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Assessment of osteoporosis knowledge, awareness, and risk factors among premenopausal and postmenopausal women from Jordan: a cross-sectional study

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Abstract Summary Rationale Lack of information about osteoporosis knowledge and awareness among premenopausal compared to postmenopausal women in Jordan.

Main result Women had an average-poor knowledge and awareness about osteoporosis.

Significance This study highlights the need to improve women's knowledge about osteoporosis, its consequences, potential risk factors, preventive measures, and treatment options.

Purpose To assess osteoporosis knowledge, awareness, and risk factor profile among premenopausal and postmenopausal women from Jordan.

Methods This was a cross-sectional study that involved 490 premenopausal and 488 postmenopausal women from the general population of Jordan. Face-to-face interviews were conducted to collect the sociodemographic and clinical data and to complete the Osteoporosis Knowledge Assessment Tool (OKAT) questionnaire.

Results Premenopausal and postmenopausal women had an average-poor level of knowledge and awareness regarding osteoporosis, with a total mean score of 51.3 and 50.9, respectively, out of the total OKAT score of 100. More than 50% of premenopausal women correctly answered 11 questions, while >50% of postmenopausal women correctly answered 9 questions out of 20 in OKAT, which are related to knowledge and awareness about osteoporosis. The participants' marital status (being married), higher educational level, and higher economic status were significantly associated with better knowledge and awareness about osteoporosis (p-values < 0.05). Postmenopausal women had higher osteoporosis risk profile including older age, higher body mass index, less regular exercise, and less exposure to sunlight versus premenopausal women.

Conclusion Premenopausal and postmenopausal women from Jordan had an average-poor level of knowledge and awareness about osteoporosis. Higher educational levels and higher income are associated with better knowledge and awareness about osteoporosis. It is therefore crucial to improve the knowledge of women in Jordan about osteoporosis and its consequences, as well as the potential risk factors, preventive measures, and treatment options. Conducting periodic osteoporosis awareness and educational campaigns are necessary to spread the awareness of the disease.

Keywords Osteoporosis · Premenopausal women · Postmenopausal women · Risk factors · Awareness

Introduction

Bone mass is a well-known indicator of bone strength [1, 2]. The peak skeletal growth in the fourth decade and the subsequent rate of bone loss has an impact on a person's bone mass in later years [1, 2]. As bone mass, and thus, the bone strength is reduced, the fracture risk is increased in both young and old age groups [3]. In elderly people, the hip, forearm, and vertebrae are most prone to fracture risk [1, 4]. Osteoporosis is the most likely underlying cause of these fractures, which is described as a systemic skeletal disorder with bone tissue loss and decreased bone mass, which may contribute to fragile and weak bones [5, 6]. Osteoporosis is silent in nature until fractures happen [2]. As fractures cause chronic pain, disability, dependency, high mortality, and low quality of life, prevention and management are warranted among people at risk [7].

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Osteoporosis is categorized mainly into two types: primary and secondary. The primary type commonly affects postmenopausal women, and both men and women after the age of 70 years [8]. On the other hand, several disorders, selected medications, and/or idiopathic conditions are associated with secondary osteoporosis [8, 9]. Osteoporosis mainly attributed to a reduction in bone mineral density (BMD). Also, age, female gender, race, family history of osteoporosis, underweight, smoking, excessive caffeine consumption, reduction in calcium levels, immobility, vitamin D deficiency, delayed menarche, and early menopause were identified as important risk factors for osteoporosis development [10, 11].

Although both men and women are susceptible to osteoporosis, postmenopausal women are at an increased risk due primarily to decreased estradiol levels, decreased osteoblastic activity, and an abnormal increment in the osteoclastic resorption activity [12]. The majority of previous studies on osteoporosis have focused on postmenopausal women [13]; thus, further investigations are required to assess its prevalence and associated factors in premenopausal women giving its multifactorial etiology [5]. Furthermore, numerous investigations used a variety of assessment measures to describe unhealthy behaviors and a lack of understanding of osteoporosis throughout the world; however, few of these studies included premenopausal women, a crucial target population [14, 15].

Various studies have explored the knowledge of osteoporosis among postmenopausal using different instruments such as the Osteoporosis Knowledge Test (OKT), the Osteoporosis Prevention and Awareness Tool (OPAAT), the Osteoporosis Questionnaire (OPQ), the Facts on Osteoporosis Quiz (FOOQ), and the Osteoporosis Knowledge Assessment Tool (OKAT) [16, 17].

Because many of the osteoporosis risk factors are both modifiable and behavior-dependent, educational campaigns should be conducted on how to lower the risk of bone loss and fracture in women. These campaigns should raise awareness of osteoporosis and its undesirable consequences and encourage a healthy lifestyle [18, 19]. To do so, evaluating the existing knowledge of premenopausal and postmenopausal women about osteoporosis is potentially critical. Thus, tremendous efforts are directed to cover the gaps of knowledge and improve the awareness about the disease and its consequences [20]. Therefore, this study was conducted in Jordan to achieve the following goals:

1- To assess premenopausal and postmenopausal women's knowledge and awareness of osteoporosis prevention and their predictors using OKAT.
2- To assess risk factors that predispose premenopausal and postmenopausal women to osteoporosis.

