DOI:10.19056/ijmdsjssmes/2016/v5i1/83567

Original Article

Relationship of Body Mass Index and Bone Mineral Density in adult men

Bansal A[1], Bansal S[2]

[1]Dr Aman Bansal
MBBS, MS Orthopedics
Associate Professor
Department of Orthopedics
dramanbansal@gmail.com
[2]Dr Shiveta Bansal
MBBS, MD Physiology
Associate Professor
Department of Physiology
[1,2]Punjab Institute of Medical Sciences
Jalandhar, Punjab, India
drshiveta@gmail.com

Received: 14-10-2015
Revised: 08-11-2015
Accepted: 20-11-2015

Correspondence to:
Dr Aman Bansal
dramanbansal@gmail.com
9988221826, 9888233578

ABSTRACT

Background: *Osteoporosis and Obesity are severe public health problems. Body weight and Body Mass Index (BMI) are considered strong predictors of osteoporotic fractures.*

Objectives: *The interest of several studies has been focused on women, but there are only few studies worldwide focused on this issue in men. The objective is to focus towards evaluation of Bone Mineral Density (BMD) in male population.*

Material and Methods: *The study was conducted on 400 men up to the age of 80 years. 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 negative correlation between age and BMD and between age and BMI, and a positive correlation between BMI and BMD. Pearson's chi square analysis showed that BMI had a highly significant association with BMD whereas age had a highly significant association with BMD.*

Conclusions: *Although the results show significant relationship between BMI and BMD, the negative relationship of age with BMI and BMD may serve as a guidance to initiate early assessment of BMD as preventive measure of osteoporosis and fractures among ageing men population.*

Key Words: *Age, BMI, Osteoporosis, BMD, men*

Introduction

Obesity and Osteoporosis are two complex diseases with multifactorial etiology. 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.

Bones naturally become thinner as one grows older because existing bone is broken down faster than the new bone made. As a result of this, calcium and other minerals decrease in the bones and they become light in weight, less dense and more fragile. The three main factors associated with BMD are age, gender and BMI. Gender and advancing age are non modifiable risk factor for osteoporotic fracture.

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. [2]

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 Men. The interest of several studies has been focused on women, but there are only few recent studies worldwide focused on this issue in men.

Material and Methods

The study was conducted at PIMS hospital. 400 men were selected from the outpatient department of Orthopedics. 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. [3]

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. [4] 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 19 – 89 years. The mean age of the study group was 54.8 years. The BMI ranged from 13.07 to 47.36 kg/m^2 and the mean BMI was 26.90 kg/m^2. The BMD in terms of T- score ranged from -4.8 to 2.4 and the mean was -0.92.

There was a highly significant negative correlation between age and BMD and also a significant correlation between age and BMI. However a positive correlation was found between BMI and BMD in the study group. Pearson's chi square analysis showed that BMI had a highly significant association with BMD. There was an increase in BMD value with the increase in BMI. On the other hand age had a highly significant negative association with BMD as well as BMI. So with increase in age there was a decrease in BMI as well as BMD.

Table: 1 Correlation Coefficients

		BMI	BMD
Age	r =	-0.104	-0.330
	p =	0.038*	<0.001**
BMI	r =	-	0.074
	p =		0.138^{NS}

NS: p > 0.05; Not Significant, *p<0.05; Significant, **p<0.001; Highly significant

Table: 2 Age with BMD

Age (Years)	BMD		
	Normal n (%)	Osteopenian n (%)	Osteoporosis n (%)
0 – 20	8 (100)	-	-
21 – 40	45 (63.4)	26 (36.6)	-
41 – 60	87 (58)	57 (38)	6 (4)
61 – 80	77 (48.1)	76 (47.5)	7 (4.4)
>80	-	7 (63.6)	4 (36.4)
Total	217	166	17

x^2 = 48.575; df = 8; p <0.001; Highly significant

Table: 3 Age with BMI

Age (Years)	BMI			
	Normal n (%)	Overweight n (%)	Obese n (%)	Morbidily Obese n(%)
0 – 20	2 (25)	3 (37.5)	3 (37.5)	-
21 – 40	33 (46.5)	13 (18.3)	24 (33.8)	1 (1.4)
41 – 60	56 (37.3)	58 (38.7)	32 (21.3)	4 (2.7)
61 – 80	69 (43.1)	56 (35)	34 (21.3)	1 (0.6)
>80	2 (18.2)	9 (81.8)	-	-
Total	162	139	93	6

