ORIGINAL RESEARCH

Epidemiological Investigation of 387 Individuals Over 65 Years Old With Osteoporotic Fractures

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ABSTRACT

Context • With the rapidly aging population globally, osteoporosis (OP) has become a major public health problem, and fracture is a common complication of OP. Older adults, especially postmenopausal women, have a higher incidence of OP.

Objective • The study intended to analyze the clinical information, epidemiological characteristics, treatments, and follow-up results of patients with osteoporotic fractures (OPFs) in adults over 65 years old, to provide data support for the prevention, treatment, and use of OPF focus groups in clinical practice.

Design • The research team performed a retrospective analysis using electronic medical records and related imaging data of patients.

Setting • The study took place at Hebei General Hospital in Hebei, China.

Participants • Participants were 387 patients over 65 years old with osteoporotic fractures who had been admitted to the hospital between July 2012 and July 2018.

Outcome Measures • The research team recorded participants' ages, genders, fracture causes, and fracture sites. The team performed a follow-up analysis on refractures, treatment with anti-osteoporotic drugs, exercise, and survival status within the 3 years after surgery.

Results • The study's male-to-female ratio was 1:3.1, and the rate of osteoporotic fracture for females was significantly higher than that of males. The mean age of participants with fractures was 75.6 ± 8.5 years, and most fractures occurred in participants 78 to 85 years old. Of the 387 participants, 169 participants had hip fractures (43.67%); 98 had vertebral compression fractures (25.32%); 51 had distal radius and ulna fractures (13.18%); 42 had proximal humerus fractures (10.85%); and 27 had other fractures (6.98%). The number of women with fractures at each site was greater than the number of men, but the differences weren't statistically significant ($P > .05$).

The main causes of injury were falls (71.58%), and the main place of the occurrence of injury was at home (65.6%). Of the 387 participants, 346 had surgical treatment (89.41%), and the effective rate of surgical treatment was 99.42%. Three years after surgery, the research team followed up with 235 participants, for a follow-up rate of 60.72%. Within the 3 years of the follow-up period, 61 participants had refractures (25.63%), 29 received treatment with regular anti-osteoporotic drugs (12.34%), 36 exercised twice or more a week (15.32%), and 32 had died for various reasons (13.62%).

Conclusions • The study preliminarily described the epidemiological characteristics of 387 osteoporotic fractures in adults over 65 years old. More women had fractures than men; the hip was the most common fracture site, and falls were the main cause of injury. Most of the fractures occurred in the place of residence, and the refracture rate was 25.96% at three years after surgery (*Altern Ther Health Med.* 2023;29(3):207-211).

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With the rapidly aging population globally, osteoporosis (OP) has become a major public health problem. OP is a systemic bone disease, which manifests in a decrease in the bone density of bone tissue and a degeneration in the bones' internal structure, resulting in increased bone fragility and risk of fracture. Fracture is a common complication of OP and can cause severe pain and reduce a patient's ability to be active. In severe cases, patients may lose the ability to live independently, seriously impacting their physical and mental health and quality of life (QoL), or they may even die.[1]

Because of the insidious symptoms and the low rate of OP diagnosis, older adults mostly see OP as the first symptom and reason for seeking medical advice.

The poor bone formation and callus maturation in OP make patients prone to delayed healing of fractures or even nonunion, which causes them to have a long recovery period.[2] Bedrest braking and fracture-related treatment can aggravate the loss of bone mass.

Older adults, especially postmenopausal women, have a higher incidence of OP, accelerated bone loss, and destruction of bone microstructure, resulting in increased bone fragility and a significant increase in the incidence and risk of fractures.[3,4] Older adults also often have other problems, such as multiple other diseases, weakness, cognitive dysfunction, and a high fall risk, which can significantly increase the risk of refracture in the population.[5]

Pyramidal fracture and hip fracture are more common and serious than other fractures. Hip fractures include femoral neck fractures and intertrochanteric fractures. Surgery is the most effective method for the treatment of osteoporotic fractures (OPFs) in older adults. The OPF, also known as the fragile fracture, refers to a fracture that occurs due to low levels of trauma, not from violent actions, as well as due to the reduction of bone strength in patients with fractures; OPFs often cause disability and death.[6]

