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Prevalence of osteoporosis and related lifestyle and metabolic factors of postmenopausal women and elderly men

A cross-sectional study in Gansu province, Northwestern of China

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Abstract

The aim of this study was to investigate the osteoporosis prevalence and the risks of postmenopausal women and elderly men in Gansu province.

This cross-sectional study involved 3359 postmenopausal women and 3205 elderly males who were randomly selected from 7 areas in Gansu province. Areal bone mineral density (BMD) (g/cm^2) was measured at the distal one-third radius of the nonstressed forearm using dual-energy X-ray absorptiometry (DXA: Osteometer MediTech). Factors related to osteoporosis were analyzed.

The prevalence of osteoporosis in the entire study population was 9.65% for postmenopausal women and 8.08% for elderly males by WHO criteria, while the rate of osteopenia were 27.09% for postmenopausal women and 26.68% for elderly males. Risk of osteoporosis was significantly associated with age, menopause age, duration of menopause, body mass index (BMI), educational level, and alcohol consumption in postmenopausal women. In elderly men, age, BMI, current smoking, alcohol consumption, physical activity, and sun exposure were associated with osteoporosis. The bone turnover markers osteocalcin (OC) and C-terminal cross-linked telopeptides of type I collagen (β-CTX) were inversely correlated with BMD in both genders; serum P and 25(OH)D found no significant correlation with BMD. Serum Ca showed a positive effect on BMD in elderly men only.

The osteoporosis prevalence of postmenopausal women and the men aged over 60 years in Gansu province is presented. Risk of osteoporosis was significantly associated with age, menopause age, year since menopause, BMI, and educational level in postmenopausal women. In elderly men, age, BMI, and current smoking were associated with osteoporosis. This study also found that higher OC and β-CTX level were associated with lower BMD. Poor 25(OH)D, Ca, P status were not associated with an increased risk of low BMD.

Abbreviations: β-CTX = C-terminal cross-linked telopeptides of type I collagen, BMD = bone mineral density, BMI = body mass index, DXA = dual-energy X-ray absorptiometry, OC = osteocalcin.

Keywords: biochemical markers, osteoporosis, prevalence, risk factor

1. Introduction

Osteoporosis is a skeletal disease characterized by low bone mass, structural deterioration of bone tissue, and compromised bone strength predisposing to an increased risk of fracture.[1,2] It is one of the most common metabolic diseases and a leading cause of morbidity and mortality in the elderly.[3] Prior studies showed that several conditions, such as aging, sex, period of amenorrhea,

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The authors declare that they have no conflict of interests.

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parental history of fracture,[4,5] dietary calcium intake, vitamin D deficiency, low body mass index (BMI),[6] reduced physical activity,[7] and thyroid function[8] have been proposed as associated factors in bone mineral density changes in the elderly.

Some studies have reported the prevalence of osteoporosis. The reported prevalence of osteoporosis in women was 9% in the United Kingdom, 15% in France and Germany, 16% in USA, and 38% in Japan,[9] whereas in men, the prevalence was 1% in the United Kingdom, 4% in Japan, 3% in Canada, and 8% in France.[9] Prior studies reported that the prevalence of osteoporosis in Caucasian women older than 50 years varies from 7.9% to 22.6%.[10] Meanwhile, the Nutrition and Health Survey in Taiwan found that the prevalence of osteoporosis in the forearm is 25.0% in women and 11.6% in men.[11] In 2000, approximately 9.0 million osteoporotic fractures were reported, of which 1.6 million and 1.7 million were at the hips and forearm, and 1.4 million were clinical vertebral fractures.[12] All the data suggested that osteoporosis is a common disease; however, compared with other countries, less is known about the epidemiological characteristics of osteoporosis in the northwestern China.

As we all know, China is experiencing a growing osteoporosis pandemic[13] due to a large aging population. Gansu, which is located on the northwestern inland of China, covers a large area, having a variety of living habits. With the present study, we hoped to evaluate the prevalence of osteoporosis in postmenopausal women and elderly men in the urban and rural areas in Gansu province, and to determine the risks of osteoporosis in all participants. We also analyzed the relationship between BMD and biochemical markers.

