

Very Low Rates of Hip Fracture in Beijing, People's Republic of China

The Beijing Osteoporosis Project

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One third of the world's hip fractures are said to occur in Asia, mostly in China. However, there have as yet been no validated studies of hip fracture rates in China. The authors estimated the incidence of hip fractures in Beijing, People's Republic of China, and took several steps to validate the estimates. All 76 Beijing hospitals reported all 1988–1992 admissions that had been coded as 820 (hip fracture) or 821 (other femoral fracture) according to the *International Classification of Diseases*, Ninth Revision. The authors then compared a random sample of the reports with original medical records, and discovered that 70% of intertrochanteric hip fractures had been miscoded as "other femoral fractures." The authors retrained all hospital staffs to provide corrected reports. Revised reports missed only 13% of the hip fracture cases recorded in operating room logs of 11 randomly selected hospitals. To validate hospital-based estimates of hip fracture rates, the authors interviewed a random sample of 2,113 Beijing women aged 50 years or more (97% response rate); all but 4% of past fractures and all seven hip fractures had been treated in hospitals. Finally, the authors surveyed the 27 hospitals in the counties surrounding Beijing. No Beijing residents had been treated for hip fracture outside of the city. Based on the 1990 China census, age-standardized rates of hip fracture (per 100,000) in Beijing—87 for women, 97 for men—were much lower than those seen in Hong Kong in 1985 (353 for women, 181 for men) or in US Caucasians (510–559 for women, 174–207 for men). From 1988 to 1992, the rates in Beijing increased 34% in women and 33% in men. The authors conclude that hip fracture rates in Beijing are among the lowest in the world but may be rising rapidly. *Am J Epidemiol* 1996;144:901–7.

aged; Asiatic race; diagnosis; hip fractures; hospital records

Approximately one fourth of the world's population lives in the People's Republic of China. Cooper et al. (1) have estimated that one third of the world's hip fractures now occur in Asia and that a majority will occur there by the year 2050. However, these estimates are uncertain, because there have been no population-based studies of the rates of hip fracture in China, the largest country in Asia. Previous studies reported low rates in Singapore in 1960 (2) and low rates in Hong Kong in 1966 that appeared to more than double during the subsequent 20 years (3).

It has been difficult to study rates of hip fracture in China, because the *International Classification of Diseases*, Ninth Revision (ICD-9) (4) system of coding of

hospital discharge diagnoses was widely implemented there only recently, and it is not known how accurately hip fractures are being classified. Hospitals have not been required to report hip fractures to public health departments. In addition, it is not known how many hip fractures in China are treated by traditional bone-setters rather than in hospitals.

We conducted a population-based study of the rates of hip fracture among men and women living in Beijing. Our study was designed to validate the hip fracture rates reported by hospitals and to assess potential biases that might affect accurate estimation of rates of hip fracture in China.

MATERIALS AND METHODS

Identification and validation of cases: overview

We counted all hip fracture patients discharged between January 1, 1988, and December 31, 1992, from the 76 civilian and military hospitals that serve the 10 urban and suburban districts of Beijing. To find and validate cases of hip fracture, we first surveyed all Beijing hospitals. We then systematically considered

Received for publication July 5, 1995, and in final form May 6, 1996.

Abbreviation: ICD-9, *International Classification of Diseases*, Ninth Revision.

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potential sources of error in these initial hospital reports (table 1).

First, we assessed the completeness of the reports by comparing them with original discharge logs in 34 hospitals. Second, we assessed the accuracy of the coding of cases in the discharge reports by comparing these reports with radiographic and operative reports in the medical records of the same 34 hospitals. Based on the findings of our validation study, we then retrained all medical-records personnel in the remaining 42 hospitals and repeated the discharge survey in those 42 hospitals. The final discharge survey included confirmed cases from the 34 hospitals and cases in the revised reports from the remaining 42 hospitals. Third, to estimate how many hospitalized patients with hip fracture were missed by discharge logs, we compared the hip fracture cases in the revised reports and original discharge logs with hip fractures recorded in operating room logs in a randomly selected sample of 11 hospitals. Fourth, to estimate how many cases might have been missed because the patients were treated by hospitals outside of Beijing, we surveyed all cases from 27 hospitals that serve the counties surrounding Beijing. Finally, to estimate how many hip fracture cases might have been missed because patients were treated outside of hospitals, we surveyed a random sample of women residing in Beijing to determine the sources of care used to treat fractures.

