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Relationship between indicators affecting osteoporosis and femoral bone mineral density in active and inactive elderly men

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Abstract

Purpose: Osteoporosis is a decrease in bone density among older adults that can lead to painful fractures and disability. People in developing countries are not interested in examining bone mineral density until fractures occur. Therefore, the aim of this study was to investigate the relationship between the indicators affecting osteoporosis with femoral mineral density in active and inactive elderly men. **Method:** A total of 45 active and 45 inactive men with an age range of 70 to 85 years with medical records and clinical trials were selected. Anthropometric characteristics and serum indices of the subjects were used as effective indicators of osteoporosis. Pearson correlation coefficient was used to find the relationship between the indicators and the mineral density of the femur. SPSS software version 26 was used for data analysis. **Results:** The results of the present study showed that in both groups of active and inactive elderly men, a significant relationship was observed between anthropometric characteristics and serum indices with bone mineral density ($P \leq 0.05$). No significant relationship was found between other indicators. **Conclusion:** In general, the results show that there is a significant relationship between bone density and weight, body mass index, age, calcium, phosphorus and serum alkaline phosphatase of all subjects. Therefore, in adulthood and old age, these blood and anthropometric variables can be used to identify people at risk for osteoporosis.

Keywords: Bone mineral density, elderly men, blood and anthropometric indices.

Introduction

Osteoporosis or osteoporosis is a common disease that leads to thinning and weakening of bones or, in fact, to bone atrophy, and it usually affects people from middle age onwards (Al Anouti et al., 2019). This disease starts at a young age and progresses slowly over time. Early diagnosis of osteoporosis is very important and plays an effective role in raising the level of health and public health in the society (Meem, 2021). According to the definition of the World Health Organization (WHO), osteoporosis is a disease whose characteristic feature is a decrease in bone density and a change in the microscopic structure of bone tissue, which leads to an increase in bone fragility and increases the risk of fracture (Al Anouti et al., 2019). The World Health Organization committee uses bone mineral content (BMD) and T-Score to classify individuals into three conditions: healthy, osteopenic, and osteoporotic. This definition is a practical technical definition in which an individual's bone mineral content (BMD) is compared to the mean maximum bone mass of a normal adult population (Xuan, Song, Baker, & Gu, 2020). Today, osteoporosis is considered a great threat in the world and its annual mortality is more than all types of cancer (Cowdery et al., 2020). The most damage and loss caused by this disease is considered to be a fracture, one out of every 3 women and one out of every 8 men over the age of 50 has experienced a fracture caused by osteoporosis. It is estimated that about two hundred million people in the world suffer from osteoporosis. are infected (Pouresmaeili, Kamalidehghan, Kamarehei, & Goh, 2018). Based on statistics, it has been shown that the prevalence of osteoporosis is higher in the hip and spine (McCoy, Tundo, Chidambaram, & Baaj, 2019). In Iran, 50% of men over 50 and 70% of women over 50 have osteoporosis (Mirhashemi, Kalantar Motamedi, Mirhashemi, Mehrvarz, & Danial, 2017). Various factors are involved in the development of osteoporosis, 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 the specific type and style of current life. Among them, lack of movement and immobility affect

