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Assessment of Proportion of Radiologically Confirmed Osteoporosis Cases among the Suspected Cases of Female: An Institutional Based Study

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Abstract

Background: Preventing osteoporosis, a multi factorial disease, resides not only in recognizing its risk factors, but also in identifying potentially modifiable determinants of bone mineral density (BMD), the surrogate measure for osteoporosis. Thus, the present study is designed to assess and compare the risk factors of osteoporosis among women as to prevent osteoporosis, a multi factorial disease, resides not only in recognizing its risk factors, but also in identifying potentially modifiable determinants of bone mineral density (BMD), the surrogate measure for osteoporosis. **Subjects and Methods:** The present prospective observational analytical study was commenced among 350 females aged between 30-65years who were referred to the Radio diagnosis department as suspected cases of osteoporosis from various outpatient departments. Women in sample after DEXA scan were categorized in two groups; group A comprised women those having normal BMD, considered as control group and group B comprised women with low BMD either osteopenia or osteoporosis included in this group. Datawas collected according to the recommendations of the International Society for Clinical Densitometry.The data collected was compiled, tabulated, analyzed and subjected to Pearson Chi-square test for statistical analysis. **Results:** While osteoporosis was found to be significantly higher in Low class women ($p<0.07$) followed by Middle class and upper socioeconomic status. A significant difference was observed between rural and urban people ($p<0.01$). Women with moderate and low physical activity were significantly at higher risk of osteoporosis. A highly significant difference was observed between two groups in terms of weight, age, BMI, Waist circumference, Hip circumference, BMD lumbar spine, Lumbar Spine T score, Lumbar spine Z score, Femur neck BMD, Femur neck T score & Femur neck Z score whereas there was no significant difference in terms of Height. **Conclusion:** Within the limits of our study we conclude that osteoporosis is one of the growing concern and need immediate care. The lack of information regarding risk factors for osteoporosis among women is an important problem. Our results highlight the importance of knowledge regarding the risk factors like age, menopausal status, physical activity, smoking, socioeconomic status, geographical location, weight, BMI etc. There is the need for more effective education for the community and medical practitioners for the clinical significance of osteoporotic fractures and its risk factors.

Keywords: Osteoporosis, Bone Mineral Density (BMD), Dual Energy X-Ray Absorptiometry (DEXA) Scan.

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Introduction

Osteoporosis is a condition that weakens bones, making them fragile and more likely to break. It develops slowly over several years and is often only diagnosed when a minor fall or sudden impact causes a bone fracture. Low bone mass and deterioration of bone micro architecture with a consequent increase in bone fragility is characteristic of Osteoporosis. Low bone mass and bone fragility thus increases the risk of fracture.[1] It has been called as a silent epidemic disease as bone loss is silent and progressive often asymptomatic until the first fracture occurs.[2] Osteoporosis is operationally defined based on the World Health Organization (WHO) criteria as a bone mineral density (BMD) that lies 2.5 standard deviations or more below the average value for young healthy individual (T-score of < – 2.5 SD).[3]

Osteoporosis is very well known as a silent epidemic as bone loss is silent and progressive often asymptomatic until the first fracture occurs. The term "osteoporosis" was introduced by German and French physicians in the 19th century when the histology of osteoporotic bone was investigated. Osteoporosis occurs due to an imbalance of bone remodeling, leading to a reduction in bone strength. Bones become fragile due to a disruption of the structure, resulting in an increased risk of fracture. Furthermore, non-modifiable risk factors include age, sex, ethnicity, genetic factors and body built.[4]

