

Original Article

A community-based study of osteoporosis-related information in Chinese female residents aged 40 years and older

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Abstract: Purpose: Osteoporosis is one of the major chronic diseases in China. This study of osteoporosis-related information was conducted to survey the extent of osteoporosis knowledge among female residents aged 40 years and older in the urban areas of Beijing, China. Methods: This is a large scale community-based, cross-sectional study. A self-report questionnaire was used to measure osteoporosis knowledge of residents in eight districts in Beijing. A dual-energy X-ray bone mineral density (BMD) measurement for each respondent was conducted at the same time. Results: A total of 3,830 residents participated and provided their data for the analysis performed in this study. The average age was 61.52 ± 8.62 yrs. The overall prevalence of osteoporosis was 15.20%, while it was only 2.29% among the residents in the group of 40-50 years old. Multiple regression analysis showed that age and a previous history of fractures were risk factors for osteoporosis; BMI and late menopause were protective factors. Of the entire surveyed population, only 6.84% had received anti-osteoporosis medication and five people had received hormone replacement therapy (HRT). Calcium and vitamin D supplements were positively correlated with a previous fracture. Of the surveyed population, 10.34% has suffered from fractures but only 8.8% of the total had undergone BMD tests. Of the participants with fractures, 23.1% took anti-osteoporosis drugs. Fractures have a positive correlation with age and previous BMD tests, but a negative correlation with the T-score of the femoral neck and lumbar spine. Conclusions: The prevalence of osteoporosis increases with age. However, few people underwent BMD measurement or accept HRT and anti-osteoporosis medication, even for those who had a fracture history. This study suggests that bone health education programs should be implemented among Chinese residents as well as clinicians.

Keywords: Urban resident, osteoporosis, Chinese female

Introduction

Osteoporosis (OP) is a skeleton disease characterized by low bone mass and deterioration of the microarchitecture of bone tissue. The most severe complication of osteoporosis is fragility fracture, which causes loss of independence, lower quality of life, and imposes a high socio-economic burden. Research in Europe has showed that the economic burden of osteoporotic fractures will possibly increase from €36.3 billion in 2000 to €76.8 billion in 2050 [1]. About 40% of white women aged 50 years and older will experience at least one clinically recognized fracture at one site of the hip, spine, and wrist,

which is considered to increase the risk of morbidity and mortality [2, 3].

Meanwhile, Osteoporosis has become one of the major chronic diseases in China [4]. A recent study exploring the relationship between body mass index (BMI) and BMD of the lumbar vertebra and femoral neck in postmenopausal females revealed that postmenopausal females with low BMI are more likely to have osteoporosis [5]. OP is associated with multiple factors; lifestyle plays a key role in the prevention of OP [6]. A modification of lifestyle is highly recommended. However, the general public still pays little attention to osteoporosis [7]. This study

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Table 1. Demographic and clinical characteristics of the participants

Variable	Mean \pm SD or N (%)
Age (years)	61.52 \pm 8.62
BMI (kg/m ²)	23.73 \pm 3.21
Fragility fractures	397 (10.34%)
Post-menopausal female	3037 (79.3%)
Smoking	16 (0.42%)
Alcohol intake	7 (0.18%)
Osteoporosis clinical manifestations	
Back pain	3229 (84.3%)
Leg cramps	2562 (66.9%)
Fatigue	1689 (44.1%)
Loss of height	1674 (43.7%)
Kyphosis	276 (7.2%)
Osteopenia	1340 (34.99%)
Osteoporosis	582 (15.20%)
Calcium intake	893 (23.32%)
Active VitD intake	433 (11.30%)
Dairy products intake	809 (21.13%)
Previous BMD test	337 (8.80%)
Anti-osteoporosis drugs	262 (6.84%)
Family history of osteoporosis	
Yes	294 (7.68%)
No	1791 (46.77%)
Unknown	1745 (45.55%)

investigated the general situation of osteoporosis in a cohort of Chinese women aged 40 years and older in the urban area of Beijing in order to obtain osteoporosis-related information on Chinese residents.

Subjects and methods

Survey population and recruitment criteria

This study was conducted from January 2011 to December 2014. We performed an osteoporosis-related information survey using a random sample of the Chinese population. Participants were recruited from urban communities within 8 districts in Beijing. The surveyed respondents were female residents aged 40 and older who had lived in the urban areas of Beijing for more than 5 years. Written consent was obtained from all the residents before the survey, which was performed in accordance with the ethical standards in the Declaration of Helsinki, and approved by the Medicine Ethical Committee of China-Japan Friendship Hospital.

