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Investigation of the Relationship Between Bone Mineral Density, Kinesiophobia, Fear of Falling, Anxiety and Depression Levels in Patients with Osteoporosis

Osteoporoz Tanılı Hastalarda Kemik Mineral Yoğunluğu, Kinezyofobi, Düşme Korkusu, Anksiyete ve Depresyon Düzeyleri Arasındaki İlişkinin İncelenmesi

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Abstract

Objective: To evaluate the relationship between kinesiophobia, fear of falling, anxiety, and depression levels in women with osteoporosis (OP).

Materials and Methods: Female participants with OP were included in our cross-sectional observational study and their fear of falling and movement, anxiety and depression levels were questioned. Demographic data (age, body mass index, fracture history), and dual X-ray absorptiometry data were recorded. Tampa Scale of Kinesiophobia (TSK), Fall Efficacy Scale (FES), Hospital Anxiety, and Depression Scale were used.

Results: Based on their history of fracture, 77 individuals were divided into two groups: OP with fracture (n=33) and OP without fracture (n=44). The findings of the bone mineral density correlated negative with the TSK, FES, and depression levels ($p<0.05$). FES, TSK, anxiety, and depression scores were positively correlated (r=0.232; r=0.241; r=0.296). Only the existence of the fracture and anxiety levels showed a statistical relationship in the inter-group analysis (p=0.003). No statistically significant differences were detected between the fracture history and TSK, FES, and depression scores ($p>0.05$).

Conclusion: Fall efficacy was associated with kinesiophobia, anxiety, and depression. Therefore, care should be taken when warning OP patients to prevent negative consequences that may occur due to fracture. In addition to the negative consequences of fractures, balance and strengthening exercises and how to reduce falls should be emphasized.

Keywords: Osteoporosis, kinesiophobia, fall efficacy, fracture

Öz

Amaç: Osteoporoz'lu (OP) kadınlarda; kinezyofobi, düşme korkusu, anksiyete ve depresyon düzeyleri arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Kesitsel gözlemsel çalışmamıza OP olan kadın katılımcılar dahil edilerek düşme ve hareket korkuları, anksiyete ve depresyon düzeyleri sorgulanmıştır. Demografik verileri (yaş, vücut kitle indeksi, kırık öyküsü) ve dual X-ışını absorpsiyometri verileri kaydedilmiştir. Tampa Kinezyofobi Ölçeği (TKÖ), Düşme Etkinlik Ölçeği (DEÖ), Hastane Anksiyete ve Depresyon Ölçeği kullanılmıştır.

Bulgular: Kırık öyküsüne göre 77 kişi iki gruba ayrıldı: Kırıklı OP (n=33) ve kırıksız OP (n=44). Kemik mineral yoğunluğu ile TKÖ, DEÖ ve depresyon düzeyleri arasında negatif korelasyon mevcuttu ($p<0,05$). Düşme Etkinlik Ölçeği, TKÖ, anksiyete ve depresyon puanları arasında pozitif korelasyon bulunmuştur (r=0,232; r=0,241; r=0,296). Gruplar arası analizde sadece kırık varlığı ve anksiyete düzeyleri istatistiksel bir ilişki göstermiştir (p=0,003). Kırık varlığı ile TKÖ, DEÖ ve depresyon puanları arasında istatistiksel olarak anlamlı fark saptanmamıştır ($p>0,05$).

Sonuç: Düşme etkinliğinin kinezyofobi, anksiyete ve depresyon ile ilişkili olduğu bulunmuştur. Bu nedenle kırık nedeniyle oluşabilecek olumsuz sonuçları önlemek için OP hastaları uyarılırken dikkatli olunmalıdır. Ek olarak kırığın olumsuz sonuçlarının yanında denge ve kuvvetlendirme egzersizleri ile düşmelerin nasıl azaltılacağı üzerinde durulmalıdır.

Anahtar kelimeler: Osteoporoz, kinezyofobi, düşme etkinliği, fraktür

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Introduction

Osteoporosis (OP), a systemic skeletal condition that worsens bone fragility and raises the risk of fracture, is characterized by the deterioration of the microarchitecture of bone tissue and low bone mass (1). Older persons living in the community frequently struggle with OP. The World Health Organization describes OP as having a bone density that is 2.5 standard deviations below what is typical for a young adult (2). According to estimates, 200 million individuals worldwide have OP, and one in three women and one in five men are susceptible to developing an OP fracture (3,4).

