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The Impact of Pain Intensity and Sleep Quality on Quality of Life in Patients with Osteoporosis

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ABSTRACT

Osteoporosis (OP) is a progressive metabolic bone disease characterized by decreased bone density, impaired bone microarchitecture, and increased fracture risk. This study aimed to investigate the relationship between pain intensity, sleep quality, and quality of life in postmenopausal women diagnosed with osteoporosis. A total of 38 postmenopausal women with osteoporosis were included in the study. Bone Mineral Density (BMD) and T-scores of the lumbar vertebrae (L1–L4), femoral neck, and total femur were measured using the DEXA method. Demographic data such as age, educational status, and marital status, as well as clinical history, were recorded. Quality of life was assessed using the QUALEFFO-41 questionnaire, sleep quality using the Pittsburgh Sleep Quality Index (PSQI), and pain intensity using the Visual Analogue Scale (VAS). The mean age of participants was 59.13 ± 10.24 years. Poor sleep quality (PSQI ≥ 5) was observed in 22 participants, while good sleep quality (PSQI < 5) was found in 16 participants. A significant negative correlation was identified between PSQI score and the Mood subscale of QUALEFFO-41 ($r = -0.411$, $p = 0.010$). Significant positive correlations were found between VAS score and the Pain ($r = 0.688$, $p < 0.001$) and Physical Activity ($r = 0.343$, $p = 0.035$) subscales of QUALEFFO-41. In postmenopausal women with osteoporosis, both pain and poor sleep quality negatively affect quality of life. Considering these factors in clinical management may improve treatment outcomes and patient well-being.

Keywords: Osteoporosis, Sleep quality, Pain, Quality of life

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Osteoporoz Hastalarında Ağrı Düzeyi ve Uyku Kalitesinin Yaşam Kalitesi Üzerine Etkisi

ÖZET

Osteoporoz (OP), kemik yoğunluğunun azalması, kemik mikroyapısının bozulması ve kırık riskinin artmasıyla karakterize ilerleyici metabolik bir kemik hastalığıdır. Bu çalışma, osteoporoz tanısı almış postmenopozal kadınlarda ağrı düzeyi, uyku kalitesi ve yaşam kalitesi arasındaki ilişkiyi araştırmayı amaçlamıştır. Çalışmaya, osteoporoz tanılı 38 postmenopozal kadın dahil edilmiştir. Lomber vertebralar (L1–L4), femur boynu ve total femur için Kemik Mineral Yoğunluğu (KMY) ve T-skorları DEXA yöntemi ile ölçülmüştür. Katılımcıların yaş, eğitim durumu, medeni hali gibi demografik verileri ile klinik öyküleri kaydedilmiştir. Yaşam kalitesi QUALEFFO-41 anketi ile, uyku kalitesi Pittsburgh Uyku Kalitesi İndeksi (PUKİ) ile ve ağrı düzeyi Görsel Analog Skala (VAS) ile değerlendirilmiştir. Katılımcıların yaş ortalaması 59,13 ± 10,24 yıldır. Katılımcıların 22'sinde kötü uyku kalitesi (PUKİ < 5), 16'sında ise iyi uyku kalitesi (PUKİ ≥ 5) saptanmıştır. PUKİ skoru ile QUALEFFO-41 parametrelerinden Ruh Hali alt boyutu arasında anlamlı negatif korelasyon (r=-0.411, p=0.010) saptandı. VAS skoru ile QUALEFFO-41 parametrelerinden Ağrı alt boyutu (r=0.688, p<0.001) ve Fiziksel Aktivite alt boyutu (r=0.343, p=0.035) arasında anlamlı pozitif korelasyon saptandı. Postmenopozal osteoporozlu kadınlarda hem ağrı hem de kötü uyku kalitesi yaşam kalitesini olumsuz etkilemektedir. Bu faktörlerin klinik yönetimde dikkate alınması, tedavi sonuçlarını ve hasta iyilik halini artırabilir.

