Normal Value of BMD (Bone Mineral Density) in Pakistani Student Nurses and its Relation with age and other factors

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The aim of this study was to evaluate the BMD in younger age group. It was a cross-sectional observational study done in January 2003. 223 subjects were taken (all females) of age group 16-25 years. Heel Ultrasound procedure was done on all these subjects using a "Clinical Bone Sonometer" and their T-score was plotted against age. The results of the study showed that young female nurses gain bone minerals with increasing age in this group.
Key words: BMD, age, osteoporosis, osteopenia

BMD (Bone Mineral Density) is the accepted surrogate for osteoporotic fracture risk. Bone density is a better predictor of fractures than blood pressure is of stroke and cholesterol is of heart attack. BMD is felt to account for 80% of variance in bone strength and resistance to the fracture. Peak adult bone mass is reached in both genders near the age of 30 years, from this point onwards BMD steadily declines. The risk of fracture doubles with each standard deviation (T-score) below peak adult bone mass.

WHO has defined osteoporosis as a bone density below 2.5 Standard Deviations the mean BMD of young healthy adults. Osteopenia or low bone density is defined as BMD reduced between 1.0 to 2.5 Standard Deviation relative to this BMD. Normal bone density is defined as with in 1 Standard Deviation of the mean young adult BMD. Bone density may now be determined by qCT (quantitative Computed Tomography), DEXA (Dual Energy X-ray Absorptiometry) or peripheral ultrasound measurements.

Age	BMD (T-score)
16-18	-0.423
19-21	-0.4
22-25	-0.1

Methodology: It is an observational cross-sectional study of 223 female nurses of age 16-25 years. Sampling of subjects was done using Simple Random Sampling technique with following inclusion criteria:
1. Subject should be a female, student nurse.
2. Age should be between 16-25 years.

Exclusion criteria were:
1. Age <16 or >25 years.
2. Recent H/O prolonged bed rest or immobilization.
3. H/O steroid intake.

Equipment:
1. "Sahara" Clinical Bone Sonometer: It measures the speed of sound (SOS) in meters/sec and Broad Band Ultrasonic Attenuation (BUA in dB in MHz) of an ultrasound beam passed through the heel. The SOS and BUA results are combined linearly to obtain the Quantitative Ultrasound Index (QUI) and to estimate of BMD of heel (g/cmxcm).

2. Weighing Scale.
3. Height Scale.

Procedure:
A sample size of 223 subjects was taken from 2 hospitals.
Mayo Hospital   =147
Sir.Ganga Ram Hospital   =76

Brief history of every subject was taken to fulfill the inclusion criteria. Questionnaire was filled by research team members to exclude any discrepancy in the data. Height and weight was taken with full scrutiny. BMD was measured through "Sahara" Clinical Bone Sonometer from left heel of every subject. The results were collected in the form of T-score for adult Asian Female.

Results:
Out of 223 subjects, 165 subjects (74%) had their BMD in normal range (i.e. T-score >-1.0), while 55 subjects (23.6%) had BMD values in the range of Osteopenia (i.e. T-score -1.0 to -2.5) and only one subject had BMD in osteoporosis range (i.e. T-score <-2.5). Comparing BMD with Age we divided the subjects into 3 groups, and found the follow results. The results show an improving BMD with increasing age, with improvement of T-score between ages of 21 and 25, as compared to slight improvement of 0.023 from the age of 16 to 21 years.
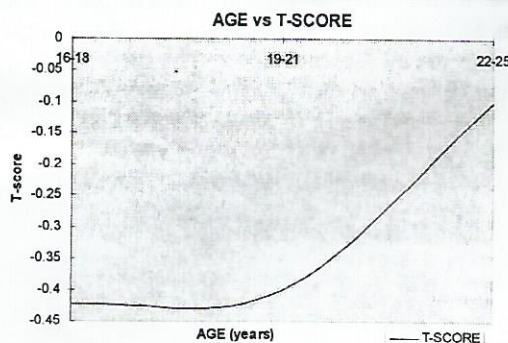
This shows that there is a trend to gather bone minerals with increasing age that is consistent with the normal

findings as the peak bone mass is achieved at the age of 30 by both males and females.

Comparison of BMD with BMI showed that BMD was in Osteopenic range in subjects with BMI less than 18 (Desirable BMI range is18.6-23.8). In subjects with desirable BMI the BMD was found to be in normal range.
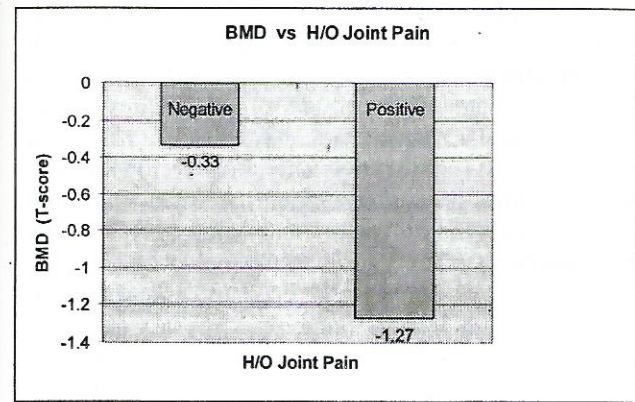
BMI	BMD (T-score)
15.1-18.6	-0.24
18.6-23.8	-0.369
23.9-28.6	-1.41
28.6	-0.4

Comparing the subjects with previous history of any fracture we found that the BMD values in subjects with positive history were less than those with no history of any fracture.

H/O Fracture	T-score	Subjects
Negative	-0.36	216
Positive	-0.77	7

Comparison of groups with H/O Joint Pains with subjects with negative history showed a better BMD value in those who did not have any joint pain history.