Initial hospital survey

Hospitals in China do not routinely report hip fracture cases to public health authorities. For the purposes of this study, the Beijing Bureau of Public Health

required all hospitals in the 10 urban and suburban districts of Beijing and the eight surrounding rural counties to report the cases of all patients discharged from the hospital (or who died in the hospital) during this period who had a primary or secondary diagnosis coded as 820 (hip fracture) or 821 (other or unspecified femoral fracture). Sex, date of birth or age, residence, and ICD-9 code were reported for each case on forms designed for this study. A total of 6,929 cases (3,820 with ICD-9 code 820 and 3,109 with ICD-9 code 821) were reported.

Comparison of initial hospital reports with original discharge logs

To confirm the completeness and accuracy of these reports, a physician (X. L., L. A., or S. R. C.) and/or medical records expert from the Beijing Bureau of Public Health visited 34 of the 76 Beijing hospitals. Among these, 20 hospitals were selected randomly. The remaining hospitals among the 34 included one which was the largest orthopedic hospital in Beijing (treating an estimated 11 percent of all hip fractures) and 13 which did not respond for training regarding the reporting and coding of hip fractures.

We first reviewed the discharge logs for all cases recorded as having a primary or secondary diagnosis coded 820 or 821. We compared these cases with the list of fractures originally reported by the hospital. These 34 hospitals initially reported 1,741 fractures coded as 820. Based on a review of these medical records, we found that 17 fractures (1.0 percent) were fractures of other types that had been misclassified and that 12 cases (0.7 percent) were of patients who had been readmitted with previously treated hip fractures.

We discovered that a few hospitals had omitted some cases from their reports. For example, the staff of one hospital misunderstood the instructions and reported a total of only 25 cases because there were 25 spaces per page on the reporting form. The staff of another hospital reported only the cases in their computer database, which covered only the last 2 years of the reporting period. Thus, we found an additional 178 hip fracture cases in discharge logs that had not been included in the original reports.

Comparison of coding in discharge logs with medical records

In the group of 34 hospitals, we also validated all of the diagnoses of hip fracture (ICD-9 code 820) and other femoral fracture (ICD-9 code 821) by comparing the discharge code with the radiographic and operative reports in the medical records. We discovered that intertrochanteric hip fractures were often classified as

TABLE 1. Potential sources of error in identification of hip fracture cases from hospital discharge surveys, and approaches taken to validate cases or estimate the magnitude of the error, Beijing, China, 1990–1992

Source of error	Approach
• Incomplete reporting of discharges	• Compared reports with discharge logs
• Inaccurate coding in discharge logs	• Compared logs with radiographs and operative reports in medical records
• Incomplete reporting of cases in discharge logs	• Compared discharge logs with operating room logs
• Treatment of cases outside of Beijing	• Surveyed surrounding hospitals for cases in residents of Beijing
• Treatment of cases outside of hospitals	• Population-based survey about sources of treatment for fractures

“tuberosity” fractures, defined as a fracture involving the line between the medial and lateral epicondyle of the femur. Tuberosity fractures had a separate code in the Chinese classification system that preceded the use of the ICD-9 codes; however, there is no code for tuberosity fractures in the ICD-9 system. Thus, these fractures were usually coded as 821 (“other femoral fractures”). We found 622 intertrochanteric hip fractures that had been coded as 821. Of the 916 confirmed intertrochanteric fractures in these 34 hospitals, 622 (70 percent) had originally been misclassified as “other femoral fractures.”

