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Associated Factors for Osteoporosis and Fracture in Chinese Elderly

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

BCDE 1,2 Yuqiang Wang*
BCDE 1 Han Ding*
BCD 3 Xiaohua Wang
BCD 1 Zhijian Wei
A 1 Shiqing Feng

1 Department of Orthopedics, Tianjin Medical University General Hospital, Tianjin, P.R. China
2 Department of Orthopedic Surgery, Affiliated Hospital of Logistics, University of Chinese Armed Police Force, Tianjin, P.R. China
3 Department of Neurological, Intensive Care Unit, Tianjin Huanhu Hospital, Tianjin, P.R. China

* Yuqiang Wang and Han Ding contributed equally to this work

Corresponding Author: Shiqing Feng, e-mail: sqfeng@tmu.edu.cn

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Background: The factors associated with osteoporosis are poorly understood in the Chinese population. This study aimed to examine the factors associated with osteoporosis and with fractures in a Chinese elderly population.

Material/Methods: This was a cross-sectional study of elderly people living in Tianjin between 2012 and 2014. Bone mineral density was measured by dual X-ray absorptiometry. The subjects completed a questionnaire about lifestyle habits, personal and family medical history, calcium intake, and exercising. Data were gathered on occurrence of fracture at 5 years or August 2018, whichever occurred first.

Results: There were 298 individuals with osteoporosis (18.5% male, median age 67 years) and 397 without (46.3% male, median age 62 years). Male sex (OR=0.051, 95% CI: 0.021–0.126), age (OR=1.049, 95% CI: 1.099–1.202), being divorced/widowed (OR=2.445, 95% CI: 1.219-4.904), digestive ulcer history (OR=3.805, 95% CI: 1.539–9.405), family history of hunchback (OR=2.659, 95% CI: 1.145–6.175), family history of osteoarthropathy (OR=4.222, 95% CI: 2.128-8.375), fracture history (OR=2.138, 95% CI: 1.307–3.496), drinking green tea (OR=0.352, 95% CI: 0.217–0.574), and exercising (OR=0.303, 95% CI: 0.193–0.475) were independently associated with osteoporosis. Digestive ulcer history (OR=3.183, 95% CI: 1.178-8.5992), exercising (OR=0.354, 95% CI: 0.139–0.903), and taking calcium supplements during follow-up (OR=0.262, 95% CI: 0.112–0.611) were independently associated with fractures in patients with osteoporosis.

Conclusions: Female sex, age, marital status, history of digestive ulcer and fracture, and family history of hunchback and osteoarthropathy are associated with osteoporosis among elderly subjects, while drinking green tea and exercising are inversely associated. Among the patients with osteoporosis, a history of digestive ulcer is associated with fractures, while exercising and taking calcium supplements are inversely associated.

MeSH Keywords: Frail Elderly • Osteoporosis • Risk Factors

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Background

Osteoporosis is a generalized skeletal disorder characterized by compromised bone strength and deterioration of bone quantity and quality, often leading to fragility fracture [1]. With the aging of the global population, osteoporosis has become a serious social and public health problem. According to the World Health Organization (WHO), the diagnostic criterion for osteoporosis is a T-score of any part of the body ≤–2.5 standard deviations (SD) [1]. At present, about 200 million people have osteoporosis worldwide and the incidence has jumped to seventh place among all common diseases, with a prevalence of 10–58%, according to the population studied [1–6]. With its recent and continuous economic development, the Chinese population is rapidly aging [7] and since age is one of the main risk factors for osteoporosis [1,6], the threat of osteoporosis to public health is becoming more significant in China [8,9].

Osteoporosis seriously affects the quality of life of elderly people, and the most serious complication of osteoporosis is fracture [1]. Indeed, women with osteoporosis have a rate ratio of 4.03 of fracture compared with women with normal bone mineral density (BMD) [10]. In addition, osteoporotic fractures in the elderly are associated with increased mortality [11], loss of autonomy, nursing home referral, and increased risk of geriatric syndromes like delirium [12].