Bone mineral density (BMD) loss is an important contributor of fracture particularly in subjects aged 65 years

and over.[5] The most effective way of screening for osteoporosis is the measurement of bone mineral density. Bone mineral density (BMD) refers to the amount of mineral per unit of space or mass per volume of the bones For the measurement of BMD current methods include radiographic absorptiometry, single-energy x-ray absorptiometry, dual-energy x-ray absorptiometry (DEXA scan), quantitive computed tomography, and quantitive ultrasound. Of these, Dexa Scan is the most widely used technique for the clinical assessment of bone-mineral density.[6]Dual X-ray absorptiometry has become the standard for measurement of low bone mineral density (BMD) associated with osteoporosis.[2] This technique is rapid, taking only 3 to 7 minutes, and delivers a radiation dose that is so low as to be equivalent to approximately 5% of the radiation dose of one chest radiograph. DEXA scanners simultaneously use a high- and a low-energy x-ray beam to measure BMD. The difference in soft-tissue and bone penetration of these two beams is used to calculate BMD. The relationship of decreased BMD seen on DEXA and increased fracture risk is that for each standard deviation decrease of BMD, fracture risk increases twofold. For every SD of decrease in BMD, the relative risk of osteoporotic fracture in the elderly population increases by a factor of 1.5 to 1.8. Therefore, a relatively small increase in BMD can significantly reduce fracture risk.[6]

Lifestyles, especially dietary patterns and physical activity levels, generally vary between urban and rural areas but how they differ may be context-specific, especially in relation to stages of economic development at country level.[7]There is therefore a need to examine the effect of urbanization on bone mass accrual and loss globally.[8] Preventing osteoporosis, a multi factorial disease, resides not only in recognizing its risk factors, but also in identifying potentially modifiable determinants of bone mineral density (BMD), the surrogate measure for osteoporosis. Thus, the present study is designed to assess and compare the risk factors of osteoporosis among women as to prevent osteoporosis, a multi factorial disease, resides not only in recognizing its risk factors, but also in identifying potentially modifiable determinants of bone mineral density (BMD), the surrogate measure for osteoporosis.

Subjects and Methods

The present prospective observational analytical study was commenced among 350 females aged between 30-65years who were referred to the Radio diagnosis Department as suspected cases of osteoporosis from various Outpatient Department of Associated Hospital of SMS Medical College, Jaipur. Age group of 30-65 years female as suspected cases of osteoporosis were selected as inclusion criteria for the study. Exclusion criteria were women with surgical menopause, pregnant and lactating women, carrying any disease or receiving treatment that could affect BMD, suffering from chronic renal disease, having endocrinopathies, liver disease,scoliosis.

A dual energy X-ray absorptiometry (DEXA) scan, also called a bone density scan, is a common technique used to measure bone density. This is completely painless procedure and is easily performed and exposes the patient to minimal radiation.

Women in sample after DEXA scan were categorized in two groups

- **Group A:** Women those having normal BMD, considered as control group.
- **Group B:** Women with low BMD either osteopenia or osteoporosis included in this group.

All the data were collected according to the recommendations of the International Society for Clinical Densitometry. WHO classification of BMD by T-score value; Normal: T-score at or above -1 SD Osteopenia: T-score between -1 and -2.5 SD Osteoporosis: T-score at or below -2.5 SD Established osteoporosis: T-score at or below -2.5 SD, plus fragility fracture.

All data were correlated, calculated, compared and evaluated under guidance from Department of Statistics.All the clinical findings and Dexa scan were analysed.

The data collected was compiled, tabulated, analyzed and subjected to Pearson Chi-square test for statistical analysis.

Results

Table 1 represents the mean description of bone mineral density Lumbar spine is 0.96, Lumbar spine T score is -1.39, and Z score is -0.43. 139 patients were normal, 117 had osteopenia and 94 had osteoporosis. Table 2 represents the mean description of bone mineral density Femur neck is 0.83, Femur neck T score is -1.21, and Z score is -0.41. 139 patients were normal, 154 had osteopenia and 57 had osteoporosis.

For calculation of sensitivity and specificity, two groups were formed based on cut-offs of densitometer values, i.e. group 1 consisted of normal cases and group 2 consisted of cases with osteoporosis/ osteopenia.

While osteoporosis was found to be significantly higher in Low class women ($p<0.07$) followed by Middle class and upper socioeconomic status. A significant difference was observed between rural and urban people ($p<0.01$). Women with moderate and low physical activity were significantly at higher risk of osteoporosis.

