Original Research Article

Prevalence and determinants of osteoporosis in women aged 40-60 years

Priya A. Vaasanthi, Sreekumary Radha, Bindu Nambisan*

Department of Obstetrics and Gynaecology, Medical College, Trivandrum, Kerala, India

*Correspondence:
Dr. Bindu Nambisan,
E-mail: bindu.nambisan1971@gmail.com

ABSTRACT

Background: Osteoporosis is a global problem which is affecting both the developed and the developing countries and also affecting men and women alike. In our community, it has been affecting adult women at a considerably earlier age than the western counterparts. Increasing life expectancy and a consequent increase in the elderly population has posed a new challenge to their health needs. Fractures related to osteoporosis are quite common. It is also an established fact that bone density measurements correlate well to the risk of developing fracture. This can be measured using DEXA (Dual energy X Ray Absorptiometry) and Quantitative Ultrasound (QUS). It is estimated that 1 out of 8 males and 1 out of 3 females suffer from this, making India one of the highest affected counties in the world.

Methods: This was a cross sectional study done over a period of 12 months at this tertiary care centre in Trivandrum, Kerala. A sample size was calculated statistically and 400 women in this age group were included in this study. A structured proforma and QUS were the study tools. The bone mineral density of the calcaneum on the right foot was measured. The t-score values were obtained using quantitative ultrasound and individuals with the score values less than -2.5 were categorized as osteoporotic.

Results: In this hospital, prevalence of osteoporosis is 17.25 % and findings suggest a significant positive correlation between age, time since menopause, sunlight exposure, family history of osteoporosis and Bone mineral density.

Conclusions: Quantitative ultrasound conclusively confirms or rules out osteoporosis or osteopenia in any population and can be used as a screening tool.

Keywords: DEXA, Osteoporosis, QUS

INTRODUCTION

Osteoporosis is a global problem with a high prevalence in the developed countries and an increasing trend in developing countries owing to increased longevity.[1] This has posed a new challenge to the health needs and care of elderly. An International consensus development conference has stated that osteoporosis is a systemic skeletal disease characterized by low bone mass and micro-architect deterioration of bone tissue with consequent increase in bone fragility and susceptibility to fractures.[2]

It is characterized by generalized reduction in bone mass due to subnormal osteoid production, excessive rate of de-ossification and sub normal osteoid mineralization. The recent World Health Organization (WHO) criteria, states that osteoporosis is also used to designate a bone mass value more than 2.5 standard deviations (SD) below the young adult mean.[3] Recent surveys state that osteoporosis is second only to cardiovascular disease as a global health care problem. This slowly progressing metabolic bone disease is widely prevalent in India. It is estimated that by 2050, half of the world's fractures will occur in Asia.[4,5] Almost one in three urban Indian women past the age of 45 has osteoporosis. Several studies have noted that Indian women suffer from this debility at a

much younger age than their western counterparts. Fractures related to osteoporosis are common. Statistics show that 1 in 3 women over 45 will suffer a fracture due to osteoporosis; this increases to 1 in 2 over 60 years.[6] The lifetime risk for an osteoporotic fracture of hip, spine or wrist has been reported to be 40%. Hence necessary steps should be taken to screen the women aged 40 -60 yrs for osteoporotic risk and prevent them from developing osteoporosis at an early age. This reduces the burden of health care system as treatment of osteoporosis is expensive. Globally, the total number of deaths related to hip fracture disease ranges from 20,000 to 30,000 annually. The annual incidence rate of osteoporotic fractures in women is greater than the combined incidence rates of heart attack, stroke and breast cancer.[7] Once a woman suffers a first vertebral fracture, there is a five-fold increase in the risk of developing a new fracture within five years. Apart from fractures, clinical manifestations of osteoporosis includes acute or chronic back pain, loss of height with change in body stature, restricted movement, immobility, dependence on nursing, loneliness, depression, reduced quality of life, and increased mortality. The risk factors for osteoporosis include increasing age, female sex, Asian origin, weight below 58 kg, BMI <25, family history of osteoporosis, family history of hip fracture, sedentary lifestyle, premature ovarian failure, nutritional deficiency of calories, proteins, low calcium intake, excessive consumption of caffeine and alcohol and chronic illness like diabetes, hypertension, ischaemic heart disease, lung diseases, mal-absorption syndrome and breast cancer.

