ORIGINAL ARTICLE

Bone Mineral Density and Its Relationship with Physical Activity, Dietary Behavior and Body Mass Index Among Rehabilitation Students

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ABSTRACT

Objective: To find out the relationship of Body Mass Index (BMI), dietary behavior and Physical Activity (PA) with Bone Mineral Density (BMD) in students of rehabilitation sciences.

Study Design: An analytical cross-sectional study.

Place and Duration of Study: It was conducted at Department of Rehabilitation Sciences, Shifa Tameer-e-Millat University, Islamabad, Pakistan within the duration of 4 months, from November 2019 to February 2020.

Materials and Methods: This study included a sample size of 157 participants recruited through non-probability convenient sampling. The students of rehabilitation sciences (males and females) of 18-25 years, who were independent in their activities of daily lives, were included, while those with any current or diagnosed medical condition, major surgery and students having any fracture or trauma were excluded. The physical activity was assessed using International Physical Activity Questionnaire-short form (IPAQ-SF), dietary behavior by Eating Attitude Test (EAT-26) and BMD by calcaneal ultrasound. Data analysis was done on SPSS version 21.

Results: The mean age of the participants was 21.22 ±1.80 years, including 27(17.20%) males and 130(82.80%) females. According to the outcome measures, most of the participants had normal BMI 92(58.6%), normal eating behavior 122(77.7%), moderate activity level 84(53.5%) and were osteopenic 95(60.5%). The spearman's correlation showed that there is a weak negative but significant relationship between BMI and BMD (r = -0.238, p= 0.003), also weak negative relationship between dietary behavior and BMD (r=-0.002, p= 0.978). The physical activity level and BMD levels have weak positive relationship, (r= 0.002, p= 0.984).

Conclusion: The result of this study suggest that the BMI has significant relationship with the bone mineral status, whereas the physical activity and eating attitudes do not contribute directly to bone mineral status.

Key Words: *Bone Mineral Density, Dietary Behaviour, Osteopenia, Osteoporosis, Physical Activity.*

Introduction

In the childhood and at puberty, the bone density and the maximum bone strength and density has already been achieved by the age of 18-20 years when the peak bone mass (PBM) has been maximally accumulated, followed by reduction in bone mass with the passing time.[1]

It was generally believed that osteoporosis was a disease of older adults, but many former studies have pointed towards the relationship of low bone mineral density (BMD) in young age with the failure to achieve ideal peak mineral density (PMD) during childhood and pre-puberty age.[2] In Pakistan the Asian Audit (2009) revealed that about 40 million people were estimated to have osteopenia and number for osteoporosis being predicted to be ten million.[3] Current statistics has shown that Asians and Caucasians getting osteoporosis are at advanced risk.[4]

In relation to bone mineral density, body mass index is the one which is directly related to a person's physical fitness and is commonly associated with BMD in different anatomical regions, due to increased bone marrow adipocity.[5, 6] Second major factor in maintaining bone mass is the dietary behavior, in that regards, calcium and vitamin D play a very vital role along with magnesium, vitamin C & K also contribute to bone health.[7,8,9] The world statistics depict that there is an increased proportion of young adults that rely on unbalanced, low energy and nutritionally-deficient diet that lead to decrease in

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bone mass.[10] Lastly, the lack of physical activity in a person's life may lead to compromise in their physical fitness.[2] The strength of muscles and aerobic capacity are directly proportional to healthier bone mass. As stated by Wolf's Law; loading stress causes a modeling response, increasing bone mass and strengthening of bones.[11] From the above discussions and past literature, it has been depicted that the modifiable factors affecting bone health include body mass composition, physical activity and eating behavior.[1] Due to the prevailing sedentary lifestyle and decrease physical activity in the young adults, the bone mineral density may be affected. There have been numerous studies conducted on the bone health in the old adult population, but limited data is available on young adults. As rehabilitation students must treat the patient physically in future, so they must have good body mass index, balanced diet and physical activity. Therefore, a study was planned with an objective to find out the relationship of body mass index, dietary behaviour, and physical activity with bone mineral density in students of rehabilitation sciences.