bone minerals (Hirota, Nara, Ohguri, Manago, & Hirota, 1992). Gender can affect fracture risk associated with osteoporosis (Meem, 2021). The findings showed that women have 5 times more fractures than men, but the risk of subsequent fractures within three years after the first fracture is relatively lower. Age is also effective in increasing the risk, and the higher the age, the higher the incidence of osteoporosis. According to the statistics of the World Health Organization, the prevalence of hip fractures increases in people over 65 years of age, which usually occurs as a result of very minor impacts and mostly after normal falls (Turk et al., 2020). Also, with increasing age, the level of hormones (testosterone in men and estrogen in women) decreases and reduces bone density and makes bones more fragile (Zanker & Duque, 2019). Height can become shorter with age because the cartilage between their joints wears out and as a result, osteoporosis occurs, and these changes can be slowed down or accelerated by lifestyle choices (Bartl, Bartl, Bartl, & Bartl, 2019). It is known that the content of bone minerals increases during childhood and reaches its maximum during puberty, after the third decade of life, the overall reduction of bone begins and with increasing age, this decrease in bone mass progresses, bone strength due to the decrease in density. Bone decreases, as a result of increasing age, bone removal is more than its repair, which causes a decrease in bone mass. These cases make chronological age one of the main risk factors for the prevalence of osteoporosis (Marin, Pedrosa, Moreira-Pfrimer, Matsudo, & Lazaretti-Castro, 2010). Also, another effective indicator in osteoporosis is weight, the lower the body weight, the less force is applied to the bones and the bone density decreases (Li, Gao, & Li, 2020). On the other hand, the effect of body weight and fat mass can be another factor to stimulate bone formation. In addition, fat tissue acts as a storage source of steroid hormones. Studies confirm that estrogen has inducing effects on the expression of osteoblast genes (Al-Suhaimi & Al-Jafary, 2020). In some studies, there is a direct relationship between body mass index and bone minerals, so BMI can be used as a predictor of bone density. According to the WHO criteria, BMI less than 18.5 is considered underweight, 18.5 to 24.99 is normal,

and more than 25 is considered overweight (Khalooeifard, Djafarian, Safabakhsh, Rahmani, & Shab-Bidar, 2020). On the other hand, bone is the main source of calcium and progenitor cells in the body. Among the various biological tests to estimate the activity of osteoblasts, measuring the amount of alkaline phosphatase is an important test. Alkaline phosphatase is an ectoenzyme produced by osteoblast cells that hydrolyzes organic phosphates at alkaline pH. Calcium and phosphate are important components of inorganic bone matrix and the main factors in maintaining bone health. Alkaline phosphatase ALP serum levels are a strong predictor of bone loss (Cirnigliaro et al., 2020). Phosphate deficiency can also lead to bone damage and clinical disease. On the other hand, various studies have mentioned the effect of physical activity in the prevention of bone tissue analysis, and considering that 40-44% of the bone density of an adult is achieved during adolescence, the effect of physical activity is especially important during growth. and maturity have shown on bone density (Iwamoto, 2017). Sports activity is a factor that maintains and stimulates bone formation, which leads to a reduction in the risk of bone fractures through the accumulation of minerals, strengthening muscles and improving the balance of a person (Espinosa et al., 2018). The effect of physical activity and the resulting mechanical pressure on increasing bone density has been proven, the mechanical pressures applied to bones through tendons and muscles It has a direct effect on bone formation and its shape change (Tong et al., 2019). Sports activities transfer force to bones in two ways: muscle tension and gravity. These forces can cause an increase in bone density, if people who follow an active life have significantly more bone mass than inactive people of the same age, and this benefit is maintained until their seventh and even eighth decade of life (Holubiac & Grosu, 2019). Therefore, the aim of this study was the relationship between the indicators affecting osteoporosis and mineral density of the femur in active and inactive elderly men.

Methods

The statistical population of the present study consisted of all patients referred to Ayatollah Kashani Hospital in the age range of 70 to 85 years. The clinical data used in this study were related to 234 patients. Out of this number, there were 120 men who had medical records in Ayatollah Kashani Hospital in Tehran during 2018-2019 and had a file containing laboratory information in the computer archive files of that hospital as suspected of osteoporosis. After completing the questionnaire containing personal information, osteoporosis and physical activity, finally 45 active men and 45 inactive men were selected. In the present study, active men were those who had regular physical activity three sessions a week for at least one year. The subjects of the inactive group also included men who did not do any special sports activities and were similar in age to the active group. After filling the consent form, the information related to 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. Body mass index was obtained by dividing the person's weight in kilograms by the second power of height in meters. Inclusion criteria included: male gender, age between 70 and 85 years, having medical records and clinical tests in the hospital and available via phone or internet. Exclusion criteria included: being treated for osteoporosis, history of taking hormonal drugs and having a chronic disease. 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. The serum test sheet of all subjects was examined and the values of the studied variables (phosphorus level, vitamin D level, alkaline phosphatase level) were recorded.

Results

In Table 1, the descriptive and anthropometric data of the subjects are presented.