Data collection

The survey questionnaires included [8] demographic data (age, gender, residential region, visit date, et al), family history of osteoporosis and fractures, the clinical features of osteoporosis, history of fragility fractures, lifestyle, previous BMD tests, height, weight (for the calculation of Body Mass Index, BMI), menopausal age (menopausal age under 45 is considered as premature menopause), history of hysterectomy and ovariectomy, smoking history (smoking more than 10 cigarettes per day for more than 3 years), heavy drinking history (daily intake of alcohol amounts to 3 units or more, 1 unit of alcohol is equivalent to one standard cup of beer (285 ml), a measure of spirits (30 ml), or a medium glass of wine (120 ml)), osteoporosis-related symptoms (low back pain, kyphosis, loss of height, leg cramps, fatigue), calcium supplements (≥ 800 mg/d) or active vitamin D (Alphacalcidol or Rocalirol, time and dosage) or any anti-osteoporosis drugs (including bisphosphonates, calcitonin, selective estrogen receptor modulators (SERMs), estrogen, time and dosage). A lumbar X-ray exam was conducted among the residents who were over 60 years of age to confirm the prevalence of subclinical vertebral fractures.

BMD test

All participants in the survey had their BMD measured. The instrument used for measuring BMD was the American Lunar enCORE 2004 Dual-energy X-ray Absorptiometry (DXA). The sites examined were the lumbar vertebrae 1-4 (L1-L4) and the left hip (femoral neck). If the left hip had a fracture or replacement, the right one would be tested instead.

Osteoporosis diagnostic criteria

All respondents were measured in terms of BMD (g/cm²). According to the WHO osteoporosis diagnostic criteria [9, 10], the T-score is the ratio of a person's BMD and the standard deviation of the peak bone mass of healthy adults

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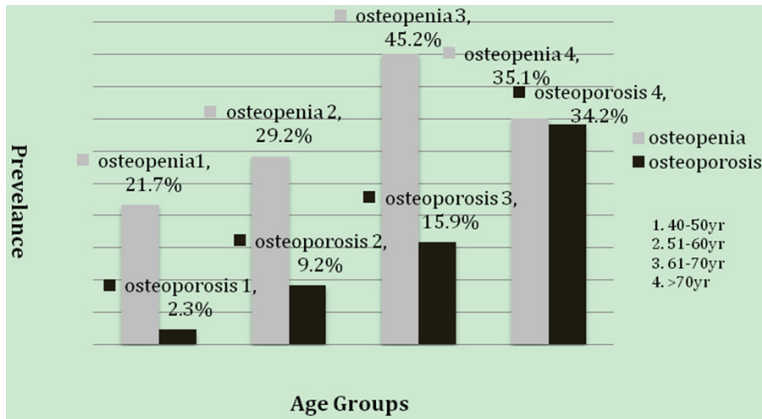


Figure 1. Prevalence of osteoporosis and osteopenia in different age groups.

variate relationships, a logistics regression analysis was conducted. A P -value of < 0.05 is considered statistically significant.

Result

Basic information of survey respondents

The total number of survey respondents was 3830. The general characteristics of the subjects are presented in **Table 1**.

Table 2. Pearson's analysis for associations among variables and T-score

Variables	Femoral Neck		Lumbar 1-4	
	r	P-value	r	P-value
BMI	0.210	0.000	0.268	0.000
Age	-0.328	0.000	-0.347	0.000
Calcium intake	-0.091	0.000	-0.102	0.000
Active vitamin D*	-0.130	0.000	-0.124	0.000
Fracture history	-0.164	0.000	-0.178	0.000
Back pain	-0.016	0.705	-0.021	0.320
Kyphosis	-0.121	0.000	-0.096	0.000
Cramps	-0.029	0.225	-0.017	0.701
Loss of height	-0.176	0.000	-0.192	0.000
Fatigue	-0.019	0.299	-0.014	0.495
Menopausal age	0.089	0.010	0.086	0.010

*Active vitamin D: Alfacalcidol or Rocalirol.

of the same gender and ethnicity. A T-score of ≥ -1 is considered normal, between -1 and -2.5 indicates osteopenia, and ≤ -2.5 osteoporosis. Any participants with a history of fragility fractures or with confirmed subclinical vertebral fractures, by X-ray exam, can also be diagnosed with osteoporosis.

