

# Prevalence of Osteoporosis using Quantitative Ultrasound for Menopausal Wwomen in Rural and Urban Area.

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## Abstract

### OBJECTIVE:

To determine the prevalence of Osteoporosis and related factors using Quantitative Ultrasound(QUS) in menopausal women in rural and urban area.

### METHODS

: A total of 1136 women aged 40 to 60 years, living in Wardha, and free of illnesses affecting bone metabolism were randomly selected to participate in the study. Subjects' bone mass was assessed by speed of sound at the calcaneus, referred to as quantitative ultrasound measurement. The threshold, defined as  $-1.8$ , was used to identify subjects with osteoporosis.

### RESULT

: The crude prevalence of osteoporosis in our study was 15%. Among premenopausal women, the crude prevalence of osteoporosis was higher in the urban areas compared with the rural areas. By contrast, postmenopausal women in the rural areas had a higher prevalence of osteoporosis

### . DISCUSSION

: The optimal method for diagnosing osteoporosis is to measure bone mineral density by dual-energy x-ray absorptiometry at the hip and lumbar spine . However, it is very difficult to apply this procedure in community-based studies because of its lack of portability and its cost. Quantitative ultrasound (QUS) measurement, a technique for measuring the peripheral skeleton, has been proposed because it can be performed quickly, is relatively inexpensive, is portable, and involves less radiation. Thus, QUS could be an ideal tool to screen for osteoporosis at the community level.

### CONCLUSION:

The crude prevalence of osteoporosis in menopausal patients in our study was 15%. Among premenopausal women, the crude prevalence of osteoporosis was higher in the urban areas compared with the rural areas. By contrast, in postmenopausal women osteoporosis was more in rural women than urban. QUS for screening of osteoporosis is a cost effective method compared to the expensive DEXA(dual energy x ray absorptiometry) .

## INTRODUCTION

Osteoporosis is a growing health problem recognized in both developed and developing countries <sup>(1)</sup>. Osteoporotic fractures, especially hip fractures, are related to considerable mortality and increasingly higher costs of health care. The increasing prevalence of osteoporosis related to more peripheral and vertebral fractures will lead to increased socioeconomic burdens because of the high cost of treatment <sup>(2, 3)</sup>. Thus, for the purposes of prevention and control, there is great interest in conducting epidemiologic surveys of the prevalence of osteoporosis and related risk factors in communities <sup>(2,4)</sup>. The optimal method for diagnosing

osteoporosis is to measure bone mineral density by (DEXA)dual-energy x-ray absorptiometry at the hip and lumbar spine. However, it is very difficult to apply this procedure in community-based studies because of its lack of portability and its cost. Furthermore, the procedure exposes subjects to low, but significant doses of ionizing radiation. Quantitative ultrasound (QUS) measurement, a technique for measuring the peripheral skeleton, has been proposed because it can be performed quickly, is relatively inexpensive, is portable, and involves less radiation. Thus, QUS could be an ideal tool to screen for osteoporosis at the community level <sup>(6,12)</sup>.

Although Asians are thought to have lower bone mass than Caucasians because of their smaller body size<sup>(13)</sup>, few population-based studies have been conducted in Asian countries. In India life expectancy is increasing as the economy improves<sup>(14)</sup>, and, with a longer lifespan, there is concern about an increased prevalence of osteoporosis. However, data were insufficient to characterize the prevalence. Thus, further studies on the epidemiologic distribution of osteoporosis and associated factors in India are required. Although osteoporosis can affect both men and women of any age, women are four times more likely than men to develop osteoporosis. Thus, the aim of the present study was to determine the prevalence of osteoporosis and related factors in rural & urban perimenopausal women.

## **MATERIALS & METHOD**

This survey was carried out at Acharya Vinoba Bhave Rural Hospital which is attached to Datta Meghe Institute Of Medical Sciences, Wardha, Maharashtra, India. Our hospital serves patients who live in both rural and urban areas. To maximize participation of rural patients, the local health staff visited each household to explain the study, obtain written consent from each subject, and remind participants of the time and date of the survey. At the end of the survey, a total of 1258 participants had been included. Patients who came from district city level & who were staff of our hospital were labelled as urban while those belonging to taluka place and below were taken as rural. All participants completed a structured questionnaire. Included was an assessment of subjects' medical history, particularly focusing on hyperparathyroidism, gastrectomy, diseases of the kidney, diabetes mellitus, rheumatoid arthritis, chronic liver disease, chronic malabsorptive syndromes, cancer, and jejunoileal bypass, as well as current or past treatment with glucocorticoids and/or thyroid hormone. Subjects were excluded from analysis if they had at least one of the above conditions. Use of oral contraceptive pills was also recorded.

