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The relationship between some indicators of osteoporosis and bone mineral density of the pelvis in active elderly men

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Abstract

Purpose: Osteoporosis usually starts at a young age and progresses slowly over time. Therefore timely diagnosis of this disease plays an effective role in raising the level of health and public health in the society. The aim of this study was to investigate the relationship between some indicators of osteoporosis and bone mineral density of the pelvis in active elderly men.

Methods: This study was semi-experimental. 25 active elderly men with the age range of 60 to 85 years were selected as available and with medical records. Anthropometric characteristics and serum indices of subjects were used as effective indices of osteoporosis. Pearson's correlation coefficient was used to find the relationship between bone mineral density of the pelvis and effector indices, data analysis was done using SPSS version 26 software.

Results: The results of this research showed that in the active elderly men, there is a significant relationship between age (P=0.044), body mass index (BMI) (P=0.021), serum calcium (P=0.037) and phosphorus levels (P=0.046) and alkaline phosphatase (P=0.016), with bone mineral density (BMD) of the pelvis. No significant relationship was found between vitamin D with BMD of the pelvis (P=0.055).

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Conclusion: In general, the results show that there is a significant relationship between bone density and body mass index, calcium and serum alkaline phosphatase indices in active elderly men. Therefore, it is possible to use the serum levels of these indicators in predicting this disease, and exercise may also be one of the influencing factors, so the effect of exercise on other bone density indicators can be investigated.

Keywords: osteoporosis, elderly, active men, bone mineral density

INTRODUCTION

Osteoporosis is the most common bone disease in humans, representing a major public health problem. It is more common in men, women, and older people (Yu & Wang, 2022). Osteoporosis is a risk factor for fracture just as hypertension is for stroke (Bartl, 2023a). Osteoporosis affects an enormous number of people, of both sexes and all races, and its prevalence will increase as the population ages. It is a silent disease until fractures occur, which causes important secondary health problems and even death (Zerzour, Haddig, & Derouiche, 2020). According to the definition of the World Health Organization, one of the indicators of osteoporosis is a decrease in bone density and a change in the microscopic structure of bone tissue, so that in the long term it leads to an increase in bone fragility and increases the risk of fracture (Agarwal, 2021). The World Health Organization committee uses bone mineral content (BMD) and T-Score to classify individuals into three conditions: healthy, osteopenic, and osteoporotic (Fattahi et al., 2019). This definition is a practical technical definition in which an individual's bone mineral density (BMD) is compared to the mean maximum bone mass of the normal adult population. Today, osteoporosis is considered a great threat in the world and its annual mortality is more than all types of cancer (Inayat et al., 2022). The most damage caused by this disease is related to bone fracture. One out of every 3 women and 1 out of every 8 men over the age of 50 has experienced a fracture caused by osteoporosis, in addition, it is estimated that about two hundred million people in the world suffer from osteoporosis (Goswami, Anitescu, Chakraborty, & Rabczuk, 2020). In Iran, 50% of men over fifty years old and 70% of women over fifty years old suffer from osteoporosis (Fahimfar et al., 2020). Fracture risk is closely correlated with bone strength and increases exponentially as the BMD decreases. Dual-energy X-ray absorptiometry (DXA) measurements of hips are the best predictors of hip fracture risks (Zellagui, Hivet, El Mouss, & Hambli,

2021). It has been observed that various factors such as age, gender, race, family history, body mass index, physical activity level, lack of calcium and vitamin D in the diet, coffee, salt, smoking and alcohol consumption and lifestyle (including inactivity and immobility) affect bone mineral density (Kopiczko, 2020). With age, the level of hormones (testosterone in men and estrogen in women) decreases and reduces bone density and makes bones more fragile (Bartl, 2023b). It is known that bone mineral density increases during childhood and reaches its maximum during youth. After the third decade of life, the decrease in bone density begins and with increasing age, this decrease accelerates, bone strength decreases and bone removal is more than its repair, these cases make chronological age as one of the main risk factors for the prevalence of osteoporosis (Kranioti, Bonicelli, & García-Donas, 2019). Some researches have shown that there is a direct relationship between body mass index and bone minerals, so it has been said that BMI can be used as a predictor of bone density (Fasihi, Tartibian, Eslami, & Fasihi, 2022; Noh et al., 2023). According to the WHO criteria, a BMI of less than 18.5 is considered underweight, 18.5 to 24.99 is normal, and more than 25 is considered overweight (Inayat et al., 2022; Shiomoto et al., 2021). Calcium and phosphate are important components of inorganic bone matrix and are the main factors in maintaining bone health. In addition, studies have shown that the serum level of alkaline phosphatase ALP predicts the severity of bone loss (Su et al., 2023). Osteoporosis prevention and treatment includes pharmaceutical and non-pharmacological interventions (Ponzano et al., 2023). The findings of various studies also show that physical activity along with adequate intake of calcium and vitamin D has a great effect in reducing the speed of bone density loss. In fact, one of the effective, safe and cheap methods to prevent or delay the onset of osteoporosis is regular physical activity (Papadopoulou et al., 2021). Regular physical activity not only makes bones healthy, but also has a direct effect on the overall health of the body by increasing muscle strength, creating balance and coordination in the body (Calcaterra et al., 2022). Physical activity is recommended as a non-pharmacological intervention to increase bone density in youth and prevent bone mass decline in middle age and old age. In elderly people, physical activity plays an important role in increasing bone density, preventing falls and possible fractures (Fasihi et al., 2022). Therefore,

