Original Article

Prevalence and risk factors for osteoporotic fracture among adults with comorbidities in Al-Ahsaa, Saudi Arabia

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Abstract

Background and Aims: Little is known about the prevalence of osteoporotic fracture, its sociodemographic correlates, and its comorbid conditions among the adult population of the Kingdome of Saudi Arabia (KSA). Hence, the present work aimed to assess the prevalence of adults at high risk of osteoporotic fracture in the presence of its known risk factors. As well, to determine the most commonly associated comorbidities of osteoporosis in Saudi Arabia. **Methods:** A cross-sectional study was performed among 518 Saudi adults aged over 45 years in Al-Ahsaa city, KSA. The Arabic version of the fracture risk assessment FRAX without bone mineral density (BMD) was presented in an online questionnaire. **Results:** The 10-year risk for major osteoporotic fracture was found in 50.81% of the participants; 23.48% of them were at high risk and 25.71% at moderate risk. Also, 26.27% of the respondents were at high risk of hip fracture. Significant correlates of osteoporotic fractures included female gender ($P = 0.003$), old age ($P = 0.000$), age at menopause ($P = 0.000$), low body mass index (BMI; $P = 0.000$), previous fracture ($P = 0.000$), alcohol consumption ($P = 0.000$), positive family history ($P = 0.000$), corticosteroids ($P = 0.000$), rheumatoid arthritis ($P = 0.000$), thyroid hyperactivity ($P = 0.000$), gonadal insufficiency ($P = 0.000$), chronic liver disease ($P = 0.000$), nutritional, or gestational disease ($P = 0.000$). **Conclusion:** More than a third of the surveyed population had osteoporosis, which was associated with many sociodemographic and clinical characteristics. Therefore, early interventions for osteoporosis and the prevention of other comorbidities may improve the outcome of osteoporosis.

Keywords: Comorbidities, fractures, Kingdome of Saudi Arabia, osteoporosis

Introduction

According to the National Institutes of Health (NIH) osteoporosis and related bone diseases, osteoporosis is defined as a skeletal disorder, characterized by decreased bone mass with a deterioration of micro-architectural bone tissues that leads to decreased bone strength and increased risk of fragility fractures of the hip, spine, and wrist.[1] Osteoporosis and its fractures are considered a major public health burden worldwide. Currently, it is estimated that over 200 million people in the world have osteoporosis, which is causing more than 8.9 million fractures each year.[2] In Saudi Arabia, osteoporosis manifests in adults aged between 50-79 years and affects 34% of women and 30.7% of men.[3]

Even though osteoporosis and its fractures are of great importance to the public health, they usually go unrecognized,[4,5] thus early detection and appropriate approach are important

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to avoid further consequences.[6] In 2018, the Saudi Mistry of Health[7] released a national plan for prevention and management of osteoporosis in Saudi Arabia and recommended strategies (Recommendation 3, P: 4) to improve the disease early recognition by primary care and family physicians. In clinical settings, osteoporosis is diagnosed based on the presence of fragility fractures or measurements of bone mineral density (BMD) by dual-energy x-ray absorptiometry (DEXA). According to the world health organization (WHO) criteria of BMD in osteoporotic patients, T-score should be ≤ -2.5 for a given individual, calculated against the reference population.[8]

There are many risk factors associated with osteoporosis. These can be classified into unpreventable risk factors and preventable risk factors.[9] Secondary osteoporosis is the presence of osteoporosis due to underlying comorbidities or medications.[10] The presence of co-existing conditions, like diabetes mellitus, hyperthyroidism, chronic liver disease, chronic malnutrition or malabsorption can increase the risk of bone loss and fractures and reduce the quality of life.[11] However, treating the underlying cause is enough to decrease the risk of osteoporotic fractures.[12] A study conducted in Saudi Arabia showed that the mean age of the patients with secondary osteoporosis was 37.4 years, with osteoporosis found in 46.4% and osteopenia in 34.1%.[13]

