

A Study on Body Mass Index and Bone Mineral Density among Adult Males

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Abstract:

Background: Body mass index (BMI) is defined as the body mass (weight) divided by the square of the body height, and is universally expressed in units of kg/m². Bone Mineral Density (BMD) test measures the density of minerals present in the bones. Role of obesity as a risk factor for osteoporosis and its related consequences remains unsettled. This study was conducted to analyze the interplay between body mass index and bone mineral density in men, since most of those studies were conducted on women.

Materials and methods: The study was done on 60 healthy males in the age group of 20 years and above. Anthropometric measurement of height (m) and weight (kg) was done. Participants were categorized into three BMI groups according to WHO criterion. BMD of lumbar spine was determined using enCORE-based X-ray bone densitometer (Lunar Prodigy advance, GE Medical Systems, USA) based on DEXA scan. Diagnosis of osteoporosis and osteopenia were done according to WHO T-score criteria. Statistical analysis was done using SPSS software version 21.

Results: The result shows that subjects with higher BMI are having high BMD, decreasing the occurrence of osteoporosis. It was also evident that subjects in the higher age group were more prone of having osteoporosis, reflecting low BMD.

Conclusion: From the results it can be concluded that BMI and BMD showed a positive correlation, whereas, advancing age is associated with low BMD.

Keywords: BMI, BMD, Osteoporosis, Osteopenia.

I. Introduction

The body mass index (BMI) is defined as the body mass (weight) divided by the square of the body height, and is universally expressed in units of kg/m². Based on the value a person can be categorized as underweight, normal weight, overweight, or obese. Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health. Bone Mineral Density (BMD) test measures the density of minerals present in the bones. Measurement of bone mineral density is an essential tool in the evaluation of patients at risk for osteoporosis, a condition in which the bones become less dense and more likely to break¹. WHO used a standardized score, called T-score, which compares BMD to average values for young healthy women to define osteoporosis. T-score of -2.5 and below is categorized as osteoporosis². Role of obesity as a risk factor for osteoporosis and its related consequences remains unsettled. Several studies have reported that body mass index has a positive correlation with BMD, thereby showing a protective role against osteoporosis³⁻⁵. However, there are some studies that contradict this data⁶⁻⁸. This study was conducted to analyze the interplay between body mass index and bone mineral density in men, since most of those studies were conducted on women.

II. Materials And Methods

The study was a cross sectional study conducted in the department of Physiology and Physical Medicine & Rehabilitation, RIMS, Manipur, India. The study was done on 60 healthy males in the age group of 20 years and above. Subjects with history of diseases that might affect bone metabolism or intake of drugs that might influence BMD were excluded from the study. Informed written consent was taken from all the subjects after having explained them the study protocol. Study met the approval from the Institutional Ethics Committee, RIMS, Imphal. Anthropometric measurement of height (m) and weight (kg) was done. Participants were categorized into three BMI groups according to WHO criterion. BMD of lumbar spine was determined using enCORE-based X-ray bone densitometer (Lunar Prodigy advance, GE Medical Systems, USA) based on DEXA scan. Diagnosis of Osteoporosis and Osteopenia were done according to WHO T-score criteria.

1.1 Data analysis

Statistical analysis was done using SPSS software version 21. Mean and Standard deviation were assessed. Fisher's Exact and Pearson's Correlation tests were done.

III. Results

Table 1. Demographic profile of study subjects

	Total	Normal ($\leq 24.9 \text{ Kg/m}^2$)	Overweight ($25\text{--}29.9 \text{ Kg/m}^2$)	Obese ($\geq 30 \text{ Kg/m}^2$)
Age (Years)	38.30 ± 15.81	34.96 ± 17.08	41.15 ± 13.90	46.66 ± 10.91
BMD (gm/cm^2)	1.09 ± 0.15	1.04 ± 0.16	1.14 ± 0.14	1.16 ± 0.07