We hypothesized that there are knowledge deficits among premenopausal and postmenopausal women in Jordan regarding osteoporosis and its related risk factors.

Methods

Study design, participants, and setting

This was a cross-sectional study, which included premenopausal and postmenopausal women who had never been clinically diagnosed with osteoporosis. The sample was recruited by convenience from workers/visitors at King Abdullah University Hospital (KAUH), and from the general population in the North of Jordan. Subjects were approached and informed about study objectives. Those who agreed to participate in the study supplied written informed consent. All data were kept confidential. The study was conducted from September 2022 to April 2023. Ethical approval to perform the study was obtained from the International Review Board (IRB) of KAUH, Jordan University of Science and Technology (JUST) (approval#: 2022/378).

Eligibility criteria included premenopausal women aged above 20 years and postmenopausal women whose period of menopause lasted more than a year [21].

Exclusion criteria included patients with malignancy, premature menopause (undergone hysterectomy), and those who were previously diagnosed with osteoporosis.

Data collection

The study questionnaires (Arabic version) were filled out during face-to-face interviews conducted by a trained clinical pharmacist. The first part of the questionnaire was used to gather data on age, current city, marital status, educational level, income, menopausal age, menarche onset, length of menopause, duration of menstruation, number of pregnancies and miscarriages, breastfeeding status, and family or personal history of fragility fracture or osteoporosis. We also collected data about lifestyle factors such as physical exercise, smoking habits, daily caffeine ingestion, daily calcium consumption, and exposure to the sun. Moreover, participants were asked about the presence of any chronic diseases, such as diabetes mellitus and hypertension, the usage of statins, vitamin D3, calcium supplements, or any other chronic medications.

Definition of study variables

Body mass index (BMI) was computed using the formula (weight (kg)/height (m^2)) and divided into BMI categories after measurements of weight and height were taken. Smoking status was divided into two categories: a current

smoker as someone who smokes cigarettes on a daily or irregular basis, and those who have never smoked or have only smoked infrequently in the past were considered as nonsmokers [22]. Regular physical exercise was defined as any sort of aerobic physical activity of moderate-intensity lasting at least 30 min per 5 days/week [23]. In adults, sun exposure was outlined as daily exposure to the sun for 10 to 15 min on the face, hands, and arms (without applying sun block and uncovered) [24]. The length of menopause was calculated by subtracting the age at menopause from the current age. The number of years between menopause and menarche was used to calculate the years of menstruation.

Study instrument: the OKAT

The OKAT was the second part of the study questionnaire [25], which was used to explore the participants' level of knowledge about osteoporosis. This questionnaire is well-known for its validity and reliability, and it is a robust and precise technique for evaluating understanding of osteoporosis [25, 26]. Also, OKAT was translated into Arabic [19], and permission to use the Arabic version of the instrument was obtained from the authors. Winzenberg and co-authors developed the OKAT in 2003 [25]. The total number of questions in the OKAT questionnaire is 20. Questions 1, 2, 8, 9, and 11 were used to test the participant's knowledge about osteoporosis; questions 3, 4, 5, 6, 7, 12, and 18 evaluated their awareness of osteoporosis risk factors. Moreover, the following questions 10, 13, 14, 15, 16, and 17 examined the participant's knowledge of osteoporosis preventive strategies, and questions 19 and 20 assessed the treatment's availability [19]. There were three options (true, false, and I don't know) for each of the multiple-choice questions. Unanswered questions and the remark "I don't know" were considered wrong. Correct responses received 1 point, while incorrect answers received 0. The participant's total score was multiplied by 5, and the level of awareness was further categorized as follows: a score of less than 20 was considered very poor, a score of 21–40 was considered poor, a score of 41–60 was considered average, a score of 61–80 was considered good, and a score of more than or equal to 81 was considered very good [20, 25].

Sampling and sample size

The sample size was determined based on the reported prevalence of osteoporosis among postmenopausal women in Jordan, which was 37.5% [21]. It was calculated using the equation [sample size= $(t)^2(q)(p)/(d)^2$], where t-value (t=1.96) indicates the 95% confidence interval, p= 0.375 (the predicted prevalence of osteoporosis, d=0.05 and q=1−p (the margin of error based on the 95% confidence interval)) [27]. Therefore, the calculated sample size was

360 participants. However, the aim was to recruit 500 postmenopausal and 500 premenopausal women.

Statistical analysis

Following data collection, statistical analysis was conducted using IBM SPSS statistics software version 25 (Armonk, NY, USA). Normality was tested using the Shapiro-Wilk test, eye inspection of the Q-Q plot, and a histogram with normal curves. Data were presented as mean ± standard deviation, frequency, or median (25th–75th percentiles) as appropriate. Differences in osteoporosis risk factors and other variables between premenopausal and postmenopausal women for continuous and categorical variables were evaluated using a t-test and chi-square test analysis, respectively. Also, the difference in answers to the OKAT between premenopausal and postmenopausal participants was evaluated using chi-square. The variables that were statistically significant in the differences in risk factors between premenopausal and postmenopausal women were included in the multiple linear regression model, to identify predictors of knowledge about osteoporosis using the OKAT score. Statistical significance was determined at $p < 0.05$ (two-tailed).

