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Türk Osteoporoz Dergisi
TURKISH JOURNAL OF OSTEOPOROSIS

Editörden / Editorial

Sevgili Meslektaşlarımız,

Öncelikle değerli meslektaşlarımıza akademik çalışmaların meyvesi olarak hazırladıkları araştırma makalesi ve olgu sunumlarını yayınlanmak üzere Emerging Sources Citation Index (ESCI) tarafından indekslenen dergimize düzenli olarak ilettikleri için çok teşekkür ederiz. Dergimiz kapsamında bu akademik çalışmaları yayınlamaktan büyük mutluluk duyuyoruz.

Türkiye Osteoporoz Derneği tarafından düzenlenen; uluslararası katılımlı 8. Ulusal Osteoporoz, Osteoartrit ve Kas İskelet Sistemi Hastalıkları Kongresi 21-24 Kasım 2024 tarihlerinde Cornelia Diamond Golf & Resort Otel, Antalya'da gerçekleştirilecektir.

Uluslararası katılımlı olarak düzenlenen bu kongrede osteoporoz, osteoartrit ve kas iskelet sistemi hastalıkları konularındaki bilgilerin güncellenmesi amaçlanmıştır. Konularında önde gelen isimlerin konuşmacı olarak yer alacağı kongre sizlerin de katılımları ve destekleri ile gerçekleştirilecektir. Katılımcılar kongremize sözlü ve poster bildiri sunumları ile katılım sağlayabileceklerdir. Bu kongrede ilk kez Türkiye Osteoporoz Derneği adına "TOD Genç Araştırmacı Teşvik Ödülü" verilecektir. Erken kayıt ve konaklama ücretlerinden faydalanmak için son tarih: 28 Ağustos 2024; Bildiri son tarihi: 13 Eylül 2024 olarak belirlenmiştir.

Siz değerli meslektaşlarımıza mutluluğun ve başarının yaşamınızdan eksik olmamasını dileyerek, sevgi ve saygılarımı sunarım.

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Prof. Dr. Yeşim Kirazlı

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The Impact of Osteoporosis on Facet Joint Denervation Treatment Outcomes in Patients with Lumbar Facet Joint Syndrome

Lomber Faset Eklem Sendromlu Hastalarda Osteoporozun Faset Eklem Denervasyon Tedavisi Sonuçlarına Etkisi

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Abstract

Objective: The aim of this study was to investigate the effect of osteoporosis (OP) on the outcomes of facet medial branch radiofrequency thermocoagulation (RFT).
Materials and Methods: Thirty-six patients with chronic lower back pain due to lumbar facet joint syndrome (LFJS) who underwent facet medial branch RFT were retrospectively reviewed. The patients were divided into two groups: Group I (without OP, n=19) and group II (with OP, n=16). Pre-intervention and post-intervention evaluations of the patients were assessed at 1, 6, and 12th months by visual analog scale (VAS).
Results: In both groups, VAS scores 1st, 6th, and 12th months after intervention were lower than those at baseline (p=0.001). There were no significant difference between the groups in terms of VAS score improvement.
Conclusion: Lumbar facet medial branch RFT is an effective and safe treatment method in both the short and long-term in patients with LFJS. OP therapy had no effect on RFT treatment results.
Keywords: Facet joint, facet medial branch, lower back pain, radiofrequency, osteoporosis

Öz

Amaç: Bu çalışmanın amacı, osteoporozun (OP) faset mediyal dal radyofrekans termokoagülasyon (RFT) sonuçları üzerine etkisini araştırmaktır.
Gereç ve Yöntem: Lomber faset eklem sendromuna (LFJS) bağlı kronik bel ağrısı şikayeti ile faset medial dal RFT uygulanan 36 hasta retrospektif olarak incelendi. Hastalar grup I (OP'siz, n=19), grup II (OP'li, n=16) olmak üzere iki gruba ayrıldı. Hastaların girişim öncesi ve girişim sonrası 1, 6 ve 12. aylarda görsel analog skala (GAS) ile ağrı skorları değerlendirildi.
Bulgular: Her iki grupta da girişimden sonraki 1., 6. ve 12. ay GAS değerleri başlangıca göre daha düşük bulundu (p=0,001). Gruplar arasında GAS skorlarındaki iyileşme açısından anlamlı bir fark gözlenmedi.
Sonuç: Lomber faset medyan sinir RFT, LFJS'li hastalarda hem kısa hem de uzun dönemde etkili ve güvenli bir tedavi yöntemidir. OP'nin RFT tedavi sonuçları üzerine etkisi yoktur.
Anahtar kelimeler: Faset eklem, faset medyan sinir, bel ağrısı, radyofrekans, osteoporoz

Introduction

Lumbar facet joint syndrome (LFJS) is a mechanical instability syndrome that occurs due to degenerative and traumatic causes in facet joints in the lumbar region. LFJS has been estimated to be responsible for 15-41% of chronic low back pain (CLBP) (1). There is usually CLBP without radicular extension, radiating to the buttocks or groin. The pain increases with standing, changing position, lumbar extension, lateral flexion, and rotation to the side of the pathological facet (2). The best diagnostic method is pain reduction with medial branch blocks (3). Facet medial nerve denervation by radiofrequency thermocoagulation (RFT) is effective in patients resistant to conservative treatments (4).
Osteoporosis (OP) is a systemic disease characterized by an increased bone fragility as a result of low bone mineral density (BMD) and micro-architecture deterioration of the bone tissue (5). With the increase in the elderly population, it has become an important public health problem. Generally, the most common symptom in patients with OP is persistent back pain (6). Vertebral fractures due to OP are known to cause back pain. In addition,

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increased bone resorption may cause back pain in patients with OP without vertebral fractures (7). Microfractures play a role in the development of chronic back pain by causing deterioration in spinal mechanics; posture disorders; stretching, pulling, and compression in soft tissue; and facet joint dysfunctions (8). Degeneration of the facet joints causes irritation in the nerves innervating the joint. It is thought that this irritation may be the cause of low back pain in some patients with OP (9). The relationship between degenerative changes in the spine and OP is not clear (10).

Although facet medial branch RFT is frequently applied in the treatment of CLBP, there are limited data on the factors affecting the success of the procedure. Moreover, there is no study evaluating the efficacy of facet medial branch RFT on pain in osteoporotic patients with LFJS. Considering that OP and LFJS are two common causes of CLBP, especially in elderly female patients, the effect of OP on RFT results applied in the treatment of LFJS is intriguing. Therefore, the aim of our study was to evaluate the effect of OP on the treatment results in female patients with LFJS treated with facet medial branch RFT.

Materials and Methods

Study Design and Participants

This retrospective study was conducted in the Department of Pain Medicine after approval was obtained from Ağrı İbrahim Çeçen University Scientific Research Ethics Committee (decision no: 159, date: 22.06.2023). Due to the retrospective nature of the study, there was no need to obtain informed consent from the patients. Records of patients who presented with a primary diagnosis of LFJS from January 2020 and January 2022 in our clinic were reviewed. The diagnosis of LFJS was based on clinical findings on physical examination and magnetic resonance imaging (MRI) scans. The diagnosis of OP was determined on the basis of the World Health Organization guidelines [i.e., dual-energy X-ray absorptiometry (DXA), BMD at the lumbar spine, femoral neck or total hip T-score ≤2.5 standard deviations] (11). The inclusion criteria were being 35 years and older, being female, having axial low back pain unresponsive to conservative treatments for at least 3 months, being diagnosed with LFJS, receiving lumbar facet medial branch RFT under fluoroscopy, and having BMD T-score measured by DXA. The following were the exclusion criteria: 1. Presence of extruded or sequestered discs, spondylolisthesis, advanced spinal stenosis, or lateral recess syndrome on lumbar MRI; 2. Previous surgery in the lumbar region; 3. Presence of acute/subacute vertebral fracture; 4. Incomplete medical record.

Clinical Assessment

Age, gender, body mass index (BMI), onset of pain, BMD T-score, and visual analog scale (VAS) scores at baseline and 1, 6, and 12 months after the procedure were collected from the medical records and follow-up forms. The pain intensity was evaluated using the VAS (0= no pain and 10= worst imaginable pain). Significant pain relief was accepted as a decrease of more than 50% on the VAS score.

The patients were categorized into two groups according to OP: those without OP (group I) and those with OP (group II).

Procedure

The injections were performed in an operating room. The patient was placed in prone position. Each patient was monitored, and vital signs were observed throughout the entire procedure (blood pressure, heart rate, SpO_2). After the AP view of the target joint was obtained, an oblique view of the patient was obtained until the Scottie dog image was formed (usually in the 15°-20° position). A 22G 10 cm radiofrequency needle with 5 mm active tip was advanced towards the junction of the superior articular process and the transverse process, the target point of which was the "dog's eye", and bone contact was achieved (Figure 1). The needle position was reconfirmed with sensory and motor stimulations (50 Hz sensory stimulation, 2 Hz motor stimulation) using the RF device. In sensory stimulation, the patient felt paresthesia in the waist, while multifidus muscle contractions were observed in motor stimulation. The needle site was verified with the absence of any finding of the radicular nerve in either stimulation. After confirmation of the exact location of the needle, analgesia was provided with 1 mL of lidocaine 1%. Then RFT was applied at 80 °C for 60 seconds for each level. After RFT, 1 mg of dexamethasone mixed with saline (total of 0.5 mL) was administered to each site to prevent neuritis. Two adjacent median branches were blocked for each facet joint block (L3 and L4 median branches were blocked for the L4-L5 facet joint).

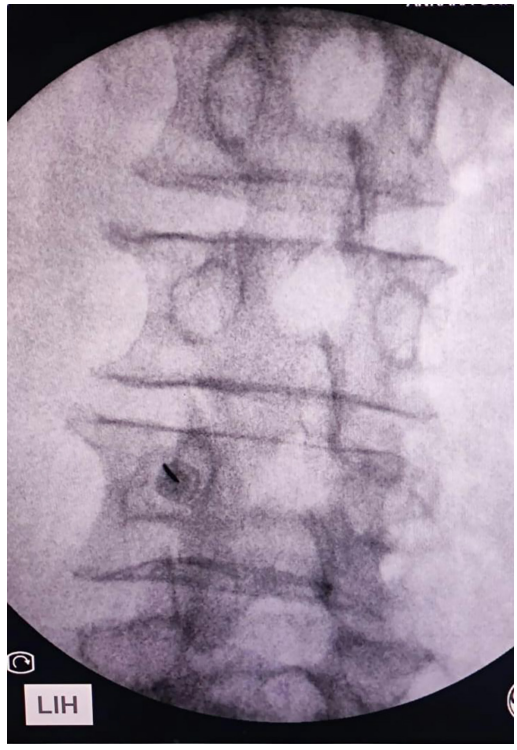

Figure 1. Oblique fluoroscopic view of lumbar facet medial branch radiofrequency thermocoagulation

RFT was applied to L3, L4 median branches and L5 dorsal rami in all patients.

Statistical Analysis

In calculating the sample size of this study, power was determined by taking at least 80% and a type-1 error of 5% for each variable. Kolmogorov-Smirnov (n>50) and Skewness-Kurtosis tests were performed to check whether the continuous measurements in the study were normally distributed and, because the measurements were normally distributed, parametric tests were applied. Descriptive statistics for continuous variables in the study are expressed as mean (mean), standard deviation, minimum, maximum, number (n), and percent (%). The independent t-test was used to compare the measurements according to the categorical groups. In the examination of the difference between the measurement periods of VAS scores, repeated ANOVA was used. Pearson correlation coefficients were calculated to determine the relationship between continuous measurements. The chi-squared test was performed to analyze the relationship between categorical variables and the group. P<0.05 was accepted as statistically significant. All analyses were conducted using IBM SPSS Statistics for Windows 25.0 (IBM Corp., Armonk, NY, USA).

Results

Figure 2 shows the CONSORT of patients. There were 19 patients in group I and 16 in group II.

Table 1 displays the patients' demographic datas. Both groups were similar in terms of height, weight, BMI, and duration of pain. The mean age was 63.26±7.71 years and 71.31±6.95 years in group I and group II, respectively. The mean age was significantly higher in group II than in group I (p=0.003) (Table 1). In group I, the mean VAS score decreased from baseline 7.05±0.71 to 2.37±2.01 at 1 month, 3.16±2.27 at 6 months, and 4.37±2.45 at 12 months. In group II, the mean VAS score decreased from baseline 7.44±0.63 to 2.44±2.16 at 1 month, 2.88±2.19 at 6 months, and 4.19±3.04 at 12 months. In both groups, the VAS scores at each evolution time point were significantly decreased compared with the baseline VAS scores (p=0.001) (Table 2).

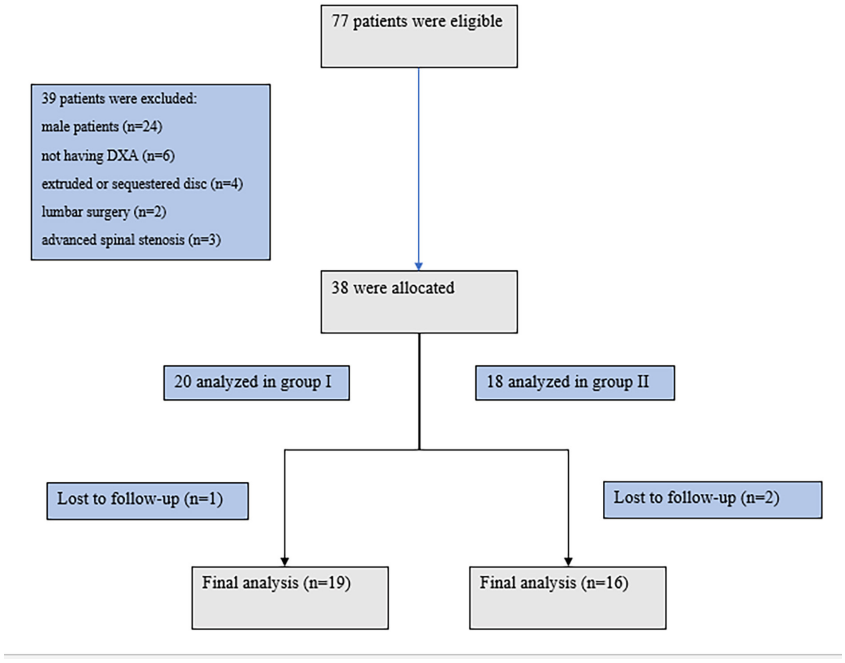

Figure 2. Flow diagram
DXA: Dual-energy X-ray absorptiometry

Table 1. Descriptive features of patients

	Group I (n=19)	Group II (n=16)	p-value
Age (mean ± SD), year	63.26±7.71	71.31±6.95	**0.003**
Height (mean ± SD), cm	161.53±8.19	159.94±9.19	0.592
Weight (mean ± SD), kg	76.11±8.03	71.81±7.56	0.115
BMI (mean ± SD)	29.44±4.68	28.19±3.22	0.374
Duration of pain, (months)	38.11±34.27	27.06±28.69	0.314

SD: Standard deviation, BMI: Body mass index

In the comparison of the groups, there was no statistically significant difference in the VAS scores between groups 1, 6, or 12 months after the intervention (1 month: p=0.923, 6 months: p=0 .711, and 12 months: p=0.847) (Table 2).

No correlation was found between significant pain relief at 1, 6, and 12 months and analyzed variables like age, BMI, and duration of pain (Table 3).

No complications were recorded during follow-up.

Discussion

One of the most common symptoms in patients with OP is back pain (12). Vertebral fractures are known to cause severe low back pain in these patients. On the other hand, patients with OP without vertebral fractures may also report low back pain (7). In rats, increased bone turnover has been shown to cause osteoclast activation, sensitize sensory nerves in the bone marrow, and eventually lead to local inflammation that causes pain even if there is no fracture (13). In addition, increased osteoclastic activity can cause acidosis, leading to overexpression of nociceptors, which activate the sensory nerve fibers, resulting in pain (14,15). OP disrupts the load-bearing balance of the spine by altering the spine biomechanics. This can cause degeneration of the facet joints and irritation of the nerves of the facet joints, which may contribute to low back pain (8,9).

With the increase in the elderly population, both OP and LFJS are seen more frequently. It can be challenge to treat CLBP in both diseases. The factors affecting and predicting the success of RFT therapy, which is effectively applied in the treatment of LFJS, are not clear. To the best of our knowledge, no study has evaluated the effect of OP on RFT treatment outcomes. Only one study investigated the efficacy of pulse radiofrequency (PRF) in osteoporotic patients with lumbar facet syndrome (16). Paksoy (16) applied median branch PRF (42 °C and 6 minutes) to 18 patients and followed them up for 6 months. Significant pain reduction was achieved in 14 patients and moderate pain relief in 3 patients, which lasted for 6 months, and only 1 patient did not have a decrease in pain. He reported that lumbar facet median branch PRF is an effective and alternative method that can improve patient's life conditions by reducing medical treatments for lumbar facet pain due to OP. In our study, we achieved successful results in patients with OP. This is consistent with the study by Paksoy (16). However, our study differs from Paksoy's (16) in terms of performing RFT, comparing it with patients without OP, and a longer follow-up period. It has been reported that the efficacy of PRF for medial nerve denervation in lumbar facet joint pain is shorter and weaker than that of RFT (17,18). Paksoy (16) followed up the patients to whom PRF was applied for 6 months and did not report long-term results. In our study, RFT was effective both in the short and long-term (12 months). The VAS scores were significantly decreased in both groups at each follow-up visit, but we did not detect any difference between the two groups in terms of pre- or post-treatment VAS scores. Possible influencing factors such as age, BMI, and duration of pain had no effect on outcomes.

Table 2. Comparision of VAS scores before and after the treatment

	Group I (n=19) (mean ± SD)	**Group II (n=16) (mean ± SD)**	***p-value**
VAS baseline	7.05±0.71[a]	7.44±0.63[a]	0.101
VAS-1st month	2.37±2.01[b]	2.44±2.16[b]	0.923
VAS-6th month	3.16±2.27[b]	2.88±2.19[b]	0.711
VAS-12th month	4.37±2.45[b]	4.19±3.04[b]	0.847
**p	**0.001**	**0.001**	

*Significance levels according to independent-samples t-test results, **Comparison results between VAS measurements (repeated ANOVA), [a, b]Shows the difference between VAS measurement periods. SD: Standard deviation, VAS: Visual analog scale

Table 3. Inter-measurement correlation analysis results

		Age	**BMI**	**Duration of pain, (months)**
VAS baseline	r	0.065	-0.119	-0.002
	p	0.545	0.263	0.988
VAS-1st month	r	-0.108	0.000	-0.045
	p	0.310	0.997	0.671
VAS-6th month	r	-0.056	0.048	0.037
	p	0.601	0.652	0.730
VAS-12th month	r	-0.130	0.103	-0.047
	p	0.222	0.336	0.658

r: Pearson correlation coefficient, BMI: Body mass index, VAS: Visual analog scale

Study Limitations

There are several limitations in our study, such as its retrospective nature, its small size, and the lack of patient quality of life measures such as the Oswestry disability index. However, it is valuable because it is the first study, to our knowledge, to investigate the effect of OP on facet medial branch RFT results.

Conclusion

Lumbar facet medial branch RFT is an effective and safe treatment procedure in both the short and long-term in patients with LFJS. OP has no effect on RFT treatment results. Prospectively designed, controlled studies are needed to identify the factors affecting the success of RFT.

Ethics

Ethics Committee Approval: The present study is retrospective and its permission was obtained from Ağrı İbrahim Çeçen University Scientific Research Ethics Committee (decision no: 159, date: 22.06.2023).
Informed Consent: Retrospective study.

Authorship Contributions

Surgical and Medical Practices: K.S.S., B.M., Concept: K.S.S., Design: K.S.S., Data Collection or Processing: K.S.S., B.M., Analysis or Interpretation: K.S.S., B.M., Literature Search: K.S.S., B.M., Writing: K.S.S., B.M.
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The Effects of Sarcopenia and Fracture Risk on Kinesiophobia, Fear of Falling, Fall Risk and Quality of Life in Geriatric Individuals

Geriatrik Bireylerde Sarkopeni ve Kırık Riskinin Kinezyofobi, Düşme Korkusu, Düşme Riski ve Yaşam Kalitesi Üzerine Etkileri

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Abstract

Objective: This study aimed to determine the relationship between sarcopenia and fracture risk in older adults and to investigate the effects of increased fracture risk in individuals with sarcopenia on the fear of falling, fall risk, kinesiophobia, and quality of life (QOL).
Materials and Methods: The study involved 132 participants. Sarcopenia risk was assessed using the SARC-F questionnaire, fracture risk with the Fracture Risk Assessment Tool, QOL with the "World Health Organization Quality of Life Scale" short form, presence of kinesiophobia with the TAMPA Kinesiophobia scale, and fall risk with the "Berg Balance scale" and "International Fall Effectiveness scale".
Results: The study included 102 women (77.3%) and 30 men (23.7%). The average age of the individuals was 70.83±6.98. There was a risk of sarcopenia in 55.5% of patients, and those at risk of sarcopenia had a 33.3% risk of hip fracture and 22.2% risk of both hip and major fracture. With regard to the risk of sarcopenia, it was observed that the fall and fracture risks increased, and the QOL decreased (p-value <0.05). Fracture risk and sarcopenia risk were higher in women, increased with age, and negatively correlated with body mass index and education level (p-value <0.05). It has been observed that both fracture risk and sarcopenia risk with fracture risk increased the risk of falls, kinesiophobia, and decreased QOL (p-value <0.05).
Conclusion: Appropriate treatment and early intervention of these conditions in sarcopenic individuals with isarcopenia and increased fracture risk may provide clinical benefits to reduce the risk of falls and fractures and improve QOL.
Keywords: Fall risk, fracture, kinesiophobia, osteosarcopenia, quality of life, sarcopenia

Öz

Amaç: Bu çalışmanın amacı yaşlı erişkinlerde sarkopeni ile kırık riski arasındaki ilişkiyi belirlemek ve sarkopenik bireylerde artan kırık riskinin düşme korkusu, düşme riski, kinezyofobi ve yaşam kalitesi üzerine etkilerini araştırmaktır.
Gereç ve Yöntem: Bu çalışmaya 132 kişi katıldı. Sarkopeni riski SARC-F anketi, kırık riski Kırık Riski Değerlendirme Aracı, yaşam kalitesi "Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği" kısa formu, kinezyofobi varlığı TAMPA Kinezyofobi ölçeği, düşme riski ise "Berg Denge Ölçeği" ve "Uluslararası Düşme Etkinliği ölçeği" ile değerlendirildi.
Bulgular: Çalışmaya 102 kadın (%77,3) ve 30 erkek (%23,7) dahil edildi. Bireylerin yaş ortalaması 70,83±6,98 idi. Hastaların %55,5'inde sarkopeni riski mevcuttu ve sarkopeni riski taşıyanların %33,3'ünde kalça kırığı riski, %22,2'sinde ise hem kalça hem de majör kırık riski vardı. Sarkopeni riski ile birlikte düşme riskinin ve kırık riskinin arttığı, yaşam kalitesinin düştüğü gözlendi (p-değeri <0,05). Kırık riski ve sarkopeni riski ile birlikte kırık riski kadınlarda daha yüksekti, yaşla birlikte artıyordu ve vücut kitle indeksi ve eğitim düzeyi ile negatif korelasyon gösteriyordu (p-değeri <0,05). Hem kırık riskinin hem de kırık riskiyle birlikte sarkopeni riskinin düşme riskini ve kinezyofobiyi artırdığı, yaşam kalitesini düşürdüğü gözlendi (p-değeri <0,05).
Sonuç: Kırık riski artmış sarkopenik bireylerde bu durumların uygun tedavisi ve erken müdahalesi, düşme ve kırık riskinin azaltılması ve yaşam kalitesinin iyileştirilmesi yönünde klinik fayda sağlayabilir.
Anahtar kelimeler: Düşme riski, kırık, kinezyofobi, osteosarkopeni, yaşam kalitesi, sarkopeni

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Introduction

With the global aging of the population, the prevalence of osteoporosis and sarcopenia is rapidly increasing, which positively correlates with increased risk of fractures, decreased quality of life (QOL), and premature mortality (1). In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) defined sarcopenia as a syndrome characterized by progressive and widespread loss of skeletal muscle strength, mass, and functions that occurs with increasing age or secondary to a disease process and is associated with risks such as physical disability, poor QOL, and mortality (2,3). The prevalence of sarcopenia varies between populations and according to the definitions and thresholds used. Thus, while prevalences of 3% to 24% have been reported in individuals older than 65 years of age when assessed using criteria and thresholds defined by the EWGSOP, the prevalence is 7.1% when there is both loss of muscle mass and loss of muscle function, and 11% when there is loss of muscle mass only (3,4).

Osteoporosis, the most common metabolic bone disease in the elderly, is characterized by microarchitectural deterioration that predisposes to fragility fractures secondary to both low bone mass and low energy transfer. According to epidemiological studies and clinical experience, bone mineral density (BMD) is not always associated with fractures, and 40% of women with fractures have normal BMD. Therefore, in order to determine the risk of fracture development, it is necessary to determine both BMD and BMD-independent risk factors. For this purpose, Kanis et al. (5) investigated risk factors independent of BMD and their predictive values in 12 international studies involving 60,000 people. the World Health Organization Fracture Risk Assessment Tool (WHO-FRAX) was developed to calculate the 10-year probability of hip fracture and any major osteoporotic fracture, taking into account femoral neck BMD and clinical risk factors (5).

In recent years, the association of osteoporosis or osteopenia and sarcopenia has been called "osteosarcopenia" and the prevalence rates of osteosarcopenia in individuals aged ≥65 years vary between approximately 5-37% (6). Both sarcopenia and osteoporosis are chronic diseases that occur for many reasons and varying results and can be seen more in the elderly than in young adults. It can result in frailty, a decrease in QOL, a decrease in mobility and functional independence, deterioration in the immune system, deterioration in respiratory functions, falls, disability, loss of strength, and sometimes death (3,7,8). Since this condition causes a serious global public health problem by placing a significant clinical and economic burden on society, identifying these individuals who may be vulnerable to the negative consequences of musculoskeletal aging is important from a clinical and public health perspective. Therefore, in our study, we aimed to determine the relationship between sarcopenia and fracture risk in older adults and to investigate the effects of increased fracture risk in sarcopenic individuals on fall risk, fear of falling, kinesiophobia, and QOL.

Materials and Methods

Study Participants

This study is a descriptive cross-sectional study conducted at Kütahya Health Sciences University, Evliya Çelebi Training and Research Hospital Physical Medicine and Rehabilitation Clinic between 1 May and 30 July 2023. All data were collected by the same evaluator at the same facility.

This study included 132 independently ambulatory individuals over the age of 65 who applied to the physical medicine and rehabilitation outpatient clinics of our hospital, whose sarcopenia risk was evaluated with the SARC-F questionnaire, and whose BMD was measured in the last 6 months. Those who refused to participate in the study, those with vestibular system disease, uncontrolled hypertension and diabetes, those with severe cognitive impairment, fully dependent or semi-dependent patients, those with advanced cerebrovascular, cardiovascular and rheumatological diseases, and those with abnormalities in blood tests that could cause loss of balance were excluded from the study.

All individuals' blood tests performed in the last 3 months and BMD measurements with dual-energy X-ray absorptiometry in the last 6 months were evaluated. In blood tests, vitamin D, vitamin B12, parathyroid hormone, calcium, albumin, and total protein levels, which are effective on sarcopenia, osteoporosis, and balance, were measured.

Before being included in the study, all individuals signed the informed consent form stating that they participated in the study voluntarily, and ethical approval was received from the Kütahya Health Sciences University Non-interventional Clinical Research Ethics Committee (decision no: 2023/01-20, dated: 11.01.2023).

Assessment of Fracture Risk

The fracture risk of all patients whose BMD was measured in the last 6 months was calculated using WHO-FRAX. The risk of fractures varies significantly across different parts of the world. Therefore, FRAX is calibrated to countries where the epidemiology of fractures and deaths is known. A FRAX model for Turkey has been available since 2008. However, in 2012, it has been updated to include newer fracture and death rates (9). FRAX® is a web-based algorithm that calculates the 10-year probability of experiencing a hip fracture and major osteoporotic fracture (hip, clinical vertebra, wrist, proximal humerus). According to the FRAX calculation table, individuals with a major osteoporotic fracture risk of over 20% and a hip fracture risk of over 3% were evaluated as high fracture risk groups (5).