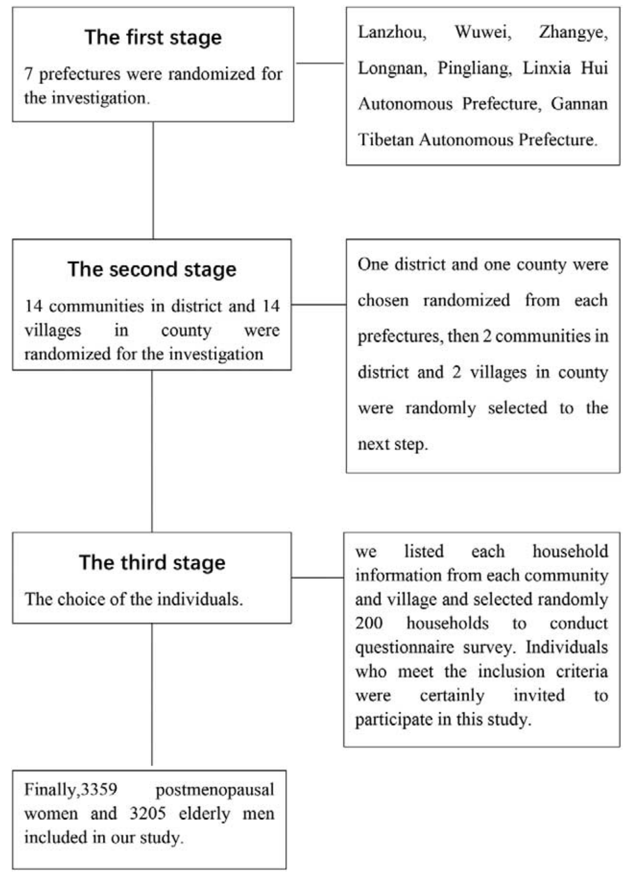

Figure 1. Flow chart for presentation of sampled subjects.

2. Methods

2.1. Sampled participants

All participants were selected from 7 towns including the urban and rural areas of Gansu province using multistage, random sampling (Fig. 1). The study was conducted from October 2014 to September 2015. Postmenopausal women were defined as women who reported experiencing menopause in the survey. Only those participants who provided written informed consent and were willing to provide blood samples were enrolled. Finally, 3359 postmenopausal women and 3205 elderly men were included for analysis. The following participants were excluded:

(1) Individuals whose clinical data were incomplete;
(2) Postmenopausal women who had undergone hormone replacement therapy;
(3) Individuals with serious chronic renal disease, chronic liver disease, or osteogenesis imperfecta;
(4) Individuals with presence of tumor;
(5) Women who had undergone hysterectomy, which is known to increase the risk of early menopause.[14]

2.2. Data sources

2.2.1. Data collection. All participants were interviewed using a standardized questionnaire to collect data regarding baseline variables, including age, sex, menopausal status, age at menopause, year since menopause, educational level, physical activity, sunlight exposure time (yes/no), current smoker (yes/no), and alcohol drinking (yes/no). Educational level was divided into 4 stages: illiteracy; primary school; high school; and college. Body weight and height were measured with the participants wearing light clothing, without shoes or jewelry. BMI was calculated as body weight (kg)/height (m^2). We used the following BMI categories: low: (<18.5 kg/m^2), normal (18.5–25.0 kg/m^2); overweight (25.0–30.0 kg/m^2); and obese (≥30.0 kg/m^2).

2.2.2. Bone mineral density (BMD) measurements. As we were required to travel to the selected area, we used a portable dual-energy X-ray absorptiometry (DXA-200: Osteometer MediTech Co., American) to measure the BMD. The area BMD (g/cm^2) was measured at the distal one-third radius of the nonstressed forearm. Trained technicians carried out all examinations and performed daily calibrations of the densitometers with equipment-specific phantoms.