The risk of fractures from falls increases quickly in people with OP due to their increased bone fragility (5,6). Due to the increased risk of fracture from falling during physical exercise in patients with OP, this may enhance their fear of falling (FOF) and, in this scenario, kinesiophobia (7).

Kinesiophobia is a fear of movement brought on by the perception of injury susceptibility and is connected to decreased levels of physical exercise (8). According to recent studies, numerous chronic musculoskeletal conditions cause fear of mobility because patients believe they will hurt worse when they move (9,10). Researchers have discovered that OP patients exhibited greater degrees of kinesiophobia than healthy patients who were age and sex-matched controls. Women who have OP are more likely to sustain fractures from falls (11). They proposed that an individual with OP might experience kinesiophobia, which is possibly connected to a fear of fracture (7).

FOF is a significant issue for many people in society, and it gets worse as people get older. It is more prevalent in women, particularly those who have OP (12). An key risk factor for acquiring a FOF is having previously fallen (12,13). Activity avoidance is frequently caused by a FOF. Therefore, leading a sedentary lifestyle raises the risk. An important risk factor for immobilization bone loss is a sedentary lifestyle (14). Sale et al. (15) discovered that patients with OP are aware of the danger of fracture, and this is coupled with healthy lifestyle adjustments like exercising and practicing mindfulness. It has also been underlined that psychological issues associated with falling, particularly in women with OP, can cause significant challenges in eveyday life. Elderly women in the community who participated in a qualitative study on the impact of FOF on daily life said that they accepted and adjusted to their FOF and that they as a result decreased their independence and participation in the outside world (16).

Falling is an important issue for OP patients. In addition, FOF and kinesiophobia, which are likely to develop in OP patients, will lead to a decrease in patients' participation in the outside world. This may cause an increase in the depression and anxiety scores of the patients. On the other hand, in the literature, there are few studies these are evaluating the relationship between kinesiophobia and fear of movement in OP.

The purpose of present study is to assess the link between kinesiophobia, fall fear, anxiety, and depressive symptoms in OP affected women.

Materials and Methods

A total of 100 patients were involved in present cross-sectional observational study conducted between November 31, 2021 and May 31, 2022. Before starting the study, the protocol was approved by University of Health Sciences Turkey Kanuni Sultan Süleyman Traning Research Hospital Ethics Committee decision no: 2021.11.308, date: 26.11.2021). All selected participants signed an informed consent form. The Declaration of Helsinki's guiding principles were followed in conducting the study. Demographic data [age, weight, height, body mass index, fracture history of the patients were questioned; the fear of movement was evaluated with the Tampa Scale of Kinesiophobia (TSK), the FOF was evaluated with the Fall Efficacy Scale (FES), the presence of anxiety and depression was evaluated with the Hospital Anxiety and Depression Scale (HADS)].

Inclusion criteria were being 45-75 years, having diagnosed with OP [lumbar spine (L1-L4) or femoral neck/total hip T-score values below -2.5], and presence of community ambulation.

Exclusion criteria were the lack of cognitive ability to understand the test instructions, being illiterate, aphasia, a psychiatric disease with a known neurological or orthopedic disease that may affect mobility, and having endocrinological diseases.

TSK, which is used for the subjective assessment of fear of movement/kinesiophobia, includes 17 items related to fear of movement and re-injury. A four-point Likert-type scale with the options "strongly disagree" and "strongly agree" is used to score each item. The overall score is between 17 and 68. High scores are associated with higher levels of kinesiophobia (17). Yılmaz et al. (18) evaluated the reliability and validity of the Turkish version of the TSK.

The FES is a self-report questionnaire that assesses the degree of anxiety related to falls. The questionnaire has 16 items, each of which is scored on a four-point scale (1 being the least interested, and 4 being the most concerned), giving a total score that ranges from 16 (no worries) to 64 (extremely worried). Ulus et al. (19) evaluated the validity and reliability of the FES-I in Turkish.

A popular self-assessment tool designed to measure psychological distress in non-psychiatric patients is the HADS. It has two subscales: a seven-item anxiety scale (HADS-A) and a seven-item depression scale (HADS-D) (20). The patient answered to each item on a 4-point (0-3) scale, hence the range of possible scores for each of the two subscales is 0 to 21. Better mood is indicated by low scores on the depression and anxiety subscales. Aydemir et al. (21) evaluated the validity and reliability of the Turkish version of HADS.

