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ORIGINAL ARTICLE

An increase in the incidence of hip fractures in Tangshan, China

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Abstract
Summary We determined the number and incidence of hip fractures in Tangshan, China, in 2010. Compared with data we reported in Tangshan from 1994, the crude and age-specific incidence increased significantly for both sexes, especially in women. Strategies are needed for effective fracture prevention in the future.
Introduction The aims of the study were to determine the incidence of cervical and trochanteric fractures of the proximal femur in Tangshan, China, in 2010 and to compare the incidence with data from 1994.
Methods The orthopedic departments of 15 hospitals in Tangshan were visited in 2010; the medical records and radiographs of patients who had sustained cervical and trochanteric fractures were reviewed. The absolute number of admissions was collated and the incidence rate per 100,000 person years was calculated, adjusted by different age ranges, and gender. We then calculated the age-standardized incidence in 2010 as compared with those from 1994.
Results The population of Tangshan in 2010 was determined to be 3,075,382 (1,558,173 males; 1,517,209 females); there were 1,509 cervical and trochanteric fractures (in 745 males and 764 females). The overall incidence was 47.8 and 50.4 fractures per 100,000 per year for men and women, respectively. Females showed a higher fracture incidence than males in those aged 55 years and over. Comparing the 2010 data with the 1994 findings, the incidence increased by 85 % in men and by 306 % in women; age-specific increases were observed in all female and male groups (except the 55–59 years age group).
Conclusions Compared with the results in 1994, the incidence of hip fracture has markedly increased in 2010 in Tangshan, China. It is necessary to implement a comprehensive policy for hip fracture prevention in our communities.

Keywords Epidemiology · Hip fracture · Incidence · Osteoporosis

Introduction

Hip fractures are the most devastating type of osteoporotic fracture and are often responsible for increasing mortality. The burden of these fractures on health care systems is increasing, mostly because of an aging population. The absolute number of hip fractures is expected to increase significantly during the next few decades. It is estimated that the total number of hip fractures worldwide will increase from 1.3 million in 1990 to 2.6 million by the year 2025, and 4.5 million by 2050 [1]. Around 30 % of hip fractures that occur worldwide are thought to arise in Asian populations; most notably that of China [2]. Our previous study, which was published in 2000, reported a lower incidence of hip fractures in Tangshan, China, compared with rates in more affluent countries, such as Hong Kong and Japan [3].

Internationally, there is a need to evaluate the burden of osteoporotic fractures. Each country should organize an action plan around the prevention of hip fractures, together with a corresponding program of financing. This work needs to predict the number of patients who, during the coming decades, will require treatment for hip fracture. However, it will also be necessary to determine whether the numbers of fractures are rising more rapidly than can be accounted for by demographic changes alone.

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The aims of this study were to determine the incidence of cervical and trochanteric fractures of the proximal femur that occurred in the city of Tangshan, China, during 2010, and to compare this rate with the incidence observed in the same area in 1994 [3].

Subjects and methods

This study was carried out in Tangshan, which is located in the north of China, 240 km east of Beijing. The present study was carried out using the same methodology as the 1994 research [3]. Data collected from the patients with the diagnosis of "cervical fracture" or "trochanteric fracture" included the following: the patient's age and gender, the type of hip fracture, and the date when the patient sustained the injury. We visited 15 hospitals with an orthopedic department in Tangshan. The medical records and radiographs of all patients who sustained a hip fracture between January 1 and December 31, 2010 were reviewed. The remaining 12 hospitals in Tangshan did not have an orthopedic department. The type of hip fracture was categorized as either cervical or trochanteric. Patients with subtrochanteric or pathological fractures and residents of other cities were excluded from this study. Fractures at the level of the base of the neck were included in the trochanteric category. Each patient was given a personal code to ensure that every fracture was recorded only once in the study.

Demographic information for 2010 was obtained from the Tangshan Census Office. The population in this study was divided into seven 5-year age groups, ranging from 50–54 to 80–84 years. Individuals aged 49 years and less and those aged 85 years and older formed two additional groups. We then determined the age-specific incidence of cervical and trochanteric fractures of the proximal femur for each age cohort. Fracture incidence, or rate, was expressed as the number of cervical or trochanteric fractures per 100,000 person years.