The World Health Organization osteoporosis definition (BMD T-score less than or equal to − 2.5 as assessed by DXA) was used for this study. Osteopenia, a less severe form of bone loss, is defined as a bone density between 1 and 2.5 standard deviations below that reference point.[4]

2.2.3. Biochemical measurements. Blood samples were collected from all participants for biochemical analyses after an overnight fast of at least 8 hours and centrifuged within 30 minutes during the survey. Fasting blood samples were collected and stored at -20°C. All serum samples remained frozen until analysis. Assays for serum osteocalcin (OC), the C-terminal cross-linked telopeptides of type I collagen (β-CTX) using agglutinin affinity method. Serum calcium was measured through the Arsenazo III method using Calcium Assay Kit (Beijing Strong Biotechnologies, Beijing, China), serum phosphorus was measured using phosphomolybdate reduction method (Beijing Strong Biotechnologies, Beijing, China), and serum 25(OH)D was measured using chemiluminescence particles immunoassays (Abbott Laboratories, Barcelona, Spain).

2.2.4. Statistical analysis. Statistical analyses were performed using the SPSS statistical package 19.0 for Windows (SPSS Inc., Chicago, IL). Mean ± standard deviations were calculated for continuous variables, whereas proportions were calculated for categorical variables. Demographic characteristics, clinical characteristics, and the level of blood samples were compared between the osteoporosis group and the nonosteoporosis group using the Student *t* test for normally distributed continuous variables, and the Chi-square test was used for normally distributed categorical variables. According to epidemiological surveys of osteoporosis or other similar literatures,[15,16] we divided the participants into 10-year-old group, and the prevalence of osteoporosis was presented as percentage (%). To find the most important factors predicting the outcome of osteoporosis, multiple logistic regression analysis was performed. The results from the multiple logistic regression were presented as odds ratios (ORs) and 95% confidence intervals (CIs). Multiple linear regression analysis was performed to determine the correlations between the forearm BMD and bone turnover makers, controlling age, height, body weight, and duration of menopause. A probability value of <0.05 was accepted as the level of statistical significance.

3. Results

3.1. Demographic and clinical characteristics of participants

There were 3359 postmenopausal women and 3205 elderly men included in our study. The demographic and clinical baseline are listed in Tables 1 and 2. There were significant differences in age, age at menopause, years since menopause, educational level, and BMI in postmenopausal women. Age, educational level, BMI, smoking habits, alcohol consumption, physical activity, and sun exposure showed significant differences among osteoporosis and nonosteoporosis groups in elderly men ($P<.05$ for all).

3.2. Prevalence of osteoporosis and osteopenia according to each age subgroups

The prevalence of osteoporosis and osteopenia in postmenopausal women and elderly men according to each age subgroups are summarized in Table 3. Generally, the prevalence of osteoporosis in the whole participants was 9.65% for postmenopausal women and 8.08% for elderly men; the percentage of osteopenia was 27.09% for postmenopausal women and 26.68% for elderly men. The prevalence of osteoporosis in the group aged 60 to 69 years and over 70 years was 3.48% and 16.83%, respectively, in elderly men. In postmenopausal women, the prevalence of osteoporosis was fairly high in the same age group; 10.96% women in the group aged 60 to 69 years and 26.48% women aged over 70 years were considered to have osteoporosis. We observed that the prevalence of osteopenia increased with age in postmenopausal women and elderly men.

3.3. Related factors for osteoporosis with multiple logistic regression analysis

According to multiple logistic regression analysis, age was a significant risk factor for having osteoporosis in postmenopausal women (OR = 1.146, 95% CI 1.128–1.165, $P<.0001$), and in elderly men (OR = 1.188, 95% CI 1.161–1.216, $P<.0001$). In postmenopausal women, menopause age (OR = 0.945, 95% CI 0.915–0.976, $P=.001$) and duration of menopause over 10 years (OR = 2.141, 95% CI 1.161–3.949, $P<.015$) were correlated with osteoporosis. In the multiple model, illiteracy (postmenopausal women: OR = 3.144, 95% CI 1.673–5.910, $P<.0001$; elderly men: OR = 1.828, 95% CI 1.241–2.693, $P<.0001$), BMI lower than 18.5 kg/m^2 (postmenopausal women OR = 21.870, 95% CI 6.696–71.431, $P<.0001$; elderly men: OR = 16.009,

Table 1

Demographic and clinical characteristics of postmenopausal women.

