Osteoporosis in Elite Population.

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***Abstract**: Attention has been drawn recently to the presence of osteoporosis in individuals of elite society. Various factors, including unbalanced diet and hormonal disturbances have been attributed to it. However, the clinical profile of osteoporosis in elite population has not been thoroughly examined. Therefore, a study of clinical profile of osteoporosis in elite population in Indian patients was carried out at the Rockland Hospital, New Delhi. Fifty patients were selected for the study on the basis of DEXA bone density findings. To our knowledge this is the first report of clinical profile of osteoporosis in elite population in Indian patients.*

INTRODUCTION

The word elite have been variously defined. In a developing society, like India, this would include people who are well educated and have access to good nutrition, a decent environment and good medical facilities and have decent knowledge about prevention & treatment of various diseases.

Attention was drawn to the what is designated as the ***'Female Athlete Triad'***, a term coined in 1992 by the American College of Sports Medicine, in response to several studies concluding that a number of female athletes suffer from the inter-related symptoms of disordered eating, amenorrhea and osteoporosis[1, 2, 3]. The study found high incidence of this entity in elite female athletes. The seriousness of this problem has been highlighted in the recent position stand of the International Olympic Committee Medical Commission[4]. These observations established that osteoporosis can be found even in otherwise well-to-do people with sound knowledge of diet and ample resources. However, no study is available on the incidence and type of osteoporosis and its complications in this population in India.

In view of the above a study of osteoporosis in the higher socio-economic group was carried out in patients reporting at the Rockland Hospital, New Delhi. This to our knowledge is the first study to document the pattern of osteoporosis in elite population in India.

MATERIAL AND METHODS

Fifty cases of Osteoporosis attending the Out Patient's and in-patient's Department of the Rockland Hospital, New Delhi, were selected for the study. The inclusion criteria were (1) cases of osteoporosis with varying etiology, (2) patients belonging to higher income group.

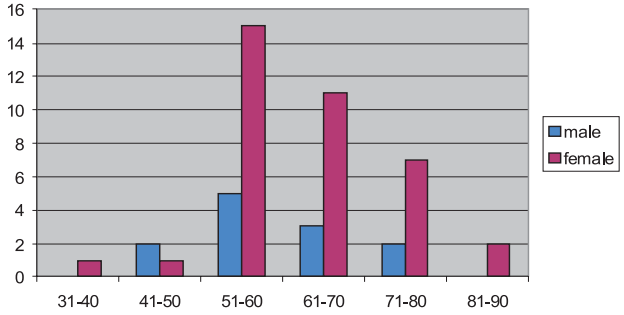
A detailed clinical history was taken with special attention to alcohol intake, smoking, sedentary life style, chronic intestinal disorders, history of taking drugs – thyroid medication, steroid based drugs for asthma, arthritis or cancer, anti-epileptics, chronic heparin administration, and the history of disorders in which osteoporosis is a common feature, such as diabetes mellitus and hypothyroidism; in females also menstrual history, including the history of late menarche or early menopause, surgery on uterus and ovaries was also taken.

The gold standard for the diagnosis was DEXA bone densitometry of Lumbar spine and proximal femur to confirm and quantify osteoporosis. X-ray of lumbosacral spine and pelvis with both hip joints was also taken in each case.

The other investigations included hemoglobin (Hb), erythrocyte sedimentation rate (ESR), blood sugar, serum calcium, serum phosphorous, alkaline phosphatase, 24-hour urinary excretion of calcium. Special investigations, wherever indicated, were done, such as serum electrophoresis for myeloma proteins, thyroid stimulating hormone.

OBSERVATIONS

Age and Sex: The findings of age and sex are given in Histogram-1. There were 13 males and 37 females in this study. The age of patients ranged from 20 to 82 years. Maximum number of patients was present in the age groups 51-60 years and 61-70 years.



Histogram-1: *Distribution of males and females with osteoporosis in the different age groups.*

It will be noted that the number of females presenting with osteoporosis is larger than males, which is statistically significant.

Hemoglobin: The patients were classified into 3 groups, those with hemoglobin >13 G%, those with 10-13 G% and those with hemoglobin less than 10 G%. The break up is shown in Table 1.

