ORIGINAL ARTICLE

Evaluation of Body Mass Index and its Effect on Bone Mineral Density

FATIMA MEHAK, OMAR ASGHAR, MUHAMMAD ALI HAIDER, *UZMA SATTAR, SANA SAGHEER*
Department of Ophthalmology, Rahbar Medical & Dental College, Punjab Rangers Teaching Hospital, Lahore.
Correspondence to: Dr Fatima Mehak, Email: ziiscent@gamil.com. Phone: 03004911939.

ABSTRACT

Background: Osteoporosis, mainly observed in elderly people especially among females with fragile and weak bones. Over-weight and obesity is perceived as protective factor for osteoporosis. This study explored a relationship of BMI with BMD.
Aim: To check the relationship of Body Mass Index with bone mineral density among adolescents.
Methodology: In this cross sectional study, patients between the ages of 13-18 years were included. BMD was measured by using Dual-energy X-rays Absorptiometry (DEXA). BMI was measured by recording height by measuring tape and weight by adult weighing scale. All the measuring tools were calibrated to the perfection as per standards. All these measurements were entered and analyzed by using SPSS.
Results: This study was conducted on 70 school students, out of these 70 students 10% showed normal BMD and 58.57% have normal BMI. It was observed during the study that participants having normal BMI have equally distributed normal and below normal BMD, while 54% below normal BMIstudents were having 54% normal BMD and 46% Osteoporosis and only 38% obese population were having normal BMD and 62% having osteoporosis.
Conclusion: There is no relationship between BMI and BMD. Not Obesity nor underweight is protective / causing osteoporosis
Key words: Osteoporosis, Bone mineral density, Obesity.

INTRODUCTION

Osteoporosis and obesity are two important major concerns of public health with increasing prevalence.1 Age and female gender increase the risk of developing both obesity and osteoporosis, which affect millions of peoples irrespective of age and gender[2]. Osteoporosis is one of the most common ailment of old age people that results in immobility. Osteoporosis means “porous bone” is a metabolic bone disease that occurs when loses to much bone, makes too little bone or both thus bones become fragile and weak[1]. The normal histological bone structure is honeycomb shape while in osteoporosis spaces in the honeycomb are much wider and larger than the normal structure[1,2,3].

Bone Mineral density test is most widely used test to determine the strength of the bones by using X-ray absorption scan[3,4]. Current osteoporosis management guidelines recommend routine bone mineral density (BMD) screening but unfortunately no guidelines are available regarding osteoporosis screening interval.5-6 BMD tells us about the bone status and the extent of mineralization (deposition of minerals for example calcium and phosphorus) and the condition of cortex (outer layer) of bone.3-5-6 Lower the BMD greater will be the chance of Osteoporosis[3,4,5] and lifetime osteoporotic fractures[6,7,8,9]

Body mass index (BMI) is a measure of amount of body fat in relation to the weight and height of individual.4 The normal Range of BMI is 18.5-24.9, under weight is below 18.5 and obese is above 24.9.3-4-5 There is strong belief that over-weight and obesity are protective against osteoporosis but this belief has been questioned and studies have shown that a high level of fat mass might be a risk of factor for osteoporosis.4-6 Body weight is directly associated with BMD[6,7]. It is shown in one of the study that BMI has been identified as an important risk factor for lower BMD and may lead to greater bone loss in older age[6]. According to another study high body mass can be due to increased physical activity or obesity, and both of the factors will increase BMD[7], but there are increasing evidences that excess weight due to adiposity is detrimental to bone and fracture risk[7,8].

Studies show lower bone formation relative to resorption markers in obese compared with leaner populations in adults18-19 and children.

Faulkner in his study shown that physical activities directly affects bone remodelling through motor stimuli which result in improvements in both. increased mineralization and increased periosteal diameter and cortical thickness thereby decreasing the risk of fracture at all body sites, BMC and BMD increased significantly with age and there was no gender difference in total body. According to the same study male age 14 to 16 have significant greater BMD values while female have by the ages of 12 to 13 years.

