

Factors associated with osteoporosis among a sample of Jordanian women referred for investigation for osteoporosis

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العوامل المرافقة لتخلخل العظام لدى عينة من النساء الأردنيات اللاتي تمت إحالتهم لاستقصاء تخلخل العظام لديهن
موفق الحيص، إيمان الكامل، خالد خير الله، طارق شطناوي، مها الغرايبة، أسماء المنياص

الخلاصة: أجرى الباحثون هذه الدراسة المستعرضة للتعرف على الترابط بين تخلخل العظام وبين عوامل اختطار نوعية لدى 384 امرأة تمت إحالتهم إلى قسم الأشعة في مستشفى الملك عبد الله الجامعي في إربد، الأردن، خلال الفترة أيلول/سبتمبر 2009 وأب/أغسطس 2010؛ لتشخيص قلة العظم أو تخلخل العظام. وقد قاس الباحثون كثافة المعدن العظمي باستخدام القياس الامتصاصي المزدوج للأشعة السينية في كل من العمود القطني (في وضعية أمامية خلفية للفقرات القطنية من الأولى حتى الرابعة)، وفي الورك الفخذي (في عنق الفخذ والمدور). وتضمنت عوامل الاختطار المدروسة العمر، والعمر عند بدء الإحاضة، ووقت الإياس، ومنسب كتلة الجسم، والسكري، وارتفاع ضغط الدم، والمشكلات الكلوية، والتدخين. وقد بلغ معدل انتشار تخلخل العظام في العينة المدروسة 13.5%، وترابطاً لتخلخل العظام ترابطاً يُعتد به إحصائياً مع كل من العمر الحالي، والعمر عند بدء الإحاضة، والسكري، وارتفاع ضغط الدم، والمشكلات الكلوية.

ABSTRACT This cross-sectional study was carried out to examine the association between osteoporosis and specific risk factors among 384 women referred to the Radiology Department at King Abdullah University Hospital, Irbid, Jordan during the period September 2009–August 2010 for diagnosis of osteopenia or osteoporosis. Bone mineral density measurements were carried out using dual energy X-ray absorptiometry at both the lumbar spine [AP: L1–L4] and femoral hip (neck, trochanter). Studied risk factors included age, age at menarche, menopause, body mass index, diabetes mellitus, hypertension, renal problems and smoking. The prevalence of osteoporosis among the studied sample was 13.5%. Osteoporosis was significantly associated with current age, age at menarche, diabetes mellitus, hypertension, and renal problems.

Facteurs associés à l'ostéoporose dans un échantillon de femmes jordaniennes orientées pour un dépistage de l'ostéoporose

RÉSUMÉ La présente étude transversale a été menée pour étudier l'association entre l'ostéoporose et des facteurs de risque spécifiques chez 384 femmes orientées vers le service de radiologie de l'hôpital universitaire du Roi Abdallah à Irbid (Jordanie), entre septembre 2009 et août 2010, pour un diagnostic d'ostéopénie ou d'ostéoporose. Des mesures de la densité minérale osseuse ont été prises à l'aide d'une absorptiométrie biénergétique à rayons X, au niveau du rachis lombaire (L1–L4) et de l'articulation fémorale (col, trochanter). Les facteurs de risque étudiés étaient l'âge au moment de l'étude, l'âge des premières règles et à la ménopause, l'indice de masse corporelle, la présence d'un diabète, d'une hypertension ou de problèmes rénaux ainsi que la consommation de tabac. La prévalence de l'ostéoporose au sein de l'échantillon étudié était de 13,5 %. L'ostéoporose était significativement associée à l'âge au moment de l'étude, l'âge des premières règles, la présence d'un diabète, d'une hypertension et de problèmes rénaux.

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Introduction

Osteoporosis is prevalent in aged adults, mostly in postmenopausal women. Diagnosis depends mainly on the quantitative assessment of bone mineral density, which is considered the most important determinant of bone strength. The clinical significance of osteoporosis is from the potential for causing fractures [1]. There are several sites of potential occurrence for osteoporotic fracture including: the spine, hip, distal forearm and proximal humerus [2].

In a study done in the North America it was estimated that 1 in 3 women and 1 in 12 men over the age of 50 worldwide have osteoporosis [3]. Osteoporosis affected about 10 million women and men in the United States in 2005 [4,5]. In Sweden, osteoporosis was estimated to affect 6.3 % of men and 21.2 % of women aged 50–80 years [6].