Postmenopausal women, persons ≥65 years of age, white people, people of Asian descent, and people with small body frame are the most affected by osteoporosis [1, 6]. In addition, lifestyle factors (e.g., low calcium intake, vitamin D deficiency, excess vitamin A intake, inadequate physical activity, smoking, and alcohol abuse), genetic factors (e.g., parental history of hip fracture, cystic fibrosis, hemochromatosis, porphyria, osteogenesis imperfecta, and hypophosphatasia), endocrine disorders (e.g., hyperparathyroidism, hypogonadal states, diabetes mellitus, and hyperthyroidism), gastrointestinal disorders (e.g., celiac disease, Crohn's disease, and cirrhosis), hematologic disorders and cancers, rheumatologic and autoimmune disorders (e.g., rheumatoid arthritis and systemic lupus erythematosus), and medications (e.g., hormonal therapies, steroids, immunosuppressants, and proton pump inhibitors) are known to increase the risk of osteoporosis [1,6,13–15]. In China, studies showed that sex, older age, lower weight, and lower body mass index (BMI) were associated with osteoporosis (reviewed by Chen et al. [8]). Nevertheless, the exact contribution is not understood for most risk factors.

Therefore, the aim of the present study was to examine the factors associated with osteoporosis and with fractures in a Chinese elderly population (outpatients and subjects from the health examination center). The results could help identify patients in need of closer follow-up.

Material and Methods

Study design and subjects

This was a cross-sectional study of elderly people living in Tianjin between September 2012 and May 2014 and surveyed at the Affiliated Hospital of Logistics College of Chinese People's Armed Police Force Hospital. Subjects with lower back pain, hip pain, or knee pain from the outpatient clinic and subjects from the health examination center were recruited. These clinics are open to the general population, but treat specific diseases. The study was approved by the local ethics committee (no. 2018-0003).

The inclusion criteria were: 1) elderly (age ≥60 years of age); 2) followed up at an outpatient clinic (geriatrics, arthropathy, and osteoporosis); and 3) household registered in Tianjin and has lived in Tianjin for >10 years at study entry. The exclusion criteria were: 1) history of taking steroids; 2) mental disorder; 3) senile dementia; or 4) did not cooperate or loss to follow-up.

BMD measurement

BMD measurement was performed using a Discovery dual-energy Bone Densitometer (Hologic, Inc., Bedford, MA, USA). The BMD values of the lumbar spine, femoral neck, and Ward's triangle were measured. The instrument was controlled by a computer and the results were analyzed automatically. The BMD results were expressed as g/cm^2. Osteoporosis was diagnosed in the presence of a T-score ≤–2.5 [1,14].

Questionnaire

The questionnaire was self-designed and discussed among orthopedic, nursing, and epidemiology experts. The questionnaire collected the sociodemographic and general health data of the subjects, including sex, age, weight, height, BMI, education level, marital status, lifestyle habits (smoking, drinking alcohol, coffee, and green tea), family history (parents, spouse, children's history of hunchback and osteoarthropathy), history of present illness (bone and joint pain, low back pain, other systems), history of fracture, past history (prostatic hyperplasia and digestive ulcer), calcium intake, and leisure time physical activity (i.e., exercising).

Follow-up

Patients with T-score <–2.5 were followed up by telephone at 5 years after enrollment or August 2018, whichever occurred first, to record whether any fracture occurred and whether calcium supplements were taken during these 5 years.

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Table 1. Characteristics of all subjects.

Variable	T >–2.5 (n=397)		T ≤–2.5 (n=298)		P
Age (years)	62	[60, 85]	67	[60, 88]	<0.001
Sex, n (%)					<0.001
Female	213	(53.7)	243	(81.5)	
Male	184	(46.3)	55	(18.5)	
Body mass index (kg/m^2)	24.5	[16.9, 36.1]	23.5	[12.5, 31.3]	<0.001
Marital status, n (%)					<0.001
Married	362	(91.2)	218	(73.2)	
Divorced/widowed	35	(8.8)	80	(26.8)	
Education level, n (%)					0.001
Senior high school/university	271	(68.3)	168	(56.4)	
Illiteracy/primary school/junior high school	126	(31.7)	130	(43.6)	
History of prostatic hyperplasia, n (%)	5	(1.3)	2	(0.7)	0.442
History of digestive ulcer, n (%)	10	(2.5)	33	(11.1)	<0.001
Family history of hunchback, n (%)	14	(3.5)	28	(9.4)	0.001
Family history of osteoarthropathy, n (%)	22	(5.5)	57	(19.1)	<0.001
History of fall and injury, n (%)	0	(0.0)	86	(28.9)	<0.001
History of fracture, n (%)	63	(15.9)	110	(36.9)	<0.001
History of taking calcium, n (%)	76	(19.1)	88	(29.5)	0.001
Smoking, n (%)					
Never	260	(65.5)	191	(64.1)	0.703
Occasional/quit smoking/smoking	137	(34.5)	107	(35.9)	
Drinking alcohol, n (%)					
Never	234	(58.9)	231	(77.5)	<0.001
Occasional/quit drinking/drinking	163	(41.1)	67	(22.5)	
Drinking coffee per week, n (%)					
Never	362	(91.2)	290	(97.3)	0.001
Occasional/everyday	35	(8.8)	8	(2.7)	
Drinking green tea per day, n (%)					
Never	189	(47.6)	224	(75.2)	<0.001
Less than 1 cup/2–3 cups/more than 3 cups	208	(52.4)	74	(24.8)	
Weekly physical exercise, n (%)					
Never	66	(16.6)	157	(52.7)	<0.001
Occasional/often	331	(83.4)	141	(47.3)	
Taking calcium agents within the 5-year follow-up (anti-osteoporosis therapy), n (%)					
Not taken	209	(52.6)	68	(22.8)	<0.001
Regular/discontinuous	188	(47.4)	230	(77.2)	
Bone mineral density of lumbar spine (g/cm^2)	0.97	[0.47, 10.77]	0.72	[0.33, 1.31]	<0.001
Bone mineral density of femoral neck (g/cm^2)	0.74	[0.54, 1.43]	0.55	[0.30, 0.71]	<0.001
Bone mineral density of Ward's triangle (g/cm^2)	0.56	[0.31, 1.09]	0.34	[0.10, 0.74]	<0.001