Anahtar Kelimeler: Osteoporoz, Uyku kalitesi, Ağrı, Yaşam kalitesi

1 Introduction

Osteoporosis is a progressive skeletal disorder characterized by reduced bone mineral density (BMD), resulting in bone fragility, tenderness, and an increased risk of fractures (WHO, 1994). It is particularly prevalent among postmenopausal women and is often accompanied by vasomotor symptoms, genitourinary syndrome, psychological disturbances, and sleep disorders (Ertüngealp & Seyisoğlu, 2000). Beyond being a localized skeletal condition, osteoporosis is recognized as a major global public health issue that significantly impairs both physical functioning and overall quality of life (Turhanoğlu et al., 2008). Globally, an estimated 150 million individuals are affected by osteoporosis, with women being nearly four times more susceptible than men. In Turkey, epidemiological data indicate that approximately half of individuals aged 50 years and older present with osteopenia, while one-quarter are diagnosed with osteoporosis (Tuzun et al., 2012). The menopausal transition represents a critical period in this context, as the decline in estrogen eliminates its protective role against bone resorption, thereby accelerating bone loss (Santos et al., 2017). Supporting this, a study conducted in 2018 reported an osteoporosis prevalence of 46.8% in postmenopausal women compared with 12.4% in their premenopausal counterparts (Kalkan et al., 2018). In recent decades, the increasing prevalence of osteoporosis, coupled with the rising socioeconomic burden of osteoporotic fractures and longer life expectancy, has intensified research interest in this condition. These factors highlight the importance of exploring the clinical manifestations of osteoporosis and their broader impact on patients' health and quality of life.

Osteoporosis is classified into primary and secondary forms according to etiological factors. Primary osteoporosis, in which no underlying disease or cause can be identified, is further divided into idiopathic, senile, and postmenopausal (PMO) types. Osteoporosis can also be categorized by location as regional or generalized. Regional osteoporosis often arises from causes other than immobilization, such as

fractures, rheumatoid arthritis, osteomyelitis, tumors, or reflex sympathetic dystrophy (Dequeker et al., 1994).

The most common physical complaints associated with osteoporosis include fractures, back pain triggered by prolonged standing, loss of spinal mobility, a reduction in height greater than 3 cm, and increased kyphosis. These symptoms may lead to difficulties in performing routine daily activities, reduced functionality, and feelings of insecurity, eventually progressing to depression and social isolation (Goldt, 1996). Particularly in postmenopausal elderly women, living with chronic pain negatively affects social life, functional capacity, and psychological well-being. The underlying cause of pain is multifactorial: fractures due to mechanical loading, changes in adjacent joints, compression of nerves or soft tissues, periosteal reaction from fractures, mechanical irritation resulting from vertebral collapse and height loss, as well as soft tissue damage independent of fractures (Bleicher, 1995). Overall, pain, muscle weakness, reduced flexibility, bone deterioration, and fractures have a detrimental impact on quality of life, and the importance of this health issue increases with longer life expectancy (Aktaş et al., 2018; Kutlu et al., 2012).The main priorities in osteoporosis management are prevention, early diagnosis, and treatment. Following the acute painful period, therapeutic goals should include improving functionality, preserving bone mass, and preventing secondary fractures. To achieve these, appropriate pharmacological treatment targeting bone quality should be combined with low-intensity exercise. Patient education is also essential, focusing on protective measures, activity modifications, and the introduction of safe physical activities such as walking or dancing. In the long term, sustained lifestyle modifications should be encouraged, including proper nutrition, adequate sun exposure, smoking cessation, reduction of excessive caffeine and soda intake, and regular exercise (Kutlu et al., 2012). Moreover, identifying and addressing risk factors affecting bone mineral density (BMD) in line with individual needs may positively influence quality of life (Aktaş et al., 2018). Generally, PMO management encompasses both pharmacological and non-pharmacological interventions. Postmenopausal women with a high fracture risk (BMD T-score $\leq$ -2.5) are considered to benefit more significantly from pharmacological treatment (Rosen & Drezner, 2020). It has also been emphasized that adequate intake of vitamins A, D, and K, protein, magnesium, and phytoestrogens contributes to bone strength, while activities such as walking, running, and resistance training are crucial for maintaining muscle strength (Özcan & Oskay, 2013). Interestingly, although exercise in postmenopausal women has been shown to increase bone density in the spine and hip, it has not been proven effective in fracture prevention (Tong, 2013). During the transition to postmenopause, symptoms such as sleep disturbances and reduced sleep quality may emerge, potentially affecting hormonal balance, cognitive performance, renal and immune function, body temperature regulation, and other vital processes (Sangkomkamhang et al., 2013). Previous research has reported that women experience more sleep problems in the postmenopausal period compared with the premenopausal phase (Simpson & Dinges, 2007). Prolonged sleep disturbances may negatively affect both mental and physical health, thereby impairing quality of life during and after menopause. Over time, these adverse effects may evolve into a self-perpetuating cycle. Interventions designed to improve sleep quality in postmenopausal women not only reduce stress associated with physiological and psychological changes but may also alleviate sleep problems (Santoro et al., 2015). Health-related quality of life is defined as the value added to life expectancy by factors such as disease, injury, disorders, functional status, perception, and social conditions (Santoro et al., 2015). With this awareness, recent years have witnessed a growing number of studies focusing on improving sleep and quality of life among women in the menopausal period. Consequently, the evaluation of quality of life in PMO has become increasingly important.