Statistical analysis

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS version 19.0 for Windows). The measurement data were represented by mean \pm SD. The comparison of the two variables used t test or chi-square test according to the different kinds of variables. An analysis of the correlation between the two variables was conducted with Pearson and Spearman tests. As for the multi-

Prevalence of osteopenia and osteoporosis

The respondents were classified into four groups according to their age: 40-50 years, 51-60 years, 61-70 years and > 70 years. The prevalence of osteoporosis for each group is shown in **Figure 1**.

Osteoporosis-related factor analysis

The single analysis of the correlation between osteoporosis related factors and the T-score are shown in **Table 2**.

Smoking and alcohol habits, as risk factors for osteoporosis, are not included in the correlation analysis since the proportions of subjects who had current smoking and alcohol habits was very low, only 0.42% and 0.18% respectively. Four of them were considered to have osteopenia, whereas no one suffered from osteoporosis.

In this study, 3037 subjects (79.3%) were post-menopausal females. The menopausal age of 367 subjects (9.58%) was under 45 years old, which we consider premature menopause. A few of them (five residents, 0.13%) had received estrogen therapy.

The univariate analysis of the correlation between menopausal age and the T-score showed a weak positive correlation with the T-score of the lumbar spine and femoral neck ($r=0.089$ and 0.086 respectively, both P value < 0.05).

Analysis of previous BMD tests

The single analysis showed that previous BMD tests are positively correlated with calcium in-

Table 3. Pearson’s analysis of previous BMD tests

Variables	Previous BMD tests	
	r	P value
Calcium intake	0.216	0.000
Active vitamin D intake	0.313	0.000
Anti-osteoporosis drugs	0.244	0.000
Fracture history	0.014	0.869

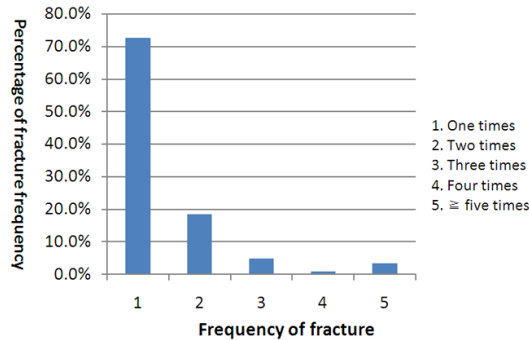


Figure 2. Percentage of different fracture frequency.

take, active vitamin D intake and anti-osteoporosis drugs taking (Table 3).

Analysis of fracture-related data

In this study, the prevalence of fracture was 10.34% (397). Most of the participants had experienced a single fracture (74.61% in participants of fractures). The percentage of participants that had experienced more than two fractures was 8.47%, but the highest number of experienced fractures was eight times. The frequency of fractures is shown in Figure 2. The univariate analysis revealed that the frequency of fractures is positively correlated with age ($r=0.161$, P value < 0.001), and negatively correlated with the T-score (femoral neck $r=-0.226$, lumbar spine $r=-0.203$, both P value < 0.001).

The predominant location of a fracture was the wrist (169/397, 42.6%), the second and third were the ankle (124/397, 31.2%) and the spine (102/397, 25.7%).

Only 23.1% of patients with fractures took anti-osteoporosis drugs. For the 92 patients with fractures who took anti-osteoporosis drugs, bisphosphonates were a common choice. 62 patients took alendronate and 5 patients used zoledronic acid. The remaining 25 patients

used calcitonin. None of them took SERM or HRT.

Multiple-factor analysis of osteoporosis

In the multiple-factor analysis, the T-score of the femoral neck or L1-L4 was considered as the dependent variable (with 0 representing $T > -2.5$ and 1 representing $T \leq -2.5$). Independent variables included age, BMI, loss of height, calcium and active vitamin D supplements, menopausal age and previous history of fractures. The Logistic regression model was adopted to conduct the multiple-factor analysis (Table 4). The result shows that age and previous history of fracture are risk factors for osteoporosis, while BMI and late menopause are protective factors.

