

# To Determine the Risk Factors and Prevalence of Osteoporosis among Adult Pakistani Population Residing in Karachi Using Quantitative Ultrasound Technique

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## Abstract

**Purpose:** The incidence and prevalence of osteoporosis has amplified worldwide. The situation is not very different in our country too. The purpose of our study was to determine the prevalence of osteoporosis, and also to establish the risk factors associated with it in Pakistan.

**Method:** It was a cross sectional study that was conducted in the primary care setting in different areas of Karachi. Bone mineral density assessment was done by the speed of sound using the quantitative ultrasound technique at the right Calcaneus. A structured questionnaire was prepared, to evaluate the risk factors associated with osteoporosis

**Results:** Out of 500 participants 21.6% were male and 78.4% were female. The overall prevalence of osteoporosis was 30.7% (24% male and 32.6% females). The prevalence of osteopenia was 44.5% (51% being male and 42.6% being female). Factors that were statistically ( $p$  value  $<0.05$ ) associated with low bone mineral density were increasing age, female gender for osteoporosis, normal to heavy weight, office work in both male and female, inadequate physical activity, inadequate sun exposure, inadequate intake of calcium, smoking in males and smokeless tobacco in both male and female, intake of steroids. Past history of fracture among the participants and the history of fracture in the parents, diabetes and depression also showed positive association, balanced diet and educational status and hypertension could not provide any significant statistical association with low bone mineral density.

**Conclusion:** The prevalence of osteoporosis is high among the adult population of Karachi and it is associated with modifiable risk factors. Non-communicable diseases like, diabetes and depression, also gave a positive association, which needs further prospective studies to confirm this association.

**Keywords:** Osteoporosis prevalence; Osteoporosis risk factors; Quantitative ultrasonography; Adult above 40 years

## Introduction

Osteoporosis is a skeletal disorder in which the density and quality of bone are reduced leading to weakness of the skeleton and increased risk of fracture particularly of the spine, wrist and hip. This disease often occurs silently without symptom and the first symptom is a fracture, leading to disability, morbidity and mortality. Several risk factors are associated with osteoporosis, some are modifiable and some are non-modifiable. Non-modifiable risk factors include female sex, old age, small thin built, Caucasian/Asian origin, and family history of osteoporosis. Important modifiable factors are calcium and vitamin D deficiency, sedentary lifestyle, smoking, excessive alcohol intake and caffeine intake, certain drugs if taken for a longer period of time are also associated with low bone mineral density

## Bourdon of the disease

Osteoporosis is recognized to be a global health problem; according to The World Health Organization Health Report (2003) 70 million people worldwide are diagnosed to have osteoporosis. According to International Osteoporosis Foundation (2000) the ratio of osteoporosis between female and male is 4:1. About 30-50% female and 15-30% male are at risk of osteoporotic fracture during their life time. Highest risk of osteoporotic hip fracture is in Norway, Sweden, Iceland, Denmark, and USA. The risk of osteoporotic hip fracture is steadily increasing in Asia, currently every 1 out of 4 hip fractures occur in Asia and Latin America, and this ratio will increase to 1 in 2 by 2050 [1]. According to the Osteoporosis Society of India (2003) the estimated number of osteoporosis patients was 26 million approximately in 2003, and this numbers will increase to 36 million by 2013. Iran contributes for 0.08%

of the global burden of hip fracture and 12.4% of the burden of hip fracture in the Middle East [2]. Pakistan, a developing country has a rapidly growing population, with the percentage of elderly progressively increasing day by day. Osteoporosis is therefore, becoming a noteworthy health problem in our country too. Epidemiological data on the prevalence of osteoporosis is insufficient and there is no clear data on the number of (osteoporotic) hip fractures per year. In a large countrywide study conducted using the quantitative ultrasound, it was concluded that there are 9.90 million osteoporotic patients (7.19 million are women, and 2.71 million are male), and these numbers will rise to 11.3 million in 2020 and 12.91 million in 2050 [3]. A similar study that was conducted in the North West Frontier Province showed a prevalence of 29% osteopenia and 42% osteoporosis [4].