Assessment of Sarcopenia Risk

In clinical practice, SARC-F is recommended as a screening test to determine the risk of sarcopenia. The SARC-F questionnaire consists of 5 questions based on self-report (strength, walking, getting up from a chair, climbing stairs, and falling). The total score varies between 0-10, and a score of ≥4 indicates a risk of

sarcopenia. SARC-F is one of the best tests that can be used in clinical practice to predict the adverse events that may occur due to sarcopenia (10). The validation of the Turkish version of the SARC-F questionnaire was conducted by Bahat et al. (11).

Questionnaire

Participants filled out surveys consisting of sociodemographic questions, including age, gender, occupation, education level, height, and body weight. In individuals participating in the study, QOL with the World Health Organization Quality of Life Scale Short Form (WHOQoL-Bref) (12,13), presence of kinesiophobia with the TAMPA kinesiophobia scale (14,15), fall risk with the Berg balance scale (16,17) and fear of falling with International Fall Effectiveness scale (18,19) were evaluated.

First of all, the relationship between sarcopenia or fracture risk and QOL, kinesiophobia, fall risk, and fear of falling was evaluated separately in the study population. All patients were then divided into 7 groups:

Group 1: No sarcopenia and fracture risk,
Group 2: Only sarcopenia risk,
Group 3: Only hip fracture risk,
Group 4: Only major fracture risk,
Group 5: Risk of both major fracture and hip fracture,
Group 6: Sarcopenia risk with hip fracture risk,
Group 7: Sarcopenia risk with risk of both major and hip fractures.

With the evaluations between the groups, the relationship between the presence of accompanying fracture risk and QOL, kinesiophobia, fall risk and fear of falling in individuals with and without risk of sarcopenia was evaluated.

Statistical Analysis

Statistical analysis was conducted using SPSS 22.0 (Statistical Package for the Social Sciences 22.0). The normal distribution suitability of the variables was assessed through visual methods such as histograms and probability graphs, as well as analytical methods including the Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics were presented as the mean and standard deviation for numerical data and as numbers and percentages for nominal data. For numerical variables exhibiting a normal distribution between two groups, the "independent samples t-test" was employed. In cases where numerical variables did not display a normal distribution, the "Mann-Whitney U test" was utilized. For numerical variables demonstrating a normal distribution among three groups or more, analysis was performed using "ANOVA (Analysis of Variance)". Conversely, numerical variables not adhering to a normal distribution were subjected to the "Kruskal-Wallis H test". The nominal data was compared using the "chi-square test". Correlation analyses were conducted using the "Pearson correlation test" for numerical variables with a normal distribution, and the "Spearman correlation test" for numerical variables lacking a normal distribution. A significance level of $p<0.05$ was considered statistically significant in the study's analysis.

Results

Relationship Between Sarcopenia Risk and Data

One hundred thirty two individuals, 102 women (77.3%) and 30 men (23.7%), were included in the study. The average age of the individuals participating in the study was 70.83±6.98. There was a risk of sarcopenia in 72 (55.5%) of the study population. No statistically significant relationship was found between demographic data in individuals with and without risk of sarcopenia. The data are given in Table 1.

No statistically significant relationship was found between the risk of sarcopenia, and kinesiophobia and fall risk. A statistically significant relationship and a moderate positive correlation were found between the risk of sarcopenia and fear of falling (rho value: 0.491). A statistically significant relationship and moderate negative correlation were found at risk of sarcopenia and in all domains of QOL (total, physical health, psychological well-being, social relationships, environment health) (rho values respectively -0.382, -0.435, -0.381, -0.386, -0.435). The data are given in Table 2.

Table 1. Relationship between sarcopenia risk and demographic data

	Total n=132 (100%)		Without sarcopenia n=60 (45.5%)		With sarcopenia n=72 (55.5%)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
Gender							0.324#
Female	102 (77.3%)		44 (73.3%)		58 (80.6%)		
Male	30 (22.7%)		16 (26.7%)		14 (19.4%)		
Age		70.83±6.98		70.20±6.22		71.36±7.56	0.533¥
Height (cm)		159.62±8.28		160.27±8.51		159.08±8.11	0.416*
Body weight (kg)		73.14±11.51		72.93±10.37		72.93±10.37	0.826¥
BMI (kg/m^2)		28.78±4.71		28.46±4.05		29.05±5.21	0.470¥
Under ideal weight (<18.5)	2 (1.5%)		0 (0%)		2 (2.8%)		0.490#
Normal (ideal) (18.5-24.9)	26 (19.7%)		14 (23.3%)		12 (16.7%)		

Table 1. Continued

	Total n=132 (100%)		Without sarcopenia n=60 (45.5%)		With sarcopenia n=72 (55.5%)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
Overweight (25.0-29.9)	52 (39.4%)		22 (36.7%)		30 (41.7%)		
First degree obesity (30.0-34.9)	42 (31.8%)		20 (33.3%)		22 (30.6%)		
Second degree obesity (35.0-39.9)	8 (6.1%)		4 (6.7%)		4 (5.6%)		
Third degree obesity (>40.0)	2 (1.5%)		0 (0%)		2 (2.8%)		
Education level							0.254#
Unschooled-literate	24 (18.2%)		8 (13.3%)		16 (22.2%)		
Primary/middle school	92 (69.7%)		44 (73.4%)		48 (66.7%)		
High school	14 (10.6%)		8 (13.3%)		6 (8.3%)		
University	2 (1.5%)		0 (0%)		2 (2.8%)		
Occupation							0.211#
Housewife	90 (68.2%)		38 (63.3%		52 (72.2%)		
Desk worker	2 (1.5%)		2 (3.3%)		0 (0%)		
Retired	40 (30.3%)		20 (33.4%)		20 (27.8%)		

Data presented as mean (± SD) or number (n/%) of patients. BMI: Body mass index, cm: Centimeter, m: Meter, kg: Kilogram, SD: Standard deviation. The p-value refers to the difference between the groups. P<0.05 statistically significant. *Independent samples t-test, #chi-square test, ¥Mann-Whitney U test

Table 2. Relationship between sarcopenia risk and kinesiophobia, balance and fall risk and quality of life

	Total n=132 (100%)		Without sarcopenia n=60 (45.5%)		With sarcopenia n=72 (55.5%)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
TSK		41.23±9.05		40.43±8.99		41.89±9.12	0.431¥
FES-I		29.53±10.60		28.70±10.49		30.22±10.72	0.309¥
BBS		45.86±8.71		50.83±5.38		41.72±8.82	**<0.001¥**
High fall risk (>21)	0 (0%)		0 (0%)		0 (0%)		**<0.001#**
Medium fall risk (21-40)	34 (25.8%)		4 (6.7%)		30 (41.7%)		
Low fall risk (41-56)	98 (34.2%)		56 (93.3%)		42 (58.3%)		
WHOQoL-BREF							
Total		54.55±19.37		61.67±21.82		48.61±14.77	**<0.001¥**
PH		50.54±20.34		60.11±19.15		42.55±17.79	**<0.001¥**
PS		59.40±18.85		66.94±19.47		53.12±15.89	**<0.001¥**
SR		65.53±18.98		71.94±19.22		60.18±17.14	**<0.001¥**
EH		69.41±15.87		76.98±14.08		63.11±14.53	**<0.001¥**

Data presented as mean (± SD) or number (n/%) of patients. BBS: Berg balance scale, EH: Environment health, FES-I: Falls Efficacy Scale-International, PH: Physical health, PS: Psychological well-being, SD: Standard deviation, SR: Social relationships, TSK: TAMPA scale for kinesiophobia, WHOQoL: World Health Organization Quality of Life Scale Brief Version. The p-value refers to the difference between the groups. P<0.05 statistically significant. #Chi-square test, ¥ Mann-Whitney U test

Of the 72 individuals at risk of sarcopenia, 24 (33.3%) had only a hip fracture risk, and 16 (22.2%) had both a hip and major fracture risk. A statistically significant and low-level positive correlation was found between the risk of sarcopenia and the risk of major osteoporotic fracture and hip fracture (p-values respectively <0.01, 0.014; rho values respectively 0.277, 0.298). The risk of sarcopenia was significantly higher in individuals with both major fracture and hip fracture risk compared to individuals without fracture risk and with only hip fracture risk.

Relationship Between Fracture Risk and Data

Of the study population, 66 (50%) were at risk of fracture, including 48 (36.4%) at risk of only hip fracture and 18 (13.6%) at risk of both major fracture and hip fracture. Considering the demographic data, while the risk of major fracture was significantly higher in the female gender, no statistically significant relationship was found between the risk of hip fracture and gender (p-values respectively <0.01, 0.678). It has been observed that the risk of fracture increases with age. In particular, a statistically significant relationship and a moderate positive correlation were found between age and hip fracture risk (p-value <0.001, rho value 0.528). There is a statistically significant negative correlation between fracture risk and height, body weight, and body mass index (BMI) (rho values respectively -0.266, -0.371, -0.380). Especially in shorter individuals, the risk of both hip and major fractures was significantly higher. There was a statistically significant low negative correlation between education level and risk of major fracture and hip fracture (rho values respectively -0.098, -0.077). No statistically significant relationship was found between occupation and fracture risk. Data are given in Table 3.

While there was no statistically significant relationship between fracture risk, and kinesiophobia, and fall risk, there was a significant positive correlation was found fear of falling (rho value 0.206). Especially in individuals at risk of hip fracture, fear of falling was significantly higher. When we look at relationship between the risk of fracture and the QOL, while there was no significant the total, social relationships, environment health domains, there was a significant negative correlation the physical health and psychological well-being domains (rho values respectively -0.231, -0.215). Data are given in Table 4.

Table 3. Relationship between fracture risk and demographic data

	Total (n=132)		**No risk of fracture (n=66)**		**Risk of hip fracture (n=48)**		**Risk of major fracture and hip fracture (n=18)**		**p-value**
	n (%)	**Mean ± SD**	**n (%)**	**Mean ± SD**	**n (%)**	**Mean ± SD**	**n (%)**	**Mean ± SD**	
Gender									**0.039#**
Female	102 (77.3%)		50 (49%)		34 (33.4%)		18 (17.6%)		
Male	30 (22.7)		16 (53.3%)		14 (49.7%)		0 (0%)		
Age		70.83±6.98		67.27±5.49		74.88±6.07		73.11±7.57	**<0.001¥**
Height (cm)		159.62±8.28		161.61±5.61		158.54±11.03		155.22±5.71	**<0.01***
Body weight (kg)		73.14±11.51		77.61±9.06		70±11.16		65.11±13.73	**<0.001¥**
BMI (kg/m^2)		28.78±4.71		29.80±3.89		28.01±5.01		27.08±5.91	**0.012¥**
Under ideal weight (<18.5)	2 (1.5%)		0 (0%)		0 (0%)		2 (100%)		**<0.001#**
Normal (ideal) (18.5-24.9)	26 (19.7%)		6 (23.1%)		14 (53.8%)		6 (23.1%)		
Overweight (25.0-29.9)	52 (39.4%)		28 (53.8%)		22 (42.3%)		2 (3.8%)		
First degree obesity (30.0-34.9)	42 (31.8%)		28 (66.7%)		6 (14.3%)		8 (19%)		
Second degree obesity (35.0-39.9)	8 (6.1%)		4 (50%)		4 (50%)		0 (0%)		
Third degree obesity (>40.0)	2 (1.5%)		0 (0%)		2 (100%)		0 (0%)		

Table 3. Continued

	Total (n=132)		No risk of fracture (n=66)		Risk of hip fracture (n=48)		Risk of major fracture and hip fracture (n=18)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
Education level									**<0.00[1#]**
Unschooled-literate	24 (18.2%)		8 (33.3%)		10 (41.7%)		6 (25%)		
Primary/ middle school	92 (69.7%)		54 (58.7%)		32 (34.8%)		6 (6.5%)		
High school	14 (10.6%)		4 (28.6%)		6 (42.9%)		4 (28.6%)		
University	2 (1.5%)		0 (0%)		0 (0%)		2 (100%)		
Occupation									0.589[#]
Housewife	90 (68.2%)		44 (48.9%)		32 (35.6%)		14 (15.6%)		
Desk worker	2 (1.5%)		2 (100%)		0 (0%)		0 (0%)		
Retired	40 (30.3%)		20 (50%)		16 (36.4%)		4 (13.6%)		

Data presented as mean (± SD) or number (n/%) of patients. BMI: Body mass ındex, cm: Centimeter, m: Meter, kg: Kilogram, SD: Standard deviation. The p-value refers to the difference between the groups. P<0.05 statistically significant. *ANOVA, #chi-square test, ¥ Kruskal-Wallis H test

Table 4. Relationship between fracture risk and kinesiophobia, balance and fall risk and quality of life

	Total (n=132)		No risk of fracture (n=66)		Risk of hip fracture (n=48)		Risk of major fracture and hip fracture (n=18)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
TSK		41.23±9.05		40.12±9.05		42.67±9.72		41.44±6.87	0.121[¥]
FES-I		29.53±10.60		27.94±11.02		32.00±10.00		28.78±9.86	**0.033[¥]**
BBS		45.86±8.71		46.61±7.98		46.13±13.16		42.44±9.72	0.172[¥]
High fall risk (>21)	0 (0%)		0 (0%)		0 (0%)		0 (0%)		0.138[#]
Medium fall risk (21-40)	34 (25.8%)		12 (18.8%)		16 (33.3%)		6 (33.3%)		
Low fall risk (41-56)	98 (34.2%)		54 (81.2%)		32 (66.7%)		12(66.7%)		
WHOQoL-BREF									
Total		54.55±19.37		55.30±17.27		53.64±22.91		54.16±17.14	0.892[¥]
PH		50.54±20.34		50.96±17.29		54.31±24.01		38.88±16.29	**0.023[¥]**
PS		59.40±18.85		60.35±15.40		61.80±22.98		49.53±15.71	**0.044[¥]**
SR		65.53±18.98		65.14±18.77		65.27±17.13		67.58±24.73	0.741[¥]
EH		69.41±15.87		68.74±13.31		70.96±16.77		67.70±21.75	0.651[¥]

BBS: Berg balance scale, EH: Environment health, FES-I: Falls Efficacy Scale-International, PH: Physical health, PS: Psychological well-being, SD: Standard deviation, SR: Social relationships, TSK: TAMPA scale for kinesiophobia, WHOQoL: World Health Organization Quality of Life Scale Brief Version. #Chi-square test, ¥Kruskal-Wallis H test

Relationship Between Sarcopenia Risk with Fracture Risk and Data

The patients were evaluated by dividing them into 7 groups according to the presence of sarcopenia and fracture risk. There was a statistically significant relationship between groups and gender. The association of sarcopenia and fracture risk was significantly higher in the female gender. Additionally, in the group with sarcopenia risk with both major and hip fracture risk (group 7), there was only female gender. It was observed that there was a statistically significant relationship and a moderate positive correlation between the groups and age (rho value 0.446). In particular, the mean age was significantly higher in the group with only hip fracture risk (group 3), in the group with sarcopenia risk and hip fracture risk (group 6), and in the group with sarcopenia risk and risk of both hip and major fracture (group 7). A statistically significant negative correlation was found between the groups and body weight and BMI (rho values respectively -0.285, -0.182). Especially in the group with sarcopenia risk and risk of both hip and major fracture (group 7), body weight was significantly lower compared to the other groups. A statistically significant relationship and low negative correlation were found between groups and education level (rho value -0.041). No statistically significant relationship was found between groups and occupation. Data are given in Table 5. A statistically significant relationship and positive correlation were found between the groups and kinesiophobia (rho value 0.153). A statistically significant relationship and positive correlation were found between the groups and the fear of falling and fall risk (rho values respectively 0.278, 0.274). Compared with other groups, the fear of falling was significantly higher in the group with only hip fracture risk (group 3), and the fall risk was significantly higher in the group with sarcopenia risk and hip fracture risk (group 6). A statistically significant relationship and low negative correlation were found between the groups and all domains of QOL (total, physical health, psychological well-being, social relationships, environment health) (rho values respectively -0.177, -0.194, -0.187, -0.154, -0.132). In comparisons between groups, the QOL total score was significantly lower in the group with sarcopenia risk and hip fracture risk (group 6). The physical health and psychological well-being scores were significantly lower in the group with only sarcopenia risk (group 2), in the group with sarcopenia risk and hip fracture (group 6), and in the group with sarcopenia risk and both major and hip fractures (group 7). The social relationship score was significantly lower in the group with only major fracture risk (group 4) and the group with sarcopenia + only hip fracture (group 6). The environment health score was significantly lower in the group with sarcopenia risk and hip fracture risk (group 6). Data are given in Table 6.

Discussion

The functions of muscle and bone tissues are closely related due to common mechanical and molecular mechanisms. The mechanical interaction between muscle and bone is described by the "mechanostat" theory, which states that muscles apply mechanical forces to bones. According to this theory, if these forces exceed a set threshold, the balance of bone turnover shifts from bone resorption in favor of bone formation. In this case, increases in muscle mass enhance bone mass and durability by intensifying tension on the bone (20).

Osteoporosis and sarcopenia have common risk factors, including aging, gender, physical inactivity, and decreases in certain vitamins and specific hormones (20). From the sixth decade of life, BMD decreases by 1-1.5% and muscle mass by 1% annually. This condition increases the risk of developing diseases such as osteoporosis and sarcopenia by two-fold (6). Studies have shown that osteoporosis increases the risk of sarcopenia, and, in addition, sarcopenia increases the risk of osteoporosis (6,20-22). The prevalence of sarcopenia is estimated to range from 5-13% in adults aged 60-70, increasing to 11-50% in those over 80 years old (23). In our study, it was observed that 55.5% of the study population had a risk of sarcopenia as assessed by SARC-F. We can state that, in our study, a higher prevalence was obtained compared to the literature because the presence of sarcopenia was not evaluated according to the criteria determined by EWGSOP, and the study population consisted of individuals over the age of 65.

A study evaluating 288 elderly individuals showed that sarcopenic individuals had a fourfold higher risk of concomitant osteoporosis compared to non-sarcopenic individuals (24). In another study, it was reported that individuals with sarcopenia had lower BMD values compared to those without sarcopenia (25). The prevalence of osteosarcopenia was found to be 14.3% in men aged 60-64 and 59.4% in men over the age of 75. In women, the prevalence was found to be 20.3% for those between the ages of 60-64 and 48.3% for those over the age of 75 (26). Reiss et al. (27) reported that osteoporosis is more prevalent in sarcopenic individuals (51.3%) compared to non-sarcopenic individuals (21.6%). In addition, in the Hertfordshire cohort study, the presence of sarcopenia in community-dwelling older individuals was shown to be associated with a higher prevalence of fractures (28). In our study, 40 individuals (30.30%) in the study population were identified to have both sarcopenia risk and fracture risk. Among these, 24 individuals (18.18%) were at risk for sarcopenia and hip fracture, and 16 individuals (12.12%) were at risk for sarcopenia, major fracture, and hip fracture.

Relationship Between Sarcopenia Risk and Data

Older postmenopausal women are at a higher risk of both osteoporosis and sarcopenia due to the diminished protective role of estrogens in musculoskeletal homeostasis (29). For this reason, women experience a more substantial and rapid decline in both bone and muscle performance compared to men. Studies have shown that sarcopenia is more common in female gender (26,27,29), and and that there is a positive correlation between age and sarcopenia prevalence (30-32). In our study, unlike the literature, no significant relationship

Table 5. Relationship between sarcopenia risk with fracture risk and demographic data

	Total (n=132)		Group 1 (n=30)		Group 2 (n=30)		Group 3 (n=24)	
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD
Gender								
Female	102 (77.3%)		26 (86.7%)		20 (66.7%)		14 (58.3%)	
Male	30 (22.7%)		4 (13.3%)		10 (33.3%)		10 (41.7%)	
Age		70.83±6.98		66.53±3.84		68.8±6.78		74.75±6.1
Height (cm)		159.62±8.28		160.8±4.54		162.07±5.8		159.5±12.35
Body weight (kg)		73.14±11.51		75.07±8.44		80±9.97		67.5±10.62
BMI (kg/m^2)		28.78±4.71		29.11±3.81		30.53±4.06		26.62±3.87
Under ideal weight (<18.5)	2 (1.5%)		0 (0%)		0 (0%)		0 (0%)	
Normal (ideal) (18.5-24.9)	26 (19.7%)		4 (13.3%)		2 (6.7%)		10 (41.7%)	
Overweight (25.0-29.9)	52 (39.4%)		12 (40%)		12 (40%)		10 (41.7%)	
First degree obesity (30.0-34.9)	42 (31.8%)		12 (40%)		14 (46.7%)		2 (8.3%)	
Second degree obesity (35.0-39.9)	8 (6.1%)		2 (6.7%)		2 (6.7%)		2 (8.3%)	
Third degree obesity (>40.0)	2 (1.5%)		0 (0%)		0 (0%)		0 (0%)	
Education level								
Unschooled-literate	24 (18.2%)		0 (0%)		8 (26.7%)		6 (25%)	
Primary/middle school	92 (69.7%)		30 (100%)		20 (66.7%)		12 (50%)	
High school	14 (10.6%)		0 (0%)		2 (6.7%)		6 (25%)	
University	2 (1.5%)		0 (0%)		0 (0%)		0 (0%)	
Occupation								
Housewife	90 (68.2%)		22 (73.3%)		18 (60%)		14 (58.3%)	
Desk worker	2 (1.5%)		2 (6.7%)		0 (0%)		0 (0%)	
Retired	40 (30.3%)		6 (20%)		12 (40%)		10 (41.7%)	

Table 5. Continued

	Group 4 (n=6)		Group 5 (n=2)		Group 6 (n=24)		Group 7 (n=16)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
Gender									0.024#
Female	4 (66.7%)		2 (100%)		20 (83.3%)		16 (100%)		
Male	2 (33.3%)		0 (0%)		4 (16.7%)		0 (0%)		
Age		66.33±2.25		73±7.07		75±6.17		73.75±7.81	<0.001¥
Height (cm)		163.33±9.31		158.5±4.95		157.58±9.7		155.25±6.08	0.085*
Body weight (kg)		78.33±1.86		76.5±2.12		72.5±11.35		63.5±13.74	<0.001¥
BMI (kg/m^2)		29.6±3.35		30.56±2.74		29.41±5.68		26.42±5.94	0.011¥
Under ideal weight (<18.5)	0 (0%)		0 (0%)		0 (0%)		2 (12.5%)		<0.01#
Normal (ideal) (18.5-24.9)	0 (0%)		0 (0%)		4 (16.7%)		6 (37.5%)		
Overweight (25.0-29.9)	4 (66.7%)		0 (0%)		12 (50%)		2 (12.5%)		
First degree obesity (30.0-34.9)	2 (33.3%)		2 (%100)		4 (16.7%)		6 (37.5%)		
Second degree obesity (35.0-39.9)	0 (0%)		0 (0%)		2 (8.3%)		0 (0%)		
Third degree obesity (>40.0)	0 (0%)		0 (0%)		2 (8.3%)		0 (0%)		
Education level									<0.001#
Unschooled-literate	0 (0%)		0 (0%)		4 (16.7%)		6 (37.5%)		
Primary/middle school	4 (66.7%)		0 (0%)		20 (83.3%)		6 (37.5%)		
High school	2 (33.3%)		2 (100%)		0 (0%)		2 (12.5%)		
University	0 (0%)		0 (0%)		0 (0%)		2 (12.5%)		
Occupation									0.113#
Housewife	4 (66.7%)		0 (0%)		18 (75%)		14 (87.5%)		
Desk worker	0 (0%)		0 (0%)		0 (0%)		0 (0%)		
Retired	2 (33.3%)		2 (100%)		6 (25%)		2 (12.5%)		

Data presented as mean (± SD) or number (n/%) of patients. BMI: Body mass index, cm: Centimeter, m: Meter, kg: Kilogram, SD: Standard deviation. The p-value refers to the difference between the groups. P<0.05 statistically significant. Group 1= No sarcopenia and fracture risk, group 2= only sarcopenia risk, group 3= only hip fracture risk, group 4= only major fracture risk, group 5= risk of both major fracture and hip fracture, group 6= sarcopenia risk with hip fracture risk, group 7= sarcopenia risk with risk of both major and hip fractures. *ANOVA, #chi-square test, ¥Kruskal-Wallis H test

Table 6. Relationship between sarcopenia risk with fracture risk and kinesiophobia, balance and fall risk, and quality of life

	Total (n=132)		Group 1 (n=30)		Group 2 (n=30)		Group 3 (n=24)	
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD
TSK		41.23±9.05		37.13±6.90		42.53±10.5		44.42±9.44
FES-I		29.53±10.60		24.73±8.59		30.4±11.66		34±10.53
BBS		45.86±8.71		50.20±5.29		42.67±9.01		51.83±5.9
High fall risk (>21)	0 (0%)		0 (0%)		0 (0%)		0 (0%)	
Medium fall risk (21-40)	34 (25.8%)		2 (6.7%)		(33.3%)		2 (8.3%)	
Low fall risk (41-56)	98 (34.2%)		28 (93.3%)		20 (66.7%)		22 (91.7%)	
WHOQoL-BREF								
Total		54.55±19.37		59.17±19.95		53.33±13.51		62.5±25.54
PH		50.54±20.34		51.19±14.93		47.62±17.22		70.53±18.49
PS		59.40±18.85		61.11±15.14		57.5±16.25		73.61±23.97
SR		65.53±18.98		67.77±19.30		66.11±17.9		73.61±18.66
EH		69.41±15.87		71.25±12.67		66.04±14.49		82.29±12.92

was found between the risk of sarcopenia and gender or age. Studies have found conflicting results regarding the relationship between BMI and sarcopenia, osteoporosis, and osteosarcopenia. Some studies have indicated that the risk of sarcopenia is elevated in older adults with a low BMI, and BMI tends to be lower in sarcopenic women (33,34). In our study, no significant relationship was found between the risk of sarcopenia and height, weight, and BMI.

Increased systemic inflammation and oxidative stress have been found in sarcopenic individuals, which are associated with decreased endurance and strength of both muscle and bone tissue (35). Several studies have shown that sarcopenia is an independent predictive factor not only for increased fracture risk but also for BMD and other clinical conditions. Additionally, there is an association between sarcopenia, fall risk, and osteoporotic fractures (4,28,36-40). In a study, it was reported that patients with severe sarcopenia experienced a higher risk of falls secondary to impairment in both static and dynamic balance, and there was an increased occurrence of multiple fractures (41). In our study, it has been found that the risk of falls increases in individuals at risk of sarcopenia.

Eguchi et al. (42) reported that sarcopenia impaired the QOL by causing spinal deformity resulting from decreased muscle mass. Miyakoshi et al. (43) concluded that the poor QOL of osteoporosis patients may be related to spinal alignment deformity due to general muscle weakness. In studies, QOL was found to be significantly lower in sarcopenic individuals, in particular, it was found that the physical function domain of QOL was impaired (44,45). In a study evaluating the QOL with the SarQoL questionnaire, it was observed that physical and mental health, functionality, daily living activities, fears, and total SarQoL scores were significantly lower in women with definite sarcopenia than in women with probable sarcopenia (32). In our study, similar to the literature, it was observed that there was a decrease in all domains of QOL (total, physical health, psychological well-being, social relationships, and environment health) in individuals at risk of sarcopenia.

Relationship Between Fracture Risk and Data

In our study, it was observed that the risk of fractures is higher in the female gender, and this risk increases with age. When we look at the studies conducted, we see similar results (26,27,29-32) Looking at the relationship between fracture risk and BMI, a low BMI is considered a risk factor for low BMD and fragility fractures (46). Studies also suggest that obesity may act as a protective factor against bone loss (47,48). On the contrary, there are also studies showing that the risk of fractures increases in overweight and obese individuals (48,49). In our study, it was found that low BMI, height and body weight were associated with an increased risk of fracture.

