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Research Article

Status of Bone mineral density in adult North Indian population using Dual-energy x-ray absorptiometry (DEXA) Scan

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Abstract
Introduction: *Osteoporosis and osteopenia are a major public health problem, associated with substantial morbidity and socio-economic burden. An early detection can help in reducing the fracture rates and overall socio-economic burden. The present study was conducted to find out its burden in the society and give appropriate care to the participants.*
Material & Methods: *A cross sectional study conducted in rural field practice area of MMIMSR between October, 2018 to March, 2019. BMD at postero-anterior lumbar spine (L2–L4) and bilateral hip joint was assessed by Hologic Explorer QDR Series bone densitometer for each participant.*
Results: *In the current study, he overall prevalence of osteoporosis was found to be higher among the male participants (26.25%) than their female counterparts (16.25%). Maximum participants who were osteoporotic were between the age group 51 to 70 years (17.5%) followed by 71 to ≥80 year's old patients (11.25%).*
Conclusion: *A significantly larger proportion of otherwise normal healthy men in our community had osteoporosis as compared to the previous notions known. It is therefore necessary to create awareness among men and women from Indian subcontinent, irrespective of their geographic location, about the risk of osteoporosis and educate those regarding preventive measures to avoid future fractures secondary to osteoporosis. There is also a need for large community-based studies so that high-risk population can be picked up and early interventions like adequate calcium intake, vitamin D supplementation, and other life style changes can be instituted.*
Keywords: *Osteoporosis, Osteopenia, DEXA-Scan, Bone density.*

Introduction

Osteoporosis is a metabolic bone disease where bone mass decreases and the bone micro architecture gets deteriorated.[1] It has serious implications on the economic growth and the public health of a nation. It may go unnoticed until further progression leading to friability fractures, spine fractures and pain in the bone's. When the Bone Mineral density (BMD) is lower than the normal peak value, but not so low as to be referred to as osteoporosis, it's called **Osteopenia**. This increases the risk of osteoporotic fractures and osteoporosis in the patients as they age. Osteoporosis is a disease recognized as a health problem worldwide and in India, medical practitioners often come across post-menopausal women and geriatric people suffering from it. Currently India has 15,44,00,705 people who are above the age of 50 years.[2] Osteoporotic fractures are related to substantial pain, disability, suffering resulting in death of the patients affected. As the longevity is increasing, the global number of geriatric population in on an ever increasing pace, India's life expectancy at present is approximately 67 years which is expected to increase to 71 years by 2025.[3] The Indian population above the age of 60 years has a likelihood of reaching at 34% by 2050.[4]Thus these trends would leave a higher percentage of population which could suffer from osteopenia and osteoporosis. In the year 2013, 50 million Indians had T-Score < -1.3.[5]

Dual-energy x-ray absorptiometry (DEXA) has been recognized as the gold standard method to detect the bone mineral density (BMD) of an individual. It has a good precision, accuracy error and reproducibility.[6] An accurate diagnosis, patient monitoring and risk estimation can be done using DEXA. In reference, DEXA has been assigned as the "GOLD STANDARD" to calculate the BMD at central and peripheral skeletal sites. It emits low dose of radiation and has high precision which makes it a better diagnostic tool. Many studies suggest that the bone strength and bone mineral density have a direct correlation. Thus BMD can be used to calculate the risk of having osteoporotic fractures in a patient. Results of DEXA Scan are calculated in form of T-Scores which is the difference between individual BMD and the mean BMD of a group of young persons of the same sex (peak BMD), divided by the group standard deviation (SD)[7] and Z-Scores which is the comparison to the **age-matched normal** and is usually used in cases of severe osteoporosis. This is the number of standard deviations a patient's BMD differs from the average BMD of their age, sex, and ethnicity.[6] Central and peripheral devices are the two types of DEXA equipment's used to calculate BMD. Central DEXA Scanner measures bone mineral density at the spine and the hip bilaterally and are usually installed in the health care centers or hospitals. It has much more sensitivity than the peripheral DEXA Scanner but is more expensive. It directly measures the BMD unlike the peripheral site techniques like the Radiographic Absorptiometry (RA) or the Quantitative Ultrasound (QUS).[8]

Objectives

The objectives of this study were:

i. To collect normative data for bilateral hip and spine BMD in Indian women and men;
ii. To evaluate the prevalence of osteoporosis in study participants using calculated central DEXA T-scores and published bone densitometer-specific T-score threshold values.

Material and Methods

This is a cross sectional study conducted in rural field practice area of MMIMSR catered by RHTC, Adhoya.

Sample: A total of 80 participants consisting of 42 males and 38 female subjects were enrolled into the study who visited the OPD at this center between October, 2018 to March, 2019. A Bone density Measurement camp was thereafter set up sponsored by a pharmaceutical company (Torrent) in March, 2019 at the centre where all the

recruited patients were assessed. Informed consents were obtained from all the participants and they participated in the study on voluntary basis. Exclusion criteria included pregnancy, documented osteoporosis or osteopenia, non ambulatory subjects, and those not willing for continued follow-up.

