Original Article

Nutritional status and its relationship with bone mass density in postmenopausal women admitted in osteodensitometry center, Isfahan-Iran

Zamzam Paknahad, Noushin Mohammadifard[1], Zahra Bonakdar[2], Akbar Hasanzadeh[3]

Department of Clinical Nutrition, School of Nutrition and Food Sciences, [1]Department of Nutrition, Isfahan Cardiovascular Research Center, [2]School of Medicine, [3]Department of Epidemiology and Biostatistics, School of Health, Isfahan University of Medical Sciences, Isfahan, Iran

ABSTRACT

Introduction: Osteoporosis is a multifactorial disease and one of the most important modifiable factors in the development and maintenance of bone mass are nutrition nutritional status and its relationship with Bone Mass Density (BMD) in postmenopausal women admitted in osteodensitometry Center, Isfahan, Iran. **Materials and Methods:** Seventy-two postmenopausal osteoporotic women were studied. BMD of the lumbar spine and total hip were measured using dual-energy X-ray absorptiometry. Demographic and dietary intakes were collected by interview and using a validated food frequency questionnaires. T-scores, Pearson correlation and one way analysis of variance tests were conducted to analyze the data. **Results:** Mean of age and duration of menopause was nearly 57.5 ± 7.2 and 10.6 ± 7.1 years, respectively. The mean t-scores for BMD of spine and hip were 0.877 ± 0.179 and 0.997 ± 0.21, respectively. The mean of calcium (Ca), phosphorous (P), fluoride (F), Vitamin D, K and Zn were less than DRI and Na more than it (all *P* value less than 0.0001). BMD of hip was significantly correlated with dietary Ca, animal protein, Zn ($P < 0.05$), but BMD of spine did not show any significant correlation with nutrients ($P > 0.05$). **Conclusion:** Most of the postmenopausal osteoporotic women in this study had a considerable deficiency in terms of micronutrients such as Ca, vitamin D and P, which can be deleterious for bone health.

Key words: Bone mineral density, diet, nutrition, women

INTRODUCTION

Osteoporosis and low bone density is a main cause of mortality and morbidity in elderly population, especially in women.[1] It caused approximately 9 million fractures in the year 2000 in the world,[2] and it is supposed to increase this number by more than three-fold by the year 2050.[3] In a study on burden of osteoporosis in Iran, premature mortality and disability was responsible for 36027 year of life lost in 2001.[4] It has been estimated that people over the age of 60 years will become 2 billion in number by this year that 45% of them will live in developing countries.[5] Increasing in elderly people, osteoporosis emerges as a main public health problem in developing countries such as Iran. There is lack of data on prevalence and incidence of osteoporosis in developing countries. About 200 million women have osteoporosis in the world,[6] but prevalence of osteoporosis varies in different countries.[4] Differences in race, lifestyle including dietary behaviors such as low calcium and vitamin D intake and excess alcohol consumption, lack of physical activity, and smoking status, family history, premature menopause, some kind of cancers and long-term

Address for correspondence: Dr. Zamzam Paknahad(Ph.D), Department of Clinical Nutrition, Faculty of Nutrition and Food Sciences , Isfahan University of Medical Sciences
Isfahan, Iran.
E-mail: paknahad@hlth.mui.ac.ir

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use of some drugs could predispose to osteoporosis.[7-16] Adequate nutrition is essential for the development and maintenance of the skeleton (i.e., bone health). Among these factors nutrition is the main characteristic seems to play an important role in the growth and maintenance of osteoporosis.[17] In addition to calcium and vitamin D, proteins, different kinds of fat, fiber, other minerals and vitamins may affect on bone density and formation.[18-22] However, there is a lack of such information, especially in developing countries. As bone mineral density (BMD) could estimate 75% of bone strength, it is a good indicator for prediction of fracture.[23] So, in the present study we tried to assess the relationship between nutrition status and BMD among menopausal women who referred to Bone Density Assay Center in Isfahan.

MATERIALS AND METHODS

In a descriptive cross sectional design, total of 72 menopausal women who attended the Osteoporosis Outpatient Clinic at the Isfahan were recruited in this study by using simple sampling. Including criteria was menopausal women who did not consumed any drugs were included and signed written consent.