Table 6. Continued

	Group 4 (n=6)		Group 5 (n=2)		Group 6 (n=24)		Group 7 (n=16)		p-value
	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	n (%)	Mean ± SD	
TSK		43±7.09		43.05±2.12		40.92±9.87		41±7.19	**<0.01¥**
FES-I		31.67±15.81		20.5±2.11		30±9.22		30±9.79	**0.014¥**
BBS		48.33±4.5		51.5±2.12		40.42±8.29		41.12±9.51	**<0.001¥**
High fall risk (>21)	0 (0%)		0 (0%)		0 (0%)		0 (0%)		**<0.001#**
Medium fall risk (21-40)	0 (0%)		0 (0%)		14 (58.3%)		6 (37.5%)		
Low fall risk (41-56)	6 (100%)		2 (100%)		10 (41.7%)		10 (62.5%)		
WHOQoL-BREF									
Total		45.83±17.08		76.36±15.76		44.79±16.03		50±12.91	**<0.01¥**
PH		66.66±22.66		55.79±1.9		38.09±16.94		36.6±15.84	**<0.001¥**
PS		70.83±6.46		67.79±10.38		44.99±14.64		46.35±13.51	**<0.001¥**
SR		47.22±11.39		81.05±14.99		56.94±10.32		64.58±24.62	**<0.001¥**
EH		69.79±8.54		87.05±9.39		59.63±11.83		63.67±19.49	**<0.001¥**

BBS: Berg balance scale, EH: Environment health, FES-I: Falls Efficacy Scale-International, PH: Physical health, PS: Psychological well-being, SD: Standard deviation, SR: Social relationships, TSK: TAMPA scale for kinesiophobia, WHOQoL: World Health Organization Quality of Life Scale Brief Version. Group 1= no sarcopenia and fracture risk, group 2= only sarcopenia risk, group 3= only hip fracture risk, group 4= only major fracture risk, group 5= risk of both major fracture and hip fracture, group 6= sarcopenia risk with hip fracture risk, group 7= sarcopenia risk with risk of both major and hip fractures. #Chi-square test, ¥Kruskal-Wallis H test

Falls and fractures secondary to age-related deterioration of the musculoskeletal system are common in older individuals and can significantly reduce both QOL and the ability to perform activities of daily living. In a study, it has been stated that older osteoporotic postmenopausal women with a history of falls have lower scores in the domains of physical and mental health, functionality, and daily living activities (32). In our study, it was observed that individuals at an increased risk of both major fractures and hip fractures exhibited lower QOL scores in the domains of physical health and psychological well-being.

Relationship Between Sarcopenia Risk with Fracture Risk and Data

Studies have demonstrated that osteosarcopenia is more prevalent in women (26,27,29), and the prevalence of both sarcopenia and osteosarcopenia increases with age (30-32). In our study, similar to the literature, it was observed that the relationship between sarcopenia risk and fracture risk was significantly higher in female gender, and both the fracture risk and the relationship between sarcopenia risk and fracture risk increased with age. In a study, it was stated that sarcopenic, osteoporotic, and osteosarcopenic individuals had lower BMI compared to healthy controls and that BMI was lowest in osteosarcopenic people (27). In addition, studies have shown that the risk of developing sarcopenia is significantly reduced in osteoporotic postmenopausal women with a higher BMI (32,50). The conflicting results on the relationship between BMI and osteosarcopenia may be due to individual differences between muscle mass and body weight components (body fat and lean mass). In our study, it was found that both the risk of fracture and the combination of sarcopenia risk and fracture risk were associated with low BMI and body weight. In the literature, we could not find any study that evaluated the relationship between education level and sarcopenia, fracture risk, and osteosarcopenia. In our study, we concluded that both the risk of fracture and the combination of sarcopenia risk and fracture risk are higher in those with lower education levels. This may be related to increased awareness and economic status related to education level.

Osteoporosis and sarcopenia are independent risk factors for fractures and falls, and individuals with both sarcopenia and osteoporosis are at a significantly higher risk of experiencing falls, fractures, and hospitalizations (8). In addition, individuals with osteosarcopenia were found to have significantly higher rates of physical dysfunction, fall risk, fracture risk, and mortality than patients with osteoporosis or sarcopenia alone (8,41,51-53). In a study, it was reported that there was no difference in fracture risk between patients with osteoporosis and osteopenia. However, in patients with osteosarcopenia and severe sarcopenia, both static and dynamic balance were lower, the risk of falling was higher,

and there was a greater association with multiple fractures (41). In our study, it was observed that the fear of falling and fall risk increased in individuals with sarcopenia risk and fracture risk, and was significantly higher, especially in individuals with only hip fracture risk and in individuals with both sarcopenia risk and hip fracture risk.

In our study, the relationship between sarcopenia risk and fracture risk and kinesiophobia was evaluated. In the literature, no study on this could be found. However, studies evaluating the relationship between fracture risk and physical activity level have shown that physical activity prevents bone loss, and leads to improvements in muscle mass and physical performance. In addition, it has been stated that long-term immobilization is associated with decreased BMD and increased fracture risk (6,54,55). In a meta-analysis evaluating 14 prospective studies, it was stated that there was a significant negative relationship between increasing physical activity levels and the risk of hip fracture in older women (56). While no relationship was found between sarcopenia risk or fracture risk and kinesiophobia in our study, it was observed that kinesiophobia was higher in individuals with sarcopenia risk and fracture risk. These individuals may experience a decrease in physical activity levels secondary to kinesiophobia, which may lead to an increase in the risk of fracture.

Studies have shown that the QOL is low in osteoporotic patients with sarcopenia, and that age, fall history, and the presence of sarcopenia have a significant impact on the general QOL of postmenopausal osteoporotic women (22,32,57). In a study, it was stated that the physical and mental health, body composition, functionality, leisure activities, and total SarQoL scores of osteoporotic postmenopausal women with sarcopenia over the age of 70 were significantly lower than those of younger women (32). In our study, it has been observed that there is an impairment in all domains of QOL with the increase in the risk of sarcopenia accompanying the increase in fracture risk. In particular, impairment was evident in all domains of QOL in individuals at risk of sarcopenia and hip fracture, and in physical health and psychological well-being in individuals at risk of sarcopenia and both major and hip fractures.

Study Limitations

Our study has some limitations. This was a cross-sectional study conducted at a single center. In the sarcopenia evaluation, data obtained from the SARC-F survey were used, but the criteria determined by EWGSOP were not used.

Conclusion

In our study, it was observed that in older adults, the association of increased sarcopenia risk and fracture risk is more common in women, the risk increases with age and is associated with lower QOL and, higher fall risk, fear of falling and kinesiophobia. Appropriate treatment and early intervention of these conditions in sarcopenic individuals with increased fracture risk may provide a clinical benefit to reduce the risk of falls and fractures and improve QOL. Recent studies evaluating both the epidemiology of osteosarcopenia and its relationship with fracture risk, fall risk, and QOL will contribute to the development of future interventions and therapeutics to maintain the independence of older people.

Ethics

Ethics Committee Approval: Ethical approval was received from the Kütahya Health Sciences University Non-interventional Clinical Research Ethics Committee (decision no: 2023/01-20, dated: 11.01.2023).

Informed Consent: Before being included in the study, all individuals signed the informed consent form stating that they participated in the study voluntarily.

Authorship Contributions

Surgical and Medical Practices: H.T., Ç.Ö., Concept: H.T., Ç.Ö., Design: H.T., Ç.Ö., Data Collection or Processing: H.T., Ç.Ö., Analysis or Interpretation: H.T., Ç.Ö., Literature Search: H.T., Writing: H.T.

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Effect of L-carnitine on Bone Strength: An Experimental Study

L-karnitinin Kemik Gücü Üzerindeki Etkisi: Deneysel Çalışma

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Abstract

Objective: Decreased bone density and strength increase the risk of fracture and thus the rates of morbidity and mortality. L-carnitine (LC) is a supplement commonly used by individuals who participate in sports, especially to increase muscle mass. The aim of this study was to investigate the effect of LC on bone strength.
Materials and Methods: In our main study 10 male Wistar rats per group, a tendon injury model was applied by clamping the left Achilles tendons of rats except the control group. LC (100 mg/kg/day) was administered intraperitoneally every day for 5 weeks in the pre-LC group and for 4 weeks in the post-LC group. LC was not given to the control group. Apart from to our main study, remaining right os femurs of rats were extracted at the end of the experiment to test bone strength to reduce the number of animals used in scientific research. 3-D bending test was performed on the extracted bones using a Zwick Roell Z0.5 mechanical testing machine.
Results: There were no significant differences among the groups in the parameters and measurements used to evaluate bone strength ($p>0.05$).
Conclusion: LC supplementation had no beneficial or detrimental effects on bone strength in healthy subjects.
Keywords: Femur biomechanics, bone strength, L-carnitine, rat, 3-D bending test

Öz

Amaç: Azalan kemik yoğunluğu ve dayanıklılığı, kırık riskini dolayısıyla morbidite ve mortalite oranını artırmaktadır. L-karnitin (LK), özellikle spor yapan bireylerin kas kitlesini artırmak için yaygın olarak kullandığı takviyelerden biridir. Bu çalışmanın amacı, LK'nin kemik dayanıklılığı üzerine etkisini araştırmaktır.
Gereç ve Yöntem: Her grupta 10 erkek Wistar sıçan bulunan ana çalışmamızda kontrol grubu dışındaki sıçanların sol Achilles tendonlarına klemple tendon injury modeli uygulanmıştır. Pre-LC grubuna 5 hafta, post-LC grubuna 4 hafta boyunca her gün LC (100 mg/kg/gün) intraperitoneal olarak uygulandı. Kontrol grubuna ise LC verilmedi. Ana çalışmamız yanında bilimsel araştırmalarda kullanılan hayvan sayısını azaltmak amacıyla deney sonunda sıçanların sağ os femurları kemik dayanıklılığını test etmek için çıkarıldı. Çıkarılan kemiklere ZwickRoell Z0.5 mekanik test cihazı ile 3-D bükme testi uygulandı.
Bulgular: Kemik dayanıklılığını değerlendirmek için kullanılan parametreler ve ölçümler bakımından gruplar arasında istatistiksel olarak anlamlı bir fark bulunmadı ($p>0,05$).
Sonuç: LC takviyesinin sağlıklı deneklerin kemik dayanıklılığı üzerine yararlı ya da zararlı bir etkisi yoktur.
Anahtar kelimeler: Femur biyomekaniği, kemik dayanıklılığı, L-karnitin, sıçan, 3-D bükme testi

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Introduction

Bone structure deteriorates due to some metabolic reasons and with advancing age, leading to bone fractures. With ageing, the balance between bone formation and destruction is disturbed and osteoblastic activity decreases compared to osteoclastic activity, which leads to loss of bone mass (1). Oxidative stress and mitochondrial dysfunction are closely related to bone strength. A large amount of energy, thus mitochondrial function, is required for the maintenance of bone mass and osteoblastic activity required for bone formation (2). Mitochondrial dysfunction causes excessive production of reactive oxygen species (ROS) (3). L-carnitine (LC), which is an essential cofactor in lipid metabolism, also has antioxidant properties. LC plays an important role in the transport of long-chain fatty acids from the inner mitochondrial membrane to the mitochondrial matrix. Thus, it contributes to energy production through beta oxidation of long-chain fatty acids and prevents oxidative stress (4). Although some studies have suggested that glucose is the main energy source for bone formation, some of them have revealed that osteoblastic cells provide their energy needs mostly by fatty acid oxidation (40-80%) (5,6). A recent *in vitro* study showed that LC increased protein production and metabolic activity of porcine osteoblast cells (7).

Bone strength, which determines bone quality, is related to the size, shape and content of bone. Changes in bone quality directly affect the biomechanical properties of bone. Three-point bending test performed to determine bone quality helps to determine the biomechanical performance of bone in research (8).

Non-pharmacological supportive treatments are sought to increase bone density and strength in order to prevent fractures. There is high tendency to use of supported treatments for well being. However, this unproven belief leads to a considerable economic cost and irrelevant drug use. Most supplements, need more attention of scientific research. The increased popularity of LC supplements is an example of this trend, as people seek natural ways to enhance their well-being. Therefore, the aim of this study is to investigate whether LC supplementation increases bone strength using biomechanical parameters.

Materials and Methods

Our study was carried out in Aydın Adnan Menderes University Faculty of Medicine Experimental Animal Production and Experimental Research Laboratory. The both tendon injury and bone strenght studies were approved by the Aydın Adnan Menderes University for Animal Experiments Local Ethics Committee (approval no: 64583101/2020/100, date: 28.10.2020).

This study was mainly planned to investigate whether LC has a healing power on tendon injury. In order to reducethe use of animals in medicine and to help future studies, the remained right os femurs of the sacrificed rats were taken from three groups to test the bone strength. Thirty male Wistar albino rats weighing 400-530 g at 36 weeks of age were divided into three groups as control group, pre-LC group and post-LC group (n=10). Control group rats were not subjected to any treatment during the study. Pre-LC group and post-LC group rats were injected intraperitoneally with ketamine hydrochloride and xylazine at a dose of 90 mg/kg+10 mg and clamped (non-invasive-ischemic) local tendon injury was performed under anaesthesia. In the pre-LC group rats, 100 mg/kg LC was administered intraperitoneally every day for a total of 5 weeks, starting one week before the injury and continuing for 4 weeks after tendon injury. Post-LC group rats were administered 100 mg/kg LC intraperitoneally every day for a total of 4 weeks after tendon injury. Throughout the study, the weight of the animals was measured and recorded consistently weekly, always on the same day. The right os femurs of the rats sacrificed on the 30^{th} day of tendon injury were dissected from the surrounding tissues and frozen at -20 °C in gauze soaked with saline. The bones were thawed at room temperature before mechanical testing. Then, the lengths of the bones (L) were measured and the midpoint of the bone was marked (Figure 1a, b). The midpoint was determined as the loading point for the three-point bending test. Before the mechanical test, cranio-caudal (Ext_{CrCau}) and medio-lateral (Ext_{ML}) periosteal external diameters were measured (Figure 1c). In the three-point bending test, Zwick Roell Z0.5 mechanical testing machine was used in the Agricultural Biotechnology and Food Safety Application and Research Center of Aydın Adnan Menderes University. For the mechanical test, the support points (span length) were determined as 15 mm, preload as 2N, and strain rate as 1 mm/d. A cranio-caudal load was applied from the midpoint of the bone (Figure 2). After the test, medio-lateral (Int_{ML}) and cranio-caudal (Int_{CrCau}) endosteal internal diameters were measured from the fractured bones. Using the endosteal and periosteal diameters, the cross-sectional moment of inertia of the bones and the two-way corticomedullary index (CMI) were calculated according to the following formula. CMI (%): [(Diaphysis diameter - Medullary canal diameter) / Diaphysis diameter]x100. The stiffness value of the bone was calculated using the force-deformation curve (Figure 3) obtained after mechanical testing. Using the stiffness, moment of inertia (I), bone diameter and distance between the support points, ultimate strength and elastic modulus were calculated by using the formulas specified in the references (9-14).

Statistical Analysis

In the statistical analysis of all the data obtained, normal distribution was checked with the Shapiro-Wilk test. One-Way ANOVA was performed for normally distributed values and Kruskal-Wallis intergroup comparison was performed for non-normally distributed values. In One-Way ANOVA test, Levene's test results for homogenous values were checked with the post-hoc Bonferoni test. For non-homogeneous values, Welch's test results were checked with post-hoc Tamhane test.

Results

The average percentage of weight gain between the 1st and 5th week of the groups was 4.48% in the control group, 2.60% in the pre-LC group and 2.51% in the post-LC group (p>0.05).

The results of bone morphometric measurements and 3-D bending test and the data obtained by using formulae are as presented (Table 1). Accordingly, it was determined that there was no statistically significant difference between the measured and formula calculated parameters between the groups (p>0.05). When the diameter values were analysed, it was noted that the medio-lateral diameter measurement values were larger than the cranio-caudal diameter measurement values in all three groups. This indicates that the corpus section of the bone has an elliptical geometry in the medio-lateral direction. In addition, in contrast to the diameter values, the CMI values were larger in the cranio-caudal direction in all three groups. Although fracture force (Fmax), strength and elastic modulus values were lower in the pre-LC group compared to the other groups, no statistically significant difference was found between the groups.

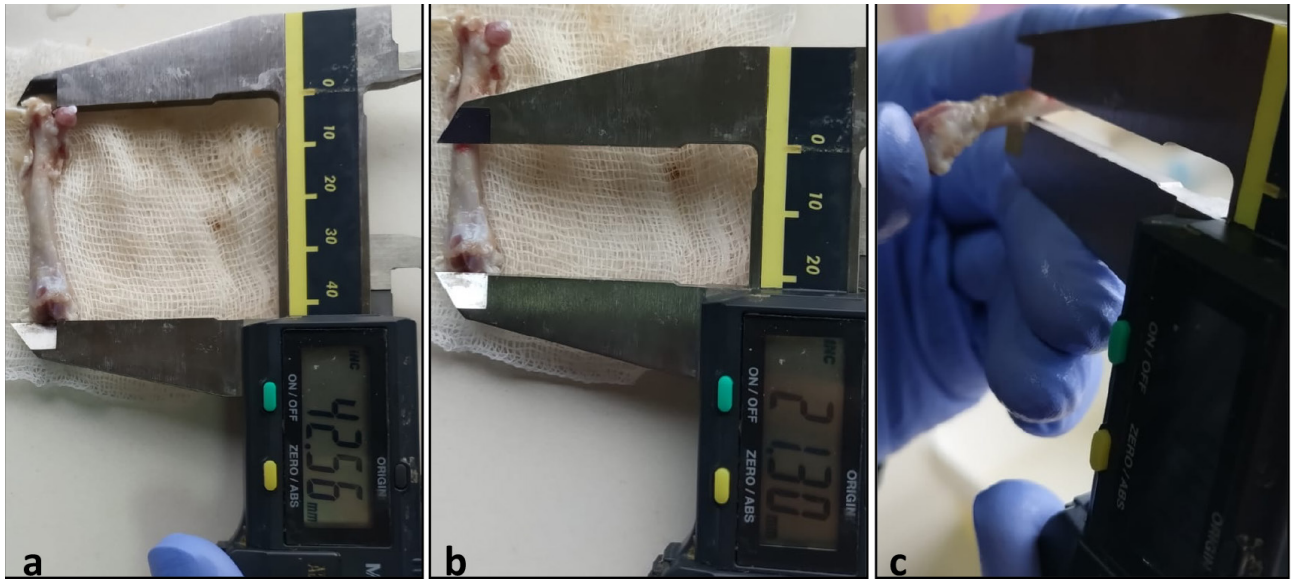

Figure 1. Measurement of the length of the bone (a), marking the midpoint of the bone (b), external cranio-caudal diameter measurement (c)

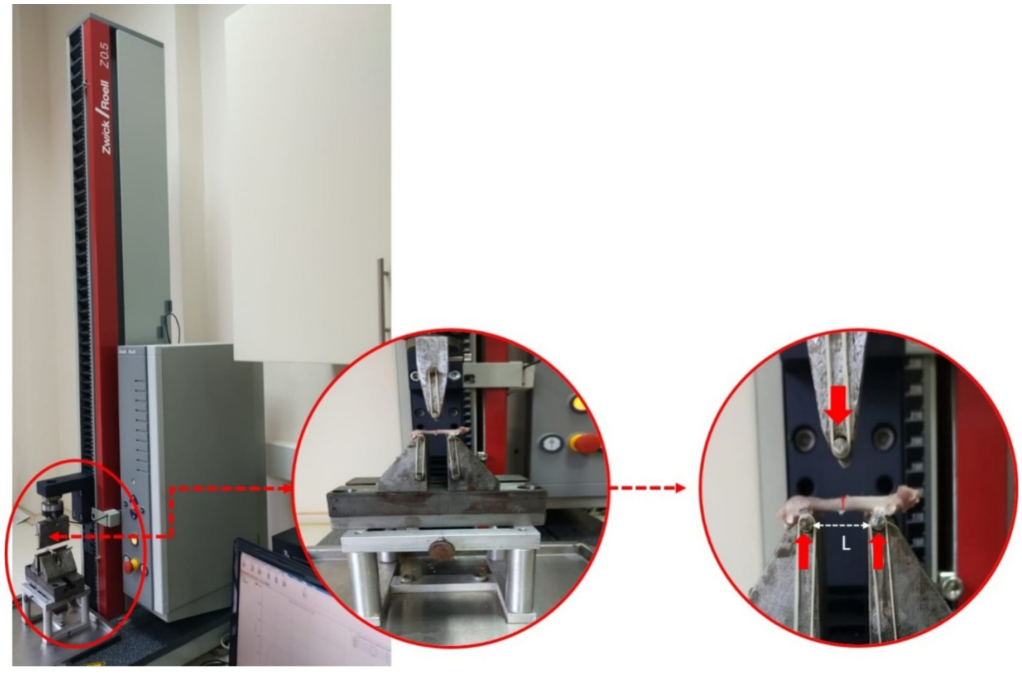

Figure 2. Three-point bone bending test with zwickroell z0.5 mechanical testing machine

Discussion

This study examined the impact of LC, a popular supplement among individuals seeking to enhance muscle strength for professional or recreational sports, on bone strenght and body metabolism. The widespread belief in the efficacy of dietary supplements for promoting well-being incurs significant economic costs.

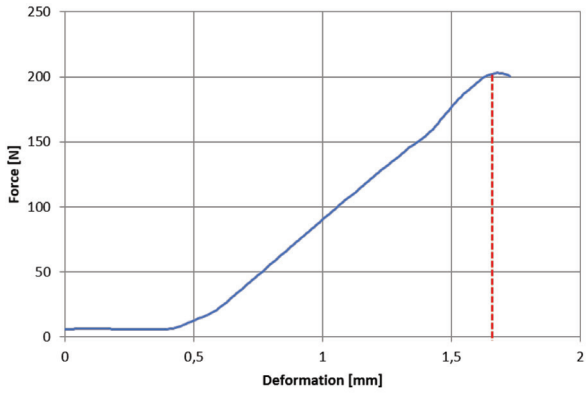

Figure 3. Force-deformation curve N/mm

In order to investigate the effect of LC on body metabolism and for adjustment of LC doses, weekly weight monitoring of the rats was performed. According to the data obtained, the groups receiving LC supplements gained less weight than the control group. In addition, the least weight gain was found in the post-LC group. Although LC supplementation was started in the pre-LC group one week before the tendon injury, it was found that the weight gain was higher in the rats compared to the post-LC group, which started LC supplementation after tendon injury. According to this result, we believe that LC shows its effect on metabolism mostly in inflammation. However, more experimental studies are needed to clarify the issue.

Many studies are showing that LC increases fracture healing and bone formation. Colucci et al. (15) showed that LC and isovaleryl LC, a derivative of LC, can prevent osteoporosis by stimulating osteoblastic activity in their *in vitro* studies based on the fact that a high energy requirement is necessary for osteoblastic activity. Terruzzi et al. (16) the results of another *in vitro* study investigating the effect of LC on osteoblastic activity in human trabecular bones revealed that LC decreased ROS production resulting from mitochondrial activity in osteoblasts and stimulated osteogenesis. Based on these results, Terruzzi et al.

Table 1. Morphometric and 3-D bending test data of the bones in all groups

		Control mean ± SD (min-max)	Pre-LC mean ± SD (min-max)	Post-LC mean ± SD (min-max)	p-value
Measured values	Ext_{ML} (mm)	4.83±0.29 (4.48-5.40)	4.84±0.29 (4.22-5.30)	4.99±0.28 (4.46-5.44)	0.387
	Ext_{CrCau} (mm)	3.82±0.27 (3.28-4.19)	3.92±0.29 (3.44-4.44)	3.75±0.26 (3.35-4.18)	0.404
	Int_{ML} (mm)	3.04±0.32 (2.56-3.41)	3.01±0.47 (2.47-3.96)	2.99±0.4 (2.48-3.52)	0.956
	Int_{CrCau} (mm)	2.02±0.23 (1.60-2.47)	2.33±0.39 (1.77-2.89)	2.17±0.29 (1.71-2.60)	0.288
	L (mm)	41.80±1.30 (39.63-43.38)	41.68±0.66 (40.90-42.53)	41.11±1.55 (38.96-43.79)	0.422
	Fmax (N)	209.00±34.27 (147.00-258.00)	192.10±20.00 (165.30-230.00)	206.00±49.51 (119.00-294.00)	0.553
Calculated values	CMI_{ML}	0.37±0.08 (0.27-0.52)	0.38±0.08 (0.25-0.51)	0.40±0.06 (0.30-0.50)	0.607
	CMI_{CrCau}	0.47±0.06 (0.31-0.53)	0.43±0.08 (0.29-0.53)	0.42±0.08 (0.32-0.55)	0.322
	I (mm^4)	12.22±3.28 (7.19-18.03)	12.80±3.28 (8.58-20.06)	11.61±3.15 (6.99-18.49)	0.718
	Stiffness (N/mm)	172.96±27.75 (102.19-196.86)	179.11±8.82 166.66-191.07	172.40±8.46 (156.95-188.22)	0.342
	Strenght (MPa)	128.29±31.73 (76.30-179.10)	114.60±22.52 (73.90-159.60)	129.14±33.84 (80.10-186.80)	0.481
	ElasticModulus (MPa)	1046.12±284.80 (743.00-1625.31)	1041.66±245.22 (664.58-1382.05)	1104.47±262.63 (659.93-1671.18)	0.840

SD: Standard deviation, min-max: Minimum-maximum, LC: L-carnitine, Ext_{CrCau}: External cranio-caudal diameter, Ext_{ML}: External medio-lateral diameter, Int_{CrCau}: Internal cranio-caudal diameter, Int_{ML}: Internal medio-lateral diameter, L: Bone length, Fmax: Fracture force, CMI_{ML}: Corticomedullary index medio-lateral, CMI_{CrCau}: Corticomedullary index cranio-caudal, I: Moment of inertia

(16) recommended LC supplementation as a candidate molecule to prevent osteoporosis. Aydin et al. (17) examined the effect of LC on fracture healing by creating an experimental fracture model in the femur bones of rats with or without ovariectomy. The results of bone density measurements of the os femurs of rats receiving low and high dose LC supplementation for thirty days showed that 100 mg/kg LC accelerated bone healing by reducing inflammation (17). Ghany et al. (18) examined the effect of amlodipine and LC supplementation on bone turnover after ovariectomy in their experimental studies on rats. In their study, alkaline phosphatase and osteocalcin markers, which are markers of bone turnover, were evaluated by biochemical analysis of blood samples obtained from rats and histomorphology of os femur metaphysis was analysed. The results of the study showed that the combination of amlodipine and LC was more effective than amlodipine and LC supplementation alone. The search for an active substance (molecule) without side effects to stimulate the bone formation mechanism for the treatment of osteoporosis continues today. In an experimental study conducted for this purpose, it was concluded that LC administration prevented dexamethasone-induced osteoporosis by reducing oxidative stress and apoptosis in bone tissue (19). In adult male rats, LC prevented the decrease in cortical thickness of the femur bone due to hyperthyroid-induced osteoporosis and showed a healing effect on histological and immunohistochemical changes (20).

In the selection of experimental animals in bone tissue studies, factors such as easy accessibility to the animal, easy maintenance and feeding, as well as bone turnover (bone formation-destruction) times are taken into consideration, but most rats are preferred as experimental animals. In our study, three-point bending test was performed on the right os femurs of rats to investigate the effect of LC on bone strenght. In our study, it was determined that the bone strength parameters and morphometric measurement values of the bone were not significantly different amongst the experimental groups. The slope of the force deformation curve gives the stiffness value. However, to interpret the strength of the bone per unit area, elastic modulus and strength values should be evaluated. In our study, it was determined that the results of these two parameters were not significantly different between the experimental groups.

Prodinger et al. (21) evaluated the mechanical test parameters in the long bones of rats weighing <400 gr and >400 gr in their study. As a result of the study, it was observed that the Fmax values of the os femurs of the group with weight (>400 gr) were compatible with the Fmax values in the present study. Hooshmand et al. (22) in the study, on the effect of LC supplementation on bone reported that LC slowed bone loss and improved bone microstructural properties by reducing bone turnover. In their study, LC and *ad libitum* nutrition were applied for 8 weeks. In addition, micro computed tomography (microCT) and bone density were analysed and trabecular bone change was demonstrated. In this case, it may not be sufficient for the effect of the 5-weeks application on the mechanical properties of the bone in this study. However, to explain the effect on trabecular tissue, it can be revealed by examining with microCT, density or histopathology. Since these methods were not applied, these deficiencies can be expressed as limitations of the study.