Statistical Analysis

SPSS version 23.0 was used to conduct the statistical analysis (MacOs, IBM Corp., Armonk, NY, USA). Using the German-made G*Power software version 3.1.9, the sample size for the study was estimated to meet the objectives of $\alpha<0.05$ and $\beta=80\%$. For the purpose of determining the normal distribution, the Shapiro-Wilk W test was employed. Mean (standard deviation) was used for descriptive statistics. Pearson and/or Spearman correlation

coefficient were used for correlation analysis. The Mann-Whitney U test and independent t-test test were preferred for intergroup analysis depending on whether or not the data was distributed parametrically. Correlation coefficients were also utilized.

Results

One hundred participants with OP who visited to Physical Medicine and Rehabilitation clinic were evaluated to include in the study. Fifteen participants were not willing to participate the study, 5 of them had endocrinological diseases, and 3 participants were immobile. Seventy seven participants were included in the study. Participants were randomized according to presence of fracture: Group 1 (OP with fracture; n=33) and group 2 (OP without fracture; n=44). Table 1 shows the participant's demographic details.

A positive correlation was detected between TSK scores and age, FES, and depression scores according to the study's variables' correlation analyses (p=0.041, r=0.233; p=0.043, r=0.232; and p=0.046, r=0.229, respectively). TSK scores and bone mineral density (BMD) values for the femoral neck, whole hip, and lumbar spine were found to be negatively correlated (p<0.001, r= -0.418; p=0.022, r=-0.260; and p=0.024, r= -0.257, respectively). A positive correlation was found between FES scores and age, TSK, anxiety and depression scores (p=0.01, r=0.292; p=0.043, r=0.232; p=0.034, r=0.241, and p=0.009, r=0.296, respectively), where as a negative correlation was found between FES scores, and T-scores and BMD values of the femoral neck and total hip (p=0.008, r=-0.299; r=-0.275; p=0.004, and p=0.016, r=-0.326; p=0.012, r=-0.285, respectively). A positive correlation was detected between anxiety scores and FES and depression scores (p=0.034, r=0.241; and p<0.001, r=0.657). Also, it was found a negative correlation between depression scores and bone density test results (Table 2).

According to inter-group analysis, there was only statistical difference between presence of the fracture and anxiety scores (p=0.003). There were no statistically differences between presence of the fracture and bone density test results, TSK, FES, and depression scores (Table 3).

Discussion

In this study, it was determined that the presence of fracture history was unrelated to the demographic data, dual X-ray absorbsiometri (DXA) values, FES, HAD and kinesiophobia scores of the patients. Only patients without fracture had higher anxiety scores than the group with fractures. There was a correlation between age and FES and TKS, and between the increase in OP levels and TKS, FES and depression scores according to the correlation analysis. The association between FES scores and age, TKS, anxiety, and depression scores was shown to be positive. Additionally, a positive correlation was detected between the FES and depression scores and the anxiety score. A diagnosis of OP was associated with an increased risk of falling. According to prior studies, people with OP are more likely to fall because of their advanced age, weakened balance, and diminished strength (22,23). Those who are older, female, and of the black race are less likely to engage in exercise or other forms of physical activity, according to research by Barkley (24). Age, FES, and TKS were found to positively correlate in our investigation, corroborating these findings. On the contrary, Resnick et al. (11) found no relationship between demographic data, FOF, and exercise participation.

Considering the serious consequences that can be experienced after falling, it is not surprising that approximately 40-60% of people who fall have reported FOF (13,25,26). Women and the elderly are more likely than men to fear falling (27,28). Although there aren't many research examining people with OP's FOF, those that have been done have revealed a connection between the two conditions (17,28,29). These findings are supported by our investigation, which found a negative connection between FES scores, T and BMD values for the femoral neck and total hip. Maggio et al. (28) argue that those who know that they have OP are likely to be afraid of fracture in any fall, which exacerbates their fear. However, in our study, contrary to this data, the presence of a history of fracture was not associated with an increase in FOF or with kinesiophobia. Unfortunately, the FOF frequently prevents people from exercising or engaging in other types of physical activity, which contributes to a loss of independence that goes beyond what is necessary to prevent bodily harm from falls or normal aging changes (11,29,30). According to Mahler and Sarvimäki (16) elderly women in the community accepted and adjusted to their FOF, and as a result, they decreased their independence and engagement in society.

