Bone Mineral Density among Postmenopausal Saudi Women in Riyadh City – A Primary Care Level Cross-Sectional Survey

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Abstract

Objectives: This study aimed to estimate the prevalence of osteopenia and osteoporosis and to identify the associated risk factors among postmenopausal Saudi women. **Methods:** A community-based cross-sectional study was conducted included 501 menopausal women from 15 primary health-care centers randomly selected to be representative of various sectors of Riyadh City and three shopping malls located in Riyadh. A tested questionnaire was used to collect information about the related risk factor. Bone mineral density (BMD) of the calcaneus bone was measured using an ultrasound bone densitometer, and serum Vitamin D was measured using an autoanalyzer. BMD was classified into different categories, according to the World Health Organization classification. Descriptive statistics and logistic regression performed. **Results:** Mean + standard deviation age was 57.7 + 6.2 years with a range of 44–81. The prevalence of low BMD in the current study (osteopenia and osteoporosis) was 18% and 6%, respectively. The age (odds ratio [OR] = 1.07, 95% confidence interval [CI]: 1.01–1.13) and waist–hip ratio (OR = 0.94, 95% CI: 0.90–0.99) were significantly independent associated with osteopenia; also age (OR = 1.16, 95% CI: 1.09–1.24) and joint pain history (OR = 6.08, 95% CI: 2.01–18.3) were significantly independent associated with osteoporosis; and age (OR 1.08, 95% CI: 1.04–1.11) and joint pain history (1.99, 1.05–3.79) were significantly independent associated with low BMD status. **Conclusions:** The prevalence of low BMD among postmenopausal women was found to be lower than that reported by other studies in Saudi Arabia. Age was the crucial factor associated with Low BMD status. Further community-based studies are required to assess the community prevalence of low BMD and implement strategies to reduce the burden of its related consequences.

Keywords: Bone density, osteopenia, osteoporosis, postmenopausal and Saudi women

Introduction

In the past two decades, osteoporosis has gained widespread attention as a major public health issue among policymakers and researchers.[1,2] There is an increasing realization of the burden of diseases attributable to osteoporosis, particularly in developed countries where the aging population and increasing life expectancy have placed a greater number of people at risk of osteoporosis.[3] In 2010, low bone mineral density (BMD) was responsible for 188,000 deaths[4] Osteoporosis has been reported to cause approximately 9 million fractures annually worldwide.[5] The lifetime probability of experiencing an osteoporotic fracture in women above 50 years of age in the developed world is >40%.[6]

Although osteoporosis is asymptomatic in most cases, it can cause clinical symptoms, such as low backache, unexplained bone pain, height loss, and spinal deformities.[7]

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Women in the Middle Eastern region are likely to experience a greater burden of osteoporosis.[8] An estimated 260,000 osteoporotic fractures occur annually in the Eastern Mediterranean region.[9] Despite many studies having been conducted in Saudi Arabia on the prevalence of postmenopausal osteoporosis, there is no clear picture on this issue.

The current study aimed to estimate the prevalence of, and factors associated with osteopenia and osteoporosis

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among postmenopausal Saudi women in Riyadh city using a community-based sampling approach and applicable community screening tool (ultrasound bone densitometer).

Materials and Methods

Study setting and participants

This community-based cross-sectional study was conducted from 2015 to 2016. The sampling technique was cluster random sample for the 15 primary health-care centers (PHCCs) and convenient sample for participants. Out of the total 116 PHCCS in the Riyadh city, 16 PHCCs were selected, four health centers from each one of the main four health sectors of the Riyadh. Only 14 were working, and two centers were under renovation, so in addition to the 14 PHCCs, the Imam University PHCC was selected to cover the northeast part of Riyadh as that area mainly occupied by the Imam University campus and served by the Imam PHCC. Participants from the three malls were 18 women had been included in PHCCs according to their residency. The final sample size was rounded off to 500 participants.[10]

Study procedures

A pretested questionnaire during a pilot study was used to collect socio-demographic details, personal habits, pertinent clinical history, obstetric history, and drug intake history. Clinical assessments were conducted in a private room to protect the privacy of the participants. Height (to the nearest 0.5 cm) was measured using a fixed stadiometer, and weight (to the nearest 500 g) was measured using a lever balance scale following the standard protocols for anthropometric measurements. Waist and Hip circumference was measured as per the World Health Organization guidelines. Blood sample for Vitamin D testing was collected from participants under strict aseptic conditions and transported under special cold boxes from the study sites to the Imam University laboratory for testing on the same day.