Based on this perspective, our study aimed to investigate the impact of pain and sleep quality—two common symptoms in this patient population—on quality of life in postmenopausal women with

osteoporosis, while also considering variables such as age, age at menopause, duration of menopause, body mass index, caffeine intake, and smoking status.

2 Methodology

This study was conducted with the approval of the Kocaeli University Clinical Research Ethics Committee (approval number: KÜ GOKAEK 2024/13.14, date: 22.08.2024) and in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants after they were provided with detailed information about the study. Patients who presented to the Outpatient Clinic of Physical Medicine and Rehabilitation at Kocaeli University between March 2024 and August 2024 were screened. Bone density was assessed by dual-energy X-ray absorptiometry (DEXA) at the lumbar spine (L1–L4) and femoral neck, and patients with a T-score < -2.5 were eligible. A total of 38 women, aged 40 years and older, who had been diagnosed with postmenopausal osteoporosis (PMO) for at least three years and were receiving vitamin D and calcium supplementation, were included. Patients with systemic diseases that could cause secondary osteoporosis, chronic illnesses or medications affecting bone metabolism, cognitive impairment, rheumatologic, orthopedic, or neurological disorders, osteomalacia, hyperparathyroidism, malignancy, or radiographic evidence of osteoporotic fractures (compression fractures) were excluded. Sociodemographic characteristics (age, occupation, education level, marital status), history of fractures, previous treatments, comorbid orthopedic or systemic conditions, and chronic medication use were recorded. Quality of life was assessed using the Quality of Life Questionnaire of the International Osteoporosis Foundation (QUALEFFO-41), which consists of five domains: pain (5 items), physical function (17 items), social function (7 items), general health perception (3 items), and mental function (9 items). Scores range from 0 to 100, with higher scores indicating poorer quality of life. The QUALEFFO-41 is a validated instrument widely used to assess health status and quality of life in postmenopausal osteoporosis (Lips et al., 1999). Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), a reliable instrument for the quantitative assessment of sleep quality (Buysse et al., 1989). The Turkish validity and reliability of the PSQI was previously established by Ağargün et al. (1996). Pain intensity was measured using the Visual Analogue Scale (VAS), ranging from “no pain” (score = 0) to “worst imaginable pain” (score = 10) (Chapman & Syrjala, 1990).

