A Retrospective Study on Bone Mineral Density Values of Dexa Scan in Elderly Men and Post-Menopausal Women in Indian Population

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ABSTRACT

Introduction: Dual energy x-ray absorptiometry (DEXA) scans to measure bone mineral density (BMD) at the spine and hip have an important role in the evaluation of individuals at risk of osteoporosis, and in helping clinicians' advice patients about the appropriate use of anti-fracture treatment. Compared with alternative bone densitometry techniques, hip and spine DEXA examinations have a number of advantages to predict fracture risk. Therefore, the aim of the present study was to assess the bone mineral density measured by DEXA scan among elderly men and post-menopausal women of Indian population.

Material and Methods: The present study was a retrospective which comprised of 100 patients including males and post-menopausal women of age above 60 years. Information regarding socio-demographic factors and clinical parameters was collected. DEXA scan was used to measure bone mineral density (BMD) to evaluate osteoporosis. BMD was measured at the femoral neck and the lumbar spine. Patients with post-menopausal status were included and with any chronic illnesses were excluded from the study.

Results: Data were analyzed by dividing the participants into sex and age-specific groups and using descriptive statistics. For each participant, the T-score was calculated as the difference between BMD and the mean BMD of a group of young persons of the same sex (peak BMD), divided by the group standard deviation (SD). Descriptive statistics were used with students t-test which showed that post-menopausal women suffer more commonly from osteoporosis than elderly men.

Conclusion: DEXA scan plays a significant role in evaluating bone mineral density and post-menopausal women are more prone to osteoporosis than elderly men.

Keywords: Bone Mineral Density, Osteoporosis, Dual Energy X-Ray Absorptiometry, Post-Menopausal Women

INTRODUCTION

Osteoporosis is a global public health problem affecting around 200 million people worldwide. This disease is characterized by reduction in bone mass and disruption of bone architecture leading to impaired skeletal strength and an increased predisposition for fractures. Loss of bone mineral density (BMD) is related to hormonal imbalance, ageing, environmental factors, life style and genetic predisposition. The disease is classified clinically to be either primary or secondary osteoporosis. Primary osteoporosis refers to both bone loss occurring in post-menopausal women and bone loss owing to the normal ageing process. Secondary osteoporosis refers to bone loss that ensues as a secondary effect of other diseases or drug treatment.[1,2]

It is reported that 42.5% women and 24.6% men above the age of 50 years suffer from osteoporosis. The rates of osteoporotic fracture in India are among the highest in Asia. Loss of bone mass in women occurs predominantly in the postmenopausal period due to disturbances in the balance between bone resorption by osteoclasts and bone formation by osteoblasts, which lead to reduction in BMD. In men, lower levels of testosterone and/or estrogen can also result in an increased risk of osteoporosis. Inadequate intakes of calcium and vitamin D, sedentary lifestyle, tobacco, and alcohol abuse may also add to this condition.[3,4,5]

Fractures resulting from osteoporosis most commonly occur in the hip, spine, and wrist, and can be debilitating. Perhaps

because such fractures tend to occur at older ages in men than in women, men who sustain hip fractures are more likely than women to die from complications. 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. Reasons attributed for lower bone mineral density (BMD) in Indians include possible genetic differences, nutritional deficiency and smaller skeletal size.[6] Osteoporosis-related fractures are associated with substantial pain, suffering, disability, and possibly even death for the affected patients. Further, increasing longevity has resulted in an increasing number of senior citizens globally; life expectancy at present is ~67 years in India and is expected to increase to 71 years by 2025 and to 77 years by 2050. Thus, increasing longevity and a greater proportion of the Indian population over the age of 50 years are likely to result in an increased number of people affected by osteoporosis.[6]

It has clinical and public health implications because of the mortality, morbidity, and cost of medical care related with osteoporotic fracture. About 1.6 million hip fractures occur each year worldwide and the incidence is set to increase to 6.3 million by 2050. Bones naturally become thinner as we grow older because existing bone is broken down faster than the new bone made. As a result of this, calcium and other minerals decrease in the bones and they become light in weight, less dense, and more fragile. The bones might break if it goes thinner and weaker. Therefore, thicker bones take longer time to get osteoporosis. Although osteoporosis can occur in men, it is most common in women older than 65 years of age.[7]

