Original Article

Bone Mineral Density Measured by Ultrasound among Resident Doctors of Multan and their Correlation with Common Risk Factors

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Abstract

Objective: To determine the bone mineral density (BMD) among resident doctors of Multan and correlate them with common risk factors.

Study Design: Cross sectional study.

Place and duration of study: The study was conducted at Nishtar Hospital Multan from May 2012 to July 2012.

Methodology: All the resident doctors working at Nishtar Hospital Multan were included in our study. One hundred and fifty doctors were enrolled on basis of convenient sampling, ultrasound of right calcaneal bone was performed using Osteosys machine, factors leading to reduced bone mineral density were recorded in Proforma and analyzed using SPSS 10.

Results: Only 29 doctors out of 150 selected cases had normal BMD, 107 doctors, were osteopaenic and 14 doctors were osteoporotic. BMD had significant positive correlation with weight, height, Body Mass Index (BMI), physical activity, diet and calcium phosphorus ratio.

Conclusion: Young healthy resident doctors had significantly lower bone mineral density. We identified positive correlation with lower BMI, reduced height, poor bioavailability of dietary calcium, inadequate physical activity and Vitamin D deficiency.

Key Words: Bone mineral density, Environmental factors, Osteopaenia.

Introduction

Osteopenia and osteoporosis were defined as per recommendations of the international society for clinical densitometry.[1] Due to hectic and erratic work schedules resident doctors are more likely to have poor sun exposure and unhealthy dietary habits. They are also likely to have inadequate physical activity owing to their sedentary life style.

These factors may affect their vitamin D status and BMD. Hence we conducted a study to determine the BMD and effects of anthropometric parameters, sunlight exposure, physical activity, dietary factors including protein, calcium and phosphorus intake, and vita-

min D status on BMD of resident doctors at a tertiary care teaching hospital.

BMD is the measurements of density of minerals including calcium in bones, two methods "Quantitative ultrasound (QUS) and radiographic assessment", are considered standard methods. QUS is a high frequency sound wave(velocity as m/s) absorption by bone, generally referred to as Broad band ultrasound attenuation (BUA). Ultrasound velocity measured by QUS correlates with some mechanical properties of cortical bone as well as bone density. The advantages of QUS include its lack of radiation, portability and ease of operation, cost affectivity. Ultrasound measurement of calcaneous, phalanges & tibia provides an accurate indication of osteoporotic fracture risk. QUS has been proposed as a possible alternative or adjunct to x-ray based methods for assessing osteoporosis and fracture risk.[2]

Methodology

This prospective cross sectional study was carried out between May 2012 to July 2012 after permission of institutional ethical committee. The research participants were enrolled after obtaining a written informed consent by convenient sampling.

Inclusion criteria were all resident doctors working at Nishtar Hospital Multan. Pregnant and lactating women, and those who were on calcium and vitamin D supplements for the last three months and known patients of bone mineral disorders were excluded from the study. Dietary intake of calcium was evaluated. Participation in various physical activities since the time of admission in the medical college was recorded. Bone mineral density was measured by ultrasound of Rt calcaneum (Osteosys machine) and expressed as T scores and Z scoring using Caucasian normative data, just like Left calcaneal BUA was measured with the contact ultrasound Bone Analyzer (CUBA) Clinical system, Mccune Ultrasonics Ltd. (Winchester, UK).

Statistical analysis was done using SPSS version 10. Continuous variables were expressed as mean ± SD. Correlation between BMD and various factors were calculated by Pearson's correlation coefficient. Comparison of study population's BMD to that of Caucasian was done by using independent "t" test ($P<0.05$ was consisted to be statistically significant).

BMD tests are performed to determine whether a patient has osteoporosis or osteopaenia. According to WHO criteria patient's measured BMD was subtracted from a BMD reference range of women in their thirties (YN = Young Normal). This figure is then divided by the standard deviation to calculate T score as a criteria for BMD status.

Results

One hundred and fifty (150) resident doctors were enrolled in the study. The base line characteristics of the study population are shown in Table I.

Table I. Base line Characteristics of doctors to be studied.

Characteristics	Female (n = 40) Mean ± SD
Age (yrs)	26.33 ± 1.58
Height (Cm)	158.34 ± 4.85
Weight (Kg)	54.69 ± 8.75
BMI (Kg/m^2	21.59 ± 3.41
Sun light exposure (min/wk)	42.99 ± 60
Physical activity (min/wk)	125.34 ± 65.28
Haemoglobin (g/dl)	12.82 ± 1.69
25(OH)D(ng / ml)	10.94 ± 4.54

When compared to Caucasian normative database only 29 doctors out of 150 selected cases had normal BMD, 107 were osteopaenic and 14 osteoporotic. (Table II)

Calcaneal bone was checked on ultrasound to see effects of osteoporosis (Distribution of BMD) data ob-

tained on (Z scores) was comparable to data obtained with (T-Score).

Table II. Prevalence of osteopaenia and osteoporosis at any site is expressed as Z Scores.

Characteristics	Normal	Osteopenia	Osteoporosis
Females (n=150)	29 (19.33%)	107 (71.33%)	14 (9.33%)

Bone mineral density of study population is correlated with various factors separately in females. Weight and BMI had significant positive correlation with BMD. Height and age had not significant positive correlation with BMD as shown by Pearson's correlation coefficient.

Sunlight exposure showed a decreasing trend over the years after entry into medical profession. Current sunlight exposure/ week were lower in girls and it had significant positive correlation with Serum 25(OH)D and with BMD.

