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Original article

Prevalence of osteoporosis and osteopenia in an apparently healthy Indian population - a cross-sectional retrospective study

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ABSTRACT

Objectives: An understanding of bone mineral density (BMD) pattern in a population is crucial for prevention and diagnosis of osteoporosis and management of its complications in later life. This study aimed to screen the bone health status and factors associated with osteoporosis in an apparently healthy Indian population.

Methods: A retrospective review of medical records was done in a tertiary-care hospital for the subjects who had undergone preventive health-check-ups that included BMD measurements at femur-neck, total-femur, and lumbar-spine.

Results: We evaluated 524 subjects (age, 50.0 ± 12.4 years) including 41.2% female and 58.8% male subjects. Osteoporosis was present in 6.9% subjects (female, 11.1%; male, 4.2%) and osteopenia in 34% subjects (female, 40.3%; male, 29.9%). Absolute BMD was higher in male subjects ($P < 0.001$) compared to female subjects at all bone sites. Prevalence of osteoporosis increased with age in female subjects, but not in male subjects. Osteoporosis rates in the age-groups of 30–39, 40–49, 50–59, 60–69, and ≥70 years were 3%, 3.4%, 14.3%, 18.6%, and 36.4%, respectively in female subjects while prevalence in male subjects was 0%, 4%, 6.5%, 4.3%, and 5.6%, respectively, at lumbar spine. Height ($r = 0.234–0.358$), weight ($r = 0.305–0.388$), body mass index ($r = 0.143–0.285$) and physical activity ($r = 0.136–0.153$) were positively; and alkaline phosphatase ($r = -0.133$ to -0.203) was negatively correlated with BMD (all $P < 0.01$) at all sites. These parameters retained significant correlation after controlling for age and sex. No correlation of serum 25-hydroxy-vitamin-D and calcium was noted with BMD ($P > 0.05$) at any site.

Conclusions: Further data on absolute BMD, T scores, and prevalence rates of osteoporosis/osteopenia on multiple bone sites have been presented in this article.

1. Introduction

Osteoporosis is a global public health problem affecting over 200 million people worldwide. It is a disease characterized by reduction in the bone mass and disruption of bone architecture leading to impaired skeletal strength and an increased predisposition for fractures [1–3]. Osteoporosis has clinical and public health implications because of the mortality, morbidity, and cost of medical care related with osteoporotic fractures [4]. Hip fractures are a useful surrogate for determining the international burden of osteoporosis [5,6]. About 1.6 million hip fractures occur each year worldwide and the incidence is set to increase to 6.3 million by 2050 with major increase projected outside of Europe and the United States [7]. It is estimated that more than about 50% of all osteoporotic hip fractures in the world will occur in Asia by the year 2050 [8]. In India, there were around 26 million osteoporosis cases in 2003, while in 2013, 50 million people were either osteoporotic or had low bone mass. An annual incidence rate (hip fractures) of 163 and 121 per 100,000 per year in women and men, respectively, above the age of 55 years has been reported in a study in North India [9].

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Although osteoporosis occurs in all populations, not all populations are at equal risk [10]. Studies have reported that Asian women have higher predisposition for osteoporosis than their Caucasian counterparts [11]. Reasons attributed for lower bone mineral density (BMD) in Indians include possible genetic differences, nutritional deficiency and smaller skeletal size [9]. In a review article, Lei et al. [12] noted that though osteoporosis is a serious health problem in both Caucasians and Asians, both are 2 distinct major ethnic groups, which may have differential genetic determination underlying complex genetic diseases such as osteoporosis. Bone phenotypes are determined by both genetic and environmental factors and their interactions. Rapidly accumulating data have reported that the genetic factors can explain about 50%–90% of total BMD variation. A number of bone-related candidate genes, such as the estrogen receptor gene and vitamin D receptor gene, alpha2-HS-glycoprotein and parathyroid hormone, have been investigated for their association with bone phenotypes [12]. Additionally, there are differences in bone health between ethnic groups in both men and in women. Variations in body size and composition are likely to contribute to reported differences [13].

An understanding of BMD pattern in a population is crucial for prevention, diagnosis of osteoporosis and management of its complications in later life [14]. There is not much data on prevalence of osteoporosis/osteopenia in healthy Indian population. We undertook current investigation to examine the prevalence of osteoporosis/osteopenia and related risk factors in an apparently healthy Indian population.