BMD of the left calcaneus bone was measured using an ultrasound bone densitometer (Sahara Clinical Bone Sonometer, Hologic, Bedford, MA, USA). This instrument estimates BMD from the quantitative ultrasound index and compares it to that of young, healthy, sex-matched subjects to produce a t-score. The instrument used in the current study has a predictive power of 0.72 for the area under the curve. BMD status was classified as follows: normal was a t-score of ≥ -1, osteopenia was a t-score of -1 to -2.5, and osteoporosis was a t-score of <-2.5.[11]

Statistical analysis

Data entry and analysis were carried out using SPSS 17 Statistical Package for social science. A descriptive analysis was performed, and the data were described in terms of percentages or the mean and standard deviation (SD). The prevalence of osteopenia, osteoporosis status was reported along with 95% confidence intervals. The prevalence of low BMD included both osteopenia and osteoporosis, was age-standardized with reference to the national population of Saudi women, as published by the General Authority for Statistics, the Kingdom of Saudi Arabia.[12]

Chi-square tests for the categorical variables and independent samples *t*-tests for the continuous variables. In addition to backward stepwise logistic regression using the likelihood ratio method was performed. $P < 0.05$ was considered statistically significant.

Results

In the current community-based survey, a total of 501 postmenopausal Saudi women completed the interviews and laboratory testing. The mean age ± SD was 57.7 + 6.2 years.

Table 1 shows that the prevalence of osteopenia was 18.0% (95% confidence interval [CI]: 14.8–21.6), of osteoporosis was 6.0% (95% CI: 4.2–8.4), and of low BMD was 24.0% (95% CI: 20.4–27.9). The prevalence is progressively increased significantly with the advance of the participants' age ($P < 0.001$).

The mean age of low BMD was 60.4 ± 7.5 years significantly higher than the mean age of study participants was 57.7 + 6.2 years < 0.001.

The prevalence of low BMD is significantly higher among illiterate women compared to university graduated (54.2% vs. 44.9% $P = 0.04$) and the prevalence among the physically active women was significantly less in compared to the total sample (16.7% versus 25.3 $P = 0.01$).

Other characteristics as marital status, occupation, residence, and diet containing adequate vegetables were not associated with significant differences in the prevalence of low BMD.

Table 2 reveals that a history of fracture is significantly higher in participants with low BMD compared to the total participants (5.8% vs. 2.4% $P = 0.005$). The use of oral contraceptive pills (OCP) is significantly higher in low BMD 75.8% than total participants 67.5% ($P = 0.02$).

Some of the commonly reported comorbidities as hypertension (56%), diabetes (54%), thyroid disorder, and the serum Vitamin D were not associated with significant differences in the prevalence of low BMD.

Table 3 shows that waist–hip ratio (WHR) was significantly associated with osteopenia, the mean ages at menarche, the mean number of pregnancies, live births, living children, and children breastfed were not statistically significant between different groups of BMDs.

Table 4 shows that older age, illiteracy, physical inactivity, history of fracture, and history of renal disease were significantly associated with low BMD status in the bivariate analysis [Table 4]. In the multiple regression analysis, the final model retained age, joint pain history,

Table 1: Comparison of the social and clinical characteristics of the study participants according to bone mineral density status

