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Association between Body Mass Index and Bone Mineral Density: Study among Indian Females

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Abstract: Osteoporosis is as a systemic skeletal disease characterized by low bone mass and micro-architectural deterioration with a consequent increase in bone fragility with susceptibility to fracture especially in females. Underweight or low BMI is an important but neglected parameter which affects bone mineral density.To determine any association between the body mass index, and bone mineral density in apparently healthy Indian adult females. This study was carried out at tertiary care medical institute of corporation of metropolitan city and at private hospitals in Mumbai city of Maharashtra, India. Apparently healthy female individuals who had fulfilled inclusion and exclusion criteria and had given the consent for the study were enrolled. Body Mass Index (BMI) and Bone Mineral Density (BMD) were measured as per the standardized methods. Descriptive statistics for parameters given as proportion, mean and standard deviation. Chi square test was used as test of significance. The study was carried out on 73 apparently health female individuals.All volunteer participants were between the age group of 18 – 76 years . Out of total participants 6 female underweight, 28 female were normal, overweight included 27 females and 12 females were obese. 8 female had normal BMD, 19 female had osteopenia and 22 female had osteoporosis. There was statistically significant association between body mass index and bone mineral density. Lower BMI was associated with both higher possibilities of either osteopenia or osteoporosis. there was no statistically significant association between age and bone mineral density.Body Mass Index is an important determinant of Bone Mineral Density in female population.
Keywords: Females, Body Mass Index, Bone Mineral Density, Association, India.

INTRODUCTION

Osteoporosis is defined as a systemic skeletal disease characterized by low bone mass and micro-architectural deterioration with a consequent increase in bone fragility with susceptibility to fracture [1, 2]. Osteoporosis is a major public health problem, affecting millions of people worldwide especially female gender [3].

Most studies to date, on risk factors for osteoporosis have considered body mass index (BMI) only as a possible confounder [4]. Underweight or low BMI is an important but neglected parameter which affects bone mineral density. Bone remodeling occurs in response to physical stress, and weight bearing exercise can increase peak bone mass achieved in adolescence [5]. Low body mass index (BMI) is associated with lower peak bone mass, and an adverse influence on bone loss [6, 7]. This may be the consequence of reduced peripheral estrogen production by adipose tissue among thin women, less mechanical loading of the skeleton and metabolic influences on body composition.

The first normative reference database of BMD in the Indian population both women and men was established using digital x-ray radiometry. According to this 29.9 % of women and 24.3 % of men between the age of 20 and 79 years had low bone mass. About 50 % women and 36 % of men over 50 years of age had low bone mass, suggesting a higher prevalence of low bone mass in the Indian population compared to the west [8].

Present study was carried out to determine any association between the body mass index, and bone mineral density in apparently healthy Indian adult females.

MATERIALS AND METHODS

This study was carried out at tertiary care medical institute of corporation of metropolitan city and at private hospitals in Mumbai city of Maharashtra, India.

Study Sample

73 apparently healthy female Individuals who had fulfilled inclusion and exclusion criteria and had given the consent for the study were enrolled.

Selection of the subjects

The Pre-test instructions were given. The test was properly explained and demonstrated. Before starting the test procedure a written informed consent was obtained from all 73 voluntary participants fulfilling inclusion and exclusion criteria.

Inclusion criteria

- Normal healthy females
- Age group 18 - 76 years
- Who had given written informed consent

Exclusion criteria

- Individual with chronic illness (chronic renal diseases, chronic liver Diseases etc.)
- Individual on calcium supplementation.
- Individual on hormonal replacement therapy
- Chroic Smokers and alcoholics
- Individual with the regular physical exercise
- Individual on steroid therapy
- Pregnant and Lactating women
- Known case of osteoarthritis/ Rheumatoid arthritis

General and systemic examination: A thorough general examination was done before doing a systemic examination of cardiovascular system ,respiratory system, alimentary system and nervous system.

Equipments used

Harpeden stadiometer - for measuring height
Weighing machine with a sensitive lever
Bone mineral densitometer - calscan

Body – mass index estimation

The height of subject was recorded in meters (m) using Harpeden stadiometer. Height is measured with subject standing erect on flat fleet, looking straight ahead and back in contact with the measuring bar. Body weight of every subject was recorded in 'Kg' with the help of weighing machine with a sensitive machine. Body –mass index was obtained by using simple formula (Quetlet's index).

$$BMI = \text{Weight in Kg} \ / \ \text{Height in m}^2$$

The subjects were classified into four groups according to their BMI: underweight (U), when BMI was less <18 kg/m^2; normal (N), when BMI was between 18 and 24.9 kg/m^2; overweight (OW) with BMI between 25 and 29.9 kg/m^2; and obese, when BMI was more than 30 $kg/m^{2.}$

Measurement of bone mineral density

The DXL Calscan (Demetech AB) was used to determine heel bone mineral density (BMD). Bone mineral density was classified using World Health Organization Diagnostic Criteria For Osteoporosis [9].

