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# *Osteoporosis Awareness and Knowledge in Postmenopausal Breast Cancer Survivors*

## *Postmenopozal Meme Kanseri Hastalarında Osteoporoz Farkındalığı ve Bilgi Düzeyleri*

***Songül Keskin Kavak, Lale Aktekin, Engin Eren Kavak*, Burcu Sevingül, Merve Önoğul***

Ankara Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital, Department of Physical Therapy and Rehabilitation, Ankara, Turkey
*Ankara University Faculty of Medicine, Department of Medical Oncology, Ankara, Turkey

## *Abstract*

**Objective:** To determine the awareness and knowledge levels of osteoporosis in postmenopausal breast cancer survivors (PBCS) who have completed adjuvant chemoradiotherapy, are under hormonal therapy, or are being monitored, and to examine potentially related factors.
**Materials and Methods:** Between March 2022 and December 2022, 73 breast cancer patients with clinically and biochemically proven menopause were included in the study. The demographic characteristics and clinical findings of the patients were recorded. The participants' osteoporosis knowledge level (OKL) regarding osteoporosis was evaluated with the osteoporosis knowledge test and their osteoporosis awareness level (OAL) was evaluated with the osteoporosis awareness test. P values <0.05 were considered statistically significant.
**Results:** The mean age of the patients was 59.8±9.4 years (minimum-maximum: 32-75). Their OKL's were categorized as follows: 9.6% poor, 58.9% moderate and 31.5% good. Nutrition knowledge level (NKL) was distributed as follows: 9.6% poor, 37.3% moderate and 52.1% good. Exercise knowledge level (EKL) was distributed as follows: 13.7% poor, 31.5% moderate and 54.8% good. As the patient's age increased, it was observed that OAL, OKL, NKL and EKL decreased. A statistically significant correlation was found between higher education level and higher OAL (r=0.246, p=0.036). There was a significant inverse correlation between menopausal duration and OKL (r=-0,280, p=0.017). There was no significant difference in OAL, OKL, NKL and EKL between patients who received hormone therapy and those who did not.
**Conclusion:** Our study, which assessed the awareness level of osteoporosis for the first time in PBCS, indicates the need for further research on the development of patient education programs for osteoporosis prevention and the improvement of methodological approaches specific to measuring awareness and knowledge levels in cancer patients.
**Keywords:** Osteoporosis knowledge test, osteoporosis awareness test, postmenopausal breast cancer survivors

## *Öz*

**Amaç:** Adjuvan kemoradyoterapisi tamamlanan, hormonoterapi altında veya izlemde postmenopozal meme kanseri hastalarında (PMKH) osteoporoz farkındalık ve bilgi düzeylerini belirlemek ve ilişkili olabilecek faktörleri incelemektir.
**Gereç ve Yöntem:** Mart 2022 ile Aralık 2022 tarihleri arasında menopozu klinik ve biyokimyasal olarak kanıtlanmış 73 meme kanseri hastası çalışmaya dahil edildi. Hastaların demografik özellikleri ve klinik bulguları kayıt altına alındı. Katılımcıların osteoporoza yönelik bilgi düzeyi (OBD) osteoporoz bilgi testi, osteoporoz farkındalık düzeyi (OFD) osteoporoz farkındalık testi ile değerlendirildi. P değerleri <0,05 istatistiksel olarak anlamlı kabul edildi.
**Bulgular:** Çalışmamızda hastaların yaş ortalaması 59,8±9,4 yıl (minimum-maksimum: 32-75) idi. OBD'leri %9,6'sı kötü, %58,9 orta, %31,5 iyi idi. Beslenme bilgi düzeyi (BBD); %9,6 kötü, %37,3 orta,%52,1 iyi seviyedeydi. Egzersiz bilgi düzeyi (EBD); %13,7 kötü, %31,5 orta, %54,8 iyi seviyedeydi. Hasta yaşı arttıkça; OFD, OBD, BBD ve EBD'nin düştüğü gözlemlendi. Eğitim düzeyi yüksek olan PMKH'de OFD de yüksek bulundu ve istatistiksel olarak anlamlı görüldü (r=0,246, p=0,036). Menopoz süresi ile OBD arasında anlamlı ters korelasyon görüldü (r=-0,280 p=0,017). Hormonoterapi alan ve almayan hastalar arasında OFD ve OBD; BBD ve EBD açısından anlamlı bir fark görülmedi.
**Sonuç:** PMKH'de ilk kez OFD'nin değerlendirildiği çalışmamız; osteoporozun önlenmesine ilişkin hasta eğitim programının oluşturulması için çok daha fazla çalışmaya ve kanser hastalarının özelinde farkındalık ve bilgi düzeyini ölçen metodolojik yöntemleri geliştirmeye ihtiyaç olduğunu göstermektedir.
**Anahtar kelimeler:** Osteoporoz bilgi testi, osteoporoz farkındalık testi, postmenopozal meme kanseri hastaları