Results

Differences in osteoporosis risk factors and other variables between premenopausal and postmenopausal participants

As listed in Table 1, there was a significant difference in the mean age between premenopausal and postmenopausal women (36.81±9.85 vs. 59.77±8.49, p-value < 0.001). Obesity among postmenopausal women was significantly higher than that among premenopausal women (48.2% vs. 30.8%, p-value < 0.001). The proportion of premenopausal women who were single was significantly higher compared to the postmenopausal women (26.9% vs. 6.4%, p-value < 0.001). Premenopausal women were significantly more likely to have completed their university education than postmenopausal women (69.6% vs. 44.5%, p-value < 0.001). Unemployment among premenopausal women was significantly lower than that among postmenopausal women (48.2% vs. 63.9%, p-value < 0.001). The median number of family members of the premenopausal women was significantly lower compared to the postmenopausal women (6 (4–7) vs. 7 (5–8), p-value < 0.001). The premenopausal women had a significantly lower percentage of family income that was below 500 JD compared to the postmenopausal women (46.1% vs. 56.8%, p-value < 0.01). The premenopausal women reported a lower median number of pregnancies and miscarriages compared to the postmenopausal women

Table 1 Differences in osteoporosis risk factors and other variables between premenopausal and postmenopausal participants

Variable	All participants ($n= 978$)	Premenopausal women ($n= 490$)	Postmenopausal women ($n= 488$)	p-value*
Age (years)	48.26±14.71	36.81±9.85	59.77±8.49	<0.001
BMI (kg/m^2)	29.24±5.94	27.87±6.02	30.61±5.53	<0.001
Normal (<25 kg/m^2)	225 (23)	168 (34.3)	57 (11.7)	<0.001
Overweight (25 to <30 kg/m^2)	367 (37.5)	171 (34.9)	196 (40.2)	
Obese (≥30 kg/m^2)	386 (39.5)	151 (30.8)	235 (48.2)	
Marital status				<0.001
Single	163 (16.7)	132 (26.9)	31 (6.4)	
Married	704 (72)	342 (69.2)	362 (74.2)	
Divorced	16 (1.6)	8 (1.6)	8 (1.6)	
Widow	95 (9.7)	8 (1.6)	87 (17.8)	
Education				
Primary school	229 (23.4)	54 (11)	175 (35.9)	<0.001
Secondary school	191 (19.5)	95 (19.4)	96 (19.7)	
University	558 (57.1)	341 (69.6)	217 (44.5)	
Employment				
Student	66 (6.7)	65 (13.3)	1 (0.2)	<0.001
Employed	364 (37.2)	189 (38.6)	175 (35.9)	
Unemployed	548 (56)	236 (48.2)	312 (63.9)	
Number of family members	6 (4–8)	6 (4–7)	7 (5–8)	<0.001
Family income (JD)				
≤500	503 (51.4)	226 (46.1)	277 (56.8)	<0.01
501–1000	328 (33.5)	185 (37.8)	143 (29.3)	
>1000	147 (15)	79 (16.1)	68 (13.9)	
Smoking				
Yes	152 (15.5)	88 (18)	64 (13.1)	0.04
No	826 (84.5)	402 (82)	424 (86.9)	
Drinking coffee				
Yes	787 (80.5)	402 (82)	385 (78.9)	0.23
No	191 (19.5)	88 (18)	103 (21.1)	
Exercise				
No exercise	634 (64.8)	271 (55.3)	363 (74.4)	<0.001
Not regular exercise	119 (12.2)	89 (18.2)	30 (6.1)	
Regular exercise	225 (23)	130 (26.5)	95 (19.5)	
History of bone fracture				
Yes	280 (28.6)	104 (21.2)	176 (36.1)	<0.001
No	698 (71.4)	386 (78.8)	312 (63.9)	
Family history of osteoporosis				
Yes	292 (29.9)	135 (27.6)	157 (32.2)	0.07
No	686 (70.1)	355 (72.4)	331 (67.8)	
Family history of bone fracture?				
Yes	558 (57.1)	269 (54.9)	289 (59.2)	0.18
No	420 (42.9)	221 (45.1)	199 (40.8)	
Current vitamin D supplement				
Yes	443 (45.3)	172 (35.1)	271 (55.5)	<0.001
No	535 (54.7)	318 (64.9)	217 (44.5)	
Current calcium supplement				
Yes	175 (17.9)	44 (9)	131 (26.8)	<0.001
No	803 (82.1)	446 (91)	357 (73.2)	

Table 1 (continued)

