



PREVALENCE OF OSTEOPOROSIS AND OSTEOPENIA IN SOUTH INDIAN POPULATION USING CALCANEAL QUANTITATIVE ULTRASOUND TECHNIQUE

Orthopedics

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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 the South Indian population. **Materials and Methods:** A cross sectional study was done in a tertiary-care hospital involving 776 subjects who approached bone mineral density camp. It was measured using calcaneal quantitative ultrasonography (QUS) and T-scores were calculated.

Results: We evaluated 776 subjects (age 43.25 ± 14.28 years) including 445 female and 331 male. Osteoporosis was present in 23.6% subjects (female, 25.4%; male, 21.1%) and osteopenia in 41.1% subjects (female, 40.9%; male, 41.4%).

Conclusion: Prevalence of osteoporosis is steeply rising in recent times. To the contrary men are equally affected as women.

KEYWORDS

Osteoporosis, Bone mineral density, Prevalence, T-score

INTRODUCTION

Osteoporosis is a global public health problem affecting over 200 million people worldwide. It is a disease characterized by reduction in bone mass and disruption of bone architecture leading to impaired skeletal strength and an increased predisposition to fractures¹⁻³. Osteoporosis has clinical and public health implications because of mortality, morbidity and cost of medical care related with osteoporotic fractures⁴. Hip fractures are useful surrogate for determining the international burden of osteoporosis. India is the osteoporotic capital in the world with 1 out of 8 males and 1 out of 3 females suffer from osteoporosis. Fracture risk is multi-factorial; thus, many independent factors, including those related to the risk of fall, contribute to the risk over and above that reflected by BMD⁵. In India, osteoporotic fractures occur 10-20 years earlier than in western countries. It is estimated that more than 50% of all osteoporotic hip fractures in the world will occur in Asia by the year 2050^{1,4}.

It is invariably associated with vitamin D deficiency which is most common and pandemic, and it is the most underdiagnosed and undertreated nutritional deficiency in the world⁶. Osteoporosis has haunted women since the dawn of history. Egyptian mummies from 4000 years ago have been found with the telltale dowager's hump⁷. But it equally affects both sexes in recent times¹. Low bone density exhibits the main risk factor for osteoporosis, other risk factor includes progressive age, early menopause and reduced intake of calcium and vitamin D along with lack of sunlight exposure⁸. Education and literacy level does not influence occurrence of osteoporosis⁹. In a review article, Lei et al noted that though osteoporosis is a serious health problem in both Caucasians and Asians, both are two distinct major ethnic groups which may have differential genetic determination underlying complex genetic diseases such as osteoporosis. A number of bone related candidate genes such as estrogen receptor gene and vitamin D receptor gene, alpha2-HS-glycoprotein and parathyroid hormone have been investigated for their association with bone phenotypes⁴.

Dual energy X-ray absorptiometry (DEXA) technology, the gold standard for diagnosing osteoporosis by measuring bone density^{1,2}. However, there are several limitations of DEXA, which prevent it from being used for mass screening of osteoporosis. A population based screening program is currently necessary as osteoporosis is a rising healthcare problem in the developing countries¹. Different sites have been used for estimation of bone mineral density like vertebra, hip and forearm by DEXA, but Quantitative Ultrasound (QUS) of cancellous bone in the heel still remain the commonest modality for measuring bone density. Moreover, QUS screening conclusively confirms or rules out osteoporosis and osteopenia in any population¹⁰.

An understanding of BMD pattern in a population is crucial for prevention, diagnosis of osteoporosis and management of its

complications in later life. There is not much data on prevalence of osteoporosis/osteopenia in Indian population. We undertook current investigation to examine the prevalence of osteoporosis/osteopenia on community basis using ultrasound bone densitometer.

MATERIALS AND METHODS

A cross sectional study was conducted by Institute of Orthopaedics and Traumatology at Coimbatore medical college hospital, Tamil Nadu, India for screening the people using Calcaneal QUS based SOS approach. The study group consisted of 776 subjects who approached bone mineral density camp conducted on October 2019, in our institute. The age group was between 17- 85 years. Out of 776 subjects included in the study, 331 were male and 445 were female.