It has been a long going and never ending debate on the effect of BMD and BMI. Osteoporosis and osteopenia are the conditions associated with low bone mineral density, and It is the major issue of public health. Most studies that are performed on childhood activity and bone mineral mass have been undertaken in elite sporting populations and are not therefore generalizable to normally active children.

METHODOLOGY

Study design: This cross sectional study was carried out in eye department of Punjab Rangers Teaching hospital, Lahore. The observed study variables were Bone Mineral Density (BMD) and Body Mass Index (BMI) among 15 to 18 years of age in school students. Prior to conduction of study, a verbal consent was obtained from each student and ethical approval from the hospital. Prior to the study every participant was explained about the procedure and

answered all their concerns and doubts about the study. These variables were recorded and reflected in results tables and graphs. Later results were presented as analytical discussion while recommendations were written for future course of action.

Study population/subjects: 70 patients whose age range from 14th to 18th years belonging to 8th, 9th and 10th grades at school and presenting in ophthalmology department with complain of headache having no any refractive error.

Duration: The study data was collected in the month of August 2019

Data collection: Densitometer was used to measure bone mineral density BMD while metric rule and weighing scale were used to determine the BMI.

Calibration: The calibration of densitometer is carried out every 90 days and a machine is acceptable for screening having +/- 0.05 density unit variance from the actual density stated in the national standard step tablet or step wedge calibration film.

Data analysis: Data was entered into SPSS and frequencies were obtained and presented as bar charts.

RESULTS

The table shows that out of 70 sample subjects 59% patients were having normal BMI, 24% are overweight and 17% are under weight. Now 59% and 29% of normal BMI patients were suffering from osteopenia and osteoporosis respectively. Among 24% over weight and obese students only 6% were having normal BMD while 53% were having osteoporosis and 41% osteopenia. Those underweight patients were 58% osteopenia and 34% osteoporosis while only 8% having normal BMD.

Figure No. 1 shows that among 41 patients having normal BMI, students of 8th grade had 39% Osteopenia and 17% were Osteoporosis, while grade 9th and 10th had 15% and 5% Osteopenia and 7% and 5% Osteoporosis. The highest percentage of normal BMD among these 41 patients were found in grade 10th that is 12% while in grade 8th had 5% and grade 9th had 2% of normal BMD.

Figure No. 2 shows that among 12 patients having below normal level BMI, grade 8th had 33% osteopenia and 26% were osteoporosis, while grade 9th and 10th had 17% and 8% osteopenia and 8% and no osteoporosis. The highest percentage of normal BMD among these 12 patients were found in grade 10th that is 8% while in grade 8th had 5% and 9th had no of normal BMD.

Figure No. 3 shows that among 17 patients having above normal level BMI, grade 8th had 17% osteopenia and 29% were osteoporosis, while grade

9th and 10th had 12% and 18% osteopenia and 12% and 06% osteoporosis. The normal level BMD among these 12 patients were found only in grade 10th that is 6% while in grade 8th and 9th had no of normal level BMD.

Table 1: BMD and BMI data of patients.

Items			BMD		
			Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)
BMI n (%)	Normal	41 (59%)	05 (12%)	24 (59%)	12 (29%)
	Under-weight	12 (17%)	01 (08%)	07 (58%)	04 (34%)
	Over-weight	17 (24%)	01 (06%)	07 (41%)	09 (53%)
Total		70 (100%)	07 (10%)	38 (54%)	25 (36%)

Fig. 1: Grade wise Normal BMI relationship to BMD.

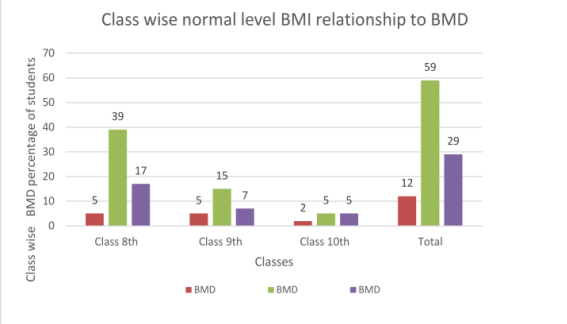


Fig. 2: Grade wise Below Normal BMI relationship to BMD.