Conservative treatment of fractures in older adults and prolonged bed rest are prone to causing serious complications, such as hypostatic pneumonia, lower extremity venous thrombosis, pressure ulcers, and urinary tract infections, and the mortality rate is high.[7-9] If no active surgical intervention occurs, about 20% of hip-fracture patients die within 6 months of the fracture.[10]

OPF Incidence

According to Arceo-Mendoza and Camacho, nearly 500 000 OPFs occur in Europe every year in patients aged 50-79 years, of whom women account for 1.1% and men account for 0.6%.[11]

At present, the population in China over the age of 60 has exceeded 210 million, accounting for about 15.5% of the total population; the population over the age of 65 is nearly 140 million, accounting for about 10.1% of the total population.[12] The latest epidemiological data which the Chinese Health Commission released in 2018, showed that the incidence of OP in people aged 40-49 years was 3.2%, in people over 50 years of age was 19.2%, and in people over 65 years old was as high as 32.0%.[13]

With the increase in the older population and the high prevalence of OP, the incidence of fractures has also continued to rise. About 35% of women and 20% of men in China will experience their first OPF after the age of 50, of which about 50% may suffer an OPF again.[14]

OPF Incidence in Men and Women

From the age of 40, the bone density of the human body begins to gradually decrease, and after menopause with the decline of ovarian function, the levels of women's hormones, such as estradiol and progesterone, drop rapidly.[15]

The hormone estradiol in women can directly inhibit the action of osteoclasts through the main receptor of osteoblasts, the estrogen receptor. The dynamic balance between osteoblasts and osteoclasts is disrupted, which makes bone resorption more frequent than bone formation and results in a higher prevalence of OP in women than in men of the same age.[15]

These changes can also reduce the levels of tumor necrosis factor (TNF) and interleukin (IL) in blood and tissues by binding to the receptor, inhibiting the growth and differentiation of osteoclast precursors, and thereby, indirectly inhibiting the effects of osteoclast activity and reducing bone resorption.

In China, the *Guidelines for the Diagnosis and Treatment of Primary Osteoporosis (2017)* has pointed out that the incidence of vertebral fractures in women over 50 years old in China is 15%, and the incidence of vertebral body fractures in women over 80 years old is about 36.6%.[18] Women's risk of developing an OPF at age 85 is eight times higher than at age 45, while in men, it's five times higher.[19] Therefore, it's of great clinical significance for postmenopausal and perimenopausal women to take estrogen substitutes and supplements of calcium and vitamin D and to perform scientifically validated and reasonable physical exercise and use other anti-osteoporotic treatments.

Compared with treatment, early prevention is more important, and health education about anti-osteoporotic actions for middle-aged and older people should re-emphasize the attention of medical and health personnel. Moreover, home protection for older adults, and barrier-free passages and facilities in public places can also play an important role.

Current Study

At present, the early identification of OPF in older adults is insufficient, and no targeted intervention exists for the high-risk OPF population. This increases the difficulty of OPF treatment and rehabilitation, resulting in the adverse clinical outcomes of disability and death. Therefore, effective prevention and treatment of OP and osteoporotic fractures are an important and urgent problem to be solved in clinical practice.

The epidemiology of osteoporotic fractures in older adults can provide demographic characteristics, such as fracture incidence, predisposing location, and predisposing age group, and play an important role in the prevention and treatment of OPF.

The current study intended to analyze the clinical information, epidemiological characteristics, treatments, and follow-up results of OPF patients over 65 years old, to provide data support for the prevention, treatment, and use of OPF focus groups in clinical practice.

METHODS

Participants

The research team performed a retrospective analysis using electronic medical records and related imaging data of patients at Hebei General Hospital in Hebei, China. Potential participants were patients over 65 years old with OPFs who had been admitted to the hospital between July 2012 and July 2018.

