

# Determining the risk factors and prevalence of osteoporosis using quantitative ultrasonography in Pakistani adult women

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## ABSTRACT

**Introduction:** Osteoporosis-related bone fractures are a significant public health problem. The aim of this study was to determine the prevalence of osteoporosis among Pakistani women and identify modifiable risk factors.

**Methods:** A cross-sectional study was conducted in an obstetrics/gynaecology setting during March–April 2007 in Quetta, Pakistan. A total of 334 women older than 20 years of age underwent quantitative ultrasonography and were interviewed to find out the risk factors for osteoporosis. Bone mineral density was assessed by the speed of sound using a quantitative ultrasound device. The sociodemographic characteristics of normal, osteopenic and osteoporotic women were compared using the chi-square test for categorical variables and ANOVA for continuous variables. Binary logistic regression was used to determine the independent predictors of being osteopenic or osteoporotic.

**Results:** 146 (43.7 percent) women were reported to be normal, 145 (43.4 percent) were osteopenic and 43 (12.9 percent) were osteoporotic. The mean age and standard deviation of the participants were 36.7 years +/- 13.0 years, with a body mass index (BMI) of 25.81 (standard deviation 5.10) kg per square metre. In the univariate analysis, factors that were associated with osteoporosis/osteopenia included age, parity, BMI, smoking (pack years), consumption of calcium-rich food/week, personal and family history of osteoporosis, education and socioeconomic status (p-value is less than 0.05). Using binary logistic regression with osteoporosis/osteopenia as an outcome compared to normal individuals, BMI, smoking pack years, a family history of osteoporosis/

fracture and house ownership were found to be independent predictors of the outcome.

**Conclusion:** The prevalence of osteoporosis and osteopenia is high, especially among young Pakistani women, and is associated with modifiable risk factors.

**Keywords:** osteoporosis prevalence, osteoporosis risk factors, quantitative ultrasonography, women's health

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## INTRODUCTION

Osteoporosis and related fractures are a major public health problem and become more important with an ageing population.<sup>(1)</sup> 30%–50% of women and 15%–30% of men suffer from osteoporosis-related fractures in their lifetime.<sup>(2)</sup> Fractures are associated with increased morbidity and mortality, and impose a considerable financial burden on the community.<sup>(3)</sup> The total cost of osteoporotic fractures, mostly hip fractures, has been estimated to be USD 10–20 billion per year in the United States alone.<sup>(4)</sup> Considering the overall burden of hip, spinal and other fractures, including hospitalisation and time off work, the human and financial costs of osteoporotic fractures are enormous.<sup>(5)</sup>

In Pakistan, life expectancy at birth has increased from 41 years in 1950 to 61.9 years in 1998, and is expected to be 72.4 years in 2023.<sup>(6)</sup> The proportion of elderly and post-menopausal women is on the rise. In the future, more Pakistani women will suffer from osteoporosis-related fractures that lead to a poor quality of life. Studies indicate a high prevalence of risk factors associated with osteoporosis in the community.<sup>(7,8)</sup> According to one survey, 72% of people lead a sedentary lifestyle, and vitamin D deficiency among Pakistani women has been reported to be as high as 83%.<sup>(7,8)</sup> Moreover, the Pakistani diet has been found to be deficient in calcium.<sup>(9)</sup> The prevalence of smoking has been reported to be 22%–40% in most

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**Table I. Basic sociodemographic characteristics and other variables.**

