

# Epidemiology of hip fractures in Zanjan, Iran

Majid Valizadeh · Saeideh Mazloomzadeh · Robab Azizi

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## Abstract

**Summary** The aim of this study was to estimate the incidence of hip fracture in Zanjan, Iran and to describe its seasonal variation. A total of 244 cases of hip fractures (131 men, 113 women) were recorded during 1 year. The annual age-standardized incidence rates were 206.5 and 214.8 per 100,000 men and women, respectively. Most fractures occurred in winter, in-house and daytime. In-hospital mortality was 2.5%. Incidence rate of hip fracture (HF) was less than in western countries mostly due to lower incidence in women, which is probably because of breast-feeding.

**Introduction** One of the most important consequences of osteoporosis is HF, which causes high mortality, morbidity, and significant costs. The incidence of HF in the elderly varies in different areas. Various incidence rates of HF have been reported from countries in the Middle East. The aim of this prospective study was to estimate the annual incidence of hip fracture in Zanjan, a province of Iran, and to describe the seasonal variation of HF incidence which has not been evaluated in two previous studies conducted in this country.

**Materials and methods** All cases of HF aged 50 years or more admitted in three referral hospitals with orthopedics

facilities in Zanjan province between 21 March 2006 and 20 March 2007 were subjected in the study. The age- and sex-specific incidence rates of hip fracture per 100,000 person-years were calculated using the population data from the last national census in Iran 2007.

**Results** A total of 244 cases of hip fractures (131 men, 113 women) were recorded. The annual age-standardized incidence rate was 214.8 per 100,000 women and 206.5 per 100,000 men. The number (%) of fall-induced HF was 88 (67.2%) in men and 102 (90.3%) in women. The female to male ratio for total and fall-related HF was 1.0 and 1.1, respectively. The HF was more predominant in winter (38.5%). In-hospital mortality was 2.5%, and majority of HF were sustained in-house and daytime.

**Conclusion** We found a relatively low incidence of hip fracture and fall-related hip fracture in Iran than those in western countries, which is mostly due to the lower rate in women. These findings disagree with our expectations considering the bone mineral density and vitamin D status of Iranian population, especially women. Breastfeeding could be one of the probable protective factors.

**Keywords** Hip fracture · Incidence · Iran · Osteoporosis · Zanjan

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M. Valizadeh (✉)

Department of Internal Medicine, Vali e Asar Hospital,  
Zanjan University of Medical Science,  
Zanjan, Iran  
e-mail: mvalizadeh47@yahoo.com

S. Mazloomzadeh

Department of Social Medicine,  
Zanjan University of Medical Sciences,  
Zanjan, Iran

R. Azizi

Health Center,  
Zanjan, Iran

## Introduction

One of the most important consequences of osteoporosis is hip fracture (HF), which causes high mortality, morbidity, and significant costs. The incidence of hip fracture in the elderly varies in different area of the world. For instance, it is highest in the USA and lowest in Africa. Indeed, understanding the epidemiology of HF could provide basic information in defining the burden of illness and planning

**Table 1** Annual age- and sex-specific incidence rates (per 100,000) of hip fracture

Age group	Male number	Population	Rate	95% CI	Female number	Population	Rate	95% CI	F/M ratio
50–59	16	27,990	57.2	29.2–85.2	8	32,262	24.8	7.4–42.2	0.4
60–69	25	19,580	127.7	77.6–177.8	23	20,242	113.6	67.2–160.0	0.9
70–79	56	15,380	364.1	268.9–459.3	30	12,985	231.0	148.7–313.3	0.6
≥80	34	5,677	598.9	396.5–801.3	52	4,993	1041.5	758.0–1325.0	1.7
Total	131	68,627	190.9	158.1–223.7	113	70,482	160.3	130.7–189.9	0.8

for preventive strategies for osteoporosis. Despite numerous studies that have been published on the epidemiology of hip fracture in developed countries [1–5], this issue has been poorly understood in developing countries.

