Bone Mineral Density in Healthy South Indian Men

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Abstract

Osteoporosis is characterized by low bone mass and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. It has been difficult to attribute bone loss in aging men to either testosterone or estrogen deficiency. 179 apparently healthy South Indian men in the age group of 40-80 yrs were studied. Body Mass Index (BMI), Bone Mineral Density (BMD) and serum testosterone were estimated. The BMD of L1-L4 vertebrae & left hip were measured using Dual Energy X-ray Absorptiometry (DEXA- Hologic Delphi W, SN 70462, QDR system software version 11.1). Serum total testosterone was estimated by RIA methods for all individuals. There is a gradual decrease in the BMD-HIP / Incidence of osteoporosis with advancing age. But age has no significant correlation with bone mineral density (BMD-spine -r = 0.0098, *P*=0.8965, left hip r = -0.1304, *P* = 0.082). Body mass index (BMI) correlated positively with BMD (BMD-spine -r = 0.318, left hip -r = 0.422, *P*<0.0001). There is no significant association between BMD and serum total testosterone levels (BMD-spine -r = 0.1947, *P* = 0.351, BMD left hip-r = 0.2317, *P* = 0.2651). The increasing incidence of Osteoporosis with advancing age poses a major threat to the elderly population and a low Body Mass Index (BMI) has a significant role in the incidence of Osteoporosis. Serum testosterone has no effect on BMD and the cause of osteoporosis in the elderly remains uncertain.

Key Words: *bone mineral density, body mass index, DEXA, osteoporosis, men, serum testosterone*

Osteoporosis is an asymptomatic, systemic bone disease characterized by low bone mass and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture.[1] Few studies have even reported that the mortality & morbidity among men suffering from osteoporosis is higher than women.[2,3] The most common complications of osteoporosis are vertebral and hip fractures.[4] DEXA is used as a diagnostic test to assess the risk factor (low bone mass). Few studies estimated that the rate of bone loss in men is greater in trabecular bone than in cortical bone and can occur at a rate of 1% per year in older men.[5,6] Risk factors consistently associated with bone loss in elders include female sex, thinness, cigarette smoking and weight loss, while weight gain appears to protect against bone loss for both men and women. Factors predisposing to vertebral fracture in men are less well defined compared with women. The association between endogenous sex steroids and bone mineral density (BMD), especially the influence of testosterone on bone mineral density has remained controversial. Studies have either demonstrated no association[7,8] or a weak one.[9] Reports of young men with normal serum testosterone but low peak bone mass, incomplete epiphyseal closure and tall stature are available.[10]

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The present study was undertaken to estimate the bone mineral density of South Indian men of different age groups and to observe the incidence of osteoporosis in them. And association between serum total testosterone and bone mineral density is also studied.

Methods

Two hundred and twenty adult men in the age group of 40-80 years, who consented to participate in the study, were enrolled from the general population. Informed consent was taken from the subjects. The study was conducted in the Department of Endocrinology, M S Ramaiah Medical College and Hospital, Bangalore, Karnataka, India. Subjects with history of any fractures, significant illness, smoking, alcoholism, hyperthyroidism, diabetes mellitus, hypertension, long standing steroid therapy/drug therapy that could affect bone mineral density were excluded from the study. Study was approved by the Institutional Ethics Committee.

One hundred and seventy-nine men (out of 220) fulfilled the inclusion and exclusion criteria. Weight and height were measured with the subjects dressed in light indoor clothes without shoes. The body mass index was calculated using Quetlet's Index (wt in kg/Ht in cms^2). Bone mineral density (BMD) of lumbar vertebrae (L2, L3, L4), the neck, trochanter and ward's triangle of the left femur were measured using Dual Energy X-ray absorptiometry (DEXA-Hologic Delphi W, SN 70462, QDR system software version 11.1). The reproducibility of repeated measurements of the phantom lumbar spine and left hip has been good in our preliminary studies. About 2-2.5 ml of blood was collected for Serum Testosterone estimation. The Bone health was classified as per the European Foundation for osteoporosis and bone disease, the National Osteoporosis Foundation of the

United States and the World Health Organization (WHO 1994).

Statistical analysis[11]: Two-tailed independent Student's *t*-test, Pearson's correlation and regression analysis has been performed to find the significance of BMD correlation with the variables-age, BMI and serum testosterone levels. The statistical software namely SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate tables.

Results

A DEXA (Dual electron X-ray absorptiometry) scan was done for 179 subjects. Bone mineral density (BMD) of Spine (lumbar vertebrae-L2, L3, L4) and hip (neck, trochanter and ward's triangle of the left femur) were measured using DEXA. BMD was compared with weight, height, BMI and serum testosterone levels. There is a gradual decrease in the BMD-HIP with advancing age. BMD-SP does not change in this fashion (Table 1). BMD values in the healthy BMI group (≥18 and <23) are osteopenic. BMD values in the other BMI groups are in the normal ranges (Table 2). There is a gradual decrease in the total serum testosterone levels with advancing age (Table 3). BMI has a significant positive correlation with both BMD-SPINE and BMD-HIP (P<0.0001 in both). Age and serum testosterone levels did not show significant correlation (Table 4). Regression analysis to assess the influence of the dependent variables-age and BMI on BMD showed that BMI is a better predictor of BMD (Table 5).