Variable	All participants (n= 978)	Premenopausal women (n= 490)	Postmenopausal women (n= 488)	p-value[*]
Frequency of dairy products intake				
None	27 (2.8)	17 (3.5)	10 (2)	0.02
1–3 times/month	79 (8.1)	42 (8.6)	37 (7.6)	
1–6 times/week	431 (44.1)	193 (39.4)	238 (48.8)	
1–3 times/day	441 (45.1)	238 (48.6)	203 (41.6)	
Frequency of exposure to sun light				
Not at all	460 (47)	225 (45.9)	235 (48.2)	0.04
Not every day	302 (30.9)	140 (28.6)	162 (33.2)	
Daily (<10 min)	58 (5.9)	37 (7.6)	21 (4.3)	
Daily (≥10 min)	158 (16.2)	88 (18)	70 (14.3)	
Other chronic diseases				
Yes	453 (46.3)	151 (30.8)	302 (61.9)	<0.001
No	525 (53.7)	339 (69.2)	186 (38.1)	
Age at 1st menstruation (years)	13.49±1.72	13.40±1.79	13.58±16.5	0.09
Number of pregnancies	4 (1–6)	3 (0–5)	5 (3–8)	<0.001
Number of miscarriages	0 (0–1)	0 (0–1)	1 (0–2)	<0.001

[*]Student's t-test, or chi-square test as appropriate. p-values< 0.05 were considered statistically significant. Data are presented as frequency (%), mean ± standard deviation, or median (25th–75th percentiles) as appropriate. *BMI*, body mass index; *JD*, Jordanian Dinar; *n*, number of participants

(3 (0–5) vs. 5 (3–8), p-value < 0.001) (0 (0–1) vs. 1 (0–2), p-value < 0.001), respectively. The percentage of smokers among the premenopausal women was significantly higher compared to the percentage of smokers among the postmenopausal women (18% vs. 13.1%, p-value =0.04). Premenopausal women were more likely to exercise than postmenopausal women (26.5% vs. 19.5%, p-value <0.001), less likely to have previous bone fractures (21.2% vs. 36.1%, p-value < 0.001), and less likely to be currently taking vitamin D (35.1% vs. 55.5%, p-value < 0.001) and calcium supplements (9% vs. 26.8%, p-value < 0.001). The premenopausal women had a higher daily consumption of dairy products, and their daily sunlight exposure was longer compared to the postmenopausal women (p-value < 0.05). The percentage of premenopausal women with a previous history of other chronic disorders (asthma, rheumatoid arthritis, osteoarthritis, gout, and systemic lupus erythematosus) was significantly lower than postmenopausal women (p-value < 0.001).

Difference in answers of the OKAT between premenopausal and postmenopausal participants

The results from the OKAT for premenopausal and postmenopausal women are shown in Table 2, along with the percentage of correct answers for each item. More than 50% of premenopausal women correctly answered 11 questions, while more than 50% of postmenopausal women correctly answered 9 questions out of 20 in OKAT. Premenopausal and postmenopausal women had the highest correct response rates for the question "Osteoporosis leads to an increased risk of bone fracture" at 95.3% and 88.1%, respectively. Premenopausal women had a second correct response rate of 82.7% for the item, "By age 80, the majority of women have osteoporosis," whereas postmenopausal women had a second correct response rate of 84% for the item, "Osteoporosis is more common in men." However, the lowest correct rate among the premenopausal and postmenopausal women for "Osteoporosis usually causes symptoms (e.g., pain) before fractures occur," was 10% and 13.1%, respectively. On reviewing the answers to these questions, it was observed that 71.4% of the premenopausal women (n =350) and 68.2% (n =333) of the postmenopausal women do not know that having a higher peak bone mass at the end of childhood gives protection against the development of osteoporosis in later life. About 68.8% (n =337) of the premenopausal women and 77.5% (n =378) of the postmenopausal women had the misconception that any kind of physical activity is good for preventing osteoporosis. Only 23.9% (n =117) of the premenopausal women and 31.8% (n =155) of the postmenopausal women answered correctly that white women had the highest risk of fracture when compared to other races. High salt consumption was perceived as a risk factor for osteoporosis by 33.7% (n =165) of the premenopausal women and 34.8% (n =170) of the postmenopausal women. Most premenopausal (63.1%, n =309) and postmenopausal women (62.7%, n =306) were not aware that hormone replacement therapy could help prevent further bone loss at any age after menopause. Only 44.3% (n =217) of the premenopausal women and 38.5% (n =188) of the postmenopausal women recognized that Jordan had effective osteoporosis treatment. Table 3 shows

Table 2 Difference in answers of the OKAT between premenopausal and postmenopausal participants