A trained technician using QUS measured the BMD of the right side calcaneum of the individuals. Bone has a mechanically anisotropic structure (Figure 1). In contrast to bone density measurements based on X-ray attenuation, ultrasound parameter reflects the anisotropic of bone^{1,2,11}. Therefore, QUS may have greater potential to be used in the assessment of bone strength^{11,12}. The system consisted of unfocused transducers. There are two probes on the QUS device: the emission and receiver probes. The sound waves produced by any unique piezo electric probes are emitted and travelled longitudinally or horizontally through the bone under study^{1,11}. The segment of bone under study will be placed between these probes and the ultrasound waves emitted from the emission probes will be sensed by the receiver probe. According to the International Society of Clinical Densitometry (ISCD) Calcaneal QUS is the only recognised measurement of QUS as the determinant of bone health status^{1,11}.

T-scores were obtained and categorised based on WHO classification (Table 1). Individuals with T score value less than -2.5 were categorised as osteoporotic and those T score between -2.5 to -1 were considered osteopenic and those with T Score value more than -1 were considered to be normal. The results were analyzed statistically using the Chi-square test. The statistical significance was set at p value <0.05.

RESULTS

We studied 776 subjects (age 43.25 ± 14.28 years: range 17-85 years) who were categorised into two groups based on sex. Study population included 331 (42.7) males and 445 (57.3) females. Indian Council of Medical Research carried out a large multicenter study, which confirmed data from smaller, single center studies, and showed that Indians have lower mean BMD. In the present study, prevalence of osteoporosis and osteopenia among the people was 23.6% and 41.1% respectively (Figure 2).

Association between gender and BMD

In the study (Table 2) low BMD accounts for about 66.3% among females and 62.5% among males. This is in concordance with some of

the recent studies on osteoporosis. It says men are equally vulnerable to osteoporosis in recent times (Figure 3). In majority of studies conducted on osteoporosis prevalence of low BMD is more among females.

Association between age and BMD

Advancing age is the major risk factor for developing osteoporosis. Low BMD in the age group of 16-30, 31-45, 46-60, 61-75, 75-100 are 51.5%, 62.6%, 72.3%, 75.4%, and 84.6% respectively (Table 3). There is steep increase in low BMD as the age advances. Osteopenia persists equally among 16-30 (42.05%), 31-45 (43.7%) and 46-60 (41.75%) age group (Table 3).

Association between age-wise gender distribution and BMD

In the age-wise statistical data analysis (Table 4), there was a high prevalence in the age group of 45-60 years, pertaining to the old age. In the gender-wise statistical data analysis, the prevalence osteopenia among females in the age group 16-30, 31-45, 46-60 are 42.3%, 42.2%, and 40.8% respectively (Table 4). Osteopenia would be replaced by osteoporosis in early period in these subjects. In the age group 16-30 years the prevalence of osteoporosis was 14.9% in males comparable to 5.8% in females. In the age group 46-60 and 61-75 years the prevalence of osteopenia and osteoporosis are 42.7%, 21.9% and 19.4%, 47.2% respectively. It seems osteopenia converted to osteoporosis as age advances. Thus it is clearly evident that age and gender plays an important role in the pathogenesis of osteoporosis.

DISCUSSION

Overall prevalence of osteoporosis and osteopenia was about 23.6%, and 41.1% respectively in the age group 17-85 years. It is quite high because the study includes more of middle aged and elderly people. This is comparable with other Indian studies (Table 5). The worldwide incidence of osteoporosis is rising because of increase in the aging population and sedentary lifestyle². Approximately 60 million people at present have osteoporosis in India. The rate of hip fractures is expected to triple over the next three decades. Once the woman is in her fifth decade, there is a gradual loss of BMD. It is noteworthy that there is considerable increase in bone loss during the 5 years immediately following menopause.