BMD at postero-anterior lumbar spine (L2–L4) and bilateral hip joint was assessed by **Hologic Explorer QDR Series bone densitometer**. Subjects were considered at moderate risk if T score was between less than –1 and –2.5 and diagnosed with Osteopenia and at high risk if T score was less than –2.5 and diagnosed as Osteoporosis, according to the WHO classification.[9] After testing, the patients were informed about the results of their investigations and counseled regarding risk of osteoporosis. Education regarding the screening results and standard information on dietary recommendations and supplementation and lifestyle modification. The patients were provided with appropriate pharmacological therapy and an orthopaedic consultation was given to all those in the osteopenic and osteoporotic spectrum.

Statistical Analysis:

Qualitative variable is expressed as percentages and quantitative variable is expressed as mean and standard deviation. Pearson's chi square test is used to examine the differences in prevalence of osteoporosis and osteopenia. Associations were considered statistically significant at $P<0.05$ level at confidence interval of 95%. All statistical analyses were performed by using SPSS version 20 statistical package.

Results

In the current study, maximum study participants were between ≤30 to 50 years old (41.25%) followed by 51 to 70 year old's (38.75%). 52.5% of the participants were females while 47.5% were males.

When the Bone Mineral density T-scores were measured for the participants at various sites, highest value for osteoporosis (-3.28 ± 0.91) and for osteopenia (-1.58 ± 0.40) was found at lumbar spine. (Table 1)

When the correlation was evaluated between Bone Mineral density (T-score) at Right Hip and gender, it was found that higher prevalence of osteoporosis (16.66%) and of osteopenia (16.66%) was amongst male participants. This association was found to be statistically insignificant (p = 0.194) (Table 2)

When similar correlation was evaluated for Left Hip, similar pattern was observed with 16.66% males being osteoporotic and 28.75% of males osteopenic. This number was higher than the female participants. This association was found to be statistically significant (p = 0.037) (Table 2)

On evaluation of the correlation between the age of study group and the BMD T-scores, it was observed that maximum participants were osteoporotic (26.25%) at lumbar spine (lowest T-score) compared with the other 2 sites. Similarly lowest T-score was found at lumbar spine for 30% of the participants followed by 20% participants having slightly higher T-score (osteopenic) at Left hip Joint. These associations were found to be statistically insignificant.12.5% of participants had osteoporosis according to T-Score at Right Hip Joint. The association was found to be statistically significant (p = 0.037) (Table 3)

The overall prevalence of osteoporosis was found to be higher among the male participants (26.25%) than their female counterparts (16.25%). Maximum participants who were osteoporotic were between the age group 51 to 70 years (17.5%) followed by 71 to ≥80 year's old patients (11.25%). The correlation between these parameters were found to be statistically insignificant. (Table 4)

Table 1: Mean Bone Mineral Density at various sites

Right Hip Bone Mineral Density (T-Scores)	Mean Value (Standard Deviation)		
	Normal	Osteopenia	Osteoporosis
	0.52 ± 0.83	-1.58 ± 0.40	-3.10 ± 0.62
Spine Bone Mineral Density (T-Scores)	0.50 ± 0.85	-1.88 ± 0.36	-3.28 ± 0.91
Left Hip Bone Mineral Density (T-Scores)	0.36 ± 0.75	-1.63 ± 0.478	-3.11 ± 0.52

Table 2 Association of gender with osteoporosis and osteopenia (n=80)

		Bone Mineral Density(T-SCORE) (Right Hip Joint)			Total	P-Value (95% CI)
		Normal	Osteopenia	Osteoporosis		
Gender	**Male**	28(66.66)	7(16.66)	7(16.66)	42	0.194
	Female	32(84.21)	3(7.89)	3(7.89)	38	
Total		**60(75)**	**10(12.5)**	**10(12.5)**	**80**	
		Bone Mineral Density(T-SCORE) (Left Hip Joint)				
Gender	**Male**	23(54.76)	12(28.75)	7(16.66)	42	0.037
	Female	31(81.57)	4(1.05)	3(7.89)	38	
Total		**54(67.5)**	**16(20)**	**10(12.5)**	**80**	
		Bone Mineral Density (T-SCORE) (Spine)				
Gender	**Male**	18(42.85)	13(30.95)	11(26.19)	42	0.979
	Female	17(44.73)	11(28.94)	10(26.31)	38	
Total		**35(43.75)**	**24(30)**	**21(26.25)**	**80**	

Table 3: Association of age with osteopenia and osteoporosis (n=80)