To compare this rate with the incidence observed in the same area in 1994, we combined the data of those aged 70 years and older into a single group, which is aligned with the grouping method used in 1994, in which the oldest age group was over 70 years.

The study was approved by the local ethics committee at Hebei United University.

Results

Population of Tangshan in 2010

The 2010 population of Tangshan was determined to be 3,075,382 (1,558,173 males; 1,517,209 females) according to data from the Sixth National Population Census (2010). Compared with 1994, a dramatic increase in population was observed in every age interval by 2010. The population of those aged over 65 years of age in 2010 was 306,143 (149,718 males; 156,425 females), representing 14.08 % of the total population; this was higher than in 1994 (6.08 % of the population).

Number and incidence of hip fractures in 2010

A total of 1,509 cervical or trochanteric fractures of the proximal femur occurred in 2010 (745 males; 764 females) with a male-to-female ratio of 1:1.03. From the total number of injuries, 55 % (834) of all cervical or trochanteric fractures occurred in the "elderly population" (people aged 65 years and over); 44 % (668) of fractures occurred in the "advanced age group" (over 70 years of age). More hip fractures were observed in males than females in those younger than 55 years of age. However, with increasing age, more females than males sustained hip fractures (Table 1). The proportion of trochanteric fracture was lower in females than in males (41.9 vs. 51.7 %), which increased considerably with age in females, whereas it decreased slightly in males aged over 80 years.

The overall incidence of the combined number of cervical and trochanteric fractures was 49.1 per 100,000 people per year (47.8 for males; 50.4 for females). An age-dependent increase in incidence was observed in both genders, except for males aged 50–54 years who had a slightly higher incidence than the 55–59 year group. The gender-specific incidence showed that females had a higher incidence of hip fracture than males in all age groups 55 years of age and over, but the opposite result was observed in the younger groups.

The average age of patients with hip fracture was 60.8 years for men and 68.0 years for women. For cervical fractures, the average age was 58.1 years for men and 65.6 years for women; for trochanteric fractures, the average age was 63.5 years for men and 70.9 years for women. Thus, the average age of patients who presented with trochanteric fractures was higher than those with cervical fractures in both gender groups.

Change in the number and incidence of hip fractures from 1994 to 2010

The total number of cervical and trochanteric fractures observed in Tangshan increased from 1994 to 2010 (Table 2), as did the number in each age group for both males and females. Both the crude fracture incidence and age-specific fracture incidences increased in 2010 when compared with 1994, except in males aged 55–59 years (Table 2, Fig. 1).

Discussion

This study describes the incidence of hip fractures in Tangshan in 2010 and shows that there was a significant increase in

Table 1 Number and age-specific incidence of cervical and trochanteric fractures of the proximal femur and percentage of trochanteric fractures in Tangshan in 2010

Age	Number of cervical fractures	Incidence	Number of trochanteric fractures	Incidence	Combined number	Incidence	Trochanteric fractures (%)
Male							
−49	97	9.9	94	9.6	191	19.4	49.2
50–54	28	22.6	33	26.6	61	49.2	54.1
55–59	36	25.0	32	22.3	68	47.3	47.1
60–64	40	42.8	31	33.2	71	76.1	43.7
65–69	40	61.9	32	49.5	72	111.4	44.4
70–74	37	71.4	43	83.0	80	154.37	53.8
75–79	32	77.9	49	119.3	81	197.23	60.5
80–84	27	87.2	38	122.7	65	209.8	58.5
85+	23	89.0	33	127.7	56	216.7	58.9
Total	360	23.1	385	24.7	745	47.8	51.7
Female							
−49	34	3.6	15	1.6	49	5.2	30.6
50–54	37	30.5	9	7.4	46	37.9	19.6
55–59	71	52.0	24	17.6	95	69.6	25.3
60–64	62	68.3	32	35.2	94	103.5	34.0
65–69	57	91.8	37	59.6	94	151.4	39.3
70–74	53	105.0	48	95.1	101	196.1	47.5
75–79	50	118.4	54	127.9	104	248.7	51.9
80–84	43	124.2	53	153.0	96	280.1	55.2
85+	37	127.2	48	165.0	85	292.2	56.5
Total	444	29.3	320	21.1	764	50.4	41.9

Incidence is expressed as the number of fractures per 100,000 population per year

age and gender-specific fracture incidences compared with those observed in Tangshan in 1994.