	Total, *n* (%)	Normal BMD, *n* (%)	Osteopenia, *n* (%)	*P*	Osteoporosis, *n* (%)	*P*	Low BMD, *n* (%)	*P*
Age group (years)								
≤60	383 (76.4)	309 (80.7)	62 (16.2)	0.001	12 (3.1)	<0.001	74 (19.3)	<0.001
61-70	99 (19.8)	65 (65.7)	20 (20.2)		14 (14.1)		34 (34.3)	
>70	19 (3.8)	7 (36.8)	8 (42.1)		4 (21.1)		12 (63.2)	
Total	501	381 (76.05)	90 (17.97)		30 (5.98)		120 (23.95)	
Age (years) , mean±SD	57.7±6.2	56.9±5.5	59.5±7.4	<0.001	63.1±7.4	<0.001	60.4±7.5	<0.001
Marital status								
Married	374 (74.7)	292 (76.6)	65 (17.4)	0.42	17 (4.5)	0.04	82 (21.9)	0.11
Widowed	93 (18.6)	63 (16.5)	20 (21.5)		10 (10.8)		30 (32.3)	
Divorced	34 (6.8)	26 (6.8)	5 (14.7)		3 (8.8)		8 (23.5)	
Education level								
Illiterate	225 (44.9)	160 (42.0)	45 (20.0)	0.35	20 (8.9)	0.02	65 (54.2)	0.04
Secondary	208 (41.5)	169 (44.4)	33 (15.9)		6 (2.9)		39 (32.5)	
University	68 (13.6)	52 (13.6)	12 (17.6)		4 (5.9)		16 (13.3)	
Occupation								
Homemaker	434 (86.7)	332 (76.5)	73 (16.8)	0.13	29 (6.7)	0.12	102 (23.5)	0.54
Working	67 (13.4)	49 (73.1)	17 (25.4)		1 (1.5)		18 (26.9)	
Residence								
Urban	311 (62.1)	242 (77.8)	51 (16.4)	0.44	18 (5.8)	0.86	69 (22.2)	0.48
Rural	106 (21.2)	77 (72.6)	23 (21.7)		6 (5.7)		29 (27.4)	
Nomad	84 (16.8)	62 (73.8)	16 (19.0)		6 (7.1)		22 (26.2)	
Diet containing adequate vegetables*								
No	252 (50.3)	197 (78.2)	42 (16.7)	0.39	13 (5.2)	0.37	55 (45.8)	0.26
Yes	249 (49.7)	184 (73.9)	48 (19.3)		17 (6.8)		65 (54.2)	
Physically active**								
No	374 (74.7)	274 (71.9)	73 (19.5)	0.07	27 (7.2)	0.03	100 (83.3)	0.01
Yes	127 (25.3)	107 (28.1)	17 (13.4)		3 (2.4)		20 (16.7)	

*Adequate quantities of vegetables: Eating vegetables three days in a week, **Being physically active is defined as three days to do moderate-intensity activities per week. *P* value is from χ^2 or Fisher's exact test. BMD=Bone mineral density, SD: Standard deviation

Table 2: Comparison of the clinical characteristics of the study participants according to bone mineral density status

	Total, *n* (%)	Normal, *n* (%)	Osteopenia, *n* (%)	*P*	Osteoporosis, *n* (%)	*P*	Low BMD, *n* (%)	*P*
History of fracture								
No	489 (97.6)	376 (98.7)	86 (17.6)	0.05	27 (5.5)	0.001	113 (94.2)	
Yes	12 (2.4)	5 (1.3)	4 (33.3)		3 (25.0)		7 (5.8)	0.005*
Comorbidity								
No hypertension	222 (44.3)	174 (78.4)	36 (16.2)	0.33	12 (5.4)	0.54	48 (21.6)	0.27
Hypertension	279 (55.7)	207 (74.2)	54 (19.4)		18 (6.5)		72 (25.8)	
No diabetes mellitus	238 (47.5)	180 (75.6)	43 (18.1)	0.92	15 (6.3)	0.77	58 (24.4)	0.83
Diabetes mellitus	263 (52.5)	201 (76.4)	47 (17.9)		15 (5.7)		62 (23.6)	
No joint pains	447 (89.2)	345 (77.2)	79 (17.7)	0.43	23 (5.1)	0.01	102 (22.8)	0.08
Joint pains	54 (10.8)	36 (66.7)	11 (20.4)		7 (13.0)		18 (33.3)	
No Vitamin D pills	249 (49.7)	193 (77.5)	42 (16.9)	0.49	14 (5.6)	0.67	56 (46.7)	0.44
Vitamin D pills	252 (50.3)	188 (74.6)	48 (19.0)		16 (6.3)		64 (53.3)	
No oral contraceptive pills	338 (67.5)	247 (64.8)	66 (19.5)	0.12	25 (7.4)	0.03	91 (75.8)	0.02*
Oral contraceptive pills	163 (32.5)	134 (35.2)	24 (14.7)		5 (3.1)		29 (24.2)	