Potential participants were included in the study if they: (1) were older than 65 years, (2) met the World Health Organization's (WHO's) diagnostic criteria for OP: T<-2.5SD, and (3) had an OPF.

Potential participants were excluded from the study if they: (1) had osteoporotic fractures that outpatient clinics had treated conservatively with braces or plaster immobilization or (2) didn't have detailed demographic and bone mineral density data available.

The Ethics Committee of Hebei Provincial People's Hospital approved the study's protocols.

Procedures

Data collection. Two orthopedic attending physicians extracted and recorded participants' ages, genders, injury sites, causes of injury, locations of occurrence of the injury, and other information. All participants had surgery for their fractures. The research team obtained information about post-injury anti-osteoporotic treatments, daily levels of exercise, and re-occurrence of osteoporotic fractures from participants, using telephone or face-to-face interviews, starting with the initial fracture to end of follow-up at 3 years after surgery.

Outcome measures. The research team: (1) evaluated the efficacy of treatment, (2) examined the distribution of fracture sites in the male and female participants, and (3) assessed the distribution of injury causes in the male and female participants

Outcome Measures

Efficacy.[20] Effective rate = (cases of Healing + cases of improvement)/total cases × 100%. The criteria for healing, using an X-ray examination, included: (1) the edge of the bone's broken end had completely disappeared, (2) the periosteal reaction density was similar to the bone shadow, and (3) the callus filled the defect with the same density as the bone cortex and the bone's two edges connected with each other.

The criteria for improvement, using an X-ray examination, included: (1) the edge of the bone's broken end was still visible but had nearly disappeared, (2) the periosteal reaction was deeper and the amount of callus had increased but the defect hadn't filled, and (3) the density was deeper, and the edge was clear.

The criteria for unsuccessful healing, using an X-ray examination, included: (1) the fracture at the bone's end tended to blur, (2) the periosteum had responded slightly, and (3) no callus was visible.

Distribution of fracture sites. The fracture sites included: (1) hips fractures, (2) vertebral compression fractures, (3) fractures of the distal radius and ulna, (4) proximal humerus fractures, and (5) other fractures,

Distribution of injury causes. The injury causes included: (1) falls, (2) daily activities, (3) traffic accidents, and (4) other causes.

Statistical Analysis

The research team performed the data analysis using the SPSS 20.0 (IBM, Chicago, IL, USA) statistical software. The team: (1) used the Shapiro-Wilk test for measurement data to determine whether the data were normally distributed; (2) expressed measurement data with a normal distribution as means ± standard deviations (SDs); (3) used the t-test of independent samples to compare the ages of male and female participants, and (4) used the X2 test to compare the distribution of fracture sites in males and females. $P < .05$ was considered to be statistically significant.

RESULTS

Participants

The research team selected 387 participants, including 95 males and 292 females, with a male-to-female ratio of 1:3.1 (Table 1). Females accounted for 75.45% of all participants, significantly more than males ($P < .05$).

Participants were 66-91 years old, with an average age of 75.6 ± 8.5 years. The average age of male patients was 73.9 ± 7.6 years, and the average age of female patients was 76.1 ± 8.6 years. No significant differences existed in age between the male and female participants ($P > .05$). Most fractures occurred in participants aged 78 to 85 years.

Surgical Outcomes

Among the 387 participants (Table 2), 346 underwent surgery (89.41%), including: (1) 162 participants who had hip fractures and underwent hip replacement (46.82%); (2) 82 participants (23.70%) with vertebral, body compression fractures, 65 of whom underwent percutaneous bone cement vertebroplasty (18.79%) and 17 of whom underwent open reduction and internal fixation (4.91%); (3) 43 participants with fractures of the distal ulna and radius who underwent open reduction and internal fixation (12.43%); (4) 38 participants with proximal humerus fractures who underwent open reduction and internal fixation or closed reduction with intramedullary nails and external fixators (10.98%); and (5) 21 participants with other fractures who also received surgery (6.07%). Of the 346 participants, 344 had good fracture healing (99.42%), and two had nonunion (0.58%).