Physical activity showed decreasing trend over the years after entry into medical profession and this resulted in decreased BMD. In our study and as shown in table 1, mean daily calcium intake of study population was adequate in females. Dietary calcium had no significant correlation with BMD but there was positive correlation of calcium to phosphorus ratio with BMD. Presence of family history of osteoporosis had significant correlation with BMD.

Mean serum calcium was normal while mean serum 25 (OH) D was low in females.

Vitamin D insufficiency was found in (97%) of subjects as serum 25 hydroxyvitaminD (25(OH)D) concentration less than 12 nanogram per ml is associated with Vitamin D deficiency while level between 12-20 ng/ml are inadequate for bone and over all health in healthy individuals while levels between 20-50 ng/ml are generally considered adequate for bone and overall health in healthy individuals.

Discussion

The risk of osteoporosis and hence osteoporotic fracture is related to peak bone mass (PBM) achieved,[3] the precise age at which PBM is achieved is still controversial. Two recent Indian studies report PBM to be achieved at an average age of 26 – 30 years. [4, 5] Genetic factors account for up to 85% of the variation in bone mass, while environmental factors such as calcium and vitamin D Deficiency, poor physical activity and poor sunlight exposure account for the rest.[6] Most of the patients who sustain hip fracture have associated underlying osteoporosis by calcaneal ultrasound, which if not treated can result in future fragility fractures.[7] Bone adiposity accounted for less than 11% of the differences between the peripheral and central DEXa measurements and QUS.[8] several factors present realization of PBM.

Higher protein intake does not have an adverse effect on bone in premenopausal women. Cross sectional analyses suggest that low vegetable protein intake is associated with lower BMD.[9]

In our study the Bone mineral density was lower than that of Caucasians 15.2 – 19.8%, with significant higher prevalence of osteopenia and osteoporosis. This value is even higher than a study from India (50% Osteopenia in healthy Indians).[10]

In another study, Assessment of BMD in the Pakistani population by comparing with a reference Caucasian population showed similar results but may have limited validity due to difference in genetic factors and skeletal size.[11]

A recent meta-analysis has shown inconsistent association between vitamin D status and BMD except in old age. [12] Low availability of calcium from diet and lesser physical activity of our resident doctors might have contributed to low BMD in them. However, it is difficult to

explain high prevalence of low BMD on the basis of its known determinants. Moreover nutritional status, sunlight exposure and physical activity of the study population during childhood and adolescence that may significantly affect BMD, were not assessed in this study.

Low BMD in Pakistanis may get translated into increased risk of fractures in old age because of higher prevalence of osteoporotic fractures in Pakistanis than Caucasians. Moreover it has been suggested that osteoporotic fractures occur 10-20 years earlier in Asians (Peak age 50-60 years) than Caucasians (70-80 years).[13]

The bone mass is determined predominantly by genetic factors , however no significant correlation was found in our study between family history of osteoporosis and BMD. It is probably due to small number of subjects having positive proven family history of fractures and lack of screening of family members. Hence, low prevalence of family history of osteoporosis or fractures may not rule out genetic contribution. Body weight and BMI had highly significant positive correlation. Throughout much of the developed and developing world, obesity and osteoporosis are important public health concerns. In a recent survey, >50% of U.S adults are overweight or obese.[14]

The association of obesity has not been a study factor and osteoporosis has been studied in another recent review[15] and in a meta-analysis.[16] Although details remain unclear, the general consensus is that obesity seems to moderate the effects of osteoporosis by increasing BMD.[17] Studies comparing Dexa derived percent body fat rates of obesity to BMI have, to date, focused mainly on women.[18]

We identified reduced physical activity in our doctors. results confirmed the beneficial role of long term and intensive physical activity on BMD. Other Studies have shown that dancers have lower risk of BMD reduction as compared to the general population.

Duration of sunlight exposure is positively correlated with vitamin D status. We assume that subjects with reduced vitamin D may be due to long indoor working hours during residency. In our study, dietary calcium intake had no significant influence on BMD.

Limitations of the study: Resident doctors may not be representative of the general population. They may have some unknown risk factors that are unique to them. Other limitations of the study included younger population that might have not reached peak BMD and the small sample size.

Further studies are required to elucidate the possible unknown determinants of BMD that might have led to high prevalence of low BMD in resident doctors.

Conclusion

Young healthy resident doctors in a tertiary referral centre in NHM had significantly lower BMD. Besides genetic factors, lower Body weight, lower height; lower BMI, decreased bioavailability of calcium from diet, inadequate physical activity contributed to lower BMB.

Recommendations: It is necessary to draw attention of our resident doctors towards ill effects of their life style on their BMD and that they should have recommended dietary allowances of vitamin D (600 iu) or 15 microgram per day. Best food sources for vitamin D are flesh of fatty fish and fish liver oil, small amount of vitamin D are found in beef liver, cheese and egg yolk. Some foods are also fortified with vitamin D like milk, orange juice, yogurt, margarine. Sunlight providing Ultraviolet radiation as wavelength of 290-320 nano meters penetrates uncovered skin and converts cutaneous 7 dehydrocholesterol to previtamin D_3 and approximately 5-30 minutes of sun exposure between 10:00 A.M.to 3:00 P.M. at least twice a week to face, arms, legs or back without sunscreen usually leads to sufficient vitamin D syn-

thesis and that the moderate use of commercial tanning beds that emit 2-6% ultraviolet radiation is also effective.[19, 20]

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