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Table 2. Associated factors for osteoporosis in all subjects.

Variable	Univariable logistic regression		Multivariable logistic regression	
	OR (95% CI)	P	OR (95% CI)	P
Gender (Male *vs.* Female)	0.262 (0.184, 0.373)	<0.001	0.051 (0.021, 0.126)	<0.001
Age	1.107 (1.079, 1.136)	<0.001	1.149 (1.099, 1.202)	<0.001
Marital status (divorced/widowed *vs.* married)	3.796 (2.466, 5.842)	<0.001	2.445 (1.219, 4.904)	0.012
Education level (Illiteracy/primary school/junior high school *vs.* senior high school/university)	1.664 (1.219, 2.273)	0.001	0.69 (0.434, 1.097)	0.117
Body mass index	0.892 (0.851, 0.935)	<0.001	0.583 (0.27, 1.259)	0.170
History of prostatic hyperplasia (yes *vs.* no)	0.530 (0.102, 2.749)	0.450		
History of digestive ulcer (yes *vs.* no)	4.819 (2.335, 9.946)	<0.001	3.805 (1.539, 9.405)	0.004
Family history of hunchback (yes *vs.* no)	2.837 (1.466, 5.490)	0.002	2.659 (1.145, 6.175)	0.023
Family history of osteoarthropathy (yes *vs.* no)	4.031 (2.402, 6.767)	<0.001	4.222 (2.128, 8.375)	<0.001
History of fracture (yes *vs.* no)	3.102 (2.17, 4.435)	<0.001	2.138 (1.307, 3.496)	0.002
History of taking calcium (yes *vs.* no)	1.77 (1.244, 2.519)	0.002	1.389 (0.869, 2.219)	0.169
Smoking (occasional/quit smoking/smoking *vs.* never)	1.063 (0.776, 1.456)	0.703		
Drinking alcohol (occasional/quit drinking/ drinking *vs.* never)	0.416 (0.297, 0.584)	<0.001	1.521 (0.873, 2.651)	0.139
Drinking coffee per week (occasional/everyday *vs.* never)	0.285 (0.13, 0.624)	0.002	0.497 (0.188, 1.312)	0.158
Drinking tea per day (<1 cup/2–3 cups/>3 cups *vs.* never)	0.3 (0.216, 0.417)	<0.001	0.352 (0.217, 0.574)	<0.001
Weekly physical exercise (occasional/often *vs.* never)	0.179 (0.126, 0.254)	<0.001	0.303 (0.193, 0.475)	<0.001

Data collection

After the questionnaire was returned, it was validated and captured by 2 persons. Discrepancies in data entry were detected using data comparison. Questionnaires with >5% of missing data were rejected.

Statistical analysis

Continuous data that did not conform to the normal distribution were described as medians (range) and analyzed using nonparametric tests. Categorical data were described as frequencies (percentage) and analyzed using the chi-square test or Fisher's exact test, as appropriate. Logistic regression analysis was performed in the general population with osteoporosis as the outcome, and variables with significant differences in the univariable analyses were incorporated into the multivariable analysis (enter method). In the osteoporotic population, fracture as outcome was analyzed by logistic regression, and variables with significant differences in the univariable analyses were incorporated into the multivariable analysis (enter method). Statistical analysis was performed using SPSS 21.0 (IBM, Armonk, NY, USA). Two-tailed P-values <0.05 were considered statistically significant.

