

COMPARATIVE STUDY OF PERIPHERAL BONE MINERAL DENSITY IN GOVERNMENT AND PRIVATE SCHOOL CHILDREN IN BIKANER DISTRICT RAJASTHAN

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Abstract

Summary -Peripheral bone density measurements are scarce and the factors, which predict bone mineral density at these sites, especially in children, are not clearly known. In this study, age, height, weight and BMI had a significant association on peripheral bone mineral density in healthy Indian school children.

Introduction- Factors that lead to the attainment of peak bone mass at peripheral sites, during period of growth are not clearly known.

Methods- Hundred children are randomly selected 7- to 17-year-old children from govt. and private schools were assessed clinically and a recording of their height and weight was undertaken. Bonemineral density measured by ultrasound bone densitometer. at the calcaneum (BMDca).

Results -bone mineral density is assessed in correlation of following parameters:-When age wise BMD was analysed between both study groups, government school children had lower BMD values in both age groups (7-11 years, 12-17 years) and the difference between BMD in both age groups was statistically highly significant ($p < 0.01$). Considering sex wise distribution of Bone mineral density it was clearly shown that BMD among private school children had higher values among both males and females, and the difference is statistically highly significant ($p < 0.01$) among females. When Bone mineral density levels were compared according to BMI levels, the difference was observed to be not significantly associated with BMI levels ($p > 0.05$) though government school children showed lower BMD levels as compared to private school children.

Conclusion -age, nutrition, height and weight are significantly associated with BMD at peripheral sites.

Keywords: Bone mineral density, Distal forearm, ultrasound bone densitometer, Socioeconomicstatus.

I. Introduction

The foundation for lifetime skeletal health is established during childhood and adolescence. Therefore, understanding the determinants contributing to childhood bone accumulation provides the best means towards early diagnosis and management of osteoporosis¹. One commonly cited notion is that each individual possesses a "Bone Bank," in which early deposits lay the foundation for

skeletal health; later, during aging or in response to metabolic stresses, skeletal remodeling accelerates and withdrawals from the account exceed deposits, thereby compromising skeletal integrity. The natural process of bone remodeling makes youth the best time to "invest" in one's bone health. Although there is controversy regarding the exact timing of peak bone mass, bone size and strength reach a maximum by early adulthood¹⁻³ Studies show that 60–80% of variability in bone mass is due to genetic factors, with

nutrition, lifestyle, physical activity and hormonal factors causing the rest.

Peripheral ultrasound densitometry provides an easy and convenient method of assessing bone mineral density in young subjects; Quantitative ultrasound (QUS) is a relatively recent and noninvasive method of estimating bone mineral status at peripheral skeleton. In addition to bone density, QUS methods provide some structural information, which may be important in determining the fracture risk^{4,6}. However, the role of bone densitometry in clinical practice in children is not clear⁷. Device-specific thresholds have been listed for clinical interpretation based on studies in adults, but they are yet to be applied to pediatric populations⁸. Peripheral bone mineral density (BMD) measurements suffer because of lack of reference data and absence of clearly set predictors of BMD at these sites. While studies looking into the predictors of BMD have mainly focused on lifestyle and anthropometry, the role of biochemical parameters has not been clearly defined.

The aim of the present study was to investigate BMD at calcaneum in 7- to 17-year old subjects and to assess the relationship between age, height, weight and BMD, to assess the awareness about importance of nutrition in different socio-economic groups.

II. Materials and Method-

The study was conducted at Sardar Patel Medical College, and Associated Group of Hospitals, Bikaner, Rajasthan Under this cross-sectional comparative study of 6 month duration, 100 subjects were selected randomly from selected government & private schools of Bikaner district(RAJ.) subjects were selected by simple random sampling technique and their approval was taken prior in form of informed consent form. And divided into group 1(govt.),and group 2(pvt).

Inclusion criteria-

- Age between 7-17 years
- Apparently healthy children

Exclusion criteria-

- Known inborn metabolic disease ex. Celiac disease
- Sick or malnourished children
- Handicapped children

Study tool & Equipments:

1. Pre tested structured questionnaire
2. Height measurement: Stadiometer
3. Weight measurement: digital weighing machine
4. SONOST-2000 Ultrasound Bone densitometer

Methodology:

After obtaining permission from institutional ethical committee and from respective schools, the study was conducted on 100 school children from govt. and private school, selected for 7-17yr age, by simple random sampling. Socio demographic data was collected by interview method of school children. Bone mineral density (BMD) was measured at the calcaneum (BMDca) by ultrasound bone densitometer which included following steps.