Bone mineral density is the best available means to assess bone strength and the only important tool in the early diagnosis of osteoporosis so that effective preventive and therapeutic measures can be initiated at the earliest. It is acknowledged that bone density measurements were related to future fracture risk.[8] Several techniques exist for measuring bone mass or density. BMD is calculated using Dual Energy X-ray Absorptiometry (DEXA) and quantitative ultrasound. Quantitative Ultrasound (QUS) is a newer evolving promising technique which is finding increasing application.[9] Retrospective and prospective studies have shown that QUS may be an alternative or complementary investigation to Dual Energy X-Ray absorptiometry (DEXA).[10,11] Several prospective studies have reported that ultrasound of the heel was roughly equivalent to DXA in predicting overall fracture risk.

The calcaneus is the most popular measurement site for QUS, as it is easily accessible, and for weight-bearing bone like the neck of femur and the vertebral bodies. Also it consists of almost only metabolically active trabecular bone and may express early skeletal changes. QUS has been used in this study as a screening tool as it is relatively inexpensive, portable and free of ionizing radiation. DEXA has high radiation exposure and not easily portable.

METHODS

A cross sectional study was conducted at Department of Obstetrics and Gynaecology, SAT Hospital, Medical College, Trivandrum, Kerala, India during period of 12 months.

Sample size

400 patients has been included in this study in the age group of 40 – 60 years using the formula ,

$$n = \frac{4pq}{l^2}$$

Where, p =0.5 (prevalence of disease)

q =1- p

l = 10 % of p

Source of patients

Patients attending the gynaecology OPD, SAT Hospital, Trivandrum.

Inclusion criteria

Patients attending gynaecology OPD in the age group of 40-60 yrs.

Patients who are willing to participate.

Exclusion criteria

Patients with already diagnosed Systemic diseases like renal and hepatic disorders, rheumatoid arthritis, thyrotoxicosis, Addisons disease and Cushings syndrome.

Patients on long term steroids, heparin, warfarin, thyroxine, hydrocortisone, phenytoin, hormone replacement.

Patients who are not willing to participate in the study.

Study tools

Structured proforma, Quantitative ultrasound

Study procedure

Patients who reported to the OPD of Gynaecology in the age group of 40-60 yrs were included in the study. Informed consent and a proforma to record the patient's personal and demographic details were obtained. The bone mineral density of the calcaneum on right foot was measured with the patient in sitting position by a trained technician in the OPD using quantitative ultrasound (Figure 1, 2). The t –score values were obtained using

quantitative ultrasound. Individuals with t score values less than -2.5 were categorized as osteoporotic. Those with t score between -2.5 and -1 were considered osteopenic and those with values more than -1 were considered to be normal.

RESULTS

Table 1: Age distribution.

Age group	Total number of women	Percentage
40-44 yrs	141	32.25
45-49 yrs	111	27.75
50-54 yrs	78	19.25
55-60 yrs	70	17.75
Total	400	100

Age distribution

35.25% of study sample were in the age group of 40 - 44 years, 27.75% were between 45-49 years, 19.25% were between 50-54 years, 17.75% women were between 55-60 years.

Educational status

9% were illiterate, 30% women studied till class 7, 42.5% studied till 10th, 19% had studied up to degree.

Table 2: Primary outcome.

Primary outcome	Number of women	Prevalence of disease	95% confidence interval
Osteoporosis	69	17.25%	13.78-21.19%
Osteopenia	165	41.25%	36.50-46.13%
Normal BMD	166	41.50%	36.74-46.38%

Occupation

77.25% of women in our study population were housewives, 9% were manual labourers, 12% were having office work and 1.75% was doing a professional job.