All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). The Shapiro–Wilk test was used to assess the normality of data distribution. Variables with normal distribution were expressed as mean ± standard deviation (SD), whereas non-normally distributed variables were presented as median (25th–75th percentile). Categorical variables were reported as frequency (percentage). Between-group comparisons were performed using the Mann–Whitney U test for continuous variables. Associations between categorical variables were evaluated with the Chi-square test, and correlations between numerical variables were analyzed using Spearman’s correlation coefficient. A p-value of <0.05 was considered statistically significant. Sample size estimation was conducted using the G*Power software (Version 3.1.9.4) with an effect size of 0.95, $\alpha = 0.05$, and power $(1-\beta) = 0.95$, indicating that a minimum of 38 participants ($n_1 = 19$, $n_2 = 19$) was required.

3 Results

Thirty-eight female patients with a mean age of 59.13±10.24 years participated in the study. Six (15.8%) of the participants were white-collar workers, 5 (13.2%) were blue-collar workers and 27 (71.1%) were

not employed. Of the participants, 31 (81.6%) were married and 7 (18.4%) were single. In terms of educational status, 15 (39.5%) were primary school graduates, 12 (31.6%) were university graduates and 11 (28.9%) were high school graduates (Table 1).

Table 1: *Demographic characteristics*

Age, Mean± SD	59.13 ± 10.24
Occupation, n (%)	
White collar	6 (15.8)
Blue collar	5 (13.2)
Not working	27 (71.1)
Education, n (%)	
Primary school	15 (39.5)
High school	11 (28.9)
University	12 (31.6)
Marital Status, n (%)	
Single	7 (18.4)
Married	31 (81.6)

Mean: Average, SD: Standard deviation, n: Number

Descriptive statistics of pain, sleep and quality of life scores of the patients who participated in the study are given in Table 2. The median VAS score was 6 (IQR: 4-8), median PSQI score was 6 (IQR: 2-8.25) and median QUALEFFO-41 total score was 35 (IQR: 31-47).

Table 2: *Descriptive statistics of VAS, PSQI and QUALEFFO-41 quality of life scores*

	Median (IQR)
VAS	6 (4-8)
PSQI	6 (2-8.25)
QUALEFFO-41	
Pain	40 (18.75-50)
Physical Activity	23.5 (8.5-31)
Social	44 (24-60.25)
General Health	58 (48-60)
Mood	58 (51.5-64.5)
Total	35 (31-47)

IQR Interquartile range (25th-75th percentile)

The demographic characteristics of patients with good sleep quality (PSQI < 5) and poor sleep quality (PSQI ≥ 5) are presented in Table 3. No statistically significant differences were observed between the

two groups in terms of age, educational level, and marital status (p = 0.873, p = 0.838, and p = 0.675, respectively).

Table 3: *Comparison of the groups with poor and good sleep quality in terms of demographic characteristics*

	PSQI<5 (n=16)	**PSQI≥5 (n=22)**	**p**
Age, Mean± SD	58.81 ± 9.97	59.36 ± 10.66	0.873
Occupation, n (%)			NA
White collar	3 (18.8)	3 (13.6)	
Blue collar	2 (12.5)	3 (13.6)	
Not working	11 (68.8)	16 (72.7)	
Education, n (%)			0.838
Primary school	6 (37.5)	9 (40.9)	
High school	4 (25)	7 (31.8)	
University	6 (37.5)	6 (27.3)	
Marital Status, n (%)			0.675
Single	2 (12.5)	5 (22.7)	
Married	14 (87.5)	17 (77.3)	

Mean: Average, SD: Standard deviation, n: Number NA: Not applicable (p value could not be given because the assumptions of the chi-square test were not met)

The comparisons of patients with good (PSQI<5) and poor (PSQI≥5) sleep quality in terms of pain and quality of life are given in Table 4. No statistically significant differences were found between the groups in terms of VAS (p = 0.589), total QUALEFFO-41 score (p = 0.781), or the QUALEFFO-41 subscales of Pain, Physical Function, Social Function, General Health, and Mental Function (p = 0.114, p = 0.510, p = 0.122, p = 0.101, and p = 0.084, respectively).