Fracture Sites

Table 3 and Figure 1 show the distribution of fracture sites in men and women that includes all participants, including those who didn't have surgery. Of the 387 participants, 169 participants (43.67%), 47 men and 122 women, had hip fractures; 98 participants (25.32%), 19 men

Table 1. Distribution of fracture sites in different genders [n, (%)]

Groups	All fractures	Hip fractures	Vertebral compression fractures	Fractures of distal radius and ulna	Proximal humerus fracture	Other fractures
Male	95	47 (12.1)	19(4.9)	10 (2.6)	12 (3.1)	7 (1.8)
Female	292	122 (31.5)	79 (20.4)	41 (10.6)	30 (7.8)	20 (5.2)
χ^2		0.659	1.158	0.603	0.328	0.026
P value	-	0.417	0.282	0.437	0.567	0.872

Table 2. Distribution of injury causes in male and female fracture patients [n, (%)]

Groups	Fall	Daily activities	Traffic accident injuries	Others
Male	62 (16.0)	26 (6.7)	2 (0.5)	5 (1.3)
Female	215 (55.6)	73 (18.9)	1 (0.3)	3 (0.8)
Total	277 (71.6)	99 (25.6)	3 (0.8)	8 (2.1)

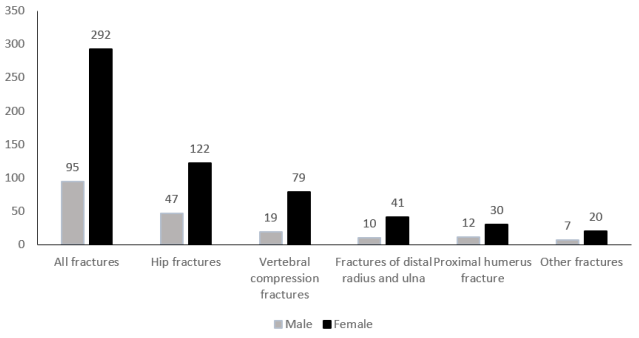
Table 3. Distribution of Fracture Sites in Male and Female Participants

Groups	All Fractures n = 387 n (%)	Hip Fractures n = 169 (43.67%) n (%)	Vertebral Compression Fractures n = 98 (25.32%) n (%)	Fractures of Distal Radius and Ulna n = 51 (13.18%) n (%)	Proximal Humerus Fractures n = 42 (10.85%) n (%)	Other Fractures n = 27 (6.98%) n (%)
Male	95 (24.55)	47 (27.81)	19 (19.39)	10 (19.61)	12 (28.57)	7 (25.93)
Female	292 (75.45)	122 (72.19)	79 (80.61)	41 (80.39)	30 (71.43)	20 (74.07)
χ^2		0.659	1.158	0.603	0.328	0.026
P value		.417	.282	.437	.567	.872

Table 4. Distribution of Injury Causes in Male and Female Participants (N = 387)

Groups	All Locations n = 387 n (%)	Falls n = 277 (71.58%) n (%)	Tripping Caused by Daily Activities n = 99 (25.58%) n (%)	Traffic Accidents n = 3 (0.77%) n (%)	Other Causes n = 8 (2.07%) n (%)
Males	95 (24.55)	62 (22.38)	26 (26.26)	2 (66.67)	5 (62.50)
Females	292 (75.45)	215 (77.62)	73 (73.74)	1 (33.33)	3 (37.50)
χ^2		2.467	0.211	2.896	6.353
P value		.016	.646	.089	.012

Figure 1. Distribution of Fracture Sites in Male and Female Participants



and 79 women, had vertebral compression fractures; 51 participants (13.18%), 10 men and 41 women, had distal radius and ulna fractures, 42 participants (10.85%), 12 men and 30 women, had proximal humerus fracture, and 27 participants (6.98%), 7 men and 20 women, had other fractures. The number of women with fractures at each site was greater than the number of men, but the differences weren't statistically significant ($P > .05$).