**Address for Correspondence/Yazışma Adresi:** Songül Keskin Kavak MD, Ankara Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital, Department of Physical Therapy and Rehabilitation, Ankara, Turkey
**Phone:** +90 507 437 31 13 **E-mail:** songuleren2005@gmail.com **ORCID ID:** orcid.org/0000-0003-4409-4996
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## Introduction

Breast cancer is the most common cancer worldwide among women. According to the 2020 GLOBOCAN database, it has the highest incidence rate at 11.7% (1). The rate and magnitude of bone resorption caused by cancer treatment are higher than age-related bone loss (2). Approximately 80% of breast cancer patients experience bone loss (3). Breast cancer survivors have specific risk factors for osteoporosis, such as aromatase inhibitor (AI) therapy lasting over 6 months, age over 65 years, early menopause, radiotherapy, tamoxifen use during the premenopausal period, chemotherapy-induced menopause, low body mass index (BMI) below 20 kg/m$^2$, a history of hip fracture among first-degree relatives, a history of spontaneous or low-energy trauma associated fracture, oral glucocorticoid use at a dose of ≥7.5 mg per day for 3 months or longer, alcohol abuse (consuming more than 3 standard alcohol units per day) and smoking. In this population, calcium and vitamin D deficiencies are common, which further increases the risk of osteoporosis (4). The risk of early-stage osteoporosis developing as a result of cancer treatment poses a significant economic burden and leads to higher healthcare costs (5). Understanding the specific effects on bone health in breast cancer survivors and increasing their awareness and knowledge about osteoporosis can potentially prevent complications and morbidities.

According to the accessible literature, there is no existing study regarding the awareness level of osteoporosis in breast cancer survivors. However, in a study conducted on a smaller number of patients, it was found that breast cancer patients had lower osteoporosis knowledge levels (OKL) compared to cancer-free individuals (6). The objective of this study is to measure the previously unexplored osteoporosis awareness level (OAL) and OKL in postmenopausal women who have undergone breast cancer treatment.

## Materials and Methods

This is a prospective study conducted between March 2022 and December 2022 at the tertiary health institution/oncology training and research hospital. The study included 73 patients who were diagnosed with breast cancer, had clinically and biochemically confirmed menopause, completed adjuvant treatments (chemotherapy, radiotherapy, hormone therapy), and/or continued hormone therapy. None of the patients included in the study were found to have metachronous metastasis/local recurrence during the diagnostic process. The demographical data and risk factors of the patients, such as age, education status, time since surgery, menopause duration, smoking, alcohol use, and presence of comorbidities, were recorded. Additionally, the bone mineral density (BMD) BMI (kg/m$^2$), and vitamin D levels of all participants were evaluated. Dual hip and lumbar energy X-ray absorptiometry scans were used to assess BMD.

The study assessed the OAL, OKL, hormone therapy, the use of medications for osteoporosis treatment, and the presence of a history of known fractures in the participants.

### Patient Evaluation Methods

### Osteoporosis Knowledge Level

The osteoporosis knowledge test (OKT) was applied to assess patients' knowledge on various topics related to osteoporosis prevention, such as calcium intake, exercise, and activity levels. The test was initially developed by Kim et al. (7) as a multiple-choice questionnaire aimed at measuring the knowledge level about osteoporosis. In 2011, it was revised and the number of questions increased to 32. The revised OKT consists of two subgroups: The nutrition subgroup [nutrition knowledge test (NKT)] with 26 questions (1-11 and 18-32) and the exercise subgroup [exercise knowledge test (EKT)] with 20 questions (1-17 and 30-32). Fourteen questions are common to both subgroups (1-11 and 30-32). All questions are multiple-choice. Correct answers are scored as 1 and all incorrect or "don't know" answers are scored as 0.