A highly significant difference was observed between two groups in terms of weight, age, BMI, Waist circumference, Hip circumference, BMD lumbar spine, Lumbar Spine T score, Lumbar spine Z score, Femur neck BMD, Femur neck T score & Femur neck Z score whereas there was no significant difference in terms of Height (table 4).

Table 1: BMD Lumbar Spine (g/cm^2), Lumbar spine T score, Lumbar spine Z score

Variable	Mean	SD
BMD Lumbar Spine	0.96	0.22
Lumbar spine T score	-1.39	1.52
Lumbar spine Z score	-0.43	1.58
WHO classification	N	%
Normal	139	39.7

Osteopenia	117	33.4
Osteoporosis	94	26.8

Table 2: BMD Femur neck (g/cm^2), Femur neck T score, Femur neck Z score

Variable	Mean	SD
BMD Femur neck	0.83	0.22
Femur neck T score	-1.21	1.22
Femur neck Z score	-0.41	1.10
WHO classification	N	%
Normal	139	39.7
Osteopenia	154	44.0
Osteoporosis	57	16.2

Table 3: Description of various variables among the study groups

Variables	Normal		Osteopenia + osteoporosis		Chi square	p value
	N	%	N	%		
Geographical location						
Rural	16	4.6	66	18.9	18.26	<0.001*
Urban	123	35.1	145	41.4		
Socio economic status						
Upper	86	24.5	11	3.14		
Middle	47	13.4	66	18.8	171(2)	<0.001*
Lower	6	1.7	134	38.2		
Physical activity						
Low	32	9.1	87	24.9		
Moderate	94	26.9	120	34.3	19.35(2)	<0.001*
High	13	3.7	4	1.1		
Smoking						
No	138	39.4	209	59.7	2.25	0.69
Yes	1	0.3	2	0.6		

Table 4: Mean description of age, weight (kg), height (cm), BMI(kg/m$^{2)}$, waist circumference (inch), hip circumference (inch), BMD Lumbar Spine (g/cm^2),Lumbar spine T score, Lumbar spine Z score, BMD Femur neck(g/cm^2), Femur neck T score, Femur neck Z score among the study groups

Variables	Normal		Osteopenia + osteoporosis		p value
	Mean	SD	Mean	SD	
Age	46.47	8.02	57.45	9.27	<0.001*
Weight	68.38	11.61	57.40	9.87	<0.001*
Height	156.44	6.48	156.14	6.39	0.669
BMI	27.81	5.11	23.67	4.46	<0.001*
Waist circumference	35.17	3.83	33.06	3.77	<0.001*
Hip circumference	39.43	3.97	37.25	3.91	<0.001*
BMD Lumbar Spine	1.18	0.12	0.81	0.14	<0.001*
Lumbar spine T score	0.12	0.79	-2.39	0.95	<0.001*
Lumbar spine Z score	0.50	1.46	-1.05	1.33	<0.001*
BMD Femur neck	1.05	0.14	0.69	0.14	<0.001*
Femur neck T score	-0.04	0.69	-1.97	0.85	<0.001*
Femur neck Z score	0.27	0.86	-0.86	0.99	<0.001*

Discussion

Socioeconomic data revealed that 40.0% belonged to low socioeconomic status, 32.2%were middle class and 27.2% belonged to upper class. Socioeconomic status in present study showed that majority of the patient's belonged to low and middle socioeconomic status.

Studies have suggested that Low SES and minority race/ethnicity status are also independently associated with greater perceived stress in adolescents, which can leave its biological signature in changes in the hypothalamic-pituitary-adrenal axis, sympathetic nervous system, inflammation, and glucose regulation. In turn, the dysregulation of these systems has been related to low BMD.In current study out of 350 women 139 had normal BMD whereas 211 women had low BMD either osteopenia or osteoporosis. In normal group among 139 women 86 i.e24.5% belonged to upper socioeconomic status, 47 i.e. 13.4% belonged to middle class and 6 i.e1.7% belonged to low class. In low BMD group among 211 women 11 i.e3.14% belonged to upper socioeconomic status, 66 i.e18.8% belonged to middle class and 134i.e1.38.2% belonged to low class. In present study we found that low BMD was found to be significantly higher in low class women (p<0.001) followed by middle class and upper socioeconomic status.