*$P < 0.05$ was considered statistically significant. *P* value is from χ^2 or Fisher's exact test as the case may be. BMD: Bone mineral density

history of fracture, OCP intake, and history of renal disease. However, only age (1.08, 1.04-1.11, $P < 0.001$) and joint pain history (1.99, 1.05–3.79, $P = 0.03$) were independently associated with low BMD status.

Table 3: Comparison of the gynecological history, anthropometry, and Vitamin D status of the study participants according to bone mineral density status

	Mean±SD		Osteopenia		Osteoporosis		Low BMD	
	Total	Normal	Mean±SD	P	Mean±SD	P	Mean±SD	P
Gynecological details								
Age at menarche	13.0±1.3	13.0±1.3	12.9±1.4	0.56	12.9±1.7	0.62	12.9±1.5	0.48
Number of pregnancies	8.0±3.1	8.0±3.0	8.1±3.5	0.86	7.8±3.3	0.70	8.0±3.4	0.97
Number of live births	7.1±2.9	7.1±2.8	7.0±3.2	0.86	7.1±3.2	0.99	7.0±3.2	0.88
Anthropometry								
Weight (kg)	77.6±14.0	77.6±12.9	77.7±16.6	0.95	77.0±18.5	0.82	77.5±17.0	0.96
Height (cm)	155.6±6.5	155.7±6.1	156.1±7.8	0.61	153.4±7.5	0.05	155.4±7.8	0.66
BMI	32.1±5.5	32.1±4.8	32.0±7.2	0.88	32.5±6.5	0.64	32.1±7.0	0.94
Waist circumference (cm)	104.2±13.7	104.6±13.4	101.9±15.7	0.11	105.7±12.4	0.69	102.8±15.0	0.24
Hip circumference (cm)	120.5±10.2	120.7±10.1	120.4±10.8	0.86	118.9±11.1	0.40	120.1±10.9	0.60
WHR	86.9±8.5	87.2±8.4	84.9±9.2	0.04	89.0±6.9	0.29	86.0±8.8	0.23
Serum Vitamin D level (ng/mL)	20.3±10.7	20.0±10.4	20.2±10.4	0.92	23.8±15.1	0.10	21.1±11.8	0.40

P value is from independent *t*-test. BMD: Bone mineral density, WHR: Waist–hip ratio, SD: Standard deviation, BMI: Body mass index

Table 4: Multiple logistic regression-factors independently associated with osteopenia, osteoporosis, and bone mineral density status in the study participants

	β	OR (95% CI)	P	Percentage correctly classified	Omnibus tests of model coefficients
Model 1 (osteopenia)					
Age	0.068	1.07 (1.01-1.13)	0.02	82	0.008
WHR	−0.054	0.94 (0.90-0.99)	0.02		
Physically active	−0.728	0.48 (0.19-1.18)	0.11		
Constant	−0.650		0.78		
Model 2 (osteoporosis)					
Age	0.151	1.16 (1.09-1.24)	<0.001	93	<0.001
Joint pains	1.806	6.08 (2.01-18.3)	0.001		
OCP intake	−0.891	0.41 (0.14-1.18)	0.10		
Height	−0.058	0.94 (0.88-1.01)	0.08		
Family history of osteoporosis	0.956	2.60 (0.91-7.38)	0.07		
Constant	−2.843		0.61		
Model 3 (low BMD status)					
Age	0.079	1.08 (1.04-1.11)	<0.001	76	<0.001
Joint pains	0.693	1.99 (1.05-3.79)	0.03		
History of fracture	1.211	3.35 (0.98-11.4)	0.05		
OCP intake	−0.456	0.63 (0.38-1.04)	0.07		
History of renal disease	1.208	3.34 (0.83-13.4)	0.08		
Constant	−5.785	1.07 (1.01-1.13)	<0.001		