STATISTICAL ANALYSIS

Descriptive statistics for parameters given as proportion, mean and standard deviation. Chi square test was used as test of significance.

Ethical considerations

The study was conducted according to the Declaration of Helsinki, the protocol was reviewed and approved by the Institutional Ethics Committee (IEC). Written informed consent was obtained from all the subjects.

RESULTS

The study was carried out on 73 apparently health female individuals at tertiary care medical institute of Municipal Corporation of a metropolitan city and private hospitals in Mumbai. All volunteer participants were between the age group of 18 – 76 years.

Out of total participants 6 female underweight, 28 female were normal, overweight included 27 females and 12 females were obese. Bone mineral density was classified using World Health Organization Diagnostic Criteria for Osteoporosis. As per the criteria, 8 female with normal BMD, 19 female with osteopenia and 22 female with osteoporosis were found. The details of the important variables are mentioned in the table no. 1.

As per table no. 2, there was no statistically significant association between age and bone mineral density.

Table-1: distribution of study subjects according to important variables (n=73)

Sr. No.	Variable	Frequency (%)
1	Age-Groups (In Years)	
	18 – 25	4 (5.5 %)
	26-36	10 (13.7 %)
	37-47	19 (26%)
	48-58	20 (27.4%)
	59-69	16 (21.9%)
	>70	4 (5.5%)
2.	BMI Classification	
	< 18.5	6 (8.2 %)
	18.5-24.99	28 (38.4 %)
	25-29.99	27 (37.0 %)
	>30	12 (16.4 %)
3.	BMD Distribution	
	Normal	8 (11.0%)
	Osteopenia	43 (58.9%)
	Osteoporosis	22 (30.1%)

Table-2: association of age group with BMD

Age Group	BMD			
	Osteopenia		Osteoporosis	
	Present	Absent	Present	Absent
18 – 36	7	6	3	11
36 – 76	37	23	20	39
X^2	0.27		0.33	
P Value	0.30 (Not Significant)		0.28 (Not Significant)	

Table-3: association of BMI with BMD

BMI	BMD			
	Osteopenia		Osteoporosis	
	Present	Absent	Present	Absent
< 18.5	5	2	1	5
18.5 – 24.99	5	23	21	7
> 25	13	25	22	17
X^2	7.71		7.5	
P Value	0.02 (Highly Significant)		0.02 (Highly Significant)	

As per table no. 3, there was statistically significant association between body mass index and bone mineral density. Lower BMI was associated with both higher possibilities of either osteopenia or osteoporosis.

DISCUSSIONS

Osteoporosis is a major disease of concern and thus it is necessary to study the trends of these diseases in community. In the present study age of individuals and BMD showed no statistically significant association.The previous literature of Nguyen *et al.* [10] , Tryniszewski and Mariusz gadzicki [11] ,indicated that advancing age was associated with low BMD.

There are a number of studies on the effect of BMI on BMD. However, as ethnicity may modify the relation between the two [12]. In the present study BMI of individual and BMD showed statistical significance. As per literature available the association between the two showed positive correlations that means as BMI of person increases, BMD also increases. Similar results were reported by Wieslaw Tryniszewski and Mariusz Gadzicki [11]. Chan and Anderson [3] did similar study and their results showed strong stastical dependency between BMI and BMD. Their study also concluded that encouraging physical activity at all ages is a top priority to prevent osteoporosis. Baheiraei *et al.* [13] also reported the consistent finding that lower BMI was associated with lower BMD. Nguyen and Sambrook *et al.* [10] concluded from their study that a physically active lifestyle and stable weight in the later decades of life may retard proximal femur bone loss and thus contribute to reduction of fracture risk. Study

by G. Amarendra Reddy and Bharati Kulkarni *et al*. [14] showed that overweight may be associated with better BMDs at the hip but not at other sites after controlling for the bone area. Kamal A. S. Al-Shoumer and Vasanthy Nair *et al*. [15] showed similar results that BMD of the spine, femur neck, and femur total demonstrated significant positive correlations with body weight and BMI. Results of Wardlaw GM [16] were similar as that of our study. The Studies of National Osteoporosis Foundation also suggested that low BMI should be included in the risk assessment tools for evaluation of osteoporosis and osteoporotic fracture risk [17]. In of the important Indian studies conducted by Kumar et al it was also concluded that BMI is an important determinant of BMD in Indian females. In addition, the effect of increase in BMI on BMD has a ceiling effect, and moderate to morbid obesity might not actually be a preventive factor for osteopenia [12].