When the validation study was complete, we had confirmed 2,512 hip fractures in the discharge logs of these 34 hospitals.

Retraining of medical records staff and repeat survey

Based on the results of this validation study, the Beijing Bureau of Public Health mandated that medical records staff from the 42 civilian and military hospitals that had not been included in the validation study attend a training session on the reporting and coding of hip fractures. This session, led by study investigators (L. A. and X. L.), described and discussed how to retrieve all hip fracture cases from discharge logs and described ICD-9 coding of hip fractures. It specifically covered “tuberosity” fractures and their correct coding as intertrochanteric fractures in the ICD-9 system. This session included specific instructions about how to accurately complete the data forms for this study. The retrained personnel then rechecked their discharge logs and medical records for all fractures coded as 820 or 821 during 1988–1992 and submitted revised reports to the Bureau. These 42 hospitals originally reported 1,395 hip fractures (including 127 intertrochanteric fractures). The revised reports from these hospitals contained 2,679 hip fracture cases, including an additional 587 intertrochanteric fractures originally reported as “other femoral fractures” and 697 other cases missed by the original reports.

Final discharge survey data

We counted hip fractures from the 34 hospitals whose records had been revised by the external reviewers, plus the revised reports from the other 42 hospitals. The corrected reports included 5,191 hip fracture cases as compared with 3,136 in the initial hospital survey—a 65 percent increase.

Comparison of discharge data with operating room logs

To determine whether the final revised reports that were based on discharge logs might have missed hip fracture cases, a physician (X. L.) compared the revised lists with the operating room logs for 1991–1992 in a random sample of 11 hospitals. Of these 11 hospitals, five were sampled from the 34 hospitals whose records were reviewed by external reviewers and six were sampled from the 42 other hospitals. Original medical records were reviewed for all cases that were found on one but not both lists. We discovered that 13.3 percent of hip fractures listed in operating room logs had not been included in the revised reports of hospital discharge diagnoses.

Survey of hospitals outside of Beijing

To estimate how often residents of Beijing were admitted to hospitals outside of the city, the Beijing Bureau of Public Health asked all 27 other hospitals that admit hip fractures in the counties surrounding Beijing to report all cases of hip fracture for 1988–1992, along with the residence of each patient.

Population survey regarding sources of treatment for fractures

To determine how often women with fractures might use alternative sources of care for fractures, such as traditional bonesetters, instead of hospitals, we surveyed a random sample of women aged 50 years or more from Beijing. We randomly selected one health district from each of the four central districts of Beijing. Since the four districts have different populations of women aged 50 and over, we set a target recruitment level for each district that was proportional to the population of women aged 50 or more living in that district according to the 1990 census. Within each district, we randomly selected “street committees” (neighborhoods) and randomly ordered the streets within each committee. Interviewers contacted a consecutive sample of women aged 50 and over, beginning with the first street and continuing until the quota for that district had been met. To identify age-eligible women, we began with women listed as registered residents in each street committee. In addition, we asked all contacts for names of other age-eligible women living on that street or in that apartment building.

Women were asked whether they had suffered any fracture during the past year and the type of fracture. Locations of fractures were identified, as needed, with the aid of a diagram of the human skeleton. We asked the woman whether the fracture had been diagnosed

and treated at a hospital (inpatient or outpatient) or by a traditional bonesetter.

Census data

For each district in Beijing, we obtained a population count for each 5-year age group, by sex, from the 1990 China census.

Analysis

Discharge data were analyzed separately for each of the 5 years of study. We observed that rates rose during the period of investigation. We considered the possibility that this rise in rates might reflect less accurate capture and coding of cases in discharge summaries during 1988 and 1989, the first 2 years after ICD-9 codes were introduced to all hospitals. Therefore, we pooled data from 1990–1992 for our principal analyses and for comparisons with rates in other countries.