- **Subject preparation-** any metal object was removed from the area to be scanned.

Examination technique-

Calcaneum -The subject was asked to place the heel in the foot support and the lower leg rests back against the leg support. Scan time was kept short (15 seconds) and care was taken to ensure that the patient keeps still and does not move as there are no immobilization devices supplied.

Hundred children (50 from LSES and 50 from USES groups) were randomly selected for clinical, laboratory and BMD assessment .The children were from four randomly selected schools: two state-run schools that cater to subjects from LSES and two private schools that enroll students from USES. Socioeconomic stratification was based on the type of school.

DATA COLLECTION & ANALYSIS:

Data thus measured and collected from both groups of school children were entered into excel sheet and analysed with help of appropriate descriptive and analytical statistics and tests of significance. $P < 0.05$ was considered critical level of any statistical test to be significant.

III. Results

Hundred children between 7 and 17 years were analyzed; 50(50%) from govt. school and 50 (50%) from private school. Data was analyzed separately for both the groups because of differences in the socioeconomic status. All the variables were normally

distributed and no log transformation was necessary for the analysis.

Physical and other parameters

The age, physical characteristics and biochemical parameters of the two groups in the cohort is shown

in Table 1. There was no difference in the mean age between the groups. The body mass indexes (BMI) in USES subjects were significantly higher than LSES subjects.

Table 1: age, physical characteristics and biochemical parameters of the two groups in the cohort is shown

Variable	Categories	Private School Children	Govt. School Children
Age (years)	7-11yr	30%	54%
	12-17 yr	70%	46%
BMI (kg/m ²)	Underweight	14%	32%
	Normal	68%	68%
	Overweight	12%	
	Obese	6%	
Father occupation	Professional and skilled	80%	2%
	Semi skilled	18%	38%
	Unskilled	2%	60%

Bone mineral density

The overall significant difference in BMD values in both groups (p<0.05). also government school students show lower bone mineral density than private school children.

Table 2: Comparison of BMD in different schools:-

BMD	GOVERNMENT SCHOOL CHILDREN	PRIVATE SCHOOL CHILDREN	P VALUE
	MEAN ±SD	MEAN ±SD	
	- 0.3988 ± .44681	- 0.603 ± .485219	P = 0.031

Association of BMD with other parameter-

In order to understand the relationship between anthropometric and biochemical parameters and BMD, crude correlations were first calculated (Table 2). Age, gender and significantly positive correlations

Table 3: Association of BMD with other parameter(age, gender)

AGE GROUPS	BMD		P value
	GOVERNMENT SCHOOL MEAN±SD	PRIVATE SCHOOL MEAN±SD	
7-11 YEARS (N _G =27, N _P =15)	- 0.71 ± 0.13	-1.02 ± 0.11	P = 0.0001(highly significant)
12-17 YEARS (N _G =23, N _P =35)	-0.05 ± .40	-0.42 ± 0.47	P = 0.003 (highly significant)
SEX	BMD		P value
	GOVERNMENT SCHOOL MEAN±SD	PRIVATE SCHOOL MEAN±SD	
MALE (N _G =25, N _P =26)	-0.10 ± 0.42	-0.29±0.48	P = 0.14 (not significant)
FEMALE (N _G =25, N _P =24)	-0.73 ± 0.13	-0.94 ± 0.14	P = 0.0001 (highly significant)

2. When Bone mineral density levels were compared according to BMI levels, the difference was observed to be not significantly associated with BMI levels ($p > 0.05$) though government school children showed lower BMD levels as compared to private school children.

Table 4: BMD DISTRIBUTION ACCORDING TO BMI

BMI	BMD		P VALUE
	GOVERNMENT SCHOOL MEAN±SD	PRIVATE SCHOOL MEAN±SD	
UNDERWEIGHT	-0.41 ± 0.42 (n ₁ =16)	- 0.62 ± 0.44 (n ₁ =7)	P = 0.28 (not significant)
NORMAL	-0.47 ± 0.45 (n ₂ =34)	-0.57±0.52 (n ₂ =34)	P = 0.40 (not significant)
OVERWEIGHT	NIL	-0.64±0.39 (n ₃ =6)	-
OBESE	NIL	-0.91±0.21 (n ₄ =3)	-