Variable	No. (%)	Exercise/walk
Bone mineral density		
Normal	146 (43.7)	Yes 23 (6.89)
Osteopenic	145 (43.4)	No 311 (93.11)
Osteoporotic	43 (12.9)	
Total	334 (100)	
Mother tongue		Amenorrhoea > 6 months
Pashto	221 (66.17)	Yes 44 (13.17)
Urdu	45 (13.47)	No 290 (86.83)
Balochi/Brahvi	25 (7.49)	
Persian	23 (6.89)	Postmenopausal
Punjabi	17 (5.09)	Yes 85 (25.45)
Other	3 (0.9)	No 249 (74.55)
City of permanent residence		Premature menopause (< 45 years)
Quetta	311 (93.11)	Yes 34 (10.2)
Other	23 (6.89)	No 51 (15.3)
Marital status		Premenopausal 249 (74.6)
Married	269 (80.5)	
Single	45 (13.5)	
Widowed	16 (4.8)	
Other	4 (1.2)	
Occupation		
Housewife	298 (89.22)	
Working woman	36 (10.78)	
Literate		
Yes	103 (30.84)	
No	231 (69.16)	
House ownership		
Yes	228 (68.26)	
No	106 (31.74)	
Car ownership		
Yes	63 (18.86)	
No	271 (81.14)	
Monthly income (rupees)		
< 5,000	139 (41.6)	
5,000–10,000	115 (34.4)	
10,000–20,000	27 (8.1)	
> 20,000	14 (4.2)	
Not available	39 (11.7)	
Familiar with osteoporosis		
Yes	39 (11.7)	
No	295 (88.3)	
Ever smoked?		
Yes	66 (19.76)	
No	268 (80.24)	
Present smoking status		
Daily	48 (14.37)	
Occasionally	14 (4.19)	
Not smoking at present/never smoked	272 (81.44)	
Atraumatic fracture before 25 years of age		
Yes	16 (4.79)	
No	318 (95.21)	
Family history of osteoporosis		
Yes	134 (40.12)	
No	200 (59.88)	
Presence of any comorbidity		
Yes	54 (16.17)	
No	280 (83.83)	
Steroid use		
Yes	16 (4.79)	
No	318 (95.21)	
Use of homoeopathic medicines		
Yes	68 (20.36)	
No	266 (79.64)	
Use of calcium supplements		
All/most of the time	12 (3.59)	
Sometimes	83 (24.85)	
Little/never	239 (71.56)	
Type of clothing		
Whole body covered	238 (71.26)	
Hands/face visible	82 (24.55)	
Head/arms visible	14 (4.19)	

recent population-based studies.<sup>(10,11)</sup> To our knowledge, the prevalence of osteoporosis and its risk factors among Pakistani women are hitherto unknown. It is hypothesised that a large proportion of young Pakistani women are at risk of developing osteoporosis in the future. Through cross-sectional research, this study aimed to determine the prevalence of osteoporosis in a representative sample of Pakistani women and uncover its associated risk factors.

## METHODS

Ethical approval for the study was obtained from the Department of Obstetrics and Gynaecology, Bolan Medical College, Quetta, Pakistan as well as the local ethical committee for research, and the research conducted was performed according to the Declaration of Helsinki. The study was carried out during March–April 2007 in the city of Quetta in Balochistan, the largest province in Pakistan. Quetta is a metropolitan city and the capital of the province. People belonging to different castes live here along with many refugees who were from the adjacent war-torn country of Afghanistan and migrated during the early 1980s and 1990s. Patients were enrolled into the study from the outpatient department of the Department of Obstetrics and Gynaecology, Bolan Medical College. This is one of the major teaching/tertiary care centres in the province.

In March 2007, all female patients, who were older than 20 years of age and presented to the clinic with a variety of obstetrical and gynaecological complaints, along with their female attendants above the age of 20 years, were informed about the purpose of the study, its risks as well as the long-term benefits for the subjects and the community as a whole. Posters inviting participants were also put up in the department and in various other leading healthcare centres in the city. Participants were ensured of complete confidentiality and informed about the dissemination of the research findings. Formal consent was obtained from women who agreed to participate in the study. All participants were requested to visit Fatima Clinic, Quetta, where they were interviewed and where they underwent

**Table II. Basic sociodemographic characteristics (continuous variables).**

Variable	Mean ± SD	Range
Age (years)	36.7 ± 13.0	20–60
No. of children	5.24 ± 3.11	0–15
Education (years)	2.87 ± 4.66	0–18
Education of spouse (years)	3.90 ± 5.80	0–18
Weight (kg)	62.35 ± 12.79	33–98
Height (cm)	155.40 ± 6.40	139–175
BMI (kg/m <sup>2</sup> )	25.81 ± 5.10	16.6–39.1
Smoking (pack years)	1.59 ± 4.51	0–30
Intake of calcium-rich food (times/week)	4.10 ± 2.65	0–7
Exercise/walk (mins/week)	5.39 ± 31.99	0–420

quantitative ultrasonography to determine their bone mineral density (BMD). Women older than 20 years of age were included in our study to analyse preventive behaviour for osteoporosis among young women in Pakistan.