Primary outcome

In our study 17.25 % of women were osteoporotic, 41.25% women had osteopenia and 41.5% of women had normal BMD on QUS.

A comparison between normal and osteoporotic women with respect to age was done and the results were tabulated. Majority of osteoporotic women (36.6%) in this study were in the age group of 55 – 60 yrs. As age increases, the prevalence of osteoporosis also increases.

Mean age of cases is 50.91 and control group is 45.99 and is statistically significant (p=0.0001).

Table 3: Comparison between normal and osteoporotic women with respect to age.

Age group	Normal	Osteoporosis	Total no of women	Women with osteoporosis (%)
40-44	80	14	141	9.9%
45-49	42	18	111	16.2%
50-54	28	11	77	14.28%
55-60	16	26	71	36.6%
Mean	45.99	50.91		
SD	5.36	6.69		

t value = -5.430; p value = 0.0001

Distribution according to age of menarche

Mean age at menarche for osteoporotic women was 13.75 and that of normal women was 13.69 in this study and did not show statistical significance.

Table 4: Distribution according to menopausal status.

	Osteoporosis		Normal		total
Menopause attained	38	55%	50	30.1%	88
Menopause not attained	31	44.9%	116	69.8%	147
Total	69		166		235
Chi-square value =12.9	Odds ratio =2.84				
p value = 0.00032	95 % CI =1.53 -5.29				

Distribution according to menopausal status

Relationship between menopause and osteoporosis was checked and in our study, 55% of women who had osteoporosis were postmenopausal, when compared to only 30.1 % of normal women had attained menopause. Menopausal status was statistically significant in this study.(p value=0.00032).

Distribution according to age since menopause

In this study, 39.4 % of osteoporotic women had menopausal age of <5 years and 23.6 % had menopausal age >10 years. Mean duration of menopause was 7.61 yrs in cases and 5.43 yrs in control group (p value=0.032). According to this, years since menopause, shows statistical significance.

Table 5: Distribution according to age since menopause.

Age since menopause	Osteoporosis	Normal
≤5 yrs	15(39.4%)	33(66%)
6-10yrs	14(36.8%)	8(16%)
>10 yrs	9(23.6%)	9(18%)
Total	38	50
Mean in years	7.61	5.43
SD	5.28	5.48
Chi-square value =6.88	p value: 0.032	

Distribution according to years since last child birth (LCB) for parous women

Mean duration since last child birth was 21.5 years in the cases and 18years in control group (p value =0.0001). According to this study, years since last child birth had significant correlation with osteoporosis.

Table 6: Distribution according to years since last child birth (LCB) for parous women.

	Osteoporosis	Normal
No of parous women	68	161
Mean (years)	22.63	19.06
Median (years)	21.5	18.00
SD	5.99	5.09

p value: 0.0001

Distribution according to menstrual cycle

In this study, 17.3% of women with osteoporosis had irregular cycles and 18.6% of normal women had irregular cycles. Regularity of menstrual cycle did not show statistical significance here.

Table 7: Distribution according to calorie intake in 24 hr recall.

	Osteoporosis	Normal
No of women	69	166
Mean calorie intake (kcal)	1456	1491.5
SD	238	295.6

t test : 0.967; p value: 0.335

Distribution according to marital status

69 women diagnosed with osteoporosis were married, 163 women amongst those with normal BMD were married and 3 were unmarried. According to Fisher's Exact test, p value = 0.56. Marital status did not show significant correlation with osteoporosis.

Table 8: Distribution according to calorie intake in 24 hr recall.

	Osteoporosis	Normal
No of women	69	166
Mean in grams	51.49	48.85
SD	14.86	13.97

t test: -1.26; p value: 0.209

Distribution according to calorie intake in 24 hr recall

According to this, mean calorie intake for case was 1456 k cal and that of control was 1491.5 k cal and did not have significant correlation with osteoporosis.

Distribution according to protein intake in 24 hr recall

Mean protein intake for cases was 51.49 grams and that of control was 48.85 grams. Protein intake did not show significant correlation with osteoporosis in this study (Table 8).