Bone mineral density (BMD) is a quantitative measure of bone mass and represents the total mineral in a selected volume of bone in the hip or in the spine. BMD is an important clinical measure of bone strength and health; Dual-energy X-ray absorptiometry (DXA) is a widely used technique to assess bone mineral density (BMD) at different skeletal sites and therefore suitable to stratify individuals with low bone mass who are at risk of osteoporosis and associated fractures.[8]

Dual-energy X-ray absorptiometry (DEXA) being a clinically manifested procedure of evaluating bone mineral density (BMD) in the lumbar spine, proximal femur, forearm, and whole body is used especially in detection and managing osteoporosis. It is also used in monitoring prognosis with management of these conditions and to measure whole-body composition.[9]

The principal intent of DEXA is to determine bone mineral density precisely and consistently and comparing the assessment to the intended population of asymptomatic individuals. The results of BMD can be interpreted using WHO T-score definition of osteoporosis, a proven ability to predict fracture risk, proven effectiveness at targeting anti-fracture therapies, and the ability to monitor response to treatment.[10]

Among the anthropometric variables, low BMI and low weight are also interrelated with the occurrence of osteoporosis. It was found that low BMI is a good indicator for referral of women less than 60 years for measurements of BMD. Till date few studies have been conducted among elderly men and post- menopausal women in India. Hence, the aim of the present study was to evaluate the early bone fracture and osteoporosis using the help of dual energy x-ray absorptiometry (DEXA) scan in elderly men and postmenopausal women among Indian population.

MATERIAL AND METHODS

The present study was a retrospective study in which data was collected after requisite approval from Institutional Ethics Committee of Chettinad Hospital and Research Institute, Kelambakkam from October 2016 to November 2017. The study consisted of sample of 100 patients both male and post-menopausal females aged above 60 years. 50 males and 50 females were analysed for the bone mineral density. Patients who were determined to have post-menopausal status were included in the study and those with pathological and traumatic fracture, secondary osteoporosis, metabolic bone disease with malignant bone metastasis, hypogonadal states and undergone treatment with thiazides, diuretics, estrogen and calcium which can alter the bone metabolism were excluded from the study.

Information about socio-demographic and clinical parameters was collected during interviews with the patients. The patients were asked about their age, age at menopause, marital status, education, work status, living situation, previous non-vertebral fractures, vertebral deformities, parental history of fracture, smoking and drinking alcohol, calcium and vitamin D supplements.

DEXA scan was used for analyzing the bone mineral density (BMD) using GE lunar prodigy ENCORE 1.5 software. Bone mineral density is the measurement of calcium levels in bones and also determines if a patient has osteopenia or osteoporosis. While osteopenia may be diagnosed using plain radiographs, the most common method of measuring BMD is through Dual Energy X-ray Absorptiometry or DEXA. This scan uses low-energy x-rays that exposes patients to much less radiation than standard x-rays and can assess calcium levels in bone. The results are measured as a "T-score", which is derived by comparing it to an average score for a healthy 30-year-old of the same gender and race. The difference between the "normal young" score and the patients score is referred to as a standard deviation (SD).

The scanning was performed by two technicians, and the interpretation was done by one radiologist. BMD was assessed at the lumbar spines AP (L1-L4) and femoral neck. Based on WHO classification, individuals with T-score values higher than –1 were classified as normal, those with T-score between –1 and –2.5 as "Osteopenic" and those with T-score less than –2.5 as "Osteoporotic". T-scores are calculated by taking the difference between a patient's measured BMD and the mean BMD in healthy young adults, matched for gender and ethnic group, and expressing the difference relative to the young adult population standard deviation (SD) as follows:[11]

$$\text{T-score} = \frac{\text{Measured BMD - Young adult mean BMD}}{\text{Young adult population SD}}$$

STATISTICAL ANALYSIS

Descriptive statistics were presented in the form of percentage, mean and SD. Comparisons between the groups were assessed by Student's t-tests using SPSS v.21.

