Prevalence of osteoporotic vertebral fracture among community-dwelling elderly in Shanghai

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To the Editor: Osteoporosis is becoming a common, serious, and costly health problem, which causes over nine million fractures annually worldwide.[1] Currently, osteoporotic fractures are a considerable burden to public health services and have fairly high morbidity and mortality.[2] Vertebral fractures are the most common osteoporotic fracture and may lead to a high risk of further fracture and could be prevalent in both females and males.[3] Ling *et al*[4] and Ms. OS studies[5] evaluated the prevalence of vertebral fractures in Beijing and Hong Kong, respectively. However, our knowledge of the descriptive epidemiology and risk factors for vertebral fracture in China still remains poor.

In this cross-sectional study, 14,075 participants including 6313 males (aged 60–97 years) and 7762 females (aged 60–98 years), were gathered voluntarily through the SCEHE (Shanghai Community-dwelling Elderly Health Examination) by family doctors in six communities all over Shanghai from 2014 to 2016. The six communities were Fenglin, Lingyun, Longhua, Qixian, Sanlin, and Xujiahui.

All the participants were contacted by the staffs in the community to attend the physical examinations. The common physical examinations did not include the X-ray examination targeted to the thoracic and lumbar spine (T4-L4). We informed the participants who were willing to undergo the X-ray examination of the related risks, and they signed a consent form. The agreed participants were requested to provide us relevant information consisting of characteristics, chronic disease history, and for females, age at menopause. After that, lateral thoracolumbar (T4-L4) X-ray radiography was taken. All the radiographs and the medical history information were collected to Shanghai Jiao Tong University Affiliated Sixth People's Hospital together. The semi-quantitative system by Genant *et al*[6] was adapted for grading vertebral deformities by the same experienced radiologist within 3 months. The study protocol was approved by the Ethics Committee of Human Research of the Shanghai Jiao Tong University Affiliated Sixth People's Hospital.

Basic information such as age, height, weight, and body mass index (BMI) was obtained. Years since menopause (YSM) were defined as the time since menopause began and at least 1 year. The radiograph was taken in the respective Community Health Service Center (CHSC), and the same protocol was adapted in each CHSC. A radiograph was taken with the patient in the left lateral position and was centered at T10. All participants underwent only one radiograph of the thoracic and lumbar spine to limit radiation exposure and due to workforce and financial limitations. In total, 99% of the radiographs covered T10-L2, over 95% of the radiographs covered T8-L3, and over 92% of the radiographs covered T6-L4. All X-ray images were stored and brought to the Shanghai Jiao Tong University Affiliated Sixth People's Hospital. An experienced professor of semi-quantitative techniques analyzed the radiographs and separated them into fractured and non-fractured groups.

Fasting blood samples included routine blood examinations (mainly hemoglobin), hepatic function (mainly alanine transaminase), renal function (mainly serum creatinine), serum lipids (mainly serum cholesterol), and fasting blood glucose. Measurements were taken at each CHSC clinical lab using different biochemistry systems, so we only adopted a qualitative comparison for disease diagnosis, not for quantitative comparison or data analysis.

In this study, we collected 11 characteristics of all participants: age, BMI, YSM for females, and disease history including hypertension, diabetes, coronary heart disease, stroke, hyperlipidemia, chronic liver disease, chronic kidney disease, and malignant tumor. Statistics were analyzed using SPSS 19.0 (SPSS Inc., Chicago, IL, USA), and according to the semi-quantitative technique of Genant, deformities greater than or equal to grade 1 were considered fractured. The characteristics of the fractured participants were compared with non-fractured participants within the same sex, using t tests for continuous variables and Chi-squared analysis for categorical data. All statistical tests were two sided. Normally distributed data, such as age, weight, and height, are presented as the mean ± standard deviation (SD), and a P value <0.05 was considered statistical significant.

We successfully collected 14,075 X-ray images and 9239 disease histories. The participants recruited for statistical analysis were separated into stratified age groups with 5-year intervals and divided into two different cohorts according to fractured or non-fractured. The basic anthropometry of the 14,075 participants and the chronic disease history for 9239 participants were summarized in Supplementary Tables 1 and 2 (http://links.lww.com/CM9/A63). The characteristics of the two cohorts are stated in Supplementary Table 3 (http://links.lww.com/CM9/A63). The male fractured cohort were more likely to be older (72.1 $vs.$ 71.2 years, $P < 0.001$) and shorter (165.2 $vs.$ 166.3 cm, $P < 0.001$) and less weight (66.5 $vs.$ 67.4 kg, $P = 0.002$) when compared to the non-fractured cohort. The fractured cohort had a lower rate of diabetes (12.8 $vs.$ 16.5%, $P = 0.025$) and a higher rate of stroke (5.5 $vs.$ 3.7%, $P = 0.034$) than the non-fractured cohort. In addition, similar results were presented in the female fractured cohort, which was older (74.2 $vs.$ 70.9 years, $P < 0.001$) and shorter (152.2 $vs.$ 154.5 cm, $P < 0.001$) and less weight (56.5 $vs.$ 57.9 kg, $P < 0.001$); the fractured cohort had a higher rate of hypertension (41.2 $vs.$ 37.5%, $P = 0.011$) than the non-fractured cohort.