Another study showed that fracture risk was $3.7 \pm 3.1\%$ among men aged between 40 to 90 years, among whom 2.3% had secondary osteoporosis.[14] Therefore, new assessment tools have been developed to detect high-risk individuals to prevent such fractures and improve health-related quality of life.[15]

Since there are no signs and symptoms of osteoporosis, most of the patients are diagnosed once the fracture occurs. Therefore, the primary goal of treatment of osteoporosis should be the prevention of first fragility fracture. Hence, it is important to identify the frequency of patients who are at high risk of osteoporotic fracture to set appropriate preventative methods and protect them. There is no specific study that examined such patients in Saudi Arabia, particularly the general population at Al-Ahsaa city. Therefore this study aimed to calculate the frequency of adults at high risk of osteoporotic fractures in the presence of comorbidities including type 1 diabetes mellitus, hyperthyroidism, chronic liver disease, hypogonadism, premature menopause, chronic malnutrition or malabsorption, and also to determine the most common associated risk factors of osteoporosis.

Methods

A cross-sectional and community-based study was conducted among the Saudi adult males and females aged from 45-65 years in Al-Ahsaa city, KSA. The minimum sample size was estimated to be 500, but we managed to reach a total of 574 individuals. The assessment was conducted using an electronic online questionnaire, which consisted of the Arabic version of the fracture risk assessment FRAX without bone mineral density (BMD). The questionnaire included two parts. The first part consisted of six questions about sociodemographic data. The consent was obtained from the participants at the beginning of the survey, then data regarding the age, gender, and residence area. Length in centimeters (cm) and weight in kilograms (kg) were obtained to calculate the body mass index (BMI) using (Kg/m2) equation. The second part included 15 questions that assessed the presence of previous fractures, family history, smoking, and alcohol drinking, use of corticosteroids, background history of osteoporosis, rheumatoid arthritis, type 1 diabetes mellitus, hyperthyroidism, chronic liver disease, hypogonadism, premature menopause, and chronic malnutrition or malabsorption. Also, the 10-year probability of major osteoporotic fractures in the hip, spine, or wrist was measured using the United States (US) White version of the FRAX tool without BMD as recommended by the Saudi osteoporosis society.[16]

Ethical approval was obtained from the research and studies committee at the college of medicine at King Faisal University, Date: 02/03/2019. All participants were informed that their information will be kept confidential and will not be used but for the purpose of the study.

The Statistical Package for Social Science (IBM SPSS version 21, SPSS Inc., Chicago, IL) was used for the statistical analysis. The mean and standard deviation was calculated for continuous variables. Categorical variables were presented as frequencies and percentages. Compression between different variables was performed using the Chi-square, independent *t*-test, or Pearson's correlation coefficient. A P value of <0.05 was considered statistically significant.

Results

The study included a total of 574; of them 18 were excluded because they refused to participate and 38 were from outside AlAhsa, KSA, giving a response rate of 90.2%. There were 260 (51.08%) males and 249 (48.92%) females. The age group were classified into 4 categories; age between 45-50 years ($n = 207$, 40.67%), age between 51-55 years ($n = 129$, 25.34%), age between 56-60 years ($n = 101$, 19.84%), and age between 61-65 years ($n = 72$, 14.15%). There were

Table 1: Sociodemographic features of the study population

Variables	%
Sex	
Men	51.08
Women	48.92
Age (years)	
45-50	40.67
51-55	25.34
56-60	19.84
61-65	14.15
Have you ever been diagnosed with osteoporosis?	
Yes	35.4
No	64.6
Less than enough	

35.36% (n = 180) of participants who were already diagnosed with osteoporosis [Table 1].