Variable	Osteoporosis	Nonosteoporosis	P
N	324	3035	
Age [Mean (SD)]	69.07 (6.81)	60.34 (8.01)	<.001
Age at menopause [Mean (SD)]	47.97 (4.02)	48.86 (4.32)	<.001
Duration of menopause [Mean (SD)]	20.67 (9.47)	11.44 (8.54)	<.001
Educational level			<.001
College [n (%)]	15 (4.63)	366 (12.06)	
High school [n (%)]	119 (36.73)	1322 (43.56)	
Primary school [n (%)]	76 (23.46)	592 (19.50)	
Illiteracy [n (%)]	114(35.18)	755 (24.88)	
BMI, kg/m^2			<.001
<18.5 [n (%)]	21 (6.48)	66 (2.17)	
18.5–24.9 [n (%)]	234 (72.23)	1691 (55.72)	
25.0–29.9 [n (%)]	65 (20.06)	1091 (35.95)	
≥30 [n (%)]	4 (1.23)	187 (6.16)	
BMD, g/cm^2 [Mean (SD)]	0.248 (0.040)	0.438 (0.092)	<.001
Lifestyle habits			
Current smoking [n (%)]	2 (0.62)	42 (1.38)	.370
Alcohol consumption [n (%)]	33 (10.19)	233 (7.68)	.939
Physical activity [n (%)]	216 (66.67)	1878 (61.88)	.091
Sun exposure [n (%)]	282 (87.04)	2636 (86.85)	.926

P values were obtained using the 2-sample *t* test for continuous variables and the Chi-square test for categorical variables.
BMD = bone mineral density, BMI = body mass index, WHR = waist hip ratio.

Table 2

Demographic and clinical characteristics of elderly men.

variable	Osteoporosis	Nonosteoporosis	P
N	259	2946	
Age [Mean (SD)]	73.7 (5.85)	67.04 (5.68)	<.001
Educational level			<.001
College [n (%)]	51 (19.69)	434 (14.73)	
High school [n (%)]	81 (31.27)	1444 (49.02)	
Primary school [n (%)]	55 (21.24)	630 (21.38)	
Illiteracy [n (%)]	72 (27.80)	438 (14.87)	
BMI, kg/m^2			<.001
<18.5 [n (%)]	25 (9.65)	57 (1.93)	
18.50–24.99 [n (%)]	168 (64.86)	1526 (51.80)	
25.00–29.99 [n (%)]	61 (23.55)	1222 (41.48)	
≥30 [n (%)]	5 (1.94)	141 (4.79)	
BMD (g/cm^2) [Mean (SD)]	0.351 (0.039)	0.545 (0.092)	<.001
Lifestyle habits			
Currently smoking [n (%)]	112 (43.24)	1023 (34.73)	.006
Alcohol consumption [n (%)]	45 (17.37)	970 (32.93)	<.001
Physical activity [n (%)]	127 (49.03)	1918 (65.11)	<.001
Sun exposure [n (%)]	219 (84.56)	2651 (89.99)	.006

P values were obtained using the 2-sample *t* test for continuous variables and the Chi-square test for categorical variables.
BMD = bone mineral density; BMI = body mass index.

Table 3

Prevalence of osteoporosis of postmenopausal women and elderly males according to different age group.

		Osteoporosis			Osteopenia		
Age group	N	n	%	*P*	n	%	*P*
postmenopausal women							
Total	3359	324	9.65		910	27.09	
Age							
40–49	198	0	0.00	<.001	6	3.03	<.001
50–59	1206	23	1.91		182	15.09	
60–69	1396	153	10.96		455	32.59	
≥70	559	148	26.48		267	47.76	
Elderly men							
Total	3205	259	8.08		855	26.68	
Age							
60–69	2100	73	3.48	<.001	469	22.33	<.001
≥70	1105	186	16.83		386	34.93	

95% CI 5.313–48.237, $P<.0001$), alcohol consumption (postmenopausal women OR = 1.706, 95% CI 1.079–2.679, $P=.022$; elderly men: OR = 2.076, 95% CI 1.426–3.024, $P<.0001$) were significantly associated with osteoporosis. Current smoking (OR = 2.088, 95% CI 1.539–2.833, $P<.001$), physical activity (OR = 0.567, 95% CI 0.413–0.779, $P<.001$), and sun exposure (OR = 0.572, 95% CI 0.376–0.869, $P=.009$) were significantly associated with osteoporosis only for elderly men (Table 4).