Table 4: *Comparison of the groups with poor (PSQI≥5) and good (PSQI<5)sleep quality in terms of VAS and QUALEFFO-41 quality of life scores*

	PSQI<5 (n=16) Median (IQR)	**PSQI≥5 (n=22) Median (IQR)**	**p**
VAS	5 (3.25-7.5)	6 (4.75-8)	0.589
QUALEFFO-41	35 (20-53.75)	42.5 (12.5-50)	0.781
Pain	14.5 (4.5-26.75)	26.5 (11.75-33.75)	0.114
Physical Activity	40.5 (26.75-53)	46 (21-61.75)	0.510
Social	50 (35-58)	58 (50-66)	0.122
General Health	61 (58-66)	55 (49.25-63.25)	0.101
Mood	32.5 (27.25-41.5)	38 (32-52)	0.084

IQR Interquartile range (25th-75th percentile)

Correlations between PSQI, VAS, and QUALEFFO-41 quality of life scores are presented in Table 5.

Significant correlations were found between the PSQI and the QUALEFFO-41 Mental Health subdomain (r = -0.411, p = 0.010), indicating a negative relationship. VAS scores showed significant

positive correlations with the QUALEFFO-41 Pain subdomain ($r = 0.688$, $p < 0.001$) and Physical Function subdomain ($r = 0.343$, $p = 0.035$) in postmenopausal osteoporosis patients.

Tablo 5: *Correlations between PSQI, VAS, and QUALEFFO-41 scores*

		PSQI	**VAS**
QUALEFFO-41			
Pain	r	0.132	0.688
	p	0.430	**<0.001**
Physical Activity	r	0.315	0.343
	p	0.054	**0.035**
Social	r	-0.057	0.079
	p	0.733	0.639
General Health	r	0.184	0.029
	p	0.269	0.861
Mood	r	-0.411	-0.094
	p	**0.010**	0.573
Total	r	0.233	-0.091
	p	0.158	0.589

r: Spearman correlation coefficient

4 Discussion

Complications associated with osteoporosis can negatively affect physical, mental, social, and emotional health, thereby reducing overall quality of life (Mediati et al., 2014). Skeletal disorders such as osteoporosis are characterized by decreased bone mineral density, chronic pain, limited mobility, and an increased risk of fractures. Consequently, clinical follow-up that relies solely on bone mineral density measurements may not fully capture the patient's health status. Comprehensive evaluation should also include assessments of pain, functional capacity, and quality of life, which are critical indicators of the disease's impact (Eskiyurt, 2005). In the present study, alongside bone mineral density assessments, we employed the QUALEFFO-41, a widely validated instrument for evaluating health-related quality of life in patients with osteoporosis, to provide a more holistic understanding of patient well-being.

Pain, one of the most prevalent and debilitating complications of osteoporosis, has been closely linked with depressive symptoms, which in turn may exacerbate bone loss through complex neuroendocrine and immunological pathways (Eskiyurt, 2005). Previous research indicates that both pain and depression adversely affect physical functioning and daily activity levels in women with osteoporosis (Onat et al., 2013; Liu et al., 2002). Consistent with these findings, our study revealed significant correlations between pain scores and the QUALEFFO-41 subdomains of Pain and Physical Activity, highlighting the interplay between pain severity and functional limitations. Understanding the multifactorial mechanisms underlying pain in osteoporosis is essential for the development of effective pain management strategies, which are likely to have downstream effects on mobility, mental health, and overall quality of life (Hübscher et al., 2010).

Chronic pain has also been shown to negatively influence sleep quality, often creating a vicious cycle in which sleep disturbances exacerbate pain perception, and persistent pain further disrupts sleep.