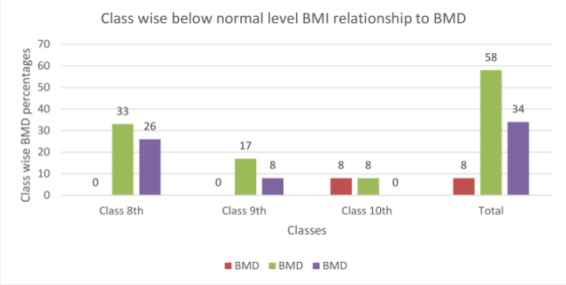
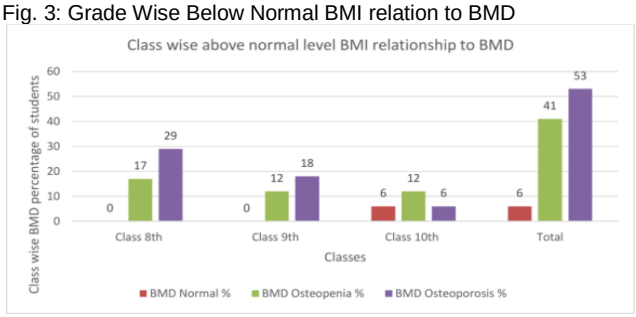


Fig. 3: Grade Wise Below Normal BMI relation to BMD



DISCUSSION

It was believed previously that obesity and osteoporosis have common genetic and environmental factors. Osteoporosis and Obesity both are associated with morbidity and mortality. According to our research obese patients were also osteoporotic as well as patients with normal BMI and these are similar findings in previously conducted studies which suggested that abundance of adipose tissue may have a negative impact on the quality of bone in adults and children and lower bone formation.This study was conducted in reference to a cohort study conducted in Pakistan in 2016 that included

normal border line test values for BMD and BMI as 50 and 30 respectively.17 According to Sudhaa Sharma study both diseases have common precursor that bone marrow mesenchymal stromal cell. As it is mentioned above in the literature review BMD below 54 is considered as Osteoporosis while BMI above 30 and 35 are considered as over-weight and obsess. It was observed during the study that participants having normal BMI have equally distributed normal and below normal BMD, while 54% below normal BMI students were having 54% normal BMD and 46% Osteoporosis and only 38% obese population were having normal BMD and 62% having osteoporosis. The findings are supporting the recent shift that larger the body mass greater are the chances of osteoporosis. The null hypothesis that we tested during this research study was "Obesity protective of Osteoporosis in high school students". This study strongly supported rejected the null hypothesis and support the concept that obesity is either having no positive effect rather it over weight and obese students showed less than 50% BMD value. study conducted in Karachi Pakistan came with the conclusion that increase in body fat is related with weak bones observed in 33% of the study group[18]. If we look into the results of our study it clearly shows that there is no significant relationship of BMI with BMD even age wise or class wise apart from that 17-18 years' have lesser osteopenia and osteoporosis as compared to class 8th and 9th students. By looking at the results, we reject the null hypothesis that BMI is having a relationship with BMD thus there is no relationship of BMI with BMD. According to our research obese students were also osteoporotic as well as students with normal BMI. Obesity didn't prevent from decreased bone mass in our study population. These inconsistent findings reflect and support the inherently complicated nature of this fat mass and bone mass and needs some new approach to accommodate the confounding effects of fat mass on bone.

Limitation: The study has few limitations like sample size was very small, study was conducted in an evening school, gender comparison was not provided and cross sectional time trends not assessed thus we are unable to generalize this study. The resources were limited and security risk were prevailing therefore only one school/academy was observed during the study. Another limitation was the age of study participants (15 to 18-years) and results are applied to obese children of 8, 9 and 10 class. There is a significant difference between the study sample and population therefore the sample cannot be considered as a representative sample of general population.

CONCLUSION

It is observed during the study that BMI had no relationship with BMD. These results are though supporting many studies of past that have similar findings and the only difference that we observed that younger age patients have more osteopenia and osteoporosis as compared to older age patients.

Recommendation: We can used BMI as a measure of body fats that can also be improved by using more advance tests blood leptin levels can be taken to check for the fat content of the individuals.

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