Materials and Methods

It was a cross sectional analytical study conducted at Department of Rehabilitation Sciences, Shifa Tameer-e-Millat University Islamabad, Pakistan from November 2019 to February 2020. Rao software calculator was used to the calculate the sample size with confidence interval level 95%, margin of error 5% and while assuming the students of rehabilitation sciences to be 3000 in the twin cities of Pakistan, which came to be 341. While in this study data was collected from 157 participants using nonprobability convenient sampling due to low response rate. The approval was taken from Institutional Review Board and Ethics Committee (IRB & EC) Shifa International Hospital & Shifa Tameer-e-Millat University Islamabad, Pakistan (Ref: IRB#073-563-2019 received on 13th November 2019). Students (males and females) of 18-25 years, who were independent in their activities of daily lives, were included, while students with any current or diagnosed medical condition, major surgery and those having any fracture or trauma were excluded. The data collection was done by manual distribution of self-administered questionnaire in booklet form among the students. The questions were structured in English language. In addition, informed consent was attached with each questionnaire. The participants who were a part of the study had right to withdraw at any time during the study. The participants were informed that their confidentiality would be preserved, and no physical, psychological, and emotional harm is intended.

Demographic information was collected using self-constructed questionnaire which included age, gender, marital status, BMI (height in m^2 and weight in kg). International physical activity questionnaire-short-form was used to record the level of physical activity in students which is a reliable and valid tool.[12,13] Eating Attitude Test-26 questionnaire was used to assess the eating pattern in the undergraduate students.[14] EAT-26 has reliable internal consistency (cronbach's alpha = 0.822–0.922), test–retest reliability (interclass correlation coefficient = 0.817) and convergent validity (r = 0.450–0.750).[14] Sonsot-3000 machine was used to check the BMD at the level of calcaneus. It is used previously in various studies and has been proven to be very reliable.[1,15] T-scores were noted for each participant. T-values had three categories where T> -1.0 was considered normal, between 2.5 to -1.0 was considered osteopenia and T =< -2.5 was osteoporotic.[1,15]

Data was entered and analyzed using SPSS 21. The descriptive analysis was reported as frequency, percentage and mean for age, dietary behavior, physical activity level and BMD. Shapiro-wilk test showed $p<0.05$ representing that data was not normally distributed, therefore spearmen correlation test was used to find the relationship of BMI with BMD, PA and dietary behavior. The level of significance was taken as $P<0.05$

Results

Out of 157 participants, 27(17.20%) were males and 130(82.80%) were females. The mean age of the participants was 21.22 ± 1.80years. Majority of the participants were in the normal category of BMI 92 (58.6%), followed by underweight 33(21%), overweight 26(16.6%) and obese 6(3.8%). According to EAT-26, 122(77.7%) participants showed normal eating behaviour while 35(22.3%) showed abnormal eating pattern. As stated by IPAQ-SF results, 24(15.3%) showed vigorous activity levels, 84(53.5%) showed moderate activity level and 49(31.2%)

showed low activity levels. Whereas, on the BMD scan 56(35.7%) participants were found to have normal bone mineral density, 95(60.5%) were osteopenic and 6(3.8%) were osteoporotic. Mean and Standard Deviation of age, BMI, dietary behaviour, PA, and BMD. (Table I)

BMI showed a significant ($p<0.05$) relationship with BMD, while dietary behaviour and physical activity showed a non-significant ($p<0.05$) relationship with BMD respectively. (Table II)

Table I: Mean and Standard Deviation of Age, Body Mass Index, Dietary Behavior, Physical Activity and Bone Mineral Density