The results of a few previous studies carried out in the Middle East show various incidence for hip fracture in this area [6–8]. To our knowledge, only two studies have been published on the epidemiology of HF in Iran [6, 7]. The most recent study reported a low rate for HF incidence in Iran than those in Western countries. Although this study has covered a larger area across the country (nine provinces), it was carried out on warm season of the year and had a short duration (4.5 months). Thus, the possibility of underestimation in incidence rates cannot be ruled out.

The aim of this prospective study was to determine the annual incidence of hip fractures in patients 50 years of age and older in Zanjan province of Iran. We also described age- and sex-specific incidence rates of low trauma (fall-induced) fracture, seasonal variation, and in-hospital mortality.

## Materials and methods

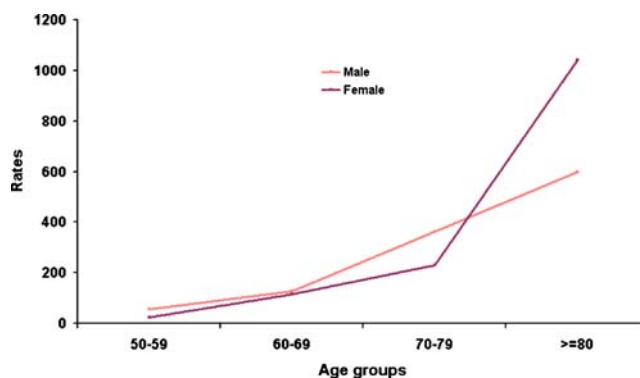
Zanjan province is located in the northwest region of Iran almost 300 km far from Tehran. Its latitude is 36.41°N and has a Mediterranean climate characterized by cold snowy weather in the mountains and moderate climate in the plains in wintertime. In the summers, the weather is warm. Based on the national census in 2007, the province has 964,601 habitants, 14.4% of which is 50 years old and over.

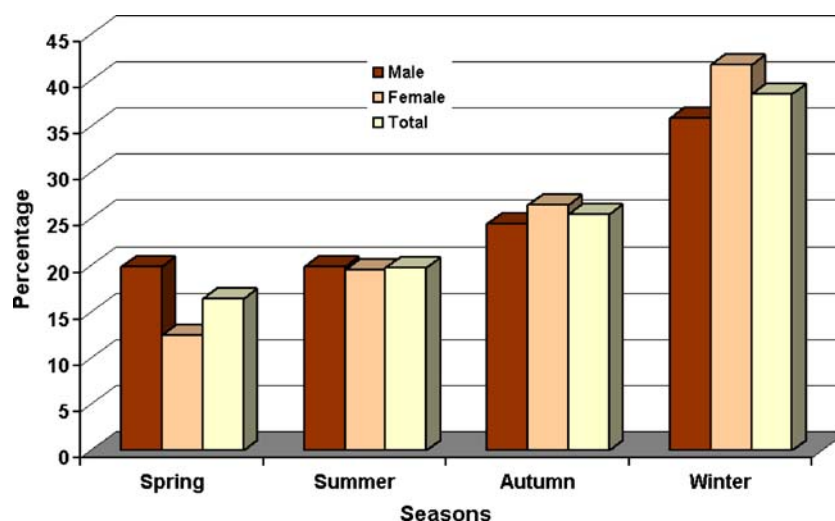
Zanjan has three referral hospitals with orthopedic facilities. We collected our data from these hospitals. All cases of HF aged 50 years or more admitted in these hospitals between 21 March 2006 and 20 March 2007 were included in the study. A daily surveillance was performed for all the orthopedic units and each admitted case of hip fracture investigated carefully by a trained research assistant. Fractures were classified as: (1) the proximal femur (i.e., those occurring above the level of the lesser trochanter), (2) cervical, (3) intertrochanteric, and (4) greater trochanter. Patients, or a family member, were interviewed to collect information in regards to the past medical history, time and place of the fracture occurrences. Patients' outcome (death in hospital or discharge) was also determined.

The age- and sex-specific incidence rates of hip fracture per 100,000 person-years were calculated by dividing the number of hip fractures during the study period by the number of persons who were equal or more than 50 years old during that period. The population data were obtained from the last national census in 2007 provided by the Iranian Statistical Center, the branch of the management and planning organization. The age-specific rates in men and women aged ≥50 years were then applied to the 2000 US population to calculate age-adjusted rates of hip fracture. For this purpose, the direct method of standardization was used. Usual statistical procedures (*t* test) were applied as appropriate.

