Original Article

Pattern of nutrition, physical activity level and body mass index (BMI) in women with osteoporosis

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Abstract

Introduction:
Several factors, such as nutrition, body mass index and physical activity, are involved in the incidence of osteoporosis. Thus, this study was conducted to determine the pattern of nutrition, physical activity level and body mass index in women with osteoporosis.

Materials and Methods:
100 osteoporotic patients participated in this research. The patients were classified based on their body mass index and physical activity level. Daily intake of nutrients was evaluated using Food frequency questionnaire (FFQ) and 24 hour recall. Questionnaires and data were analyzed in DFP and SPSS.13 softwares using the sample t-test and Spearman-correlation.

Results:
According to the results, 50.5% of the patients were in the overweight and obese groups and 89% of them had low activity or were inactive. Average consumption of zinc, magnesium and copper in all age groups and average consumption of calcium in women older than 51 years was significantly less than the recommended dietary allowances (RDA)($P<0.001$). However, the average consumption of phosphorus, iron, and vitamin C in all age groups was significantly higher than RDA ($P<0.001$).

Conclusion:
The result showed that obesity and low activity are common in osteoporotic patients. The intake of the nutrients with positive effects on the bone density is less than the standards recommended.

Keywords: Nutritional Status, Osteoporosis, Obesity, Physical Activity

Introduction:

Osteoporosis is an age-related metabolic disease that is more common in women, and may cause fractures as a result of demineralization of the bone (1), and occurs when bone mineral density (BMD) is greatly reduced (2).

Studies reveal that nearly 25 million women and 12 million men are affected worldwide. In Iran, osteoporosis of the lumbar vertebrae is prevalent among 41.7% of women and 10.2% of men, and osteoporosis of femor is present in 4.7% of women and 1.2% of men (2, 3). The

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economic consequences of this disease are also significant, and according to the ministry of health reports, the annual cost of hip fractures is estimated between 8,000,000 and 16,000,000 US dollars (3).

Several risk factors are involved in the incidence of this disease such as dietary pattern, physical activity, and body mass index (BMI), all of which can be changed. In their study in 2007, Zhao et al. showed that an increase in body fat and obesity does not have protective effects on the bone mass (4). Nunez et al. in a study in 2007 on female mice and obese post-menopausal women found similar results (5).

Kumar et al. in their study in 2010 showed that intake of energy, protein, and calcium, together with physical activity has a significant effect on the bone mineral density (6). On the one hand, many studies indicate a synergistic effect of physical activity. In other words, various degrees of inactivity can cause loss of bone mass (2, 7). On the other hand, bone mass reduction can lead to lack of physical activity (8, 9).

Considering the high prevalence of osteoporosis and high cost of its treatment, and also, the importance of controllable factors like balanced diet and physical activity in the incidence of this disease, this study was conducted to examine dietary patterns, physical activity levels, and BMI status in women with osteoporosis attending Shahid Chamran and MRI hospitals in Shiraz.

Materials and Methods:

For this cross-sectional descriptive study, conducted between Feb 2007 and Jul 2008, 100 women with osteoporosis that attended Shahid Chamran and MRI hospitals in Shiraz were selected with simple sampling method. They were studied after signing consent forms. Study inclusion criteria were one year's residence in Shiraz and diagnosis of the disease by assessment of the lumbar and pelvis bone mineral density (BMD) using Dual X-Ray Absorotiometry system. Those with a history of early ovariectomy, hypothyroidism, hyperthyroidism, chronic renal failure, malabsorption and diarrhea, chronic obstructive pulmonary disease, unilateral paralysis of the body, sub-total gastrectomy, use of medications like phenytoin, phenobabital, thyroid hormones, corticosteroids, methotrexate, cyclosporine, lithium, tetracycline, antacids containing aluminum, heparin, and derivatives of phenothiazines, a family history of osteoporosis, a history of menstrual disorders, and smoking were excluded from the study. Once study population was identified and made aware of the study objectives, using interview and questionnaire techniques, the following information was collected: personal details (age, occupation, education, and income), dietary information (weight, height, nutritional intake), physical activity (type, frequency, and duration), reproductive history status (menopause, age at menopause, number of pregnancies and intervals between them, pregnancies before 18, and lactation).

Samples were divided into four groups based on BMI; lean, normal weight, overweight, and obese and based on physical activity levels into sedentary, low-active, active, very active groups (2). It should be noted that the level of physical activity of these patients was determined according to physical activity index and information obtained from the questionnaires on the type, frequency, and duration of activities. Also, the level of nutrition intake was decided in the form of number of units per day, month, and year using food frequency questionnaire that included 100 types of foods. Then questionnaires were analyzed using DFP software for calculation of daily intake of calcium, copper, magnesium, iron, zinc, phosphorus, protein, and vitamins A and C (all having an important role in bone health) and mean intake of each of these nutrients was compared with RDA. The 24 hour diet reminder was also used to record patients' daily intake and calculate daily

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energy consumption. Results obtained were compared with the estimated energy requirements (EER) (2). Data were analyzed by SPSS-13 software using descriptive statistics, t-test, and Spearman correlation coefficient. P<0.05 indicated significance level.

