**Original Article**

# Relation between obesity and osteoporosis in women

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## ABSTRACT

***Background:*** *Osteoporosis is a multifactorial skeletal disease, whose mechanisms are not fully understood. It is more common in older people, especially in Post menopausal women. Body Mass Index (BMI) is often used to predict Bone Mineral Density (BMD). Obese women have always been considered protected against Osteoporosis and Osteoporotic fractures.*

***Objectives:*** *Several studies have challenged the widespread belief that obesity is protective against fracture. The aim of this study was to assess the effects of BMI on BMD in premenopausal and postmenopausal women.*

***Material and Methods:*** *The study was conducted on 400 women divided into two age groups of 21-50 years (premenopausal) and 51 - 90 years (post menopausal). Subjects having history of diseases or drugs that might influence BMD were excluded from the study. Height (m) and weight (kg) were measured and BMI was calculated. Calcaneus bone was scanned for QUS to measure BMD. The diagnosis of Osteoporosis and Osteopenia were done according to WHO T- score criteria. The whole data was collected and statistically analyzed using Correlation Coefficients and Pearson's Chi Square test.*

***Results:*** *Pearson's correlation analysis showed a positive correlation between age and BMI but no significant correlation between BMI and BMD.*

***Conclusions:*** *The results showed that there was no statistically significant relationship between BMI and BMD (p value > 0.05). According to our results, there is no protective role of Obesity in the development of Osteoporosis. There must be more detailed study in molecular and cellular level to explain the role and influence of obesity on BMD in women.*

***Key Words:*** *Obesity, BMI, osteoporosis, BMD, women*

## Introduction

Obesity and Osteoporosis are two common diseases with an increasing prevalence and a high impact on morbidity and mortality. Osteoporosis is a major public health problem all over the world. It is characterized by low bone mass and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. [1] Bone Mineral Density (BMD) test measures the density of minerals present in the bones using a special scan. This can be used to assess the strength of bones.

Obesity was commonly thought to be advantageous for maintaining healthy bones due to the higher bone mineral density observed in overweight individuals. However, several recent studies have challenged the widespread belief that obesity is protective against fracture and have suggested that obesity is a risk factor for certain fractures. The effect of obesity on fracture risk is site dependent. Moreover the relationship between obesity and fracture may also vary by sex, age and ethnicity. Risk factors for fracture in obese individuals appear to be similar to that in non obese populations, although patterns of falling are particularly important in the obese. [2] Research is needed to determine if and how visceral fat and metabolic complications of obesity are casually associated with bone status and fragility fracture risk.

Body Mass Index is a widely used index to measure obesity. Low BMI causing low BMD has been reported in several articles. There are also contradictory data available which show obesity is associated with low bone mass. In the past decade, considerable effort has been expended in the development of methods for assessing the skeleton noninvasively in order to provide early detection

and precise monitoring of this disease. Although osteoporosis involves the whole body, measurements of BMD at one site can be predictive of fractures at other sites. Since the definition of osteoporosis includes bone mass as a parameter, measurement of bone mineral density (BMD) has become an essential element in the evaluation of patients at risk for osteoporosis. [3]

Although many studies have investigated the association between Body Mass Index (BMI) and Bone Mineral Density (BMD), the results are inconsistent. The objective of this study was to analyze the relationship between body mass index and bone mineral density in Women.

## Material and methods

The study was conducted at PIMS hospital. 400 women were selected from the outpatient department of Orthopedics and divided into Premenopausal (20-50 yrs) and postmenopausal (51-90 yrs) groups. Subjects having history of diseases that might affect bone metabolism or taking drugs that might influence BMD were excluded from the study. An informed consent was taken from all the participants and a relevant questionnaire was given to them. The study protocol was approved by local Ethical Committee.

Height (m) and weight (kg) was measured in light clothing and without shoes and BMI was calculated as ratio of subjects' weight to height squared ($kg/m^2$). Participants were categorized into three BMI groups according to WHO criterion. [4] Normal weight (BMI <24.9 $kg/m^2$), overweight (BMI =25.0- 29.9 $kg/m^2$) and obese (BMI>30 $kg/m^2$).

Calcaneus bone was scanned for Quantitative Ultrasound to measure BMD. This bone is easily accessible, has a high (> 90 %) trabecular bone content, is responsive to gravitational forces and is relatively small in size. In addition portability, low cost and lack of ionizing radiations have made Quantitative Ultrasound a popular mode of imaging for mass screening. The diagnosis of Osteoporosis and Osteopenia were done according to WHO T- score criteria. [5] According to it, a T-score between +1 and -1 is considered normal or healthy. A T-score between -1 and 2.5 indicates low bone mass or Osteopenia. A T-score or -2.5 or lower indicates Osteoporosis. The greater the negative number, the more severe the Osteoporosis.