The EKT score ranges from 0 to 20 points and the NKT score ranges from 0 to 26 points (8). The upper third of scores represents good knowledge, the middle third represents moderate knowledge and the lower third represents insufficient knowledge regarding osteoporosis preventive behaviors (9). The Turkish validity and reliability study of the revised OKT was conducted by Şimşir Atalay et al. (10).

### Osteoporosis Awareness Test

The Turkish version of the "osteoporosis awareness test" (OAT) was administered to assess patients' awareness level regarding osteoporosis and its validity and reliability have been demonstrated (11). The OAT is evaluated using a 4 point likert scale. As the total score obtained from the scale increases [minimum (min) =31, maximum (max) =124], the awareness of osteoporosis also increases. The scale consists of five subscales and does not contain reverse items or cutoff points.

### Statistical Analysis

The data of the study were recorded with the statistical package for the social sciences (SPSS) version 25 (IBM corporation. New York. United States) program and statistical analyses were made. Frequency tables and descriptive statistics were used to interpret the findings for statistical analysis. The "Student's t-test" value was used to compare the scale score averages of the independent variables with normal distribution. Pearson correlation "r" coefficient was used for normally distributed averages in the comparison of the relationship between the scale point averages according to the research question. P values <0.05 were considered statistically significant. Ethical approval for this study was obtained from the University of Health Sciences Turkey, Dr. Abdurrahman Yurtaslan Ankara Oncology Health Education Application and Research Center Non-Interventional Clinical Research Ethics Committee (no: 2022-02/47, date: 10.03.2022). Written informed consent was obtained from all patients after providing them with detailed information about the study.

### Power Analysis

Power analysis is a valuable tool in medical research for determining the minimum sample size needed to detect a clinically significant effect at a specific level of statistical significance. In our study, a post hoc power analysis was performed using the G Power 3.1.9.2 program. We pre-determined an effect size (Cohen's d) of 0.5, which represents the magnitude of the effect we wanted to detect. The alpha level (type I error) was set at 0.05, which is the significance level we chose to accept for our statistical tests. The power level was set at 0.95, indicating our desired probability of correctly rejecting a false null hypothesis. After conducting the power analysis, it was determined that a sample size of 70 patients would be sufficient to achieve a power level of 0.951 with a 5% margin of error. This means that our study should have adequate statistical power to detect the effect size we specified.

## Results

The study included a total of 73 postmenopausal female patients diagnosed with breast cancer, with an average age of 59.8±9.4 years (min-max =32-75). Out of the participants, 13 were smokers. It was observed that a significant portion of the participants had quit smoking after being diagnosed with breast cancer. Table 1 provides a summary of the demographical and clinical characteristics of all patients. Out of the participants, 65 were hormone receptor positive, and the most commonly used hormone therapy was letrozole with 44 patients (60.3%), followed by 14 patients (19.2%) on anastrozole, 3 patients (4.1%) on tamoxifen, and 4 patients (5.5%) on gonadotropin-releasing hormone analog + AI. It was observed that a significant portion of the patients included in the study, 84.9% (62 patients), were using AI. Out of the patients who received hormone therapy, 59 of them (90.7%) had a treatment duration of less than 5 years. In the study, 39 patients (53.4%) had not received osteoporosis treatment before. Among the participants, 34 patients (46.6%) had previously undergone osteoporosis treatment, with an average treatment duration of 2.42±1.3 years. The relationship between patients' BMD levels and risk factors such as age, smoking status, BMI, vitamin D levels and hormone therapy duration was evaluated and summarized in Table 2. It is worth noting that there were no patients in the study who reported alcohol consumption. The OAT and OKT were evaluated, and it was found that the average OAT level for all patients was 77.7±20.3 (range =31 to 124), and the average OKT level was 18.71±5.55 (OKT is scored between 0 and 32). Patients' OKT scores were evaluated as follows: 7 patients (9.6%) had a poor knowledge level (0-10.7), 43 patients (58.9%) had a moderate knowledge level (10.08-21.4), and 23 patients (31.5%) had good knowledge level (21.5-32). When looking at the OKT subgroup analysis, the average EKT score was 10.27±3.69 (ranging from 0 to 16), and the average NKT score was 14.00±3.35 (ranging from 0 to 21).