Similar bidirectional relationships exist between sleep quality and mood disorders, particularly depression (Liu et al., 2002). In line with this, our results demonstrated a significant association between the QUALEFFO-41 Mental Health subdomain and sleep quality. This finding underscores the interrelated nature of psychological well-being and sleep in patients with osteoporosis and suggests that interventions aimed at improving sleep may have broader benefits for mental health and quality of life. It is also important to recognize that osteoporosis can contribute to chronic and secondary pain, further complicating sleep quality. The interconnections among osteoporosis, pain, depression, and sleep have physiological consequences, as impaired sleep may reduce bone formation and increase bone resorption, ultimately leading to a decline in bone mineral density (Vellucci et al., 2018). In our cohort, 22 out of 38 patients exhibited poor sleep quality, consistent with previous studies reporting high prevalence of sleep disturbances in postmenopausal osteoporosis (Sürücü et al., 2022). Such findings emphasize that sleep quality should be considered a key component in the holistic management of osteoporosis, alongside pharmacological and lifestyle interventions.

Osteoporosis represents a chronic condition that significantly impacts multiple domains of life, including physical function, social participation, psychological well-being, and overall life satisfaction. Symptoms such as pain, fear of falling, decreased mobility, and poor mood can collectively diminish the patient's ability to maintain independence and engage in daily activities. Understanding these challenges, as well as their complex interrelationships, is crucial for developing effective patient-centered interventions. Strategies that simultaneously address pain, sleep, mood, and functional limitations may enhance patients' capacity to cope with their condition and improve long-term outcomes.

Some limitations of our study include its cross-sectional design, which precludes causal inferences regarding the relationships between quality of life, pain, and sleep, and the relatively small sample size compared to previous large-scale studies. While the limited sample may have reduced the statistical power for certain analyses, significant associations were still identified, indicating meaningful relationships among key variables. Future research with longitudinal designs and larger cohorts is warranted to further elucidate causal pathways and explore the efficacy of targeted interventions aimed at improving quality of life in this population.

In conclusion, the findings of this study highlight the multifaceted nature of osteoporosis and its impact on quality of life. Clinicians should be aware of the importance of pain management and sleep quality in postmenopausal women with osteoporosis, as these factors are closely linked with both physical and psychological well-being. Interventions targeting these domains, along with lifestyle modifications such as exercise, nutrition, and stress management, may play a critical role in enhancing quality of life during the postmenopausal period. Moreover, integrating holistic assessments of pain, sleep, and mental health into routine clinical care can facilitate personalized strategies that not only address the physiological aspects of osteoporosis but also support patients in maintaining autonomy, functionality, and overall life satisfaction.

5 Declarations

5.1 Limitations of Study

The study included only 38 participants, which may limit the generalizability of the findings. Subjective variables such as pain and sleep quality were assessed through self-report measures. Participant bias and individual perception differences may have influenced the results.

5.2 Acknowledgement

There were no individuals or institutions, other than the authors, who contributed to this research.

5.3 Funding Source

No financial support was received for this research.

5.4 Conflict of Interest

The authors declare that there is no conflict of interest in this study

5.5 Authors' Contributions

Corresponding Author Serkan Kablanoğlu: Took responsibility for generating the research idea or hypothesis, organizing and reporting data, conducting the literature review during the research process, interpreting and presenting findings logically, and drafting the main manuscript.

2. Sahar Shadman: Took responsibility for organizing and reporting data and contributed to the logical interpretation and presentation of findings.

3. Ilgın Sade: Took responsibility for conducting surveys, organizing and reporting data, and contributing to the drafting of the entire manuscript or the main section.

4. Çiğdem Çekmece: Provided critical revision of the manuscript before submission, not only in terms of grammar and language but also regarding intellectual content.

6 Human and Animal Related Study

6.1 Ethical Approval

The study protocol was approved by Kocaeli University Faculty of Medicine Ethics Committee with decision number GOKAEK-2024 /13.14 dated 22.08.2024. Additionally, the study adhered to the principles of the Helsinki Declaration

6.2 Informed Consent

Written informed consent was obtained from all participants who agreed to take part in the study.

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