## Results

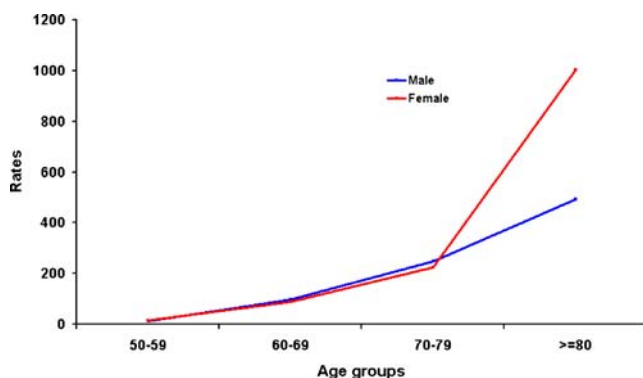
A total number of 244 new cases of hip fracture (131 men, 113 women) occurred in people aged ≥50 years during the study period. The mean age (±SD) of patients was 73.9±11.1. The mean age (±SD) for men and women were 72.0±10.6 and 76.0±11.4 ( $P=0.005$ ), respectively. The age- and sex-specific incidence rates and female to male ratio of hip fractures were presented in Table 1. The crude annual incidence rate was 190.9 in men and 160.3 in women. In both sexes, the rates dramatically increased with increasing age. The incidence rates were lower in women than men up to age 80, where it became almost double in women (Fig. 1). The annual age-standardized incidence rates were 206.5 per 100,000 men and 214.8 per 100,000 women. The female to

**Fig. 1** Incidence rates of hip fractures by age groups

**Fig. 2** Seasonal variations of incidence of hip fracture

male ratio of hip fracture incidence was 1.0. The highest incidence of HF occurred in winter (38.5%), with the lowest incidence in spring (16.4%; Fig. 2). A similar pattern was observed for both sexes.

In 54 cases (22.1%), fracture was appropriate with trauma intensity; however, 190 (77.9%) had low-trauma (fall-induced) fracture. In low-trauma fracture group, 102 (53.7%) and 88 (46.3%) cases were women and men, respectively (female/male ratio, 1.1). The mean age ( $\pm$ SD) in this group was  $75.9 \pm 10.3$  (range, 50–113). The mean age ( $\pm$ SD) was  $74.5 \pm 9.3$  for men and  $77.1 \pm 11.0$  for women ( $P=0.09$ ). The highest frequency of low-trauma hip fracture was observed in both men and women aged  $\geq 80$  years; however, in this age group, the fall-induced rate in women was two times greater than men (Fig. 3). Most of low-trauma fractures were sustained in house (56.2%) and in daytime (85.1%). In-hospital mortality in patients with HF during study period was 2.5% (six cases: four men and two women). All deaths occurred in patients aged  $\geq 75$  years, and half of them were observed in winter.

**Fig. 3** Incidence rates of low-trauma hip fracture by age groups

## Discussion

In this study, the standardized incidence rates of hip fracture were 206.5 and 214.8 per 100,000 men and women, respectively. The rates in both sexes were more than those reported by the previous study in Iran [6]. This difference may be due to the duration of that study. Moayeri and his colleagues collected data in a limited timeframe and did not consider the effect of seasonal variation on the incidence of hip fracture. We found that HF is more frequent in winter.

Although the incidence rate of hip fracture in the present study was more than the latest study in Iran, it was lower than in western countries. Hip fracture has two main causes: low bone mineral density (BMD), which is an index for bone strength, and the falling. Low BMD has been known as an important risk factor for hip fracture in the elderly. So far, there is no evidence indicating that Iranian people have a higher BMD compared to population living in western countries. Importantly, results of studies carried out in Tehran (Iranian capital) and in many Iranian large cities on BMD have indicated that this index in Iran is slightly lower than it is in developing countries [9, 10]. The other risk factor for osteoporotic fracture is propensity to fall. With respect to the high prevalence of vitamin D deficiency in Iran [11] and lower BMD, the probability of falling and hip fracture is expected to be high. However, the low rate of hip fracture in both our and the previous study is unexpected.