Table 1. Variation of BMD in different age groups

Age (Years)	BMD-SP Mean ± SD	BMD-HIP Mean ± SD
41-50	0.9883 ± 0.1128	0.9803 ± 0.1233
51-60	0.9389 ± 0.1246	0.9749 ± 0.1767
61-70	0.9601 ± 0.1496	0.9394 ± 0.1335
71-80	0.9720 ± 0.1799	0.9165 ± 0.1296

Table 2. Comparison of BMD and BMI

BMI	BMI Mean ± SD	BMD-SPINE Mean ± SD	BMD-H Mean ± SD
18≤ BMI <23 (Healthy BMI)	20.900 ± 1.409	0.920 ± 0.139	0.889 ± 0.126
23≤ BMI <25 (Overweight)	23.990 ± 0.612	0.963 ± 0.137	0.929 ± 0.101
25≤ BMI <30 (Type 1 obesity)	26.930 ± 1.212	0.995 ± 0.150	1.000 ± 0.164
BMI >30 (Type 2 obesity)	32.750 ± 1.843	1.002 ± 0.149	1.045 ± 0.148

Table 3. Serum total testosterone in different age groups

Age (decades)	Serum Total Testosterone (ng/dl)
41-50	3.92 ± 0.53
51-60	3.67 ± 0.81
61-70	3.06 ± 1.44
71-80	2.74 ± 0.51

Table 4. Correlation of independent variables with BMD

Independent Variables	BMD-SPINE		BMD-HIP	
	r value	*P* value	r value	*P* value
AGE	0.009793	0.8965	-0.1304	0.082
BMI	0.2944	<0.0001	0.4199	<0.0001
Serum total testosterone	0.1947	0.351	0.2317	0.2651

Table 5. Regression analysis to assess the influence of age and BMI in BMD

Variables	BMD-SPINE	BMD-HIP
	Beta	Beta
Age	0.035	-0.062
BMI	0.017	0.109

Discussion

The present study has tried to observe the normal BMD and prevalence of osteoporosis in south Indian men. Optimization of bone health is a process that occurs throughout the lifespan in both males and females. Predictors of low bone mass include female gender, increased age, estrogen deficiency, hypogonadism, white race, low weight and body mass index (BMI), family history of osteoporosis, smoking, alcohol, and history of prior fracture. There is an increased fracture risk with decrease in bone mineral density (BMD) depending upon the site of measurement and the techniques used.

The BMD of hip decreased with advancing age while the BMD of vertebrae did not significantly correlate with age. As trabecular bone is more sensitive than the cortical bone, to the known and unknown physiological determinants of BMD, we could hypothesize that the absence of this correlation could be because of the influence of these determinants. Lack of prospective studies, makes it uncertain when bone loss due to aging begins. But cross sectional studies report that they start in both sexes in the 30 s in comparison to the other functions that are lost with advancing age.

There is a significant positive correlation between BMD and BMI. As also observed in the regression analysis, BMI is a better predictor of BMD than age.

Men with low BMI or weight tend to have less BMD leading to recurrent fractures.[12] In our study, subjects in all the BMI categories had healthy mean BMD values except the normal BMI category (≥18 and <23 kg/m^2) where both the skeletal sites (L1 – L4 vertebrae and left hip) were found to be osteopenic. It is not clear, whether the BMD after a particular age is largely decided on BMI. Excessive weight is thought to increase the axial pressure loading on the skeleton, which is considered to be an important reason for their increased BMD, besides nutritional and hormonal factors. Weight-bearing activity during adolescence is a positive predictor of peak bone mass in men.[13]. However, with increasing obesity, the sedentary lifestyle probably led by these individuals seems to have a negative impact on the BMD.[5]

There is a gradual decrease in the serum total testosterone in all the individuals with advancing age. But, there is no significant positive correlation between the serum total testosterone and BMD. These results are similar to those of earlier studies.[7,8] A large number of studies have demonstrated low estradiol level associated with low BMD, incomplete epiphyseal closure and a normal testosterone level[10] in men.[8,14] This could explain the role of estradiol in the normal bone mass. Hence, it could be concluded that the testosterone is not associated with bone mineral density but is responsible for the formation of larger bones in men compared to women. Aging is therefore a vital factor in deterioration of BMD, rather than the decreasing in total testosterone with advancing age.

Conclusions

Osteoporosis is a common among elderly men, the cause of which is still uncertain. A positive correlation does exist between BMI and bone density. In an effort to increase the quality of life in the elderly, the focus should be on the early diagnosis and prevention of osteoporosis in the younger age groups.

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