Additionally, it has been noted that OP patients are very likely than the general population to experience psychological issues such anxiety and depression (31). Additionally, a lower BMD is

Table 1. Demographical characteristics of the participants

	Group 1 (n=33)	Group 2 (n=44)	p
Age (year)	65.6 (7.9)	65.8 (7.8)	0.642
BMI (kg/m^2)	29.0 (5.1)	28.5 (4.5)	0,.342
Ca (mg/dL)	9.6 (3.7)	9.6 (0.3)	0.349
PTH (pg/mL)	36.3 (16.8)	45.2 (18.3)	0.646
25-OH vitamin D_3 (ng/mmol)	23.7 (11.2)	24.0 (11.2)	0.092

BMI: Body mass index, Ca: Calcium, PTH: Parathormon
P values for homogenity. There were no statistically significant differences between age, BMI, level of calsium, parathormon and 25-OH vitamin D_3

Table 2. Correlations between the variables of the study

	TSK	FES	HADS-anxiety	HADS-depression
Age				
r	0.233	0.292	-0.117	0.076
p	0.041*	0.010*	0.310	0.509
T-score (femoral neck)				
r	-0.170	-0.299	-0.053	-0.277
p	0.140	0.008*	0.648	0.015*
Z-score (femoral neck)				
r	-0.045	-0.218	-0.091	-0.259
p	0.697	0.056	0.433	0.023*
BMD (femoral neck)				
r	-0.418	-0.326	-0.123	-0.301
p	<0.001*	0.004*	0.288	0.008*
T-score (total hip)				
r	-0.096	-0.275	-0.110	-0.303
p	0.480	0.016*	0.341	0.007*
Z-score (total hip)				
r	0.027	-0.110	-0.182	-0.327
p	0.816	0.339	0.114	0.004*
BMD (total hip)				
r	-0.260	-0.285	-0.172	-0.398
p	0.022*	0.012*	0.134	<0.001*
T-score (L1-L4)				
r	0.129	0.164	0.098	0.142
p	0.263	0.154	0.395	0.218
Z-score (L1-L4)				
r	0.093	0.097	0.091	0.107
p	0.422	0.402	0.430	0.355
BMD (L1-L4)				
r	-0.257	0.146	-0.035	0.034
p	0.024*	0.205	0.762	0.770
TSK				
r	1	0.232	0.153	0.229
p	-	0.043*	0.185	0.046*
FES				
r	0.232	1	0.241	0.296
p	0.043*	-	0.034*	0.009*
HADS-anxiety				
r	0.153	0.241	1	0.657
p	0.185	0.034*	-	<0.001*
HADS-depression				
r	0.229	0.296	0.657	1
p	0.046*	0.009*	<0.001*	-

TSK: Tampa scale of kinesiophobia, FES: Fall efficacy scale, HADS: Hospital anxiety and depression scale, BMD: Bone mineral density
There was a positive correlation between TSK scores and age, FES, and depression scores. TSK scores and BMD values for the femoral neck, whole hip, and lumbar spine were found to be negatively correlated. Positive correlation was found between FES scores and age, TSK, anxiety and depression scores whereas a negative correlation was found between FES scores, and T scores and BMD values of the femoral neck and total hip. There was a positive correlation between anxiety scores and FES and depression scores. Also, it was found a negative correlation between depression scores and bone density test results

associated with higher levels of depression or anxiety (32,33). In present study, patients with OP without a fracture history had higher levels of anxiety than those with a fracture history. And while depression levels do correlate with BMD, anxiety levels do not. The presence of fracture was not found to be associated with the depression levels of the patients. Considering the serious consequences that can be experienced after falling, the fear of experiencing a fracture may have led to an increase in the anxiety levels of the patients. Moreover, a positive correlation was detected between FES and depression score, anxiety score, and tampa score in our study. Kinesiophobia caused by the FOF have caused the fear of movement in the patients, and their

