Effects of age and gender on the likelihood of hip fracture in the elderly population in Shanghai, China

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The population in China is aging, and the number of people >65 years is rising from 5.5% in 1990 to a predicted 13.3% in 2025 and 23% by 2050. Population aging would result in a marked increase in the prevalence of age-related diseases. Osteoporotic fractures have been considered as one of the age-related diseases.[1,2] Moreover, the most serious fracture is hip fracture, owing to its high morbidity, mortality, disability, and financial burden. Many studies have demonstrated that there is a substantial variation in the incidence of hip fracture in different regions of the world.[3] The knowledge on hip fracture risk is mainly derived from incidence studies. However, the accuracy of the incidence study may depend, to some extent, upon the method of data collection. Compared to developed countries in Europe and North America, a substantially lower incidence of hip fracture was reported in China and other developing countries.[4,5] Due to inadequate infrastructure and lack of nationwide medical record system, the data in developing countries were retrieved from different hospitals. In these countries, not all persons with fractures had an access to surveyed hospitals and some small hospitals, particularly in the rural areas, were difficult to survey. In addition, many cases of fractures might be misclassified or not reported in the hospital discharge file. Accordingly, underestimation of the incidence may occur in these studies.

The risk factors for hip fracture in Chinese population have not been sufficiently studied in the literature. Recently, we performed a sample study to determine the effects of age and gender on the likelihood of hip fracture in urban Shanghai. By this investigation and analysis, we hope to elucidate the effects of age and gender on the likelihood of hip fracture in the elderly population in urban Shanghai. The elderly hip fracture patients (>60 years) obtained from Shanghai Ninth People's Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China were included in this study. If the fractured patients were evenly distributed in each age and gender stratum, the age and gender distribution for fracture patients will be the same as that for the total population. However, the likelihood of a hip fracture may differ in different gender and age strata of the population. In the present study, we divided hip fracture patients according to the demographic data on the elderly (>60 years) in Shanghai, assuming that the age and gender distribution for patients was the same as that for the elderly population. These estimated numbers were compared with the corresponding observed (actual) numbers for patients. If there is no significant difference between the estimated and observed numbers, we suggested that the age and gender do not contribute to the likelihood of hip fracture.

The demographic data for the elderly >60 years of age in Shanghai were obtained from the Bureau of Civil Affairs of Shanghai in 2005. More than 7.7 million people were included in the database. In addition, the emergency and discharge databases of Shanghai Ninth People's Hospital were used for patient's search. Patients who were >60 years received care for hip fractures (ICD9 codes 820.0 through 820.9) during a 5-year-period (2000-2005) were considered for entry into the study. Two distinct subtypes of hip fracture, closed trochanteric (codes 820.20 and 820.21) and closed cervical (codes 820.01, 820.02 and 820.03), were included in the study. Closed subtrochanteric (codes 820.22 and 820.32) and open fractures of the hip (codes 820.9 through 820.13, 820.19, 820.30, 820.31 and 820.32) were excluded from this study. Senior orthopedic surgeons reviewed all medical records and x-ray films. Patients were divided into specific subgroups according to age and gender. The age was stratified as 10 years from 60 to >90. The following variables were calculated for each subgroup.

Estimated number: the cases in each gender and age stratum was divided according to the proportion of the total elderly population (>60 years) in Shanghai. Estimated number by age for each gender = total cases for each gender times the percentage of the total population for each age stratum. Estimated number by gender for each age stratum = total cases for each age stratum times the percentage of the total population for each gender. The actual number of cases in each gender and age stratum is the total observed number.

The ratio between observed and estimated numbers (O/E). Accordingly, O/E = one suggests that the likelihood of hip fracture is completely positively correlated with the proportion of the total population. This correlation becomes weaker as the O/E ratio goes to either higher or lower levels. O/E <1 and >1 suggest

Disclosure. This study was supported by the Program for Shanghai Key Laboratory of Orthopedic Implant, Ninth People's Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China. (Grant No. 08DZ2230330).

that the likelihood of hip fracture is lower and higher respectively, than O/E = 1. Therefore, the O/E ratio can reflect the likelihood of hip fracture in a given gender or age stratum. The data were first generated for all fractures grouped together and then stratified according to the specific subtype. For overall and each subtype of hip fracture, the differences between estimated and observed numbers were compared within fixed age or gender strata using the Chi-square test by SPSS Version 10.0.

There were 1,183 hip fracture patients, 373 men and 811 women, enrolled in this study. The age was 77.3 ± 8.20 years for men and 78.2 ± 7.67 years for women. The group for femoral trochanteric fracture contained 199 men and 314 women; the ratio between men and women (men/women) was 0.63. However, the group for femoral neck fracture contained 174 men and 497 women; the men/women ratio was 0.35.

Age-related differences. Compared estimated and observed numbers by age, significant differences were found in each type of fracture for both gender (p<0.001, **Table 1**). In the age interval of 60-69 years, no matter what type of fracture, observed numbers were significantly less than the estimated numbers in both gender, and O/E ratios were all considerably <1. In contrast, for age strata >70 years, observed numbers were all greater than the estimated numbers in both gender; O/E ratios were considerably >1. In general, O/E ratio increased exponentially with age.