The EKT results showed that 10 patients (13.7%) had a poor knowledge level (scored between 0-5.3), 23 patients (31.5%) had a moderate knowledge level (scored between 5.4-10.6), and 40 patients (54.8%) had a good knowledge level (scored between 10.7-16). Regarding the NKT, 7 patients (9.6%) had a poor knowledge level (scored between 0-7), 28 patients (37.3%) had a moderate knowledge level (scored between 8-14) and 38 patients (52.1%) had a good knowledge level (scored between 15-21). The correlation of osteoporosis risk factors, which may be related to the OKT and OAT values of the patients, was examined in Tables 3 and 4 below.

**Table 1. Sociodemographic and clinical characteristics of the patients**

| | |
|---|---|
| Age (years), mean ± SD (min-max) | 59.8±9.4 (32-75) |
| BMI (kg/m$^2$), mean ± SD | 28.9±4.3 |
| Current smokers, n (%) | 13 (17.8) |
| Comorbidity, n (%) | 44 (60.3) |
| Hypertension (HT) | 13 (17.8) |
| Diabetes mellitus (DM) | 2 (2.7) |
| HT + DM | 16 (21.9) |
| Hypothyroidism + HT | 4 (5.5) |
| Asthma | 4 (5.5) |
| Rheumatic disease | 5 (6.8) |
| **Education level, n (%)** | |
| Semiliterate | 9 (12.3) |
| Primary school | 40 (54.8) |
| High school | 16 (21.9) |
| University | 8 (11.0) |
| Mean time elapsed postmastectomy (years) | 4.18±2.30 |
| Average age of menopause (years) | 45.5±4.13 |
| Average menopause times (years) | 14±8.07 |
| Mean serum 25(OH)D levels (ng/mL) | 20.66±12.0 |
| Lumbar BMD T-score | -1.83±0.97 |
| Total hip BMD T-score | -1.02±0.93 |

Min-max: Minimum-maximum, SD: Standard deviation, BMD: Bone mineral density, BMI: Body mass index

**Table 2. Correlation between BMD level and osteoporosis risk factors**

| | Lumbar BMD T-score (mean: -1.83±0.97) | Total hip BMD T-score (mean: -1.02±0.93) |
|---|---|---|
| Age | r=0.076, p=0.523 | r=0.178, p=0.132 |
| Smoking | r=0.178, p=0.132 | r=0.132, p=0.791 |
| Vitamin D | r=-0.118, p=0.329 | r=-0.235, p=0.050 |
| BMI | r=0.323, p=0.005 | r=0.357, p=0.002 |
| Hormone therapy period | r=-0.082, p=0.506 | r=0.037, p=0.764 |

Pearson correlation, BMD: Bone mineral density, BMI: Body mass index

| Table 3. Comparison of test scores of those in the case group | | | | |
|---|---|---|---|---|
| | **OAT** | **OKT** | **EKT** | **NKT** |
| Hormone therapy + (n=65) | 78.1±20.1 | 18.82±5.59 | 10.34±3.82 | 14.14±4.39 |
| Hormone therapy - (n=65) | 74.88±23.37<br>p=0.674 | 17.88±5.54<br>p=0.655 | 9.75±2.43<br>p=0.674 | 12.88±4.12<br>p=0.443 |
| Fracture history + (n=6) | 80.00±10.71 | 21.51±4.73 | 12.17± 3.86 | 16.50±3.39 |
| Fracture history - (n=67) | 77.57±21.07<br>p=0.295 | 18.51±5.60<br>p=0.782 | 10.10±3.66<br>p=0.192 | 18.13±4.38<br>p=0.143 |
| Osteoporosis tx. + (n=34) | 79.71±21.81 | 18.38± 6.09 | 10.18±3.95 | 13.71±5.07 |
| Osteoporosis tx. - (n=39) | 76.08±19.17<br>p=0.452 | 19.00±5.09<br>p=0.639 | 10.36±3.49<br>p=0.835 | 14.26±3.66<br>p=0.594 |
| Student's t-test done, OAT: Osteoporosis awareness test, OKT: Osteoporosis knowledge test, EKT: Exercise knowledge test, NKT: Nutrition knowledge test | | | | |