Information on fracture history, family history of fracture and osteoporosis, socioeconomic status, lifelong occupation, educational level, and recreational weight-bearing exercise was collected from each subject. The interview also asked about current age and age at menarche and menopause, as well as number of children.

Lifelong occupation was defined as the occupation that the subject engaged in most frequently in her life. It was classified as heavy work (farmers, manual workers), office work (office clerks and other sedentary jobs), or domestic

work (housewife). Educational level was categorized in three groups, by number of years of schooling: low level (5 years), medium level (6–8 years), and high level (9 years).

Recreational weight-bearing exercise was assessed by inquiring about regular weight-bearing exercise during at least the past 12 months. The subjects reported the number of sessions of weight-bearing exercise of at least 30 minutes per week. Active behaviour was defined as engaging in more than two sessions per week.

**Anthropometry measurement:** Height and weight were measured while subjects were standing, wearing light clothing and no shoes. Body mass index was calculated as the ratio of weight (in kilograms) to height (in meters) squared. Waist circumference was measured at the minimum circumference between the umbilicus and iliac crest, and hip circumference was measured at the widest circumference around the buttocks.

**Bone mass assessment:** Bone mass was assessed by speed of sound (m/second) using a QUS device (SAHARA, QUS). This device is small and portable, with a gel-coupled (dry) system that can measure speed of sound at the calcaneus. For all subjects, speed of sound was measured at the right calcaneus. The measurement was taken in a temperature-controlled environment and was performed by a trained medical technician only. Standardization and calibration with standards were performed before the first measurement of each survey day. The T-score for each subject was calculated by using the peak speed-of-sound value for a defined population of young adults, and its standard deviation. We calculated the peak speed-of-sound value for young adults (speed of sound peak value for young adults) by estimating peak bone mass, which was itself defined as the average maximum bone mass achieved by young, healthy, sex- and race-matched adults. For our own population, we defined the young adult population by identifying the age range at which speed of sound reached peak value. Speed of sound peak value for young adults and standard deviation peak value for young adults were determined as the mean speed-of-sound value for the young adult population and its standard deviation, respectively.

A person was classified as having osteoporosis if her T-score was  $-1.8$  and as normal if the score was  $>-1.8$ . In this paper, data are presented as percentage and as mean (standard deviation). Student's t test (two sided) was applied to examine differences in age, number of children, anthropometric indicators, and speed-of-sound values

between women in rural and urban areas. Bonferroni's t test was used to identify significant differences in speed-of-sound values for 5-year age groups to define the age range for young adults and their peak speed-of-sound value. Chi-square testing was used to examine differences in the prevalence of osteoporosis, active weight-bearing exercise, lowest educational level, and heavy lifelong occupation between women in the rural and urban areas.

## RESULTS

The medical histories analysed for all patients and data on 136 subjects with illnesses deemed to affect bone metabolism were excluded from analysis. Thus, data on a total of 1122 women (551 in urban and 571 in rural areas) were available for analysis. In the rural areas, anthropometric indicators such as weight, body mass index, and waist/hip ratio were significantly lower in both premenopausal and postmenopausal women, while height was significantly lower only in postmenopausal women compared with those in the urban areas. Premenopausal women accounted for 46.5 percent of the population. Compared with urban women, most of the women in the rural areas had a lifelong occupation involving heavy work and engaged in more weight-bearing exercise in their leisure time. Postmenopausal women in the rural areas had more children and a lower educational level than those in the urban areas.

The prevalence of osteoporosis in premenopausal age group was higher in urban women (3%) as compared to rural (1%) while it was lower in urban (27%) area women in postmenopausal women as compared to rural women (34%) shown in Table 1.