The whole data was collected and statistically analysed using appropriate statistical methods. Correlations coefficients were determined between Age and BMI, Age and BMD and BMI and BMD. Pearson's chi square analysis was used to relation of Age with BMI and BMD and between BMI and BMD. One way ANOVA with Post –Hoc Turkey HSD was also applied to show comparison of mean values in different groups according to BMD and BMI.

## Results

The age of study group ranged from 20 – 88 years. The mean age of the study group was 49.3 years. (Table 1) The BMI ranged from 14.92 to 52.48 $kg/m^2$ and the mean BMI was 27.73 $kg/m^2$. The BMD in terms of T- score ranged from -3.8 to 5.36 and the mean was -1.06.

There was a significant negative correlation between age and BMI. (Table 2) However no significant correlation was found between obesity and osteoporosis in both the groups. (i.e. Premenopausal and Postmenopausal women) This is clearly depicted in Table 3 which shows that the p value is > 0.05 for both the groups. Pearson's chi square analysis of Table 4 shows that BMI had no significant association with BMD. Thus the study shows that no definite relationship can be established between Obesity and Osteoporosis in Women.

**Table 1: Age Distribution**

| Age (Years) | Number of cases | %age |
|---|---|---|
| <=50 yrs | 238 | 59.50 |
| > 50 yrs | 162 | 40.50 |
| Total | 400 | 100.0 |
| Range 20-88 | Mean ± SD | 49.33 ± 12.68 |

**Table 2: Correlation Coefficients**

| | | BMI | BMD |
|---|---|---|---|
| Age | r = | 0.113 | -0.003 |
| | p = | 0.024* | 0.957 |
| BMI | r = | - | -0.027 |
| | p = | | 0.590 |

**Table 3: Correlation Coefficients**

| | | | BMD |
|---|---|---|---|
| Age <=50 yrs | BMI | r = | -0.053 |
| | | p = | 0.415 |
| Age > 50 yrs | BMI | r = | 0.022 |
| | | p = | 0.779 |

**Table 4: BMI with BMD**

| BMI | BMD | | | Total |
|---|---|---|---|---|
| | Normal n(%) | Osteopenia n(%) | Osteoporosis n(%) | |
| Normal (<25) | 63(47.7) | 58(43.9) | 11(8.3) | 132 |
| Overweight (25-29.9) | 65(41.9) | 76(49.0) | 14(9.0) | 155 |
| Obese (30-39.9) | 39(38.6) | 49(48.5) | 13(12.9) | 101 |
| Morbidly obese (>40) | 5 (41.7) | 7 (58.3) | - | 12 |
| Total | 172 | 190 | 38 | 400 |

$x^2 = 4.504$; df = 6; p = 0.609; Not significant

## Discussion

In the present study we noted decrease in BMI with age. This can be explained by the decrease in the fat content and body mass as the age advances. Our study demonstrated that there was no significant relation of BMI with BMD in women. Thus study concluded that obesity is not a protective factor for Osteoporosis. Several other studies have shown similar results. A study by Robbins J et al [6] concluded that BMIs should not be used in select individuals for BMD screening. According to Oommen A et al, [7] there was no statistically significant association between BMI and BMD. A study conducted by Saravi et al [8] reported no significant effect of BMI on BMD. Body weight, BMI and aging are not the only factors affecting bone loss. Therefore it is recommended to assess other risk factors. On the other hand, low body mass index (BMI) causing low bone mineral density (BMD) has been reported in several articles. Study results by Lloyd JT et al [9] confirmed the positive association between BMI and BMD, and this relationship does not differ by age, sex or race. Similarly, a study by Fawzy T et al [10] concluded that association between advancing age and lower BMI is an important risk factor in the occurrence of low BMD. Principal explanation for this association is heavier mechanical loading on bones with subsequent bone remodelling to resist this loading. Moreover, fat and bone are linked by many pathways which ultimately serve the function of providing a skeleton appropriate to the mass of adipose tissue it is carrying. Leptin, adiponectin, adipocytic estrogens, insulin and amylin are involved in this connection. However, excessive body fat, and particularly abdominal fat, produces inflammatory cytokines which may stimulate bone resorption and reduce bone strength. A study corroborating this has been conducted by Greco EA et al. [11]. According to him, overweight was neutral or protective, whereas obesity was associated with a low bone mass, compatible with a diagnosis of Osteoporosis.

In conclusion, this study provides new clinical evidence that morbid obesity may not be considered as a protective factor against osteoporosis in female populations. Rather there might be a risk of bone loss and the development of osteoporosis in a subpopulation of obese

individuals. Thus a specific and careful characterization of skeletal metabolism and further studies evaluating BMD modifications might be useful in female severely obese subjects, as ageing might increase their risk of developing fractures later in life.

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