| Table 4. Correlation between test scores and osteoporosis risk factors | | | | |
|---|---|---|---|---|
| | **OAT** | **OKT** | **EKT** | **NKT** |
| Age | r=-0.279<br>p=0.017 | r=-0.278<br>p=0.017 | r=-0.282<br>p=0.016 | r=-0.265<br>p=0.023 |
| Smoking | r=-0.011<br>p=0.924 | r=0.053<br>p=0.656 | r=0.008<br>p=0.945 | r=-0.082<br>p=0.489 |
| Education level | r=0.246<br>p=0.036 | r=0.159<br>p=0.18 | r=0.222<br>p=0.059 | r=0.193<br>p=0.102 |
| Duration of menopause | r=-0.189<br>p=0.109 | r=-0.280<br>p=0.017 | r=-0.212<br>p=0.072 | r=-0.190<br>p=0.108 |
| Pearson correlation, OAT: Osteoporosis awareness test, OKT: Osteoporosis knowledge test, EKT: Exercise knowledge test, NKT: Nutrition knowledge test | | | | |

## Discussion

In our study, which primarily consisted of hormone receptor-positive postmenopausal breast cancer patients, a significant and consistent correlation was observed between BMI and lumbar as well as total hip BMD. These findings align with existing literature and provide valuable insights into the relationship between BMI and BMD in this patient population.

Interestingly, we found no direct association between factors such as hormone therapy usage, osteoporosis treatment, or fracture history and the osteoporosis knowledge and awareness levels of the patients.

Furthermore, we observed statistically significant correlations between age and both osteoporosis knowledge and awareness levels. Additionally, educational level was found to be significantly associated with osteoporosis awareness, while menopausal duration was related to OKL. These results underscore the importance of considering these demographic factors in assessing and addressing osteoporosis-related knowledge and awareness in postmenopausal breast cancer patients.

In a previous study conducted on postmenopausal breast cancer survivors (PBCS), the OKL was found to be lower than healthy participants ($p<0.01$) (6). Similarly, in our study, the majority of breast cancer survivors had a moderate level of total osteoporosis knowledge (58.9%), while 9.6% had a low knowledge level. Regarding exercise knowledge, 13.7% of the patients had a low level, 31.5% had a moderate level, and 54.8% had a good level. For nutrition knowledge, 9.6% had a low level, 37.3% had a moderate level, and 52.1% had a good level.

According to accessible literature, our study is the first to use the OAT (Osteoporosis Awareness scale) in PBCS. This novel application of the OAT in our study contributes to the understanding of osteoporosis awareness and knowledge level specifically in breast cancer survivors, which was previously unexplored in the literature. By utilizing this assessment tool, we aimed to assess and enhance the level of awareness and knowledge about osteoporosis among PBCS patients, potentially leading to better preventive measures and improved bone health outcomes in this population.

There are studies suggesting that high levels of vitamin D may reduce the risk of progression in breast cancer patients. Vitamin D is believed to inhibit tumor angiogenesis (formation of new blood vessels that feed tumors) and modulate the immune system. It has been proposed in studies that it could potentially reduce the risk of estrogen receptor-positive breast cancer by lowering estrogen levels (12). Therefore, the treatment of vitamin D deficiency in PBCS should be a priority.

In a systematic meta-analysis published in the Cancer Causes & Control Journal in 2016, the prevalence of vitamin D deficiency was examined among postmenopausal women with breast cancer. The analysis showed that the prevalence of vitamin D deficiency ranged from approximately 25% to 86%, with an

overall estimate of approximately 55% based on the included studies (13). Consistent with the literature, our study also found that the average serum 25(OH)D levels in the participating patients were insufficient.

The most common comorbidities observed in PBCS patients, consistent with our study, are hypertension and diabetes mellitus. Chemotherapy-induced hypertension is known to be associated with elevated blood pressure, especially in postmenopausal women with increased obesity and insulin resistance (14). These factors may contribute to the development and exacerbation of hypertension and diabetes mellitus in breast cancer survivors, warranting close monitoring and management of these conditions to optimize the overall health and well-being of the patients.

In the literature, studies conducted on PBCS patients have shown a decrease in total lumbar and hip BMD values (15,16). Similarly, in our study, the mean lumbar BMD value was found to be lower, indicating osteopenia in both lumbar and average total hip BMD values. These findings highlight the importance of monitoring bone health in postmenopausal breast cancer survivors and implementing appropriate measures to prevent further bone loss and reduce the risk of osteoporosis-related complications.