Variables entered in Model 1 were age, age at first pregnancy, WHR, history of renal disease, history of fracture, age at marriage, early menopause, physical activity, age at last pregnancy, OCP. Variables entered in Model 2 were age, past history of fracture, joint pain history, education, physical activity, OCP, marital status, height, family history of osteoporosis. Variables entered in Model 3 were age, past history of fracture, physical activity, OCP, education, history of renal disease, bone defect, join pain history, osteoporosis treatment, marital status. WHR: Waist–hip ratio, OCP: Oral contraceptive pills, OR: Odds ratio, CI: Confidence interval, BMD: Bone mineral density

Discussion

The prevalence of osteopenia (18%) and osteoporosis (6%) reported in the current study were lower than those reported in other studies in Saudi Arabia.

In a previous community-based cluster survey conducted in Riyadh in 2009, the prevalence of low BMD among postmenopausal women based on quantitative ultrasound (QUS) (Achilles) was 50%, which is twice as high as that reported by the current study.[13] In another study, in PHCCs of Jeddah in 2002, using dual-energy X-ray absorptiometry (DEXA) (Lunar) of the lumbar spine, the prevalence of osteopenia and osteoporosis was twice as high as that reported by the current study (50.8% and 30.4%, respectively).[14] In a study conducted among postmenopausal women recruited from shopping malls, health-care centers, and outpatient departments in 2006–2007 in the Eastern Province, the prevalence of osteopenia and osteoporosis was found to be close to that reported in the current study (30.3% and 23%, respectively), based on the QUS (Achilles) of the calcaneum.[15] In another study based on DEXA (Lunar) of the femur conducted in Jeddah during 2000–2003, the prevalence of osteopenia and osteoporosis were 57% and 7.8%, respectively, higher than the current study results.[16] Results of a study conducted among Saudi women in 2010 aged ≥50 years screened from schools, colleges, and malls in the eastern province based on the QUS (Achilles) of the calcaneum found that the prevalence of osteopenia was 31.2% and that of osteoporosis was 15.6%.[17]

Studies from other countries in the region also reported varying estimates. A Qatari study performed on 314 women aged >50 years in PHCCs in 2011–2012 reported a prevalence of 5.7% for osteopenia and 0.3% for osteoporosis based on DEXA (Lunar) of the femur.[18] A hospital-based study conducted among 292 Jordanian postmenopausal women reported a prevalence of 46.6% for osteopenia and 13% for osteoporosis based on DEXA of the femur and spine.[19]

In the USA, the prevalence of osteopenia and osteoporosis in postmenopausal white women was reported to be 54% and 30%, respectively.[20] In another American study, the prevalence of osteopenia and osteoporosis using heel sonography was found to be 34% and 3.4%, respectively.[21] In 27 European Union countries, the prevalence of osteoporosis among women aged ≥50 years ranged from 19.3%–23.4%, and the prevalence increased from 6.3% in women aged 50–54 years to 47.2% in those aged 80 years or older. These prevalence figures were based on DEXA of the hip or spine.[22]

The above findings show that there is a wide variation in the prevalence of low BMD not only between different countries but even between different parts of Saudi Arabia. Many factors influence the prevalence of low BMD. First, the age structure of the study populations is the most critical determinant of prevalence. Second, postmenopausal status is usually self-reported, and such information is not always available from other studies for comparisons; hence, the age group >50 years was used. Third, the method for measuring BMD (DEXA or ultrasound bone densitometer), studies using DEXA, and vertebral sites are likely to report higher estimates. Fourth, the sampling strategy (random, convenient, or cluster sampling) and the study setting (hospital- or community-based) greatly influence prevalence. Hospital-based studies generally produce higher estimates because of the high-risk pool of patients they select compared to the low-risk pool of participants included in a community-based study. Fifth, the variations in the distribution of risk factors, such as gynecological history, dietary differences, serum Vitamin D levels, physical activity levels, and others, also affect the prevalence of BMD.[23]