The questionnaire was designed in English and then translated into both Urdu (the national language of Pakistan) and Pashto (the local language). An independent back translation was done, compared with the original questionnaire and the discrepancies were corrected. An initial pilot questionnaire with 30 items was tested on a representative sample to check if the interviewers or patients faced any difficulties with any part of it. The final version was prepared according to the feedback received from the pilot study. The research team comprised six doctors and four research assistants. The research assistants selected were females who were trained to administer the questionnaire in both Urdu and Pashto. The interview also included an assessment of the subjects' basic sociodemographic characteristics, medical, smoking and menstrual history. Their history of low-trauma fracture was obtained. Low-trauma fracture was defined as a fracture occurring from a trivial/minor injury. Interviewers first determined if patients had any first-degree relative who had suffered a fracture. They then enquired as to how it had occurred. It was only included if it occurred from low-trauma injuries. Fractures such as those sustained as result of a car accident or fall from a major height were excluded. The family history was elucidated by asking for the occurrence of osteoporosis or low-trauma fracture among the patients' first-degree female relatives. Steroid use was also noted. The use of homoeopathic medicines was also recorded because it has been reported that many homoeopathic medicines that are sold in Pakistan contain steroids. Surrogate markers of socioeconomic status reported in the National Survey of Pakistan (reference) such as "house ownership" and "car ownership" were also included.<sup>(12)</sup>

Height and weight of all the subjects were recorded while they were wearing light clothes and no shoes. Care was taken to ensure that the upper border of the external auditory meatus was in line with the lower border of the orbit for the height measurement.<sup>(13)</sup> Body mass index (BMI) was calculated as the weight divided by the square of height (kg/m<sup>2</sup>).

BMD was assessed by the speed of sound (m/sec) using a quantitative ultrasound device manufactured by Sahara Clinical Bone Sonometer (Hologic Inc, Bedford, MA, USA). The sonometer measures the broadband ultrasound attenuation (BUA, in dB/MHz) and speed of sound (SOS, in m/sec) of an ultrasound beam that is passed through the heel. The BUA and SOS are combined to yield an index (quantitative ultrasound or "stiffness" index [QUI]), which is then used to estimate the calcaneal BMD (in g/cm<sup>2</sup>).<sup>(14)</sup> The latter is inferred from a linear combination of BUA and SOS, and is not an actual measurement of calcaneal BMD.<sup>(15)</sup> This device is small and portable, with a gel coupled (dry) system that can measure the SOS on the calcaneus. A phantom supplied by the manufacturer was used to calibrate the machine before each screening session and then standardised to the Asian women before usage.<sup>(16)</sup> For all subjects, the measurements were done on the right calcaneus. If the subject had a history of fracture or any bone disorder of the right foot, the left heel was evaluated. The measurement was taken in a temperature-controlled environment (20°C), and was performed only by a trained technician.

Several techniques to measure BMD have been introduced in the last two decades.<sup>(17)</sup> Although dual energy X-ray absorptiometry (DXA) is considered the gold standard for the assessment of BMD, the last decade has seen the advent of quantitative ultrasonography (QUS) for the indirect assessment of bone quality. It is especially suited to developing countries and for screening purposes; and since there is no ionising exposure, the devices are portable and the costs are considerably lower.<sup>(18)</sup> The combination of ultrasonography with risk factor inquiry identified 90% of women with osteoporosis.<sup>(19)</sup> T-score measurement was used to determine the BMD level and presence and risk of osteoporosis. A T-score is the standard deviation of a patient's BMD compared to a healthy young reference population.<sup>(16)</sup> According to the World Health Organisation criteria, individuals with a T-score of less than -2.5 are diagnosed as osteoporotic, those with a T-score of between -2.5 and -1 as having a low bone density and at risk of osteoporosis (osteopenia) and a T-score of greater than -1.0 as normal.<sup>(15,16,20)</sup> Although the gold standard for evaluating BMD is via a DXA scan, measurements were done using