Prevalence of osteoporosis. Speed-of-sound value reached its peak at age 30–34 years, started to decline at age 35–39 years, and declined significantly from age 45 to 49 years. Because mean speed-of-sound values at ages 35–39 years and at ages 40–44 years were similar or even higher than for the age group 20–24 years, we defined women aged 20–44 years as young adults to calculate peak speed-of-sound value (speed of sound peak value for young adults) and its standard deviation (standard deviation) for our own population. On the basis of this value, the crude prevalence of osteoporosis was estimated at 15.4 percent in the study population. Table 2 shows that the prevalence of osteoporosis in the age groups increased with age.

As shown in table 3, age, menopause, number of children,

height, educational level, lifelong occupation, and recreational weight-bearing exercise acted as significant predictors for osteoporosis. These associations were adjusted for age at menarche, weight, body mass index, waist/hip ratio, family history of osteoporosis, previous fracture, and oral contraceptive use. Age and number of children were positively related to the risk of osteoporosis, while height was negatively related to the risk of osteoporosis. Increased educational level was associated with a significantly reduced risk of osteoporosis. For women who engaged in weight-bearing exercise at least three times a week, the prevalence of osteoporosis was three times lower than for those who did not. Regarding menopause status, postmenopausal women had a three-times higher risk of osteoporosis than premenopausal women. On the basis of lifelong occupation, office workers and housewives had double the risk of osteoporosis compared with women engaged in heavy work.

## DISCUSSION

Recently, use of QUS at peripheral sites has been proposed for measuring bone density in large populations<sup>(3,15)</sup>. In the current study, we attempted to identify the prevalence of osteoporosis and related factors in perimenopausal women of wardha district by using QUS at the calcaneus with our data-derived T-score and by defining osteoporosis as a T-score of  $-1.8$ . By using this method, we estimated the prevalence of osteoporosis in perimenopausal women in rural and urban communities of wardha city. The age-adjusted prevalence of osteoporosis for our participating subjects was 9.0 percent. In addition, we found contrasting distributions of osteoporosis between urban and rural areas.

Speed-of-sound measurements at the calcaneus can identify persons at risk of osteoporotic fracture as reliably as bone mineral density measurements<sup>(15)</sup> and could be an ideal tool to screen for osteoporosis at the community level<sup>(6–12)</sup>. However, it also has been demonstrated that the T-score threshold of  $-2.5$  may lead to underestimation of the prevalence of osteoporosis when QUS is measured at the heel. Recent studies on the Hologic Sahara and the Hologic UBA575+ (Hologic, Bedford, Massachusetts) and on the Osteometer DTUone (Osteometer MediTech, Inc., Hawthorne, California) QUS devices indicate that a T-score threshold of  $-1.8$  identifies the same percentage of persons with osteoporosis as the World Health Organization threshold for bone mineral density measurements<sup>(12)</sup>. The Sahara Qus100 device used in our study is very similar used to measure QUS parameters at the calcaneus. The device

comes with a manufacturer's recommended cut off value for diagnosing osteoporosis, validated by dual-energy x-ray absorptiometry<sup>(12)</sup>. In addition, we found excellent agreement between the manufacturer's cutoff and our data-derived T-score in classifying osteoporosis ( $\kappa = 0.967$ ,  $p < 0.001$ ). Therefore, we felt it was reasonable to apply a T-score threshold of  $-1.8$  to define osteoporosis in our population.

The age at peak bone mass depends on skeletal sites or technologies used<sup>(14)</sup>. Evidence from previous studies indicates that QUS parameters start to decline from the age of 40–45 years and fall steadily thereafter. Our study showed similar results, with the peak value of speed of sound occurring from 20 to 44 years of age, followed by a significant decline thereafter. For these reasons, we concluded that defining peak speed-of-sound value as the mean for women aged 20–44 years and defining osteoporosis by using a T-score threshold of  $-1.8$  is reasonable in screening for osteoporosis in our population when the CM-100 device is used.