3.4. The biochemical markers based on group with and without osteoporosis

The study participants were divided into osteoporosis and nonosteoporosis groups according to T-score in all participants. Analysis of data by *t* test was used to compare biochemical markers between the 2 groups. Table 5 summarized that participants with osteoporosis, compared with nonosteoporosis, had higher OC, β-CTX, lower BMD, and lower serum Ca in postmenopausal women and elderly men. We failed to observe significant differences with regard to serum 25(OH)D levels in postmenopausal women and elderly men.

3.5. Multiple linear regression analysis of biochemical markers and BMD at the forearm

We performed multiple linear regression analysis to describe the relationship between biochemical parameters and BMD (Table 6). We observed a relationship between OC (postmenopausal women: r = -0.237, elderly men: β = -0.227), β-CTX (postmenopausal women: β = -0.101; elderly men: β = -0.237), and BMD at the forearm in postmenopausal women, which was also statistically significant in elderly men. Indeed, after adjustment for age, height, body weight, and duration of menopause in postmenopausal women, there was a significant negative correlation between OC (β = -0.238), β-CTX (β = -0.100), and BMD. When adjusted for age, height, and body weight in elderly men, the OC (β = -0.237), β-CTX (β = -0.237), and serum Ca (β = 0.106) also correlated with BMD ($P<.05$ for all).

Table 4

Related factors for osteoporosis in postmenopausal women and elderly males with multiple logistic regression analysis.

	Postmenopausal women			Elderly males		
Variable	OR	OR (95% CI)	*P*	OR	OR (95% CI)	*P*
Age, y	1.146	1.128–1.165	<.001	1.188	1.161–1.216	<.001
Age at menopause (years)	0.945	0.915–0.976	.001	—		
Duration of menopause, y						
<10	1.000			—		
≥10	2.141	1.161–3.949	.015			
Region						
Urban area	1.101	0.830–1.446	.490	1.299	0.972–1.737	.077
Rural area	1			1		
Educational level						
Illiteracy	3.144	1.673–5.910	<.001	1.828	1.241–2.693	<.001
Primary school	2.362	1.243–4.490	.009	1.098	0.717–1.681	.669
Secondary school	2.582	1.388–4.803	.003	0.715	0.474–1.078	.109
College	1.000			1.000		
BMI, kg/m^2						
<18.5	21.87	6.696–71.431	<.001	16.009	5.313–48.237	<.001
18.50–24.99	9.823	3.546–27.212	<.001	4.186	1.606–10.912	.003
25.00–29.99	3.132	1.108–8.852	.031	2.306	0.862–6.168	.096
≥30	1.000			1.000		
Current smoking	3.058	0.679–13.779	.146	2.088	1.539–2.833	<.001
Alcohol consumption	1.706	1.079–2.679	.022	2.076	1.426–3.024	<.001
Physical activity	1.144	0.842–1.554	.391	0.567	0.413–0.779	<.001
Sun exposure	0.844	0.556–1.282	.426	0.572	0.376–0.869	.009

Categorical variables were as follows: Educational level (reference: College), Year since menopause (reference: <10 years), BMI (reference: ≥30), Current smoking (reference: no), Alcohol consumption (reference: no). Physical activity (reference: no), Sun exposure (reference: no);

Continuous variables were as follows: age (years); Age at menopause (years);

P values were obtained using multivariate logistic regression analysis.

We had adjusted the year, age at menopause, and duration of menopause in postmenopausal women and adjusted age in elderly males as covariates.

BMI = body mass index; CI = confidence interval; OR = odds ratio. —there are no data.

Table 5

Biochemical parameters based on group with and without osteoporosis in all subjects.