Table 1: Anthropometric information of subjects

Variables	Mean and standard deviation	
	Active men (n=45)	Inactive men (n=45)
Age (years)	75.36 ± 9.74	76.34 ± 8.76
Height (cm)	165.67 ± 8.36	164.87 ± 7.35
Weight (kg)	71.83 ± 12.76	72.55 ± 10.64
Body mass index (kg / cm^2)	29.37 ± 8.23	28.45 ± 7.19

The correlation coefficient values between osteoporosis indices and mineral density of the femur of active men 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 observed between anthropometric characteristics (age, weight, body mass index) and serum indicators (calcium, phosphorus and alkaline phosphatase levels) with mineral density of the femur of active men. $P \leq 0.05$). While no significant relationship was found between other indicators (height and serum vitamin D) ($P \geq 0.05$).

Table 2: Correlation coefficient between osteoporosis indices and bone mineral density (BMD) of femur of active men

Osteoporosis indicators	BMD active group (n=45)	
	Correlation coefficient (r)	p-value
Age (years)	-0.75	0.044*
Height (cm)	-0.31	0.17
Weight (kg)	0.73	0.032*
BMI (kg / m^2)	0.86	0.021*
calcium (mg / dl)	0.84	0.037*
phosphorus (mg / dl)	0.67	0.046*
Vitamin D (mg / dl)	0.24	0.55
alkaline phosphatase(mg / dl)	0.81	0.016*

***Significant difference at P≤0.05 level**

The values related to the correlation coefficient between the body mass index and mineral density of the femur of active men are shown in Table 3. According to Table 3, it can be seen that in inactive elderly men, a significant relationship was observed between anthropometric characteristics (age, weight, body mass index) and serum indicators (calcium, phosphorus, and alkaline phosphatase) with mineral density of the femur of inactive men. P≤0.05). While there was no significant relationship between other indicators (height and serum vitamin D) (P≥0.05).

Table 3. Correlation coefficient between osteoporosis indices and bone mineral density (BMD) of inactive men's femur

Osteoporosis indicators	BMD active group (n=45)	
	Correlation coefficient (r)	p-value
Age (years)	-0.84	0.033*
Height (cm)	-0.22	0.47
Weight (kg)	0.75	0.012*
BMI (kg / m^2)	0.69	0.048*
calcium (mg / dl)	0.88	0.022*
phosphorus (mg / dl)	0.73	0.036*
Vitamin D (mg / dl)	0.39	0.47
alkaline phosphatase(mg / dl)	0.78	0.019*

***Significant difference at P≤0.05 level**

Discussion

The aim of this study was to investigate the relationship between osteoporosis indices and femur bone mineral density in active and inactive obese elderly men. The results showed that there is a significant relationship between age, weight and body mass index with the amount of bone minerals in active and inactive obese elderly men. From the third decade of life, the process of decreasing bone density begins, which indicates that chronological age is one of the risk factors for osteoporosis (Fugiel, Ignasiak, Skrzek, & Sławińska, 2020). The most important factor in the occurrence of osteoporosis is age, as the strength of bone tissue decreases with age and its resistance decreases. Bone is a living tissue and different cells work inside it. A group of these cells

called osteoblasts are constantly forming bones, and another group called osteoclasts are responsible for absorbing bone. At a young age, bone is made more; But after about 85 years of age, less material is replaced for the material that is removed from the bone, and this process causes a gradual decrease in the amount of bone-forming material, and as a result, it causes a loss of density and a decrease in its strength. With age, the total bone mass of the body decreases and the risk of fracture increases. Also, weight is another effective indicator in osteoporosis, the higher the body weight, the more force is applied to the bones and the bone density increases (Zhu, Liu, & Chen, 2021). The results of several studies were consistent with the results of this study. Carvalho et al. (2019) 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 (Crispim Carvalho et al., 2019). Also, at the end of their study, Sirnig Liaro et al. (2020) 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). Among other results of the above research, a significant relationship was observed between BMI of both groups of active and inactive obese elderly men and bone mineral content. The increase in body mass not only causes an additional burden on the bones, which itself is the cause of increasing the density of mineral materials, in fact, the response of bone tissue to mechanical stimuli is a necessary biological phenomenon that adapts the skeleton against the environmental pressures caused by physical activities. Zhao et al. (2007) 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). In a study consistent with the results of the current study, Bakker and his colleagues (2003) discovered a direct and positive relationship between body mass and bone density and found that BMI can be used as a predictor of bone density (Bakker, Twisk, Van Mechelen, & Kemper, 2003). Also, 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). Panigo et al. (2006) also confirmed the positive relationship between body mass index and bone mineral content (Paniagua, Malphurs, & Samos, 2006). The results of some researches were inconsistent with the present study. In a study, Andreoli et al. (2011) stated that obesity significantly reduces the risk of osteoporosis, while it does not reduce the risk of osteopenia (Andreoli et al., 2011). Fawzy et al. (2011) stated that there is a significant relationship between obesity and osteoporosis, but compared to normal people, there was no significant relationship between BMD and BMI (Fawzy et al., 2011). Greco et al. (2010) showed that obese subjects had lower mineral content, which was consistent with the diagnosis of osteoporosis (Greco et al., 2010).