Conclusion

Nowadays, LC is included in many support products offered for healthy living as asupplement. In this study, it was determined that the bone biomechanical properties evaluated after LC supplementation did not differ from the control group. Based on this result, we believe that when used by healthy subjects, it will not have any positive or negative effect on bone strength. Further large-scale experimental studies are needed for the use of LC to increase bone formation in diseased models.

Ethics

Ethics Committee Approval: The study were approved by the Aydın Adnan Menderes University for Animal Experiments Local Ethics Committee (approval no: 64583101/2020/100, date: 28.10.2020).

Informed Consent: When this study is performed on animals, no informed consent is required.

Authors Contributions:

Surgical and Medical Practices: Z.S.K., Concept: Z.S.K., B.D., Design: Z.S.K., B.D., Data Collection or Processing: Z.S.K., F.S.K., B.D., Analysis or Interpretation: Z.S.K., F.S.K., B.D., Literature Search: Z.S.K., F.S.K., B.D., Writing: Z.S.K., F.S.K., B.D.

Conflict of Interest: No conflicting interest are declared by authors.

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Examining the Relationship Between Leisure Time Physical Activity Constraints and Healthy Lifestyle Behaviors Among University Students

Üniversite Öğrencilerinde Serbest Zaman Fiziksel Aktivite Kısıtlayıcıları ile Sağlıklı Yaşam Biçimi Davranışları Arasındaki İlişkinin İncelenmesi

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Abstract

Objective: The aim of this study is to examine the relationship between leisure time and physical activity constraints and healthy lifestyle behaviors among university students and to determine possible differences according to sociodemographic and physical characteristics.
Materials and Methods: The participants were reached using the purposeful sampling method, which is an improbable sampling method, and students from a public university located in a province in Southeastern Anatolia were accepted as the target group. The study population consisted of students who received health education at the level of associate degree (n=380). The questionnaire created by the researchers comprises three parts. The first part of the form consisted of descriptive questions that query the sociodemographic characteristics, the second part consisted of the Scale of Leisure Time Physical Activity Constraints, and the third part consisted of the Healthy Life Style Behavior Scale-II form.
Results: In the present study, sociodemographic characteristics of the participants, such as gender, persons sharing living quarters, transportation preferences, and regular exercise, were effective in reducing leisure physical activity constraints, and the department they studied at the university, gender, and regular exercise were effective in reducing healthy lifestyle behaviors, as well. In addition, as a result of the present study, it was determined that leisure time and physical activity constraints have a negative effect on healthy lifestyle behaviors.
Conclusion: Interventions to reduce physical activity constraints may also have a positive effect on a healthy lifestyle.
Keywords: Physical activity, leisure activities, healthy life, student

Öz

Amaç: Çalışmamızın amacı, üniversite öğrencilerinde serbest zaman fiziksel aktivite kısıtlayıcıları ile sağlıklı yaşam biçimi davranışları arasındaki ilişkiyi incelemek, sosyodemografik ve fiziksel özelliklere göre olası farklılıkları ortaya koymaktır.
Gereç ve Yöntem: Katılımcılara olasılıksız örneklem yöntemlerinden olan amaçlı örneklem yöntemi ile ulaşılmış, bunun için Güneydoğu Anadolu'daki bir ilde bulunan kamu üniversitesinin öğrencileri hedef kitle olarak kabul edilmiştir. Araştırmanın evrenini, ön lisans düzeyinde sağlık eğitimi alan öğrenciler oluşturmuştur (n=380). Literatür kaynaklı olarak araştırmacılar tarafından oluşturulan anket formu üç bölümdür. Formun birinci bölümü sosyodemografik özellikleri sorgulayan tanımlayıcı sorulardan, ikinci bölümü, Serbest Zaman Fiziksel Aktivite Kısıtlayıcıları Ölçeği ve üçüncü bölüm ise, Sağlıklı Yaşam Biçimi Davranışları Ölçeği II'den oluşmuştur.
Bulgular: Çalışmamızda katılımcıların cinsiyet, barınma şekli, ulaşım tercihleri ve düzenli egzersiz yapmak gibi sosyodemografik özelliklerinin serbest zaman fiziksel aktivite kısıtlayıcıları üzerinde etkili oldukları ve üniversitede okumuş oldukları bölüm, cinsiyet ile düzenli egzersiz yapma durumlarının da sağlıklı yaşam biçimi davranışları üzerinde etkili olduğu belirlenmiştir. Ayrıca çalışmamız sonucunda serbest zaman fiziksel aktivite kısıtlayıcılarının sağlıklı yaşam biçimi davranışları üzerinde negatif yönde bir etkisi olduğu saptanmıştır.
Sonuç: Fiziksel aktivite kısıtlayıcıları üzerinde yapılacak olan müdahalelerin sağlıklı yaşam biçimi üzerinde de olumlu etki oluşturacağı düşünülmektedir.
Anahtar kelimeler: Fiziksel aktivite, serbest zaman aktiviteleri, sağlıklı yaşam, öğrenci

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Introduction

Leisure time is defined as an activity area that bring individuals in valuable meanings of life and they experience psychologically, spiritually, socially, and/or culturally in different ways in the sense (1). It is crucial to include physical activities in leisure time activities in terms of their healthy life quality. Physical activity refers to body movements that cause energy expenditure more than the energy consumed at rest in the individual as a result of contraction of skeletal muscles. Leisure time physical activities, on the other hand, are a general definition of activities that are attended in leisure time intervals for individual interests and needs. These activities may include activities such as walking, sports, swimming, and dancing, as well as exercise programs structured with dimensions such as duration, frequency, and target (2). Although the contribution of physical activity to health is known, the literature has reported that the level of physical activity exhibited by individuals during their leisure time is insufficient (3,4). Studies have reported that university students have considerably difficulties in participating in leisure time activities and only a low rate (18%) of students do physical activity at an adequate level (5,6). Leisure time constraints, on the other hand, are factors that prevent the individuals from participating in leisure time activities, reduce the number of subsequent participation in activities, cause loss of time, negatively affect the motivation and desire to participate in activities, and decrease the expected satisfaction from the activities (7). University is an ideal setting for an individual to develop a lifestyle that will determine their current and future health (8).

Therefore, the aim of this study is to examine the relationship between leisure time physical activity constraints and healthy lifestyle behaviors among university students and to determine possible differences according to sociodemographic and physical characteristics. Its data is expected to guide the approaches to be planned on leisure time physical activity constraints.

Materials and Methods

Design and Data Collection Method of the Study

Quantitative method and descriptive cross-sectional design were used in the study. Data were collected between October and December 2022.

Population and Sample

The population of the study consisted of students who received health education at the level of associate degree. G*Power 3.1.9.2 program was used to calculate the sample size. By taking tail (s); two, effect size d; 0.2, alpha (α) err prob: 0.2, Power (1-β err prob); 0.95, non-centrality parameter δ; 3.61, critical t; 1.96 and df; 326 into consideration, total sample size was calculated to be 327 people, and the data were obtained from 392 people.

The participants were reached with the purposeful sampling method, which is one of the improbable sampling methods, and the students of a public university located in a province in Southeastern Anatolia were accepted as the target group.

Ethical Considerations

Before the study, approval from the Gaziantep Islam Science and Technology University Non-Interventional Clinical Research Ethics Committee and necessary permission from the related institution were obtained (decision no: 152.19.11, date: 14.09.2022). Moreover, the participants were informed with the informed consent form attached to the questionnaire in the context of the criteria of the Declaration of Helsinki.

Data Collection Tools

Individual Information Form: This form includes questions about some socio-demographic characteristics of the participants [age, gender, university year, place of residence, habits, mode of transportation, body mass index (BMI) value].

Scale of Leisure Time Physical Activity Constraints (LTPA-C): The scale developed by Öcal (9,18) in 2012 is a 6-point Likert type scale. The lowest and highest scores of the scale are 38 and 228 points, respectively. There are no reverse scored questions in the scale. The scale has a total of 38 items and has eight subscales. These subscales are Body Perception (BP), Willpower (WP), Facility; F, Income (I), Society (S), Family (Fa), Time (T), and Skill Perception (SP). The subscale BP (items 1-6) questions the perception of the person's physical condition. The subscale WP (items 7-10) questions the decision-making power of the person to do physical activity or continue to do physical activity if yes. The subscale F (items 11-18) questions the area, field, and opportunities in the environment for physical activity. The subscale I (items 19-23) questions the person's budget for physical activity. The subscale S (items 24-27) questions the attitudes of the person's circle, other than first-degree relatives, about physical activity. The subscale Fa (items 28-31) questions the attitudes of the person's first-degree relatives about physical activity. The subscale T (items 32-34) questions the restriction on the T that the person will allocate for physical activity to the obligatory works. The subscale SP (items 35-38) questions the perception of the person about knowledge and skills related to physical activity. In the validity and reliability study of the scale, it was reported that the Cronbach's α coefficients ranged between 0.83 and 0.92 for the subscale of the scale, and was 0.93 for the overall scale (9).

In this study, Cronbach's α value found to be 0.834 in BP, 0.629 in WP, 0.795 in F, 0.901 in I, 0.831 in S, 0.838 in Fa, 0.765 in T, 0.838 in SP, and 0.908 for LTPA-C. In the literature, it is accepted that if Cronbach's α coefficient is $0.00 \leq \alpha < 0.40$, the scale is unreliable; if it is $0.40 \leq \alpha < 0.60$, the scale has a low reliability; it is $0.60 \leq \alpha < 0.80$, the scale is highly reliable; and if it is $0.80 \leq \alpha < 1.00$, the scale is highly reliable (10). Therefore, the Cronbach's α coefficients of the LTPA-C and subscale scores used for this study were calculated to be highly reliable.

Healthy Life Style Behaviour Scale II (HLBS-II): The Health-Promoting Lifestyle Profile was developed by Walker and Hill-Polerecky (11) in 1996, based on Pender's health promotion model. HLBS-II aims to assess health promoting behaviors in individuals. In 2008, Bahar et al. (12), conducted its validity and reliability study and adapted it into Turkish. The Cronbach's α value of the scale was 0.92. Subscales of the scale are Spiritual Growth (SG: items 6, 12, 18, 24, 30, 36, 42, 48, and 52), Interpersonal Relations (IPR: Items 1, 7, 13, 19, 25, 31, 37, 43, and 49), Nutrition (N: Items 2, 8, 14, 20, 26, 32, 38, 44, and 50), Physical Activity (PA: Items 4, 10, 16, 22, 28, 34, 40, and 46), Health Responsibility (HR: Items 3, 9, 15, 21, 27, 33, 39, 45, and 51) and Stress Management (SM: Items 5, 11, 17, 23, 29, 35, 41, and 47). Items of this four-point Likert scale are rated as 1 point for "never", 2 points for "sometimes", 3 points for "often", and 4 points for "regular". The lowest and highest scores of the scale are 52 and 208, respectively. Each subscale can be evaluated independently, or the total score of the scale can be calculated. Higher scores indicate that the individual applies the specified health behaviors at a high level.

In this study, the Cronbach's α coefficients of the scale were found to be 0.753 for HR, 0.710 for PA, 0.553 for N, 0.804 for SG, 0.667 for IPR, 0.691 for SM, and 0.903 for HLBS-II. The scale was calculated as highly reliable in terms of total score (12).

Statistical Analysis

The data of the study were analyzed with the SPSS-23 program. Error controls, tables and statistical analyses were done. Number and percentage values were given for descriptive statistical evaluation. Normality analyses were carried out using calculation, graph and hypothesis testing methods for the total scores of LTPA-C and HLBS-II, which are dependent variables, and it was observed that the total scores of both scales were normally distributed. For this reason, parametric tests (Independent samples t-test and One-Way ANOVA), Pearson correlation analysis, and multiple regression analysis were applied. Statistical significance level was accepted as $p<0.05$.

Results

The study was completed with 380 volunteer students (294 females, 86 males) attending Vocational School of Health Services. Out of the students, 207 were the 1st-year students and 173 were the 2nd-year students. The mean age of the participants was 19.91±1.73 years [minimum-maximum (min-max): 17.00-40.00] and their BMI values were 21.90±4.02 (min-max: 15.57-48.00). Out of the students included in the study, 115 stated that they had a regular exercise habits; whereas, 265 stated that they did not have a regular exercise habits.

Table 1 shows the situations that caused a difference in the analyses made to determine whether or not the descriptive characteristics of the participants cause a difference on the LTPA-C and HLBS-II. It was determined that the variables of age range, university year, smoking habit, presence of chronic disease, persons sharing living quarters, and BMI categorical classification did not make a difference ($p>0.05$). While those who were male, were going to school by walking and stated that they did not exercise regularly had high LTPA-C scores, those who stated that they were regularly exercising and were studying in an elderly care program had high HLBS-II scores ($p<0.05$).

When scores of the LTPA-C subscales were examined in the present study, it was determined that the leisure T PA constraint factors were F (25.09±8.68), I (17.90±5.56) and S (14.42±5.40), respectively (Table 2).

When the distribution of the subscale scores of LTPA-C in terms of gender was examined, it was found that there was a statistically significant difference in the subscales of WP, I, S, and SP (respectively p=0.014, p=0.021, p=0.006, and p=0.001) (Table 3).

When the distribution of the subscale scores of LTPA-C in terms of regular exercise habit was examined, a statistically significant difference was determined in the subscales of BP, WP, S, and SP (respectively p=0.007, p=0.000, p=0.020, and p=0.000) (Table 4).

Table 1. Comparison of LTPA-C and HLBS-II in terms of descriptive characteristics of participants (n=380)

Characteristics		LTPA-C Mean ± SD	Test value	HLBS-II Mean ± SD	Test value
Gender	Female Male	109.38±27.34 101.46±30.83	t=2.293 **p=0.022**	123.52±21.80 128.47±25.57	T=-1.779 p=0.076
Mode of transportation	Public transport Personal vehicle Walking	107.26±28.10 75.80±26.46 109.81±28.28	F=3.554 **p=0.030**	125.24±23.54 134.80±27.01 122.73±20.58	F=0.976 p=0.378
Program they studied	Physical med. reh. First aid Medical secretaryship Elderly care	107.29±25.53 107.95±31.26 107.93±26.85 107.24±30.74	F=0.018 p=0.997	124.16±21.02 119.56±23.24[a] 125.36±21.23 130.83±25.20[a]	F=3.613 **p=0.013**
Regular exercise	Yes No	101.29±28.07 110.32±28.04	t=-2.882 **p=0.004**	129.24±21.67 122.64±22.98	T=2.613 **p=0.009**

[a, b] Shows the groups from which the difference originates. $p<0.05$

LTPA-C: Scale of Leisure Time Physical Activity Constraints, HLBS-II: Healthy Life Style Behaviour Scale II, SD: Standard deviation, Physical med. reh.: Physical medicine and rehabilitation

When the overall HLBS-II and its subscales were analyzed, it was remarkable that the subscales of PA (16.61±5.56), N (17.09±4.49) and SM (18.72±4.40) had a lower mean score compared to the other subscales (SG: 25.50±5.43, IPR: 25.08±5.46, HR: 19.49±4.69). The total score of HLBS-II was determined as 124.64±22.77.

When analyzing the distribution of the subscale scores of the "HLBS-II" in terms of gender, it was found that there was a significant difference in the subscales of N and PA (respectively p=0.034 and p=0.000) (Table 5).

When the distribution of the subscale scores of the "HLBS-II" in terms of regular exercise was examined, it was observed that there was a significant difference in the subscales of N and PA (respectively p=0.034 and p=0.000).

The value of leisure T, PA constraints had a negative effect on health lifestyle behaviors. 4.7% of healthy lifestyle behavior can

Table 2. The participant's LTPA-C total and subscale scores (n=380)

Subscales	Mean ± SD	Min	Max	95%CI
Body Perception: BP	11.39±5.12	6	36	10.88-11.91
Willpower: WP	11.61±5.04	4	38	11.10-12.12
Facility: F	25.09±8.68	8	64	24.22-25.97
Income: I	17.90±5.56	8	69	17.19-18.62
Society: S	14.42±5.40	4	24	13.87-14.96
Family: Fa	8.37±4.57	4	24	7.90-8.83
Time: T	9.69±4.06	3	18	9.28-10.10
Skill Perception: SP	9.19±4.28	4	24	8.76-9.62
LTPA-C	107.59±28.32	38	199	104.73-110.44

LTPA-C: Scale of Leisure Time Physical Activity Constraints, Min: Minimum, Max: Maximum, SD: Standard deviation, CI: Confidence interval

Table 3. Distribution of the participant's scores of LTPA-C subscales in terms of gender (n=380)

Subscale	Gender		Test value
	Female	Male	
Body Perception: BP	11.45±4.80	11.20±6.09	t=0.387, p=0.699
Willpower: WP	11.95±4.80	10.44±5.64	t=2.466, **p=0.014**
Facility: F	25.39±8.70	24.09±8.59	t=1.219, p=0.223
Income: I	18.36±6.91	16.36±7.48	t=2.314, **p=0.021**
Society: S	14. 83±5.30	13.01±5.53	t=2.773, **p=0.006**
Family: Fa	8.23±4.40	8.83±5.13	t=-1.074, p=0.284
Time: T	9.58±3.97	10.06±4.38	t=-0.965, p=0.335
Skill Perception: SP	9.56±3.97	7.90±4.19	t=3.204, **p=0.001**

LTPA-C: Scale of Leisure Time Physical Activity Constraints, p<0.05

Table 4. Distribution of the participants' scores of LTPA-C subscales in terms of regular exercise (n=380)

Subscale	Regular exercise		Test value
	Yes	No	
Body Perception: BP	10.32±4.12	11.86±5.43	t=-2.720, **p=0.007**
Willpower: WP	9.60±4.73	12.48±4.92	t=-5.310, **p=0.000**
Facility: F	24.66±8.95	25.28±8.58	t=-0.645, p=0.520
Income: I	17.93±7.24	17.89±7.03	t=0.041, p=0.968
Society: S	13.44±5.59	14.84±5.27	t=-2.336, **p=0.020**
Family: Fa	8.21±4.39	8.43±4.66	t=-0.430, p=0.667
Time: T	9.51±4.10	9.77±4.05	t=-0.581, p=0.561
Skill Perception: SP	7.95±3.74	9.72±4.39	t=-3.771, **p=0.000**

LTPA-C: Scale of Leisure Time Physical Activity Constraints, p<0.05

be explained by leisure T, PA constraints. As can be seen, leisure T, PA constraints had a predictive effect on healthy lifestyle behaviors (Table 6).

Discussion

The present study aimed to examine the relationship between leisure T, PA constraints and healthy lifestyle behaviors among university students.

The results of the present study pointed out that gender, persons sharing living quarters, regular exercise habits and mode of transportation caused differences on leisure T, PA constraints and regular exercise habit caused differences on healthy lifestyle behavior. It was determined that female students perceived leisure T, PA constraints higher than male students, similar to the study conducted by İnal and Salar (13) on university students studying at the faculty of health sciences. Studies examining PA participation and leisure T, PA constraints in Turkey support the present study and have indicated that female subjects perceive more constraints in their participation in physical activities and leisure activities (14-16). In this context, the subscales that female students perceive more leisure T, PA constraints were WP (13), S (15,17) and I (17) as a result of the present study, which is compatible with the literature. However, the present study differs from the literature because the subscale of T, which is shown as constraint for women many T's in studies, is not in the first place in terms of constraint factors among the other subscales (15,17). Again, unlike the literature, we concluded that the subscale of SP is among the constraints for female students. Based on these results, we can interpret that the attitudes of the social circle of female students toward PA and their inability to provide the I and motivation that may be necessary for PA negatively affect the decision about whether to participate in regular physical activity, which is the result of will, or whether to continue do PA or not (10).

In the present study, it was found that the constraints of male for participation in leisure T, PA were the facilities in the surrounding area, the limited budget they can allocate for physical activity, and the attitudes of their social circle toward PA participation, similar to female students. In this context; having a friend or relative other than their first-degree relative (Fa) who is aware of the importance and necessity of PA and can provide support for including leisure T physical activities into their daily lives would be an important factor in minimizing the social environment constraint for both female students and male students.

As a result of our research, we found that the first three items that students who have a habit of exercising regularly perceive as the most restrictive factors are BP, WP and S. When we examined students who did not have regular exercise habits, we found that they perceived topics such as F, I, S and WP as significant limiting factors. Öcal (18) The results of the study they conducted by using the LTPA-C survey with university students for similar purposes with our study are quite consistent with our study, and S, I, F and WP were reported as the subheadings that were perceived as the most restrictive.

When we examine the subheading of WP, which is an important topic about starting a PA and continuing a PA regularly, we see a significant difference in the group comparison and among the subheadings of the LTPA-C survey, the highest score is between the two groups who exercise regularly and those who do not have a regular exercise habit. We saw that it was the title that made the difference. Consistent with this result of our study, the literature reported that one of the most important free T, PA restrictors for students is WP (19,20).

When we examined the leisure T, PA constraints of those who did and did not do regular PA as a result of the present study,

Table 5. Distribution of the participant's scores of HLBS-II subscales in terms of gender (n=380)

Subscale	Gender		Test value
	Female	Male	
Spiritual growth: SG	25.36±5.28	26.00±5.92	t=-0.954, p=0.341
Interpersonal relations: IPR	25.21±5.50	24.62±5.35	t=0.874, p=0.383
Nutrition: N	16.83±4.47	18.00±4.46	t=-2.128, **p=0.034**
Physical activity: PA	15.95±5.40	18.84±5.53	t=-4.342, **p=0.000**
Health responsibility: HR	19.42±4.58	19.72±5.06	t=-0.507, p=0.612
Stress management: SM	18.65±4.29	18.97±4.76	t=-0.599, p=0.549

HLBS-II: Healthy Life Style Behaviour Scale II, p<0.05

Table 6. Predictors of healthy lifestyle behavior (n=380)

Characteristic	B	SE	β	t	p	95% CI
Constant LTPA-C	143.377 -0.174	4.491 0.040	 -0.217	31.925 -4.313	0.000 0.000	134.547-152.208 -0.253- -0.095

R=0.217, R^2=0.047, F=18.60, p=0.000, Durbin-Watson =0.092
LTPA-C: Scale of Leisure Time Physical Activity Constraints, B: Beta content, SE: Standard error, CI: Confidence interval

we concluded that the social environment was an important constraint factor, which supports this result.

When we analyzed the leisure T, PA constraints of the participants according to persons sharing living quarters, we observed that persons sharing living quarters had an effect on the T factor and the students who stayed at home alone were less restricted in terms of T compared to the other students. In the study conducted by Özgül and Saatçı (21) on medical school students, they determined that the total mean score of HLBS-II was 120.1±18.1. In the study conducted by Aksoy and Uçar (22) with nursing students, they reported that the total mean score of HLBS-II was 136.12±19.16. Considering that the maximum score of HLBS-II is 208, the mean score of HLBS-II, found in the present study including the students of vocational school of health services, was 124.64±22.77, which was above the middle level of the scale, similar to the studies conducted with the medical students in the literature. In the study conducted by Pasinlioğlu and Gözüm (23) on health behaviors with healthcare professionals working in primary health care services, they reported that the total mean score of HLBS-II scale was 117.5±17.1. It was observed that the scale mean scores of health science students were higher than scores of healthcare professionals. This is thought to be associated with the effectiveness of the current education and course content of the students studying in these departments on healthy lifestyle behaviors.

In the study conducted by Özgül and Saatçı (21) to examine healthy lifestyle behaviors in medical school students, they reported that there was a significant correlation between gender and PA subscale and male students had higher scores in PA subscale. Likewise, in their study Ünalan et al. (24), revealed that male students did more PA than female students. When we examined the differences in healthy lifestyle behaviors according to gender in the present study, we observed that male participants had higher scores in the subscale of PA compared to their female counterparts, which is compatible with the literature. Considering the predictive effect of LTPA-C on HLBS-II, this result can be associated with female students' higher perceptions of PA constraints such as S, I and WP compared to male ones.

Conclusion

In the present study, conducted to examine the relationship between leisure T, PA constraints and healthy lifestyle behaviors among university students, sociodemographic characteristics of the participants such as gender, persons sharing living quarters, transportation preferences and regular exercise were effective on leisure PA constraints, and the department they studied at the university, gender and regular exercise were effective on healthy lifestyle behaviors, as well. In addition, as a result of the present study, it was determined that leisure T PA constraints had a negative effect on healthy lifestyle behaviors. When examining the HLBS-II subscales in terms of those with and without regular PA habits, we found that those who did regular PA had higher scores in the PA and SM subscales. Concerning the correlation between the LTPA-C and HLBS-II, it was remarkable that there was a significant correlation between the WP subscale of LTPA-C and all the subscales of HLBS-II.

By means of the trainings to increase PA, it is suggested to raise awareness of being physically active and to bring the habit of doing PA regularly in daily life.

Ethics

Ethics Committee Approval: Approval for the study was granted by the Gaziantep Islam Science and Technology University Non-Interventional Clinical Research Ethics Committee (decision no: 152.19.11, date: 14.09.2022).

Informed Consent: Consent form was obtained from all students participating in the study.

Authorship Contributions

Surgical and Medical Practices: B.T., A.B., Concept: B.T., A.B., Design: B.T., A.B., Data Collection or Processing: B.T., A.B., Analysis or Interpretation: B.T., A.B., Literature Search: B.T., A.B., Writing: B.T., A.B.

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Kinesiophobia and Related Factors in Patients with Osteoporosis and Osteopenia

Osteoporoz ve Osteopeni Hastalarında Kinezyofobi ve İlişkili Faktörler

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Abstract

Objective: This study aimed to determine the relationship between kinesiophobia, physical activity level (PAL), and quality of life (QoL) in patients with osteoporosis (OP) and osteopenia (OPN).
Materials and Methods: The study included 41 patients with OP and 41 with OPN. Kinesiophobia was assessed using the Tampa scale of Kinesiophobia, PAL using the International Physical Activity Questionnaire-Short Form, and QoL using the European Osteoporosis Federation QoL questionnaire.
Results: The study was completed with 80 patients (40 patients in each group. Although there was a significant difference between the two groups in kinesiophobia (p=0.027), no significant difference was observed in terms of activity levels (p=0.103). In addition, a significant correlation was observed between kinesiophobia and PAL and all sub-parameters of QoL in patients with OP (p<0.05). A significant correlation was observed between kinesiophobia and PAL in patients with OPN (p<0.001, r=-0.544) however no significant correlation was observed between kinesiophobia and QoL (p>0.05).
Conclusion: Kinesiophobia was found to be high in patients with OP and OPN, which negatively affected the PAL and QoL of patients with OP. Considering the positive effects of exercise on these patients, the evaluation and treatment of kinesiophobia have become increasingly important.
Keywords: Kinesiophobia, physical activity level, quality of life, osteoporosis, osteopenia

Öz

Amaç: Bu çalışmanın amacı osteoporoz (OP) ve osteopeni (OPN) hastalarında kinezyofobi, fiziksel aktivite düzeyi ve yaşam kalitesi (QoL) arasındaki ilişkiyi belirlemektir.
Gereç ve Yöntem: Çalışmaya 41 OP ve 41 OPN hastası dahil edildi. Kinezyofobi, Tampa Kinezyofobi ölçeği, fiziksel aktivite seviyesi Uluslararası Fiziksel Aktivite Anketi-Kısa Formu ve QoL, Avrupa Osteoporoz Federasyonu QoL anketi kullanılarak değerlendirildi.
Bulgular: Çalışma her grupta 40 hasta olmak üzere 80 hasta ile tamamlanmıştır. İki grup arasında kinezyofobi açısından anlamlı bir fark bulunurken (p=0,027), aktivite düzeylerinde anlamlı bir fark gözlenmemiştir (p=0,103). Ayrıca, OP'li hastalarda kinezyofobi ve fiziksel aktivite seviyesi ile QoL'nin tüm alt parametreleri arasında anlamlı korelasyon gözlenmiştir (p<0,05). OPN'li hastalarda kinezyofobi ve fiziksel aktivite seviyesi arasında anlamlı bir korelasyon gözlenirken (p<0,001, r=-0,544), kinezyofobi ve QoL arasında anlamlı bir korelasyon saptanmamıştır (p>0,05).
Sonuç: Kinezyofobinin OP ve OPN hastalarında yüksek olduğu ve bu durumun OP hastalarında fiziksel aktivite seviyesi ve QoL düzeyini olumsuz etkilediği bulunmuştur. Egzersizin bu hastalar üzerindeki olumlu etkileri göz önüne alındığında, kinezyofobinin değerlendirilmesi ve tedavisi giderek daha önemli hale gelmektedir.
Anahtar kelimeler: Kinezyofobi, fiziksel aktivite seviyesi, yaşam kalitesi, osteoporoz, osteopeni

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Introduction

Osteoporosis (OP) is a disease characterized by deterioration of the microarchitecture of bone tissue and low bone mineral density. This may lead to a decrease in bone strength, an increase in bone fragility and consequently an increased risk of fracture (1). It is known as a silent disease because it does not show any symptoms until a symptomatic fracture develops, particularly in elderly individuals (2). OP-related fractures usually occur in the hip, vertebrae and wrist. OP causes excess morbidity, mortality, decreased quality of life (QoL) and health expenditures (3). The prevalence of OP is 2% and the incidence of hip fracture is 13 per 10,000 men and women over the age of 50 years in Turkey (1). Rates increase with age. In recent years, the rate of OP in 80-year-old women was approximately 30%. OP and its complications, particularly hip fractures, cause significant physical, psychological, social and economic burdens for patients and governments (2).