A number of studies have been done in the countries of the Middle East [7–11]. The prevalence in Lebanon is estimated to be 31% among women according to WHO criteria. In Kuwait, the prevalence of osteoporosis in Kuwaiti women was about 18%. In Jordan 13% of the females above 40 years of age were osteoporotic. In Saudi Arabia, the prevalence of osteoporosis among the Saudi population was estimated in the range 35%–48%. In another study, the prevalence of osteoporosis among Saudi females over 31 years was 0%–7%, whereas it was about 28% among women over 50 years [12].

The risk factors associated with osteoporosis may be modifiable or non-modifiable [13]. Non-modifiable risk factors include age and sex: estrogen deficiency following menopause or oophorectomy is correlated with a rapid reduction in bone mineral density. Ethnicity is also recognized as a non-modifiable risk factor and European or Asian ancestry predisposes for osteoporosis. Genetics is also a predisposing

factor: those with a family history of osteoporosis are more likely to have increased risk [14].

Diabetes mellitus (DM) is associated with increased incidence of osteoporosis fractures via visual impairments resulting from diabetic retinopathy and cataract [15]. Adult women with type 1 DM also have relatively decreased bone mass, increased fracture risk, and delayed fracture healing compared with healthy women without DM. In addition, researchers have shown that the biomechanical integrity of diabetic bone may be impaired [16]. However, this is not so for patients with type 2 DM; in fact, they may be relatively protected from osteoporosis.

Menopause is a major risk factor for osteoporosis. The incidence of fractures increases by about 40% with menopause in developing countries [8]. The relationship between osteoporosis and hypertension can be understood through menopause: the underlying mechanism is through hormonal changes as part of the aging process and the accompanying reduction in estrogen and progesterone [17]. Age itself is also a risk factor since it is associated with low bone mineral density; the risk for osteoporosis is doubled among elderly women [18].

Increased age at menarche affects the incidence of osteoporosis. Menarche after age 14 years is associated with increased incidence of osteoporosis. This risk factor is most likely associated with estrogen deprivation [19].

Body mass index (BMI) is also a risk factor, with obesity being a protective factor. A lower incidence of fractures has been reported in obese women [20].

Renal problems are also regarded as a risk factor through the metabolism of vitamin D and parathyroid hormone. When metabolic disturbances end with decreased calcium level, bone resorption is likely to occur and this can lead to osteoporosis [21].

Other risk factors, the modifiable risk factors, depend on lifestyle, and can be avoided. These include: alcohol, vitamin D deficiency, tobacco smoking, malnutrition, a high protein diet, excess physical activity, heavy metals and soft drinks [22–24].

Objectives

This study was carried out to examine the risk factors associated with osteoporosis among Jordanian women referred to the Radiology Department at King Abdullah University Hospital. The risk factors studied included, age, age at menarche, menopause, DM, renal problems, hypertension, BMI and smoking.

Methods

This cross-sectional study was conducted at King Abdullah University Hospital, Irbid, Jordan. The study involved all 392 female patients referred to the Department of Radiology from other specialty departments during the period September 2009 to August 2010. The sample comprised 51 inpatients admitted to the Orthopaedics wards for surgical treatment for fractures at different sites. The remaining 333 patients were referred from Medicine, Orthopaedics, Endocrinology and Urology outpatients departments for the diagnosis of osteopenia or osteoporosis. Eight patients were excluded from the study: 3 were severely ill with multiple fractures and 5 refused to be involved in the study after full explanation of the aims. The final sample included 384 women, a response rate of 97.9%.

All participants were informed about the research study and gave informed approval. The study was approved by the ethical committee of Jordan University of Science and Technology.

A special question form was designed by the researchers for the purpose of the study after reviewing

previous studies. This was evaluated by the scientific committee of the university. The questionnaire was administered and completed by the researchers by interviewing the patients. The main information gathered included sociodemographic characteristics, weight, height, and age at menarche, menopause, and reported illnesses such as DM, hypertension, renal problems and smoking status.

All patients who had clinical, radiological or serological findings of osteoarthritis or rheumatoid arthritis were excluded. Patients on steroid treatment were also excluded.

Measurement of bone mineral density

Bone mineral density measurements at both the lumbar spine [AP: L1–L4] and femoral hip (neck, trochanter) were carried out by using dual-energy X-ray absorptiometry (DXA), which is considered the gold standard for the diagnosis of osteoporosis. We used the following diagnostic guidelines [25]: normal: T-score ≥ -1.0 ; low bone mass (osteopenia): T-score between -1.0 and -2.5 ; osteoporosis: T-score ≤ -2.5 .

We used the World Health Organization definition of BMI [26]: normal: BMI $18.5 < 25 \text{ kg/m}^2$; overweight: BMI $25 < 30 \text{ kg/m}^2$; obese: BMI $> 30 \text{ kg/m}^2$.