In this study, the prevalence of osteoporosis in study group women was found to be lower than that in Japanese women in the age group 50–79 years (29.5 percent vs. 51.2 percent) but was similar or higher in comparison to nearby countries such as China (3.7 percent vs. 3.7 percent in the age group 40–49 years, 8.4 percent vs. 3.9 percent in the age group 50–59 years) and Korea (12.8 percent vs. 11.8 percent in women aged 50 years). when the same age range was compared or when the same method was used to classify osteoporosis. When we put the information into context, Japanese women aged 50–79 years were infants and young children during World War II. Their nutrition was poor, and calcium intake in 1946 was only 253 mg per day. Therefore, the prevalence of osteoporosis in that age group is very high. In wardha, women who are aged 50–79 years were also exposed poor nutrition & low calcium intake. Thus, it is reasonable to compare the prevalence of osteoporosis between study group and Japanese women aged 50–79 years. The situation may be the same with Chinese women in the same age range. This factor might explain why the prevalence of osteoporosis is comparable in study group and Chinese women aged 40–49 years.

Factors affecting bone mineral density have been studied extensively. Recently, the impact of risk factors on QUS parameters has also been given more attention. Our data show that increasing age and postmenopausal status are predictors of low speed of sound. Increased age was

associated with a significantly increased risk of osteoporosis, especially when women become postmenopausal. This finding is consistent with those from other studies<sup>(10,15)</sup>. Our study also agreed with previous research reporting that low educational level was related to increased risk of osteoporosis<sup>(10)</sup>, short stature and a large number of children are predictors of low speed of sound. These associations were demonstrated in previous studies<sup>(11)</sup> and were also confirmed in our data. In addition, our survey indicates that engaging in recreational, active weight-bearing exercise and having a lifelong occupation involving heavy work can help protect subjects from osteoporosis.

Our study also revealed contrasting distributions of osteoporosis between urban and rural areas of the country. To our knowledge, this finding has not been observed in other countries and is likely due to socioeconomic characteristics of wardha. In rural areas, most of the people are farmers and take part in more active weight-bearing exercise, which might explain why the prevalence of osteoporosis among rural premenopausal women was lower compared with that among urban women. However, because rural postmenopausal women have more children, a lower stature, and a lower educational level, the prevalence of osteoporosis among postmenopausal women in the rural areas was higher. In addition, rural women consume fewer dairy products, and eggs/milk consumption in the rural areas was lower than in the urban areas (5.4 g per capita/day vs. 25.5 g per capita/day). Moreover, the postmenopausal women experienced greater problems with access to enough food, including calcium-rich foods, when they were teens and young adults because of poverty. Exposed to a long period of inadequate calcium intake, rural postmenopausal women are more likely to suffer from osteoporosis. This finding may partially explain why the prevalence of osteoporosis among postmenopausal women was higher in the rural areas, and it should be confirmed by further studies in order to design an appropriate intervention strategy.

The present study has several limitations. First, the T-score threshold for diagnosing osteoporosis by QUS has not been established. However, in the context of epidemiologic studies at the community level in developing countries, we could only apply QUS and use a T-score threshold of  $-1.8$  to identify subjects with osteoporosis. Many studies support the view of using QUS to screen for osteoporosis at the community level<sup>(6–12)</sup>. A previous study also applied a T-score threshold of  $-1.8$  to define osteoporosis using QUS

## Prevalence of Osteoporosis using Quantitative Ultrasound for Menopausal Wwomen in Rural and Urban Area.

For these reasons, we believe that, with a large sample size and random sampling methods, our data may truly represent the prevalence of osteoporosis in wardha City, or they may even underestimate its prevalence. Second, this study was a cross-sectional survey, and we could not measure all factors affecting the risk of osteoporosis. Moreover, using a prevalence measure to assess risk factors also has limitations because the factors associated with osteoporosis may not reflect the real cause-effect relation. Risk factors assessed by using prevalence measures can only suggest the hypothesis for a possible cause-effect relation. Thus, a prospective study is needed to confirm any association between low speed of sound and risk factors and to explain the differing patterns of osteoporosis distribution between urban and rural areas.

### CONCLUSION

This study shows that the prevalence of osteoporosis in study group women in Wardha, determined by QUS, is relatively high compared with that in nearby countries. In addition, our data indicate differing distributions of osteoporosis between rural and urban areas of Wardha. These findings suggest that osteoporosis is a problem in Wardha. Furthermore, using multiple logistic regression, we assessed associations between low speed of sound and risk factors, as well as protective factors. Because osteoporosis is related to considerable morbidity & mortality and increasingly higher costs of health care, screening for osteoporosis, particularly in high-risk populations, and setting up a National Programme to prevent and control osteoporosis in India are urgently needed.