## Materials and Method

It was a cross sectional multi centered interview based study, conducted over a period of 3 months from March to May 2011. It was conducted in primary health care setting. Medical camps were

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arranged in different areas of Karachi for bone mineral assessment using the Quantitative ultrasound technique. Though DEXS scan is the gold standard for bone mineral density assessment, but this technique is expensive and only available in big cities and hospitals in Pakistan, and not accessible to everyone so quantitative ultrasound technique was used. Quantitative ultrasound measurements of the Calcaneus bone using this technique is established as a potential indicator of the risk of fracture [5]. Studies have suggested that for every 1 standard deviation (SD) decrease in broadband ultrasound attenuation (BUA) at the Calcaneus, there is a 2.3-fold increase in the risk of hip fracture [6,7]. A total of 500 participants were included in the study, convenience sampling technique was used. Written formal consent was taken, and confidentiality was assured, identification numbers were given to the participants instead of their names. Structured questionnaire based on risk factors of osteoporosis was used for risk factor assessment, interview was conducted by the principal investigator, the questionnaire was in English but it was translated in Urdu for the convenience of the participants. Height and weight measurement was done by the qualified nurse using the standardized machine. Bone mineral density assessment was done on right Calcaneus using the quantitative ultrasound machine by a trained technician. This technique uses the ultrasound waves and measures the broadband ultrasound attenuation (BUA) (dB/MHz) and the speed of sound (SOS) m/sec in the centre of the bone. The device then combines the values of BUA and SOS to yield a parameter known as 'quantitative ultrasound index (QUI), which is expressed as T score. Data collected was put into SPSS version 17 for analysis). Data was presented as percentages and mean (standard deviation) Descriptive statistical analysis was done for mean (standard deviation), and frequency was applied for percentages to find out the prevalence of osteoporosis and osteopenia. Participants were divided into three groups based on the WHO criteria for T score: normal, osteopenic, and osteoporotic. Variables reaching the statistical significance (p-value <0.05) were included in the final results.

## Results

Out of 500 participants 21.6% were male and 78.4% were female. The overall prevalence of osteoporosis was 30.7% (24% male and 32.6% females). The prevalence of osteopenia was 44.5% (51% being male and 42.6% being female). Factors that were statistically associated with low bone mineral density along with their p values are in Table 1 and 2.

## Discussion

### Prevalence of osteoporosis

The prevalence of osteoporosis is high in our part of the world, among our study participants 32.6% female and 24% male were osteoporotic, other studies conducted in this area showed similar results [3,4]. A preliminary survey done in India our neighboring country, reported that the prevalence of osteoporosis and osteopenia among Indian women at the age of 45 is 20.3% and 36.8% respectively and this prevalence increases to 100% after 65 [8].

### Age of the participants

The mean age of the participants was 51.8 ± 10.48 years. Increasing age showed a positive association with osteoporosis, as proved by other studies. This decrease in bone mineral density with age is because of decreased kidney function, vitamin D deficiency, increase in the parathyroid hormone, decrease testosterone levels in male and decreased estrogen levels in females leading to decreased uptake and absorption of calcium [9].

Variables	Normal	Osteopenia	Osteoporosis	p-value
Male	26	56	26	
Female	96	167	128	
Bone mineral density	122	223	154	
Body Mass Index (BMI)				<0.001
Under weight	2	14	23	
Normal	43	98	80	
Over weight	41	53	29	
Obese	36	58	22	
Education				0.430
Illiterate	14	21	12	
<5 Yr of Education	9	27	25	
B/W 6-12 Yrs of Education	60	102	87	
>12 Yrs of Education	30	65	30	
Occupation				<0.001
Domestic	79	141	114	
Heavy work	15	25	17	
Office work	27	57	20	

Statistically significant at <0.05;  
Statistically very significant at <0.01;  
Statistically most significant at <0.001

**Table 1:** Comparison of risk factors among normal, osteopenic and osteoporotic individuals.

### Sex

Among our study population 392 (78.4%) were female and 108 (21.6%) were male. The incidence of osteoporosis was more among female than male with a percentage of 33% female and 24% male, but it was reverse for osteopenia as 52% of male and 43% of female were osteopenic. Osteoporosis is considered to be the disease of postmenopausal women, this perception persist because this disease manifest 10 years early in women than men. The risk of further fracture after a fragility fracture is two folds in women but three folds in men, thus the absolute risk of subsequent fracture (per 100 patient year) in men is 5.7% and in women is 6.2%, figures pretty much similar. Additionally the mortality associated with these fragility fractures is three folds in men and two fold in women [10]. Thus this disease is equally important for male and female.