Causes of fractures

Table 4 and Figure 2 show the distribution of injury causes. Of the 387 participants, 277 participants (71.58%), 62 men and 215 women, had fractures that falls caused. After falls, the causes of fractures included 99 participants (25.58%), 26 men and 73 women, who tripped during daily activities; three participants (0.77%), two men and one woman, who

Figure 2. Distribution of Injury Causes in Male and Female Participants

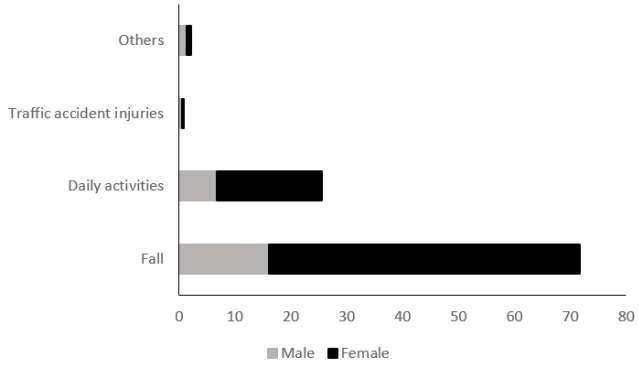


Table 5. Follow up data three years after surgery

Groups	Refracture	Anti-osteoporotic	Exercised twice or more	Mortality
Males (n = 58)	13	7	11	7
Females (n = 177)	48	22	25	25
χ^2	0.503	0.005	0.789	0.157
P value	.478	.942	.374	.692

had traffic accidents, and 8 participants (2.07%), 5 men and 3 women, who had fractures for other reasons . The site of the occurrence injury was mainly at home (data not shown), including 254 participants (65.6%).

Follow Up

At three years after surgery, the team had followed up with 235 participants, with a follow-up rate of 60.72% (Table 5). Of them, 61 participants had refracture within three years (25.96%). Among the 235 follow-up participants, 29 had adhered to regular anti-osteoporotic treatment (12.34%); 36 had exercised twice or more per week (15.32%), and 32 had died due to various reasons (13.62%).

DISCUSSION

Among the 387 participants with osteoporotic fractures in the current study, the male-to-female ratio was 1:3.1, and females accounted for 75.45% of all participants, significantly more than males ($P < .05$), which was consistent with the data reported in previous literature.[16,17]

In the current study, 43.7% of OPFs occurred in the hip, while falls caused 71.6% of the fractures and 65.6% of the fractures occurred in the place of residence, which is also consistent with previous studies.

In the current study, 89.41% of participants received surgical treatments, and the effective rate of surgical treatment was 99.42%. During the three-year postoperative follow-up, the refracture rate was 25.96%, and the adherence of the 235 participants in the follow-up group to anti-OP treatment and exercise was low, at 12.34% and 15.32%, respectively.

46-62% of BMD values are determined by genetic factors, and 38-54% are determined by surrounding environmental factors.[21] Therefore, good living habits, such as reasonable diet, exercise, and adequate sunlight exposure, combined with regular anti-OP drug treatment, can have a positive effect on improving bone mineral density in the elderly and reducing the incidence of osteoporotic fractures.

The current study had some limitations. First, the sample size was small, which may have biased the results to a certain extent. Second, the follow-up time was short, and the study didn't follow up on the efficacy of conservative treatment of fractures in patients with OP, nor did it examine the risk of fractures in patients with OP without prior fractures. The plan of the research team's next project will include more patients and a longer follow-up time, focusing on the relationship between the effects of anti-osteoporotic treatments and the incidence of refracture.

CONCLUSIONS

The study preliminarily described the epidemiological characteristics of 387 osteoporotic fractures in adults over 65 years old. More women had fractures than men; the hip was the most common fracture site, and falls were the main cause of injury. Most of the fractures occurred in the place of residence, and the refracture rate was 26.0% at three years after surgery.

FUNDING STATEMENT

Directive Task of the Hebei Health Commission (No. 20150120) supported the study.

AUTHOR CONTRIBUTIONS

Zhaoxu Yang and Dong Xing contributed equally to this paper.

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