Cases of hip fracture were limited to those coded as 820 in revised reports on residents of one of the 10 metropolitan districts of Beijing. The annual incidence of hip fractures for those 10 districts was calculated for each 5-year age group by sex. The denominators for calculation of hip fracture rates were the numbers of women and men in each 5-year age category who were living in Beijing according to the 1990 census.

For comparison with other studies, rates of hip fracture in women and men aged 50 years or more were standardized to the US population (5). Ratios of age-specific rates in men versus women were based on these age-standardized rates. Because our surveys indicated that the revised reports may have missed 13 percent of hip fractures in operating room logs, we multiplied the age-standardized rates for Beijing by

1.13 for purposes of comparing rates with those reported from other countries.

RESULTS

Validation studies

A total of 3,107 hip fractures were initially reported by all 67 Beijing hospitals. After our validation of cases and retraining of medical records staffs, the final revised hospital discharge survey included 5,191 hip fractures among residents of Beijing. The 27 hospitals surrounding Beijing reported 1,176 hip fracture cases during 1988–1992; none of these patients were Beijing residents.

We identified 2,186 age-eligible women in our random sample of Beijing residents, and 2,113 women (97 percent) completed the interview. Of these, 381 women (18 percent) reported having a previous fracture; 365 (96 percent) of them said that the fracture had been diagnosed and treated at a hospital. Seven women (0.3 percent) reported a previous hip fracture, and all seven had been treated in a hospital.

Rates of hip fracture

The age-specific incidence of hip fractures increased rapidly after age 50 in both women and men (tables 2 and 3 and figure 1). Hip fracture rates were slightly lower in women than in men. Among all adults aged 50 years or more, the female:male ratios for rates of hip fracture in 1990–1992 were 0.95 for persons aged 50–59 years, 0.82 for persons aged 60–69, 1.07 for those aged 70–79, and 0.78 for those aged 80 years or more.

The rates of hip fracture in women aged 50 years or more (standardized to the US population) increased 34

TABLE 2. Numbers and age-specific rates of hip fracture among women in the 10 urban districts of Beijing, China, 1990–1992

Age group (years)	Total no. of cases	Population (thousands)	Annual rate (per 100,000)
20–24	7	305.3	0.8
25–29	15	404.9	1.2
30–34	26	397.8	2.2
35–39	43	334.4	4.3
40–44	34	211.1	5.4
45–49	55	180.0	10.2
50–54	109	228.9	15.9
55–59	169	196.4	28.7
60–64	210	140.8	49.7
65–69	235	97.1	80.7
70–74	268	61.5	145.2
75–79	198	52.9	124.8
80–84	150	25.2	198.5
85–89	64	11.0	193.7
≥90	33	3.1	351.1

TABLE 3. Numbers and age-specific rates of hip fracture among men in the 10 urban districts of Beijing, China, 1990–1992

Age group (years)	Total no. of cases	Population (thousands)	Annual rate (per 100,000)
20–24	22	420.6	1.7
25–29	38	484.2	2.6
30–34	56	438.8	4.3
35–39	86	354.7	8.1
40–44	69	216.3	10.6
45–49	58	166.8	11.6
50–54	104	209.2	16.6
55–59	185	212.2	29.1
60–64	253	113.1	74.6
65–69	236	100.8	78.1
70–74	211	60.0	117.3
75–79	153	35.9	142.2
80–84	122	16.3	250.1
85–89	47	5.4	288.7
≥90	13	1.1	408.0

