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Research Article

Effect of body mass index on bone mineral density

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ABSTRACT

Background: Body mass index (BMI) is a good indicator for measurement of bone mineral density (BMD) which measures the density of minerals present in the bones using a special scan. BMD can be used to assess the strength of bones. Osteoporosis is a natural phenomenon of wear and tear. Obesity is an independent risk factor for low BMD. Dual-energy X-ray absorptiometry (DEXA) is the most accurate way to measure BMD. DEXA is a gold standard technique for diagnosing osteoporosis. Hence the current study was designed to study the effect of BMI on BMD.
Methods: The present retrospective study was conducted on the patients who were referred to the Department of Radio diagnosis for DEXA scan were selected. Eighty 50-80 years old men who attended various departments were included. BMI was measured as weight in kilograms by height in meters square. BMD was assessed by DEXA scan.
Results: Eighty men in the age group of 50-80 (62.46 ± 7.63) years were included in the study. All men underwent a standard BMD scans of femoral neck and lumbar vertebrae (L2-L4) using a DEXA scan. BMI (28.1 ± 4.93) kg/m^2 shows a highly significant positive correlation with BMD (171 ± -1.76 ± 1.71) SD, r = 0.53 p<0.01.
Conclusions: The results suggest lower BMI is an important risk factor for the occurrence of low BMD. BMD can be used for screening test for osteoporosis.

Keywords: BMI, BMD, Osteoporosis, DEXA Scan, Obesity

INTRODUCTION

Obesity and osteoporosis are two important and growing public health problems worldwide. Obesity is a condition of excessive body fat that causes or exacerbates several public health problems. Body mass index (BMI) is widely used as an index of the degree of obesity, primarily because it is easy to measure. Obesity is an independent risk factor for low bone mineral density (BMD).

Osteoporosis is a condition characterized by a decrease in the density of bone, decreasing its strength and resulting in fragile bones. As a phenomenon of aging the bones become thin or osteoporotic. As a result of this, calcium and other minerals decrease in the bones and they become light in weight, less dense, and more fragile. Many factors also contribute family history of osteoporosis and fracture, genetics, lack of exercise, lack of calcium and vitamin D, tobacco & alcohol consumption, and dietary habits. Both osteoporosis and obesity have been defined as social diseases because of their high impact on mortality and morbidity.[1] These two diseases affects the quality of life of patients.

BMD test measures the density of minerals present in the bones using a special scan. Dual-energy X-ray absorptiometry (DEXA) is the most accurate way to measure BMD & is a gold standard technique for diagnosing osteoporosis. This can be used to assess the strength of bones. Relationship between BMI and BMD was reported for many populations.[2-4] Low BMD is a

major risk factor for osteoporosis and its related fractures.[3] Stress fractures are common with the advanced age. Although osteoporosis can occur in men, it is most common in women older than 65 years of age. The current study was designed to study the effect of BMI on BMD.

METHODS

The present retrospective study was conducted in the patients who were referred to the Department of Radio diagnosis for DEXA scan in a government tertiary care center in Karnataka. People who underwent DEXA scan from January till December 2014 formed the study subjects. DEXA Scanning was performed by technician and the interpretation was done by a radiologist. For the present study, eighty 50-80years old men who attended various departments were included. Height and weight had measured. BMI was calculated from the height and weight. BMI was calculated based on the formula weight (kg)/height square (sq. m). The standard classification of BMI by CDC indicates less than 18.5 as underweight, 18.5–24.9 as Normal, 25.0–29.9 as overweight, and 30.0 and above as obese.[5] Technician measured BMD at the femoral neck and the lumbar spine (L2 to L4) using a DEXA densitometer. T-Score was obtained. WHO criteria were used for categorizing the respondents based on DEXA results. WHO classification of BMD by T-score value;

Normal: T-score at or above -1 SD
Osteopenia: T-score between -1 and -2.5 SD
Osteoporosis: T-score at or below -2.5 SD
Established osteoporosis: T-score at or below -2.5 SD, plus fragility fracture.[6,7]

Statistical analysis

The results were expressed as mean ± standard deviation (SD). A p value of <0.05 was considered statistically significant. Statistical analysis was performed using the statistical package for social & sciences. Pearson correlation was applied to correlate between parameters.

RESULTS

Eighty men in the age group of 50-80 (63.23 ± 5.65) years were included in the study (Table 1 & Figure 1). All men underwent a standard BMD scans of femoral neck and lumbar vertebrae (L2-L4) using a DEXA scan. BMI was measured as weight in kilograms by height in meters square. BMI (28.1 ± 4.93) kg/m^2 shows a highly significant positive correlation with BMD (-1.76 ± 1.71) SD, r = 0.53, p<0.01 (Table 2 & Figure 2).

