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(RESEARCH ARTICLE)

Bone mineral density and nourishment

Ćatović Amra *, Bajgorić Ersan and Agić Almedin

Faculty of Medicine, University of Sarajevo Bosnia and Herzegovina.

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Abstract

Some diet pattern is connected with higher risk of obesity and deficit of different nutrients. Both can contribute to complications of chronic disease like osteoporosis. The primary objective of this study was to analyze the correlation between bone mineral density and body mass, i.e. nutrients intake. The cross-sectional study included 25 patients who had regular osteodensitometrycal checkup. Patients anthropometrics' characteristics were collected by interview. Dietary pattern was estimated through food-frequency questionnaire and average meal was made. Nutritional analysis computer program (Nutrics Professional Nutrition Analysis Software) was used to analyze the average intake of nutrients from the food intake data. The average T score of hip was at level of osteopenia (-1.7), and BMI was 25.80 kg/m^2. By comparing the results using Pearson coefficient, we found positive linear trend and statistical significance at $p < 0.05$. The average T score of lumbar spine was at level of osteoporosis (-2,19), and average intake of calcium was 1519 mg. By comparing the results using Pearson coefficient, we found negative linear trend and statistical significance at $p < 0.05$. These data indicate that BMI and nutrients intake are connected with the risk for osteoporosis. There is the need for osteoporosis prevention strategies based on nutrition recommendations.

Keywords: Bone health; Nutrients; Osteoporosis; Prevention

1. Introduction

Osteoporosis has been identified as a major public health concern [1]. Characteristics of this common skeletal disease are low bone strength and increased risk of fracture. Fractures are associated with adverse outcomes such as acute and chronic pain, diminished quality of life, disability, increased mortality, and substantial healthcare expenses. Postmenopausal women and men aged 50 and older are at risk of this disease [2]. The different degrees of nutrition in patients are associated with risk of chronic disease [3]. The most abundant minerals in the body (phosphorus and calcium) are essential nutrients important for the mineralization of bones and teeth. Vitamin D is a fat soluble vitamin which promotes calcium absorption in the gut and is required for bone growth and bone remodeling. Vitamin K is a fat soluble vitamin that plays an important role in bone health (especially postmenopausal) [4]. The primary objective of this study was to analyze the connection between bone mineral density and body mass, i.e. nutrients intake.

2. Patients and Methods

The study was designed as a cross-sectional study. The diet nutrients intake of patients presented on the Clinic of Nuclear Medicine of the Clinical Center University of Sarajevo was analyzed. The sample included 25 patients who had regular osteodensitometrycal checkup, express by T and Z score of the hip and lumbar spine. Patients anthropometrics' characteristics were collected by interview.

* Corresponding author: Ćatović Amra
Faculty of Medicine, University of Sarajevo Bosnia and Herzegovina.

The research instrument was food-frequency questionnaire (FFQ) that was conducted during March 2015 for three days, so average meal was made for female and for mail subjects. Table 1. presents diet log of subject.

Table 1 Diet Log of Examiners.

Meal	Day 1	Day 2	Day 3
Breakfast	comflour, onions, half liter of milk	cheese, ginger, 2 slices of bread	Sardines, 2 slices of bread
Snack	1 glass of milk	tea	jam fruit, 1 slice of bread
Lunch	white rice, salmon, 3 slices of bread	beans with beef, garden salad, 2 slices of bread	chicken soup, beef, slices of bread
Snack	1 banana	2 oranges	2 apples,1 kiwi
Dinner	1 glass of yogurt	popcorn	1 glass of compote

In this study nutritional analysis computer program (Nutrics Professional Nutrition Analysis Software) was used to analyze the average intake of nutrients from the food intake data.

Statistical analyses were performed using the Statistical Package for Social Sciences software (IBM, version 23.0). Continuous data were presented as mean and standard deviation (SD). In the bivariate analysis, the association (using Pearson's chi-squared test) of parameters of bone mineral density were estimated according to the nourishment status.

3. Results

Characteristics of the subjects are presented in Table 2. A total of 25 patients (2 males and 23 females), with a mean age ± standard deviation, of 60.48 ± 10.55 years, participated in this study. The mean weight was 71.20 ± 13.06 and mean height was 165.96 ± 8.65. Mean BMI was 25.80 ± 3.79.