Data analysis

Data analysis was carried out using SPSS, version 17. The chi-squared test was used as a test of significance ($P < 0.05$) for the unadjusted effect. Backward stepwise conditional multivariate regression analysis was used to investigate and quantify the adjusted effect of each of the independent variables on the disease status using adjusted odds ratio (OR) and 95% confidence interval (CI).

Results

Table 1 shows the distribution of the study population according to

Table 1 Distribution of Jordanian women patients ($n = 384$) referred for radiology, according to dependent and independent variables

Variable	No.	%
Current age (years)		
< 50	108	28.1
50–60	119	31.0
> 60	157	40.9
Age at menarche (years)		
< 13	312	81.3
≥ 13	68	17.7
Missing data	4	1.0
Body mass index		
Normal	49	12.8
Overweight	121	31.5
Obesity	214	55.7
Diagnosis		
Normal	184	47.9
Osteopenia	148	38.5
Osteoporosis	52	13.5
Menopause		
Yes	292	76.0
No	90	23.6
Missing data	2	0.4
Diabetes mellitus		
Yes	50	13.0
No	334	87.0
Hypertension		
Yes	69	18.0
No	315	82.0
Renal problems		
Yes	18	4.7
No	366	95.3
Smoking		
Yes	17	4.4
No	367	95.6

descriptive variables. Just over 80% of the women reported age at menarche as < 13 years. Just 13.5% of the women were diagnosed as osteoporotic, with 38.5% osteopenic. DM was reported by 13.0%, 18.0% had hypertension, and 4.7% had renal problems.

Table 2 shows the distribution of the study population according to bone mineral density and clinical variables. It shows that 25.5% of the women aged > 60 years had osteoporosis compared to only 7.4% of those

aged < 50 years and the difference was statistically significant ($P < 0.001$).

Age at menarche was statistically significantly associated with osteoporosis: 15.7% of osteoporotic women reported age at menarche at < 13 years compared to 4.4% at age ≥ 13 years ($P < 0.001$) (Table 2). The proportion of menopausal women with osteopenia (46.6%) and osteoporosis (13.0%) was statistically significantly greater than for nonmenopausal women (13.3% and

Table 2 Distribution of Jordanian women patients ($n = 384$) referred for radiology according to bone mineral density and clinical variables

Variable	Bone mineral density						Total		P-value
	Normal		Osteopenia		Osteoporosis		No.	%	
	No.	%	No.	%	No.	%			
Age (years)									
< 50	71	65.7	29	26.8	8	7.4	108	28.1	< 0.001
50–60	68	57.1	47	39.5	4	3.4	119	31.0	
> 60	45	28.7	72	45.8	40	25.5	157	40.9	
Total	184	47.9	148	38.5	52	13.5	384	100.0	
Age at menarche (years)									
< 13	118	37.8	145	46.5	49	15.7	312	82.1	< 0.001
≥ 13	62	91.2	3	4.4	3	4.4	68	17.9	
Total	180	47.4	148	38.9	52	13.7	380	100.0	
Body mass index									
Normal	19	38.8	20	40.8	10	20.0	49	12.8	> 0.05
Overweight	64	52.9	40	33.0	17	14.0	121	31.5	
Obese	101	47.2	88	41.1	25	11.7	214	55.7	
Total	184	47.9	148	38.5	52	13.5	384	100.0	
Menopause									
Yes	118	40.4	136	46.6	38	13.0	292	76.4	< 0.001
No +	64	71.1	12	13.3	14	10.5	90	23.6	
Total	182	47.6	148	38.7	52	13.6	382	100.0	
Diabetes mellitus									
Yes	24	48.0	12	24.0	14	28.0	50	13.0	< 0.01
No	160	48.0	136	40.7	38	11.3	334	87.0	
Total	184	48.0	148	38.5	52	13.5	384	100.0	
Hypertension									
Yes	43	62.3	12	17.4	14	20.3	69	18.0	< 0.001
No	141	44.8	136	43.2	38	12.0	315	82.0	
Total	184	48.0	148	38.5	52	13.5	384	100.0	
Renal problems									
Yes	5	27.8	6	33.3	7	38.9	18	4.7	< 0.01
No	179	49.0	142	38.8	45	12.2	366	95.3	
Total	184	48.0	148	38.5	52	13.5	384	100.0	
Smoking									
Yes	11	64.7	3	17.6	3	17.6	17	4.4	> 0.05
No	173	47.1	145	39.5	49	13.4	367	95.6	
Total	184	48.0	148	38.5	52	13.5	384	100.0	

10.5% respectively) and the difference was statistically significant ($P < 0.001$).