One possibility to explain the observed low HF incidence in Iran due to the low risk for falling could be that the majority of the elderly people in Iran live with their relatives. This means that they take the advantages of better care that causes less mobility in their daily life, leading to the reduction of the falling possibility. Besides, In Iran, most of elder populations spend most of their time at home;

thus, they engage in social and recreational activities less. In contrast to Iran, in developed countries, most elder individuals live alone and apart from their family members. They have to be mobile to meet the daily requirements and take part in different social activities, which boosts the falling rate causing HF.

The second possibility to explain the low HF incidence in Iran due to the low risk for falling is application of carpet for decoration on the floor in Iran. Decoration of floor with carpet is one of Iranian traditions that could markedly reduce the risk of a fall accident at home. Besides, a carpet is able to reduce the traumatic forces that result from falling, which reduces the effect of falling on the limb. In contrast to Iran, in western countries, floors are made of wood and tiles [12–14].

The bone geometric factors, for example shorter hip axis length, have been suggested to be an independent factor contributing to the lower incidence of fracture in some Asian countries [15]. This may be considered as a reason for the low observation of HF incidence in Iran; however, so far, no comparative investigation has been carried out on this factor in Iran. Thus, this issue remains as a matter of further dispute.

The results of this study have shown that the female to male ratio of hip fracture incidence was less than 1.0 for all age groups except  $\geq 80$ . The female to male ratio of the annual age-standardized incidence rate (1.0) was also lower than that reported in most western countries [5,16–18]; however, it was similar to the areas with low incidence rates of hip fracture in Asia, such as rural areas in Turkey [19] and Beijing in China [20]. The complete etiology of HF in these areas is not well understood [19–22].

Majority of differences in the ratio observed in this study is related to lower incidence in women, but the rate of hip fracture in Iranian men resembles those recorded in most western countries. A previous study in Iran showed similar results about the sex ratio [6]. This finding is not consistent with the lower bone density demonstrated in Iranian women than in men [9, 10]. This is why we proposed that the risk of falling in women in our region may be less than in men. One study carried out in our country suggested that the incidence of fall injuries in men was higher than in women in age groups less than 60 years. After this age, however, the incidence rates showed a dramatic increase in women than in men. That study could not explain why shift in hip fracture incidence occurs after the age of 80 [23]. Interestingly, the results of some studies suggest that breast-feeding may reduce the risk of hip fractures in elderly women. These studies reported a dose–response relationship between the average duration of breast-feeding per child and the risk of hip fracture [24–27]. Bearing in mind that the majority of our female patients had a history of breast-feeding (86.8%), protective effect of breast-

feeding can partly explain the lower rate of hip fracture in our population.

We demonstrated lower incidences of HF in spring and summer than in autumn and winter. Some studies point to cold climate as a possible reason for the increase in winter fractures, perhaps related to shorter daylight time, lower exposure to sunlight, and synthesis of vitamin D or frozen ground [28–32]; however, in our study, most of hip fractures occurred in house and in daytime.

The lower in-hospital mortality for patients with HF in our study (2.5%) compared to that of international level (4–12%) [33] may be attributable to the lower age of our patients, which provides lower comorbidity.

Under-registration of HF cases is one of the major concerns in epidemiological studies based on data collection from hospitals. HF patients almost never stay home. Before registration in other centers for surgery, patients should be referred to our hospitals. Thus, the risk of under-registration of cases could not provide an impact on the results of our study. To our knowledge, this is the first prospective study with appropriate duration on HF incident carried out in Iran. The results of this study at least could be extended to other provinces with a similar climate.

In summary, we found a relatively low incidence of hip fracture and fall-related hip fracture in Iran than in those which has been reported in western countries, which is mostly due to lower rate in female. These findings disagree with our expectations considering the bone mineral density and vitamin D status of Iranian population especially for women. This may be due to several indirect factors including family support, life habit, carpet flooring, and breast-feeding and bone geometric factors. To evaluate the effect of indirect factors on the incidence of HF in Iran, further investigations are required.

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