Item	Correct answer	n (%) of correct answer		p-value*
		Premenopausal women (n=490)	Postmenopausal women (n=488)	
1. Osteoporosis leads to an increased risk of bone fracture.	True	467 (95.3)	430 (88.1)	<0.001
2. Osteoporosis usually causes symptoms (e.g., pain) before fractures occur.	False	49 (10)	64 (13.1)	<0.01
3. Having a higher peak bone mass at the end of childhood gives no protection against the development of osteoporosis in later life.	False	140 (28.6)	155 (31.8)	<0.01
4. Osteoporosis is more common in men.	False	401 (81.8)	410 (84)	0.42
5. Cigarette smoking can contribute to osteoporosis.	True	261 (53.3)	229 (46.9)	<0.01
6. White women are at highest risk of fracture as compared to other races.	True	117 (23.9)	155 (31.8)	<0.01
7. A fall is just as important as low bone strength in causing fractures.	True	331 (67.6)	399 (81.8)	<0.001
8. By age 80, the majority of women have osteoporosis.	True	405 (82.7)	397 (81.4)	0.83
9. From age 50, most women can expect at least one fracture before they die	True	270 (55.1)	292 (59.8)	0.25
10. Any type of physical activity is beneficial for osteoporosis.	False	153 (31.2)	110 (22.5)	<0.01
11. It is easy to tell whether I am at risk of osteoporosis by my clinical risk factors.	True	338 (69)	301 (61.7)	0.02
12. Family history of osteoporosis strongly predisposes a person to osteoporosis.	True	297 (60.6)	224 (45.9)	<0.001
13. An adequate calcium intake can be achieved from two glasses of milk a day.	True	349 (71.2)	357 (73.2)	0.62
14. Sardines and broccoli are good sources of calcium for people who cannot take dairy products.	True	346 (70.6)	335 (68.6)	0.26
15. Calcium supplements alone can prevent bone loss.	False	274 (55.9)	291 (59.6)	0.13
16. Alcohol in moderation has little effect on osteoporosis.	True	141 (28.8)	98 (20.1)	<0.001
17. A high salt intake is a risk factor for osteoporosis.	True	165 (33.7)	170 (34.8)	0.77
18. There is a small amount of bone loss in the ten years following the onset of menopause.	False	122 (24.9)	184 (37.7)	<0.001
19. Hormone therapy prevents further bone loss at any age after menopause.	True	181 (36.9)	182 (37.3)	0.14
20. There are no effective treatments for osteoporosis available in "Jordan."	False	217 (44.3)	188 (38.5)	0.17

*Student's *t*-test, or chi-square test as appropriate. *p*-value < 0.05 was considered statistically significant. Data are presented as frequency (%), or mean ± standard deviation as appropriate; *OKAT*, Osteoporosis Knowledge Assessment Tool; *n*, number of participants

that although premenopausal women had a higher mean score (51.27±13.97) for all OKAT questions compared to postmenopausal women (50.93±14.80), this difference was not statistically significant (*p*-value =0.72). Also, premenopausal and postmenopausal women had an average to poor level of knowledge regarding osteoporosis. Table 4 demonstrates that the difference in mean OKAT item subscales was not statistically significant between premenopausal and postmenopausal women except for the item assessing understanding and knowledge about osteoporosis, which was higher among the premenopausal women as compared to the postmenopausal women (3.15±1.00 vs. 3.01±1.05, *p*-value =0.03).

Table 3 Level of osteoporosis knowledge and awareness according to OKAT score

Level of osteoporosis knowledge and awareness according to OKAT score (0–100)	All participants (n= 978)	Premenopausal women (n=490)	Postmenopausal women (n=488)	p-value*
Very poor awareness (≤20)	27 (2.8)	8 (1.6)	19 (3.9)	0.04
Poor awareness (21–40)	240 (24.5)	120 (24.5)	120 (24.6)	
Average awareness (41–60)	504 (51.3)	266 (54.3)	238 (48.8)	
Good awareness (61–80)	199 (20.3)	90 (18.4)	109 (22.3)	
Very good awareness (≥81)	8 (0.8)	6 (1.2)	2 (0.4)	
Average total OKAT score (0–100)	51.11±14.39	51.27±13.97	50.93±14.80	0.72

*Student's *t*-test, or chi-square test as appropriate. *p*-value < 0.05 was considered statistically significant. Data are presented as frequency (%), or mean ± standard deviation as appropriate; *OKAT*, Osteoporosis Knowledge Assessment Tool; *n*, number of participants

Table 4 The difference in mean OKAT item subscales between the premenopausal and postmenopausal participants

OKAT item subscales	Range	Premenopausal women (n=490)	Postmenopausal women (n=488)	p-value[*]
Knowledge of osteoporosis (Q 1, 2, 8, 9, 11)	0–5	3.15±1.00	3.01±1.05	0.03
Awareness of osteoporosis risk factors (Q 3, 4, 5, 6, 7, 12, 18)	0–7	3.47±1.38	3.54±1.38	0.45
Knowledge of osteoporosis preventive strategies (Q 10, 13, 14, 15, 16, 17)	0–6	2.83±1.21	2.87±1.38	0.66
Assessment of treatment's availability (Q 19, 20)	0–2	0.77±0.71	0.80±0.69	0.60

[*]Student's *t*-test. *p*-values < 0.05% were considered statistically significant. Data are presented as mean ± standard deviation; *OKAT*, Osteoporosis Knowledge Assessment Tool; *n*, number of participants

Predictors of osteoporosis knowledge and awareness among participants (OKAT score)

Multiple linear regression analysis (Table 5) indicated a significant association between OKAT score and the educational level (secondary school and university), economic status (1000–1500 JD) of participants, and the marital status (married) (*p*-value <0.05). The strongest association was for the educational status of university level, as being at this level of education increased the OKAT score by 0.21 (*p*<0.001).