Hb level	Males	Females	Total Pts
less than 10 G %	2 (%)	3 (%)	5
10 to 13 G %	7 (%)	28 (%)	34
>13 G%	4 (%)	6 (%)	10
Total Males	13 (%)	37 (%)	50

Though it was not the aim of the study to examine the pattern of anemia, we tried to rule out from the history the possibility of hemolysis, hemorrhage in each case. Aplastic anemia was ruled out from the general blood picture. We empirically started oral iron therapy in all patients as a routine practice. A review of literature shows high incidence of anemia in Indian patients even in the higher

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income group[5] for which various mechanisms have been elaborated [6,7,8,9].

Fracture risk: The relation between the risks of fracture as assessed from the DEXA report is shown **Table 2**. The fracture risk was reported as mild (risk 1), moderate (risk 2) and severe (risk 3).

Table 2*: Fracture Risk in Osteoporosis*

Fracture risk	1	2	3
Cases	7	19	24
Fracture present	1	7	2

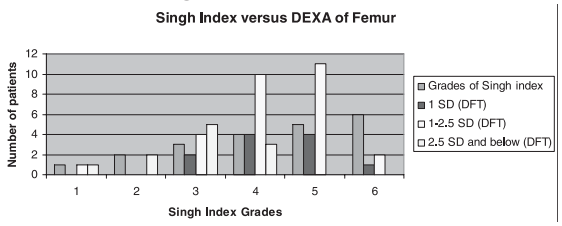
Ten patients out of the total of 50 cases had presented with fracture. A correlation was attempted between the fracture risks as per the DEXA findings. Six patients had compression fracture of vertebra, two patients had fracture neck of femur, one patient had Colles' fracture and one had fracture of the shaft of humerus. The patient presenting with the fracture of humerus, Colles' fracture and fracture neck of femur had a history of fall or had typical deformity but no patient of spinal fracture gave any history of significant injury. The patients with the fracture of humerus, Colles fracture, and fracture of neck of femur had typical deformity. On the other hand the patients with spine fracture mainly presented with localized backache. No patients had signs of neurological deficit.

Backache: The usual presentation of the patients was low backache, but some patients complained of generalized body ache. Low back ache was the main presenting feature of milder cases of osteoporosis. Generalized body ache was a prominent presentation in moderate and severe osteoporosis. While pain responded to analgesics in milder cases, many advanced cases who did not respond to the usual analgesics, nasal insufflations of Calcitonin spray was very helpful in some cases.

High calcium intake, gradual exercise, and a balanced diet greatly helped in ameliorating the symptoms, though no significant improvement in X-ray picture or DEXA findings was noted during the period of study.

Neurological involvement: No patient had overt neurological deficit in this study in spite of collapse of vertebrae. Patients with collapse of vertebrae had pain in legs and paraesthesias. Patient's with collapse of vertebra were advised extension braces to be worn when the patient was ambulatory to prevent further collapse of the vertebrae and hence preventing improvement of neurological symptoms.

Bone density (DEXA) and Singh Index**:** Plain radiographs of trabecular bone show a distinct pattern of differences in the appearance of healthy and osteoporotic bone. We therefore evaluated Singh index[26] against the findings of DEXA of proximal femur. The Singh index has been evaluated against 1 standard deviation (1 SD), 1-2.5 standard deviation (1-2.5 SD) and less than/equal to 2.5 standard deviation (2.5 SD and below) of DEXA findings. The findings are shown in the **Histogram-2** below.



Histogram-2*: Singh Index and DEXA of Femur*

The above findings show an overall agreement of the Singh Index with the DEXA findings as regards the hip joint. Though the Singh index was intended to throw light on the total osteoporotic process, a comparison with DEXA of spine in the present study shows that this may not be the case. However, the DEXA findings of lumbar spine (L 1 to L 4) revealed established osteoporosis (DEXA T-values of lumbar spine had SD ≤2.5). We therefore conclude that the Singh Index has poor reliability and poor diagnostic value in screening patients of osteoporosis, especially with respect to spine.

Causes of osteoporosis and coexistent diseases

The cause of osteoporosis in the present study comprised of multiple myeloma, post menopausal, idiopathic, unbalanced diet and lack of physical activity. Co-existent diseases in this group, which included diabetes mellitus, hypertension. coronary artery disease (CAD), hypothyroidism; detailed evaluation of nutritional status was not feasible in the present study. However, the dietetic history revealed high incidence of unbalanced diet, which was rich in calories but deficient in calcium and protein.