An increasing trend of hip fracture incidence has been observed in several Asian countries and cities. The age-specific rates of hip fracture in Beijing, China, especially among those aged 70 and older, increased dramatically between 1990 and 1992, and 2002 and 2006. The rate of hip fractures continued to rise rapidly from 2002 to 2006 at about 10 % per year [4]. A study performed in the city of Gwangju and in Chonnam Province, Korea, reported that the incidence of hip fracture increased from 3.3 persons per 10,000 population in 1991, to 13.3 per 10,000 in 2001, a fourfold increase over 10 years [5]. The age-specific incidence of hip fracture reported in Tottori Prefecture from 1986 to 2006 slightly increased, rather than stabilizing [6]. Our results are similar to these study findings; compared with data we reported in Tangshan City from 1994, the crude and age-specific incidence increased significantly for both sexes, especially in women.

A recent survey [7] from Hong Kong, China, reported that the age-adjusted incidence rate of hip fracture among the population aged 65 years and over (per 100,000 population) decreased from 381.6 for men and 853.3 for women in 2001 to 341.7 for men and 703.1 for women by 2009. This suggests that hip fracture incidence amongst the Chinese population in Hong Kong is following the same decline that has been observed in Western countries over the past decade; from a plateau observed in the years around 2000, the Hong Kong trajectory has lagged behind the West by a few years. This trend might also be replicated in other Asian countries during subsequent years.

The rapidly increasing elder population is probably the main driver for the observed increase in the crude hip fracture incidence. The population over 65 years of age in Tangshan in 2010 was 306,143, representing 14.08 % of the total population, which was much higher than 6.08 % in 1994. The markedly increased proportion of older people could undoubtedly contribute to the increase in crude hip fracture incidence, but not to the age-specific incidence.

Changes in lifestyle could be mainly responsible for the increased age-specific incidence. Physical activity, as a protective factor for hip fracture [8, 9], has been declining because of the urbanization of Tangshan and other cities in China; the per capita income in Tangshan in 2010 was five times that in 1994; the number of adults owning cars increased from 1 per 100 adults in 1994 to 18 per 100 adults in 2010.

Table 2 Change in age-specific incidence of hip fracture in Tangshan from 1994 to 2010

Age	1994			2010		
	Number of hip fractures	Population	Incidence	Number of hip fractures	Population	Incidence
Male						
50–54	7	20,115	34.8	61	123,878	49.2
55–59	17	28,334	60.0	68	143,735	47.3
60–64	15	24,793	60.5	71	93,357	76.1
65–69	17	24,182	70.3	72	64,636	111.4
70+	18	16,670	108.0	282	149,718	188.4
Total	74	114,094	64.9	554	575,324	96.3
Female						
50–54	4	28,571	14.0	46	121,331	37.9
55–59	6	29,496	20.0	95	136,414	69.6
60–64	12	23,125	51.9	94	90,823	103.5
65–69	15	18,148	82.6	94	62,104	151.4
70+	19	12,189	156.0	386	156,425	246.8
Total	56	111,529	50.2	715	567,097	126.1
Both genders						
50–54	11	48,686	22.6	107	245,209	43.6
55–59	23	57,830	39.8	163	280,149	58.2
60–64	27	47,918	56.3	165	184,180	89.6
65–69	32	42,330	75.6	166	126,740	131.0
70+	37	28,859	128.2	668	306,143	218.2
Total	130	225,623	57.6	1,269	1,142,421	111.1

Incidence is expressed as the number of fractures per 100,000 population per year

People are relying more on cars and buses now, instead of walking or biking, therefore their outdoor physical activities and exposure to sunlight decreased than before. Decreasing the risk of falling is crucial given approximately 90 % of all hip fractures occur as a consequence of falls [10]. A specific exercise, "squatting," which has been proven to be beneficial for strengthening leg and back muscles, and may improve balance [11], is at risk of disappearing as the lifestyle of residents in most cities in China changes [4]. Another lifestyle change that may have decreased calcium absorption, as reported by Xia et al. [4], is that many residents have moved from single-unit housing with outdoor courtyards, to multistory buildings. As a consequence, the reduced exposure to sunlight may have increased rates of vitamin D deficiency.