Also, the results of the present study showed that there is a significant relationship between serum calcium, phosphorus and alkaline phosphatase with bone minerals in both active and inactive groups. 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. In line with the above study, Hashimoto et al. (2021) reported a significant relationship between serum phosphorus and calcium levels with osteoporosis (Hashimoto, Shikuma, Mandai, Adachi, & Uchida, 2021). Suzuki et al. (2018) 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) also, in line with the study of Parsley. et al. (2019) 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). Lea et al. (2018) reported a significant relationship between calcium, serum phosphorus and vitamin D with bone minerals. Contrary to the above

study, Tariq et al. (2019), in a study titled "Alkaline phosphatase as a predictor of bone mineral density in the elderly" showed that alkaline phosphatase and calcium are not predictors of bone mineral density in the elderly with osteoporosis, while Alkaline phosphatase and serum calcium are strong predictors for healthy elderly people (Tariq, Tariq, Lone, & Khaliq, 2019). It seems that the implementation of sports programs both in treatment and in prevention have a positive effect on the density of bone mass (Mohammad Rahimi et al., 2020). In addition, having a proper exercise program, in addition to reducing the risk of injury, increases a person's sense of satisfaction (Tidman & Skotzke, 2020). It is clear that all Verz programs Objects do not have such characteristics. In terms of the type of sports exercises, studies have shown that exercises that do not have a pressure nature have less effect than weight bearing exercises such as running and jumping or are completely ineffective (Hutson, O'Donnell, Brooke-Wavell, Sale, & Blagrove, 2021). The mechanism of the effect of sports exercises in the prevention and treatment of osteoporosis is such that the process of building and rebuilding bones is under the influence of systemic hormones and pressures on different areas of the body (Prisby, 2017). Choosing a suitable sports activity depends on the goal of the treatment and the limitations of the patient. If the goal of the treatment is to strengthen the bones and muscles and the patient has no limitations, weight bearing activities with high pressure and resistance activities are suitable choices, but if the patient has limitations such as reduced bone density, weight bearing activities with low pressure are recommended (LeRoith et al., 2019). One of the limitations of the present research was the impossibility of determining the role of the diet used by the subjects in the past years due to the importance of diet in the bone density of people. Another limitation was the lack of available medical records of subjects aged 70 to 85, especially active people. The more the number of subjects, the more accurate and complete results of the relationship between blood factors and anthropometry and bone density can be obtained and can be used to identify people at risk of osteoporosis and

improve the quality of life and health level of people in the community and prevent fractures caused by it.

Conclusion

In general, the results of this research showed that there is a significant relationship between bone density and weight, body mass index, age and serum calcium, phosphorus and alkaline phosphatase of all subjects. Considering this issue, it can be said that one of the applications of the results of this research is to use the value of these indicators in predicting the level of bone density of people. Also, in adulthood and old age, it may help to use these blood and anthropometric variables in people aged 70 to 85 to identify people at risk of osteoporosis.

Conflict of Interests

We are grateful to all the participants in this research and to all the people who helped us in conducting this research.

Ethical considerations

This study was approved by the Research Ethics Committee of Allameh Tabatabai University, ID: IR.ATU.REC.1399.038, and the participants signed an informed consent form.

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