One of the most important preventive and therapeutic approaches in OP is physical activity, because inactivity is an important risk factor for bone loss. Weight-bearing activities reduce bone loss, fall risk and fractures (4). The rate of OP and sarcopenia decreases as the level of physical activity increases according to the study conducted in Korean elderly individuals (5).

Fear of movement is a significant issue that has adverse effects on both the physical and mental well-being of patients, ultimately impacting their QoL. This fear can result in varying levels of participation limitations and disability issues. Furthermore, individuals with kinesiophobia tend to limit their activities and avoid exercise, which can lead to a long-term decline in physical fitness, reduced activity levels, functional impairments, disuse, and even depression. Recognizing this problem and incorporating strategies to address kinesiophobia into the treatment plan may have a positive impact on overall treatment outcomes (6).

Recent studies have shown that many chronic musculoskeletal diseases, such as back pain, lead to kinesiophobia because of the belief that pain will increase during activity (7,8). Kinesiophobia in OP patients with inadequate knowledge has been shown to be associated with lower physical activity levels (PAL) in individuals with chronic pain (9). Consequently, the risk of a sedentary lifestyle is increasing. Inactivity leads to an increased risk of not only chronic pain but also other health problems such as cardiovascular diseases. Kinesiophobia is also associated with poor treatment outcomes (10). OP is a painless, silent disease unless osteoporotic fractures occur. However, the diagnosis of OP with inadequate education about the disease may lead to kinesiophobia in OP patients. An irrational belief that possible falls and related fractures will increase during physical activity may be observed in these patients. Studies evaluating the levels of kinesiophobia and related factors in patients with OP and OPN are limited in the literature. Gunendi et al. (11) showed that patients with OP had higher levels of kinesiophobia than age and gender-matched healthy control group. They also concluded that there was a moderately significant relationship between kinesiophobia and QoL (11). Oksuz and Unal (12) also concluded that pilates exercise training was effective in reducing kinesiophobia in patients with OP. The aim of this study was to compare the level of kinesiophobia in female patients with OP and OPN and to evaluate the relationship between kinesiophobia and PAL and QoL in these patients.

Materials and Methods

Study Design

The study was approved by Fırat University Non-Interventional Clinical Research Ethics Committee referenced 2023/10-17 (date: 27.07.2023). An informed consent form was taken from the participants.

The study included 82 postmenopausal female patients with OP who were being treated and followed up at Elazığ Medical Hospital. Female patients with lumbar vertebrae and femoral neck T-scores <-2.5 standard deviation (SD) for OP patients and T-scores between -1 and -2.5 SD for OPN patients according to the World Health Organization classification system and dual energy X-ray absorbsiometer (DEXA) at least 1 year ago and aged 45-65 years were included in the study. Patients who had a history of fracture or fall within the last 1 year, neurologic or musculoskeletal diseases that may affect mobility, and chronic pain that may cause kinesiophobia were excluded from the study. Demographic data [age, height, weight, age at menopause, body mass index (BMI)] and bone dansimetry results reported within the last one year were recorded.

Outcome Measurements

Kinesiophobia Assessment

The Tampa scale of Kinesiophobia (TSK), which has been validated in Turkish, was used to assess kinesiophobia. This questionnaire, which evaluates fears associated with pain or previous injury, consists of 17 questions. A 4-point Likert scale (1= strongly disagree, 2= disagree, 3= agree, 4= strongly agree) was used to evaluate the questions. The minimum score is 17 and the maximum score is 68. This questionnaire evaluates the increase in pain with movement, fear of injury and avoidance of movement due to pain (6).

Physical Activity Level Assessment

PAL was assessed with the International Physical Activity Questionnaire-Short Form (IPAQ-SF). The Turkish validity and reliability of the IPAQ was performed by Saglam et al. (13). This questionnaire provides information about the time spent in walking, moderate and vigorous activities in the last 7 days. There is also a separate section on sitting. This section asks how much time is spent sitting on average per day. The total score is calculated by multiplying the duration (minutes) and frequency (days) of walking, moderate and vigorous activities by certain values (13).

Quality of Life Assessment

The European Osteoporosis Federation Quality of Life Questionnaire (QUALEFFO-41) was used to assess health-related QoL. This questionnaire covers five dimensions of health: pain (QP), physical functioning (QPF), social activities (QSA), general health assessment (QGH) and mental functioning (QMF). Higher scores indicate worse health-related QoL (14).

Statistical Analysis

SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA) software was used for statistical analysis of the data collected in the study. Descriptive statistics were shown as mean ± SD. Normality distribution was analyzed by Kolmogorov-Smirnov test. Two independent sample mean comparisons for continuous variables were performed using the test of significance of the difference between two means when parametric test assumptions were met, and Mann-Whitney U test when parametric test assumptions were not met. Spearman correlation analysis was used to determine the relationship between the parameters. The statistical significance level was accepted as $p<0.05$.

Results

This study was completed with a total of 80 OP and OPN patients, 40 in each group. One patient with OP and one patient with OPN were excluded from the study due to having an additional neurologic disease and not willing to the study, respectively (Figure 1). Demographic characteristics and DEXA results of the patients are summarized in Table 1. There was no statistically significant difference between the groups in age and BMI ($p>0.05$), however age at menopause was statistically lower in the group with OP ($p=0.038$). QoL, kinesiophobia and PAL comparisons of the groups are summarized in Table 1. There was a statistically significant difference between the two groups in QMF ($p=0.007$) and QT ($p<0.001$) parameters, which are the subheadings of the QUALEFFO-41, while no significant difference was observed in the other subheadings ($p>0.05$). While there was a significant difference in kinesiophobia in OP and OPN patients ($p=0.027$), no significant difference was observed in PAL ($p=0.103$). The relationship between QUALEFFO-41, TSK and IPAQ scores in individuals diagnosed with OP and OPN are summarized in Table 2 and Table 3, respectively.

Discussion

This study was planned to evaluate kinesiophobia and associated factors in OP and OPN patients. The results of the study showed that patients with OP had higher kinesiophobia scores, worse QoL and lower PAL than patients with OPN. In addition, kinesiophobia scores of OP patients were significantly correlated with all sub-parameters of QoL and negatively correlated with PAL. One of the barriers to physical activity is kinesiophobia. Considering the importance of physical activity in patients with OP, it is necessary to evaluate and treat kinesiophobia in these patients.

Kinesiophobia, refers to an irrational and debilitating fear of engaging in physical activities and movement, driven by the fear of experiencing painful injuries or re-injury. This fear can often be attributed to a lack of proper knowledge about the condition (15). Kinesiophobia may develop due to an excessive concern about getting injured during physical exercise, especially when patients have inadequate education about their disease (16). It is important to recognize that kinesiophobia is a psychological and cognitive factor that can impede the recovery process following

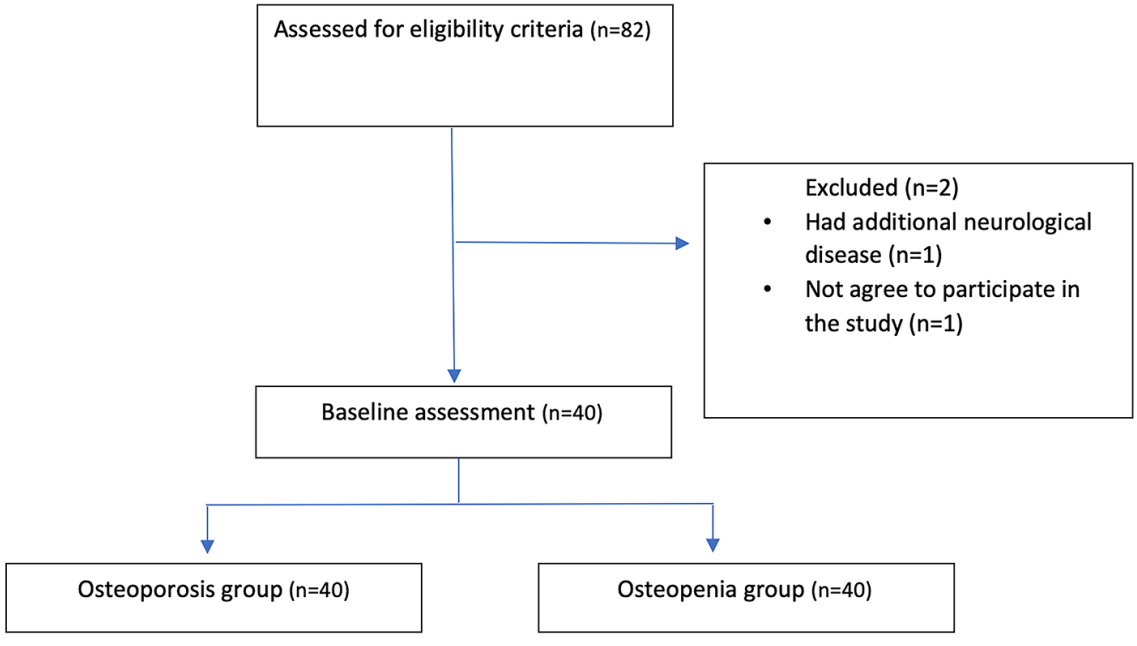

Figure 1. CONSORT flow diagram on study design

Table 1. Comparison of demographic characteristics, DEXA results, quality of life, kinesiophobia and physical activity level of osteoporosis and osteopenia patients

Characteristics	OP group (n=40)	OPN group (n=40)	p-value
Age/years	56.28±4.65	55.72±4.69	0.769
BMI/kg/cm^2	29.51±5.07	30.36±5.34	0.610
Menapouse age	45.68±3.99	47.90±4.68	**0.038**
LVBMD (L1-L4)	-2.7±0.38	-1.71±0.58	**<0.001**
LVBMD (L2-L4)	-2.9±0.38	-1.65±0.68	**<0.001**
FNBMD	-1.26±1.00	-1.06±0.84	0.205
FNBMD	-1.17±0.93	-1.01±0.83	0.240
QP	40.12±22.02	33.05±19.90	0.078
QPF	30.52±12.56	29.43±11.92	0.992
QSA	58.13±18.63	50.00±16.13	0.059
QGH	57.54±14.25	55.12±12.85	0.301
QMF	49.78±14.49	40.48±13.42	**0.007**
QT	42.60±10.45	32.56±7.98	**<0.001**
TSK	43.07±6.44	39.17±7.27	**0.027**
IPAQ	1163.95±111.77	1218.95±168.72	0.103

DEXA: Dual energy X-ray absorbsiometer, OP: Osteoporosis, OPN: Osteopenia, LVBMD: Lumbal vertabrae bone mineral dansitometry, FNBMD: Femur neck bone mineral dansitometry, BMI: Body mass index, kg: Kilogram, cm: Centimeter, QP: Pain subscale of QUALEFFO-41, QPF: Physical function subscale of QUALEFFO-41, QSA: Social activites subscale of QUALEFFO-41, QGH: General health subscale of QUALEFFO-41, QMF: Mental function subscale of QUALEFFO-41, QT: Total score of QUALEFFO-41, TSK: Tampa scale of Kinesiophobia, IPAQ: International Physical Activity Questionnaire, QUALEFFO-41: European Osteoporosis Federation Quality of Life Questionnaire

Table 2. Correlations among kinesiophobia, physical activity level and quality of life in patients with osteoporosis

Parameters		QP	QPF	QSA	QGH	QMF	QT	TSK	IPAQ
QP	r	1	0.270	0.198	0.369	0.331	0.543	0.381	0.090
	p	-	0.092	0.220	**0.019**	**0.037**	**<0.001**	**0.015**	0.580
QPF	r	0.270	1	0.084	0.214	0.295	0.277	0.642	-0.301
	p	0.092	-	0.608	0.184	0.065	0.084	**<0.001**	0.059
QSA	r	0.198	0.084	1	0.205	0.334	0.231	0.401	-0.292
	p	0.220	0.608	-	0.205	**0.035**	0.152	**0.010**	0.067
QGH	r	0.369	0.214	0.205	1	0.312	0.524	0.401	-0.139
	p	**0.019**	0.184	0.205	-	**0.050**	**<0.001**	**0.010**	0.392
QMF	r	0.331	0.295	0.334	0.312	1	0.533	0.453	-0.436
	p	**0.037**	0.065	**0.035**	**0.050**	-	**<0.001**	**0.003**	**0.005**
QT	r	0.543	0.277	0.231	0.524	0.533	1	0.398	-0.027
	p	**<0.001**	0.084	0.152	**<0.001**	**<0.001**	-	**0.011**	0.870
TSK	r	0.381	0.642	0.401	0.401	0.453	0.398	1	-0.476
	p	**0.015**	**<0.001**	**0.010**	**0.010**	**0.003**	**0.011**	-	**0.002**
IPAQ	r	0.090	-0.301	-0.292	-0.139	-0.436	-0.027	-0.476	1
	p	0.580	0.059	0.067	0.392	**0.005**	0.870	**0.002**	-

QP: Pain subscale of QUALEFFO-41, QPF: Physical function subscale of QUALEFFO-41, QSA: Social activites subscale of QUALEFFO-41, QGH: General health subscale of QUALEFFO-41, QMF: Mental function subscale of QUALEFFO-41, QT: Total score of QUALEFFO-41, TSK: Tampa scale of Kinesiophobia, IPAQ: International Physical Activity Questionnaire, QUALEFFO-41: European Osteoporosis Federation Quality of Life Questionnaire

a trauma (17). Consequently, this fear can lead to a reduction in physical activity, negatively impacting a patient's postoperative therapy and rehabilitation efforts (18). This often results in a pattern of avoidance behavior, in which individuals shy away from everyday activities such as exercise, socializing, and work, thereby exacerbating their pain experience (15). Although there was no pain in OP patients until fracture development, kinesiophobia values were found to be high in our study.

Table 3. Correlations among kinesiophobia, physical activity level and quality of life in patients with osteopenia

Parameters		QP	QPF	QSA	QGH	QMF	QT	TSK	IPAQ
QP	r	1	0.011	-0.002	0.221	0.433	0.581	0.216	-0.191
	p	-	0.947	0.990	0.170	**0.005**	**<0.001**	0.181	0.237
QPF	r	0.011	1	0.127	0.028	-0.102	0.154	-0.041	0.020
	p	0.947	-	0.436	0.865	0.532	0.341	0.800	0.903
QSA	r	-0.002	0.127	1	0.163	0.091	0.363	0.105	-0.032
	p	0,990	0.436	-	0.314	0.576	**0.021**	0.518	0.846
QGH	r	0.221	0.028	0.163	1	0.307	0.594	0.084	0.045
	p	0.170	0.865	0.314	-	0.054	**<0.001**	0.605	0.783
QMF	r	0.433	-0.102	0.091	0.307	1	0.636	0.161	0.031
	p	**0.005**	0.532	0.576	0.054	-	**<0.001**	0.321	0.848
QT	r	0.581	0.154	0.363	0.594	0.636	1	0.256	-0.056
	p	**<0.001**	0.341	**0.021**	**<0.001**	**<0.001**	-	0.111	0.730
TSK	r	0.216	-0.041	0.105	0.084	0.161	0.256	1	-0.544
	p	0.181	0.800	0.518	0.605	0.321	0.111	-	**<0.001**
IPAQ	r	-0.191	0.020	-0.032	0.045	0.031	-0.056	-0.544	1
	p	0.237	0.903	0.846	0.783	0.848	0.730	**<0.001**	-

QP: Pain subscale of QUALEFFO-41, QPF: Physical function subscale of QUALEFFO-41, QSA: Social activites subscale of QUALEFFO-41, QGH: General health subscale of QUALEFFO-41, QMF: Mental function subscale of QUALEFFO-41, QT: Total score of QUALEFFO-41, TSK: Tampa scale of Kinesiophobia, IPAQ: International Physical Activity Questionnaire, QUALEFFO-41: European Osteoporosis Federation Quality of Life Questionnaire

Vlaeyen et al. (19) defined a score above 37 as a high kinesiophobia score. The mean score of OP patients in our study was 43.07 and that of OPN patients was 39.17. A possible reason for this may be inadequate patient education. This result may change with more information about their disease and the importance of physical activity. Fletcher et al. (20) showed that reducing the fear of activity in patients with chronic pain may be possible with the patient's understanding of the neurophysiology of pain. Therefore, educating patients about pain physiology in the treatment of chronic pain was suggested to decrease fear of movement. Similarly, organizing education about the disease and treatment in patients with OP may reduce kinesiophobia in these patients.

A significant negative correlation was found between kinesiophobia and PAL in patients with OP and OPN in this study. Especially weight-bearing exercises provide mechanical stress, so the bone response is higher and aerobic exercise is beneficial for increasing enzymatic activation of osteoblasts (21). However, the results of our study support that kinesiophobia negatively affects the level of physical activity in patients with OP and OPN. Similar to our study, Pang et al. (22) also found a negative correlation between kinesiophobia and PAL in patients with OP. In studies conducted in patients with chronic low back pain and osteoarthritis, a significant relationship was found between kinesiophobia and PAL (7,23). However, no significant correlation was found between kinesiophobia and PAL in studies evaluating factors associated with kinesiophobia in patients with systemic lupus erythematosus and chronic neck pain (24,25).

Significant differences were observed in kinesiophobia and QoL between OP and OPN patients in this study. Although no significant difference was found in PAL, it was observed that patients with OP had lower activity levels than patients with OPN. Mısırcı et al. (26) concluded that OP and OPN patients had higher kinesiophobia levels compared to healthy controls; however no significant difference was found in kinesiophobia in OP and OPN patients. The authors interpreted the reason for the lack of significant difference as insufficient information to distinguish between the two diseases (26). Kinesiophobia levels of patients with OP and OPN were found to be significantly different in this study. Although patients with OPN also had high levels of kinesiophobia, fear avoidance behavior was higher in patients with OP. This result suggested that patients with OP were more fearful and avoided activity probably due to fear of fracture risk. Ceylan and Korkmaz (27) found that kinesiophobia was significantly associated with fall risk. Therefore, further studies should investigate treatments to reduce fall risk and kinesiophobia such as balance and strengthening exercises.

Health-related QoL refers to physical, mental and social well-being and is a subset of QoL (28). OP has negative effects on health status and these effects are reflected on QoL. In previous studies, it has been demonstrated that QoL decreased in patients with OP with and without fractures (29,30). Assessing QoL in postmenopausal women with OP provides important information for OP prevention and treatment practices in this population (31). In our study, when the QoL of OP and OPN women was compared, a significant difference was observed in the total QoL score and mental health sub-parameter. Although

no significant difference was found in other sub-parameters, it was concluded that the scores of patients with OP were worse than those of OPN. This result may be interpreted that patients take OP more seriously and put more psychological pressure. Pilates exercises have been shown to improve QoL in patients with OP (12). Studies on the effects of exercise and physical activity on QoL should be increased.

A significant correlation was found between kinesiophobia and all sub-parameters of QoL in patients with OP; no relationship was found in patients with OPN in QoL. It was observed that high kinesiophobia score was associated with low QoL in OP patients. Therefore, kinesiophobia may negatively affect QoL in these patients. Although high levels of kinesiophobia were observed in patients with OPN, no significant relationship was found with QoL. This may be interpreted as kinesiophobia may affect clinical outcomes more in patients with OP. Kinesiophobia was found to have a negative effect on QoL, and a significant relationship between high kinesiophobia and low QoL has been reported in patients with chronic musculoskeletal pain (32,33). Altuğ et al. (7) showed that kinesiophobia caused a negative effect on QoL in patients with low back pain. Similarly, Gunendi et al. (11) reported a significant negative correlation between kinesophobia and QoL in the patients with OP. Consistent with the literature, we found a correlation between increased kinesophobia and decreased QoL in OP patients. Overcoming kinesiophobia in the OP patients may contribute to improved QoL.

Study Limitations

Kinesiophobia is known to be associated with anxiety and depression. The fact that we did not evaluate psychological symptoms in our study can be seen as a limitation. In addition, the absence of a healthy control group may also be considered as a limitation. More comprehensive studies evaluating the relationship between OP and OPN symptoms and kinesiophobia are required.

Conclusion

In conclusion, patients with OP had more impaired kinesiophobia, QoL and PAL than patients with OPN according to the results of our study. In addition, there was an inverse relationship between kinesiophobia level, PAL and QoL in OP patients. Besides, a significant relationship was observed between kinesiophobia and PAL in patients with OPN. Preventing kinesiophobia in patients with OP and OPN may be a potential treatment method to increase PAL and QoL. Future studies should investigate treatments to prevent kinesiophobia and improve QoL and PAL.

Ethics

Ethics Committee Approval: The study was approved by Fırat University Non-Interventional Clinical Research Ethics Committee referenced 2023/10-17 (date: 27.07.2023).

Informed Consent: An informed consent form was taken from the participants.

Authorship Contributions

Concept: S.B.Y., Design: S.B.Y., Data Collection or Processing: M.S.E., Analysis or Interpretation: M.S.E., Literature Search: M.S.E., S.B.Y., Writing: M.S.E., S.B.Y.

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A Quality and Reliability Analysis of Geriatric Exercise Videos on YouTube

YouTube'daki Geriatrik Egzersiz Videolarının Kalite ve Güvenilirlik Analizi

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Abstract

Objective: The aims were to (1) analyze the exercise content of the most viewed videos among the exercise videos published in English for geriatric individuals on YouTube and (2) examine the videos in terms of reliability and quality.
Materials and Methods: A YouTube search was performed in January 2023, and 150 videos were included. Video metrics: number of views, likes, dislikes, comments, video duration, and exercise types were evaluated. The popularity, reliability, and quality of videos were evaluated using the Video Power index, modified DISCERN score, and global quality score (GQS), respectively.
Results: Most of the exercise videos were about strengthening and stretching. According to the GQS, 25.3% of the videos were of low quality, 52.7% were of moderate quality, and 22% were of high quality. Most of the information providers were medical doctors in the high-quality group (p<0.001), DISCERN scores (low moderate quality: p<0.001, low high quality: p<0.001) were different according to quality level. Video duration and number of comments were lower in the high-quality group (p=0.003).
Conclusion: Videos with short duration and few comments, regardless of the number of likes or dislikes, can also be high-quality videos. To make an appropriate choice of exercise videos on YouTube, geriatric individuals should select videos uploaded by medical doctors and official institutions.
Keywords: Geriatric individuals, quality, reliability, YouTube

Öz

Amaç: Amaçlar 1- YouTube'da geriatrik bireylere yönelik, en çok görüntülenen İngilizce egzersiz videolarının, egzersiz içeriklerini analiz etmek, 2- videoların güvenilirlik ve kalite açısından değerlendirmesini yapmaktır.
Gereç ve Yöntem: Ocak 2023'de, YouTube araması yapıldı ve 150 video dahil edildi. Video metrikleri: görüntülenme sayısı/beğenilme/beğenilmeme/yorum sayıları/video süresi ve egzersiz tipleri değerlendirildi. Videoların popülerliği, güvenilirliği ve kalitesi Video Power indeksi, modifiye DISCERN skoru ve Global Quality skoru (GQS) ile değerlendirildi.
Bulgular: Videoların çoğu güçlendirme ve germe ile ilgiliydi. GQS'e göre videoların %25,3'ü düşük kalitede, %52,7'si orta kalitede ve %22'si yüksek kalitedeydi. Yüksek kalite grubunda bilgi sağlayıcıların çoğu tıp doktorlarıydı (p<0,001), DISCERN skorları (düşük-orta kalite: p<0,001, düşük-yüksek kalite: p<0,001) kalite seviyesine göre farklıydı. Yüksek kalite grubunda video süresi ve yorum sayısı daha düşüktü (p=0,003).
Sonuç: Süresi kısa ve yorum sayısı az olan videolar, beğenilme-beğenilmeme sayısından bağımsız olarak yüksek kaliteli video olabilir. YouTube platformunda uygun egzersiz seçimi için geriatrik bireyler medikal doktorlar veya resmi kurumlar tarafından yüklenmiş videoları seçmelidir.
Anahtar kelimeler: Geriatrik bireyler, kalite, güvenilirlik, YouTube

Introduction

It is known that human life expectancy and the elderly population are gradually increasing as a result of early diagnosis and treatment approaches in parallel with scientific developments all over the world. According to the scientifically accepted definition of real age by the World Health Organization (WHO), old age begins with the age of 65 (1). The elderly population over 65 years old constitutes 8.5% (617 million) of the world population. According to the estimations of the "An Aging World: 2015"

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report, it is predicted that this rate will jump to 17% in 2050 and the number of elderly people will reach 1.6 billion (2).

The increase in the elderly population brings with it many chronic diseases. It is known that regular physical activity is one of the most important health behaviors in the prevention or reduction of the severity of chronic diseases (3). However, it is estimated that around 66 percent of adults over the age of 75 do not engage in any regular physical activity (4). The WHO reported that approximately 3.2 million deaths each year are associated with physical inactivity (5). For this reason, it is recommended by the WHO that elderly individuals should do moderate-intensity physical activity for at least 15 minutes a week, taking into account the physical activity level (6).

However, the belief that increasing health problems in older adults will cause a decrease in their ability to exercise keeps them away from exercising. Coaching the elderly person by accompanying someone from the same age group who has been particularly successful in exercise can strengthen the self-efficacy belief of the elderly person (7). In addition, motivating factors such as physician recommendation, information about the benefits of exercise and living close to exercise centers in order to direct them to physical activity are also beneficial (8). In this context, there are informative videos on various social media platforms in order to increase the exercise motivation of older adults and increase their self-efficacy. However, there is no study that evaluates the quality levels of these videos as to whether they are useful by providing accurate information.

The aims of this study were: 1) to analyze the exercise content of the most popular exercise videos targeting geriatric individuals on YouTube, the widely used social media platform, considering factors such as views, likes, duration, and more; and 2) to examine the reliability and quality of these videos.

Materials and Methods

Video scans were made on the YouTube platform using the terms "older, elder, senior exercise" on January 12, 2023 (using website: https://www.youtube.com/). All videos were evaluated by two independent physical medicine and rehabilitation specialists on the same day. Non-English videos containing advertisements, music, animations and lasting longer than 1 hour were excluded from the study. The first 150 videos in English that included the words older, elder, senior exercise and did not include exclusion criteria were evaluated in the study.

Video Metrics Analysis and Categorization

Total days on YouTube, number of view, likes, dislikes and comments, the duration of the videos were recorded in the evaluation. In addition, the types of exercises included in the videos were determined as strengthening exercises, aerobic exercises, stretching exercises, balance exercises, pilates, water exercises, yoga, thai chi exercises. Suggestions that did not belong to any exercise type were classified as other. What type of exercise was described in each video was noted by two independent physical medicine and rehabilitation specialists.