Unni J etal[9] was also found that women from the lower socioeconomic strata had a significantly higher percentage of osteopenia and osteoporosis (p=0.001). Similarly Demeter S et al[10] found significantly higher BMD among high SES women in all age and morbidity state.

Of the 350 patients included in the study 82 belonged to rural area i.e.23.4%, 268 belonged to urban i.e. 76.6%. So in present study a significantly higher percentage of patients belonged to urban area (p<0.001). In present study there were a higher number of women with low BMD in urban areas. Of the 211 women in low BMD group 145 belonged to the urban area. In this study a statistically significant difference was observed between 2 groups(p<0.001).Lifestyles, especially dietary patterns and physical activity levels, generally vary between urban and rural areas but how they differ may be context-specific, especially in relation to stages of economic development at country level.[11]

Mika Matsuzaki et al[12] in their study reported that Meta-analysis showed conflicting evidence for urban-rural difference in BMD; studies from high income countries generally showed higher BMD in rural areas while the results were more mixed in studies from low and middle income countries.

Chatlert P et al[13] showed that BMD in rural individuals were significantly higher than in urban individual. Femoral neck BMD (0.23gm/cm) in rural women were significantly higher (P<0.001). Brennan S L et al[14] reported that residents of rural region had lower risk of hip fracture as compared to the urban.

Gu W et al[15]found that urban women had significantly higher BMD than their rural counterparts (p< 0.01).

Whereas Tariq S et al[16] found no significant difference in BMD of both rural and urban areas (p=0.321).

Of the 350 patients 119 said their physical activity was low i.e. 34%, 214 patients mentioned moderate physical activity i.e. 61.1% and only 17 of them mentioned high physical activity i.e. 4.9%.Low levels of physical activity have also been associated with bone loss. Various studies have shown that physical activity in postmenopausal women helps in osteoblast differentiation and bone formation. Howe closet al[17] in their study analyzed many randomized control trials (RCTs) including 4,320 participants, and verified that the type of exercise that better benefit femoral neck BMD was the lower limb no-impact high intensity resistance training. The authors also concluded that for the spine BMD combined exercises (resistance + aerobic + impact) seem to be most recommended.In current study result showed that Women with moderate and low physical activity were significantly at higher risk of osteoporosis (p<0.001).

Of the 350 patients 347 said they don't smoke i.e. 99.1% and 3 said they smoke i.e. .09%. In present study we did not found any relationship between smoking and BMD. Ourstudy concurs with the study of Eisman J et al[18] they also reported that smoking had no relationship with low BMD.

Mean weight in present study was found to be 61.76± 11.86, mean height was 156.26± 6.41, mean BMI was 25.31±5.14, mean waist circumference was 33.90± 3.93 and mean hip circumference was38.12± 4.09.

BMD lumbar spine mean was 0.96 ± 0.22, mean lumbar spine t score was -1.39± 1.52 and mean lumbar spine z score was -0.43± 1.58. Patients were divided based on W.H.O classification of the 350 patients included in study 139 were normal i.e. 39.7%, 117 had osteopenia i.e. 33.4% and 94 had osteoporosis i.e. 26.8% so in present study prevalence of osteoporosis at lumbar spine was 26.8%.

In present study mean description of bone mineral density femur neck was 0.83±0.22, femur neck T score was -1.21±1.22 and femur neck Z score was -0.41±1.10. 139 i.e. 39.7% patients were normal, 154 i.e.44% had osteopenia and 57 i.e. 16.2% had osteoporosis. In present study prevalence of osteoporosis at femur neck was 16.2%.

In current study a comparison was made between normal BMD group and Low BMD group either having osteopenia or osteoporosis. Result showed that a highly significant difference was observed in Age, weight, BMI, waist circumference, hip circumference, BMD lumbar spine, lumbar spine T score, lumbar spine Z score, BMD Femur neck, Femur neck T score and Femur neck Z score (p<0.001).Whereas no significant difference was observed in respect of Height (p<0.669).