Results

Characteristics of the subjects

A total of 695 subjects were included in the study; among them, 298 (42.9%) were diagnosed with osteoporosis and their BMD was lower at all 3 sites compared with patients without osteoporosis (all P<0.001) (Table 1). Among the osteoporotic patients, 8 were lost to follow-up (2.7%).

Associated factors for osteoporosis in all subjects

Table 2 presents the associated factors for osteoporosis. The multivariable analysis showed that male sex (odds ratio

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Table 3. Characteristics of the patients with osteoporosis.

Variable	Non-fracture (n=271)		Fracture (n=27)		P
Age (years)	67	[60, 86]	65	[60, 88]	0.947
Sex, n (%)					0.993
Male	221	(81.5)	22	(81.5)	
Female	50	(18.5)	5	(18.5)	
Body mass index (kg/m^2)	23.5	[16.3, 31.3]	23.6	[12.5, 30.5]	0.610
Marital status, n (%)					0.210
Married	201	(74.2)	17	(63.0)	
Divorced/widowed	70	(25.8)	10	(37.0)	
Education level, n (%)					0.034
Senior high school/university	158	(58.3)	10	(37.0)	
Illiteracy/primary school/junior high school	113	(41.7)	17	(63.0)	
History of prostatic hyperplasia, n (%)	1	(0.4)	1	(3.7)	0.043
History of digestive ulcer, n (%)	25	(9.2)	8	(29.6)	0.001
Family history of hunchback, n (%)	25	(9.2)	3	(11.1)	0.749
Family history of osteoarthropathy, n (%)	48	(17.7)	9	(33.3)	0.049
History of fall and injury, n (%)	81	(29.9)	5	(18.5)	0.214
History of fracture, n (%)	102	(37.6)	8	(29.6)	0.411
History of taking calcium, n (%)	78	(28.8)	10	(37.0)	0.370
Smoking, n (%)					0.770
Never	173	(63.8)	18	(66.7)	
Occasional/quit smoking/smoking	98	(36.2)	9	(33.3)	
Drinking alcohol, n (%)					0.653
Never	211	(77.9)	20	(74.1)	
Occasional/quit drinking/drinking	60	(22.1)	7	(25.9)	
Drinking coffee per week, n (%)					0.365
Never	263	(97.0)	27	(100.0)	
Occasional/everyday	8	(3.0)	0	(0.0)	
Drinking tea per day, n (%)					0.206
Never	201	(74.2)	23	(85.2)	
Less than 1 cup/2–3 cups/more than 3 cups	70	(25.8)	4	(14.8)	
Weekly physical exercise (occasional/often *vs.* never), n (%)					0.020
Never	137	(50.6)	20	(74.1)	
Occasional/often	134	(49.4)	7	(25.9)	
Taking calcium agents within 5-year follow-up (Anti-osteoporosis therapy), n (%)					0.001
Not taken	55	(20.3)	13	(48.1)	
Regular/discontinuous	216	(79.7)	14	(51.9)	
Bone mineral density of lumbar spine (g/cm^2)	0.72	[0.33, 1.31]	0.68	[0.38, 0.96]	0.050
Bone mineral density of femoral neck (g/cm^2)	0.55	[0.34, 0.71]	0.51	[0.30, 0.64]	0.024
Bone mineral density of Ward's triangle (g/cm^2)	0.34	[0.18, 0.74]	0.31	[0.10, 0.65]	0.001

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Table 4. Associated factors for fracture in patients with osteoporosis within 5 years.