Discussion

With its increased population, China is becoming an aging society. Osteoporosis, as a common chronic disease among the elderly, has become one of the top four health problems in China for the elderly [7]. Fractures, a serious complication of osteoporosis, affect the quality of life of the elderly [11, 12]. This study was community-based and aimed to investigate the general situation of osteoporosis in a cohort of Chinese female aged 40 and older in the urban areas of Beijing in order to gain osteoporosis-related information on Chinese residents.

The results showed that more of the residents took calcium supplements, with the calcium intake proportion reaching to 44.9%. But the awareness of osteoporosis among all survey respondents was not high. Only 8.8% respondents had had BMD measurements performed, and the rest were unaware of whether they had osteoporosis. Moreover, about half of the respondents (45.55%) did not know whether they had a family history of osteoporosis.

Most previous studies have shown that the prevalence of osteoporosis increases with age [13]. Concordance with the previous study, the prevalence of osteoporosis in our study reaches 34.2% among people over 70 years of age whereas only 2.29% of people under 50 years of age have osteoporosis. The prevalence of surveyed people with low bone mass is quite high (21.8%-45.2%) in different age groups, especially in residents of 61-70 years.

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Table 4. Multiple-factor Logistic regression analysis of T-score

Variable	B	S.E	Wald	P value
Age	-.087	.007	134.574	.000
Loss of height	-.016	.018	.956	.332
Previous history of fractures	-.409	.127	11.054	.001
Calcium intake	-.051	.102	.207	.651
VitD intake	-.126	.154	.867	.376
BMI	.141	.015	63.467	.000
Menopausal age	.743	.163	22.464	.000

This study investigated five common clinical manifestations of osteoporosis. The top three are back pain (84.3%), leg cramps (66.9%), and fatigue (44.1%). Clinical manifestations of osteoporosis are non-specific. The analysis of the correlation between the five clinical manifestations of osteoporosis and the T-score indicated that the main three manifestations had no correlation with the T-score while the specific manifestations of osteoporosis, such as loss of height and kyphosis, had significant correlation with the T-score. Therefore, for the patients with kyphosis or loss of height, further osteoporosis-related inspections, such as BMD measurement, should be considered.

Most previous studies have found a positive correlation between BMI and bone density, and a negative correlation between previous history of fracture and bone density. Postmenopausal females with low BMI are more likely to have osteopenia and osteoporosis [14]. Our study has consistent results. But in this study, supplements of calcium and active vitamin D were negatively correlated with T-scores, which contradicts previous studies indicating that supplements of calcium and active vitamin D can prevent osteoporosis. Careful analysis of the data revealed that taking calcium tablets and active vitamin D had a correlation with a previous history of fractures and BMD tests. Possibly the majority of residents took calcium and vitamin D after the diagnosis of osteoporosis with BMD or suffered from fractures, so the survey respondents may take calcium and active vitamin D following the recommendation of doctors. This is similar to the findings of a French study about the osteoporosis among females aged 75-85. In that study 59% of the women took calcium supplements, but calcium supplements were significantly related to osteoporotic fractures, BMD tests and low BMI [15]. Our study did not include plain vitamin D supplement, mainly because the current Beijing mar-

ket and the vast majority of hospitals in China have no plain vitamin D but only active vitamin D. Logistic regression analysis showed that high BMI and late menopause are the protective factors for osteoporosis, while age and previous history of fractures are the risk factors.

Although there has been a lot of controversy about HRT treatment of osteoporosis in recent years, new relevant data suggests that HRT can help prevent fractures and osteoporosis among postmenopausal women [16, 17]. A study in Poland of females over 55 years of age showed that the proportion of people using HRT reached 11.8-33.5% of the total population [18]. But, generally, fewer women in Asian countries adopt HRT than do in Western countries [19]. A Malaysian study of women aged 40-65 showed that the percentage of people using HRT is 8.1% and its main purpose is to improve the symptoms of menopause [20]. In our study, only five people (0.13%) took supplemental estrogen.