Table 3. Comparison of the both groups according to presence of the fracture

	Group 1 (n=33)	Group 2 (n=44)	p	95% Confidence interval of the difference	
				Lower	Upper
Femur neck T-score	-2.2 (0.9)	-2.1 (0.9)	0.476	-0.53	0.30
Femur neck Z-score	-0.8 (0.8)	0.6 (1.0)	0.473	-0.58	0.27
Femur neck BMD	0.701 (0.114)	0.710 (0.119)	0.737	-0.063	0.044
Femur total T-score	-1.7 (0.9)	-1.8 (0.8)	0.481	-0.24	0.52
Femur total Z-score	-0.6 (0.8)	-0.7 (0.9)	0.568	-0.29	0.52
Femur total BMD	0.775 (0.104)	0.765 (0.101)	0.679	-0.037	0.056
L1-L4 T-score	-2.3 (1.2)	-2.3 (0.6)	0.247	-0.42	0.51
L1-L4 Z-score	-0.7 (1.6)	-0.9 (0.9)	0.315	-0.27	0.89
L1-L4 BMD	0.884 (0.159)	0.863 (0.104)	0.829	-0.38	0.08
TSK	36.8 (6.0)	38.4 (5.0)	0.198	-4.15	0.87
FES	26.7 (6.9)	29.0 (8.9)	0.221	-5.99	1.51
HADS					
Anxiety	5.6 (1.9)	7.7 (3.9)	0.003*	-3.46	-0.73
Depression	5.4 (2.9)	6.9 (4.4)	0.085	-3.11	0.20

TKS: Tampa scale of kinesiophobia, FES: Fall efficacy scale, HADS: Hospital anxiety and depression scale
There was only statistical difference between presence of the fracture and anxiety scores. No statistically differences were found between presence of the fracture and bone density test results, TSK, FES, and depression scores, BMD: Bone mineral density

participation in the outside world decreased, which may have led to an increase in the depression and anxiety levels of the patients.

The literature have few studies that evaluate kinesiophobia in OP patients (3,7,34). According to Gunendi et al. (7) They found that OP patients had higher kinesiophobia levels than healthy individuals of similar age and gender. In addition, Mısırcı et al. (3) found similar levels of kinesiophobia in patients with postmenopausal OP and osteopenia, and the level of kinesiophobia in both patient groups was found to be higher than in healthy controls. Patients with OP and osteopenia may have similar degrees of kinesiophobia since it is difficult to differentiate between the two conditions as a result of a lack of knowledge.

However, in our study, contrary to this data, kinesiophobia increases as the level of OP increases. A negative correlation was found between TKS and BMD values of femoral neck, total hip and lumbar spine. In addition, the history of fracture was not considered to be associated with kinesiophobia. The level of kinesiophobia was found to be correlated with anxiety and depression in both OP and osteopenia patients. In addition, high kinesiophobia scores are associated with anxiety and depression (3). There is only one study in the literature comparing kinesiophobia and FOF, and a weak-moderate positive correlation was found between the two (3). Similarly, a positive correlation was found between fall efficacy and tampa in our study. Additionally, it was discovered that patients with high kinesiophobia had greater FOF than those with low kinesiophobia. It might be said that FOF may worsen kinesiophobia or that kinesiophobia may cause FOF (3).

It is critical to comprehend the idea of FOF in older persons with OP in order to be able to construct fall prevention programs and to best address the FOF. Regardless of the extent of the disease, even just knowing you have OP can cause you to reduce your physical activity, which can lead to deconditioning and an increase in risk. Informing older persons with OP of the increased risk of falling should therefore be done with caution (35). In order to lower the risk of falling and to prevent falls, patients should be informed. How patients can improve their balance and strength and prevent falls through the use of the proper exercise techniques should be covered in this information.

Study Limitations

The limitations of the study are the small number of patients included in the study. Correlations observed are weak due to the small number of patients. For this reason, new studies with larger number of patients are needed.

Conclusion

As OP deepens, the patients' fall efficacy, kinesiophobia and depression levels increase. However, this situation was not associated with the presence of fracture. In addition, there is a relationship between FOF, kinesiophobia and depression. For this

reason, caution should be exercised when warning OP patients in order to prevent the negative consequences that may occur due to fractures. In addition to the negative consequences of the fracture, balance and strengthening exercises and how to reduce falls should be emphasized.

Ethics

Ethics Committee Approval: Approval for the study was granted by the University of Health Sciences Turkey, Kanuni Sultan Süleyman Training and Research Hospital Ethics Committe. (decision no: KAEK/2021.11.308, date: 26.11.2021).
Informed Consent: Consent form was obtained from all patients participating in the study.
Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.D.K., Concept: C.M.C., M.D.K., Design: C.M.C., M.D.K., Data Collection or Processing: C.M.C., M.D.K., Analysis or Interpretation: M.D.K., Literature Search: C.M.C., Writing: C.M.C.
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