As precisely mentioned by LJ Melton [18], preventing osteoporosis, a multifactorial disease, requires not only recognizing its risk factors, but also identifying the potentially modifiable determinants of bone mineral density.

CONCLUSION & RECOMMENDATIONS

The present study concluded that Body Mass Index is an important determinant of Bone Mineral Density in female population. These parameters can be assessed by simple and non-invasive method, requiring less of expertise. Hence they can be promoted for use at community level. Larger and multicentric studies will be of more value. Biochemical markers like lipid profile studies, blood glucose level, and newer biochemical markers like vit. D, PTH, interleukin (IL)-6, leptin adiponectin, TNF –α, gherlin which are postulated to have role in patho - physiology of metabolic diseases associated with obesity, can be incorporated for further studies.

Further studies are required to investigate the effect of other factors like exposure to sunlight, calcium intake, and other habits like smoking, diet, and so forth. More immediately, the role of weight maintenance in the prevention of osteoporosis is an important public health message that needs to be more widely appreciated. It is suggested that educational strategies are needed to increase awareness of factors that contribute to maintaining bone health among females.

REFERENCES

1. Consensus Development Conference V Diagnosis, prophylaxis, and treatment of osteoporosis. Am J Med. 1994;90:646–650
2. Barrett KE, Barman SM, Boitano S, Brooks HL. Hormonal control of calcium and phosphate metabolism & physiology of Bone. Ganong's review of medical physiology. 23rd Edition. New Delhi: Tata McGraw Hill Education Private Limited; 2010. P. 363 – 75.
3. Kai MC, Anderson M, Lau EMC. Exercise interventions: defusing the world's osteoporosis time bomb. Bulletin of the World Health Organization. 2003; 81(11):827-830.
4. Mishra AK. Gajjar K, Patel K. Association between body mass index and bone mineral density among healthy women in India. International Journal of Medical Research & Health Sciences. 2016; 5(4):156-160.
5. Eddy DM, CC JJ, Cummings SR, Dawson-Hughes B, Lindsay R, Melton LJ, Slemenda CW. Osteoporosis: review of the evidence for prevention, diagnosis, and treatment and cost-effectiveness analysis. Status report. Osteoporosis International. 1998;8(SUPPL. 4).
6. Dennison E, Eastell R, Fall CH, Kellingray S, Wood PJ, Cooper C. Determinants of bone loss in elderly men and women: a prospective population-based study. Osteoporosis International. 1999 Oct 20; 10(5):384-91.
7. Rabbi Moses Ben Maimon, Complete Dictionary of Scientific Biography. 2008.
8. Pande KC. Prevalence of low bone mass in healthy Indian population. J Ind Med Assoc. 2002; 100(10):598–600.
9. WHO Scientific Group on the assessment of Osteoporosis at Primary Health Care Centre level. As available from, http://www.who.int/chp/topics/Osteoporosis.pdf (last accessed on 7/11/2017)
10. Nguyen TV, Sambrook PN, Eisman JA. Bone loss, physical activity, and weight change in elderly women: the dubbo osteoporosis epidemiology study. Journal of Bone and Mineral Research. 1998; 13 (9): 1458–1467.
11. Tryniszewski W, Gadzicki M. The behaviour of bone mineral density and bone metabolism index in young and menopausal women with the consideration of Body Mass Index. Med Sci Monit. 2010; 16 (7): CR342-347.
12. Kumar A, Sharma AK, Mittal S, Kumar G. The relationship between body mass index and bone mineral density in premenopausal and postmenopausal north Indian women. Journal of Obstetrics and Gynaecology of India. 2016; 66(1):52-56.
13. Baheiraei A, Pocock NA, Eisman JA, Nguyen ND, Nguyen TV. Bone mineral density, body mass index and cigarette smoking among Iranian women: implications for prevention, BMC Musculoskeletal Disorders. 2005; 6 (34).
14. Reddy GA, Kulkarni B. Bone mass of overweight affluent Indian youth and its sex-specific association with body composition. Archives of Osteoporosis. 2009; 4 (1-2): 31-39.
15. Al-Shoumer KAS, Nair V. Prevalence of low bone mass in postmenopausal Kuwaiti women residents in the largest province of Kuwait. Archives of Osteoporosis. 2012; 7 (1-2) : 147-153

16. Wardlaw GM. Putting body weight and osteoporosis into perspective. The American journal of clinical nutrition. 1996 Mar 1; 63(3): 433S-6S.
17. National Osteoporosis Foundation. Osteoporosis Physician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC, USA: National Osteoporosis Foundation; 1998.
18. Melton LJ. Epidemiology of osteoporosis: predicting who is at risk. Ann N Y Acad Sci. 1990; 592: 295–306.