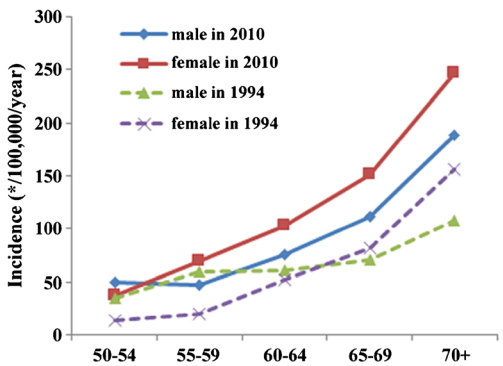

Fig. 1 Incidence of hip fractures in Tangshan in 1994 and 2010. Age-specific fracture incidences increased in 2010 when compared with 1994, except in males aged 55–59 years

The cervical-to-trochanteric ratio (1.14:1) of hip fractures in 2010 was significantly different to the ratio in 1994 (4.0:1). It has been suggested that trochanteric fractures are closely related to osteoporosis and advancing age [10, 12]. This observation suggests, from another point of view, that osteoporotic hip fractures related to advancing age are increasing. However, the proportion of trochanteric fractures in the present study was lower in women than in men. This observation is unexpected and is difficult to explain considering the decline in estrogen levels in older women and associated osteoporosis. However, similar results have been reported elsewhere. For example, a 2006 study from Finland reported that the proportion of trochanteric fractures was lower in women than men in the 60–69, 70–79, and 80–89 years age groups, while for those aged over 90 years, the proportion of trochanteric fractures was higher in women than men [13]. Furthermore, a study from southeastern Norway in 2007 reported that the proportion of trochanteric fractures was 41 % for men and 38 % for women [14].

Several studies have suggested a wide geographic variation in hip fracture incidence between countries, with the highest rates reported in Northern European countries [14, 15] and the USA [16]. The lowest rates have been reported in African and

some Asian populations [5, 6, 17]. In line with these previous studies, our study results showed lower hip fracture incidences in China than in Western countries. Furthermore, the mean age of hip fracture in the present study was lower than the mean age reported in studies from Western countries; this might be partially attributable to the shorter life expectancies in China than in Western countries. Other possible reasons might be short of calcium intake or physical exercises in Chinese, but these should be confirmed by further study.

There are some limitations in our study that should be acknowledged. First, the oldest age group used for comparing rates between 1994 and 2010 was the over 70 years group. In relation to the dramatically increased elder population in this study, this approach might have created limitations for uncovering the precise details about the change of hip fracture incidence in the participants aged 70 years and over. Furthermore, we speculated that changes in the lifestyle and habits of the population were potential reasons for causing the increased age-specific hip fracture incidence. Although there is no supporting evidence from published data, these changes were obvious to the research team and are also reinforced by the findings in a recent report from Beijing, China [4].

Assuming there is no change in the age and sex-specific incidence of hip fractures around the world, Gullberg et al. have estimated that 45 % of all global hip fractures will occur in Asia by 2050 [1]. However, a review of recent studies suggests the age-specific hip fracture rates are decreasing in some European countries and North America [2]. However, the present study, and others from Asia [4–6] indicate these projections have substantially underestimated the number and proportion of hip fractures that will occur in Asia.

In conclusion, compared with the results in 1994, the number of hip fractures in Tangshan has greatly increased in 2010, which renders increased crude incidence with an age-specific style. These alterations might be associated with the great changes in lifestyle and increasing aged population. It is necessary to implement a comprehensive policy for hip fracture prevention in our communities.

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Conflicts of interest None.

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