In the present study, prevalence of osteoporosis and osteopenia among women 25.4% and 40.9% was comparable with men 21.1% and 41.4% respectively. It seems to be men are equally affected as women. This is in concordance with few studies and contradictory to most studies in the literature. According to Sengodan VC¹ et al., the prevalence of low BMD was 33.4% among males and 36.4% among females. According to Prasad D V¹³ et al., the prevalence of osteoporosis studied using Calcaneal QUS in health care professionals was 23.03% among males and 34.21% among females. Pande KC using digital X-ray radiogrammetry revealed that 29.9% of women and 24.3% of men between the age of 20 and 79 years had low bone mass.

In the present study the prevalence of osteoporosis in the young generation (16-30 years) was 17.8% (male-14.9%, female-5.8%). It is quite uncommon. It says the impact of sedentary lifestyle and usage of electronic gadgets among younger generation irrespective of gender. In a study conducted by Sengodan VC¹ et al., the prevalence of osteoporosis among young nursing students (17-21 years) was 8.37%. The prevalence of osteoporosis among male doctors was 11.32% whereas in female doctors it was 10.9%. Hence, in concurrence with previous suggestions, active young male adults must also be screened and treated for osteoporosis. However most of the studies showed female predominance. This also suggests that even in younger generation the prevalence is quite high when compared to older times. This prompts to find out the recently developing risk factors among the people such as level of physical activity reduced markedly, sophisticated mode of transportation, addiction to smoking and other mode of tobacco consumption and lack of awareness even in literates. School and College curriculum have to include awareness programs to compete the modifiable risk factors from emerging among young people.

The prevalence of low BMD among women in the age group of 46-60 years was 76%. According to Sengodan¹ VC et al., the prevalence of 58.75% of low BMD level was reported among women in the age group of 40-60 years. According to Pavalan Louis² et al., the prevalence of either osteopenia or osteoporosis was almost 90% in the population above the age of 50 years. Prevalence of low BMD is

increasing as the age advances¹. Osteopenia persists equally among 16-30, 31-45, and 46-60 age group (Table 3). They are more vulnerable to become osteoporosis in near future if there are not properly counseled and managed by awareness.

Prevalence of osteoporosis and osteopenia was 36.3% and 40.8% respectively in age 45-60 years of women. This is comparable with other studies. Marwaha et al reported an overall prevalence of osteoporosis of 42.5% in women above 50 years of age. Lu et al have reported a prevalence of 18.4% in Chinese women above 50 years of age while Korean women showed a prevalence of 24.4%. A study on Iranian women above 45 years reported a prevalence of 50.7% while another study by Ejaz et al suggests a higher prevalence of osteoporosis in Pakistani postmenopausal women (49.3%). The present study and other Indian studies such as Marwaha et al., Aggrawal (2011)¹⁴, and Shetty et al., have also reported high prevalence of osteopenia in Indian population indicating the need to target this population at risk for preventing the progression to osteoporosis related complications in future⁸.

Sanjeev Chaudhary et al⁹, clearly stated that osteoporosis is high amongst working women, teachers and housewives but it is quite low in tribal, farm workers and labour class women. Education and literacy standard does not influence the occurrence of osteoporosis. High sunlight exposure and increased activity levels in the tribal and farm worker group accounts for decreased prevalence compared to executive job and housewife group. According to Sunil Nikose the prevalence osteoporosis in rural community has less linear correlation with age group of the patients; rather it is closely related with socioeconomic status and emotional family support of the patients⁷. Shazia Haris et al concluded that low BMD has strong association with overweight and non-communicable diseases like diabetes and depression¹⁵. This clearly indicates stress and emotional deprivation are risk factors for developing osteoporosis.

Osteoporosis is a major global public health problem associated with significant morbidity, mortality, and socioeconomic burden¹. Despite this, it often remains undiagnosed until a fracture occurs. QUS is an affordable and portable technique reported to predict the risk of osteoporotic fractures in elderly women. The use of an economical method for screening BMD is the need of the hour in our country for population-based screening.