Variable	Univariable logistic regression			Multivariable logistic regression		
	OR (95% CI)		P	OR (95% CI)		P
Sex (Male *vs.* Female)	1.005	(0.363, 2.781)	0.993			
Age	1.015	(0.961, 1.073)	0.594			
Marital status (divorced/widowed *vs.* married)	1.689	(0.739, 3.862)	0.214			
Education level (illiteracy/primary school/junior high school *vs.* senior high school/university)	2.377	(1.049, 5.384)	0.038	1.636	(0.678, 3.949)	0.274
Body mass index	0.938	(0.828, 1.061)	0.306			
History of prostatic hyperplasia (yes *vs.* no)	10.385	(0.631, 170.921)	0.101			
History of digestive ulcer (yes *vs.* no)	4.143	(1.646, 10.426)	0.003	3.183	(1.178, 8.599)	0.022
Family history of hunchback (yes *vs.* no)	1.23	(0.346, 4.375)	0.749			
Family history of osteoarthropathy (yes *vs.* no)	2.323	(0.984, 5.483)	0.054			
History of fracture (yes *vs.* no)	0.698	(0.295, 1.652)	0.413			
History of taking calcium (yes *vs.* no)	1.456	(0.638, 3.319)	0.372			
Smoking (occasional/quit smoking/smoking *vs.* never)	0.883	(0.382, 2.04)	0.770			
Drinking alcohol (occasional/quit drinking/ drinking *vs.* never)	1.231	(0.497, 3.049)	0.654			
Drinking coffee per week (occasional/everyday *vs.* never)	0	(0, Inf)	0.987			
Drinking tea per day (<1 cup/2–3 cups/>3 cups *vs.* never)	0.499	(0.167, 1.494)	0.214			
Weekly physical exercise (occasional/often *vs.* never)	0.358	(0.147, 0.874)	0.024	0.354	(0.139, 0.903)	0.030
Taking calcium agents within 5 years (regular/ discontinuous *vs.* none)	0.274	(0.122, 0.617)	0.002	0.262	(0.112, 0.611)	0.002

[OR]=0.051, 95% confidence interval [CI]: 0.021–0.126, P<0.001), age (OR=1.049, 95% CI: 1.099–1.202, P<0.001), being divorced/ widowed (OR=2.445, 95% CI: 1.219–4.904, P=0.012), history of digestive ulcer (OR=3.805, 95% CI: 1.539-9.405, P=0.004), family history of hunchback (OR=2.659, 95% CI: 1.145–6.175, P=0.023), family history of osteoarthropathy (OR=4.222, 95% CI: 2.128–8.375, P<0.001), history of fracture (OR=2.138, 95% CI: 1.307–3.496, P=0.002), drinking green tea (OR=0.352, 95% CI: 0.217–0.574, P<0.001), and exercising (OR=0.303, 95% CI: 0.193–0.475, P<0.001) were independently associated with osteoporosis (Table 2).

Characteristics of the patients with osteoporosis

Compared with the patients without fracture during the 5-year follow-up, the patients with fracture had a lower education level (P=0.001), higher frequency of digestive ulcer (29.6% *vs.* 9.2%, P=0.001), higher family history frequency of osteoarthropathy (33.3% *vs.* 17.7%, P=0.049), lower frequency of exercising (25.9% *vs.* 49.4%, P=0.02), and lower BMD at all 3 sites (all P<0.05) (Table 3). The use of calcium supplements was lower during the 5-year follow-up in the fracture group (51.9% *vs.* 79.7%, P=0.001).

Associated factors for fracture in the patients with osteoporosis

The multivariable analysis showed that a history of digestive ulcer (OR=3.183, 95% CI: 1.178–8.599, P=0.022), exercising (OR=0.354, 95% CI: 0.139–0.903, P=0.030), and taking calcium supplements during follow-up (OR=0.262, 95% CI: 0.112–0.611, P=0.002) were independently associated with fractures in patients with osteoporosis (Table 4).

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Discussion

The contribution of the risk factors for osteoporosis is poorly understood in the Chinese population. Therefore, this study aimed to examine the factors associated with osteoporosis and with fractures in a Chinese population. The present study showed that sex, age, being divorced/widowed, history of digestive ulcer, family history of hunchback, family history of osteoarthropathy, history of fracture, drinking green tea, and exercising are associated with osteoporosis among elderly Chinese subjects. Among the patients with osteoporosis, a history of digestive ulcer, exercising, and taking calcium supplements are associated with fractures.