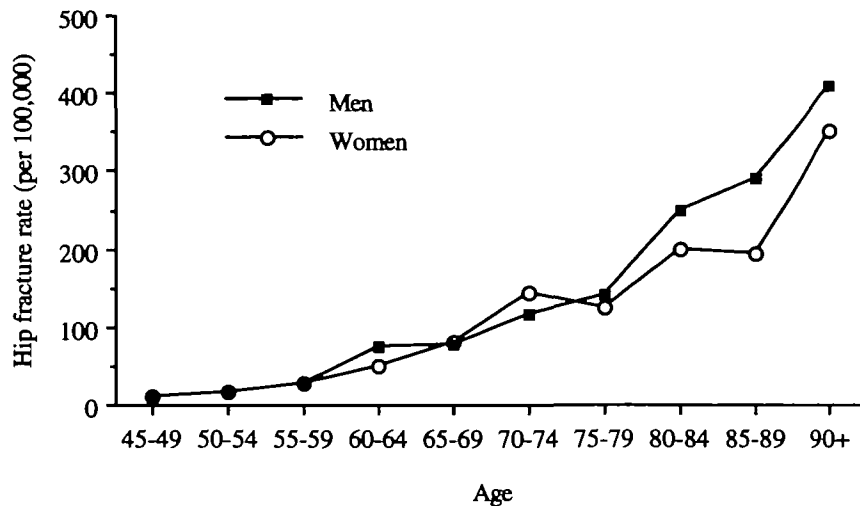


FIGURE 1. Rates of hip fracture among women and men aged 45 years or more in Beijing, People's Republic of China, 1990-1992.

percent from 61.1 (per 100,000) in 1988 to 81.8 in 1992. Similar increases were observed for men.

Comparisons with hip fracture rates in other countries

Rates of hip fracture among women in Beijing were about one sixth or less of the rates reported for Caucasian populations in the United States and Europe (5) and about one fourth of the rates recently reported for women in Hong Kong (3) (table 4). Rates for men in Beijing were approximately half of the rates reported for Caucasian men in the United States and for Chinese men in Hong Kong.

TABLE 4. Rates of hip fracture in women and men from selected published studies*

Geographic area, racial group, and year(s) of study (ref. no.)	Age-standardized rate per 100,000	
	Women	Men
Norway, whites, 1983-1984 (9)	1,293	551
Stockholm, Sweden, whites, 1972-1981 (16)	622	291
New Zealand, whites, 1973-1976 (17)	620	151
California, whites, 1983-1984 (18)	559	207
Rochester, New York, whites, 1965-1974 (19)	510	174
Hong Kong, Chinese, 1985 (3)	353	181
California, Asians, 1983-1984 (18)	338	104
Texas, Hispanics, 1980 (20)	263	118
California, blacks, 1983-1984 (18)	219	144
California, Hispanics, 1983-1984 (18)	197	90
Hong Kong, Chinese, 1965-1967 (6)	153	96
Beijing, China, 1990-1992 (current study)	87.4†	96.8‡
Singapore, Asians, 1955-1962 (2)	75	100

* All rates were standardized to the US population.

† From Maggi et al. (5).

‡ This estimated rate includes a 13% increase to account for underreporting of surgical cases.

DISCUSSION

To our knowledge, this is the first population-based study of hip fracture rates in China that has confirmed the completeness and accuracy of reports of hip fracture and has estimated the degree of underreporting by hospital discharge summaries. We have found that rates of hip fracture among older women in Beijing are among the lowest ever reported and are only a fraction of the rates observed among Caucasian women in the United States and Europe. Furthermore, these rates are much lower than those reported for women in Hong Kong, who have a similar racial composition as women in Beijing. Recent rates of hip fracture in Beijing resemble rates that were reported for Hong Kong during the 1960s (6).

We also found that rates of hip fracture among adults aged 50 years or more in Beijing were slightly higher in men than in women. This similarity of rates in men and women has been noted in other studies that have reported low rates of hip fracture in women (5). The reason that international rates vary more among women than among men is unclear. In Beijing, it is believed that men, even after age 50, are more likely to have hip fractures because they have greater exposure to potential occupational trauma and bicycle accidents. There are no data on comparative rates of falls among men and women in China, and at least one study of Chinese men and women living in Taiwan has shown significantly higher levels of bone density of the lumbar spine in men than in women (7).