### Body Mass Index

The mean height and weight were 159 ± 8.9 cm and 63.4 ± 12 kg respectively. BMI was calculated using the formula,

$$\text{Weight in Kg/Height in (m)}^2$$

Forty Four percentage participants were normal, 25% were overweight and 23% were obese. Normal to high BMI is a statistically significant risk factor for osteoporosis. This result is contrary to the previous studies in our country in which low BMI was a significant risk factor for osteoporosis. The incidence of osteoporosis is increasing day by day and so is obesity, a study was conducted in USA to determine the protective effect of overweight and increase in bone mineral density, it was concluded that overweight was not a protective factor for osteoporosis [11]. In another study it was found that visceral fat was inversely associated with BMD at lumbar spine and femoral neck, in men and women [12].

### Education status

Education status could not show any statistical significance, Pakistan being a third world country, literacy rate is low and less facilities are available for free education and restrictions for female education compared to neighboring countries, and this is a risk

Variables	Normal	Osteopenia	Osteoporosis	p-value
<b>Age at menopause</b>				0.001
<45 Yrs	33	59	67	
>45Yrs	12	25	23	
Regular menses	51	18	40	
<b>Habits</b>				0.001
Smoking	16	23	10	
Other form of oral tobacco	20	56	70	
Alcohol	0	0	0	
<b>Level of Activity</b>				
Daily	16	19	10	
<3 days a week	16	26	23	
None	90	178	121	
<b>Sum exposure</b>				
<4 hrs a week	85	162	133	
More than 4 hrs a week	37	61	21	
<b>Balance Diet</b>				0.184
Yes	58	103	58	
No	64	120	96	
<b>Calcium intake</b>				
Dairy products daily	6	9	3	
Dairy products occasionally	12	26	15	
Calcium Supplements	24	30	29	
None	121	223	154	
<b>Drug Intake</b>				
Steroids	5	5	21	
Antiseizure	4	5	4	
Past history of fracture				<0.001
Yes	13	24	35	
No	107	199	119	
<b>Comorbids</b>				
Hyper tensión	31	57	35	0.350
Diabetes	15	30	34	0.006
Depression	18	30	42	0.001
<b>History of fracture in parents</b>				0.0005
One parent	12	30	40	
Both parents	1	9	12	
None	109	184	102	

**Table 2:** Comparison of risk factors among normal, osteopenic and osteoporotic individuals.

factor for many diseases including osteoporosis [13]. Similar studies conducted in other countries of South East Asia also showed significant association between low education and osteoporosis [14,15]

### Occupation

Most of the females in our study were housewives and majority of the males were office workers, this occupation showed positive association with low bone mineral density, the reason seems to be is the lack of physical activity and less exposure to sun. One of the studies in India found out that the incidence of osteoporosis is less in those rural women who are involved in farming [15]. Thus heavy physical work seems to be a protective factor for osteoporosis.

### Menstrual factors

Adult bone mass attained is equal to the peak bone mass achieved in early adulthood minus the amount of bone lost throughout the life [16]. Women start with a less BMD than men, and lose it at a faster rate. This decline in bone density doubles at menopause and triples after 13 years and remains elevated thereafter. There are basic physiological differences between male and female, male have higher BMD from

infancy and this continues in adulthood, their vertebra are larger than female [17]. Calcitonin, a hormone responsible for calcium deposition in bones is secreted at a higher level in male than female [18]. Nulliparity, amenorrhea and early menopause are also risk factors for female. In our study early menopause in female gave strong statistical significance with osteoporosis.