In our study, we observed a statistically significant decrease in the total hip T-score in PBCS who had low serum 25(OH)D levels. However, we did not find a significant correlation between the decrease in lumbar T-score and these factors. These findings suggest that vitamin D deficiency may have a more significant impact on bone health in the hip region compared to the lumbar region in PBCS. Further research and larger sample sizes may be needed to better understand the complex relationship between bone health and various factors in this population.

In the study, no significant relationship was found between smoking and BMD in both lumbar and total hip T-scores. This suggests that smoking may not have a direct impact on bone health in postmenopausal breast cancer survivors. However, it is important to note that smoking is associated with various other health risks and can have detrimental effects on overall health. The lack of a significant relationship with BMD in this study might be due to various other factors affecting bone health in this specific population. Further research and larger studies may be necessary to explore the potential long-term effects of smoking on bone health in PBCS.

Obesity is known to increase the risk of breast cancer in postmenopausal women. Higher levels of adipose tissue can lead to an increase in estrogen levels in the body. Estrogen is a hormone that can promote the growth of hormone receptor-positive breast cancer cells. Additionally, adipose tissue can produce inflammatory substances and hormones, such as insulin, that may play a role in the development of breast cancer (17).

However, it is also true that low BMI (<20 kg/m$^2$) is a risk factor for fractures in PBCS. In our study, when BMI was compared with BMD, a significant relationship was observed in both lumbar T-score and total hip T-score. This suggests that, in line with the literature, an increase in BMI has a protective effect against osteoporosis (18).

In postmenopausal breast cancer patients, it is a well-known fact that chemotherapy and long-term hormone therapy can increase bone resorption and lead to bone loss. Chemotherapy can have negative effects on bone cells, while hormone therapy can decrease estrogen levels, contributing to bone loss.

Consistent with the literature, our study also observed a significant decrease in lumbar T-score in patients undergoing long-term hormone therapy. These findings are important evidence for preserving bone health and reducing the risk of osteoporosis in postmenopausal women diagnosed with breast cancer.

Therefore, it is recommended to initiate antiresorptive treatments in postmenopausal breast cancer patients who start AI therapy, regardless of whether they have a history of fractures or not, at the early stages of breast cancer diagnosis. These treatments can help prevent bone loss and protect bone health (19).

In March 2016, a guideline was published by the European Panel of Leading Experts in the Field of Breast Cancer Management, which addressed the prevention of treatment-related bone loss and metastasis in breast cancer treatment. The guideline recommended the use of adjuvant bisphosphonates, lifestyle recommendations, and pharmacological interventions.

Regarding dietary intake, the guideline suggested calcium supplementation (1000 mg per day) and vitamin D supplementation (800-1000 IU per day) if intake is insufficient. Additionally, all patients at risk were advised to engage in regular exercise and reduce smoking and alcohol consumption.

For women with an increased risk of fractures, antiresorptive treatments were recommended. It emphasized that women with a lumbar or total hip T-score ≤-2 or those with two or more clinical risk factors for fractures should be considered for treatment.

This guideline highlights the importance of addressing bone health in breast cancer patients and offers recommendations to prevent bone loss and reduce the risk of fractures and metastasis. It underscores the significance of a comprehensive approach in breast cancer management, including lifestyle modifications and pharmacological interventions, to improve patient outcomes and quality of life (20).

PBCS who receive aromatase AI as part of their treatment may experience an annual bone loss rate of approximately 2.5% (21). In addition to spinal and hip fractures, patients undergoing AI therapy may also be at risk for fractures in peripheral joints (22). In our study, we observed that 6 patients (8.2%) with a history of fractures experienced fractures while under AI treatment. Among these patients, 4 (66%) had fractures in the distal end of the radius, and 2 (33%) had a history of proximal humerus fractures.

However, when comparing patients with and without a history of fractures, we did not find any statistically significant differences in the OAT score (p=0.295), OKT score (p=0.782), EKT score (p=0.192), and NKT score (p=0.143). This indicates that the

level of osteoporosis awareness and knowledge, as well as exercise and nutrition knowledge, was not significantly different between patients with and without a history of fractures in our study. Further research may be needed to explore other potential factors contributing to the development of fractures in this population.