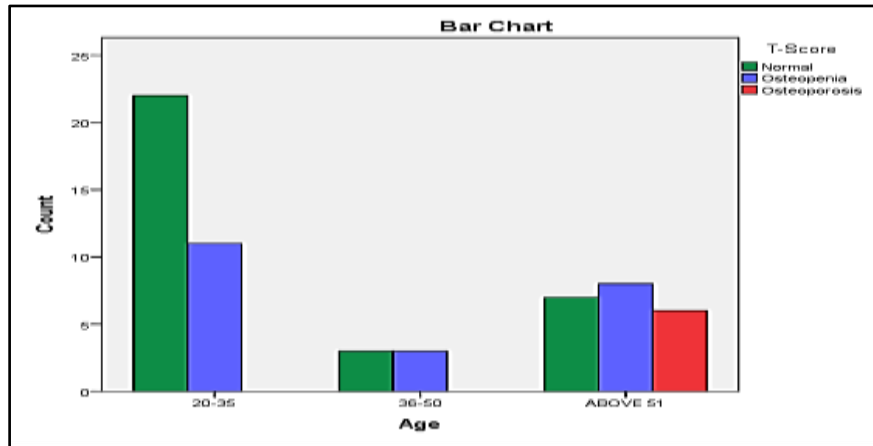


Fig 1. Age with BMD

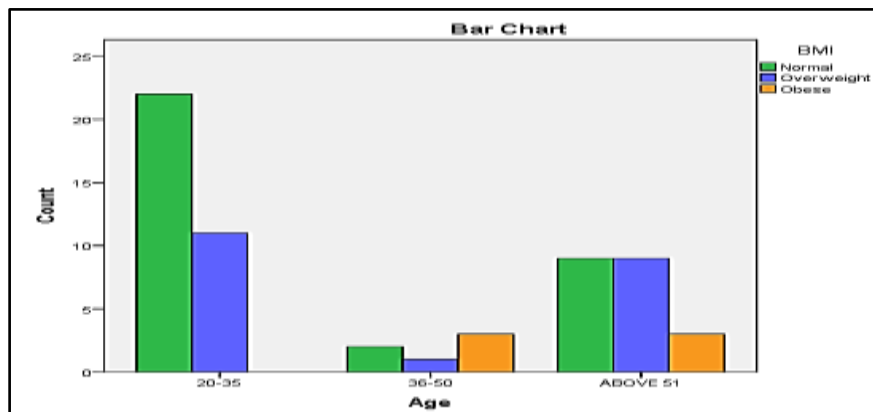


Fig 2. Age with BMI

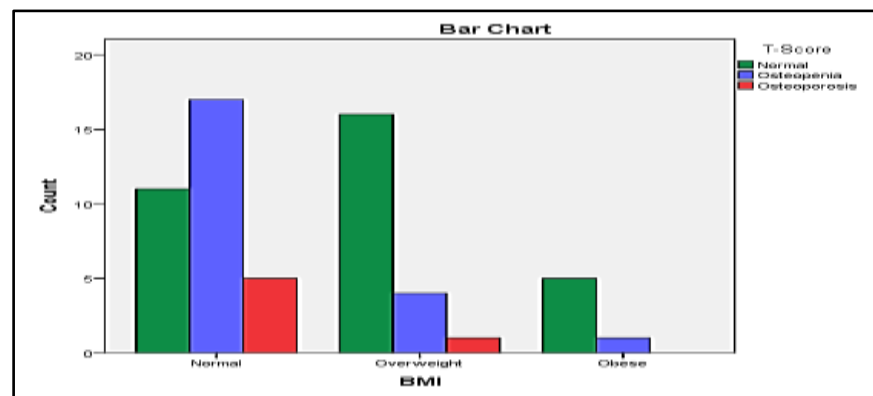


Fig 3. BMI with BMD

Table 2. Pearson's Correlation coefficients

		BMI	BMD
Age	r	0.170	-0.534
	p	0.005**	0.007**
BMI	r		0.424
	p		0.016*

It was obvious that with increasing BMI, there was decrease in the occurrence of osteoporosis. This shows that subjects with higher BMI are having high BMD (Fig 3). There was a statistically significant association between BMI and BMD ($P < .05$). The details are depicted in Table 2. It was also evident that subjects in the higher age group were more prone of having osteoporosis, reflecting low BMD in this age group (Fig 1), and this was statistically significant Table 2.

IV. Discussion

From the results it was evident that BMI have a positive correlation with BMD. Lloyd J et al⁹ also in his study concluded that there was a significant relationship between BMI and BMD supporting our findings. M.R. Salamat et al¹⁰ and A. Baheiraei et al¹¹ also reported this trend of interplay between BMI and BMD.

Some of the explanation that tries to explain this trend of association is:

- Heavier mechanical loading on bones with subsequent bone remodeling to resist this loading.
- Role of several adipokines in bone remodeling through effect on both formation and resorption.
- Increased secretion of insulin and increased plasma levels of leptin.
- Increased estrogen synthesis in adipose tissue.

However, a negative association of obesity with BMD was observed in some studies, contradicting this study^{12,13}. Assumed mechanisms put forth to support their results were, secretion of pro-inflammatory cytokines that stimulate bone resorption, decreased levels of adiponectins and increased parathormone levels. The results also revealed that there was a negative relationship between age and BMD. And there are few studies that documented advancing age was associated with low BMD^{14,15}.

V. Conclusion

From the results it can be concluded that BMI and BMD show a positive correlation, whereas, advancing age is associated with low BMD. So, early assessment of BMD can be used as a preventive measure against osteoporosis. This may help reduce fractures among ageing male population and its associated morbidity and mortality.

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