### Figure 1

Table 1. Prevalence of osteoporosis in women living in urban and rural areas

	RURAL	URBAN
Premenopausal	1%	3%
postmenopausal	34%	27%

### Figure 2

Table 2. Crude prevalence of osteoporosis, by age group, among rural women living in wardha district in 2008 who participated in a survey of osteoporosis.

Age group (years)	No.	Normal (%)	Osteoporosis (%)
40-49	332	96.3	3.7
50-59	341	91.6	8.4
60-69	275	69.5	30.5
70-79	159	43.8	56.2
≥80	15	20.8	79.2
Total	1122	84.6	15.4

### Figure 3

TABLE 3. Significant predictors of osteoporosis

	Factor	Odds Ratio
1	<b>Menopause status</b>	
a	Premenopausal	1.00
b	Postmenopausal	3.38
2	<b>Educational level</b>	
a	Lowest	1.00
b	Medium	0.54
c	Highest	0.45
3	<b>Lifelong occupation</b>	
a	Heavy work	1.00
b	Office work	2.00
c	Housewife	1.95
4	<b>weight-bearing exercise</b>	
A	No	1.00
b	Yes	0.30
5	<b>No. of children</b>	1.75

### References

1. Delmas PD, Fraser M. Strong bones in later life: luxury or necessity? *Bull World Health Organ* 1999;77:416-22.
2. Barrett-Connor E. The economic and human costs of osteoporotic fracture. *Am J Med* 1995;98(suppl 2A):S3-8.
3. Boyanov M, Popivanov P. Prevalence of low forearm bone density in a Bulgarian female referral population. *Osteoporos Int* 2002;13:288-95.
4. Liao ER, Wu XP, Deng XG, et al. Age-related bone mineral density, accumulated bone loss rate and prevalence of osteoporosis at multiple skeletal sites in Chinese women. *Osteoporos Int* 2002;13:669-76.
5. World Health Organization. Assessment of osteoporotic fracture risk and its application to screening for postmenopausal osteoporosis. Geneva, Switzerland: World Health Organization, 1994:29-30. (WHO technical report series no. 843).

6. Hans D, Dargent-Molina P, Schott AM, et al. Ultrasonographic heel measurements to predict hip fracture in elderly women. *Lancet* 1996;348:511–14.
7. Pluijm SM, Graafmans WC, Bouter LM, et al. Ultrasound measurements for the prediction of osteoporotic fractures in elderly people. *Osteoporos Int* 1999;9:550–6.
8. Wuster C, Hadji P, Blaul G, et al. Quantitative bone ultrasound (QUS) of the heel bone for diagnosis of osteoporosis in the general community. *Zentralbl Gynakol* 1999;121:137–42.
9. Benitez CL, Schneider DL, Barrett-Connor E, et al. Hand ultrasound for osteoporosis screening in postmenopausal women. *Osteoporos Int* 2000;11:203–10.
10. Yamaguchi J, Truman G, Cameron ID. Lifestyle factors affecting bone ultrasonometry of the calcaneus in Japanese women. *Calcif Tissue Int* 2000;66:43–6.
11. Nairus J, Ahmadi S, Baker S, et al. Quantitative ultrasound: an indicator of osteoporosis in perimenopausal women. *J Clin Densitom* 2000;3:141–7.
12. Kim KI, Han IK, Kim H, et al. How reliable is the ultrasound densitometer for community screening to diagnose osteoporosis in spine, femur, and forearm? *J Clin Densitom* 2001;4:159–65.
13. Bhudhikanok GS, Wang MC, Eckert K, et al. Differences in bone mineral in young Asian and Caucasian Americans may reflect differences in bone size. *J Bone Miner Res* 1996;11:1545–56.
14. United Nations Development Programme. Basic facts about Viet Nam. UNDP Viet Nam CountryOffice, Hanoi, Viet Nam, March 2005.
15. Thuy VTT, Chau TT, Cong ND, et al. Assessment of low bone mass in Vietnamese: comparison of QUS calcaneal ultrasonometer and data-derived T-scores. *J Bone Miner Metab* 2003;21:114–19.

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