Source of the Videos

The uploaders of the videos were classified as official institutions (government and official associations), medical doctors, physical therapist, geriatric individual and unspesified source.

Assessment of Popularity, Reliability and Quality

The popularity evaluation of the videos was made using the "Video Power index" (VPI). This index is calculated as follows: (likes×100/ (likes + dislikes) × (views/day) /100 (9,10).

The quality of the videos was assessed via the 5-point Global Quality score (GQS) adapted by Bernard et al. (11). It evaluates the quality, flow and usefulness of videos. 1-2 points exhibit low quality, 3 points exhibit moderate quality, 4-5 points exhibit high quality.

The 5-point modified "DISCERN score" adapted by Singh et al. (12) was used to determine the reliability of the videos. It has five main topics as follows: 1. Are the aims clear and achieved? 2. Are reliable sources of information used? 3. Is the information presented balanced and unbiased? 4. Are additional sources of information listed for patient reference? 5. Are the areas of uncertainty mentioned? The range of final score was 0 to 5. Higher scores indicates better reliability.

Ethics Statement

Publicly available videos were evaluated for this study. Additionally, since no human participants or test animals were included in this study, ethics committee approval was not required. Similar studies in the literature were planned in the same way (9,13-16).

Statistical Analysis

The analysis of the study was performed using SPSS for Windows 21.0 software. The Shapiro-Wilk's test was used to investigate the suitability of the data for normal distribution. The Kruskal-Wallis H test (for multiple comparisons, the Dunn test) was used for intergroup comparisons. Chi-square analysis (Pearson exact chi-square test) was used in the analysis of the created cross tables. The Spearman correlation coefficient was used to determine the relationships between the variables. Quantitative data were summarized as mean ± standard deviation, median (Q1; Q3); qualitative data were summarized as number (%). A p-value <0.05 was considered statistically significant.

Results

Of the 158 English videos examined, 150 videos that met the criteria were selected for assessment, 8 videos were excluded. This process is indicated in the flow chart (Figure 1).

The exercise types shown in the videos were evaluated, 86 (57.3%) of the videos showed strengthening, 91 (60.7%) stretching, 63 (42%) aerobic, 16 (10.7%) balance, 10 (6.7%) pilates, 11 (7.3%) yoga, 2 (1.3%) Thai chi exercises. In 49 (32.7%) videos, there were no recommendations for any type of exercise (Table 1).

The information providers of the videos were identified, there were official institutions in 9 videos (6%), medical doctors in

7 videos (4.66%), physical therapists in 58 videos (38.66%), geriatric individuals in 11 videos (7.33%), and unspecified sources in 65 videos (43.33%).

Videos were divided into three categories according to GQS, 38 videos were determined as low quality (25.3%), 79 videos as medium quality (52.7%), and 33 videos as high quality (22%) (Figure 2).

There was a significant difference between groups in terms of information provider (p<0.001): most of the information providers were medical doctors in high quality group (71.4%). Moreover DISCERN scores were found significantly different. It was found higher in high quality group while it was the lowest in low quality group (p-value between low-moderate quality: p<0.001, p-value between low-high quality: p<0.001) (Table 2).

Comparison of video metrics showed that video duration and number of comments were significantly lower in the high quality group according to GQS (p=0.003). VPIs was similar according to quality in three groups (p>0.05) (Table 2).

The VPIs were compared between information providers, a significant difference was found. When a comparison was made between the groups, the VPI value was statistically significantly lower in videos from official institutions than in videos from physical therapist and medical doctors (p=0.022) (Table 3).

A significant difference was found between the DISCERN scores of the information providers. When the comparison was made between the groups, DISCERN scores were significantly higher (p<0.001) in videos received from official institutions than in videos received from geriatric individuals and unspecified sources (Table 3).

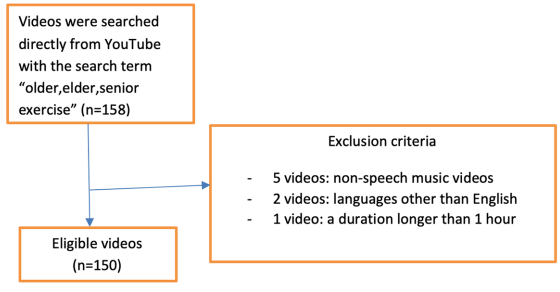

Figure 1. Flowchart of selected videos

Table 1. Distribution of exercise types

Types of exercise	n (%)
Strengthening	86 (57.3%)
Stretching	91 (60.7%)
Aerobic	63 (42%)
Balance	16 (10.7%)
Pilates	10 (6.7%)
Yoga	11 (7.3%)
Thai chi	2 (1.3%)
In-water exercise	0 (0%)
Others	49 (32.7%)

There was a statistically positive correlation between the DISCERN and GQS scores (r=0.75 p<0.001).

Discussion

With the increase in internet usage all over the world, the use of various video sharing sites and social media platforms as a source of information has increased. It was reported that 8 out of 10 internet users access health information online in the Health Information National Trends Survey report (17). The most popular of the video sharing sites is YouTube, with more than 2 billion views per day (18). For this reason, it is important that the content of the videos presented on YouTube is reliable and scientifically correct. For this purpose, this is the first study to systematically investigate the popularity, quality and reliability of English language exercise videos for geriatric individuals on YouTube.

In this study, 25.3% of the videos were low quality, 52.7% were moderate quality and 22% were high quality. Similarly, in a study evaluating YouTube videos related to ankylosing spondylitis exercises, 33.9% of the videos were found to be of low quality (15). In a study by Ertem et al. (14) evaluating priformis exercise videos on YouTube, 31% videos found to be of low quality. In another study evaluating videos of exercises for the coronavirus disease-2019 lockdown, the proportion of low quality videos was even higher (76.5%) (19). It is determined that the quality of exercise videos published on YouTube is mostly low.

In our study, it was determined that videos from medical doctors were of higher quality according to GQS. However, in the study in which exercise videos related to priformis syndrome were evaluated, videos from non-physician healthcare professionals were found to be of higher quality, and in the same study, when video source providers were evaluated according to mDISCERN scores, doctors and other healthcare professionals were found to have high reliability (14). In our study, videos originating from official institutions were more reliable than geriatric individuals origin videos and videos of unspecified origin. In another study, DISCERN scores, videos produced by healthcare workers show the highest scores (19). According to these studies, it is seen that videos originating from medical doctors and healthcare

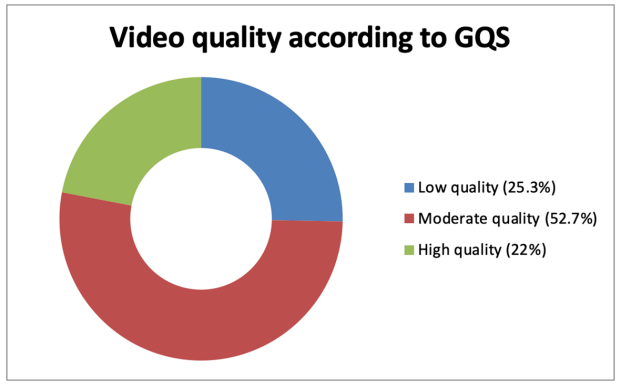

Figure 2. Proportion of videos according to Global Quality score
GQS: Global Quality score

Table 2. Comparison of videos according to their quality level				
	Low quality (n=38)	**Moderate quality (n=79)**	**High quality (n=33)**	**p-value**
Information provider	**n (%)**	**n (%)**	**n (%)**	
Official institutions	1 (11.1%)	3 (33.3%)	5 (55.6%)	**p<0.001***
Medical doctor	0 (0%)	2 (28.6%)	5 (71.4 %)	
Physical therapist	7 (12.1%)	35 (60.3%))	16 (27.6%)	
Geriatric individuals	1 (9.1%)	9 (81.8%)	1 (9.1%)	
Not specified	29 (44,6%)	30 (46.2%)	6 (9.2%)	
DISCERN score	**n (%)**	**n (%)**	**n (%)**	**p<0.001***
1	13 (100%)	0 (0%)	0 (0%)	
2	25 (30.9%)	55 (67.9%)	1 (1.2%)	
3	0 (0%)	24 (49%)	25 (51%)	
4	0 (0%)	0 (0%)	7 (100%)	
5	0 (0%)	0 (0%)	0 (0%)	
Video metrics	**Median (25-75%)**	**Median (25-75%)**	**Median (25-75%)**	
Days on YouTube	1022 (818-2024)	1030 (789-1908)	1424 (831-2347)	0.616
Duration (seconds)	1112 (820-1732)	1155 (707-1593)	710 (486-974)	**0.003****
Number of views	515495 (291453-1807000)	546288 (256884-1089746)	321603 (217382-767643)	0.105
Number of likes	6068 (3045-16034)	5971 (3209-12659)	4471 (2433-11318)	0.399
Number of dislikes	5 (3-19)	6 (4-25)	9 (4-53)	0.827
Number of comments	416 (149-833)	318 (168-504)	150 (68-333)	**0.003****
Video Power index	**Median (25-75%)**	**Median (25-75%)**	**Median (25-75%)**	
	523.7(284.8-907.2)	422.5(206.6-1246.7)	299.3(131.6-1045)	0.71

*Chi-square test, **Independent samples Kruskal-Wallis test

Table 3. Information provider variables related with Video Power index and DISCERN score				
Information provider	**Video Power index Median (25-75%)**	**p-value**	**DISCERN score Median (25-75%)**	**p-value**
Official institutions	105.02 (57.22-613.59)	**0.022***	4 (2.5-4)	**p<0.001***
Medical doctors	1107.85 (309.70-1501.30)		3 (2-3)	
Physical therapists	519.1764 (210.25-1180.25)		3 (2-3)	
Geriatric individuals	448.6658 (350.77-949.0044)		2 (2-2)	
Not specified	446.8183 (212.32-1032.46)		2 (2-2)	

*Independent samples Kruskal-Wallis test

professionals are of higher quality and reliability. It is therefore important to choose the right source of information to obtain quality information from the YouTube.

In our study, consistent with the literature, DISCERN scores used to evaluate reliability were found to be higher in the high quality group and lower in the low quality group (15,20,21).

In our study, the VPI value was statistically significantly lower in videos from official institutions than in videos from medical doctors and physical therapist. However, in a study evaluating exercise videos in polycystic ovary syndrome, there was no difference in VPI, DISCERN, GQS scores between the groups including health employees, sports trainers, and nutritionists as professional video source and the patients and the unidentified as non-professional video source (16).

When video quality according to GQS was compared with video metric features, there was no significant difference between number of like, dislike, view and VPIs in our study. In a study by Rodriguez-Rodriguez et al. (19) when the same parameters

were compared according to DISCERN scores, similarly, no significant difference was found. In the exercise video study in ankylosing spondylitis, there was no difference between video quality according to GQS and number of views per day, likes per day and comments per day, but significant differences were found in the number of dislikes per day (15).

In our study, the duration of high quality videos was shorter than low and medium quality videos (median: 710 sec: 11.8 min). According to this result, it is proved that longer video duration is not an indicator for video quality and that quality and efficient information can be provided with shorter duration videos. In addition, the fact that the number of comments was lower in the high quality video group in our study showed that the number of comments is not an indicator for video quality. Similarly, in the study of Ertem et al. (14) it was found that videos with fewer comments per day were of higher quality, and in the same study, videos with fewer views per day and likes per day were found to be high quality videos. In the exercise video study in ankylosing spondylitis, no relationship was found between the number of daily comments and quality (15). In this context, studies show that videometric features are not decisive for video quality.

Study Limitations

One of the most important limitations of the study is that only the first 150 videos uploaded in English language were evaluated. In addition, due to the dynamic structure of the YouTube platform, video metrics such as the number of like-dislike views change daily, and the videos on different video sharing platforms were not evaluated.

Conclusion

YouTube platform offers a wide variety of exercise videos for geriatric individuals. However, selecting reliable and scientifically quality videos among these videos is very important for the geriatric population with high fragility. In this study, the most important factor for video quality was the information provider. When the information providers of high quality videos were evaluated, it was determined that the highest rate was from medical doctors, and the second was from official institutions. In addition, it was determined that videos with short duration and few comments, regardless of the number of like-dislike, can also be high quality videos. In terms of reliability, videos from official institutions were found to be more reliable than videos from geriatric individuals and unspesified sources. Those who want to learn about exercise for elderly people through YouTube videos are recommended to watch the videos uploaded by medical doctors and official institutions.

Ethics

Ethics Committee Approval: This study did not include human or animal subjects. Ethical board approval was not required.

Informed Consent: The study does not require patient consent.

Author Contributions

Concept: B.O., G.S., F.B., O.A., Design: B.O., F.B., O.A., Supervision: O.A., Data Collection or Processing: B.O., G.S., C.B., Critical Review: B.O., F.B., G.S., O.A., C.B., Analysis or Interpretation: B.O., G.S., F.B., O.A., C.B., Literature Search: B.O., G.S., F.B., O.A., C.B., Writing: B.O.

Conflict of Interest: No conflict of interest was declared by the authors.

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Postmenopozal Dönemde Kemik Mineral Dansitesi ile Trombosit Endeksleri Arasındaki İlişki

Relationship Between Bone Mineral Density and Platelet Indices in Postmenopausal Period

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Öz

Amaç: Postmenopozal dönemde yaşam kalitesi üzerinde oldukça etkili olan osteoporozu değerlendirmek için kadınlarda kemik mineral yoğunluğu değerleri ile platelet indeksleri arasındaki ilişkiyi değerlendirmek amaçlanmıştır.
Gereç ve Yöntem: Çalışma retrospektif dizayn edilmiş olup Ocak 2021 ve Ocak 2023 tarihleri arasında kadın hastalıkları ve doğum polikliniğine başvuran, takiplerinde kemik mineral dansitesi ölçümleri yapılmış, dahil edilme ve dışlanma kriterlerini karşılayan postmenopozal 316 hastanın verileri alınarak yapıldı. Veriler kemik mineral yoğunluk değerlerine göre normal, osteopeni ve osteoporoz olarak 3 grupta değerlendirildi. Hastaların aynı gün bakılmış hemogram sonuçlarında platelet indeksleri ile yaş, vücut kitle indeksi (VKİ) ve kemik mineral yoğunlukları karşılaştırıldı.
Bulgular: Gruplara ayrılarak incelendiğinde yaş verilerinin normal dağılıma uyduğu, osteoporoz grubunun yaş ortalaması 61,4; osteopeni grubunun 58,4 normal grubun 56,2 olarak bulundu. Kilonun normal dağılıma uyduğu ve osteoporoz grubunun ortalama kilo değeri 72,9 kg, osteopeni grubunun 74,09 ve normal grubun 79,4 olduğu görüldü. Gruplar karşılaştırıldığında yaş, platelet sayısı, platelet dağılım genişliği, ortalama platelet hacmi (MPV), platelet büyük hücre oranı ve trombositkriti değerleri arasında anlamlı bir fark görülmemekle birlikte VKİ açısından bakıldığında osteoporoz ve normal grup arasında anlamlı fark bulundu (p=0,027).
Sonuç: Literatürde platelet sayısı ve MPV ile osteoporoz arasında ilişki olduğunu gösteren birçok çalışma olmasına rağmen bizim çalışmamızda platelet indeksleri ile bir ilişki bulunmadığı ve VKİ arttıkça osteoporoz riskinin azaldığı gösterilmiştir.
Anahtar kelimeler: Osteoporoz, platelet indeksleri, kemik mineral yoğunluğu

Abstract

Objective: This study aimed to assess the association between women's platelet indices and bone mineral density to evaluate osteoporosis, which has a significant impact on quality of life throughout the postmenopausal age.
Materials and Methods: The study was retrospectively designed, and data from 316 postmenopausal patients who applied to the obstetrics and gynecology outpatient clinic between January 2021 and January 2023, underwent bone mineral density measurements during follow-up, and met the inclusion and exclusion criteria were obtained. The data were evaluated in 3 groups as normal, osteopenia, and osteoporosis according to bone mineral density. Platelet indices, age, body mass index (BMI), and bone mineral density were compared with platelet indices in the hemogram results of the patients on the same day.
Results: The mean ages of the osteoporosis, osteopenia, and normal groups were 61.4, 58.4, and 56.2 years, respectively. The mean weight was 72.9 kg in the osteoporosis group, 74.09 kg in the osteopenia group, and 79.4 kg in the normal group. When the groups were compared, no significant difference was observed between age, platelet count, platelet distribution width, mean platelet volume (MPV), platelet-large cell ratio, and thrombocytocrit but a significant difference was found between the osteoporosis and normal groups in terms of BMI (p=0.027).
Conclusion: Although numerous studies in the literature have demonstrated a connection between osteoporosis and MPV and platelet count, our investigation revealed no such association and showed that the risk of osteoporosis decreased as BMI increased.
Keywords: Osteoporosis, platelet indices, bone mineral density

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Giriş

Osteoporoz, kemik kırılganlık eğilimini artıran, kemik kütlesi gücü ve mimarisinde sistemik bir bozulma ile ortaya çıkan tıbbi ve sosyoekonomik bir durumdur. Yaş, cinsiyet, hayat tarzı, gündelik hareketlilik durumu, diyet, sigara, alkol tüketimi, vücut kitle indeksi, diyabet hastalığı, steroid kullanımı gibi etmenler osteoporoz gelişimini etkilemekle beraber yapılan çalışmalarda bu hastalığın gelişimine neden olduğuna da değinilmiştir (1). Dünya Sağlık Örgütü'nün (DSÖ) yaptığı bir çalışmaya göre kadınlar için osteoporoz, kemik mineral yoğunluğu (KMY) veya kemik mineral içeriği değerinin genç yetişkin referans aralık ortalamasının 2,5 standart sapma veya daha fazla altında olması durumunda teşhis edilebilir (2). Kemik gücünün azalması, KMY dışında kemik oluşumu ve erimesi (turnover), kemik geometrisi (kemiğin boyutu ve şekli) ve mikro mimari oranları gibi birçok faktörle ilişkilidir (3).

DSÖ'ye göre menopozdaki kemik dansitesi azalışı, osteoporoz ve kırık oranlarının artmasında önemli bir etkendir (4). Osteoporoz ve menopoz arasındaki ilişki iyi bilinmektedir. Menstrüasyonun doğal şekilde kesilmesi olarak tanımlanan menopoz, osteoporoz gelişimi için önemli bir risk faktörüdür. Menopoz sürecinde, kemik sağlığının korunmasında çok önemli bir rol oynayan östrojen seviyelerinde bir düşüş yaşanır (5). Menopoz döneminde östrojenin kesilmesi kemik erimesinde artışa ve kemik oluşumunda azalmaya yol açarak kemik yeniden şekillenmesinde olumsuz bir dengeye ve kemik kütlesi kaybının hızlanmasına neden olur (5,6). Kemik rezorpsiyonu ve oluşumu arasındaki bu dengesizlik osteoporoz gelişimine katkıda bulunur (6).

Osteoporoz çeşitli yöntem ve kriterlerle teşhis edilir. Genellikle kullanılan yöntemlerden biri dual-enerji X-ışını absorpsiyometrisi gibi teknikler kullanılarak KMY'nin ölçülmesidir. Amerika Birleşik Devletleri'nde menopoz sonrası kadınlarda ve yaşlı erkeklerde osteoporoz teşhisi için standart kriter, KMY testi ile lomber omurga, femur boynu veya total kalçada T-skorunun ≤-2,5 olmasıdır. Bu kriter National Bone Health Alliance Working Group (Ulusal Kemik Sağlığı Birliği Çalışma Grubu) tarafından tavsiye edilmektedir (7).

Hormonal değişikliklere ek olarak, enflamasyon da menopoz sırasında osteoporoz patogenezinde rol oynayabilir (5,6). Enflamasyon, kemik rezorpsiyonu ve oluşumu arasındaki dengeyi bozarak kemik kaybının artmasına neden olabilir (5). Enflamatuvar süreç, sitokinler ve östrojen eksikliği de dahil olmak üzere çeşitli faktörlerden etkilenebilir (5,6). Tümör nekroz faktör-alfa (TNF-α), interlökin 1 (IL-1), IL-6 gibi bazı sitokinlerin de osteoporoz patogenezindeki rolü bilinmektedir (8). Yapılan bazı çalışmalarda platelet (PLT) indeksi ile KMY arasında korelasyon gösterilmiştir (9-13). PLT aktivasyon kaskadında görev aldığı tespit edilmiş IL-6'nın kemik rezorpsiyon regülatörü olduğu bilinmekle beraber bu durumlar beraber göz önünde bulundurulduğunda PLT endeksleri [ortalama platelet hacmi (MPV), platelet dağılım genişliği (PDW), PLT] ile KMY arasında bir ilişki mevcudiyeti hakkında araştırma gereksinimi doğmaktadır. Çalışmamızda, postmenopozal kadınlarda trombosit endeksleri ile KMY ölçümleri arasındaki ilişki varlığını araştırmayı amaçladık.

Gereç ve Yöntem

Çalışma retrospektif dizayn edilerek Ocak 2021 ve Ocak 2023 tarihleri arasında kadın hastalıkları ve doğum kliniğine başvuran, postmenopozal takiplerinde kemik mineral dansitesi ölçümleri yapılmış, 50-85 yaş aralığında, osteoporoz nedeni ile herhangi bir ilaç kullanmayan, osteoporoza neden olabilecek herhangi bir sistemik hastalığı olmayan hastalar dahil edildi. Çalışma için Erzincan Binali Yıldırım Üniversitesi Klinik Araştırmalar Etik Kurulu'ndan 2023-18/5 sayılı onay alınmıştır (tarih: 19.10.2023). Tüm hastaların lomber 1-4, femur boyun, femur total kemik mineral yoğunluk değerleri ile T-skorları, PLT, PDW, MPV değerleri kaydedildi. Tüm verilerine ulaşılabilen, dahil edilme ve dışlanma kriterlerini karşılayan 306 hasta çalışmaya alındı. KMY değerlerine göre T-skoru -1'den büyük olanlar normal, T-skoru -1 ile -2,5 arasında olanlar osteopeni ve T-skoru -2,5'ten küçük olanlar osteoporoz grubu olarak 3 grupta değerlendirildi. Hastaların aynı gün bakılmış olan hemogram sonuçlarında PLT endeksleri ile yaşları, VKİ'leri ve KMY'leri karşılaştırıldı.

İstatistiksel Analiz

İstatistiksel analiz ve oranlar için SPSS 21.0 programı kullanılarak, sürekli değişkenlerin normal dağılıma uygunluğu için Kolmogorov-Smirnov testi kullanıldı. Normal dağılıma uygun değişkenlerin korelasyon varlığını belirlemek için Pearson korelasyon testleri, normal dağılım göstermeyen değişkenler için Spearman korelasyon testi kullanıldı. Kategorik değişkenler sayı (%), olarak ve aralarındaki farkların değerlendirilmesi ki-kare testi ile yapıldı. İstatistiksel olarak $p<0,05$ değeri anlamlı kabul edildi.

Bulgular

Çalışma gruplarındaki hastalar toplamda değerlendirildiğinde yaşları 50 ile 85 arasında değişmekte ve ortalaması 58,7±7,18 idi. Boyları 141 ile 175 cm arasında ortalaması 156,5±5, 7 cm ve VKİ'leri ortalaması 30,5 kg/cm^2 idi. PLT değerleri 131.000/µL ile 445.000/µL arasında değişmekle birlikte ortalama 263.000±56.000/µL idi. MPV, trombositkriti (PCT), PDW ve P-LCR değerleri ortalamaları sırası ile 10,05 fL; %0,26; 11,45 fL ve 25,7 olarak bulundu.

Yaş, boy, VKİ, osteoporoz düzeyi, PLT sayısı (PS), MPV, PCT, PDW ve platelet büyük hücre oranı (P-LRC) değerleri arasındaki ilişkiyi değerlendirmek amacı ile Spearman korelasyon testi kullanıldığında; yaş ve boy arasında negatif yönde güçlü ($r=-0,197$) ve anlamlı ($p<0,05$) ilişki ve osteoporoz seviyesi arasında yine güçlü ($r=0,212$) ve anlamlı ($p<0,05$) ilişki bulunmuştur. Yani yaş arttıkça boyun azaldığı ve osteoporoz düzeyinin arttığı tespit edilmiştir. Boy ile osteoporoz arasında zayıf ($r=-0,120$) ve anlamlı ($p<0,05$) ilişki olduğu boy arttıkça osteoporozun azaldığı bulunmuştur. VKİ ile osteoporoz arasındaki ilişki incelendiğinde zayıf ($r=-0,115$) ve anlamlı ilişki olduğu VKİ arttıkça osteoporozun azaldığı bir kez daha gösterilmiştir. PCT ile osteoporoz şiddeti arasında zayıf ve negatif yönde ($r=-0,123$) ilişki bulunmuştur (Tablo 1).

T-skoru -1'den büyük olanlar normal, T-skoru -1 ile -2,5 arasında olanlar osteopeni ve T-skoru -2,5'ten küçük olanlar osteoporoz

grubu olarak 3 grupta incelendiğinde; L1-4 T-skoruna göre 53 kişi osteoporoz, 224 kişi osteopeni ve 29 kişinin ise normal grupta yer aldığı görüldü. Aynı şekilde femur boynu T-skorlarına göre 19 kişi osteoporoz, 268 kişi osteopeni ve 19 kişi normal grupta yer alırken; hastaların toplam T-skorlarına göre bir gruplama yapıldığında; ostoporozu olmayan 38 kişi, osteopenisi olan 208 kişi ve osteoporozu olan 60 kişi olduğu görüldü.

Gruplara ayrılarak incelendiğinde yaş verilerinin normal dağılıma uyduğu osteoporoz grubunun yaş ortalaması 61,4; osteopeni grubunun yaş ortalaması 58,4 ve normal grubun yaş ortalaması 56,2 olarak bulundu. Kilo açısından incelendiğinde osteoporoz grubunun ortalama kilo değeri 72,9 kg, osteopeni grubunun 74,09 kg ve normal grubun ortalama kilo değerinin 79,4 kg olduğu görüldü. Boy açısından bakıldığında ortalamalarının sırası ile 155,07; 157,02 ve 156,68 cm olduğu görüldü. VKİ'lerinin osteoporoz grubu ortalama değeri 30,4 kg/m^2, osteopeni grubunun 30,2 kg/m^2 ve normal grubun ise 32,38 kg/m^2 olduğu görüldü.

PS'lerin normal dağılım gösterdiği ve osteoporoz grubunun ortalama PLT değeri 254x10^3/µL, osteopeni grubunun 258x10^3/µL ve normal grubun 265x10^3/µL olduğu izlendi.

MPV değerinin normal dağılıma uymadığı osteoporoz grubunda 9,96 fL, osteopeni grubunda 10,05 fL ve normal grupta 10,2 fL olduğu görüldü.

PCT değerlerinin sırasıyla 0,24-0,26 ve PDW değerinin sırasıyla 11,2-11,4 ve 12,08 olduğu görüldü.

P-LRC değerinin osteoporoz grubunda ortalama değerinin 24,9, osteopeni grubunda 25,7 ve normal grubunda 27,14 olduğu görüldü.

Grupları karşılaştırmak için post-hoc analiz yapıldığında; sadece yaş açısından osteoporoz, osteopeni ve normal grup arasında anlamlı fark bulundu. Boy, kilo, VKİ, PS, PDW, MPV, P-LRC ve PCT değerleri arasında anlamlı bir fark görülmedi (p>0,016).

Tartışma

Kimble ve ark. (14) yapmış olduğu sıçanlarda cerrahi olarak menopoz yapılarak azalan megakaryosit sayıları ve osteoklast kativitesinin ve mast hücre sayılarının arttığını gösteren çalışmada osteoporozun kemik iliği hematopoez fonksiyonunu azalttığı savunulmuştur. Yine buna benzer olarak Kim ve ark. (15) çalışmasında postmenopozal dönemde kadınların trombosit sayısı ile kemik mineral dansitesi arasında pozitif ilişki olduğu gösterilmiştir. Ayrıca osteoporoz için yaş, ağırlık değerlerini bağımsız prognostik faktör olarak göstermişlerdir (15). Yakın tarihli araştırmalar, trombosit endeksleri ile KMY arasındaki ilişkinin ters yönde olduğunu göstermektedir (16,17).