Table 3 shows the chronic medical conditions associated with osteoporosis in this study**.**

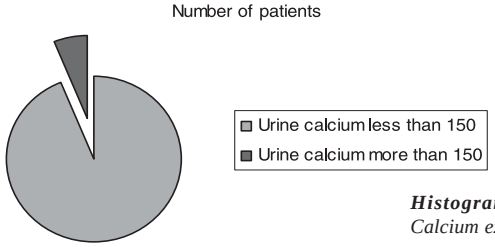
Table-3: *Diseases associated with Osteoporosis*

Associated Diseases	Number of patients
Bronchial Asthma	1
CAD	1
DM	14
HT	10
Hypothyroidism	6
Multiple Myeloma	2
Valvular Heart Disease	1
Total	35

Out of a total of 50 patients of osteoporosis, 19 had one or more associated diseases. These diseases included bronchial asthma (1 case), coronary artery disease (1 case), diabetes mellitus (14 cases), hypertension (10 cases), hypothyroidism (6 cases), multiple myeloma (2 case) and valvular heart disease (1 case). Of these 19 patients 6 had two or more associated diseases. For this reason, the number of associated diseases is more than the total number of patients with associated diseases.

24-Hour Urinary Calcium: Urinary calcium in patients in this series is given in the **Histogram 3.** Normal excretion of urinary calcium was taken as less than 150 mg in 24 hours at normal dietary intake of calcium [Harrison's Principles of Internal Medicine].

Forty seven patients (94%) had urinary excretion of calcium less than 150 mg in 24 hours. But three patients (6 %) were found to excrete calcium more than 150 cut-off limit. Two of these patients had urinary calcium of 158 and 160 mg/24 hrs, which are not significantly elevated from the normal value of 150 mg/24 hrs. Only one patient had urinary calcium 211.6 mg%. This patient had diabetes mellitus as an associated disease. There was no hypercalcemia in this patient (serum calcium being 9.2 mg %).



Histogram 3*: Urine Calcium excretion*

DISCUSSION

Incidence of Osteoporosis

The findings of age and sex are given in Histogram-1. It will be noted that the number of females presenting with osteoporosis is larger than males.

The amount of calcium loss in males may be lower on account of their more vigorous physical activity. Studies have shown that accumulation of calcium in bone is greatly influenced by physical activity[10].

In general, the females were housewives in this higher income group. They had lot of domestic help to look after their routine work, which further curtailed their physical activity. Further, the hormonal disturbances in the perimenopausal period are known to influence bone mineral concentration[11,12]. The peak bone-mass attained during adolescence is an important determinant of bone density in the later period of life[13] The boys being more physically active tend to attain higher peak-bone mass during the adolescent period, thereby influencing the development of osteoporosis in the later age group.

Causes of osteoporosis

In our study the maximum number of patients had diabetes mellitus. The other two conditions forming the bulk of association in our series, namely the CAD and hypertension, have no direct relation with osteoporosis.

Weinstock et al (1989)[14] found no correlation between BMD and diabetes duration or current glycemic control in postmenopausal women[15]. Short-term measures of control, such as glucose levels or A1C results, have also not been found to reflect cumulative bone damage measured by BMD Valerio et al[16]. The complications of diabetes may represent cumulative results of long-term poor control. Several studies have demonstrated an association between BMD and microvascular complications[14]. In a prospective study reported that after 11 years, only those subjects who developed retinopathy or proteinuria had worsening of their BMD[17]. Forst et al.[18] found a decreased BMD in the cortical bone at the hip and a greater decrease at the distal limb in association with peripheral neuropathy. The lumbar spine had a non significant decrease in BMD in these patients with Type-1 diabetes[19, 20] The Blue Mountain Eye Study in Australia[21] found an association between retinopathy and all fractures in both men and women with all types of diabetes[19,20]. Some studies have shown stabilized and improved BMD in patients with type 1 diabetes with improved glucose control over time[19, 22]. Hypercalciuria, a potential risk factor for osteoporosis, has long been noted in patients with poorly controlled Type-1 or Type-2 diabetes, and was shown to improve with lower A1C results[21,23].