CONCLUSION

Prevalence of osteoporosis is steeply rising in recent times. To the contrary men are equally affected as women. The need of the hour is to establish risk factors and preventive measures to combat the complications and to lead the prosperous old age. Lack of physical activity, Increased bodyweight, smoking, lack of calcium in diet, reduced sun exposure, chronic illness and emotional deprivation can be attributed as risk factors. Government have to analyse the burden of silent disease to the society and create awareness programs and policies to prevent it. However our study group was small with only 776 subjects. A large multicentric study is warranted.

FIGURES:

Figure 1: Trabecular bone.

X-ray micro-computed tomography image (showing a 4 x 4 x 4 mm volume of human calcaneal (heel) bone).

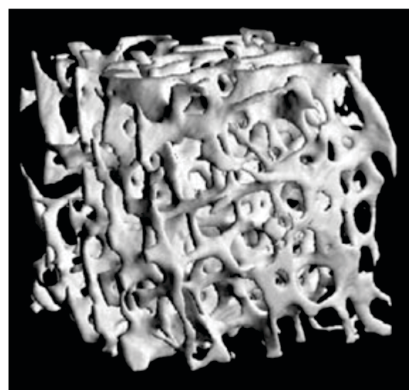


Figure 2: Prevalence of osteoporosis and osteopenia in the present study

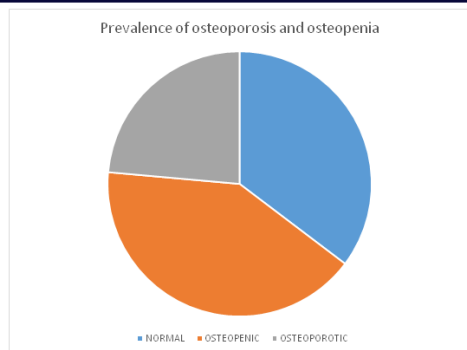


Figure 3 : Genderwise distribution of BMD

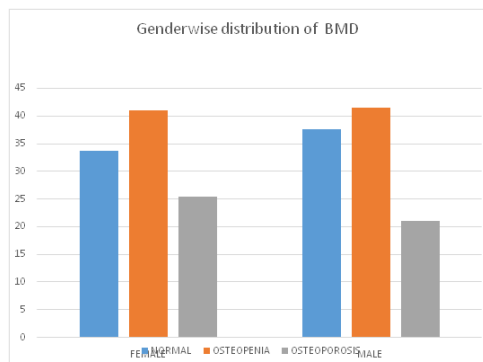


Table 1: WHO classification of BMD

T score	Classification
T > -1.0	Normal
-1.0 > T > -2.5	Osteopenia
T < -2.5	Osteoporosis

Table 2: Association between gender and BMD

Result			gender		P VALUE
			F	M	
Result	Normal	Count	150	124	0.330
		% within result	54.7%	45.3%	
		% within gender	33.7%	37.5%	
	Osteopenic	Count	182	137	
		% within result	57.1%	42.9%	
		% within gender	40.9%	41.4%	
	Osteoporotic	Count	113	70	
		% within result	61.7%	38.3%	
		% within gender	25.4%	21.1%	

Table 3: Association between age and BMD

Crosstab		age_group						P Value
			16 to 30	31 to 45	46 to 60	61 to 75	76 to 100	
result	normal	% within result	30.3%	38.0%	25.5%	5.5%	7.9%	0.000
		% within age_group	48.5%	37.4%	27.7%	24.6%	15.4%	
		Count	72	121	105	13	8	
	osteopenic	% within result	22.6%	37.9%	32.9%	4.1%	2.5%	
		% within age_group	42.1%	43.5%	41.5%	21.3%	61.5%	
		Count	16	53	78	33	3	
	osteoporotic	% within result	8.7%	29.0%	42.6%	18.0%	1.6%	
		% within age_group	9.4%	19.1%	30.8%	54.1%	23.1%	
		Count	88	174	183	46	11	
	below normal	Count	88	174	183	46	11	
		Percentage within age_group	51.5	62.6	72.3	75.4	84.6	