IV. DISCUSSION

This study provides information on BMD in peripheral sites in healthy Indian children (of Bikaner dist.) and its relationship with age, gender and anthropometry. Comparison of densitometric values across different populations can be discussed under following three headings-

Socioeconomic status-In present study, both school types i.e. upper and lower socioeconomic status had significant difference in BMD values in both groups ($p < 0.05$). Also government school students showed lower bone mineral density than private school children ($0.3988 \pm .44681$ vs $0.603 \pm .485219$). Our study in accordance of Marwaha RK et. al⁹ study conducted in (2005), showed that bone mineral density was significantly ($P < 0.01$) higher in the USES group than in the LSES group. This result was also within the range of other published findings by Marwaha RK et al¹⁰ (2007) in their study of Peripheral bone mineral density and its predictors in healthy school girls from two different socioeconomic groups in Delhi. They Also found that BMDdf and BMDca increased with age and tended to plateau by 16 years and 12 years of age respectively in both the groups. Also Age, height and weight explained approximately 50% of the variability.

2. Age -Our study showed significant difference among both study groups when compared according to age groups and the difference was statistically highly significant ($p < 0.01$). BMD among both groups increased with increasing age our result was similar to the findings of M Z Mughala et al¹¹ (1997) and Sundberg M et al¹² in 1998, they observed significant correlations between QUS and age ($r = 0.34-0.54$), also observed that boys increased all their bone mineral variables with age, whereas girls showed a decreasing trend from age 15 years. Result

of our study was also with in the range of study conducted by, Suárez Cortina L et al¹³ (2011) in which they showed that Age and exercise showed a direct linear relationship with bone mineral density. But in contradictory to our findings, K. Wünsche et al¹⁴ (2000) found that there is no correlation between the ultrasound bone parameter and age.

3 Gender -Our study observed sex wise distribution of Bone mineral density and it is clearly shown that BMD among private school children has higher values among both males and females, and among female students the difference is statistically highly significant ($p < 0.01$). our study in accordance of Hasselstrom H et al¹⁵ study conducted in 2006) Found that there was no difference in calcaneus BMD when comparing boys and girls, whereas the boys had 4.5% (0.013 g/cm^2) higher forearm BMD than the girls ($P < 0.001$). Calcaneal BMD (mean 0.318 g/cm^2) was 11% higher than forearm BMD (mean 0.283 g/cm^2). Similar result were also found in study by Nohara T et al¹⁶ (2009) they found that In children under 16 years old, BMD of the calcaneus is higher in girls than in boys. but contradictorily van Coeverden SCCM et al¹⁷ (2002) in their study doesn't found any difference in increases in BMD in different sex.

4. According to BMI-When Bone mineral density levels were compared according to BMI levels, the difference was observed to be not significantly associated with BMI levels. ($p > 0.05$) in our study, but in study of A M Fehily et al¹⁸ (1992) found that BMD was positively associated with body weight ($P < 0.01$) in both sexes. M Z Mughala et al (1997) in their study assessment of bone status using the contact ultrasound bone analyser found that the mean calcaneal (BUA) increased with height, and weight. In accordance to that the study conducted by Sundberg M et al (1998), found significant positive correlation coefficients between BMD and body size

in both sexes even after adjusting for the effect of age, Shivane VK et al¹⁹ (2015) also found that weight, height, body mass index (BMI), had positive correlations with the values of QUS.

V. CONCLUSION

USES (private school children) subjects in this study had higher mean BMDca than LSES (govt. school children) subjects, which is explained by the significantly higher anthropometric parameters. Adolescence is a period of increasing demand on the skeletal framework. The difference in BMD between USES and LSES becoming significant in the pubertal age groups is consistent with this observation. Difference in BMD between the two socio-economic groups of same ethnic origin further reinforces the effect of nutrition on BMD. The extent and mechanism of this association needs further investigation, since these are not well understood at present. Strengths and limitations of the study As in our study, the most obvious result was lower Bone Mineral Density among government school children when analysed between various categories of age, sex & BMI.

In summary, age, height and weight remain the best predictors of BMD at calcaneum. Nutrition plays a significant role in attaining optimal bone density. Further prospective studies measuring BMD in children, also taking into account pubertal status would be required to validate our observations in this cross sectional study. There is also need for intervention studies evaluating the role of nutrition in improving BMD and peak bone mass in our population.

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