RESULTS

The present study showed that using the DEXA scan T-score ranges, 40% of Indian females aged 64 years or more were classified as having osteoporosis whereas males were having 4%. Furthermore, 36% and 16% of females and males aged 62 years or more respectively were found to be at risk of osteoporosis as depicted in Table no. 1 and Table no. 2.

The bone mineral density decreased with increasing age at both the spine and femur neck significantly after the age of 60 years as depicted in Table no. 3. The T scores for spine among 61-65 years were found to be -1.0±1.32 followed by 1.86±1.12 for 66-70 years and -2.39±1.17 for the patients above 71 years. The T-scores for Right neck were observed to be -0.36±1.56 for the age group 61-65 years followed by -1.0±0.37 for 66-70 years patients and -2.3±1.24 for patients above 71 years. In addition, the T-scores for left neck were found to be -0.60±1.14 for the age group 61-65 years followed by -1.39±0.71 for 66-70 years patients and -2.3±1.44 for patients above 71 years which was found be highly statistically significant with p value <0.05 as shown in Table no. 3.

It was observed from Table no. 4 which showed that the results of the DEXA measurements and the proportion of patients who had osteoporosis, osteopenia and normal BMD at different skeletal sites among males and females. It was found that among males, osteoporosis most commonly affected right femur neck and left femur neck followed by lumbar spine and the least affected sites were left total neck

Classification	T-score range	No. of subjects n=50 (Females)	Age (in years)	BMD (gcm^{-2})
Normal	≥ -1	4 (8%)	62.1±6.2	0.594±0.052
At risk of Osteoporosis	≤ -1to ≥ - 2.5	18 (36%)	62.6±7.1	0.546±0.042
Osteoporosis	≤ -2.5	28 (56%)	64.4±6.6	0.252±0.064
Table-1: Shows evaluation of osteoporosis on the basis of BMD scores among Females				

Classification	T-score range	No. of subjects n=50 (Males)	Age (in years)	BMD (gcm^{-2})
Normal	≥ -1	24 (48%)	64.2±6.2	0.614±0.072
At risk of Osteoporosis	≤ -1to ≥ - 2.5	14 (28%)	62.4±7.1	0.396±0.024
Osteoporosis	≤ -2.5	12 (24%)	60.1±6.4	0.265±0.482
Table-2: Shows evaluation of osteoporosis on the basis of BMD scores among males				

Parameters	61-65 years	66-70 years	Above 71 years	P value
Spine BMD(L1-L4) gcm^{-2}	0.72±0.14	0.65±0.16	0.60±0.15	0.004
T-score	-1.0±1.32	1.86±1.12	-2.39±1.17	0.002
Rt. Neck BMD gcm^{-2}	0.56±1.24	0.52±1.42	0.42±1.46	0.034
T-score	-0.36±1.56	-1.0±0.37	-2.3±1.24	0.001
Lt. Neck BMD gcm^{-2}	0.56±1.22	0.44±0.21	0.36±0.12	0.001
T-score	-0.60±1.14	-1.39±0.71	-2.3±1.44	0.001
Table-3: Showing differences of Mean and SD among different age groups				

Variable	Osteoporosis	Osteopenia	Normal BMD
Lumbar spine	20 (40%)	18 (36%)	12 (24%)
Left femur neck	11 (22%)	27 (54%)	12 (24%)
Right femur neck	7 (14%)	28 (56%)	15 (30%)
Left total neck	4 (8%)	16 (32%)	30 (60%)
Right total neck	8 (16%)	20 (40%)	22 (44%)
Table-4: Shows prevalence of osteoporosis and osteopenia at measured sites among females			

Variable	Osteoporosis	Osteopenia	Normal BMD
Lumbar spine	3 (6%)	4 (8%)	43 (86%)
Left femur neck	2(4%)	4 (8%)	44 (88%)
Right femur neck	4(8%)	8 (16%)	38 (76%)
Left total neck	1 (2%)	4(8%)	45 (90%)
Right total neck	2 (4%)	3 (6%)	45 (90%)
Table-5: Shows prevalence of osteoporosis and osteopenia at measured sites among males			

and the osteopenia affected right femur neck followed by lumbar spine and left femur neck and the least affected sites were right total neck. Among females, osteoporosis most commonly affected lumbar spine followed by left femur neck and right total neck and the osteopenia affected right femur neck followed by left femur neck and lumbar spine.