DISCUSSION

Osteoporosis & obesity are major public health problem all over the world. The present study reveals low BMI individuals lose more bone compared to those with higher BMI individuals (Figure 2). Studies conducted by Ravn et al and Bjarnason and Christiansen indicates that early postmenopausal women who have low BMI lose more bone compared to those with higher BMI women.[2,8] Studies conducted by Van der Voort et al found that thinning of bone is related to both osteoporosis and increased fracture risk.[9,10] Hence, low BMI was included in the risk assessment tools for evaluation of osteoporosis and osteoporotic fracture risk as suggested by Eddy et al and National Osteoporosis Foundation and Black et al.[11-13] Studies from different authors emphasize the importance of exercise on BMD. Chan et al and Loud et al in their study indicate that exercise at a younger age helps to maximize the BMD.[14,15]

Table 1: Distribution of study subjects by age.

Age in years	Number	Percentage
<60	29	36.25
60-65	21	26.25
65-70	23	28.75
>70	7	8.75
Total	80	100

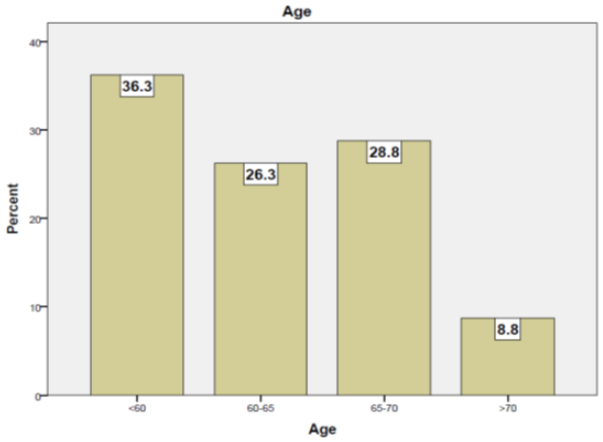

Figure 1: Bar chart showing distribution of subjects by age.

Bone mass decreases after 35 years of age, and bone loss occurs more rapidly in women after menopause. Risk factors for osteoporosis include genetics, lack of exercise, lack of calcium and vitamin D, personal history of fracture as an adult, smoking, excessive alcohol consumption, history of rheumatoid arthritis, low body weight, and family history of osteoporosis. Patients with osteoporosis have no symptoms until bone fractures occur.

The exact mechanisms whereby how the adipose tissue exerts positive effects on BMD status are not known clearly. However the pathophysiological relevance of adipose tissue for skeletal integrity probably resides in the role of several adipokine in bone remodelling through the effects on both formation and resorption. Recently, bone has been considered an endocrine organ affecting

body weight control and glucose homoeostasis through the actions of bone-derived factors such as osteocalcin and osteopontin.[16-19] The relationship between fat and the bone constitutes a homoeostatic feedback system in which adipokine and molecules secreted by osteoblasts and osteoclasts represent the link of an active bone-adipose axis.[17-19] However, the mechanisms by which all these events occur remains unclear. Several data indicate that women with high BMI are protected from osteoporosis.[20,21]

Table 2: Correlation between BMI and BMD.

BMI (kg/m^2) (Mean±SD)	BMD (SD) (Mean±SD)	r	p
28.1 ± 4.93	-1.76 ± 1.71	0.53	< 0.01

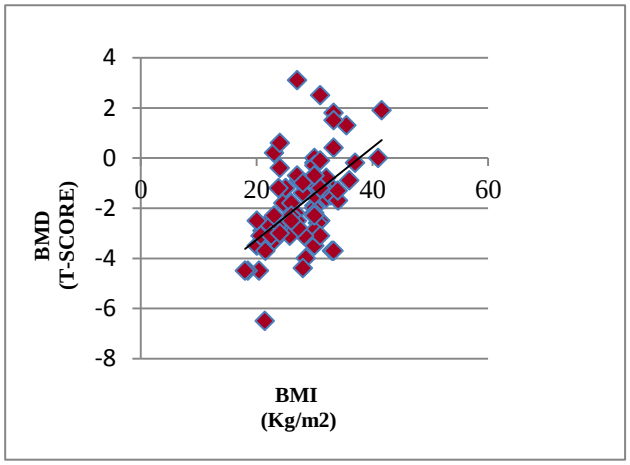

Figure 2: Scatter diagram showing correlation between BMI & BMD.

Obesity is also associated with BMD because of the conversion of androgen to estrogen, which improves bone mass in both men and women.[22-24] However, the mechanisms by which all these events occur remain unclear. In our study, we excluded women in order to rule the effects of hormones in various phases of life viz, pre & post-menopausal.

CONCLUSION

From the above study we can conclude the followings.

1. Lower BMI is an important risk factor for the occurrence of low BMD.
2. BMD can be used for screening test for osteoporosis.
3. Efforts are needed for prevention of osteoporosis in elderly men as well as postmenopausal women with low BMI.
4. In order to prevent the risk of osteoporosis, patients should be advised to maintain a normal weight.
5. Exercise prescription helps to maintain the BMD in all ages.

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