The bivariate analysis in our study showed that some factors were significantly associated with low BMD status; however, in the multivariable analysis, only age, WHR, and history of joint pains were significant. Age and history of joint pains increased the risk of having low BMD, whereas higher WHR was protective. It is a well-known fact that age is the single most important predictor of low BMD.[24] BMI or WHR has also been shown to be protective against osteoporosis in several studies.[25,26] The presence of joint pains could be an effect of low BMD or an effect of increasing age itself, but the fact that it was retained in the stepwise model indicates that it could be independently associated with low BMD. Osteoporosis may be responsible for bone pain. Several studies in postmenopausal women conducted previously in Saudi Arabia have reported several other risk factors for osteoporosis, for example, early or late menopause, history of fractures, dietary factors, age, body weight, residence type, type 2 diabetes, physical activity, presence of comorbidities, family history, ORT, duration of lactation, and parity.[27-34]

In the past few years, there has been significant interest in the role of Vitamin D in the prevention of osteoporosis and related fractures in the elderly. In the current study, serum Vitamin D levels were not associated with BMD status. There are conflicting reports of an association between serum Vitamin D and BMD. Although a few studies support the hypothesis that lower serum Vitamin D levels are associated with low BMD status,[35] many other studies do not.[29,30,36] The Saudi Centre for Evidence-Based Health Care does not recommend routine Vitamin D supplementation for fracture prevention in elderly patients without deficiency.[37] Similarly, a recent meta-analysis found that there was only a small benefit at the femoral neck with Vitamin D supplementation; they concluded that the widespread use of Vitamin D among adults without risk factors for osteoporosis was inappropriate as a prevention strategy based on current evidence.[38] A Cochrane review also concluded that Vitamin D supplements with or without calcium are unlikely to reduce hip fracture risks in elderly.[39] Conversely, a multinational study in 18 countries found that serum Vitamin D deficiency was prevalent between postmenopausal women with osteoporosis.[40]

Strengths and limitations

The use of ultrasound bone densitometer for the measurement of BMD in the heel in a community setting is a convenient approach, particularly for Saudi women.

The sample selected from the PHCCs was representative to Riyadh City.

The limitations in the current study included; the ultrasound bone densitometer is only a screening tool, unlike DEXA, which is the reference standard for the measurement for BMD. Therefore, the prevalence estimated in this study is expected to be lower than that reported by studies using DEXA. In addition, there is a possibility of recall bias regarding the information that was collected in the study.

Recommendations

Further community-based studies are required to assess the national-level prevalence of osteopenia and osteoporosis in the community and to implement an effective program to reduce the burden of its related consequences.

Further studies are required to identify the correction factor for different instruments so the instruments can be standardized to reflect the performance of DEXA.

Implement programs and training to increase the physicians' awareness for adopting preventive practices to screen and detect early the declining bone mass.

Conclusions

Low BMD is a pertinent health problem that affects postmenopausal women in Saudi Arabia. Effective preventive strategies are required to reduce the burden of osteoporosis and osteoporosis-related fractures. National-level prevalence studies and standardization of research methods are required to determine the burden of low BMD in Saudi Arabia accurately.

Ethics approval and consent to participate

This research has been conducted according to the ethical principles stated in the Declaration of Helsinki. Ethical clearance for this study was obtained from the Institutional Ethical Committee of Imam Mohammad Ibn Saud Islamic University (IMSIU). The results of the tests kept confidential and were communicated to the participants, and appropriate referral to specialist care was provided in cases of abnormal findings. The study was conducted with the supervision of the director of public health for the Riyadh region, local health authorities and Imam Medical center administrators.

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Conflicts of interest

There are no conflicts of interest.

Author's contributions

The study was conceived and implemented by MAM. The manuscript was written and finalized by MAM. The author has critically reviewed and approved the final draft and is responsible for the content and similarity index of the manuscript.

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