x^2 = 25.951; df = 12; p = 0.011; Significant

Table: 4 BMI with BMD

BMI	BMD		
	Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)
Normal (<25)	72 (44.4)	83 (51.2)	7 (4.3)
Overweight (25-29.9)	81 (58.3)	50 (36)	8 (5.8)
Obese (30-39.9)	63 (67.7)	30 (32.3)	-
Morbidly obese (>40)	1 (16.7)	3 (50)	2 (33.3)
Total	217	166	17

x^2 = 31.347; df = 6; p <0.001; Highly 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. It was also found that there was a statistically highly significant negative correlation between age and Bone Mineral Density. Similar results in BMD have been observed in various studies. Martin Rupperecht, et al. study on calcaneus bone displayed age –related changes in its microstructure and the age related bone loss of either sex. [5] In the study by Pluskiewicz W, et al. age correlated significantly with calcaneus BMD in the whole group as well in males. [6]

Body weight and Body mass index are potentially modifiable factors and are generally considered essential determinants of Bone Mineral Density. Our study demonstrated positive association of elevated BMI with BMD in men. Several other studies have shown positive correlation of BMI and BMD in all male subjects included in the study. The results of Lloyd J et al [7] confirm the association between BMI and BMD.

The study by Salamat M et al [8] concluded that both BMI and weight are associated with BMD and overweight and obesity decrease the risk of Osteoporosis. Principal explanation for this association is heavier mechanical loading on bones with subsequent bone remodelation to resist this loading. Some of other putative mechanisms are increased secretion of insulin and increased plasma levels of leptin.

However, there are other published studies focused on the impact of fat mass on BMD that demonstrated negative association of obesity with BMD. Contrary to results of our study and above mentioned studies, Greco et al [9] reported low lumbar BMD in obese patients, while a recent study by Emaus N et al [10] demonstrated a non linear relationship between body mass index and bone mineral density. The assumed mechanisms for these results are secretion of pro-inflammatory cytokines that stimulate bone resorption, decreased levels of adiponectins and increased paratharmone levels. These mechanisms could also be explained by prevalence of sedentary lifestyle and relative lack of weight bearing activity in this group.

To conclude, although the results show significant relationship between BMI and BMD, the negative relationship between age and BMD may serve as a guidance to initiate early assessment of

the BMD and also preventive measures of osteoporosis and fractures among ageing men population.

References

1. Robert Lindsay R, Cosman F. Osteoporosis. In: Kasper DL, Fauci AS, editors. Harrison's principles of Internal Medicine. 16th ed. New York USA: Mc Graw Hill; 2008: p. 2268-2278.
2. Kanis JA, Delmas P, Burckhardt P, Cooper C, Torgerson D. Guidelines for diagnosis and management of osteoporosis. Osteoporosis Int 1997; 7:390-406.
3. BMI classification according to WHO. Available at: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html. Accessed June 25th 2014.
4. Bone Mass Measurement: What the Numbers Mean. Available at: http://www.niams.nih.gov/health_info/bone/bone_he Accessed February 19th 2015.
5. Rupprecht M, Pogoda P, Mumme M, Johannes M, RuegerJM, Puschel K, et al. Bone microarchitecture of the calcaneus and its changes in aging: A histomorphometric analysis of 60 human specimens. Journal of Orthopedic Research 2006;24:664-674.
6. Pluskiewicz W, Piotr Adamczyk P, Bogna Drozdzowska B, Antoni Pyrkosz A, Halaba Z. Quantitative Ultrasound and peripheral bone densitometry in patients with genetic disorders. Ultrasound in Medicine and Biology 2006;32:523-528.
7. Lloyd JT, Alley DE, Hawkes WG, Hochberg MC, Waldstein SR, Orwig DL. Body mass index is positively associated with bone mineral density in US older adults. Arch Osteoporos 2014 Dec;9(1):175.
8. Salamat MR, Salamat AH, Abedi I, Janghorbani M. Relationship between weight, body mass index and bone mineral density in men referred for Dual energy X ray absorptiometry scan in Isfahan, Iran. J Osteoporos 2013;2059-63.
9. Greco EA, Formari R, Rossi F, Santiemma V, Prossomariti G, Annoscia C, et al. Is obesity protective for osteoporosis? Evaluation of bone mineral density in individuals with high body mass index. Int J Clin Pract 2010 May; 64(6):817-820.
10. Emaus N, Wilsgaard T, Ahmed LA. Impacts of Body mass index, physical activity and smoking on femoral bone loss. The Tromso Study. J Bone Miner Res 2014 Mar 28; doi: 10.1002/jbmr.2232.

Cite this article as: Bansal A, Bansal S. Relationship of Body Mass Index and Bone Mineral Density in adult men. Int J Med and Dent Sci 2016; 5(1):1033-1037.
Source of Support: Nil
Conflict of Interest: No