Table 2: Calculation of 10-year risk for major osteoporotic fractures among the study population

Risk	%
Risk of osteoporotic fracture	
High	50.8
Moderate	25.7
Low	23.5
Risk of osteoporotic hip fracture	
Yes	26.7
No	73.3

Using the FRAX score, the 10-year risk for major osteoporotic fractures including the spine, hip, and wrist, the risk was classified into high, moderate, and low. A total of 50.8% were at high risk, 25.7% at moderate risk, and 23.5% at low risk. Also, 26.72% of participants were at risk of osteoporotic hip fracture [Table 2]. Table 3 shows that osteoporotic fractures were significantly associated with female sex (r = 0.129, P = 0.003), old age (r = 0.644, P = 0.000), age at menopause (r = 0.282, P = 0.000), and low BMI (r = 0.176, P = 0.000).

Table 4 summarizes the clinical risk factors correlated with osteoporotic fractures, including previous fracture (r = 0.667, P = 0.000), positive family history (r = 0.614, P = 0.000), alcohol

Table 3: Distribution of severity of 10 years risk of osteoporotic fractures with sociodemographic characteristics

Sociodemographic characteristics		Severity of 10-year risk for osteoporotic fractures			Spearman's correlation coefficient	*P*
		Low	Moderate	High		
Gender	Male	130	76	47	0.129	0.003
	Female	121	51	69		
Age group	45-50	163	29	9	0.644	0.000
	51-55	68	31	27		
	56-60	13	35	48		
	61-65	7	32	32		
BMI	Underweight	4	8	3	0.176	0.000
	Normal	87	49	58		
	Overweight	90	34	39		
	Obesity class 1	43	25	10		
	Obesity class 2	12	6	5		
	Obesity class 3	2	0	0		
Age at menopause	Before the age of 45 years	56	35	47	0.282	0.000
	After the age of 45 years	65	16	22		

Table 4: Distribution of the 10-year risk for osteoporotic fracture among different clinical risk factors

Clinical risk factors		Severity of 10-year risk of osteoporotic fractures			Pearson's coefficient	*P*
		Low	Moderate	High		
History of previous fracture	Yes	11	38	88	0.667	0.000
	No	240	89	28		
Family history of hip fracture	Yes	24	59	98	0.614	0.000
	No	227	68	18		
Smoking	Yes	90	67	52	0.083	0.063
	No	161	60	64		
Drinking consumption	Yes	6	17	16	0.208	0.000
	No	245	110	100		
Taking corticosteroid	Yes	59	93	101	0.522	0.000
	No	192	34	15		
Rheumatoid arthritis	Yes	43	58	71	0.333	0.000
	No	208	69	45		
Type 1 diabetes	Yes	33	24	25	0.087	0.049
	No	218	103	91		
Thyroid hyperactivity	Yes	49	56	67	0.349	0.000
	No	202	71	49		
Gonadal insufficiency	Yes	27	47	50	0.338	0.000
	No	224	80	66		
Chronic liver disease	Yes	21	40	46	0.275	0.000
	No	230	87	70		
Nutritional or gestational disease	Yes	113	88	85	0.188	0.000
	No	38	39	31		

consumption (r = 0.208, *P* = 0.000) use of corticosteroids (r = 0.522, *P* = 0.000), rheumatoid arthritis (*r* = 0.333, *P* = 0.000), thyroid hyperactivity (r = 0.349, *P* = 0.000), gonadal insufficiency (r = 0.338, *P* = 0.000), chronic liver disease (r = 0.275, *P* = 0.000), nutritional, or gestational disease (r = 0.188, *P* = 0.000). Both smoking and type 1 diabetes were not correlated with the 10-year risk for osteoporotic fractures [Table 4].

Discussion

The present study provides data on the risk factors of osteoporosis based on a sample of Saudi population aged 45 years and older. Overall, 35.4% self-reported having an established diagnosis of osteoporosis. According to the Pearson correlation analysis, the 10-year risk for osteoporotic fracture was significantly related to sex, age, previous fracture, family history, alcohol consumption, and use of corticosteroids. Women with age of menopause before 45 years had a significantly higher risk of osteoporotic fractures compared to women with menopause after 45 years. The risk was significantly high in individuals with comorbid disorders, including thyroid hyperactivity, gonadal insufficiency, rheumatoid arthritis, chronic liver disease and nutritional or gestational disease. Type 1 diabetes showed no significant association.