Variable	Postmenopausal women					Elderly men				
	Osteoporosis		Nonosteoporosis			Osteoporosis		NonOsteoporosis		
	Mean	SD	Mean	SD	*P*	Mean	SD	Mean	SD	*P*
OC, ng/mL	25.34	13.61	21.19	8.73	<.001	19.88	6.74	17.22	6.62	<.001
β-CTX, ng/mL	0.431	0.207	0.383	0.172	<.001	0.369	0.167	0.302	0.135	<.001
BMD, g/cm^2	0.25	0.03	0.44	0.09	<.001	0.351	0.039	0.545	0.092	<.001
Ca, mmol/L	2.42	0.20	2.37	0.21	<.001	2.31	0.37	2.40	0.21	<.001
P, mmol/L	1.16	0.20	1.13	0.26	.018	1.03	0.25	1.04	0.22	.621
25 (OH)D, ng/mL	16.96	10.43	16.10	9.88	.137	17.54	6.69	16.53	8.04	.053

β-CTX = C-terminal cross-linked telopeptides of type I collagen; Ca = calcium; OC = osteocalcin; P = phosphorus.

4. Discussion

A large-scale, population-based, cross-sectional study was conducted to estimate the prevalence of osteoporosis among a sample of Gansu postmenopausal women and the men aged over 60 years. Moreover, we investigated the possibility of an association between BMD at the forearm and biochemical markers of bone turnover of all participants. The most common skeletal sites measured by DXA are the lumbar spine and the proximal femur. Peripheral sites, such as the forearm, may also be measured for diagnosis of OP.[17] One study suggests that low BMD at the forearm reflects a state of low BMD at the spine or hip, and that osteopenia or OP of the forearm could reflect the same state in the spine or hip.[18]

We evaluated the prevalence of osteoporosis at the forearm in postmenopausal women and elderly men in Gansu province and found that 9.65% postmenopausal women and 8.08% elderly men had osteoporosis; the prevalence of osteopenia was much higher than osteoporosis. The OP prevalence increased progressively after the age of 60 years in postmenopausal women, whereas the male OP prevalence increased after the age of 70 years. A survey reported that the prevalence of osteoporosis was 10.3% in the population older than 50 years in US.[19] The rate of osteoporosis in Caucasians women older than 50 years varies from 7.9% to 22.6%.[20] In Italy, nearly 34% in a cohort of 4000 women occurred osteoporotic fractures.[12] A cross-sectional study among healthy elderly men aged 50 years and older from Beijing WangZuo Community showed that 18.5% of them had osteoporosis and 55.5% had osteopenia.[21] The prevalence of osteoporosis in Changchun varies from 7.7% to 75.56%,[22] while Liu et al[23] reported that the rate of primary osteoporosis of the native Chinese population was 6.6%. Compared with prior studies, the osteoporosis rate in our study was similar to the United States[19] and the data reported by Liu et al,[23] while lower than that in Changchun.[22] Of note, there were differences in the OP prevalence among individuals with the same age and sex but have different race and geographical region.

Aging is associated with an increased risk of osteoporosis.[14,24] The lower protein intake,[25] higher proportion of 25 (OH)D_3 deficiency,[13] hypogonadism, reduced of sex hormones,[26] and reduced bone turnover rates[27] due to aging might partly explain the results. In postmenopausal women of this study, the duration of menopause was negatively associated with OP, whereas age at menopause was positively associated with OP. The association between menopausal duration and OP as seen in the present study was agreed with other studies.[4,28] Several studies that support the obesity was a protective factor for osteoporosis.[6,16,29,30] In their opinion, the effect of obesity on BMD was believed to be mediated by mechanical loading of BMI on bone formation.[4] In our study, when compared with the lower BMI, the risk of having osteoporosis was decreased in other 3 groups, which confirmed this hypothesis.