Demographic and physiologic characteristics such as age, pregnancy number, duration of menopause, history of lactation were collected by questionnaire. Dietary pattern were assessed by a food frequency questionnaire (FFQ), which was translated to Persian with a nutrition expert. All data were collected by trained nutritionist.

Participants were asked to report their frequency of consumption of each food item during the previous year on a daily (e.g., bread), weekly (e.g., rice, meat) or monthly (e.g., fish) basis. To assist the subjects to report accurately, household utensils were used. The questionnaires were validated in the Nationwide Food Consumption Survey project, which has been reported in Farsi.[24]

Dietary data was conducted in Nutritionist 4 software. BMD was measured by dual-energy X-ray absorptiometry (DXA) using Lunar DPX-MD device (Lunar Corporation, Madison, Wisconsin, 53713. USA). The DXA device was calibrated daily and weekly by using appropriated phantoms methods. To assess BMD, second to fourth lumbar spine and from the hip bone, bone density was expressed as g/cm^2.[25]

Statistical analysis

T-scores were used to compare mean of dietary intakes with dietary reference intakes (DRIs) to assess the relationship between dietary intake and bone density.

Pearson and Spearman correlations were done. One way analysis of variance (ANOVA) was conducted to compare bone density in women with different menopausal period. *P* value less than 0.05 was considered significant.

RESULTS

Mean age of subjects was 57.5 ± 7.2. The demographic characteristics and bone density levels were shown in Table 1. Table 2 shows the BMD of spinal and hip declined by increasing the menopausal period ($P < 0.05$).

The comparing of dietary intake such as calcium (ca), phosphorus (P), energy, total fat, protein, sodium (Na), fluoride (F), zinc (Zn), vitamin C, D and K and fiber and ω_3 fatty acids with DRI were shown subjects consumed significantly Ca, P, F, vitamin D, K and Zn less than DRI and Na more than it ($P < 0.0001$).

Table 1: Basic characteristics of postmenopausal women

Characteristics	Mean±SEM*
Age	57.5±7.2
Body mass index (kg/m^2)	27.60±4.2
Menopausal duration	10.6±7.1
Pregnancy	4.4±2.6
Lactation duration	5.5±5
Spine bone mineral density (g/cm^2)	0.99±0.21
Hip bone mineral density (g/cm^2)	0.88±0.18
Dietary intake	
Energy (kcal)	1763.8±486.7
Total protein (g)	71.1±24.4
Animal protein (g)	33.3±19.3
Vegetable protein	37.9±12.7
Total fat (g)	48.2±13.4
ω3 fatty acid (g)	0.24±0.5
Fiber (g)	20.2±8.7
Calcium (mg)	1024.3±425.0
Phosphorus (mg)	1223.4±407
Magnesium (mg)	282.8±85.9
Zinc (mg)	7.8±2.2
Sodium (mg)	1930.5±614.1
Potassium (mg)	3108.1±1192.1
Fluoride	181.0±90.7
Vitamin D	2.1±1.8
Vitamin C	215.6±135.4
Vitamin K	159.3±109.1
Vitamin B_2	2.1±0.6

*Mean±Standard error

Table 2: Comparing the mean of bone mineral density based on history of menopause

Duration of Menopause (Y)	Hip density (g/cm^2) Mean±SEM*	Spine density (g/cm^2) Mean±SEM
<5	0.96±0.21	1.11±0.28
5-10	0.91±0.18	0.93±0.20
11-15	0.80±0.14	0.90±0.11
15-20	0.84±0.14	0.97±0.14
>20	0.78±0.05	0.9±0.08
P value	<0.05	<0.05

*Mean±Standard error

As it is showed at Table 3, BMD of hip showed significant relationship with animal protein ($r = 0.211$, $P < 0.05$), Zn ($r = 0.2$, $P < 0.05$), Ca ($r = 0.19$, $P < 0.05$), and vitamin B_2 ($r = 0.202$, $P < 0.05$) intake, but BMD of spine did not show any significant relationship with nutrients. BMD of spine showed significant relation with BMI ($r = 0.28$, $P < 0.01$) and age ($r = -0.209$, $P < 0.05$), at the other hand BMD of hip showed similar relation with BMI ($r = 0.27$, $P < 0.05$) and age ($r = -0.355$, $P < 0.01$).

DISCUSSION

This study indicated that there was a weak correlation between dietary intakes and BMD. Animal protein, Ca, Zn and vitamin B_2 had significant positive association with BMD. On the other hand there was a negative significant relationship with age. While by increasing menopausal period, the BMD was declined.