Table 5 Predictors of osteoporosis knowledge and awareness among participants (OKAT score 0–100)

	R^2	ANOVA	Model	n	B	β	p-value[*]
OKAT score (0–100)	0.09	F (18,958) = 5.172, *p*-value < 0.001	Constant	-	38.146	-	<0.001
			Menopausal status				
			Premenopausal	490	-	-	-
			Postmenopausal	488	1.02	0.04	0.48
			Age (years)	978	−0.03	−0.03	0.67
			Marital status				
			Single	163	-	-	-
			Married	704	4.67	0.15	0.01
			Divorced	16	2.29	0.02	0.55
			Widow	95	2.83	0.06	0.25
			Educational level				
			Primary school	229	-	-	-
			Secondary school	191	3.51	0.1	0.02
			University	558	5.96	0.21	<0.001
			Employment status				
			Student	66	-	-	-
			Employed	364	−0.69	−0.02	0.77
			Unemployed	548	−2.31	−0.08	0.35
			Number of family members	978	0.24	0.04	0.34
			Economic status (JD)				
			Less than 500	503	-	-	-
			501–1000	328	−1.00	−0.03	0.39
			1000–1500	147	5.51	0.14	<0.001
			Age at 1st menstruation (years)	978	0.32	0.04	0.22
			Number of pregnancies	978	0.04	0.01	0.87
			Number of miscarriages	978	0.16	0.02	0.61
			Previous experience of bone fracture	978	−0.95	−0.03	0.35
			Family history of osteoporosis	978	0.71	0.02	0.48
			Family history of bone fracture	978	1.69	0.06	0.07

[*]Multiple linear regression analysis (*p*-value <0.05 was considered statistically significant); *OKAT*, Osteoporosis Knowledge Assessment Tool; *JD*, Jordanian Dinar; R^2, squared coefficient of determination; *B*, un-standardized coefficient; *β*, standardizes coefficient; *F*, *F*-statistic

Discussion

To our knowledge, this is the first research in Jordan that explored knowledge regarding osteoporosis and its related risk factors among premenopausal and postmenopausal women. The purpose of selecting premenopausal and postmenopausal women as study participants is that the majority of previous studies on osteoporosis focused on postmenopausal women, and further investigations were required to assess its prevalence and associated factors in premenopausal women as well [5, 28]. Moreover, postmenopausal women have the highest risk of osteoporosis and fragility fractures, which justifies early preventive screening for this group at earlier stages of the life [29, 30].

We found that premenopausal and postmenopausal women had an average to poor level of knowledge regarding osteoporosis. However, postmenopausal women had better awareness about osteoporosis compared to the premenopausal women. Also, the difference in mean OKAT item subscales was not statistically significant between premenopausal and postmenopausal women except for the item assessing understanding and knowledge about osteoporosis, which was higher among the premenopausal women as compared to the postmenopausal women. Average to poor level of knowledge about osteoporosis could be related to the inadequate health education, lack of post-reproductive health centers in Jordan, poor patient-physician communication, a lack of periodic clinical and health evaluation programs due to cultural norms, and the difficult economic situations [31, 32]. Conducting a direct comparison between studies is challenging due to the variety in the methodologies used and the various tools utilized for osteoporosis knowledge assessment. Also, the type of study participants and the numerous cultural and social factors could assist in clarifying the variations in the studies' findings [25, 33, 34]. When compared to studies using the OKAT or similar instruments [19, 20, 35], consistent findings of moderate to low knowledge about osteoporosis were observed among Syrian women [19, 36]. Also, a study among 558 Chinese orthopedic nurses showed a moderate to low level of knowledge regarding osteoporosis [35]. However, a poor level of awareness was observed in studies conducted among Palestinian postmenopausal women [37], Saudi middle-aged and elderly women [38], and Indian postmenopausal women [20].

Although premenopausal women had a higher total mean score of OKAT (51.27±13.97) compared to postmenopausal women (50.93±14.80), this difference was not significant. On the contrary, another study among Syrian women [36] showed the opposite finding, demonstrating that women in the menopausal age group had significantly higher average OKAT scores than women in their reproductive age (71±8.4 vs. 69±7.6). This could be explained by their results showing that social media represented the ultimate source of information on osteoporosis among Syrian women [36].

Our study reported a significant association between OKAT score and educational level. This adds to our former observation that higher education was a significant predictor of women knowledge about menopause [39]. Also, previous studies utilizing a different questionnaire about osteoporosis knowledge support this finding [40–42]. For example, one study concluded that "postmenopausal Polish women who were older and less educated demonstrated lower levels of understanding of osteoporosis and its complications" [40]. However, another study failed to show similar findings, as there was no statistically significant relationship between education or age and the participants' knowledge about osteoporosis [36]. The majority of Jordanian premenopausal and postmenopausal women in the present study had completed their diplomas or university degrees in an educational specialty; this could in part explain that their knowledge about osteoporosis was average to poor. Therefore, osteoporosis educational programs should be adapted to patients' literacy levels in order to raise their awareness of osteoporosis.

In the present study, levels of knowledge about osteoporosis were not significantly associated with the age of Jordanian premenopausal and postmenopausal women. This goes with findings from the following studies [36, 43], but contrasts with the study conducted among Polish women [40] and a multi-center study performed in Turkey which demonstrated an inverse association between age and the level of knowledge about osteoporosis [44]. This variation in the results could be attributed in part to the exclusion of cognitively impaired patients. It has been hypothesized that variations in older patients' awareness about osteoporosis are related to their cognitive function, which is crucial to one's capacity to assess and understand health-related knowledge [45].