Prevalence rates are difficult to compare as prevalence estimates are most commonly based on measuring the bone mineral density using WHO's criteria with T-scores.[17,18] However, our results are close to those of other Saudi studies.[3,13,19,20] In 2018, the Saudi ministry of health reported that the prevalence of osteoporosis was 28.2% in men and 37.8% in women aged above 50 years,[7] which is similar to the prevalence in the present study. In comparison with other Saudi studies, results vary depending on the methodology used to measure osteoporosis.

Research studies have consistently demonstrated that the incidence of osteoporosis and osteoporotic fractures is higher in women than in men, and it tends to increase steeply with advancing age.[21,22] The role of age and gender in osteoporotic fractures are evident in this study as women showed an increased risk of osteoporosis and osteoporotic fractures compared to men, as well as the risk of osteoporosis and osteoporotic fractures positively correlated with age. In the current analysis, women with age of menopause before 45 years had a higher risk for osteoporotic fractures compared to those with menopause at older ages. These findings agree well with what has been shown by other studies, which found that early natural menopause emerged as a significant independent predictor of osteoporosis, regardless intervention with hormonal therapy and calcium and vitamin D supplementation.[23-25]

In this study, the risk of osteoporotic fractures was higher among individuals with family history than among those without a family history of osteoporosis. Similar findings have been reported by other studies that found family history to be an independent risk factor for osteoporosis.[26-29]

The present study is mainly concerned with the estimation of the risk for osteoporosis and fractures related to it in the existence of other medical comorbidities. Our analysis showed that the 10-year risk for osteoporotic fractures was higher in individuals with diagnosed thyroid hypersensitivity, which is in agreement with other studies[30] Bone changes in people with hyperthyroidism are characterized by enhanced turnover of both cortical and trabecular bone leading to increased mobilization of bone mineral and porosity.[31] Gonadal insufficiency in adults is a well-recognized cause of overall bone loss and a risk factor for the development of osteoporosis. Bone loss has been well correlated with gradual and age-dependent decline in estrogen and testosterone in female and male osteoporosis, respectively.[32] This is supported by our finding of the higher risk of osteoporosis and related fractures in those who self-reported having gonadal insufficiency. Similar to previous studies, the risk of osteoporotic fractures in this study was found to be higher in patients with rheumatoid arthritis,[33,34] liver disease,[35,36] type 1 diabetes[37] and nutritional deficiency.[38]

Results of studies that examined the relationship between osteoporosis and smoking and osteoporosis and alcohol consumption including fracture risk and low BMD remain inconclusive.[39-42] In this study, both alcohol and smoking were significantly correlated with osteoporotic fracture risk. Inconclusive results have also been found in studies assessing the relationship between osteoporosis and body weight. In some studies, lower BMI was correlated with reduced osteoporosis and fracture risk, which is what we found in the present study.[43,44]

Study limitations

Although this study is one of few examining the risk factors for osteoporosis and osteoporotic fractures in a large sample of Saudi adults, it has some limitations. The use of self-reported information on clinical data may lead to biased estimates and reporting bias. As well, the prevalence of osteoporosis was mainly based on self-reported diagnoses and was not clinically verified. Even though the prevalence rate in this study was comparable with the findings of other studies, inaccurate data about the diagnosis of osteoporosis, such as misclassification and misunderstanding, are unavoidable.

Conclusion

Osteoporotic fractures were common and associated with many sociodemographic and clinical factors. It was evident that osteoporotic fractures are significantly related to several comorbidities. Interventions for osteoporosis could be improved by providing early care or prevention of other comorbid diseases.

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Conflicts of interest

There are no conflicts of interest.

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