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

Variable	Normal	Osteopenic	Osteoporotic	p-value
Mean age (years)	34.7	33.7	54.0	< 0.001***
Mean parity	4.72	4.92	7.70	< 0.001***
Mean BMI (kg/m <sup>2</sup> )	26.9	25.7	22.6	< 0.001***
Mother tongue				
Pashtoon	89	100	32	0.167
Others	57	45	11	
Occupation				
Housewife	129	128	41	0.382
Working woman	17	17	2	
Familiar with osteoporosis				
Yes	17	19	3	0.547
No	151	107	37	
House ownership				
Yes	112	94	22	0.003**
No	34	51	21	
Car ownership				
Yes	31	28	4	0.210
No	115	117	39	
Have smoked				
Yes	19	27	20	< 0.001***
No	127	118	23	
Smoking (pack years)	0.53	1.47	5.36	< 0.001***
Calcium-rich food/week	4.78	3.94	2.31	< 0.001***
Postmenopausal				
Yes	23	28	34	< 0.001***
No	123	117	9	
Amenorrhoea > 6 months				
Yes	14	19	11	0.024*
No	132	126	32	
Premature menopause				
Yes	12	10	12	0.377
No	11	8	22	
Literate				
Yes	54	45	4	0.002**
No	92	100	39	
Education (years)	3.42	3.01	0.58	0.002**
Education of husband (years)	4.48	4.19	1.11	0.005**
Family history				
Yes	46	63	25	0.004**
No	100	82	18	
Atraumatic fracture				
Yes	1	5	10	< 0.001***
No	145	140	33	
Steroid use				
Yes	2	11	3	0.035*
No	144	134	40	
Use of homoeopathic medicine				
Yes	33	21	14	0.024*
No	113	124	29	
Calcium supplements				
All/most of the time	5	6	1	0.479
Sometimes	42	34	7	
Never	99	105	35	
Clothing				
Whole body covered	100	103	35	0.511
Hands/face visible	38	37	7	
Head/arms visible	8	5	1	
Exercise/walk				
Yes	14	8	1	0.175
No	132	137	42	
Exercise (mins/week)	10	1.39	3.26	0.064
Comorbidity				
Yes	18	24	12	0.051
No	128	121	31	

\* statistically significant at &lt; 0.05; \*\* statistically significant at &lt; 0.01; \*\*\* statistically significant at &lt; 0.001.

QUS due to portability and affordability.

Data was entered into Microsoft Access 2000 and analysed using the Statistical Package for Social Sciences version 14.0 (SPSS Inc, Chicago, IL, USA). Participants were divided into three groups: normal, osteopenic and

osteoporotic. The sociodemographic characteristics of the groups were compared using the chi-square test for categorical variables and ANOVA for continuous variables. The primary analysis used binary logistic regression to determine independent predictors of being osteopenic/

**Table IV. Predictors of osteoporosis/osteopenia in Pakistani women.**

Variable	Odds ratio	95% confidence interval	p-value
BMI ( $\text{kg}/\text{m}^2$ )	0.92	0.87–0.98	0.014
House ownership	0.47	0.24–0.92	0.029
Smoking (pack years)	1.12	1.01–1.24	0.036
Family history of osteoporosis/fracture	1.91	1.03–13.53	0.040

osteoporotic. Variables reaching statistical significance ( $p < 0.05$ ) were included in this final model.

## RESULTS

The basic sociodemographic characteristics of the individuals are shown in Tables I and II. A total of 334 individuals consented to be screened and participated in the interviews. Only 39 (11.7%) participants were familiar with the term/disease “osteoporosis”. The mean age and standard deviation of the participants was  $36.7 \pm 13.0$  years. 221 (66.2%) participants spoke the native language Pashto, followed by 45 (13.5%) who spoke Urdu, 25 (7.5%) Balochi/Brahvi, 23 (6.9%) Persian and 17 (5.1%) Punjabi. Almost all ( $n = 311$ , 93.1%) of the participants were residents of Quetta. 269 (80.5%) were married, 45 (13.5%) were single and 16 (4.8%) were widowed. Most of the women were housewives ( $n = 298$ , 89.2%). The literacy rate, defined as whether or not an individual could read, was low ( $n = 103$ , 30.8%). 228 (68.3%) individuals owned a house, while 63 (18.9%) owned a car. 139 (41.6%) had a monthly income of less than Rs 5,000 (USD 84), and 115 (34.4%) had a monthly income of between Rs 5,000 (USD 84) and Rs 10,000 (USD 167).