We found that the participants with lower education levels were more likely to have osteoporosis than individuals with higher education level, especially in postmenopausal women. The finding agreed with the previous research that demonstrated the association between educational level and risk of osteoporosis.[4,21,31–34] Although little is known of the definitive reasons why educational level may have an effect on BMD and OP, it may be explained by the more knowledge of prevention of osteoporosis in the participants with high educational level,[35] the greater level of physical activity and nutritional intake of more educated individuals, lower dietary calcium intake,[36] and increased likelihood of smoking of lower educated,[37] and

Table 6

Multiple linear regression analysis of biochemical parameters and BMD at the forearm.

Variable	Postmenopausal women				Elderly men			
	Not adjusted		Adjusted		Not adjusted		Adjusted	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*
OC, ng/mL	−0.237	<.001	−0.238	<.001	−0.227	<.001	−0.227	<.001
β-CTX, ng/mL	−0.101	<.001	−0.100	<.001	−0.237	<.001	−0.237	<.001
Ca, mmol/L	−0.086	<.001	−0.081	.053	0.106	<.001	0.106	<.001
P, mmol/L	−0.063	.186	−0.061	.119	−0.002	.871	−0.004	.813
25(OH)D, ng/mL	0.009	.413	0.006	.150	−0.008	.614	−0.010	.586

Models are adjusted for age, height, body weight, and duration of menopause.
β-CTX = C-terminal cross-linked telopeptides of type I collagen; OC = osteocalcin; P = phosphorus.

determinants during childhood or adolescence[38] or environmental factors such as lead exposure and sun exposure. Examinations of how educational level may affect the relationship with OP may also inform interventions and/or preventive measures. However, this is also a very important issue for public health research and an appropriate delivery of public health programs. Thus, future work to examine any differences in OP related to culture or ethnicity should be encouraged. We found a correlation between physical activity, sun exposure, current smoking, alcohol intake, and osteoporosis in elderly men. Although we failed to find the same trend in postmenopausal women, this still suggests the importance of the lifestyle in prevention of osteoporosis. Vitamin D and calcium supplements were asked for our study and we did not use these for the statistical analysis because we did not have enough data to quantify the amount of supplements.

In the present study, multiple linear regression analysis was used to evaluate the effects of the changes in the levels of biochemical markers on the BMD at the forearm. Using the BMD as dependent variables and biochemical markers as independent variables, we found that changes in level of OC, β-CTX, and serum Ca significantly influenced the BMD of forearm in all participants, indicating that the combination of bone formation and resorption marker was a good predictor for bone loss. Several studies have found significant association among biochemical markers and BMD.[39–41] Previous studies have found that bone turnover markers are negatively associated with age.[39] After adjustment for age, height, body weight, and duration of menopause, we found that the OC and β-CTX remain show effect on BMD, while serum Ca is associated with BMD in elderly men only. In addition, serum $25(OH)_2D_3$ levels were not associated with BMD. A community-based study[39] in Beijing failed to detect any association between 25(OH)D and BMD, identically. This may be because there were comparable levels of vitamin D deficiency in both the osteoporosis and nonosteoporosis groups, as there is a high prevalence of vitamin D deficiency in Gansu Province.[13]

Our study has some limitations as follows: first, the main limitation in the current study caused by the cross-sectional nature of the study and in the procedures used to select participants, who were all volunteers and ambulatory; second, we only asked for the frequency of sun exposure, smoking, physical activity, and alcohol consumption, while the level of smoking, drinking, and the type of physical activity was not taken into consideration; third, our investigation may provide evidence on the prevention of osteoporosis in Gansu province. In the current study, we use a portable DXA to measure BMD at the forearm, as we were required to travel to the selected area and we failed to compare the forearm BMD with other sites such as the lumbar.

5. Conclusion

The present study provides data on the prevalence of osteoporosis and osteopenia in postmenopausal women and elderly men in the northwestern of China. The risk for osteoporosis was significantly associated with age, menopause age, year since menopause, BMI, and educational level in postmenopausal women. In elderly men, osteoporosis was associated with age, BMI, current smoking, alcohol consumption, physical activity, and sun exposure. After adjustment for age, height, body weight, and duration of menopause, the present data indicated that higher OC and β-CTX level was associated with lower BMD. Poor 25(OH)D, serum Ca, and P status were not associated with an increased risk of low BMD.

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