Age group (Years)	Bone Mineral Density (T-SCORE) Right Hip Joint			Total	Chi-square test (95%CI)
	Normal (n)	Osteopenia (n)	Osteoporosis (n)		
≤ 30 - 50	27 (81.8)	4(12.1)	2(6.06)	33	$X^2 = 10.2278$ p = 0.037
51 - 70	25(80.64)	1(3.22)	5(16.13)	31	
71 - ≥ 80	8(15)	5(31.25)	3(18.75)	16	
Total	**60(75)**	**10(12.5)**	**10(12.5)**	**80**	
	Bone Mineral Density (T-SCORE) Left Hip Joint				
≤ 30 - 50	26(78.79)	5(15.15)	2(6.06)	33	$X^2 = 6.95$ p = 0.138
51 - 70	21(67.74)	5(16.13)	5(16.13)	31	
71 - ≥ 80	7(43.75)	6(37.5)	3(18.75)	16	
Total	**54(67.5)**	**16(20)**	**10(12.5)**	**80**	
	Bone Mineral Density (T-SCORE) Spine				
≤ 30 - 50	20(60.60)	8(24.24)	5(15.15)	33	$X^2 = 7.376$ p = 0.117
51 - 70	11(35.48)	10(32.25)	10(32.25)	31	
71 - ≥ 80	4(25)	6(37.5)	6(37.5)	16	
Total	**35(43.75)**	**24(30)**	**21(26.25)**	**80**	

Table 4: Prevalence of osteopenia and osteoporosis in population (n=80)

		Osteopenia	Osteoporosis	Chi-square test
Age group	**≤ 30 - 50**	5(6.25)	11(13.75)	$X^2 = 0.624$ p = 0.732
	51 - 70	10(12.5)	14(17.5)	
	71 - ≥ 80	7(8.75)	9(11.25)	
Total		**22(27.5)**	**34(42.5)**	
Gender	**Male**	12(15)	21(26.25)	$X^2 = 0.0667$ p = 0.796
	Female	10(12.5)	13(16.25)	
Total		**22(27.5)**	**34(42.5)**	

Discussion

- In India, the precise figures on the prevalence of osteoporosis are not available at present. 1 out of 8 males and 1 out of 3 females in India suffers from osteoporosis, making India one of the largest affected countries in the world.
- Total prevalence of osteoporosis was 42.5% while of osteopenia was 27.5% in this study group. Concurrent results were seen by **Babu AS. et al**[10] where prevalence of osteoporosis was 42.2% .
- In our study, we attempted to look at the prevalence of osteoporosis and osteopenia in healthy male and female subjects of North India.
- Male osteoporosis is an underreported public health problem. This study is conclusive of the following trend. When it was expected that females should show higher prevalence, males in this study population showed a higher prevalence at 26.25%. **Melton LJ. et al**[11]in their study at Rochester saw similar results where prevalence of osteoporosis was 19% amongst male study subjects.
- In this study osteopenia amongst males of northern region was found to be much less at 15%. **Shetty S. et al**[12] conducted a study on 252 males residing in urban areas of South India and found prevalence of osteoporosis at any one site was 20% and that of osteopenia was a much higher at 58%.
- This study shows females in North India have lower prevalence of osteoporosis (16.25%) and of osteopenia (12.5%) compared with men. Similar results were seen by **Acharya et al**[13]who conducted a retrospective study using DEXA scan records which showed that 18.1% females in the study were osteoporotics while 47% were osteopenics. Similarly through a cross sectional study conducted amongst women in 2013, **Agrawal T. et al**[14] found that 13.3% of study subjects were osteoporotics.
- In the present study, the Mean BMD was lowest at the Lumbar spine (-3.28 ± 0.91 for osteoporotics and -1.88 ± 0.36 for osteopenics) followed by BMD at Right hip joint and Left hip joint respectively. Consistent results were seen in a study by **Choe HS. et al**[15] where lowest BMD was found at Lumbar spine (-2.57 ± 1.16 for osteoporotics and -1.01 ± 0.93 for osteopenics) followed by Femoral neck BMD.
- This study shows higher prevalence of osteoporosis at Left hip joint amongst males (16.66%) compared to females (7.89%) (p-value = 0.03). The reason for this discordance could be multiple: genetics, dominance, immobilization, training, working procedures, osteoarthrosis/-arthritis, illnesses, etc.
- Osteopenia in this was higher in males (15%). Similar trend was seen in a study by **Dutta N. et al**[16] where 45.5% males were osteopenics. In a study by **Looker AC. et al**[17]28–47% men from their study population had osteopenia.
- This study shows overall highest prevalence of osteoporosis at lumbar spine (26.25%) compared to 12.5% and 12.5% respectively at Left hip joint and Right hip joint for either of the gender. Also **Paul T. et al** [18]found similar results in south Indian population where higher percentage of osteoporosis prevalence was found at spine (42.7%) than at hip (11.4%). Similar results were seen by **Lee J. et al**[19] in their study subjects from Korea where highest prevalence of osteoporosis was seen at Lumbar spine for both the genders.
- This study shows an overall 30% osteopenia at lumbar spine while it was 20% at Left hip joint and 12.5% at Right hip joint for both gender. **Thangwijitra S. et al**[20] reported a similar trend amongst

females where prevalence of osteoporosis and osteopenia both were almost equal at lumbar spine and at hip joint. **Hilmi I.et al**[21] observed where higher prevalence of osteopenia was found at Lumbar spine (58%) than at the hip joint(51%).

Conflict of Interest: NA
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