The current study revealed that the better economic status was significantly associated with improved knowledge about osteoporosis. Similar observations were reported in previous studies [46, 47]. Most of the participants in the current study were from low- and middle-income groups. So, this could explain the average to poor level of awareness about osteoporosis that was observed. However, according to a previous observation [48], Saudi female students of poor socioeconomic status were more knowledgeable about osteoporosis. This could be related to the fact that these students spend more time familiarizing themselves about osteoporosis-related concepts [48].

The major strength of this study was the relatively large sample size which allows for generalization of our findings. Also, it is the first study to be conducted among Jordanian premenopausal and postmenopausal women that compared their risk factors for developing osteoporosis and the differences in their responses to the OKAT score. In contrast, the current study has some limitations. The first drawback

of this study was its cross-sectional design, which prevented the authors from attempting to explain the causal connections between variables. Also, some information collected in the study such as the menopause factors might have subjected to recall bias. Additionally, the best way to determine the impact of education on a person's current level of awareness is to perform a teaching session about osteoporosis, its risk factors, and treatment while also evaluating the questionnaire responses before and after the session. The second drawback was that the questionnaire did not provide participants with the option to elaborate on their opinions and responses. However, the questionnaire that was used to evaluate the knowledge of Jordanian women was validated, reliable, and authorized for use in clinical research. Also, data collection was challenging as cancer patients and those who had undergone hysterectomy were excluded from the study.

Conclusion and recommendations

This study found that premenopausal and postmenopausal women in Jordan had an average to poor understanding of osteoporosis. Adolescence is the ideal time to start osteoporosis prevention. The community should be fully educated about the prevalence of osteoporosis and its implications, as well as the potential risk factors and treatment choices. Healthcare providers should highlight the need for a healthy diet and regular activity for optimal bone health throughout life. A greater understanding of osteoporosis is linked to better patient adherence to treatment in the management of chronic diseases. Thus, patient education is critical since many people are unaware of the serious effects of osteoporosis. Also, periodic osteoporosis awareness programs should be held to increase knowledge about osteoporosis. This will aid in fracture prevention by facilitating adequate screening, early diagnosis, and prompt treatment initiation.

Data availability Data are available upon reasonable request from the corresponding author.

Declarations

Conflicts of interest None.

References

1. Aspray TJ, Hill TR (2019) Osteoporosis and the ageing skeleton. Subcell Biochem 91:453–476

2. Kanis JA et al (2019) European guidance for the diagnosis and management of osteoporosis in postmenopausal women. Osteoporos Int 30(1):3–44

3. Zhu X, Zheng H (2021) Factors influencing peak bone mass gain. Front Med 15(1):53–69

4. Clynes MA et al (2020) The epidemiology of osteoporosis. Br Med Bull 133(1):105–117

5. John Cecily HS (2020) Early detection and prevention of osteoporosis among pre- and postmenopausal women in Saudi Arabia. Clin Nurs Res 29(1):48–55

6. Pazianas M, Miller PD (2021) Osteoporosis and chronic kidney disease-mineral and bone disorder (CKD-MBD): back to basics. Am J Kidney Dis 78(4):582–589

7. Crandall CJ (2015) Risk assessment tools for osteoporosis screening in postmenopausal women: a systematic review. Curr Osteoporos Rep 13(5):287–301

8. Salari N et al (2021) The global prevalence of osteoporosis in the world: a comprehensive systematic review and meta-analysis. J Orthop Surg Res 16(1):609

9. Rossini M et al (2016) Guidelines for the diagnosis, prevention and management of osteoporosis. Reumatismo 68(1):1–39

10. Bijelic R, Milicevic S, Balaban J (2017) Risk factors for osteoporosis in postmenopausal women. Med Arch 71(1):25–28

11. Ensrud KE, Crandall CJ (2017) Osteoporosis. Ann Intern Med 167(3):ITC17–ITC32

12. Sitati FC, Obimbo MM, Gichangi P (2021) Knowledge and beliefs on osteoporosis among African postmenopausal women in a Kenyan semi-rural county of Kiambu. J Bone Metab 28(1):91–98

13. Cavkaytar S et al (2015) Effect of reproductive history, lactation, first pregnancy age and dietary habits on bone mineral density in natural postmenopausal women. Aging Clin Exp Res 27(5):689–694

14. Tardi P et al (2021) The development of a reliable and valid instrument to measure the osteoporosis-related knowledge: validation of the Hungarian version of Osteoporosis Knowledge Assessment Tool (OKAT). BMC Public Health 21(Suppl 1):1515

15. Ishtaya GA et al (2018) Osteoporosis knowledge and beliefs in diabetic patients: a cross sectional study from Palestine. BMC Musculoskelet Disord 19(1):43

16. Toh LS et al (2015) The development and validation of the Osteoporosis Prevention and Awareness Tool (OPAAT) in Malaysia. PloS One 10(5):e0124553

17. Pande KC et al (2000) Development of a questionnaire (OPQ) to assess patient's knowledge about osteoporosis. Maturitas 37(2):75–81

18. Tella SH, Gallagher JC (2014) Prevention and treatment of postmenopausal osteoporosis. J Steroid Biochem Mol Biol 142:155–170