Table 2 Characteristics of the participants (means ± SD).

Variable	Total	Males	Females
Number of Examiners	N = 25	N = 2	N = 23
Age (years)	60.48 ± 10.55	56.00 ± 14.14	60.87 ± 10.51
Weight (kg)	71.20 ± 13.06	80.00 ± 28.28	70.44 ± 11.92
Height (cm)	165.96 ± 8.65	174.00 ± 25.46	165.7 ± 6.80
BMI	25.80 ± 3.79	25.89 ± 1.75	25.79 ± 3.94

Nutrients intake is presented in Table 3. Average phosphorus intake was 3660 mg, average calcium intake was 2024 mg, average vitamin D intake was 6.5 µg, and average vitamin K intake was 86.9 µg.

Table 3 Single nutrient average intake

Nutrients	Total
Phosphorus (mg)	2219
Calcium (mg)	1519
Vitamin D(µg)	5.3
Vitamin K (µg)	78.5

Average hip T score was -1.55 SD (0.10 to -2.7), average hip Z score was -1.23 SD (1.70 to -6.00), average lumbar spine T score of -2.19 SD (-1.0 to -3.30) and average lumbar spine Z score of -1.38 SD (0.7 to -5.80). These results are shown by Figure 1.

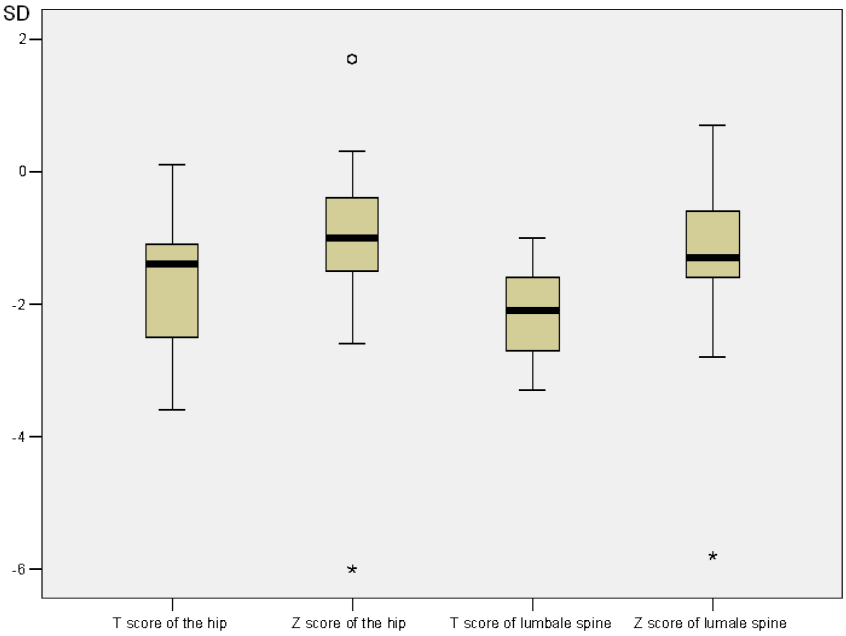

Figure 1 T and Z scores of the hip and lumbar spine

The average T score of hip was at level of osteopenia (-1.7), and BMI was 25,80 kg/m^2. By comparing the results using Pearson coefficient, we found positive linear trend and statistical significance at $p < 0.05$. The average T score of lumbar spine was at level of osteoporosis (-2.19), and average intake of calcium was 1519 mg. By comparing the results using Pearson coefficient, we found negative linear trend and statistical significance at $p < 0.05$ (Table 4).

Table 4 Pearson's correlation coefficients between nourishment and parameters of bone mineral density (*p<0,05)

Nourishment	**Parameters of bone mineral density**			
	T score of the hip (-1,75±0,903)	Z score of the hip (-1,07±1,46)	T score of lumbar spine (-2,19±0,64)	Z score of lumbar spine (-1,38±1,36)
BMI (25,80±3,80)	0,460*	0,328	0,087	0,126
Phosphorus (2219 mg)	0,193	0,192	-0,303	-0,192
Calcium (1519 mg)	0,365	0,364	-0,495*	-0,364
Vitamin D (5.3 μg*)*	-0,078	-0,078	-,102	0,078
Vitamin K (78.5 μg*)*	0,287	0,286	-0,421	-0,286

4. Discussion

The most common metabolic bone disease is osteoporosis [5]. Correlation between T scores and BMI indicate that a low body mass index can be a useful clinical tool for an early intervention to prevent osteoporosis and its complication [6].