DISCUSSION

Osteoporosis is a major public health problem worldwide. The epidemiology of osteoporosis is however not well known in our country and region. The present study was conducted at the Chettinad Hospital and Research Institute, Kelambakkam to focus on bone mineral density in postmenopausal women and elderly men who have no risk towards secondary causes of osteoporosis using DEXA scan. In the present study, the data showed that the prevalence of osteoporosis among postmenopausal women was 56% and osteopenia was 36% respectively.

In the present study, among elderly men the prevalence was reported to be 24% for osteoporosis and 28% for osteopenia, which is much higher than that reported for some other populations. In Postmenopausal Caucasian women the prevalence of osteoporosis was (30%) as found by Genant et al (21.2%) in Swedish women aged 50–80 in the study of Kanis et al.[12,13] It is also higher than that reported for women in some Arab countries Sadat et al in Lebanon the prevalence of osteoporosis in women was reported to be 31%, in Kuwaiti women 18%, in Saudi Arabia it was 28% among women aged over 50 years and in Jordan it was estimated to be 13% of females over 40 years of age.[14] The possible explanation for these discrepancies might be related to the population, research designs, sampling methods and methodological differences.

In the current study, a significant correlation between bone mineral density and age was established, as the age increases especially after the age of 55 years, bone mineral density decreases. Estrogen deficiency after menopause might be the reason to report age as a risk factor. The findings of this study support a number of previous studies considering aging and menopause as the two major factors likely to be associated with increasing risk of bone tissue destruction.

The bone mass possessed by any older adult, male or female, reflects peak mass achieved at skeletal maturity and all losses associated with advancing age. At skeletal maturity, males attain higher bone mineral density as measured by dual energy x-ray absorptiometry (DEXA), than females. This difference is due to larger bone size as the area of male bones is approximately 35-40% larger than female bones. This larger bone size of men contributes to lower risk of osteoporotic fracture. Despite this larger bone size, osteoporotic fractures are common in older men which reflect substantial bone loss with advancing age as observed in the present study.[15]

The development of estrogen deficiency at menopause has long been associated with rapid bone loss and plays a key role in development of osteoporosis in women. As androgen levels decline slowly with advancing age in men, they do not experience a similar mid-life phase of rapid bone loss. Absence of this rapid loss may explain the different histologic patterns observed with advancing age between men and women.

Specifically, immediately following menopause, estrogen deficiency leads to elevated bone resorption, which causes trabecular perforation thereby weakening bone structure out of proportion to loss of density.[16]

Osteoporosis and frequent fracture are not limited to post-menopausal women. There is increasing attention being paid to osteoporosis in men as they suffer from these fractures about 10 years later in life than women. In the present study also, 24% men were affected due to osteoporosis and 28% were affected due to osteopenia which reflects that older men are also susceptible to osteoporotic fractures but women are more likely to suffer more with a percentage of 56%. This finding is in concordance with the study done by M Anburajan and D Ashok Kumar et al where he stated that 31.8% (7/22) of Indian women aged 50 years or more were classified as having osteoporosis and no Indian male was found to have osteoporosis but 16.7% (4/24) of men aged 50 years or more were classified as being at risk of osteoporosis.[17] The correlation between BMD at the femoral neck and BMI observed was highly positive in a cross-sectional study conducted among postmenopausal women by Steinschneider et al. The findings suggest that the increased BMD commonly reported in overweight women may result from soft tissue interference with BMD determination by DEXA. A hospital-based study conducted in elderly males by Paniagua et al. observed that 37.3% were normal, 35.6% were osteopaenic and 27.1% were osteoporotic.[18,19] DEXA can measure as little as 2% of bone loss per year. It is quick, and very low doses of radiation are used, but it is more costly when compared to ultrasound testing. The limitations of this study were less sample size and data on risk factors and regarding BMI was not collected. However, the derived normal reference data among Indian men and women can be valuable for clinical as well as for research work.

CONCLUSION

Postmenopausal women in this study suffer from osteoporosis and osteopenia higher than elderly men. Further studies with larger sample size are required to investigate the effect of osteoporosis among men and post-menopausal women.

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