In present study the mean and standard deviation of age of the normal BMD group was 46.47± 8.02 and of low BMD group was 57.45± 9.27. There was a highly significant difference was observed between 2 groups. Older age was found to be associated with low BMD. Unni J et al[9]reported in their study that increasing age was found to be an important risk factor for low BMD. This difference in the older age group was statistically significant (p=0.016).

In present study the mean and standard deviation of weight of the normal BMD group was 68.38± 11.61 and of low BMD group was 57.40± 9.87. The women with low BMD had significantly low weight as compared to the normal group (p<0.001). Various studies showed that body weight has a protective effect for Bone mineral density. SoltanilA et al[19]also found a positive association between body weight and BMD (p<0.01).

Shatrugna V et al[20] suggested that the nutritional status of women appears to be an important determinant of bone parameters. BMD at all the skeletal sites and whole body increased significantly with increasing body weight of women (P<0.05).

In present study the mean and standard deviation of BMI of the normal BMD group was 27.81± 5.11 and of low BMD group was 23.67± 4.46. In our study we found comparatively low BMI in osteopenic and osteoporotic women.

Aghaeiet al[21]found a significant correlation between BMI and BMD (p<0.01). Silva et al[22]in their study reported that BMI> 25 kg/m2 was a protective factor for low BMD. Sharma S et al[23]also found a positive relationship between BMD and BMI correlation coefficient was0.192.

WasanA et al[24]found the highest percentages of osteopenia and osteoporosis, 48.3% and 44.7%, respectively in obese patients. No significant correlations was found by them between the BMI and BMD in osteopenia and osteoporosis (p-value = 0.2001 and p-value = 0.4622), respectively.

In present study normal group BMD lumbar spine mean was 1.18± 0.12, mean lumbar spine t score was 0.12± 0.79 and mean lumbar spine Z score was -0.50± 1.46 whereas in low BMD group BMD lumbar spine mean was 0.81± 0.14, mean lumbar spine t score was -2.39± 0.95 and mean lumbar spine Z score was -1.05± 1.33. there was a significantly low lumbar spine BMD ,lumbar spine T score and lumbar spine z score was found in osteopenic and osteoporotic patients(p<0.001).

In present study normal group BMD femur neck mean was 1.05± 0.14, mean femur neck T score was -0.04± 0.69 and mean femur neck Z score was 0.27± 0.86 whereas in low BMD group BMD femur neck mean was 0.69± 0.14, mean femur neck T score was –1.97± 0.85 and mean Femur neck Z score was -0.86± 0.99. there was a significantly low femur neck BMD ,femur neck T score and femur neck Z score was found in osteopenic and osteoporotic patients(p<0.001).

Kadam NSet al[25] in their study reported significantly lower T-scores which was observed at LS in men compared to premenopausal (P < 0.05). At left femur, T-scores were lower in men compared to premenopausal women (P < 0.05) but not postmenopausal women (P > 0.1). The prevalence of osteoporosis in men at LS was lower than postmenopausal women but higher than premenopausal women. The authors concluded that in Indian men, a low T-score compared to women indicates higher susceptibility to osteoporosis. However no men we included in the present study.

Aghaeiet al[21] in their study reported Mean T-Score at lumbar spine and femoral neck was −1.07 ± 1.19 and −1.75 ± 1.33 respectively. Mean BMD value at lumbar spine and

femoral neck was 0.92 ± 0.19 and 0.77 ± 0.16 respectively. The prevalence of osteoporosis at lumbar spine and femoral neck was 33.7% and 16.7, respectively. In our study prevalence of osteoporosis at lumbar spine and femoral neck was 26.8% and 16.2%.

Conclusion

Within the limits of our study we conclude that osteoporosis is one of the growing concern and need immediate care. The lack of information regarding risk factors for osteoporosis among women is an important problem. Our results highlight the importance of knowledge regarding the risk factors like age, menopausal status, physical activity, smoking, socioeconomic status, geographical location, weight ,BMI etc. There is the need for more effective education for the community and medical practitioners for the clinical significance of osteoporotic fractures and its risk factors.

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