Diet and lifestyle approach can prevent loss of bone mineral density and the progression to osteoporosis. A large and cooperative bone-making and maintenance team composed of nutrients and other compounds, including vitamins D and K, and the minerals calcium and phosphorus.

Calcium is crucial for preventing any bone-related diseases. Not all calcium consumed is absorbed and calcium recommendations (Recommended Dietary Allowances – RDAs) have been set high enough to accommodate a 30 percent absorption rate. The recommendation for adolescents to the age of 18 years is 1300 mg daily, people between ages 19 and 50 should consume about 1,000 mg of calcium a day; for women older than 50 and all adults older than 70, recommendations are raised again to 1200 milligrams a day [7]. Milk and milk products are good sources of calcium. Suggested daily milk amounts for young children (2 to 8 year) are 2 cups, and for older children, teenagers, and all adults are 3 cups. Good sources are calcium-set tofu, bok choy, kale, calcium-fortified orange juice, and broccoli. Some dark green, leafy vegetables— notably spinach and Swiss chard—appear to be calcium-rich but actually provide little calcium because they contain binders that limit absorption [4].

Vitamin D's special role in bone health is to assist in the absorption of calcium and phosphorus. In vitamin D deficiency, production of calbindin, a protein that binds calcium in the intestinal cells, slows and calcium passes through the GI tract unabsorbed. Vitamin D can be obtained from sun exposure, foods, and supplements. The vitamin D RDAs are based on the assumption that people receive minimal sun exposure. The recommendation for adults between ages 19 and 70 is 15 μg/day or 600 IU/day; and for adults older than 70 is 20 μg/day or 800 IU/day [7]. Few foods naturally contain vitamin D. The best sources are the flesh of fatty fish (such as trout, salmon, tuna, and mackerel) and fish liver oils are among. Beef liver and egg yolks have small amounts of vitamin D. Cheese naturally contains small amounts of vitamin D. Mushrooms provide variable amounts of vitamin D depending on UV light exposing [8]. Milk, many ready-to-eat cereals, and some brands of yogurt and orange juice are fortified with vitamin D. Fortified foods provide most of the vitamin D [4].

Vitamin K participates in the metabolism of bone proteins, most notably osteocalcin, which bind to the minerals that form bones. Vitamin K is made in the GI tract by the billions of bacteria that normally reside there. Once synthesized, vitamin K is absorbed and stored in the liver. This source provides about half of a person's needs. Because of insufficient evidence to establish RDA, intake at the level of adequate intake (AT) is assumed to ensure nutritional adequacy. AI for men is 120 μg/day and for women is 90 μg/day [9]. Vitamin K–rich foods are green vegetables and vegetable oils can easily supply the rest [4].

Phosphorus is the second most abundant mineral in the body. About 85 percent of it is found combined with calcium in the hydroxyapatite crystals of bones and teeth. Over the years, researchers have emphasized the importance of an ideal calcium-to-phosphorus ratio to support calcium metabolism, but there is little or no evidence to support this concept [4]. The phosphorus RDA for adults is 700 mg/day [10]. Significant sources are foods derived from animals (meat, fish, poultry, eggs, milk). Because phosphorus is commonly found in almost all foods, dietary deficiencies are unlikely.

Lifestyle choices can improve bone health. These include: increase physical activity; reduce sodium intake; increase consumption of fruits and vegetables; maintain a healthy body weight; avoid smoking; limit alcohol intake [3]. Bone forms and remodels in response to physical stress. For bone health weight-bearing physical activity and exercise that improves balance should be encouraged [11].

5. Conclusion

Data from our study indicate that BMI and nutrients intake are connected with the risk for osteoporosis. There is the need for osteoporosis prevention strategies based on nutrition recommendations. The findings of this study are limited by the use of a small sample from just one clinic which may not be a representative of all patients with osteoporosis in B&H. However, baseline information about the relationship between bone mineral density and eating habits was certainly obtained from the present study.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of informed consent

Informed consent was obtained from all individual participants included in this study.

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