Gender-related differences. The difference by gender varied with the type of fracture. For trochanteric fracture, no significant difference was shown between estimated and observed numbers for all patients. Only patients aged 60-69 years showed significant gender difference (p=0.048); O/E ratio, however, was significantly greater in men (1.46) than in women (0.61). For femoral neck fracture, there was a significant difference between estimated and observed numbers by gender for all patients (p<0.001), and O/E ratio was substantially greater in women (1.32) than in men (0.59). The significant difference between the estimated and observed numbers occurred in patients in 60-89 age strata (p<0.05) and O/E ratios were all greater in women than in men.

In the current study, results showed that the likelihood of hip fractures, including femoral neck and trochanteric fractures, increased exponentially with age in both gender. In addition, women had a significantly higher risk of femoral neck fracture than men. Age has been considered as a surrogate marker for several risk indicators, including hormone decrease, bone loss, impaired bone quality, and propensity to fall. There is a strong association between age and bone loss showed by bone mineral content decrease at the proximal femur and the risk of hip fracture. Moreover, nearly all women in a series of cohorts in the Baltimore Hip Studies had low hip bone mineral density at the time of fracture.[6] There is an evidence that men with hip fracture are also associated with low bone mineral density. The loss of both cancellous and cortical bone is a common event in the elderly and would make a profound contribution to the fragility fracture. In addition, the accumulation of microdamage in hypermineralized old bone may also increase the risk of hip fragility fracture in the elderly.[7] Visual handicaps, muscular weakness and gait disturbance would increase the incidence of falling, which consequently raises the risk of hip fracture. There are inconsistent data in the literature on the gender difference in the rate of hip fracture. Most investigators suggested that women had a significantly higher hip fracture risk than men.[8,9] However, an opposite gender ratio was reported in some countries. Interestingly, all 3 reports published in Northern China (Shenyang, Beijing and Tangshan) demonstrated a higher hip fracture risk in men than in women.[3,10,11] In contrast, the risk of hip fracture in Hong Kong and Taiwan was significantly higher in women than in men.[12,13]

Table 1 - Age difference in femoral trochanteric fracture and femoral neck fracture.

Groups	Estimated number		Observed number		O/E	*P*-value
	n	%	n	%		
Femoral trochanteric fracture (years)						
Men						<0.001
60-69	125	(63.1)	35	(17.7)	0.28	
70-79	60	(30.3)	67	(33.8)	1.12	
80-89	13	(6.6)	85	(42.9)	6.54	
>90	1	(0.5)	11	(5.56)	11.0	
Women						<0.001
60-69	185	(58.9)	17	(5.4)	0.09	
70-79	100	(31.8)	113	(36.0)	1.13	
80-89	27	(8.6)	156	(49.7)	5.78	
>90	2	(0.6)	28	(8.9)	14.0	
Femoral neck fracture (years)						
Men						<0.001
60-69	110	(63.0)	39	(22.4)	0.35	
70-79	52	(30.1)	67	(38.5)	1.29	
80-89	11	(6.6)	56	(32.2)	5.09	
>90	1	(0.4)	12	(6.9)	12.0	
Women						<0.001
60-69	293	(59.0)	85	(17.1)	0.29	
70-79	158	(31.8)	233	(46.9)	1.47	
80-89	43	(8.7)	151	(30.4)	3.51	
>90	3	(0.6)	28	(5.6)	9.33	

O/E - observed and estimated numbers

Likely, our study demonstrated that in urban district of Shanghai the likelihood of overall hip fractures was significantly more in women compared with men. Hong Kong, Taiwan and Shanghai are the areas located in Southern China. It suggests that the gender ratio for hip fracture has a regional difference in China. The causes for this regional difference remain unclear. Compared to people who live in southern China, northern people have a bigger stature and are more physically active even in older life. These factors are a double-edged sword, which may generate a stronger bone, but resulted in a higher incidence of injury. In many studies, the femoral neck and trochanteric fractures are considered jointly. However, the etiology of these 2 fractures is different. Our data showed that there was no significant difference in the likelihood of trochanteric fracture between men and women. The significant gender difference occurred in femoral neck fracture. Women <90 years old had a significantly higher likelihood to suffer from femoral neck fracture. It suggests that the significant gender difference in hip fracture is only associated with fracture of the femoral neck. Hip structure seems to be an important determinant for hip fracture.[14] It was reported that the femoral neck diameter increased with age in men, but not in women. The increased size can accompany an increment in strength of the femoral neck, thereby resulting in a lower risk of femoral neck fracture for elderly men.

The limitation of this sample study is that it can not demonstrate the incidence of fracture in a city or a country. Moreover, the results obtained from one local region may not be generalized to the others.

In conclusion, this study provided information on age- and gender- related difference in hip fracture in urban Shanghai. The likelihood of hip fracture in Shanghai elderly people increased exponentially with age. In addition, women had a significantly higher risk of femoral neck fracture than men.

Received 16th May 2009. Accepted 25th July 2009.

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