Table 4: Association between age-wise gender distribution and BMD

result * age_group * gender Crosstabulation									
Gender				age_group					P value
				16 to 30	31 to 45	46 to 60	61 to 75	76 to 100	
F	Result	NORMAL	Count	54	57	36	3	0	1500.000 100.0% 033.7%
			% within result	36.0%	38.0%	24.0%	2.0%	0.0%	
			% within age_group	51.9%	37.0%	22.9%	12.0%	0.0%	
		OSTEOPENI C	Count	44	65	64	6	3	182100.0% 40.9% 113100.0%
			% within result	24.2%	35.7%	35.2%	3.3%	1.6%	
			% within age_group	42.3%	42.2%	40.8%	24.0%	60.0%	
		OSTEOPOR OTIC	Count	6	32	57	16	2	445100.0% 1.8% 100.0%
			% within result	5.3%	28.3%	50.4%	14.2%	1.8%	
			% within age_group	5.8%	20.8%	36.3%	64.0%	40.0%	
M	Result	NORMAL	Count	29	47	34	12	2	124100.0% 37.5% 0.007137
			% within result	23.4%	37.9%	27.4%	9.7%	1.6%	
			% within age_group	43.3%	37.9%	35.4%	33.3%	25.0%	
		OSTEOPENI C	Count	28	56	41	7	5	100.0% 21.1%
			% within result	20.4%	40.9%	29.9%	5.1%	3.6%	
			% within age_group	41.8%	45.2%	42.7%	19.4%	62.5%	
		OSTEOPOR OTIC	Count	10	21	21	17	1	1.4% 12.5%
			% within result	14.3%	30.0%	30.0%	24.3%	1.4%	
			% within age_group	14.9%	16.9%	21.9%	47.2%	12.5%	

Table 5: Indian studies on osteoporosis:

Researcher	subject	Study type and findings
Sengodan VC et al (Tamil Nadu - 2018)	A total of 863 individuals of which 215 were males and 648 were females	Prevalence of low BMD is about 33.4% in males and 36.4% in females
Louis P, Sengodan VC et al., Tamil Nadu (2019).	500 women of low socioeconomic status	The prevalence of low BMD was 74% by spine BMD, 66% by hip BMD using DEXA scan.
KannanRajendran(2015) Chennai-India	A total of 183 individuals of which 79 males and 104 females were screened	The BMD in the age group more than 20 years was evaluated. The prevalence of osteoporosis was 29.5% and osteopenia was 42.1%
Priya A Vasanthi(2016) Kerala-India	A total of 400 women aged between 40 and 60 were screened	The prevalence of osteoporosis was 17.25% and osteopenia was 41.5%
Sunil Nikose Maharashtra(2015)-India	A total of 3532 females in the age group of 20-76 years were screened	In the age group between 20 and 76 years, the prevalence of osteoporosis was 32.13% and osteopenia was 35.78%
SanjeevChoudhary et al - 2019 - Maharastra	A total of 3287 women aged above 45 years	Prevalence of 43.3%, high among executive females (55.2%) than tribal women (31.08%)
NeelamKaushal et al - 2018- New Delhi	Healthy 524 subjects	Prevalence of osteoporosis and osteopenia was 6.9% and 34% respectively.
Nandita Dutta et al - 2015	93 subjects	Prevalence of osteoporosis 85.7% in age group 50-60 years and 87.5% in age above 60 years. Prevalence of osteopenia was 68.5% in age group of 40-50 years.
Nandita Dutta et al	A total of 93 subjects(60 females)	The study revealed that the prevalence of osteoporosis in

(2015)Assam - India	and 33 males)aged more than 40years were screened	the age group between 50 and 60 years was 85.71% and more than 60 years was 87.5%.In the group between 40 and 50 years, the prevalence of osteopenia was 68.75%
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