None of our patient had Type-I diabetes mellitus. Although it is well known that diabetes mellitus favours the development of osteoporosis, none of our patients had longstanding diabetes which can be considered as a causative factor.

The incidence of coronary artery disease, hypertension and diabetes mellitus, is known to increase with advancing age. Their presence in large number in the present series cannot be related to as causative factors.

Prolonged use of steroid therapy is also well known to cause osteoporotic changes, but none of our patients had sufficiently long intake of oral steroids to account for causation of osteoporosis. Multiple myeloma was detected in two patients. However, the lesions were localized to spine which presented as vertebral compression fractures and generalized osteoporosis. We therefore conclude that association of diseases in the present series was casual and did not seem to have any direct cause-effect relationship. It is however possible that these diseases could have contributed to ongoing osteoporotic process.

***Urinary Calcium*:** In this regard it is worth mentioning a study of urinary calcium in osteoporosis carried out by Bhandarkar and Nordin[24]. They found a significant difference between the ability of normal subjects and patients with osteoporosis to reduce their urinary calcium excretion. In the normal subjects the mean excretion of calcium fell significantly on low calcium diet, but in the osteoporotic cases it did not. They could not conclude with confidence whether the failure of osteoporotic subject to reduce urinary calcium excretion was a cause or the effect of osteoporosis, they concluded on the basis of their previous observations that the former was inherently more possible. They concluded from their studies[25] that there is no relation between dietary calcium and urinary calcium in osteoporosis. But osteoporosis may be due to disturbances in renal handling of calcium, the cause of which could be obscure, but it might be connected with the alleged role of oestrogenic hormones or might perhaps be connection with high incidence of infection of urinary tract infection in women. We could not work out the calcium balance studies as the patient left the hospital. But it is proposed that a careful observation of renal handling of calcium deserve to be studied in greater detail in all patients of osteoporosis.

Singh Index

To underline the usefulness of this pattern in osteoporosis, the Singh index grading system was devised in the 1960s by using radiographs of the proximal femur[26]. It is based on the radiological appearance of the trabecular bone structure of the proximal femur on a plain anteroposterior radiograph. The Singh index is used to assess patterns of trabecular loss.

Dual-energy X-ray absorptiometry (DEXA) provides a more precise estimate of bone mineral density[27,28,29] and is considered to be the ***'gold standard'*** for measuring osteoporosis[30].

Koot et al.[31] assessed the inter-observer and intra-observer agreement of readings of the Singh index and compared the indices for measuring osteoporosis[30] with the results of DEXA. They did not find any good relation between DEXA and Singh Index[31]. As per the original description by Singh et al, the grade-1 represents the severest form of osteoporosis. The criteria laid down by them are given in Table-4 below.

Singh Index has been recently criticized for its low reliability due to the subjective nature of its ill defined grading and cut-off level for osteoporosis[27,28,29,30]. Currently DEXA is considered as the gold-standard for diagnosis of osteoporosis.

The commonly acknowledged medical risk factors for osteoporosis are chronic liver disease, chronic renal failure, thyroid disease, particularly hyperthyroidism or excessive thyroxin replacement, primary hyperparathyroidism, prolonged immobilization, Cushing's syndrome or disease, Corticosteroid therapy, Malabsorptive illnesses

Table 4: *Singh Index*

Grades of Singh Index	Details of Singh Index
Grade 6	All the normal trabecular groups are visible and the upper end of femur seems completely occupied by cancellous bone.
Grade 5	The structure of principal tensile and principal compressive trabeculae is accentuated. Ward's triangle appears prominent.
Grade 4	Principal tensile trabeculae are markedly reduced in number but can still be traced from the lateral cortex to the upper part of femoral neck.
Grade 3	There is a break in the continuity of the principal tensile trabeculae.
Grade 2	Only the principal compressive trabeculae stand out prominently, the others have been more or less completely resorbed.
Grade 1	Even the principal compressive trabeculae are markedly reduced in number and are no longer prominent

e.g., Coeliac disease, Crohn's disease, Eating disorders (anorexia nervosa, bulimia), Rheumatoid arthritis, Organ transplant recipients, treatments for certain malignancies e.g. breast cancer, prostate cancer[32,33].

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