Variables	Mean ± S. D
Age (years)	21.22 ± 1.80
BMI (Kg/m^2)	21.92 ± 3.89
Dietary Behaviour	13.24 ± 9.15
Physical Activity Level (METs)	1661.60 ± 1867.74
BMD Level (g/cm^2)	-1.28 ± 0.75

Table II: Correlation of Body Mass Index, Dietary Behaviour and Physical Activity on Bone Mineral Density

		BMD Level
BMI	r-value	-0.238
	p value	0.003
Dietary Behaviour (EAT-26)	r-value	-0.002
	p value	0.978
Physical Activity (IPAQ-SF)	r- value	+0.002
	p value	0.984

Discussion

Analysis of the study showed that BMI had a negative, weak, and significant relationship with BMD, proving that body mass of an individual is an important predictor of bone mineral which is consistent with previous study of Hee-Sook Lim et al. that concluded body fat and consumption of fats had a negative correlation with bone mineral status.[16]

According to the studies conducted by Hervàs et al. and Ho-Pham et al. showed that lean bone mass had greater effect on BMD than higher BMI and also that lean bone mass was related with greater BMD in adults due to the combined effect of mechanical loading and biochemical actions.[1, 17] The study of Iwaniec and his colleague Turner, also concluded that higher body weight can increase mechanical loading on bone, altering its microarchitecture but it also has the potential to increase the amount of atypical loading on the bone, which in turn can increase the risk of fracture.[18] Hence, the findings of these three studies are in par with the results of this present study, supporting the fact that lower BMI has beneficial effects on bone mineral density of young adults.

There was a negative and insignificant relationship between the eating attitude and BMD inferred that the higher score of the EAT-26 (eating disorder attitude), the lower will be the BMD. Although most of the respondents i.e., 122(77.7%) in this study were classified as normal, asymptomatic, or free of problem, while 35(22.3%) had a risk of developing eating disorders. Work of Bennell et al. indicated that the abnormal dietary behaviours can cause amenorrhea, low BMD, or maximised risk of stress fracture. Thereby, this was in line with the past studies that examined eating attitude disorders with the bone mineral density and concluded that the bad eating behaviour is basically the reason for low BMD and is closely related to an increase in endogenous cortisol production and decrease in BMD.[15]

On the other hand, the results of this study showed that the physical activity had a weak positive relationship with BMD. Kopiczko et al. concluded that physical activity has the most significant effect on bone status especially.[19] This statement is consistent with the study findings proving that physical activity does have impact on bone mineral density. The lack of significant relationship between PA and BMD in the present study might be due to the difference in the level, duration and type of activity performed by the participants and that the sample size was not large. Furthermore, majority of the participants who had moderate level of activity, reported walking being the most common activity of their daily life and that it was not habitual (not performed regularly) and non-continuous (consisted of large rest bouts). Furthermore, such activity did not challenge the body's skeletal system to initiate an adaptive response in the bones to enhance BMD. Evidence suggests that the resistance exercises which produce forces on bone tissue led to its proper development. High-intensity power training has shown to provide significant improvement for the hip, trochanter, and lumbar spine BMD.[19] This has been supported by the

study of Kim et al. which showed no association between moderate intensity PA and BMD in women.[20]

Limitations and Recommendations of Study

In this study, we were unable to reach the estimated sample size due to low response rate so future studies should be conducted with a larger sample size. Further, the objective way of assessing the physical activity of the participants should be considered. The study will help the clinicians to plan programs that can help in primary preventions for bone disorders for the university students. This study recommends that BMI is important for students of rehabilitation sciences, to prevent Osteopenia and Osteoporosis, therefore, students should be guided through lectures/ seminars about its importance in their well-being.

Conclusion

It is concluded that the BMI has significant relationship with the bone mineral status, whereas the physical activity and eating attitudes do not contribute directly to bone mineral status among students of rehabilitation sciences.

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CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATMENT

The data that support the findings of this study are available from the corresponding author upon request.