19. Sayed-Hassan R, Bashour H, Koudsi A (2013) Osteoporosis knowledge and attitudes: a cross-sectional study among female nursing school students in Damascus. Arch Osteoporos 8:149

20. Senthilraja M et al (2019) Osteoporosis knowledge and beliefs among postmenopausal women: a cross-sectional study from a teaching hospital in southern India. J Family Med Prim Care 8(4):1374–1378

21. Hyassat D et al (2017) Prevalence and risk factors of osteoporosis among Jordanian postmenopausal women attending the National Center for Diabetes, Endocrinology and Genetics in Jordan. Biores Open Access 6(1):85–93

22. Lydick E et al (1998) Development and validation of a simple questionnaire to facilitate identification of women likely to have low bone density. Am J Manag Care 4(1):37–48

23. Guidelines Review Committee (2010) Global recommendations on physical activity for health. www.who.int https://www.who.int/publications/i/item/9789241599979

24. Holick MF (2020) Sunlight, UV radiation, vitamin D, and skin cancer: how much sunlight do we need? Adv Exp Med Biol 1268:19–36

25. Winzenberg TM et al (2003) The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: the Osteoporosis Knowledge Assessment Tool (OKAT). BMC Musculoskelet Disord 4:17

26. Kim KK et al (1991) Development and evaluation of the Osteoporosis Health Belief Scale. Res Nurs Health 14(2):155–163

27. Pourhoseingholi MA, Vahedi M, Rahimzadeh M (2013) Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench 6(1):14–17

28. Conradie M, de Villiers T (2022) Premenopausal osteoporosis. Climacteric 25(1):73–80

29. Cohen A (2017) Premenopausal osteoporosis. Endocrinol Metab Clin North Am 46(1):117–133

30. Bonaccorsi G et al (2021) Postmenopausal osteoporosis: risk evaluation and treatment options. Minerva Obstet Gynecol 73(6):714–729

31. Othman B et al (2020) Prevalence, knowledge of and attitude towards hepatitis B virus among pregnant females in Jordan. J Viral Hepat 27(11):1108–1118

32. Abuhammad S et al (2022) Stigma toward healthcare providers from patients during COVID-19 era in Jordan. Public Health Nurs 39(5):926–932

33. Sayed-Hassan RM, Bashour HN (2013) The reliability of the Arabic version of Osteoporosis Knowledge Assessment Tool (OKAT) and the Osteoporosis Health Belief Scale (OHBS). BMC Res Notes 6:138

34. Alefishat E et al (2015) Increasing patient knowledge and awareness about osteoporosis among Jordanian women. Eur J Pers Cent Healthc 3:100–107

35. Peng L et al (2020) Osteoporosis knowledge and related factors among orthopedic nurses in Hunan province of China. Int J Orthop Trauma Nurs 36:100714

36. Alhouri A et al (2022) Assessing the knowledge and attitude towards osteoporosis among Syrian women: a cross-sectional study. Int J Rheumatol 2022:6431151

37. Abd-Alhameed I, Saba E, Darwish HM (2010) Prevalence and awareness of osteoporosis among postmenopausal Palestinian women. Archives of Osteoporosis 5:111–118

38. Al-Shahrani FM, Al-Zahrani AM, Al-Haqawi AI (2010) Knowledge of osteoporosis in middle-aged and elderly women. Saudi Med J 31(6):684–687

39. Alshogran OY, Mahmoud FM, Alkhatatbeh MJ (2021) Knowledge and awareness toward menopause and hormone therapy among premenopausal women in Jordan. Climacteric 24(2):171–178

40. Tabor E, Grodzki A, Pluskiewicz W (2022) Higher education and better knowledge of osteoporosis improve bone health in Polish postmenopausal women. Endokrynol Pol 73(5):831–836

41. Abdulameer SA et al (2019) A comprehensive view of knowledge and osteoporosis status among type 2 diabetes mellitus in Malaysia: a cross sectional study. Pharm Pract (Granada) 17(4):1636

42. Drozdzowska B, Pluskiewicz W, Skiba M (2004) Knowledge about osteoporosis in a cohort of Polish females: the influence of age, level of education and personal experiences. Osteoporos Int 15(8):645–648

43. Tan HC, Seng JJB, Low LL (2021) Osteoporosis awareness among patients in Singapore (OASIS)-a community hospital perspective. Arch Osteoporos 16(1):151

44. Kutsal YG et al (2005) Awareness of osteoporotic patients. Osteoporos Int 16(2):128–133

45. Shin HY et al (2014) Association between the awareness of osteoporosis and the quality of care for bone health among Korean women with osteoporosis. BMC Musculoskelet Disord 15:334

46. AlHarthi BK et al (2017) Assessment of osteoporosis knowledge among Saudi females in Riyadh, KSA. Egypt J Hosp Med 69(3):2088–2092

47. Kadam N et al (2019) Low knowledge of osteoporosis and its risk factors in urban Indian adults from Pune city, India. Public Health Nutr 22(7):1292–1299

48. Zakai GH, Zakai HA (2015) Awareness about osteoporosis among university students in Jeddah, Saudi Arabia. J Adv Lab Res Biol 4(2)