for the hip, as noted in Canada where a decline in incidence of spine fracture did not show a decreasing trend [7]. Use of secondary data does not allow examination of trends in underlying risk factors. With ageing populations, a particular concern is how changes in trends in frailty and multimorbidity, particularly dementia, may influence incidence of fractures through falls and other lifestyle factors. Prevention and intervention programmes targeting frailty would be of increasing importance in contributing to trends in incidence and mortality in hip fractures in future [21, 22]. Nevertheless we were able to use a territory-wide

![Figure 2. Age-adjusted all-causes mortality rates at 30, 180 and 360-day after hip fracture among the population aged 65 and over in Hong Kong, by gender, 2001-09.](image)
The declining incidence could be related to various fall prevention and exercise promotion programmes, and indirectly evaluates effectiveness of osteoporosis preventive programmes. This trajectory lags behind the West by a few years and may be replicated by other Asian countries a few years later. The declining incidence could be related to various fall prevention and exercise promotion programmes, and possibly to increasing osteoporosis drugs prescription. Further studies are needed to examine the underlying factors.

Key points
- Hip fracture incidence rates declined significantly among older Hong Kong Chinese since 2001.
- This trajectory lags behind the West by a few years and may be replicated by other Asian countries a few years later.
- The declining incidence could be related to various fall prevention and exercise promotion programmes, and possibly to increasing osteoporosis drugs prescription. Further studies are needed to examine the underlying factors.

Conflicts of interest
None declared.

Funding
This work was supported by the CADENZA Project of the Hong Kong Jockey Club Charities Trust.

References