Normal BMD values for Indian females aged 20–80 years

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ABSTRACT

Background: Dual-energy X-ray absorptiometry is presently considered the gold standard for measuring bone mineral density (BMD). The International Osteoporosis Foundation and World Health Organization have recommended National Health and Nutrition Examination Survey III database values for women aged 20–29 years to be followed as reference BMD values worldwide. However, the BMD may differ for different populations.

Objective: The objective of the present study was to plot BMD values in the hip (neck) and lumbar spine (L1–L4 AP view) in Indian women aged 20–80 years. Also, BMD values in the 20–60-year-old females were compared with reference American/European population.

Result: It was found that the BMD of Indian females was 1.5–2 standard deviation (SD) s lower than that of the reference Western population in all the comparative age groups.

Conclusion: It is reasonable to conclude that BMD values of the hip and spine among comparative Indian and Western female age groups show significant differences. Hence, different normals should be followed for each population.

Key Words: Bone mineral density, dual-energy X-ray absorptiometry, BMD norms

INTRODUCTION

Osteoporosis has now become a major worldwide health problem. In 2005, in the USA, over two million fractures were predicted, costing 17 billion dollars. Nonvertebral fractures represented 73% of the total fractures and accounted for 94% of the total costs. By 2025, the annual fractures and costs are projected to increase by 50% and 25 billion dollars, respectively.[1]

As prevalence and awareness about osteoporosis increases and treatments of proven efficacy become available, the demand for the management of patients with the disease will also rise. Such demand will in turn require widespread development of facilities for the diagnosis and assessment of osteoporosis. Measurement of bone mineral density (BMD) is the central component of any provision that arises from the internationally agreed definition of osteoporosis. Osteoporosis is defined as a skeletal disorder characterized by reduced bone strength, predisposing a person to an increased risk of fracture. Bone strength primarily reflects the integration of bone density and bone quality.[2]

The diagnosis of osteoporosis thus centers around the assessment of bone mass and bone quality. There are no satisfactory clinical means to assess bone quality. Diagnosis of osteoporosis at present depends on the measurement of skeletal mass.[3]

Of particular importance is the type of normal reference range used, which should be taken from appropriate populations. Small differences between ranges have a large effect on the number of individuals with BMD below a diagnostic threshold. The current recommendation of the International Osteoporosis Foundation and the World Health Organization is to use the National Health and Nutrition Examination Survey (NHANES) III reference database in women aged 20–29 years as the reference range.[4]

The clinical consequence of osteoporosis is the fractures that arise. The accuracy of a technique in
this sense is not how closely it measures the BMD but its sensitivity and specificity to predict fractures. Many well-controlled prospective studies with dual-energy X-ray absorptiometry (DXA), particularly in the elderly women, indicate that the risk of fracture almost doubles for each SD reduction in BMD. Heaney Robert P stated that a 30% reduction in bone mass, common in osteoporosis, will decrease strength by 50%. Epidemiological data indicate that the fracture risk increases two- to three-fold for every drop of 1 SD in bone mass at any given site.

In general, site-specific measurements show higher gradients of risk for their respective sites. For example, measurements at the hip predict hip fracture with greater power than do measurements at the lumbar spine or forearm.

Bone health and fracture risk are also dependent on many other factors, of which daily intake of calcium and vitamin D is very important. Nearly all Asian countries fall far below the FAO/WHO recommendations for Calcium intake of between 1,000 and 1,300 mg/day. The median dietary calcium intake for the adult Asian population is approximately 450 mg/day, with a potential detrimental impact on bone health in the region.

MATERIALS AND METHODS

Baseline DXA scans of 300 women taken on a Hologic 4500 W (Hologic US) bone densitometer in the age group 20–80 years were analyzed. Fifty women from each decade were included in the study. DXA of the lumbar spine (L1–L4 AP view) and left hip (neck) were considered for each woman.

Women who had been diagnosed as having osteoporosis/those who had any known existing secondary cause of osteoporosis/those who had been on any bone-active medication within the past 6 months were not included in the study. Women taking calcium or a calcium and vitamin D combination were included in the study. All women belonged to the middle socioeconomic strata and their body mass index ranged between 20 and 30.

The mean and standard deviation were calculated for the BMD in each group [Tables 1 and 2]. The mean BMD was plotted against age for each group of women. A standard normal curve was then developed with 1 sigma range [Graphs 1 and 2].

The BMD values for ages 20–60 years were compared with the reference values for the European and US populations and were plotted on a graph.

ANALYSIS AND DISCUSSION

Our study indicates that the mean spinal BMD (L1–L4 AP view) in Indian females in the 20–60 years age group is about 30% less than that in the reference American/European populations [Table 3]. This means that the mean Indian BMD is about 2 SD lower than the Western BMD [Graph 3]. Similar results were seen in a study conducted at the Sanjay Gandhi Post Graduate Institute of Medical Science, Lucknow, where Nangia et al. found that the mean spinal BMD in Indian females was 2 SD (30.52%) lower as compared with the reference American population.

Our study also showed that the mean hip (neck) BMD in Indian females aged 20–60 years was about 27%
less than that in the reference American/European population [Table 4].

This means that the mean hip neck BMD is about 1.5 SD lower than the Western BMD [Graph 4]. Arya et al., from the Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, found that the mean hip (neck) BMD in a similar group of Indian females was about 2 SD (27.01%) lower than that in the reference American population.\[^9\]

Bone density measurement by DXA is widely used for the evaluation of osteoporosis because there is a strong relationship between bone mass and fracture risk. Prospective studies in postmenopausal women have shown that for each decrease of 1 SD in bone density, there is a two- to three-fold increase in the fracture risk.\[^10\]

DXA is widely regarded as the diagnostic method of choice. In this test, the differential absorption of two X-ray frequencies by soft tissue and bone enables the calculation of bone mass.

It is a well known fact that the normal reference ranges for BMD for different age groups from different population ranges vary in accordance with the genetic make up, the environmental set up, personal habits, life style, etc. of that particular geographical area/race/sex. Presently, the NHANES III database values are being followed as the standard reference curves for classifying bone medical density worldwide (as approved by the IOF and WHO). There is scant data available regarding BMD in the Indian population. In a study among Indian women aged 30–60 years from the low-income groups,
BMD at all skeletal sites was much lower than the values reported from developed countries, with a high prevalence of osteopenia (52%) and osteoporosis (29%), which was thought to be due to inadequate nutrition.[11] Studies carried out across different countries in South and South East Asia showed, with few exceptions, the widespread prevalence of hypovitaminosis D (vitamin D deficiency/insufficiency) in both sexes and in all age groups of the population.[12]

The difference in BMD values of Indian and Western females in our study is significant, with a significant $P$-value ($<0.01$) in all age groups. The probable contributory factors are differences in the genetic make up, dietary habits and life style trends. Age and medical profile of the two comparative populations was similar.

Correlation of BMD values with fracture risk in both spine and hip is yet to be performed. Before that, standard reference BMD curves need to be formulated for the normal Indian population.

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Source of Support: Nil, Conflict of Interest: None declared.