Based on the World Health Organisation’s criteria for BMD, 146 (43.7%) participants were reported as normal, 145 (43.4%) as osteopenic and 43 (12.9%) as osteoporotic. The mean T-scores were  $-0.29$ ,  $-1.68$  and  $-2.95$ , respectively. The QUI /stiffness scores were 109.6, 85.4 and 63.5, respectively. Similarly, the estimated BMD values for normal, osteopenic and osteoporotic individuals were  $0.61$ ,  $0.46$  and  $0.33 \text{ g/cm}^2$ , respectively.

The comparison of various risk factors among normal, osteopenic and osteoporotic individuals is shown in Table III. In the univariate analysis, factors reaching statistical significance ( $p < 0.05$ ) included age, parity, BMI, smoking (pack years), calcium-rich food/week, years of schooling, years of schooling of husband, menopausal status, history of low-trauma fracture, amenorrhoea  $> 6$  months, house ownership, having a first-degree relative with osteoporosis/ history of low-trauma fracture, a history of steroid use and a history of homoeopathic medicine use. Using binary logistic regression with osteoporosis/osteopenia as the outcome compared to normal individuals, BMI ( $p = 0.014$ ), smoking

pack years ( $p = 0.036$ ), family history of osteoporosis/ fracture ( $p = 0.040$ ) and house ownership ( $p = 0.029$ ) were found to be independent predictors of outcome (Table IV).

## DISCUSSION

The prevalence of osteoporosis and osteopenia was found to be high in this study. 43 (12.9%) women with a mean age of 54 years were osteoporotic and 145 (43.4%) were osteopenic. Assuming that the status of risk factors for these women does not change, a large proportion of young Pakistani women will develop osteoporosis-related fractures in the future. This will be a huge burden on the health resources of this country. A number of important risk factors for osteoporosis and osteopenia were identified, some of which are modifiable. Firstly, smoking was identified as an important risk factor with a prevalence as high as 19.8%. This is alarming as smoking among women is considered to be a taboo in Pakistani society and previous studies have reported much lower rates.<sup>(21,22)</sup> This report along with the most recent ones suggest an increase in the prevalence of women who smoke, and this is a serious risk factor not only for osteoporosis but also for lung cancer, coronary and cerebrovascular diseases.<sup>(23)</sup> Women may also be using alternative forms of tobacco, such as “Huqqa” (bubble bubble). One study reported a prevalence of tobacco use of 52% in a low socioeconomic status urban community.<sup>(21)</sup>

A smoking history of 5.4 pack years was significantly associated with osteoporosis, while a smoking history of 1.5 years was significantly associated with osteopenia ( $p < 0.001$ ). The high prevalence of smoking among Pakistani women signifies the acceptance of a hitherto “shameful act” and highlights the changing attitudes of women towards smoking. This also suggests that the smoking cessation programme has failed to deliver results in Pakistan. The entire focus and media attention has been on male smoking, while female smoking was considered to be less of a problem and thus, neglected completely. It has been observed that Pakistani women smoke cigarettes as well as smokeless tobacco. An association between smokeless tobacco and osteoporosis, however, has not yet been established.

Secondly, this study found that women with osteoporosis and osteopenia had a lower BMI compared to normal individuals. However, the idea of gaining

weight per se does not seem to be a reasonable suggestion for most women. This is simply because it would tend to increase the risks of other diseases such as diabetes mellitus, hypertension and osteoarthritis. A healthy eating pattern should be encouraged with an adequate intake of nutrients and avoidance of an obsession with losing weight, which may be a risk factor for dangerous conditions such as anorexia nervosa. In contrast, women who consumed a calcium-rich diet, mainly consisting of dairy products, were protected from osteoporosis ( $p < 0.001$ ). Nutritional counselling should therefore be an integral component of physician consultation, especially for pregnant and lactating women. This is identified as a very important modifiable risk factor for osteoporosis. Next, house ownership, which was used as an indicator of a higher socioeconomic status, was found to be protective against osteoporosis in both the univariate and logistic regression analyses. People from a higher socioeconomic status could be expected to have a diet rich in calcium and vitamin D and access to better healthcare and counselling facilities.