The present study showed that female sex, older age, and family history of osteoarthropathy are risk factors for osteoporosis, which is already well known [1,6]. Furthermore, being divorced/widowed was also associated with osteoporosis. This is supported by a study from the United States that showed that marital disruption was associated with poor bone health in men and that marital quality was associated with a good bone health in women [16]. Digestive ulcers are a common manifestation of a variety of inflammatory digestive diseases and cirrhosis, and these diseases are often associated with malabsorption and malnutrition, as well as with osteoporosis [17]. Accordingly, the present study showed that the presence of digestive ulcers was independently associated with osteoporosis. Family histories of hunchback and osteoarthropathies and personal history of fracture are indicatives of bone diseases that can affect bone metabolism and hence the risk of osteoporosis [18]. Previous studies indeed showed that kyphosis, diseases affecting bone metabolism, and history of falls and fractures were risk factors for osteoporosis [19–22]. In addition, some of those disorders can be the results of the osteoporosis itself. Indeed, kyphosis is associated with decreased BMD, and possibly results from increased fragility of the spine [23,24]. In the present study, a family history of hunchback and osteoarthritis were independently associated with osteoporosis. Those bone disorders cover a wide variety of diseases that have metabolic, inflammatory, genetic, and environmental etiologies, and additional study is necessary to refine their association with osteoporosis. Finally, drinking green tea and exercising were factors associated with osteoporosis. A recent meta-analysis showed that consuming green tea can reduce the risk of osteoporosis and the risk of hip fracture [25], mainly through the action of polyphenols that mitigate BMD loss [26]. Exercising is well known to be inversely associated with osteoporosis and bone degenerative diseases in general [27–29], supporting the validity of our results.

Fractures are the main consequence of osteoporosis and can lead to mortality, especially in the elderly [1,10,11]. The follow-up part of the study showed that history of digestive ulcer, exercising, and taking calcium supplements were associated with fractures among patients with osteoporosis. As stated above, digestive ulcers often indicate the presence of inflammatory digestive diseases and cirrhosis, and these diseases are often associated with malabsorption and malnutrition, leading to osteoporosis [17]. In addition, the systemic inflammatory state often seen in those conditions may influence the progression of osteoporosis and hence affect the risk of fracture [30]. This association between digestive ulcers and osteoporosis and fragility fractures is supported by previous studies [17,30,31]. The use of proton pump inhibitors has been shown to be associated with an increased risk of osteoporosis [32], but whether this association is due to the drug itself or to the fact that it is used to treat peptic ulcers remains unknown. As indicated above, since exercising can prevent or slow the progression of osteoporosis [27–29], exercising can decrease the risk of fragility fractures [33]. Hence, patients with osteoporosis should be encouraged to perform exercises that are adapted to their condition. Finally, taking calcium supplements after a diagnosis of osteoporosis is included in the guidelines to reduce the risk of fragility fractures [34,35], despite some controversies on the subject [36,37]. Calcium and vitamin D are cost-effective for the treatment of osteoporosis and are more accessible than bisphosphonates [38]. Nevertheless, the compliance with vitamin D supplementation is low in China [39,40].

Due to its rapid economic development, the health care situation of China has dramatically changed over the past 3 decades, but with the Westernization of lifestyle, the health conditions of Chinese have also changed [41]. Many of the chronic diseases associated with a Western lifestyle are due to the genome being ill equipped to face the nutritional characteristics recently introduced into the diet [42]. In addition, Chinese and Western populations differ in term of genetics, which affect the development of chronic diseases [43,44]. Consequently, in China, the prevalence of osteoporosis has increased over the last 20 years, affecting about one-third of the individuals aged >50 years [8], compared to 21% of women and 6% of men in the European Union [2]. Hence, combined with the aging population phenomenon and the fact that China has the world's largest population, the absolute number of patients with osteoporosis in China is important, and a better understanding of the disease in Chinese patients is paramount. Even though some factors for osteoporosis are shared between the Chinese and Western populations, their impact on disease may differ. Additional studies are necessary to examine these differences more closely.

Of course, the present study is not without limitations. This was a single-center investigation, and a larger sample size and a more in-deep questionnaire could provide additional answers about the risk factors of osteoporosis and fracture. A selection bias cannot be avoided in an observational study;

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nevertheless, we recruited subjects from 3 outpatient clinics (geriatrics, arthropathy, and osteoporosis clinics) and the health examination center. Elderly people often go to these clinics for help with age-related diseases or routine medical examination. In addition, future prospective studies should include panels of biochemical and genetic markers, as well as a complete history of exposure to drugs and chemicals, which could help improve our understanding of the risk of developing the condition. We did not investigate family histories of osteoporosis and fractures and personal histories of reproduction, breastfeeding, and hormone supplements. Finally, the fractures observed in the present study were not confirmed to be osteoporosis-related, which could have biased the results.

Conclusions

Female sex, age, marital status, history of digestive ulcer and fracture, and family history of hunchback and osteoarthropathy are associated with osteoporosis among Chinese elderly subjects, while drinking green tea and exercising are inversely associated. Among the patients with osteoporosis, a history of digestive ulcer is associated with fractures, while exercising and taking calcium supplements are inversely associated.

Conflict of interests

None.

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