Results:

This study was conducted on 100 women with osteoporosis with mean age of 58.65±9.7 years, 88.8% of whom were postmenopausal and 50.5% overweight and obese. According to the physical activity index (PA), 89% were in sedentary or low-activity range, and only 9% were active or very active. Analysis of the 24 hour diet reminder showed that participants' mean calorie intake was 1287.15±402.2, and correlation between energy intake and recommended level was insignificant (P=0.512). Mean intake of micro-nutrients of calcium, (over 51's), zinc, magnesium, copper, and calcium to phosphorus ratio (Ca/p) were significantly lower than the recommended daily allowance (P<0.001) and mean intake of phosphorus, iron, and vitamin C was significantly higher (P<0.05). Mean calcium (in women aged between 31 and 50 years) and vitamin A intake was not significantly different with the recommended daily allowance. Due to different recommended allowable values of iron and calcium for the 31 to 50, and 50 years age groups, these nutrients were separately evaluated for each of these groups. No significant correlation was observed between women's protein intake and the desirable value (P=0.294).

Table1- Participants' nutrients intake status

	RDA	Mean±SD intake	P-value
Magnesium (mg/d)	320	22.986±20.64	<0.001
Copper (mg/d)	0.9	0.576±0.56	<0.001
Zinc (mg/d)	8	4.473±2.73	<0.001
Vitamin A (µg/d)	700	777.528±664.88	0.246
Vitamin C (µg/d)	75	123.198±72.08	<0.001
Phosphorus (mg/d)	700	911.341±470.18	<0.001
Calcium (31 to 50 year olds)	1000	1026.330±524.98	0.854
Calcium (over 51)	1200	976.358±412.93	<0.001
Iron (31 to 50 year olds)	18	35.599±15.48	<0.001
Iron (over 51)	8	27.016±11.33	<0.001
Protein (gr/d)	1gr/kg $_{bw}$	80.301±33.49	0.294
Ca/P ratio	1.7	1.1721±0.71045	<0.001

Discussion:

Osteoporosis is a disease that pre-dominantly affects postmenopausal women of advanced age. This disease may be postponed by maintaining normal weight, exercise, and a balanced diet. However, in this study, over half the participants were overweight and obese. According to studies by Zhao et al. and Nunez et al. in 2007, an increase in weight does not protect bone mass. Tanko et al. in 2004 reported that obese women have the least access to environmental levels of estradiol (10). Therefore, as estrogen level can affect BMD, obesity can be effective in reducing bone mass, as well. Also, just as in other studies, majority of patients in this study were in the low physical activity category (7, 9). It appears that physical activity, directly by mechanical pressure, or indirectly by hormonal factors influence bone metabolism (11, 12).

Intake of nutrients such as zinc, copper, magnesium, and calcium (in over 51's) was not satisfactory. Other studies also indicated that patients with osteoporosis did not have suitable dietary patterns for adequate intake of these nutrients (13, 16).

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But, the mean intake of vitamin C was significantly higher than the recommended daily allowance, indicating a reasonably good intake. However, some studies revealed insignificant correlation between vitamin C intake and risk of osteoporosis (17, 18), whilst, other studies showed insufficient vitamin C intake in women with osteoporosis (19, 21).

This study showed phosphorus intake in participating women was significantly higher than the recommended daily allowance, and was accompanied by low calcium intake. High values of phosphorus reduce calcium to phosphorus ratio, leading to reduced bone mass in the long term (2). This result was echoed by results obtained in several other studies (9, 14). It seems use of high levels of dietary phosphorus with increasing parathyroid hormone and decreasing calcitriol concentration may lead to calcium homeostasis disorders (4, 22, and 23).

High consumption of retinol (alcoholic vitamin A) can heighten the risk of fracture and osteoporosis (2). Results of many studies confirm this proposition (17, 24). However, the mean vitamin A intake in participants did not significantly differ from the recommended daily allowance.

According to the results of this study, the mean iron intake was significantly higher than the recommended daily allowance, and although iron is effective in maintenance of the bone, its high consumption causes reduction in zinc absorption (effective in maintaining bone density) (14, 25, 26, 27, and 29). As zinc intake was already insufficient in this study' participants, increased intake of iron may further worsen the situation.

There are conflicting results about the correlation between energy intake and osteoporosis (25, 27). In this study, no correlation was found between these two factors, either. Therefore, further research is needed to achieve more definite results.

Conclusion: According to the results obtained in this study, use of a balanced diet containing adequate amounts of calcium, magnesium, copper, and zinc is recommended. Also, maintaining body mass index in the normal range and consistent physical activity with the aim to slow down the process of osteoporosis, particularly in the over-51-year-olds.

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