This research has also shown that a family history of osteoporosis/low-trauma fracture is an independent predictor significantly associated with developing osteoporosis ( $p < 0.05$ ). Overall, as many as 40% of women had a family history of osteoporosis. It is noteworthy though that a high proportion of women with a family history of osteoporosis tend to have low bone mass themselves. This signifies a complete lack of appreciation of the risk factors of osteoporosis. Alternatively, it could be the case that these women were simply not counselled by their physicians about the possibility that they were at an increased risk of developing this condition, unless they practised appropriate preventive behaviour, or it may be the case that osteoporosis has a strong genetic component which may not be corrected by life habits only. Similar findings have been reported elsewhere.<sup>(24)</sup>

Other risk factors that were identified to be significantly associated with osteoporosis and osteopenia in the univariate analysis only included age and postmenopausal status ( $p < 0.001$ ). The mean age of osteoporotic women in this study was 54 years. This is not surprising since bone mass is maintained by oestrogen and the abrupt decline in the level of this hormone leads to bone loss at a rate of around 3% per year in postmenopausal women. Data from Western countries suggests a marked increase in the incidence of vertebral fractures in women  $>60$  years of age;<sup>(25)</sup> unfortunately, similar local data is unavailable for comparison. Data from rapidly-industrialised Asian countries, such as Hong Kong and Singapore, suggests a dramatic increase in the incidence of hip fracture in women

$>65$  years of age.<sup>(26)</sup> This pattern is similar to that observed in white women in the United States.<sup>(20)</sup> In relatively less urbanised countries like Malaysia and Thailand, a more gradual increase in the incidence of hip fractures in ageing women is noted, a trend which could be similar to that in Pakistan.<sup>(20)</sup> The overall regional differences can be explained on the basis of genetic and environmental factors.

Next, increasing parity was significantly associated with osteoporosis ( $p < 0.001$ ), primarily because these women lose a lot of calcium during lactation and do not replace it in adequate amounts. Osteoporotic and osteopenic women, on average, had seven and five children, respectively, as compared to normal women who had five children. Considering that there are more than five children in the majority of Pakistani families, a large proportion of women taking care of these families may be at risk of osteoporosis.<sup>(27)</sup> An effective family planning programme could therefore go a long way in the prevention of osteoporosis in this country. Women with more children to take care of could also be nutritionally-deprived in underprivileged circumstances, and have little time and resources to consume a calcium-rich diet or engage in bone-strengthening exercises.

The educational level of women and their spouses, defined as the number of years spent in school, was found to be a protective factor against osteoporosis ( $p < 0.01$ ). Even being literate was found to be protective ( $p < 0.01$ ). There may or may not be a direct correlation between education and osteoporosis, although it is reasonable to assume that having a higher education may increase the tendencies of health-seeking behaviour due to greater awareness, as well as preventive behaviour such as not smoking. Educated people are more likely to be exposed to the media and be influenced by it, and may have more interactions with healthcare professionals. An interesting finding was that having a spouse who was educated could be a positive influence on bone mass ( $p < 0.01$ ). Educated people are more likely to find an educated spouse who encourages and practises health-related preventive behaviour more stringently. Only 39 (11.7%) women were familiar with the term/disease, osteoporosis. This condition seems to receive very little attention from physicians and the media alike, and hence, the high prevalence of risk factors is not surprising.

Having a history of low-trauma fracture was found to be significantly associated with osteoporosis ( $p < 0.001$ ). There is a high likelihood that when people suffer from a low-trauma fracture, they only receive treatment for the fracture but not for the underlying problem. A history of steroid use was significantly associated with osteoporosis

**Table V. Model for preventing osteoporosis: areas that require attention.**

Encourage family planning	Discourage use of all forms of smoking tobacco
Encourage use of calcium-rich food at least four times a week	Screening and identification of high-risk individuals
Encourage regular exercise/walking in all women	Regulatory body for homoeopathic medicine
Increase awareness of osteoporosis	Avoid obsession with losing too much weight.
Education for all, especially Pakistani women	Discourage the use of smokeless tobacco
Socioeconomic development needed in general for the country	Judicious use of steroids

( $p < 0.05$ ). Steroid-induced osteoporosis is well known, and in our study, 4.8% women had or were using steroids for a prolonged period of time ( $> 6$  months). Judicious use of steroids must be encouraged to avoid bone loss, and patients should be alerted to this possibility so they may consider medication and preventive behaviour.