the aim of this study was to investigate the relationship between some indicators of osteoporosis and bone mineral density of the pelvis in active elderly men.

METHOD

This study was semi-experimental. A number of 25 active elderly men in the age range of 60 to 85 years participated selectively and available in this study. Subjects completed a questionnaire containing laboratory information on osteoporosis, anthropometric characteristics and physical activity level. The subjects included elderly men who had regular physical activity three sessions a week for at least one year. Inclusion criteria included: male gender, age between 60 and 85 years, having medical records and clinical tests and available via phone or internet. Exclusion criteria included: being treated for osteoporosis, history of taking hormonal drugs and having a chronic disease. After completing the consent form by the subjects, the information related to their blood test and bone mineral density test was used. In the above study, the subjects' anthropometric characteristics (age, weight, height, body mass index) and serum parameters (calcium, vitamin D, phosphorus and alkaline phosphatase) were used. In the early hours of the morning, in the fasting state, blood samples of 5 ml each were taken from the subjects' brachial (anticubital) veins, so that all the blood samples were poured into tubes containing heparin anticoagulant immediately after blood collection and kept for 15 minutes. They were centrifuged at 3000 rpm. Iranian Pars Azmoun kits with sensitivity of one and five units per liter, respectively, and Biochemistry 240 GLOBAL auto analyzer manufactured by PBC, Italy were used to measure the desired serum indicators. The body mass index was obtained by dividing the person's weight in kilograms by the second power of height in meters. In addition to descriptive statistics, Pearson's correlation coefficient test was used to analyze the research data. SPSS version 26 software was used for data analysis.

Table 1: WHO definitions of osteoporosis based on BMD

Classification	Bone Mineral Density	T Score
Normal	Within 1 SD of the mean level for a young adult reference population	T score at −1.0 and above
Low bone mass (Osteopenia)	Between 1 and 2.5 SD below that of the mean level for a young adult reference population	T score between −1.0 and −2.5
Osteoporosis	2.5 or more below that of the mean level for a young adult reference population	T score at or below −2.5
Severe or established (osteoporosis)	2.5 or more below that of the mean level for a young adult reference population with fractures	T score at or below −2.5 with one or more fractures

WHO: World Health Organization; BMD: bone mineral density; SD: standard deviation

RESULTS

Table 2 shows the descriptive and anthropometric information of the subjects.

Table 2: Anthropometric information of subjects

Variables mean and standard deviation	mean and standard deviation (n=25)
Age	72.36 ± 11.64
Height (cm)	164.62 ± 7.38
Weight (kg)	73.80 ± 12.20
BMI (kilograms per square meter)	27.47 ± 8.13

The correlation coefficient values between osteoporosis indices and bone mineral density of men's pelvis are shown in Table 2.

According to the data in Table 2, it can be seen that in active elderly men, a significant relationship was found between anthropometric characteristics (age and body mass index) and serum indices (calcium,

phosphorus and alkaline phosphatase levels) with femur mineral density (P≤0.05).). While no significant relationship was found between serum vitamin D and bone mineral density (P≥0.05).