Table 9: Distribution according to calcium intake/24 hr recall.

	Osteoporosis	Normal
No of women	69	166
Mean calcium intake (gms)	367.7	391.02
SD	140.85	139.36

t test: 1.161; p value: 0.248

Table 10: Distribution according to family history of osteoporosis.

Family h/o	Osteoporosis	Normal
present	16(23.1%)	17(10.2%)
absent	53(76.8%)	149(89.7%)
Total	69	166
Chi-square value = 6.77	p value = 0.0093	
Odds ratio = 2.65 95 % CI =1.17 – 5.98		

Distribution according to calcium intake/24 hr recall

Mean calcium intake for cases was 367.7 grams and that of control was 391.02 grams. Calcium intake did not show significant correlation with osteoporosis. (p value = 0.248). It was also noted in this study that 5.7% of osteoporotic and 5.4% of normal BMD women had calcium supplements. Intake of supplements did not show any statistical significance.

Distribution according to exercise

In this study, 39% of osteoporotic women had exercise and 45.1% of normal women had exercise. Exercise does

not show statistical significance. Also it was noted that duration of exercise was also not statistically significant.

Distribution according to sun exposure

In this study, 42% of osteoporotic women had sun exposure where as 58.4% of normal women had sun exposure. Sun exposure has significant correlation with osteoporosis (p value = 0.02) mean duration of sun exposure per day in osteoporotic women is 0.629 hrs and that of normal women is 0.91 hrs. According to Mann-Whitney U =1118.5.0 p value= 0.063. Here duration of sun exposure had no significant correlation with osteoporosis.

Table 11: Distribution according to presence of diabetes mellitus.

Diabetes	Osteoporosis		Normal		Total
Yes	19	27.5%	19	11.4%	38
No	50	72.4%	147	88.5%	197
Total	69		166		
Chi- square value = 9.31 p value=0.0023					
Odds ratio =2.94 95% Confidence interval= 1.36 – 6.36					

Distribution according to passive smoking

In this study, 16.1% of women with osteoporosis had passive smoking and 18.07% of normal women had passive smoking and did not show statistical significance.

Distribution according to alcohol intake

None of the women in this study were alcohol users.

Table 12: Distribution according to hypertension.

Hypertension	Osteoporosis		Normal		Total
Yes	10	14.4%	20	12%	30
No	59	85.5%	146	87.9%	205
Total	69		166		
Chi-square test value = 0.26 p value : 0.61 (not significant)					
Odds ratio = 1.24 95 % CI =0.50 -2.99					

Distribution according to family history of osteoporosis

In this study 23.1 % of osteoporotic women had family history of osteoporosis where as 10.2% of normal women had family history of osteoporosis. Family history has significant correlation with osteoporosis (p value=0.0093). 1.4 % of osteoporotic women had history of fracture above 50 years and 0.6 % of normal women had history of fracture. History of fracture above 50 years did not show any statistical significance (p value =0.52).

Presence of psychological stress

Over last 3 months did not show any statistical significance in this study with osteoporosis

Distribution according to presence of diabetes mellitus

27.5% of osteoporotic women had diabetes mellitus and 11.4% of normal women had diabetes. Diabetes had significant correlation with osteoporosis (p value = 0.0023).

Distribution according to hypertension

14.4% of osteoporotic women had hypertension and 12 % of normal women had hypertension. Hypertension did not show statistical significance (p value = 0.61).

Other co-morbidities like presence of ischaemic heart disease, chronic lung disease etc also did not show any statistical significance. None of the women in this study had breast cancer, skin lesions or malabsorption syndrome.

Figure 1: Measurement of BMD by trained technician under supervision of first author.

Distribution according to BMI

Mean BMI for osteoporotic women was 27.17 and that of normal women was 26.86. BMI did not show significant correlation with osteoporosis.

Anthropometric measurements

Mid-arm circumference, waist circumference and hip circumference did not show significant correlation with osteoporosis.