2. Methods

This was a single-center, cross-sectional investigation in which retrospective data were collected in Max Super Specialty Hospital, Saket, New Delhi (a tertiary care hospital) after requisite approvals from Scientific Committee and the Institutional Ethics Committee of Max Super Specialty Hospital (TS/MSSH/SKT-21/ENDO/IEC/15–11). There was no direct contact with the subjects in this retrospective study; therefore, requirement for informed consent was waived off. This study did not involve any intervention or therapy, and the research involved no risks to the subjects. Subjects were identified by subject ID numbers only, and their names and identity were not disclosed in any way during or after this database review study. Hence, subject data confidentiality has been maintained.

We reviewed the medical records of adult males and females who had voluntarily visited the hospital for general health check-up and had willingly chosen the health plans including measurement of BMD and laboratory investigations. The consecutive sampling method was used to collect the data.

2.1. Data collection

The data on sex, age (year), weight (kg), height (cm), body mass index (BMI, kg/m^2), history of smoking, alcohol consumption, exercise status (presence/absence for all) and dietary habits (vegetarian/nonvegetarian diet) were recorded. Subjects had undergone bone scanning with dual-energy-X-ray absorptiometry (DXA) machine (Lunar Prodigy Advance DXA System, GE Healthcare) during health check-ups. The absolute areal BMD values (g/cm^2) and T scores were available for five bone sites, that is, lumbar spine (L1–4), femoral neck (both right and left), and total femur (both right and left). Laboratory data were collected for uric acid (UA), total cholesterol (TC), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), high-density lipoprotein (HDL), triglycerides (TG), alkaline phosphatase (ALP), serum calcium, serum phosphorus, serum bicarbonate, fasting glucose (all measured in mg/dL), glycosylated hemoglobin (%), and vitamin D (ng/mL).

2.2. Statistical analysis

Descriptive data were presented as mean ± standard deviation or number (%), unless specified. Univariate analysis was done by Student t-test, chi-square test and 1-way analysis of variance as appropriate. Pearson correlation was calculated to assess the relationship between BMD with age and other parameters at various skeletal sites. We reassessed the relationships by partial correlation analysis after adjustment for the known confounders for low BMD as applicable. A stepwise multiple regression analysis was done to identify the significant associated factors with BMD. A 2-sided P-value of <0.05 was considered statistically significant. Bone status analysis was done using World Health Organization classification based on T score: normal BMD (T score ≥ -1), osteopenia (T score < -1 and > -2.5) and osteoporosis (T score ≤ -2.5). Statistical analysis was performed using IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA).

3. Results

We studied 524 subjects (age, 50.0 ± 12.4 years; range, 20–85 years) who were categorised into 2 groups based on sex. Study population included 216 females (41.2%) and 308 males (58.8%) with a mean age of 50.7 ± 11.9 years and 49.6 ± 12.8 years ($P < 0.313$), respectively (Table 1).

3.1. Baseline characteristics and laboratory parameters

The baseline characteristics and laboratory parameters of the study population stratified by sex are presented in Table 1. Height and weight were significantly higher in males (both $P < 0.001$) as compared to females. Males had significantly higher VLDL, TG, UA (all $P < 0.001$) and bicarbonate levels ($P = 0.039$); and significantly lower ALP ($P = 0.015$), HDL and phosphorus levels ($P < 0.001$) as compared to females. There were no significant differences in BMI, TC, LDL, bicarbonate, calcium, vitamin D, glucose (fasting), and glycosylated hemoglobin levels ($P > 0.05$) between both the sexes. Smoking and alcohol consumption were reported more in males (15% and 26.1%, respectively) as compared to females (1.1% and 3.4%, respectively). Some kind of physical activity was reported by 39.1% females and 54.3% males. Nonvegetarian diet intake was reported by 23.9% females and 31.4% males.

3.2. BMD status

Table 2A, B shows the results of the DXA measurements and the proportion of subjects who had osteoporosis, osteopenia, and normal BMD at different skeletal sites in total population, males, and females.

3.2.1. Absolute BMD and T scores

Absolute BMD (g/cm^2) was significantly higher in males (both $P < 0.001$) as compared to females at all bone sites. Males had significantly higher T scores at lumbar spine, left femur neck, and right femur neck (all $P < 0.001$) whereas T scores at left total femur ($P = 0.510$) and right total femur ($P = 0.639$) were comparable in both the sexes (Table 2A).

3.2.2. Prevalence of osteoporosis and osteopenia

In total population, prevalence of osteoporosis was 6.9%, 5.0%, 2.9%, 1.9%, and 2.7% at lumber spine, left femur neck, right femur neck, left total femur, and right total femur, respectively, whereas

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