Vertebrae of T4-L4 were analyzed in lateral radiographs of spine using the semi-quantitative technique. The prevalence of vertebral fracture was 17.2% (2414/14,075) among all participants, 17.0% (1073/6313) for males, and 17.3% (1341/7762) for females [details in Supplementary Table 4, http://links.lww.com/CM9/A63]. The vertebral fracture prevalence of females had a tendency to be higher with increasing age. While males had a relatively stable prevalence, at approximately 18% and was significantly higher than females in 60 to 64 years and 65 to 69 years group ($P < 0.001$ and $P = 0.003$, respectively), while the prevalence among females was significantly higher in the
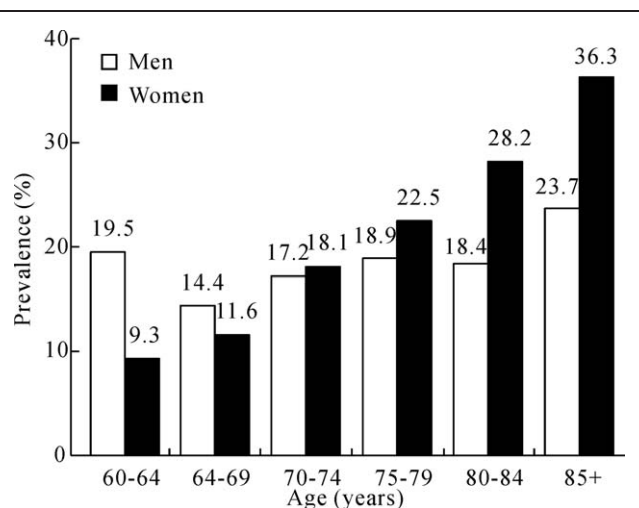
Figure 1: Prevalence of vertebral fracture among Shanghai community-dwelling elderly for males and females in different age groups.

groups of 75 to 79, 80 to 84, and over 85 years ($P = 0.041$, $P < 0.001$, and $P = 0.002$, respectively). The prevalence among 70 to 74 years females was higher than that in males (18.1% $vs.$ 17.2%) with no statistical significance ($P = 0.512$). Figure 1 shows a more direct tendency of the prevalence in different sex and age groups. The grades of the vertebral fracture were evaluated by a semi-quantitative technique, with three different grades: mild, grade 1 (G1); moderate, grade 2 (G2), or severe, grade (G3). The prevalence of G2 and G3 fracture in females was significantly higher than in males in all age groups ($P < 0.001$), except for the 60 to 64 years group ($P = 0.313$). Supplementary Table 5 (http://links.lww.com/CM9/A63) shows the prevalence of G2 and G3 fractures among Shanghai community-dwelling elders.

Among the participants, 2414 individuals suffered 3814 fractured vertebral bodies, indicating that each participant with fracture had 1.58 deformed vertebral bodies. The relative percentages of G1, G2, and G3 fractures among the fractured elderly were 68.2% (2601/3814), 21.4% (816/3814), and 10.4% (397/3814), respectively. Supplementary Figure 1 (http://links.lww.com/CM9/A63) presents the prevalence of different deformity grades among males and females in our study. Supplementary Figures 2 and 3 (http://links.lww.com/CM9/A63) show a view of the deformity grades of each vertebral body.

The most easily affected vertebrae bodies were T11, T12, and L1 [Supplementary Figure 5, http://links.lww.com/CM9/A63]. Nearly 75% of the fractures occurred at T11, T12, and L1 both in males and females. Most vertebral fractures were single, and females had a higher prevalence of single vertebral fractures than males (67.8% $vs.$ 60.7%, $P < 0.001$). However, double vertebral fractures had a higher percentage among fractured males than females (28.6% $vs.$ 20.7%, $P < 0.001$) [Supplementary Figure 4, http://links.lww.com/CM9/A63]. No significant statistical difference was found when comparing multiple (three or more) vertebral fractures between males and females (10.6% $vs.$ 11.5%). The prevalence of thoracic-lumbar fracture (in which the fracture occurred in both thoracic

and lumbar vertebrae), single thoracic vertebral fracture, and single lumbar vertebral fracture were 17.8%, 55.3%, and 26.9% in males and 18.0%, 48.0%, and 34.0% in females. Males were at greater risk of thoracic fracture than females ($P < 0.001$), whereas females had greater prevalence of lumbar fracture than males ($P < 0.001$).

The prevalence of vertebral fracture in post-menopausal females in Shanghai was relatively lower than that in Beijing among all age group according to a recent study[7]: 11.1% vs. 22.6% among 60 to 69 years group, 20.0% vs. 31.4% among 70 to 79 years group, and 30.1% vs. 58.1% among older than 80 years group, respectively. Similarly, the prevalence among males in Shanghai was also lower than that in Hong Kong,[5] which also focused on community-dwelling males using the same method, with 14.4% vs. 15.2% in the 65 to 69 years group, 17.9% vs. 19.9% in the 70 to 79 years group, and 19.8% vs. 35.9% in aged older than 80 years, respectively.

The prevalence of vertebral fracture increased with age in females, and this age-specific prevalence has been reported in many cities or countries[8]; however, previous studies found no correlation between aging and vertebral fracture in males.[9] The prevalence was stable for each age group in males, and no significant difference was found except for the age groups of 65 to 69 years and over 85 years. Meanwhile, we found that 83.3% of fractures among males were G1 and occurred at T11 or T12, while 43.3% of fractures among females were G2 or G3 and occurred at T12 or L1. Males have a higher bone mineral density (BMD) than females, and reduced BMD of the total hip and femoral neck is associated with increased odds of having a prevalent vertebral fracture,[10] which may explain the difference in fracture grade between males and females.

In conclusion, the prevalence of vertebral fracture among the elderly in Shanghai was 17.2% for all, 17.0% for males, and 17.3% for females. Males were at greater risk of mild, thoracic, and double vertebral fracture, while females were more likely to be moderate or severe, lumbar, and single onset. The prevalence among females increased with age, while was not seen in males.

Conflicts of interest

None.

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