Figure 2: Quantitative ultrasound used in the study.

DISCUSSION

Of the total of 400 patients involved in this study, majority were in the age group of 40-49 years. This could be the reason why a low prevalence was noted compared to previous studies. The prevalence of osteoporosis was 17.25% and that of osteopenia was about 41.5% which indicates that rates could rise further in coming years. The prevalence of osteopenia was 59.3% in women of age group 40-49 yrs and it is established that osteoporosis rises steeply after 50 yrs. There was a statistically significant rise in older age group(p=0.0001).Both post-menopausal state, as well as years since menopause showed statistical significance .Though age of menarche, regularity of menstrual cycle and marital status did not reveal statistical significance, years since last childbirth, had a significant correlation(p=0.0001) The calcium intake of our study population was only 350±50 mg/day as compared to the RDA of 800–1,000 mg/day, which is accepted worldwide. However, the RDA for calcium has not been established for menopausal women in India subsisting on a cereal-pulse diet, and therefore 400 mg/day of RDA for calcium is indicated.[12] The major part of this calcium intake came from plant sources, which are known to have low bioavailability. The foods rich in calcium such as milk, spices and dry fruits are expensive and not well available for majority of this population. The intake of other nutrients except fats was also substantially low, resulting in multiple nutrient deficiencies. Nutritional factors like calorie, protein, calcium intake of women involved in this study does not show significant correlation with osteoporosis. Intake of calcium supplements also does not show statistical significance. This may be because all the women studied, were from low socioeconomic group with inadequate dietary intake. History of sunlight exposure is statistically significant (p value-0.0216) though duration was not. Exercise and passive smoking did not have statistical significance. Presence of diabetes has significant correlation with osteoporosis. (P value =0.0023).[13] Other chronic illnesses like hypertension, ischaemic heart disease, chronic lung disease, did not show statistical significance. Anthropometric measurements and BMI did not show statistical significance.

Quantitative ultrasound

Identifying women with osteoporosis remains a clinical challenge. Although the results of present study in comparison to the various studies[14,15]clearly reflect the under diagnosis of osteoporosis by QUS in comparison to DEXA, but QUS still remain the commonest modality of measuring bone density of cancellous bone (peripheral bone measurement) in the heel, with advantage of low cost, lack of radiation and portability. Hence, DEXA ,remains the gold standard for measuring bone density but underscoring fairly good number of women to be osteopenic and osteoporotic in present study suggest that USG method can be useful particularly in situation where DEXA is not available, who otherwise will remain totally undiagnosed. The incidence indicated in the present study may not be the true incidence of the population as QUS yield a lower incidence or prevalence of osteoporosis if the same WHO t-score is applied.

CONCLUSION

In this hospital, prevalence of osteoporosis is 17.25 % and findings suggest a significant positive correlation between age, time since menopause, sunlight exposure, family history of osteoporosis and BMD. Differences in the prevalence of osteoporosis exist on the basis of socioeconomic strata. The results of this study did not reveal a statistically significant difference in BMD for many of the other accepted risk factors such as age at menarche, regularity of menstrual cycle, exercise, nutritional factors and smoking. It appears that more studies with larger numbers may be needed to establish their role. The International Osteoporosis Foundation suggests screening of women after age of 65 years. However, changing life style in young people (dieting, smoking, and lack of exercise) has made them vulnerable to osteoporosis at an earlier age. Further in India, there is a higher prevalence of other risk factors such as low socioeconomic strata, low calcium in the diet, Vitamin D deficiency, low education level, premature menopause, multiparty, resulting in higher risk for osteopenia and osteoporosis. Quantitative Ultrasound conclusively confirms or rules out osteoporosis or osteopenia in any population and can be used as a screening tool.

This is a hospital based study, with maximum number of women (35.25 %) in the age group of 40-44 yrs and hence prevalence of osteoporosis is lower than the previous studies. Community based studies will detect more number of osteoporotic women when compared to hospital based studies. More studies with large numbers are required to establish the previously accepted risk factors which were not significant in this study.

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