The rates of hip fracture in postmenopausal women appeared to increase 34 percent from 1988 to 1992. This might reflect the same rapid temporal increase in hip fracture rates that has been observed in Hong Kong

(3) and many European countries (8, 9). However, because ICD-9 codes first came into universal use in Beijing in 1988, it might also represent increasing accuracy of coding and recording of hip fractures during the period of the study. This second explanation is less likely, because we reconfirmed the completeness and accuracy of hip fracture reports for all 5 years. Anecdotal reports suggest that the population of Beijing was increasing during the 5-year study period because of the immigration of young laborers and families from rural areas into urban areas. Since our census data were limited to 1990, this may partially account for the temporal increase. However, the majority of immigrants into Beijing are said to be working-age adults, and we observed the temporal increase in all age groups, including the elderly, who accounted for most of the hip fractures but who rarely migrate to Beijing.

The reasons that rates of hip fracture among women in Beijing are much lower than those reported for Caucasian women or Chinese women in Hong Kong are not known. It has been reported that Asian women have a slightly lower bone density than Caucasian women (10, 11). Thus, the lower rate of hip fracture in Chinese women cannot be explained by higher bone density. Women who have a shorter hip axis length (the distance from the surface of the greater trochanter to the inner pelvic brim) have a lower risk of hip fracture (12). Asian women have a shorter hip axis length (13, 14), and Cummings et al. (13) found that the shorter hip axis length of Japanese women could reduce their risk of hip fracture by 40–50 percent. In addition, shorter women have a lower risk of hip fracture, perhaps because when they fall, their hips travel a shorter distance to the ground, resulting in lesser energy of impact (15). Finally, it is possible that women in Beijing have a lower risk of hip fracture because they are less likely to fall. We are currently investigating these hypotheses.

It is important to consider whether the very low rates of hip fracture we observed in Beijing might underestimate the true rates because of methodological problems. However, we systematically considered and investigated potential errors that might have caused us to underestimate the incidence of hip fractures in Beijing (table 1). Rates based on hospital data would be underestimated if many hip fractures were not diagnosed or treated by hospitals. However, our population-based survey indicated that only 5 percent of fractures were treated outside of hospitals; this figure is likely to be lower for hip fractures, because they generally cause such acute and profound disability. Rates may be underestimated if many residents received care for their hip fractures at hospitals other

than the ones included in our survey. However, we found that hip fractures among Beijing residents are almost never treated in the rural hospitals outside of the city.

We determined that hospital discharge surveys in Beijing may underestimate the true number of hip fractures by approximately 40 percent. In particular, most intertrochanteric fractures are coded as “other femoral fractures” rather than hip fractures, because the previous Chinese system labeled intertrochanteric hip fractures “tuberosity” fractures, a term that does not appear in the ICD-9 coding system. It is not known whether a similar problem might affect reports of hip fractures from Hong Kong or other countries in Asia. Thus, we believe that future studies of hip fractures in China must validate reported cases or they may substantially underestimate the true incidence of hip fractures.

Rates based on discharge records would be underestimated if many hip fractures treated in hospitals were not counted in discharge logs. However, we found that our revised discharge summaries missed only 13 percent of cases treated surgically. We compensated for this underreporting by increasing our estimates of age-standardized rates by 13 percent.

Even after accounting and correcting for potential sources of error, the estimated rate of hip fractures in Beijing, particularly among women, is one of the lowest in the world. The reasons for this striking difference are under investigation.

ACKNOWLEDGMENTS

This study was supported by a grant from the Health of the Elderly Programme of the World Health Organization and by the Henry J. Kaiser Family Foundation Fellowship in General Internal Medicine (S. R. Cummings).

The authors acknowledge the support of Dr. Knight Steel, formerly of the World Health Organization; Dr. Lin Yan, Division of Health of the Elderly and Rehabilitation, Ministry of Public Health of China; and Dr. Chen Yu-de, Director, Center for Health Statistics Information, Ministry of Public Health of China. The authors also appreciate the advice and encouragement of Dr. Jennifer Kelsey, Stanford University.

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