Also, 28.0% of women with DM had osteoporosis compared with 11.3% among women with no DM ($P < 0.01$) (Table 2).

Having hypertension ($P < 0.001$) and renal problems ($P < 0.01$) also had statistically significant relations with osteoporosis (Table 2).

Logistic regression of factors associated with osteoporosis

Logistic regression showed that age, DM, and age at menarche were the most significant predictors of osteoporosis (Table 3). Women who were < 50 years old were only 0.36 times as likely to have osteoporosis compared with those who were > 60 years old. This relationship was statistically significant (OR = 0.36; 95% CI: 0.15–0.83).

Participants who reported having DM were 2.56 times more likely to have osteoporosis compared with those who did not report having DM (Table 3). This relationship was statistically significant (95% CI: 1.19–5.50). Women who reported menarche at age ≤ 13 years were 2.86 more likely to have osteoporosis. However this relationship was not statistically significant (95% CI: 0.81–10.11).

Table 3 Adjusted effects of factors associated with osteoporosis in Jordanian women patients (n = 384) referred for radiology

Factor	OR	95% CI
Age (years)		
< 50	0.36	0.15-0.83
50-60	0.12	0.04-0.34
> 60	Ref	-
Diabetes mellitus		
No	Ref	-
Yes	2.56	1.19-5.50
Age at menarche (years)		
≥ 13	Ref	-
< 13	2.86	0.81-10.11

OR = odds ratio; CI = confidence interval.

Ref = reference category.

Discussion

Our data showed that the prevalence of osteoporosis among Jordanian women who had been referred for assessment of bone density by their physicians was 13.5%, which is lower than that reported for some other populations. A higher prevalence of osteoporosis was reported for postmenopausal Caucasian women (30%) [27], (21.2%) in Swedish women aged 50–80 [6]. It is also lower than that reported for women in some Arab countries [11,12]: in Lebanon, the prevalence of osteoporosis in women was reported to be 31%, in Kuwaiti women 18%, in Saudi Arabia it was 28% among women aged over 50 years and in Jordan it was estimated to be 13% of females over 40 years of age.

The data obtained from the present study showed no significant relationship between BMI and osteoporosis although other researchers have found low BMI to be significantly related with osteoporosis [28]. This could be because some of the measurements were taken from the medical records because the patients were not available and we could not ascertain their accuracy of these records.

Our findings demonstrated a significant correlation between age and osteoporosis. As the age increases,

osteoporotic cases increase, especially after 60 years, this is consistent with other studies where osteoporosis is prevalent in women after 60. Several reasons were reported age as a risk factor due to estrogen deficiency after menopause [6,29,30].

Regarding the relation between age at menarche and osteoporosis, some researchers have found that osteoporosis was more prevalent among women having their menarche after the age of 13 years [17], but this is not comparable with our findings. This may be related to the fact that some women may forgot or do not accurately recall the exact date of their menarche [31,32].

Menopause is an important predictor of osteoporosis associated as it leads to bone weakness. The findings of this study are comparable with those of other reported studies [14,30,33].

We found that significantly more women with DM had osteoporosis than women with no DM; this is comparable to the findings of other studies in which DM correlated significantly with osteoporosis [15,34].

The basic mechanism of association between hypertension and osteoporosis has not been clarified yet. The latest research has shown that rennin-angiotensin system plays a main role in blood

pressure control and has an influence on bone density [35]. High blood pressure is associated with calcium metabolism disorder, which affects increased secretion of calcium through urine [35]. Our findings showed that significantly more hypertensive women had osteoporosis than non-hypertensive women, which is comparable to other research in which a significant correlation between hypertension and osteoporosis, thought to be through a link between cardiovascular diseases and osteoporosis, was demonstrated [36].

Our results showed that renal problems were significantly associated with osteoporosis, which is comparable to other research which reported an association thought to be related to increased calcium excretion [37]. Bone disease may occur early in the course of kidney disease, and worsens as the decline in kidney function progresses, and bone density tends to be worse in cortical sites. Kidney patients also may have poor quality bone, so they can suffer fractures even without severe loss of bone mass [36,38].

Smoking was not shown to be associated significantly with osteoporosis in our study; this is contrary to the findings of some other studies in which smoking was considered a significant factor [17–19]. We think that the reason may be under-reporting of smoking among our participants because all of them were females living in a conservative community.

On consideration of the results of this study, we recommend the evaluation or measuring of bone mineral density for menopausal women, and women with DM, hypertension and renal problems for early detection of osteopenia or osteoporosis.

The main limitation of this study is that it included women with health problems. We recommended that any further national study should involve women in the community.

Competing interests: None declared.

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