H/O Joint Pain	BMD (t-score)	Subjects
Negative	-0.33	205
Positive	-1.27	18

Subjects with history of Backache were compared for their BMD values with history negative subjects and an improvement of 0.72 in the T-score was noted in subjects with no history of Backache.

H/O Backache	BMD (T-score)	Subjects
Negative	-0.35	214
Positive	-1.07	9

Plotting the Family History of Osteoporosis of history positive subjects against the history negative subjects we found an improved BMD (of 0.99) in those with no family history as compared to history positive subjects.

F/H/O Osteoporosis	BMD (T-score)	Subjects
Negative	-0.31	204
Positive	-1.3	19

Discussion:

Bone mineral density is an important indicator of the risk of osteoporosis in later life and this study showed the normal trend of BMD in young Pakistani females of 16-25 years of age. The results depict an increasing BMD in adolescence in females thus emphasizing the proper diet and healthy life style in this age group to maximize the BMD. 23.6% of them had BM in Osteopenic range thus predisposing them to osteoporosis in later life.

A significant correlation has been detected between BMI and BMD, regardless of location and age [1]. According to a Japanese study[4] lean body mass is a significant determinant of BMD in premenopausal women, while body fat mass is a significant determinant in postmenopausal women. Young females with Body mass index in upper normal and lower normal limits had lower BMD than those in more average normal range. Similarly those with a history of previous fractures, joint and back pain and family history of osteoporosis had lower BMD than the normal subjects.

According to Elgan, hormonal age is a stronger BMD predictor than chronological age. Menstrual disturbances might be an indication of a risk for low BMD and might therefore be a reason for measuring BMD among young females. Anburajan's linear regression analysis showed significant ($p < 0.001$) negative correlations between all hip BMD variables at different regions of interest and patient's age.

Other factors which might be related to decreased BMD with increasing age in adult life might be inadequate dietary calcium, repeated and multiple pregnancies, lack of physical exercises etc. The high levels of physical activity observed in women athletes increase aerobic capacity and improve muscle mass but are not sufficient to prevent the loss of bone with aging[10].

Several studies have shown that lifestyle behaviors such as use of oral contraceptives, smoking and alcohol consumption seem to have a negative influence on BMD development among young women and warrant further scrutiny.

Recommendations: Despite the fact that osteoporosis is geriatric it has its roots in childhood and adolescence and young females are especially vulnerable group of society in this respect. The health care professionals are recognizing their responsibility to promote bone health at this stage of life when the peak adult bone mass may be readily affected.

Young adolescent females are more prone to develop nutritional deficiency and eating disorder which can affect the process of achieving peak adult bone mass. In addition to this steroids and anticonvulsants may have profound effect on bone mineralization. Therefore we should stress upon dietary practices and Universal Recommendations of National Osteoporosis Foundation:

- Weight Bearing Exercises
- Calcium   (at least 1200mg/d)
- Vitamin D (400-800IU/D)
- Tobacco Avoidance
- Avoidance of Excess Sodium.

Results suggest that high Ca intake promotes concept of primary prevention of Osteoporosis by increasing bone mass.

References:

1. Ertungealp E, Seyisoglu H, Erel CT, Senturk LM, Gezer A. Changes in bone mineral density with age, menopausal status and body mass index in Turkish women. Climacteric. 1999 Mar;2(1):45-51.

2. Elgan C, Dykes AK, Samsioe G. Bone mineral density and lifestyle among female students aged 16-24 years. Gynecol Endocrinol. 2002 Apr; 16(2): 91-8.

3. Di Monaco M, Di Monaco R, Mautino F, Cavanna A. Femur bone mineral density, age and fracture type in 300 hip-fractured women. Aging Clin Exp Res. 2002 Feb; 14(1): 47-51.

4. Monaco M, Vallero F, Di Monaco R, Mautino F, Cavanna A. Biochemical markers of nutrition and bone mineral density in the elderlyGerontology. 2003 Jan-Feb;49(1):50-4.

5. Ijuin M, Douchi T, Matsuo T, Yamamoto S, Uto H, Nagata Y. Difference in the effects of body composition on bone mineral density between pre- and postmenopausal women. Maturitas. 2002 Dec 10; 43(4): 239-44.

6. Ravn P, Hetland ML, Overgaard K, Christiansen C. Premenopausal and postmenopausal changes in bone mineral density of the proximal femur measured by dual-energy X-ray absorptiometry. J Bone Miner Res. 1994; 9(12): 1975-80.

7. Dretakis EK, Papakitsou E, Kontakis GM, Dretakis K, Psarakis S, Steriopoulos KA. Bone mineral density, body mass index, and hip axis length in postmenopausal cretan women with cervical and trochanteric fractures. Calcif Tissue Int. 1999 Mar; 64(3): 257-8.

8. Anburajan M, Rethinasabapathi C, Korath MP, Ponnappa BG, Kumar KS, Panicker TM, Govindan A, Jagadeesan GN. Age-related proximal femur bone mineral loss in South Indian women: a dual energy X-ray absorptiometry study. J Assoc Physicians India. 2001 Apr; 49:442-5.

9. Nguyen TV, Sambrook PN, Eisman JA. Sources of variability in bone mineral density measurements: implications for study design and analysis of bone loss. J Bone Miner Res. 1997 Jan;12(1):124-35.

10. Ryan AS, Elahi D. Loss of bone mineral density in women athletes during agingCalcif Tissue Int. 1998 Oct;63(4):287

11. Kopaliani M, Kilasonia L. Biochemical markers of bone metabolism and cortical bone mineral density in young healthy females. Georgian Med News. 2005 Mar ;(3): 58