In a previous study, it was observed that advanced age in PBCS is associated with lower levels of osteoporosis awareness and knowledge, as well as reduced exercise capacity (20). Similarly, in our study, we also found a statistically significant negative correlation between age and osteoporosis awareness and knowledge in advanced age PBCS. This suggests that as age increases, the level of awareness and knowledge about osteoporosis decreases in this population.

Given these findings, it is crucial to develop specialized exercise programs aimed at increasing BMD for the advanced-age postmenopausal breast cancer patient group. These exercise programs should include activities such as walking, aerobic exercises, running, dancing, and resistance exercises (weight training) that can improve bone health. By promoting regular and appropriate exercise, healthcare professionals can enhance osteoporosis awareness and knowledge, and potentially mitigate the risk of fractures in this vulnerable population.

In one study, it was found that cancer patients with higher education levels had higher levels of osteoporosis knowledge (22). In our study, we also observed a weak statistically significant improvement in OAT scores among women with higher education levels (r=0.246, p=0.036). However, when we analyzed the OKT and its subgroups, we did not find a significant correlation between education level and exercise knowledge (r=0.222, p=0.059) or nutrition knowledge (r=0.193, p=0.102).

In conclusion, although women with higher education levels had higher osteoporosis knowledge among postmenopausal breast cancer survivors, their exercise and nutrition knowledge levels were not significantly affected positively. This suggests that while education level may play a role in overall osteoporosis knowledge, it may not have a direct impact on specific knowledge areas related to exercise and nutrition. Further research may be needed to better understand the factors influencing knowledge levels in different domains of osteoporosis prevention and management among this patient population.

### Study Limitations

This study aims to measure the knowledge and awareness levels of breast cancer patients only. Therefore, the findings may not apply to all cancer patients. It should be noted that the study was conducted in a comprehensive oncology center, which means that it may represent a patient group with higher awareness levels compared to cancer patients treated in general hospital settings.

## Conclusion

After breast cancer treatment (surgery, chemotherapy, radiotherapy, hormone therapy), postmenopausal women are at risk for skeletal health issues. Considering the potential risk of bone metastasis in PBCS, it is essential to recognize that the risk of osteoporotic fractures may be higher compared to other postmenopausal women. Therefore, every woman diagnosed with breast cancer should be evaluated for their fracture risk.

The assessment of fracture risk involves evaluating clinical risk factors for fractures. In PBCS, it is crucial to focus on behavior changes and developing a patient education program aimed at preventing osteoporosis. However, more research is needed in this area, especially to develop methodological approaches that measure awareness and knowledge levels in cancer patients specifically.

The prevention of osteoporosis and the implementation of educational programs for breast cancer patients should be a priority to improve skeletal health outcomes and reduce fracture risk. It is crucial to address the unique needs of breast cancer survivors and implement strategies that can help them maintain bone health throughout their survivorship journey.

### Ethics

**Ethics Committee Approval:** Ethical approval for this study was obtained from the University of Health Sciences Turkey, Dr. Abdurrahman Yurtaslan Ankara Oncology Health Education Application and Research Center Non-Interventional Clinical Research Ethics Committee (no: 2022-02/47, date: 10.03.2022).

**Informed Consent:** Written informed consent was obtained from all patients after providing them with detailed information about the study.

### Authorship Contributions

Surgical and Medical Practices: S.K.K., B.S., M.Ö., Concept: S.K.K., L.A., Design: S.K.K., L.A., E.E.K., Data Collection or Processing: S.K.K., B.S., M.Ö., Analysis or Interpretation: S.K.K., L.A., E.E.K., Literature Search: S.K.K., E.E.K., B.S., M.Ö., Writing: S.K.K.

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## References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin 2021;71:209-49.
2. Go J, Park S, Kim KS, Kang MC, Ihn MH, Yun S, et al. Risk of osteoporosis and fracture in long-term breast cancer survivors. Korean J Clin Oncol 2020;16:39-45.
3. Chen Z, Maricic M, Pettinger M, Ritenbaugh C, Lopez AM, Barad DH, et al. Osteoporosis and rate of bone loss among postmenopausal survivors of breast cancer. Cancer 2005;104:1520-30.
4. Juozaitytė E, Aleknavičius E, Jančiauskienė R, Cesas A, Pipirienė-Želvienė T, Liutkauskienė S, et al. Guidelines for diagnostics and treatment of aromatase inhibitor-induced bone loss in women with breast cancer: a consensus of Lithuanian medical oncologists, radiation oncologists, endocrinologists, and family medicine physicians. Medicina (Kaunas) 2014;50:197-203.