Hip and spine BMD in the subjects were less than normal concentrations and it was confirmed by Akbarian, *et al.* study in Iran.[26] Although, Ca, P, vitamin D and K, F, Zn and ω_3 could be effective BMD,[27,28] intake in these postmenopausal women were less than DRI. It could aggravate bone loss and osteoporosis in Iranian women. Inadequate intake of Ca might be due to poor nutrition knowledge, low socioeconomic, dislike and intolerance of milk and dairy products.[29] Similarly another study in Sabzevar, a city in the east part of Iran, revealed that elderly population consumed all essential nutritional factors for bone formation except protein less than DRI.[30]

Nutrition role may be the most controversial effect on osteoporosis.[31] Positive association of BMD in hip with animal protein in this study was confirmed with the study of Bonjour, *et al.*[32] Several studies in Iran and other countries showed increasing protein intake among those who consumed inadequate dietary protein had a positive effect on the risk of hip fracture in men and women.[33,34] Low dietary protein causes Ca malabsorption and demineralization of bones in elderly[35] and animal proteins release intestinal absorption of Ca. Also, dietary proteins induce insulin growth factor 1, which has a positive effect on bone formation.[32]

Table 3: Correlation between nutrients and bone mass density

	Hip density (g/cm²) r (*P*)*	Spine density (g/cm²) r (*P*)
Energy	0.093 (0.21)	0.026 (0.41)
Protein	0.163 (0.08)	0.05 (0.33)
Fat	0.07 (0.27)	0.429 (0.36)
Sodium	0.102 (0.197)	0.98 (0.2)
Potassium	0.081 (0.25)	0.1 (0.18)
Calcium	0.198 (0.04)**	0.1 (0.18)
Magnesium	0.062 (0.3)	0.03 (0.40)
Phosphorous	0.179 (0.06)	0.065 (0.29)
Zinc	0.206 (0.041)**	0.076 (0.26)
Fluoride	0.067 (0.28)	0.073 (0.271)
Vitamin D	0.13 (0.13)	0.04 (0.36)
Vitamin K	-0.24 (0.42)	0.063 (0.29)
Vitamin B_2	-0.2 (0.45)	0.08 (0.24)
Animal protein	0.211 (0.038)**	0.11 (0.17)

*Correlation coefficient (*P* value), **$P<0.05$

Meng, *et al.* found that the effect of more intake of protein on muscle mediated bone mass increasing.[36] So, it was consistent with other studies that demonstrated lean body mass is an important determinant of BMC and BMD.[37-41] So, according to the review study of Campbell and *et al.* safe protein intake for elderly would be 1.0-1.25 g/kg/d of high quality protein such as some kinds of animal proteins.[42]

Although, protective role of animal protein such as chicken, fish and egg confirmed the theory of "adequate protein intake is important for optimal bone health in the elderly 50 to 69 years of age", red meat consumption 4 times or more per week was shown as a risk factor in Iranian population.[5]

Similar to our study the Furrell, *et al.* and Ilich, *et al.* reported Zn, Ca and protein associated with three or more of the same BMD sites.[43] But in contrast to present study, several studies showed BMD had a significant positive association with K, Mg, P, fiber, vitamin D, E and C, fiber and significant negative relationship with dietary fat.[29,43-46] Osteoblast enzymes require Zn for collagen formation. Moreover, Zn is an essential factor that is involved in alkaline phosphatase as important osteoblast activation.[31] Sodium effects on BMD are equivocal. In the present study there was no significant association between Na and BMD, however, in studies in which Na intake was measured properly, there is a significant negative effect when daily intake exceeds 2,100 mg (90 mmol).[47] Positive relationship of vitamin B_2 with BMD might be because of the main source of this vitamin is milk and dairy product. Contrary to our expectation, there was no significant negative correlation between dietary fat and BMD. It is possible for no exceed consumption of total fat in our society (my article).

Limitation

Small sample size might be a limitation of this study. Furthermore, we did not have any data on physical activity and smoking in subjects.

CONCLUSION

Also, there is a relation between animal protein, Ca, Zn and riboflavin but not other nutrition factors and BMD. We suggest that elderly women should consume animal protein such as milk and dairy products, fish and egg based on DRI. Further studies with more sample size are suggested.

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