Table3: Correlation coefficient between osteoporosis indices and hip bone mineral density of active elderly men

Osteoporosis indices of hip (BMD) (n=25)	**Pearson correlation coefficient**	**significance level (p-value)**
Age	-0.75	0.044 *
body mass index (BMI)	0.86	0.021*
Serum calcium	0.84	0.037*
Serum phosphorus	0.67	0.046*
Serum vitamin D	0.24	0.055
Serum alkaline phosphatase	-0.81	0.016*

* Significant difference at P≤0.05 level

DISCUSSION

The aim of this study was to investigate the relationship between some indicators of osteoporosis and bone mineral density of the pelvis in active elderly men. The results showed that there is a significant relationship between age, BMI, levels of serum calcium, phosphorus, alkaline phosphatase and the amount of pelvic BMD in active elderly men.

The result of the above research was a significant relationship between BMI and bone mineral content of active elderly men. In line with the results of the above study, Zhao et al. in a study investigating "the relationship between obesity and osteoporosis" reported that weight and BMI have a positive relationship with bone mass (Zhao et al., 2007). The results of a study conducted in 2005 showed that there is a significant relationship between BMI and bone density (Baheiraei, Pocock, Eisman, Nguyen, & Nguyen, 2005). Jiang et al. also confirmed the positive relationship between body mass index and bone mineral content (Jiang et al., 2015). Carvalho et al. reported that there is a positive and significant relationship between bone mineral density and body weight, so that higher mineral

density values were reported in subjects who had more weight (de Carvalho Patriarca, de Castro Santos, Passos, & Cominetti, 2023) . Also, at the end of their study, Cirnigliaro et al reported a strong correlation between mineral density and body weight, especially in the region of the spine and femoral neck, which bear mechanical pressure (Cirnigliaro et al., 2020). The results of some researches were inconsistent with the present study. In a study, Andreoli et al. stated that body mass significantly reduces the risk of osteoporosis, while it does not reduce the risk of osteopenia (Andreoli et al., 2001). Fawzy et al. stated that there is no significant relationship between BMD and BMI compared to normal subjects (Fawzy et al., 2011). Also, a hospital study conducted in elderly men reported that obese and overweight men were more prone to osteoporosis and osteopenia (Paniagua, Malphurs, & Samos, 2006). A possible explanation for the difference between these results may be related to the age, racial difference, and the difference in the type of nutrition of the subjects. The increase in body mass not only causes an additional load on the bones, which is itself the cause of increasing the density of mineral substances, in fact, the response of bone tissue to mechanical stimuli is a necessary biological phenomenon that adapts the skeleton to environmental pressures caused by physical activities.

Other results of the present study showed that there is a significant relationship between serum calcium, phosphorus and alkaline phosphatase with the minerals of the pelvic bones of active men. Common markers of osteoporosis include calcium, phosphorus, and alkaline phosphatase, which are measured in the blood. Biochemical markers of bone resorption are said to be related to existing bone mass and help predict future bone loss (Saha et al., 2017). Many studies have been conducted to evaluate markers of bone resorption to predict bone loss and to evaluate the correlation of markers with bone mineral density. Consistent with the above study, Hashimoto et al. reported a significant relationship between serum phosphorus and calcium levels with osteoporosis (Hashimoto, Shikuma, Mandai, Adachi, & Uchida, 2021). In their study, adding vitamin D and calcium during treatment over a four-year period significantly improved lumbar bone mineral density in Japanese osteoporosis patients (Suzuki, Nakamura, & Kato, 2018). Jafari et al. reported a significant relationship between serum calcium and phosphorus with bone minerals, in their study, "the relationship between body mass index and serum calcium and

phosphate levels" investigated diabetes and metabolic syndrome (Jafari-Giv et al., 2019). Contrary to the above study, Tariq et al. in a study titled "Alkaline phosphatase as a predictor of bone mineral density in the elderly" showed that alkaline phosphatase and bone calcium are not predictors of bone mineral density in the elderly with osteoporosis, while that alkaline phosphatase and serum calcium are strong predictors for healthy elderly people (Tariq, Tariq, Lone, & Khaliq, 2019). In this case, it seems that various factors such as the age, gender of the subjects, as well as environmental factors can answer the diversity of the results related to the density of these indicators.

CONCLUSIONS

In general, according to the results of the present research and the high correlation between several serum indices with bone mineral density in active postmenopausal women, being active probably has beneficial effects on bone metabolism and has caused a better state of bone mineral density. Also, this may help to use these blood and anthropometric variables in identifying people at risk of osteoporosis in adulthood and old age. One of the strengths of this research is the relatively large number of subjects, and the fact that it was only conducted on middle-aged men can be considered as a weakness.

Contribution of authors

All authors have participated in the design, execution and writing of all parts of this research.

Conflict of interest

According to the authors of this article, there is no conflict of interest.

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