### Habits

Smoking is one of the most important modifiable risk factor for human health. One of the meta analysis on smoking and human health concluded that current smokers at the age of 50 will have decreased bone mass and increased risk of fracture, ex-smokers have the intermediate risk between non-smokers and current smokers, even the intrauterine exposure of tobacco smoke is associated with retarded skeletal growth leading to increased risk of fracture in future [19].

Females in our study were mostly taking oral form of tobacco and male were involved in both smoking and oral tobacco. Serum cotinine, a tobacco exposure marker is a risk factor for decreased bone mineral density [20]. A study conducted on multi ethnic groups of women above 60 showed that smokeless tobacco is associated with low bone mineral density [21].

### Physical activity and exercise

Peak bone is attained at the age of 25 in male and 30 in female but in individuals who are physically active the bone mass continue to increase for 5 to 10 years after skeletal maturity [22]. According to WHO (2011) physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally. With industrialization people are becoming more machine dependent thus reducing their physical activity, they are so busy that they hardly have any time for workout, among our study participants only 9% were involved in physical activity on regular bases, rest were either occasionally working-out or were sedentary and this behavior was significantly associated with low bone mineral density.

### Sun exposure

Sun exposure is a rich source of vitamin D. According to the National Osteoporosis Society (2010) sun exposure of 2 to 3 hours per week during the day (10am-3pm) is adequate to maintain the desired levels of vit D in the body. Sunlight exposure can increase the BMD of vitamin D deficient bone and lead to the prevention of nonvertebral fractures [23]. Inadequate sun exposure was a significant risk factor for osteoporosis among our participants. Pakistan is in the equatorial region where there is ample of sun shine throughout the year, but because of lack of awareness or busy life schedule people have no time for recreational activities in sun, all there recreation is limited to dine outs and parties.

### Calcium intake

Calcium and vitamin D are important factors for strong bones. Lack of adequate Calcium intake is an established risk factor for osteoporosis; our study participants were not taking sufficient amount of dietary calcium or calcium supplements. Regular intake of calcium supplements for one year by Indian women is a protective factor for osteoporosis a study says [24].

### Balanced diet

Intake of balanced diet among our participants could not give a positive association with osteoporosis, but other studies showed a

positive association between balanced diet and BMD [9]

### Medical disorders

Participants were inquired regarding the history of hypertension, diabetes and depression. All these diseases and osteoporosis share common risk factors. Diabetes and depression showed a positive association with osteoporosis. Evidence supports an association between medical disorders like diabetes and depression and increased risk of fracture [25,26]. There is a need for further longitudinal studies in our country, to confirm the association between osteoporosis and non communicable diseases.

### Corticosteroid intake

Steroids induced osteoporosis is well known and number of studies has confirmed this relationship [9]. In our study 10% of the participants were currently taking or has taken steroids (both oral and inhaled) for more than 3 months in their past. The dose for oral steroids was defined to be more than 30 mg as defined by international Osteoporosis foundation but the dose for inhaled steroids was not specified. This intake was significantly associated with low bone mineral density. Prescription of these drugs must be justified, and whenever prescription is indicated for a longer duration, risk factor assessment for osteoporosis should be done.

### History of fracture

Osteoporosis is a silent disease and mostly fracture is the first symptom to mark the disease. In our study past history of low trauma fracture among our participants as the first symptom of decrease was significantly associated with osteoporosis. History of fracture in one or both of the the parents was positive in 20.8% and was significantly associated with osteoporosis. Family history of osteoporosis is an independent risk factor for osteoporosis and this risk increases if two or more first degree relatives gave a positive history. More studies are necessary to evaluate family history as a suitable and economical tool for identifying women at risk of osteoporosis and for promoting the adoption of preventive behaviors [27].

### Conclusion

The prevalence of osteoporosis is high among the adult population of Karachi and it is associated with modifiable risk factors like lack of physical activity, insufficient sun exposure, lack of calcium intake, intake of tobacco. Our study concluded that low bone mineral density has strong association with overweight and non-communicable diseases like, diabetes and depression, this association needs further prospective studies to confirm this relationship,

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