Smoking and Alcohol intake are risk factors closely related to osteoporosis [21]. Due to the small proportion of people smoking and drinking alcohol in this study, we do not make any further assessment. The number of people smoking and drinking alcohol in this study was 23, accounting only for 0.60% of the total. None of them suffered from osteoporosis, but four smokers suffered from osteopenia. Partially because few female residents in China have a habit of smoking and drinking, Liu's analysis of the factors related to bone density among 3220 women under the age of 40 in Wuhan, a city in China, also found that there was no correlation between smoking and bone density [22]. But another domestic case-controlled study about the relevance between alcohol intake and osteoporosis among women showed that alcohol intake has a positive correlation with the prevalence of osteoporosis [23]. Therefore, the relationship between smoking, alcohol intake, and osteoporosis among Chinese females still needs to be analysed by large sample-based studies.

A new fracture survey conducted by the 27 nations of the European Union in 2010 suggested that the most common fracture is a hip fracture, followed by vertebral and fore arm

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fractures [24]. The prevalence of fracture in our surveyed population was 10.34%, with the top three fracture positions being wrist, ankle, and vertebrae. The hip fracture, which has the greatest impact on human body function, was not the most common one in our study. Jiang X's study compared different fracture risk prediction models and found that age alone was the highest risk predictor of fracture [25]. Our study has also showed that a fracture history has a positive correlation with age. Most of the respondents had had one fracture in the past and the percentage of people that had had more than two fractures was 8.47%, but the highest number of fractures was eight times. The history and frequency of fractures has a significantly negative correlation with BMD. Unexpectedly, previous BMD measurement was only 8.80% of the total participants; history of fracture has no correlation with the former BMD test. For most of the patients with fractures, doctors tended to not prescribe anti-osteoporotic drugs and BMD tests, besides surgical treatment and basic calcium and vitamin D supplements, and thus failed to provide further prevention and treatment of osteoporosis. Nurmi-Lüthje's study in Finland showed that calcium and vitamin D supplement and other anti-osteoporosis drugs used for female patients with hip fractures can significantly reduce the mortality rate after a fracture [26]. Another study has shown that osteoporosis prevention training for doctors can increase the treatment rate of osteoporosis patients, thus reducing medical costs [27]. A survey in China among osteoporosis patients with hip fractures has also showed that 63% respondents withdrew medication because of not being informed about the duration of the treatment [11].

This study suggests that the proportion of previous BMD tests among female residents in Beijing is low, while calcium and vitamin D supplements are more common among people with fractures and osteoporosis. Few people accept HRT. Public awareness of the prevention and treatment of osteoporosis is still weak. The general public as well as medical workers should pay more attention to the knowledge about osteoporosis prevention and treatment.

Disclosure of conflict of interest

None.

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References

- [1] Kanis JA and Johnell O. Requirements for DXA for the management of osteoporosis in Europe. *Osteoporos Int* 2005; 16: 229-238.
- [2] Lips P. Epidemiology and predictors fractures associated with osteoporosis. *Am J Med* 1997; 103: 3S-8S.
- [3] Melton LJ 3rd, Chrischilles EA, Cooper C, Lane AW, Riggs BL. Perspective: how many women have osteoporosis? *J Bone Miner Res* 1992; 7: 1005-1010.
- [4] Cooper C. The crippling consequences of fractures and their impact on quality of life. *Am J Med* 1997; 103: 12S-17S.
- [5] Wu SF, Du XJ. Body mass index may positively correlate with bone mineral density of lumbar vertebra and femoral neck in postmenopausal females. *Med Sci Monit* 2016; 22: 145-51.
- [6] Zhu K, Prince RL. Lifestyle and osteoporosis. *Curr Osteoporos Rep* 2015; 13: 52-59.
- [7] Chinese Health Promotion Society. Summary statement of osteoporosis white paper China 2008. *Chin J Health Manag* 2009; 3: 148-154.
- [8] Wu k, Zhou HQ, Wang GC, Wu DH, Lin B, Ma L, Zhao MJ, Wang LY, Lu X, Zhang L, Zu N. An assessment of osteoporosis awareness in older patients of out-patients clinic. *Chin J Osteoporosis* 2011; 17: 503-507.
- [9] Kanis JA. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: synopsis of a WHO report. WHO Study Group. *Osteoporos Int* 1994; 4: 368-381.
- [10] Chinese Medical Association of osteoporosis and bone mineral disease branch. Primary osteoporosis treatment guidelines. *Chinese Journal of Osteoporosis and Bone Mineral Research* 2011; 4: 2-18.
- [11] Chao AJ, Hao W, Yu WH, Wang L. Cognitive and diagnosed status questionnaire about hip osteoporosis and hip fractures in the elderly. *Chinese Journal of Osteoporosis and Bone Mineral Research* 2012; 5: 58-61.
- [12] He B, Wang YH, Zhang Wi, Lu N, Wang YM. Health behaviors and influencing factors analysis about clinical osteoporotic fractures in elderly patients. *Chong Qing Medicine* 2012; 41: 2513-2515.
- [13] Liu JF, Tian SL, Dai GJ. BMD survey in healthy population in Nanyang city, Henan province. *Chinese Journal of Clinical Anatomy* 2008; 26: 44-46.