Bizim yapmış olduğumuz çalışmada ise osteoporoz, osteopeni, ve normal gruplarda hematopoezin azaldığına dair bir kanıt bulunamamıştır. PLT sayıları her üç grupta benzer bulunmakla birlikte yaş ve VKİ'leri açısından diğer çalışmalar ile benzer sonuçlar bulunmuştur.

Tablo 1. Yaş, boy, kilo, vücut kitle indeksi, osteoporoz ve platelet indeksleri ilişkisi

Spearman's rho		Yaş	Boy	Kilo	VKİ	Osteoporoz
Yaş	Korelasyon katsayısı (r)	1,000	-0,197	-0,003	0,086	0,212
	p	-	0,001	0,954	0,134	0,000
Boy	Korelasyon katsayısı (r)	-0,197	1,000	0,127	-0,283	-0,120
	p	0,001	-	0,026	0,000	0,035
Kilo	Korelasyon katsayısı (r)	-0,003	0,127	10,000	0,887	-0,150
	p	0,954	0,026	-	0,000	0,009
VKİ	Korelasyon katsayısı (r)	0,086	-0,283	0,887	10,000	-0,115
	p	0,134	0,000	0,000	-	0,044
Nihai osteoporoz	Korelasyon katsayısı (r)	-0,212	0,120	0,150	0,115	1,000
	p	0,000	0,035	0,009	0,044	-
PLT	Korelasyon katsayısı (r)	-0,090	0,058	0,060	0,048	-0,084
	p	0,117	0,309	0,295	0,400	0,144
MPV	Korelasyon katsayısı (r)	-0,020	0,018	0,040	0,021	-0,043
	p	0,723	0,755	0,488	0,710	0,458
PCT	Korelasyon katsayısı (r)	-0,097	0,083	0,104	0,071	-0,123
	p	0,091	0,149	0,069	0,212	0,031
PDW	Korelasyon katsayısı (r)	-0,060	0,027	0,057	0,038	-0,080
	p	0,292	0,639	0,321	0,504	0,162
P-LCR	Korelasyon katsayısı (r)	-0,017	0,052	0,072	0,052	-0,661
	p	0,772	0,363	0,211	0,365	0,249

VKİ: Vücut kitle indeksi, PLT: Platelet, MPV: Ortalama platelet hacmi, PDW: Platelet dağılım genişliği, PCT: Trombositkriti, P-LRC: Platelet büyük hücre oranı

Sürücü ve Gedik (18) tarafından yapılan bir çalışmada da, kendi çalışmamıza uygun olarak osteoporoz olan grupla osteoporoz olmayan grup arasında anlamlı bir fark olmadığı bulundu.

MPV ve PDW, rutin tam kan sayımından ulaşılabilen ve hematolojik değişiklikleri belirlemek için kullanılan kullanımı kolay yöntemler olarak görülebilir. Kemik mineralizasyonunu MPV ve PDW seviyeleri gösterebilir (19). Literatürde, osteoporoz ile MPV ve PDW arasındaki ilişkiyi inceleyen çok az çalışma vardır ve bu çalışmalar çelişkili sonuçlar bildirmiştir. Diğer risk faktörleri kontrol altına alındığında, Li ve ark. (9) lomber (L2-4) ve femur boyun KMY ile MPV arasında negatif yönde anlamlı bir negatif ilişki olduğunu keşfettiler. Başka bir deyişle, postmenopozal osteoporozda MPV değerlerinin arttığını, MPV ile KMY arasında güçlü bir ilişki olduğunu ve MPV arttıkça KMY azaldığını ifade etmişlerdir. Yazarlar ayrıca yüksek MPV'nin düşük KMY için anlamlı bir faktör olduğunu da ifade etmiştir (9). Aksine Akbal ve ark. (10), osteoporozu olan hastalarda MPV ve PDW'nun önemli ölçüde düşük olduğunu ve PDW ile KMY arasında pozitif bir korelasyon olduğunu ancak MPV ile KMY arasında bir korelasyon olmadığını bulmuşlardır.

Yine yapılan bir çalışmada KMY değeri, kırmızı kan hücresi, hemoglobin ve PS'leri ile negatif korele iken, femur mineral dansite değeri beyaz kan hücresi, kırmızı kan hücresi, hemoglobin ve PS'leri ile negatif korele bulunmuştur (15). Yıldırım ve Bulut (13) yapmış olduğu çalışmada postmenopozal kadınlarda PLT ile KMY'nin ilişkisi araştırılmış ve zayıf da olsa MPV ile korele olduğu gösterilmiştir. Osteopeni ve osteoporozu olan postmenopozal kadınların kontrol grubuna göre daha yüksek MPV değerine sahip olduğu; yaş değişkeni kontrol altına alındığında MPV ile lomber, femur boyun ve femur total KMY arasında negatif yönde ve zayıf bir korelasyon olduğu gösterilmiştir. Ayrıca PDW ve PS ile KMY arasında anlamlı ilişki olmadığı gösterilmiştir (13). Trombosit şeklindeki değişiklikleri gösteren MPV ve PDW'deki artışlar, vasküler yataktaki tromboz artışı nedeniyle kemik beslenmesi bozulmasına ve sonuç olarak kemik kaybına yol açabileceği şeklinde yorumlanmıştır (9).

Bizim çalışmamızda ise bu çalışmaların aksine gruplar arasında anlamlı bir MPV farkı bulunmamaktaydı.

Turgay ve Avşar'ın (11) yapmış olduğu çalışmada ise önceki bahsedilen çalışmaların aksine, postmenopozal osteoporoz tespit edilen kadınlarda MPV ve PDW osteoporoz olmayan kadınlara göre daha yüksektir ve KMY değerleri ile bu trombosit endeksleri arasında ters yönde anlamlı ilişki bulunmuştur. Bizim çalışmamızda ise PS'de ve MPV'de her iki çalışmanın aksine negatif ve pozitif yönde ilişki bulunmamaktaydı.

Akbal ve ark. (10) tarafından 80 postmenopozal kadın, lomber (L1-4) ve femur toplam KMY değerlerine göre kontrol edilmiş, osteopeni ve osteoporoz gruplarına ayrılmış ve PLT endekslerini karşılaştırılmıştır. Çalışmanın neticesinde, bizim sonuçlarımızın aksine hem MPV hem de PDW arasında pozitif bir korelasyon olduğunu bildirmiştir.

Özellikle enflamatuvar durumlarda kilit rolleri olan IL-1, IL-6, TNF-α gibi sitokinlerin trombosit aktivasyonuna neden olabileceği vurgulanmıştır (20,21).

Bununla birlikte, IL-1, IL-6, TNF-α ve IL-11 gibi sitokinlerin de osteoporoz oluşumunda belirgin bir etkisi olduğu düşünülmektedir (8). Trombosit aktivasyonuna neden olduğu bilinen IL-6'nın kemik rezorpsiyonunun güçlü bir düzenleyicisi olması, bilim insanlarını trombosit indeksleri ile KMY arasındaki bağı açıklamaya yöneltmiştir. Literatürde bu ilişkiyi ele alan ancak çelişkili sonuçlar bildiren kısıtlı miktarda kontrollü çalışma bulunmaktadır (9,10). VKİ'deki her 1 birimlik değişilikliğin KMY'yi, fiziksel aktivite, fonksiyonel kapasite, kalsiyum alımı, sigara ve alkol alışkanlığı gibi değiştirilebilir diğer risk faktörlerinden daha fazla etkilediğini Asomaning ve ark. (22) tarafından yapılan bir çalışmada vurgulamışlardır.

Çalışmamızın retrospektif olması ve hasta sayısının az olması çalışmanın zayıf yönleri olarak sayılabilir. Daha büyük gruplarda yapıldığında daha anlamlı sonuçların bulunması olası görünebilir.

Sonuç

Literatürde PS ve MPV ile osteoporoz arasında ilişki olduğunu gösteren birçok çalışma olmasına rağmen bizim çalışmamızda PLT indeksleri ile bir ilişki bulunmadığı ve VKİ arttıkça osteoporoz riskinin azaldığı bir kez daha gösterilmiştir.

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YouTube as a Source of Information on Inflammatory Muscle Diseases: Can It Provide Valid and Reliable Information for Patients as Well as Healthcare Professionals?

Enflamatuvar Kas Hastalıkları Konusunda Bilgi Kaynağı Olarak YouTube: Hastalar ve Sağlık Profesyonelleri için Geçerli ve Güvenilir Bir Bilgi Kaynağı mıdır?

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Abstract

Objective: The increasing use of the internet has resulted in its gaining a more active role in both patient and professional education, including the YouTube platform, a popular platform for sharing and watching videos. This study aimed to evaluate the quality, usefulness, and reliability of videos on inflammatory muscle diseases on YouTube, as well as their determinants for both patient and healthcare professional education.

Materials and Methods: The keywords "Inflammatory muscle disease", "Idiopathic inflammatory myositis", "Inflammatory muscle disease treatment", "Inflammatory myositis treatment", "Dermatomyositis" and "Polymyositis" were searched on the site on April 22nd, 2022. According to the Global Quality scale, three categories (high quality, middle quality, and low quality) were created based on the educational value of YouTube videos. The reliability of the information was assessed using the DISCERN tool. The video parameters were compared between the quality groups to reveal the determinants of the quality.

Results: Seventy-five videos of patients and 116 videos of healthcare professionals were included in the video after exclusion. The numbers of high, intermediate and low-quality videos were 27 (36%), 27 (36%), and 21 (28%) for videos for patients, and 20 (17.2%), 60 (51.8%), and 36 (31%), respectively. Only the number of likes was found to be a determinant of video quality for healthcare professionals ($p<0.05$), and none of the other determinants were found to predict the quality for both groups ($p>0.05$).

Conclusion: YouTube is an open platform for information, and it includes various educational videos of various quality. Experts, such as physicians, should be encouraged to provide more content to help both patients and healthcare professionals obtain better quality information.

Keywords: Inflammatory muscle disease, polymyositis, dermatomyositis, YouTube, patient education, medical education

Öz

Amaç: İnternet kullanımının artmasıyla beraber videoların paylaşılması ve izlenmesi için popüler bir platform olan YouTube sitesi de dahil olmak üzere hem hasta hem de mesleki eğitimde internet daha aktif bir rol kazanmıştır. Bu çalışmada YouTube'da yer alan enflamatuvar kas hastalıkları ile ilgili videoların kalitesi, kullanışlılığı ve güvenilirliğinin hem hasta hem de sağlık profesyoneli eğitimi açısından değerlendirilmesi amaçlandı.

Gereç ve Yöntem: 22 Nisan 2022 tarihinde sitede "Enflamatuvar kas hastalığı", "İdiyopatik enflamatuvar miyozit", "Enflamatuvar kas hastalığı tedavisi", "Enflamatuvar miyozit tedavisi", "Dermatomiyozit" ve "Polimiyozit" anahtar kelimeleri arandı. Küresel Kalite ölçeğinde YouTube videolarının eğitici değeri temel alınarak üç kategori -yüksek kalite, orta kalite ve düşük kalite- oluşturuldu. Bilgilerin güvenilirliği DISCERN aracı kullanılarak değerlendirildi. Kalite grupları arasında video parametreleri, kalitenin belirleyicilerini ortaya çıkarmak için karşılaştırıldı.

Bulgular: Hastalara yönelik 75, sağlık çalışanlarına yönelik 116 video, çalışmaya dahil edildi. Yüksek, orta ve düşük kaliteli videoların sayısı ise sırasıyla 27 (%36), 27 (%36), 21 (%28) hasta videosu olurken, 20 (%17,2), 60 (%51,8) ve 36 (%31) oldu. Sağlık profesyonelleri için videoların kalitesinin belirleyicisi yalnızca beğeni sayısı iken ($p<0,05$), diğer belirleyicilerden hiçbirinin her iki grup için de kaliteyi yordadığı görülmedi ($p>0,05$).

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Öz

Sonuç: YouTube bilgiye açık bir platform olduğundan içerisinde çeşitli kaliteli eğitici videolar barındırmaktadır. Hem hastaların hem de sağlık çalışanlarının daha kaliteli bilgiye ulaşabilmesi için hekimler gibi uzmanların daha fazla içerik sunmaya teşvik edilmesi gerekmektedir.
Anahtar kelimeler: Enflamatuvar kas hastalığı, polimiyozit, dermatomiyozit, YouTube, hasta eğitimi, tıp eğitimi

Introduction

Inflammatory muscle diseases are a group of autoimmune disorders that manifest with the inflammation of the muscles as well as the involvement of other systems (1). The skin, lungs, heart, joints, and many other systems can be involved. These heterogeneous disorders can take many names depending on the clinical manifestations, and serological and histopathological features, including but not limited to dermatomyositis, polymyositis, inclusion body myositis, overlap myositis, and immune-mediated necrotizing myopathy (2). As the management also differs between these disorders, the clinicians involved in the diagnosis and management must have a good understanding of the mechanisms, characteristics, and treatment of these pathologies.

Learning and understanding the principles of diseases, especially the complex ones such as inflammatory muscle diseases have always been challenging for health practitioners. With the precious mission of teaching the elaborate mechanisms and treatment methods and simplifying when in need for the patients, they require a helping hand even more. Thanks to the introduction of novel methods through developing technology, many new modes of education methods have emerged in recent years. The use of the internet, videos, and interactive learning programs with the help of computers can be examples of such methods. Learning with these methods is not only being pursued by health professionals since patients and their caregivers also use them to seek information regarding their situations and possible solutions as well.

The internet has become a choice of modality for gaining information since it has been introduced. Thus, obtaining health information was not an exception. It has been claimed that almost half of the population used the internet to gain insights regarding their health status and diseases (3). Moreover, internet use is also getting popularity in medical education (4). One source of information is YouTube, a widely-used platform where users can upload and view videos. Its user-friendly design and accessibility make it a valuable educational resource for patients learning about their health conditions, as well as for medical students and professionals seeking information (5-7). However, the accuracy, quality, and reliability of information on these platforms can be questionable. Since any user can upload videos that adhere to the terms of service, there are no safeguards like peer review to ensure the content's credibility. While scientifically valid and high-quality information can be of use to patients, misleading information can be harmful (8). Although most medical professionals and students can discriminate the accuracy of the information, low-quality information can result in a waste of time and resources, and even lead them to wrong beliefs. Madathil et al. (9) reported that the healthcare information videos on YouTube varied regarding quality, having higher quality ones as well as conflicting and questionable videos. Detection of the determinants of quality and reliability of the videos can help practitioners and learners to choose the right videos to avoid misleading information and save time.

The review of the literature has shown no studies investigating the quality and reliability of the healthcare information on inflammatory muscle diseases (as a group or individual disease) provided by YouTube. Thus, the potential of YouTube to provide healthcare information to both patients and healthcare professionals is not known regarding this topic. This study seeks to evaluate the quality of healthcare information available on YouTube. Additionally, it aims to identify factors or video characteristics that influence the information's quality and reliability.

Materials and Methods

The chosen keywords, "Inflammatory muscle disease", "Idiopathic inflammatory myositis", "Inflammatory muscle disease treatment", "Inflammatory myositis treatment", "Dermatomyositis" and "Polymyositis" were written in the search bar in the site "www.youtube.com" in April 22nd, 2022. Since users typically view only the first three pages, all videos from these pages were included (10). The likelihood of a video appearing on these pages increases with its popularity, ensuring that the most popular videos are included. Our search method gave a total of 300 videos, and these videos were assessed by two researchers. Irrelevant videos, duplicates, non-English videos, or videos with serious technical flaws that made it impossible to assess were excluded. Included videos were then grouped as "for patients" and "for health professionals", and were analyzed separately.

Global quality scale (GQS): The GQS is a scale designed to assess internet information sources. It evaluates aspects such as media flow and user-friendliness. Scores range from 1 to 5, where 1 or 2 signify low quality, 3 indicates intermediate quality, and 4 or 5 denote high quality (11). The details and the criteria of GQS was given in Table 1.

DISCERN tool: The modified DISCERN tool was used to evaluate the reliability of the included videos. Scores range from 0 to 5 points, with higher scores indicating greater reliability (12,13). The details and the criteria of the modified DISCERN tool was given in Table 2.

Sources and the properties of the videos: Evaluators identified the video sources, categorizing them into the following groups: "Academic/University", "Physician", "Health-related website", "Professional organization", "Non-physician health personnel", "Patient" and "Independent User" (14). Other video characteristics, such as the total number of likes, comments, views, and video duration, were also recorded and analyzed.

Since this study uses publicly available data and does not involve human subjects, it is exempt from committee of ethics approval. This exemption applies to other similar study designs as well (13,15,16).

Statistical Analysis

The analysis was conducted using the Statistical Package for the Social Sciences version 26.0 (SPSS Inc., Chicago, IL, USA). Data were described using median (minimum-maximum), median (interquartile range), numbers, and percentages. The Shapiro-Wilk test assessed the normality of distributions. Depending on whether the data were categorical or continuous, chi-square tests and the Kruskal-Wallis test were used to compare the groups. The kappa coefficient was used to evaluate the agreement between the two researchers. The threshold for significance was considered $p<0.05$.

Table 1. Global Quality score

1	Poor quality, poor flow, most information missing, not helpful.
2	Generally poor, some information given but of limited use.
3	Moderate quality, some important information is adequately discussed.
4	Good quality, good flow, most relevant information is covered, useful.
5	Excellent quality and excellent flow, very useful.

Table 2. DISCERN score

1	Is video clear, concise and understandable?
2	Are valid sources cited? (From valid studies or experts)
3	Is the information provided balanced and unbiased?
4	Are additional sources of information listed for reference?
5	Does the video address areas of controversy/ uncertainty?

Results

The inter-rater correlation analysis for GQS scores gave the kappa score of 0.88, indicating an excellent agreement.

The duplicate videos (n=51) were removed after obtaining the initial 240 videos. Twenty-five videos were then excluded from the analysis due to language other than English (n=5), irrelevant content/advertisement (n=12), and technical issues that made the videos unassessable (n=8).

The videos were then marked for their audience, which gave 116 videos for health professionals, and 75 videos for patients, as 27 videos were found to be useful for both audiences. The general features of the videos were given in Table 3.

The sources of the videos intended for healthcare professionals were given in Table 4. Most of these videos were uploaded by physicians, and all high-quality videos were uploaded by physicians and academics/universities. The videos that were uploaded by non-physician healthcare professionals, independent users, and health-related websites were found to be of low quality. Still, most of the videos were found to be of intermediate quality, and as physicians contributed the most to the videos, they had the highest number of videos among all quality categories.

The sources of the videos intended for patients were given in Table 5. The physicians had the highest amount of numbers in these videos too, only to be seconded by the patients

Table 3. General features of the videos included for healthcare professionals and patients median (minimum-maximum)

	For healthcare professionals (n=116)	For patients (n=75)
Number of views	1743 (76-54,041)	3346 (25-220,847)
Number of likes	19 (1-655)	41 (1-374)
Number of comments	2 (0-92)	4 (0-242)
Duration (seconds)	335 (32-3569)	220 (66-3427)

Table 4. Source of the videos according to quality groups for professionals

	Low quality (n=36)	Intermediate quality (n=60)	High quality (n=20)
Physician	22 (22.9%)	55 (57.3%)	19 (19.8%)
Health-related website	1 (100%)	0	0
Academic/university	0	0	1 (100%)
Professional organization	1 (25%)	3 (75%)	0
Non-physician health personnel	5 (100%)	0	0
Patient	4 (66.7%)	2 (33.3%)	0
Independent user	3 (100%)	0	0

themselves. Most of the physicians' content was found to be high in quality (41.9%), with intermediate-quality content being very close (39.5%). Although the patients contributed the most to the high-quality videos after physicians, most of their content was of low (38.5%) and intermediate (38.5%) quality. There were also contributions from independent users and non-physician healthcare professionals to the high-quality and low-quality content.

The inter-rater correlation analysis for GQS scores gave the kappa score of 0.88, indicating an excellent agreement.

There were no differences among quality groups regarding the number of views, comments, or video durations. In both groups of videos, DISCERN scores were found to differ among videos of different qualities ($p<0.01$). Interestingly, the number of likes was found to be an indicator of quality for videos intended for healthcare professionals ($p=0.004$), and not for the videos intended for patients ($p>0.05$). The findings were given in Table 6.

Discussion

As technology advances, the internet and associated information sources like websites have become increasingly popular. However, these sources, with their vast amounts of information, also carry the risk of providing biased, flawed, invalid, or potentially harmful content (17). Since platforms like YouTube currently lack protective measures such as expert reviews and inspections, mitigating the risk of inaccurate information relies on the vigilance of users and, if they choose to recommend such resources, healthcare professionals (18). Research efforts to evaluate the quality of healthcare information on YouTube are expanding and becoming more prevalent across various medical fields (10,13,15,19). There is still no data available on the quality of videos uploaded about inflammatory muscle diseases. Moreover, most of the studies seem to solely focus on patient education. However, there seem to be many healthcare professionals, especially students (7,20). Therefore, we have decided that our analyses should also cover them as well, and potentially lead them to better sources of information.

One of the aims of our study was to define the characteristics and the sources of videos aimed at healthcare professionals. Compared to the videos aimed at patients, they seemed to have fewer numbers of views, likes numbers of comments, and longer durations. As the patients are expected to form a bigger portion of information seekers through YouTube, these findings are not unusual. High-quality and intermediate-quality videos for the education of professionals were found to be coming from physicians or academic/university sources, with 2 intermediate quality videos from the patients themselves. Thus, health

Table 5. Source of the videos according to quality groups for patients

	Low quality (n=21)	Intermediate quality (n=27)	High quality (n=27)
Physician	8 (18.6%)	17 (39.5%)	18 (41.9%)
Non-physician health personnel	2 (66.7%)	0	1 (33.3%)
Patient	10 (38.5%)	10 (38.5%)	6 (23.1%)
Independent user	1 (33.3%)	0	2 (66.7%)

Table 6. The differences between video features among quality groups for videos (median-IQR)

	For healthcare professionals (n=116)				For patients (n=75)			
	Low quality (n=36)	Intermediate quality (n=60)	High quality (n=20)	p-value	Low quality (n=21)	Intermediate quality (n=27)	High quality (n=27)	p-value
DISCERN score	1 (1-1)	2 (1-2)	2.5 (2-3)	**<0.001**	1 (1-1)	1 (1-2)	2 (1-3)	**<0.001**
Number of views	1293 (605-3071)	1692 (544-7749)	3818 (603-14,643)	0.18	2866 (940-6810)	3350 (1721-6505)	3346 (815-12,009)	0.8
Number of likes	12 (7-35)	21 (11-117)	56 (16-201)	**0.004**	21 (8.5-69.5)	58 (15-123)	44 (16-160)	0.18
Number of comments	1 (0-5)	2 (0-8)	3 (2-11)	0.11	6 (2-12)	5.5 (0-21)	4 (2-11)	0.91
Duration (seconds)	134 (77-594)	450 (161-1444)	560 (256-1837)	0.25	165 (104-482)	265 (148-601)	324 (176-644)	0.39

IQR: Interquartile range

professionals should seek these sources if they wish to get better quality information, still keeping an eye out for the videos of the patients as well, as they can also find out precious insights that are beyond the books.

The videos that may address the patients were also assessed for their sources. These videos constituted the more popular and shorter videos in our study, with more views and shorter durations. The videos that were prepared by the physicians were found to have a high quality, with more than 80% of the videos being of intermediate or higher quality. A portion of the videos that were created by patients was also found to be of worthy quality, which hints to the users to give a chance at the patients who speak for themselves. While in little numbers, videos prepared by non-physician health personnel were rarely found to have a high quality, and rare videos from independent users were found to have high-quality videos, mostly. The literature for various medical conditions is also similar, since most of the higher-quality videos belong to healthcare professionals, mostly physicians, in that field (21,22). These findings indicate that the patients may have a chance to find better quality videos if they sought videos prepared by the doctors. This also indicates that physicians should work on preparing more videos as well as academic sources such as universities, which may give even better results with a more professional approach.

Determinants of the quality of the videos were evaluated and defined for both videos that may appeal to the professionals and the patients. Our study yielded no determinants of the quality of the videos for the patients, and neither views, likes, comments nor the duration of the video were useful to predict the quality of a video. However, the number of likes was found to be useful to predict whether a video was of a higher quality for the videos aimed at healthcare professionals. Therefore, this audience may use this detail to seek better-quality videos. Similarly, neither comments, views nor durations were of use to predict the quality of these videos. Looking from the other side, the DISCERN scores of the higher-quality videos were significantly higher for both audiences. Thus, as the quality of a video increases, the information provided by the video gets more reliable and valid. These findings were similar to the ones found in the literature and back up the fact that the quality and the reliability of the information often coexist (13,23).

Study Limitations

The strengths of the study include the use of multiple evaluators to assess the videos, which gave excellent agreements on inter-rater correlations. Additionally, validated and reliable scoring systems, which have been widely used in previous research on various topics, were employed to assess the videos.

However, the study has several limitations. The videos were selected and evaluated at a single point in time, which may not represent the dynamic and ever-changing nature of YouTube. While the GQS has been extensively used in such studies, it remains a subjective scoring system, and finding an objective alternative is challenging. Furthermore, the video search was limited to those in English, so results may differ across other languages and regions.

Conclusion

With its increasing access, the internet serves as a source of information for almost anything, including health and education. YouTube is one of the most accessed and popular websites and has a mixed pool of videos regarding the quality and reliability for both patients and health professionals for inflammatory muscle diseases. Since better reliable information of higher quality matters in a platform where anyone can upload almost anything, academics, professional organizations, universities, associations, and healthcare practitioners should upload more videos to provide reliable, practical, and high-quality health-related information. Better education for the patients may help them adhere to the treatment and hopefully improve the quality of their lives.

Ethics

Ethics Committee Approval: This study does not include any human participants or animals. Videos that were available to everyone were evaluated for this study. Therefore, ethics committee approval was not required.

Informed Consent: The study does not require patient consent.

Authorship Contributions

Concept: G.T., Design: G.T., Data Collection or Processing: G.T., G.K., Analysis or Interpretation: G.T., G.K., Literature Search: G.T., G.K., Writing: G.T., G.K.

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Vitamin D Levels and Their Relationship with Ambulation in Patients with Amyotrophic Lateral Sclerosis

Amyotrofik Lateral Sklerozlu Hastalarda Vitamin D Düzeyleri ve Ambulasyonla İlişkisi

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Abstract

Objective: Vitamin D is a steroid hormone that exerts many effects on human health. Amyotrophic lateral sclerosis is a progressive neurodegenerative disease characterized by the loss of motor neurons. This can result in a number of complications, including muscle weakness, spasticity, difficulty swallowing, speech disturbances, and, in some cases, respiratory failure. A number of studies have reported an association between vitamin D and various neurological diseases. This study aimed to assess vitamin D levels in patients diagnosed with amyotrophic lateral sclerosis and compare them with those of a control group comprising healthy individuals. In addition, the correlation between vitamin D levels and functional ambulation levels will be examined.

Materials and Methods: This retrospective cross-sectional study was conducted involving 29 male and female patients diagnosed with definite amyotrophic lateral sclerosis using the El Escorial criteria and 28 healthy controls from the physical medicine and rehabilitation clinic of medicine. The medical records of the patients were consulted to obtain relevant demographic, clinical, and vitamin D levels. Subsequently, vitamin D levels were compared with those of healthy controls.

Results: The results are presented in the following section. The mean vitamin D level observed in the patient group with amyotrophic lateral sclerosis was 20.21±9.53, while in the healthy control group, it was 26.69±8.90. A statistically significant difference in vitamin D levels was observed between the two groups (p=0.034). No correlation was observed between patients' ambulation levels and vitamin D levels (p=0.202).

Conclusion: It can be concluded that patients with amyotrophic lateral sclerosis are at risk of vitamin D deficiency or insufficiency. It is therefore recommended that regular vitamin D levels are measured and treatment plans are developed for these patients.