Interestingly, the use of homoeopathic medicines was also significantly associated with osteoporosis in the community ( $p < 0.05$ ). Homoeopathy is a system of medicine based on the observation that high doses of pharmacologically-active substances cause symptoms when administered to healthy individuals. These same substances, when prepared in a very dilute form, may relieve similar symptoms in conditions resulting from different aetiologies.<sup>(28)</sup> The use of homoeopathic medicines as alternative medicine is very popular in this setting.<sup>(29-31)</sup> This was identified as a risk factor because there have been isolated reports and numerous speculations among clinicians in the country that steroids are being abused by many quacks who call themselves homoeopaths.<sup>(32)</sup> In a study of 29 different medicinal preparations, 80% were found to contain glucocorticoids. One sample contained dexamethasone and prednisolone, ten contained dexamethasone, five had hydrocortisone, six had prednisolone and one sample contained cortisone.<sup>(32)</sup> In the United States, these drugs are subject to well-defined regulatory processes similar to those for allopathic drugs.<sup>(28)</sup> However, in Pakistan, there is an urgent need for investigation and close monitoring of homoeopathic practices.

Calcium supplements were not found to be helpful in preventing osteoporosis. However, it was found that only 12 (3.6%) women took calcium supplements “most of the time”, whereas 83 (24.9%) consumed them “sometimes”. This implies that most women do not use these supplements regularly. Again, poor physician counselling could be a factor in non-compliance. For some people, the cost of using these supplements long-term may be prohibitive. Currently, this seems to be a failed strategy to avert the risk of osteoporosis in the community and other measures to prevent bone loss must be considered.

An interesting finding was that being dressed in Islamic style clothing was not significantly associated with osteoporosis. Islamic style clothing refers to clothing

(usually black) in which the entire body is covered. 238 (71.3%) women chose to wear the Islamic style clothing in this study. It seems that, contrary to popular belief, this is not an important risk factor for osteoporosis, at least in the community under investigation. Previous studies have reported a vitamin D deficiency in Pakistani women, but it is possible that participants in this particular study were getting adequate exposure to sunlight while at home.<sup>(8,33-35)</sup> Alternatively, they were making up for any deficiency by ingesting sufficient vitamin D in their diets, but this was not investigated.

This study also revealed that walking as a form of exercise was not associated with a low prevalence of osteopenia or osteoporosis. This was contrary to expectations; however, it is possible that women did not engage in the weight-bearing types of exercise known to increase bone mass. A very low percentage of women (6.9%) engaged in exercise. This might be due to cultural reasons where women are not allowed to leave home for exercise. Houses in most urban communities are small, thereby limiting opportunities to exercise at home. Another study has reported that 72% of Pakistanis lead a sedentary lifestyle, which is a source of concern.<sup>(7)</sup> Girls should be strongly encouraged to engage in weight-bearing or aerobic exercise routines early in life, in order to achieve higher peak bone mass during puberty with a consequent decreased risk of osteoporosis later on in life.

Calcaneal QUS was used to diagnose osteoporosis. This has been used by many other studies; it is considered to be a reliable assessment of bone density and has also been shown to predict fractures in elderly women.<sup>(36,37)</sup> Previous studies in Pakistan and neighbouring India have shown similar results with respect to the prevalence of osteoporosis. In a study conducted in Pakistan, 35.4% of the women had osteopenia while 12.01% had osteoporosis.<sup>(16)</sup> Similarly, a preliminary survey in India using calcaneal QUS showed the incidence of osteoporosis and osteopenia to be 20.3% and 36.8%, respectively, for women over the age of 45 years. After the age of 65 years, there was almost a 100% incidence in osteoporosis among women.<sup>(38)</sup> Likewise, calcaneal QUS found that 34.2% of elderly Korean women had T-scores of between -1.0 and -2.5, and 11.8% had T-scores of below -2.5.<sup>(39)</sup>

One limitation of this study was its cross-sectional design, and although it was randomised, it still could not be considered to be representative of the entire Pakistani population. Moreover, QUS was used for the diagnosis of osteoporosis and osteopenia. Even though it was suited to this study because of its portability and affordability, DXA remains the gold standard for assessing BMD. Secondly, this study employed convenient sampling. Ideally, for a good prevalence and risk factor estimate, door-to-door population-based screening and surveys are more appropriate and more representative of the population. Also, the intake of calcium-rich foods was assessed through two questions. A better estimate of the calcium intake could have come from a detailed food frequency questionnaire. However, this was not employed due to the time limitation. In summary, the areas that require urgent attention to prevent osteoporosis in the country are outlined in Table V.

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