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- [14] Liu S, Li J, Sheng Z, Wu X, Liao E. Relationship between body composition and age, menopause and its effects on bone mineral density at segmental regions in Central Southern Chinese postmenopausal elderly women with and without osteoporosis. *Arch Gerontol Geriatr* 2011; 53: e192-97.
- [15] Castro-Lionard K, Dargent-Molina P, Fermandian C, Gonthier R, Cassou B. Use of Calcium Supplements, Vitamin D Supplements and Specific Osteoporosis Drugs Among French Women Aged 75-85 Years: Patterns of Use and Associated Factors. *Drugs Aging* 2013; 30: 1029-38.
- [16] Eriksen EF. Hormone replacement therapy or SERMS in the long term treatment of osteoporosis. *Minerva Ginecol* 2012; 64: 207-21.
- [17] de Villiers TJ, Stevenson JC. The WHI: the effect of hormone replacement therapy on fracture prevention. *Climacteric* 2012; 15: 263-6.
- [18] Pluskiewicz W, Adamczyk P, Czekajło A, Grzeszczak W, Drozdowska B. Influence of education, marital status, occupation, and the place of living on skeletal status, fracture prevalence, and the course and effectiveness of osteoporotic therapy in women in the RAC-OST-POL Study. *J Bone Miner Metab* 2014; 32: 89-95.
- [19] Huang KE. Menopause perspectives and treatment of Asian women. *Semin Reprod Med* 2010; 28: 396-403.
- [20] Alwi SA, Rubiah ZS, Lee PY, Mallika PS, Haizal MN. Experience of hormone replacement therapy among women of Sarawak, Malaysia. *Climacteric* 2010; 13: 553-60.
- [21] Tamaki J, Iki M, Fujita Y, Kouda K, Yura A, Kadowaki E, Sato Y, Moon JS, Tomioka K, Okamoto N, Kurumatani N. Impact of smoking on bone mineral density and bone metabolism in elderly men: the FuiWara-kyo Osteoporosis Risk in Men FORMEN study. *Osteoporosis Int* 2011; 22: 133-141.
- [22] Liu HL, Yuan C, Bao L. Influencing factors of BMD analysis among 3220 women under 40 years old in Wuhan. *Chinese General Practice* 2011; 14: 181-183.
- [23] Guo JL, Qu CY, Bai F, Ma JH, Chai YF. Relations between alcoholism and osteoporosis or femoral head necrosis. *Zhonghua Liu Xing Bing Xue Za Zhi* 2013; 34: 732-5.
- [24] Svedbom A1, Hernlund E, Ivergård M, Compston J, Cooper C, Stenmark J, McCloskey EV, Jönsson B, Kanis JA; EU Review Panel of IOF. Osteoporosis in the European Union: a compendium of country-specific reports. *Arch Osteoporos* 2013; 8: 137.
- [25] Jiang X, Westermann LB, Galleo GV, Demko J, Marakovits KA, Schnatz PF. Age as a predictor of osteoporotic fracture compared with current risk-prediction models. *Obstet Gynecol* 2013; 122: 1040-6.
- [26] Nurmi-Lüthje I, Lüthje P, Kaukonen JP, Kataja M, Kuurne S, Naboulsi H, Karjalainen K. Post-fracture prescribed calcium and vitamin D supplements alone or, in females, with concomitant anti-osteoporotic drugs is associated with lower mortality in elderly hip fracture patients: a prospective analysis. *Drugs Aging* 2009; 26: 409-21.
- [27] Majumdar SR, Lier DA, Beaupre LA, Hanley DA, Maksymowych WP, Juby AG, Bell NR, Morrish DW. Osteoporosis case manager for patients with hip fractures: results of a cost-effectiveness analysis conducted alongside a randomized trial. *Arch Intern Med* 2009; 69: 25-3.