Keywords: Amyotrophic lateral sclerosis, vitamin D, ambulation

Öz

Amaç: Vitamin D insan sağlığı üzerine çok yönlü etkileri olan steroid yapıda bir hormondur. Amyotrofik lateral skleroz ilerleyici kas güçsüzlüğü, spastisite, yutma, konuşma bozuklukları ve solunum yetmezliğine yol açan motor nöronların progresif kaybıyla karakterize nörodejeneratif hastalıktır. Çalışmalarda vitamin D'nin nörolojik pek çok hastalıkla da ilişkili olduğu bildirilmiştir. Amacımız amyotrofik lateral skleroz hastalarında vitamin D düzeylerini değerlendirmek ve sağlıklı kontrollerle karşılaştırmak, vitamin D düzeyinin fonksiyonel ambulasyon düzeyleriyle ilişkisini değerlendirmektir.

Gereç ve Yöntem: Retrospektif, kesitsel çalışmaya tıp fakültesi fiziksel tıp rehabilitasyon kliniğinde takipli El Escorial kriterlerine göre kesin amyotrofik lateral skleroz tanılı kadın ve erkek 29 hasta ve 28 sağlıklı kontrol alındı. Hastaların kayıtlı dosyalarından demografik, klinik verileriyle vitamin D düzeyleri kaydedildi. Vitamin D düzeyleri sağlık kontrollerle karşılaştırıldı.

Bulgular: Amyotrofik lateral skleroz hastalarının vitamin D düzeyi: 20,21±9,53, sağlıklı kontrol grubunun 26,69±8,90 idi. Gruplar arası vitamin D düzeylerindeki fark istatistiksel olarak anlamlıydı (p=0,034). Hastaların ambulasyon düzeyi ile vitamin D düzeyleri arasında ilişki saptanmadı (p=0,202).

Sonuç: Amyotrofik lateral skleroz hastaları vitamin D eksiklik/yetersizlik açısından risk altında olan bir gruptur. Bu hastalara vitamin D düzeylerinin düzenli ölçümlerinin yapılması ve tedavilerinin planlanmasının uygun olacağını düşünmekteyiz.

Anahtar kelimeler: Amyotrofik lateral skleroz, vitamin D, ambulasyon

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Introduction

Vitamin D is a steroid hormone with a wide range of physiological effects on human health. While its most significant and well-documented effects are on the skeletal system, there is also substantial scientific evidence linking deficiency of vitamin D with a range of neurological disorders, including Parkinson's disease, multiple sclerosis, neurodegenerative conditions, migraine headaches, and diabetic neuropathy. Vitamin D receptors are expressed in a number of vital brain regions, including the substantia nigra, hippocampus, hypothalamus, thalamus, and subcortical grey nuclei, in both neurons and glial cells. In these regions, vitamin D has been demonstrated to be effective in the differentiation and maturation of neurons. It has been demonstrated to play a role in the modulation of growth factor biosynthesis, including that of nerve growth factor derived from glial cell lines, and in the biosynthesis of various transmitters, including acetylcholine (1).

It is of the utmost importance to evaluate vitamin D not only in terms of serum 25-hydroxyvitamin D [25(OH)D] levels, but also as an indicator of overall lifestyle.

Indeed, reduced vitamin D levels may indicate dietary habits and levels of physical exercise, as well as being influenced by several health-related factors, such as body mass index (BMI). It is therefore recommended that serum 25(OH)D levels be considered not only as an indicator of vitamin D status, but also as an indicator of overall health status. Furthermore, there is evidence to suggest that vitamin D plays a role in muscle strength. A deficiency in vitamin D has been associated with impaired physical performance, a reduction in bone mineral density, and an elevated incidence of falls (2). The prevalence of amyotrophic lateral sclerosis (ALS) is estimated at 2-3 per 100,000. A range of factors, including genetic, environmental, and lifestyle factors, are implicated in the etiology of this disorder. The range of medical treatment options is restricted, as there are only two approved pharmaceutical agents for the disease: riluzole and edaravone (3). Therapeutic intervention aims to improve quality of life and prolong survival through a multidisciplinary approach, with a particular focus on symptom management (4,5). Recent years have seen a growing body of evidence emerge from scientific research examining the potential role of vitamin D in the context of ALS and its relationship with the disease. The role of vitamin D levels in ALS patients and its role in the disease are subjects of considerable debate and controversy (6). The objective of our study was to evaluate vitamin D levels in patients with ALS and to compare them with those of healthy controls. Additionally, we sought to assess the relationship between patients' vitamin D levels and their functional ambulation levels.

Materials and Methods

The study was conducted using a cross-sectional, retrospectively designed methodology. The İzmir Bakırçay University Non-Interventional Clinical Research Ethics Committee has reached a decision, numbered 1438 (date: 24.01.2024), in regard to the aforementioned matter. The study population consisted of female and male patients diagnosed with definite ALS who first sought treatment at the Physical Medicine and Rehabilitation Clinic of İzmir Bakırçay University Faculty of Medicine between May and November of the years 2022-2023. Individuals who had received vitamin D treatment were excluded from the study. A review of the medications used by patients was conducted based on an analysis of their medical records. Patients with nephropathy (serum creatinine level >1.5 mg/dL), tube feeding, gastrostomy use, and those who were taking vitamin D supplements were not included in the study.

A review of the patients' follow-up files was conducted to obtain information regarding their demographic characteristics, the auxiliary devices they were using, their functional ambulation levels, and the concentration of 25(OH)D, calcium, phosphorus, and parathormone in their serum. The serum 25(OH)D levels of the patient group were compared with those of a healthy control group of the same age and gender. Subsequently, the relationship between vitamin D levels and functional ambulation values in the patient group was evaluated.

25(OH)D levels were measured by electrochemiluminescence immunoassay (ECLIA) using the Elecsys Vitamin D total III, version 2.0 kit on the Roche Cobas E 801 analyser (Roche Diagnostics, Mannheim, Germany). 25(OH)D levels were measured by ELISA. Serum 25(OH)D levels were categorised as follows: a level of less than 10 ng/mL indicates vitamin D deficiency, a level of 10-20 ng/mL indicates vitamin D insufficiency, a level of 20 ng/mL or more is considered sufficient for bone health, and a level of 30-50 ng/mL is considered sufficient for extra-bone effects. In this study, a level of 30-50 ng/mL was found to be adequate for extra-bone effects (7).

The Functional Ambulation scale (FAS) was employed to assess the patients' ambulatory abilities (8). This scale is used to classify the patient's motor skills with regard to ambulation.

- Level 0: The patient is non-functional and unable to ambulate.
- Level 1: The patient is able to walk with constant support and supervision or continuous manual assistance.
- Level 2: The patient is able to ambulate with the assistance of a walking aid, bearing minimal weight on their own limbs.
- Level 3: The patient is able to walk on flat ground without manual assistance, provided that they are under the supervision of a healthcare professional.
- Level 4: The patient is able to walk independently on flat ground, but is unable to climb stairs or traverse uneven surfaces.
- Level 5: The patient is able to walk independently on any surface and at any speed.

Patients were classified into two groups based on their FAS level. The initial cohort comprised individuals with levels 0, 1, or 2, indicative of a markedly impaired capacity for ambulation. In contrast, the subsequent cohort consisted of those with levels 3, 4, or 5, which are typically regarded as indicative of an adequate ambulatory capacity.

Patients' BMI was categorised as follows: A BMI of less than 18.4 is classified as low weight, a BMI of 18.5 to 24.9 is classified as normal weight, a BMI of 25 to 29.9 is classified as excess weight, and a BMI of 30 to 34.9 is classified as obese (9).

Statistical Analysis

Statistical analysis was performed with SPSS version 25 for Windows. Normality of the data was assessed using the Shapiro-Wilk test. Data with a normal distribution were presented as mean ± standard deviation, whereas non-normally distributed data were presented as median and interquartile range. Student's t-test or Mann-Whitney U test was used to determine whether there were significant differences in means or medians between the groups. Correlations between variables were assessed using the Pearson or Spearman test, as appropriate. Chi-square test was used to assess associations between categorical variables. A p-value of lower than 0.05 was regarded as statistically significant.

Results

Initially, 30 patients with ALS were to be included in the study. However, one patient's data was excluded as an outlier, resulting in 29 patients being included in the study. Of the 29 patients, 18 were males, and 11 were females. The healthy control group consisted of 28 individuals, of whom 17 were males and 11 were females. The group of ALS patients had a similar age and sex distribution to the control group (p=0.916).

The demographic data of the patients with ALS are shown in Table 1.

The average vitamin D level in men with ALS was 22.96±9.15, while in women, it was 15.70±8.70. There was a statistically significant difference between the two groups (p=0.022).

The ALS patient group and the control cohort had sufficient vitamin D levels to support bone health. However, the levels observed in both groups were below the optimal range for extracellular tissues (<30 ng/mL). A statistically significant difference was observed between vitamin D levels in ALS patients and healthy controls (p=0.034) (Table 2).

Figure 1 shows the levels of 25(OH)D observed in both the ALS cohort and the matched healthy control group. Vitamin D levels in patients with severe ambulatory impairment (n=8) were 16.51±6.5 ng/mL, whereas those who were able to walk (n=21) had levels of 21.62±10.23 ng/mL. There was no statistically significant difference between the two groups (p=0.202).

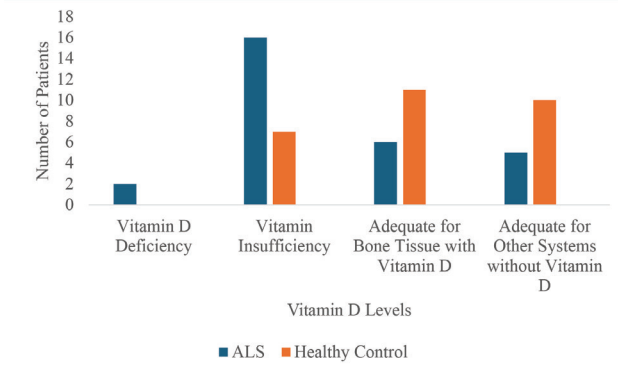

Figure 1. Vitamin D Levels of amyotrophic lateral sclerosis and healthy control group
ALS: Amyotrophic lateral sclerosis

Table 1. Demographic data of patients with amyotrophic lateral sclerosis

	n	%
Mean age in years	59.20±7.77	
Gender		
Male/female	18/11	63/37
Average year of diagnosis (year) (mean ± SD)	4.17±3.14	
Body mass index		
Low weight	1	1.8
Normal weight	12	21.1
Excess weight	9	15.8
Obese	7	12.3
Functional ambulation level		
FAS 0	7	24.1
FAS 1	0	0.0
FAS 2	1	3.4
FAS 3	5	17.2
FAS 4	11	37.9
FAS 5	5	17.2
Assistive device usage		
No device used	18	62.1
Cane	2	6.9
Walker	1	3.4
Wheelchair	8	27.6

FAS: Functional Ambulation scale, n: Patient count, %: Percentage rate, SD: Standard deviation

Table 2. Biochemical data of amyotrophic lateral sclerosis and healthy control group

	ALS	Control	p-value
Vitamin D (ng/mL)	20.21±9.53	26.69±8.90	**0.034***
Phosphorus	3.53±0.55	3.24±0.46	**0.035***
Calcium	9.48±1.43	9.55±0.28	0.106
Parathormone	44.55±15.60	41.42±12.73	0.322

*p<0.05 is statistically significant. ALS: Amyotrophic lateral sclerosis

The aim of this study was to analyse vitamin D concentrations between ALS patients and a healthy control group. The association between vitamin D levels and walking was investigated. Vitamin D levels were found to be significantly lower in the ALS patient group compared to the healthy control group. While vitamin D levels were sufficient for bone health (>20 ng/mL) in both ALS patients and the healthy group, they were low for extracellular systems in both groups. No correlation was found between the vitamin D levels and functional ambulation in ALS patients.

Discussion

Vitamin D is a powerful hormone. It has a profound effect on all systems and organs in the human body. Serum levels should be considered an indicator of lifestyle in assessments. Low vitamin D levels are indicative of dietary habits and physical activity levels, so it is recommended that vitamin D levels be taken as an indicator of lifestyle in assessments. Vitamin D exerts neuroprotective effects in numerous pathophysiological processes by modulating oxidative stress, mitochondrial dysfunction, and apoptotic pathways. In ALS, increased levels of glutamate-induced excitotoxic neuronal damage, reactive oxygen radicals, and apoptosis have been implicated in the regulation of intracellular signalling and the maintenance of interneuronal balance (10). The role of vitamin D in ALS is a topic of ongoing debate, with studies investigating its levels, potential as a biomarker, impact on disease progression, and the impact of vitamin D supplementation on clinical outcomes (6). Vitamin D inadequacy and insufficiency are recognised as global epidemics. In our country, the prevalence of vitamin D deficiency is 51.8% (9). Several studies have reported significantly lower vitamin D concentrations in patients with ALS compared to healthy controls (10-12). Cortese et al. (13) determined the average vitamin D levels in 71 patients and assessed them using the ALS Functional Rating scale-revised (ALSFR-R). The prevalence of vitamin D deficiency was found to be related to disease severity. It has also been postulated that the different degrees of ALS symptom onset may be explained by different disturbances in vitamin D signalling pathways in cortical/spinal motor neurons (13,14). In their systematic review, Plantone et al. (15) evaluated twelve observational studies and one randomised controlled trial involving 1,280 patients with ALS and compared their vitamin D levels with those of controls. The researchers found that people with ALS had reduced vitamin D levels compared with healthy controls. On average, ALS patients had vitamin D concentrations that were -6.1 ng/mL lower than those in the healthy controls (15). Regarding the frequency of vitamin D deficiency in patients with ALS, although these individuals generally have lower concentrations of vitamin 25(OH)D compared with the normal range, there are studies that report no statistically significant difference in vitamin 25(OH)D concentrations between ALS patients and controls (16,17).

Vitamin D supplementation has been shown to improve motor function and reduce the incidence of falls (18). In contrast to the findings of our study, vitamin D supplementation has been shown to have a beneficial impact on motor function in ALS mouse models, while vitamin D deficiency has been associated with a detrimental effect on motor function and disease severity (19). The researchers also looked at the association between vitamin D levels and gender in people with ALS. The results showed that men had higher vitamin D levels. It is possible that changes in hormone levels in postmenopausal women, traditional clothing and limited sun exposure in older female patients may be contributing factors (20). The present study did not find a correlation between walking and vitamin D levels. However, the progressive deterioration of ambulation in ALS patients may lead to reduced exposure to direct sunlight, which could contribute to vitamin D deficiency.

In the present study, functional ambulation was assessed in terms of gross motor function. No association was found between vitamin D levels and walking disability or respiratory function tests. This finding is consistent with the observations reported by Yang et al. (21). Nevertheless, Camu et al. (22) conducted an evaluation of vitamin D levels and their correlation with ALS prognosis using a total of nine observational studies. The researchers correlated vitamin D levels with a clinical marker used to assess ALS prognosis, the ALSFRS-R, forced vital capacity and survival. A correlation was found between low vitamin D levels in ALS patients and impairment of gross motor function and ALSFRS-R scores. Camu et al. (22) reported an association between lower vitamin D levels and more severe disease progression. Vitamin D levels were found to be positively related to survival, highlighting its neuroprotective function with respect to motor neurons (22). The available literature suggests that vitamin D supplementation has no effect on prognosis. However, a single randomised controlled trial reports an increase in ALSFRS-R with high dose vitamin D. Therefore, regular assessment of vitamin D levels in patients is recommended (23).

Study Limitations

Our study's value lies in its pioneering evaluation of vitamin D levels in ALS patients in our country. The main limitation of the study is the relatively small number of patients included. It is recommended that future studies with larger numbers of patients be planned to evaluate vitamin D levels and clinical outcomes such as ALSFR-R after vitamin D supplementation.

Conclusion

In conclusion, patients with ALS are at risk of developing vitamin D deficiency or insufficiency. It is recommended that regular assessment of vitamin D levels and supplementation be undertaken in patients with ALS, given the beneficial effects of vitamin D on all systems, with particular benefit to bone health.

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Ethics

Ethics Committee Approval: The İzmir Bakırçay University Non-Interventional Clinical Research Ethics Committee has reached a decision, numbered 1438 (date: 24.01.2024).
Informed Consent: Retrospective study.

Authorship Contributions

Concept: F.M.S., F.D.A., Design: F.M.S., F.D.A., Data Collection or Processing: F.M.S., F.D.A., Analysis or Interpretation: F.M.S., F.D.A., Literature Search: F.M.S., Writing: F.M.S.
Conflict of Interest: No conflict of interest was declared by the authors.
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Bisphosphonates: Ally or Enemy in the Fight Against Rheumatological Diseases? Two Case Report

Bifosfonatlar: Romatolojik Hastalıklarla Mücadelede Dost mu, Düşman mı? İki Olgu Raporu

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Abstract

Due to their primary and well-known antiresorptive activity, bisphosphonate (BPs) are commonly prescribed as first-line drugs for osteoporosis treatment. Some reports suggest that they may also possess immunomodulatory and anti-inflammatory properties, along with potential benefits in preventing structural joint damage in inflammatory rheumatic diseases. However, despite the promising outcomes observed with BP use in treating rheumatic disorders, numerous reports have implicated these drugs as potential contributors to the development of arthritis. In this case report, two female patients aged 71 and 55 years who developed arthritis in the wrist and dactylitis in the finger after zoledronic acid infusion are presented. This study is significant because, to our knowledge, one of our patients is the first to have been diagnosed with dactylitis, and the other case is one of the few cases in the literature presenting oligoarticular involvement of joints after zoledronic acid administration.

Keywords: Arthritis, biphosphonates, dactylitis

Öz

Bisfosfonatlar (BP'ler), iyi bilinen anti-rezorptif etkileri nedeniyle, osteoporoz tedavisinde tercih edilen ilk ilaçlardandır. Bazı çalışmalara göre, immün modülasyon, anti-enflamatuvar etki ile romatolojik hastalıklarda yapısal eklem hasarının önlemede de işlev görebilecekleri bildirilmiştir. BP'lerin romatolojik hastalıkların tedavisinde kullanılabileceğine dair bu umut verici sonuçlara rağmen, çok sayıda rapor, ilaçların artrit gelişimine katkıda bulunan bir faktör olduğuna işaret etmektedir. Zoledronik asit kullanımına bağlı el bilek artriti ve parmağında daktilit gelişen sırasıyla 71 ve 55 yaşında iki hasta sunulacaktır. Bu çalışma, hastamızın zoledronik asit uygulaması sonrası daktilit tanısı alan ilk olgu olması ve diğer olgumuzun da literatürde zoledronik asit uygulaması sonrası oligoartiküler eklem tutulumu görülen birkaç olgudan biri olması nedeniyle önemlidir.

Anahtar kelimeler: Artrit, bifosfonatlar, daktilit

Introduction

Bisphosphonates (BPs) are considered the primary medications for treating osteoporosis because of their well-established antiresorptive function. Additionally, certain publications suggest their potential role in immunomodulation, anti-inflammation, and preventing structural joint damage in inflammatory rheumatic diseases (1).

Research into the immunomodulatory effects of BPs has concentrated on understanding the mechanisms associated with the acute-phase response triggered by their administration. This includes the stimulation of pro-inflammatory cytokines via the mevalonate pathway, activation of T-cells, and reduction in cytotoxic T-lymphocyte antigen-4 (CTLA-4). In terms of the predominant rheumatologic conditions, significant emphasis has been placed on their potential to mitigate structural damage in inflammatory joint diseases and their role in modulating immune responses within bone lesions (1).

While studies suggest that BPs can be included as part of combination therapy, numerous musculoskeletal side effects have been reported following their use, contrary to previous

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indications. The most common among these is musculoskeletal pain, listed as a potential side effect on the label of all BPs. Between 1995 and 2005, the United States Food and Drug Administration received 117 reports of individuals experiencing severe musculoskeletal pain while taking BPs, including discomfort in bones, joints, and/or muscles (2,3). Atypical femoral fractures and medication-related osteonecrosis of the jaw are two more severe but rare musculoskeletal side effects associated with BP use (4). The expected annual incidence of BP-related jaw osteonecrosis is 0.7 per 100,000 individuals (5). The age-adjusted incidence rate of atypical femoral fracture due to BP use ranges from 1.8 to 113 instances per 100,000 person-years for durations of less than 2 years to 8-10 years, respectively (6). Another infrequently reported side effect of BP use is arthritis and synovitis, which are documented sporadically in the literature on a case-by-case basis.

In this case report, a 71-year-old patient experienced wrist joint pain and swelling attributed to zoledronic acid use, with symptoms managed using steroids over an 8-week period. Additionally, a 55-year-old woman presented with dactylitis, developing over 3-4 days. This report is noteworthy as it documents the first recorded instance of dactylitis in one of our patients and one of the infrequent cases of oligoarticular involvement following zoledronic acid administration documented in the literature for the other patient.

Case Report

Case 1

A 71-year-old woman diagnosed with post-menopausal osteoporosis was initiated on zoledronic acid once a year due to a T-score of -3.3 in bone density assessment. One week after administration, the patient presented to the outpatient clinic complaining of pain and swelling in both hands. She reported no history of trauma or recent excessive hand use. Medical history revealed diabetes mellitus and hypertension but no rheumatologic disease. Moreover, there were no signs or symptoms suggestive of rheumatological disorders such as aphthous or genital ulcers, dermatologic eruptions, eye involvement, dry eyes and mouth, fever, abdominal or chest pain, or inflammatory back pain. There was no family history of rheumatologic disease. Laboratory investigations showed elevated levels of C-reactive protein (CRP) (138.4 mg/L, N: 0-5), sedimentation rate (51 mm/hour), and white blood cell (WBC) count (10,200), with neutrophil count at 8140 and lymphocyte count at 1330. ENA profile, RF, and CCP were all negative. Magnetic resonance imaging (MRI) and ultrasonographic examinations revealed synovial effusion in both wrist joints and tenosynovitis in the extensor tendons (Figure 1). Treatment began with 5 mg of prednisolone, leading to significant pain relief at the one-week follow-up. However, due to persistent fluid accumulation on ultrasonographic images, the prednisolone dosage was increased to 10 mg. By the fourth week, the patient's clinical condition improved, with acute phase reactants showing regression (CRP: 7 mg/L, sedimentation 40 mm/hour, WBC: 9800, neutrophil: 7600, lymphocyte: 1200). Consequently, the prednisolone dose was tapered by 5 mg over two weeks and discontinued by the eighth week. At the one-year follow-up, there were no arthritis exacerbations observed.

Case 2

A 55-year-old patient presented to the outpatient clinic with right knee pain and swelling that developed after falling down stairs a year prior. MRI investigation revealed avascular necrosis in the lateral femoral condyle. Zoledronic acid infusion was recommended following orthopedic consultation. One day after receiving zoledronic acid, the patient returned to the clinic with pain and erythematous swelling in the middle finger of the left hand, diagnosed as dactylitis (Figure 2). She denied recent trauma or excessive hand use. The patient had no history of rheumatologic or dermatologic diseases such as psoriasis. Moreover, there were no signs or symptoms suggestive of rheumatological disorders, including aphthous or genital ulcers,

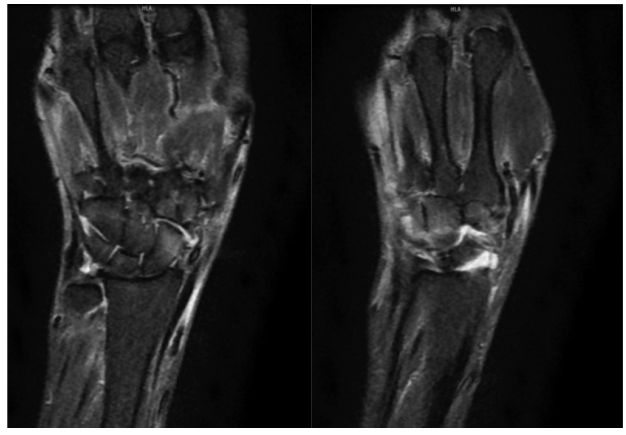

Figure 1. MRI of wrist joint. In MRI investigation, synovial effusion in both wrist joint and tenosynovitis of extensor tendons were detected
MRI: Magnetic resonance imaging

Figure 2. Dactylitis of the middle finger. Erythematous swelling is seen in middle finger of left hand accepted as dactylitis due to BP use
BP: Bisphosphonate

dermatologic eruptions, nail pathologies, eye involvement, dry eyes and mouth, recurrent fever, abdominal or chest pain, or inflammatory back pain. Laboratory investigations, including complete blood count, sedimentation rate, CRP, ENA profile, RF, CCP, and HLA B27, were all within normal ranges. Treatment commenced with non-steroidal anti-inflammatory medication, resulting in symptom resolution within 3-4 days. During the one-year follow-up, no exacerbations were noted.

Written consent was obtained from both patients for publication.

Discussion

In addition to their established mechanisms in osteoporosis treatment, some articles have proposed that BPs might possess immunomodulatory effects, anti-inflammatory properties, and the potential to mitigate structural joint damage in inflammatory rheumatic disorders (1).

One of the most recognized immunomodulatory reactions associated with BPs is the transient acute phase response (7). Studies have shown that zoledronate can modulate CTLA-4, which is elevated in various autoimmune diseases (8). Furthermore, researchers have observed a decrease in CTLA-4 expression after 3 and 5 days, suggesting that zoledronate inhibits this regulator of T-cell responses (7).

Numerous studies have illustrated how BPs halt bone degradation in rheumatologic patients. Specifically, zoledronate, especially at higher doses, has been shown to reduce bone erosion scores on histological assessments and decrease joint damage on radiological investigations in rats with collagen-induced arthritis. These findings are in line with zoledronate's capacity to inhibit osteoclastic bone resorption (9-11).

Despite the promising outcomes observed with the use of BPs in managing rheumatic diseases, there are numerous reports suggesting that BPs may act as a causative agent in the development of arthritis.

There are several case reports demonstrating that BPs can induce pseudogout attacks (12-14). Additionally, instances of arthritis without crystal detection in synovial fluid analysis have been documented in the literature. Numerous reports have also described transient or persistent arthritis following the use of alendronate (15-19).

Cases of arthritis have also been reported with other BPs besides alendronate. For instance, a patient who developed arthritis 48 hours after receiving the second dose of oral risedronate has been documented. Although her symptoms subsided quickly with rest, they returned one week later when the patient was administered another dose (20).

A patient with metastatic breast cancer developed bilateral knee pain and effusions that left her bedridden for almost four weeks within 48 hours of taking zoledronic acid (21). Another patient experienced a flare-up of hand osteoarthritis following zoledronic acid infusions (22). Additionally, a third case involved acute and severely debilitating polyarthritis induced by zoledronic acid, requiring an extended hospital stay in a frail older patient with multiple co-morbidities (23).

In this case report, a 71-year-old patient experienced wrist joint pain and swelling associated with zoledronic acid use, managed with steroids over an 8-week period, while a 55-year-old woman presented with dactylitis lasting 3-4 days. The absence of a diagnosed rheumatological disease, lack of infection or rheumatological findings upon systemic examination, normal laboratory tests for rheumatological diseases, and the temporal association with drug use all suggest the development of arthritis following BP administration. This report is significant as, to our knowledge, one patient represents the first recorded case of dactylitis following BP use, while the other case is among the few instances documented in the literature of oligoarticular involvement after zoledronic acid administration.

It is undeniable that studies have demonstrated the effectiveness of BPs in preventing structural bone damage and their immunomodulatory effects in treating rheumatological diseases. However, numerous cases, including those presented in our study, have been described in the literature following BP use, indicating potential adverse effects that cannot be overlooked. Despite the well-known side effects of BPs, reports of this nature are relatively scarce in the literature. We believe this may be due to doctors potentially underestimating the prevalence of this condition, possibly due to lack of awareness. Our report aims to draw attention to the possibility of this uncommon side effect of BPs and emphasizes the importance of considering it in the differential diagnosis of acute arthritis or synovitis in patients receiving these medications.

Ethics

Informed Consent: Written consent was obtained from both patients for publication.

Authorship Contributions

Concept: S.S.Ö., B.G., E.U.K., N.M., D.G.K., Design: S.S.Ö., B.G., E.U.K., N.M., D.G.K., Data Collection or Processing: S.S.Ö., B.G., E.U.K., Analysis or Interpretation: S.S.Ö., N.M., D.G.K., Literature Search: S.S.Ö., N.M., D.G.K., Writing: S.S.Ö., B.G., E.U.K.

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