5. Shapiro CL. Osteoporosis: a long-term and late-effect of breast cancer treatments. Cancers (Basel) 2020;12:3094.
6. Szabo KA, Webber CE, Adachi JD, Tozer R, Papaioannou A. An assessment of the level of osteoporosis knowledge in postmenopausal breast cancer patients. Int J Orthop Trauma Nurs 2010;14:150-8.
7. Kim KK, Horan ML, Gendler P, Patel MK. Development and evaluation of the Osteoporosis Health Belief Scale. Res Nurs Health 1991;14:155-63.
8. Oba S, Kajiyama N. Knowledge of osteoporosis and ıts associated factors among public health professionals in a municipal office in Japan. Healthcare (Basel) 2022;10:681.
9. Gendler PE, Coviak CP, Martin JT, Kim KK, Dankers JK, Barclay JM, et al. Revision of the osteoporosis knowledge test: reliability and validity. West J Nurs Res 2015;37:1623-43.
10. Şimşir Atalay N, Akkaya N, Şahin F. The psychometric properties of the Turkish version of revised 2011-osteoporosis knowledge test. Turk J Osteoporos 2015;21:127-31.
11. Aktürk SO, Meseri R, Özentürk MG. The psychometric property evaluation of the Turkish version of the osteoporosis awareness scale. Turk J Osteoporos 2021;27:151-8.
12. Reimers LL, Crew KD, Bradshaw PT, Santella RM, Steck SE, Sirosh I, et al. Vitamin D-related gene polymorphisms, plasma 25-hydroxyvitamin D, and breast cancer risk. Cancer Causes Control 2015;26:187-203.
13. Atoum M, Alzoughool F. Vitamin D and breast cancer: latest evidence and future steps. Breast Cancer (Auckl) 2017;11:1178223417749816.
14. Ayeni OA, Joffe M, Cubasch H, Rinaldi S, Taljaard C, Vorster E, Romieu I, Norris SA. Prevalence of comorbidities in women with and without breast cancer in Soweto, South Africa: Results from the SABC study. S Afr Med J 2019;109:264-71.
15. Tang SC. Women and bone health: maximizing the benefits of aromatase inhibitor therapy. Oncology 2010;79:13-26.
16. Ghazi M, Roux C. Hormonal deprivation therapy-induced osteoporosis in postmenopausal women with breast cancer. Best Pract Res Clin Rheumatol 2009;23:805-11.
17. Begum P, Richardson CE, Carmichael AR. Obesity in post menopausal women with a family history of breast cancer: prevalence and risk awareness. Int Semin Surg Oncol 2009;6:1.
18. Mackey JR, Joy AA. Skeletal health in postmenopausal survivors of early breast cancer. Int J Cancer 2005;114:1010-5.
19. Hadji P, Aapro MS, Body JJ, Bundred NJ, Brufsky A, Coleman RE, et al. Management of aromatase inhibitor-associated bone loss in postmenopausal women with breast cancer: practical guidance for prevention and treatment. Ann Oncol 2011;22:2546-55.
20. Bailey S, Lin J. The association of osteoporosis knowledge and beliefs with preventive behaviors in postmenopausal breast cancer survivors. BMC Womens Health 2021;21:297.
21. Eastell R, Hannon RA, Cuzick J, Dowsett M, Clack G, Adams JE, et al. Effect of an aromatase inhibitor on bmd and bone turnover markers: 2-year results of the Anastrozole, Tamoxifen, Alone or in Combination (ATAC) trial (18233230). J Bone Miner Res 2006;21:1215-23.
22. Rabaglio M, Sun Z, Price KN, Castiglione-Gertsch M, Hawle H, Thürlimann B, et al. Bone fractures among postmenopausal patients with endocrine-responsive early breast cancer treated with 5 years of letrozole or tamoxifen in the BIG 1-98 trial. Ann Oncol 2009;20:1489-98.