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Türk Osteoporoz Dergisi
TURKISH JOURNAL OF OSTEOPOROSIS

## Editörden / Editorial

Sevgili Meslektaşlarımız,

Değerli meslektaşlarımıza akademik çalışmalarını 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 Antalya'da gerçekleştirilmiştir.

Uluslararası katılımlı olarak düzenlenen bu kongrede osteoporoz, osteoartrit ve kas iskelet sistemi hastalıkları konularındaki bilgilerin güncellenmesi amaçlanmıştı. Konularında önde gelen uluslararası bilim insanlarının da konuşmacı olarak yer aldığı bu kongre bilimsel açıdan çok verimli geçmiştir. Bu kongrede ilk kez Türkiye Osteoporoz Derneği adına "TOD Genç Araştırmacı Teşvik Ödülü" verilmesi kararlaştırılmış ve üç değerli meslektaşımız bu ödüle layık görülmüştür.

Siz değerli meslektaşlarımıza 2025 yılında mutluluğun ve başarının yaşamınızdan eksik olmamasını dileyerek, sevgi ve saygılarımı sunarım.

**Editör**
**Prof. Dr. Yeşim Kirazlı**

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# *YouTube Videos as a Source of Information about Familial Mediterranean Fever: A Reliability and Quality Analysis*

*Ailesel Akdeniz Ateşi Hakkında Bilgi Kaynağı Olarak YouTube Videoları: Güvenilirlik ve Kalite Analizi*

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## *Abstract*

**Objective:** In this study we aimed to investigate the reliability and quality of YouTube videos on familial mediterranean fever (FMF).
**Materials and Methods:** A total of 42 most viewed videos related to FMF were included in this study. The videos included were divided into two groups: professional and non-professional videos. The objective assessment was conducted using two commonly used DISCERN and global quality scale (GQS) instruments.
**Results:** Twenty-nine (69.0%) videos were uploaded by professionals (physicians, health channels) and 13 (31%) videos were uploaded by non-professionals. The mean video length was found as 13.5±12.7 minutes in the professional videos and 6.28±12.6 minutes. Based on the results of the DISCERN scoring, the reliability of the YouTube videos on FMF was poor in 17 (40.5%) videos, moderate in 4 (9.5%) patients, and good in 21 (50%) videos. According to the GQS results, the quality of the videos was poor in 12 (28.6%) videos, moderate in 4 (9.5%) videos, and good in 26 (61.9%) videos.
**Conclusion:** The reliability and quality of videos uploaded by healthcare professionals are higher. Healthcare professionals, including physical therapy and rehabilitation specialists and rheumatologists, should be encouraged to upload reliable video content to appropriately guide patients.
**Keywords:** Familial mediterranean fever, YouTube, DISCERN, quality analysis

## *Öz*

**Amaç:** Bu çalışmada ailevi akdeniz ateşi (FMF) ile ilgili YouTube videolarının güvenilirliğini ve kalitesini araştırmayı amaçladık.
**Gereç ve Yöntem:** FMF ile ilgili en çok izlenen toplam 42 video çalışmaya dahil edildi. İçerilen videolar profesyonel ve profesyonel olmayan videolar olarak iki gruba ayrıldı. Objektif değerlendirme, yaygın olarak kullanılan iki DISCERN ve global kalite ölçeği (GQS) aracı kullanılarak yapıldı.
**Bulgular:** Videoların 29'u (%69,0) profesyoneller (hekimler, sağlık kanalları) ve 13'ü (%31) profesyonel olmayanlar tarafından yüklendi. Ortalama video uzunluğu profesyonel videolarda 13,5±12,7 dakika, 6,28±12,6 dakika olarak bulundu. DISCERN skorlaması sonuçlarına göre FMF'deki YouTube videolarının güvenilirliği 17 (%40,5) hastada kötü, 4 (%9,5) hastada orta, 21 (%50) videoda ise iyi olarak bulundu. GQS sonuçlarına göre videoların kalitesi 12 (%28,6) videoda kötü, 4 (%9,5) videoda orta, 26 (%61,9) videoda ise iyi bulundu.
**Sonuç:** Sağlık profesyonellerinin yüklediği videoların güvenirliği ve kalitesi daha yüksektir. Fizik tedavi ve rehabilitasyon uzmanları ve romatologlar da dahil olmak üzere sağlık profesyonelleri, hastaları uygun şekilde yönlendirmek için güvenilir video içerikleri yüklemeye teşvik edilmelidir.
**Anahtar kelimeler:** Ailevi akdeniz ateşi, YouTube, DISCERN, kalite analizi

## Introduction

Familial mediterranean fever (FMF) is an autosomal recessive inherited inflammatory disease characterized by fever and inflammation in pleura, peritoneum, skin or joints (1). The typical phenotype of FMF includes self-limiting fever and polyserositis, dermal involvement, arthritis and high acute phase response (2). The disease is caused by mutations in the *MEFV* gene that is especially prevalent in the Mediterranean basin (3). FMF is the most common hereditary autoinflammatory disease worldwide.

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FMF is most commonly seen in Jewish, Armenian, Turkish and Arab societies (1). In these tehnic groups, the incidence of FMF is 1/200-1000 with a higher carrier rate of 1/3-5 (4). Although the disease mainly affects populations from the East Mediterranean population, patients are reported from every region of the world due to travel and immigration (5,6).

Although patients with FMF experience similar main manifestations of the disease, the disease experience differs among persons. The duration, severity and personal effects of symptoms are unpredictable, leading people to seek more information about their disease. The Internet and particularly YouTube are the first researched information sources for this purpose. Recently, the Internet has become a major source of health related information (7). Recent survey studies have found that 8 of each 10 Internet users access health related information online (8). Particularly patients with chronic diseases are increasingly relying on the Internet to gain more insight into their diseases and to manage their conditions (9).

YouTube is the most commonly used Internet sharing platform with 2 billion monthly active users, 15 million content creators and 38 million active channels as of 2021 [https://invideo.io/blog/youtube-statistics/ (accessed: 09/11/2021)]. YouTube has a potential for sharing and disseminating health related information as well as as a tool for diagnostic aid and education (10). However, 86% of the online health seekers have concerns about the reliability and quality of health related information they obtained via the Internet, and especially YouTube (11). In addition, healthcare providers and government agencies have also expressed concerns about the quality of the information on this platform due to lack of any guidelines and/or intervention regulating the uploaded material on YouTube. This issue raises questions about the risk of disseminating misleading health related information (12). These concerns have prompted researchers to conduct analysis studies in order to evaluate the reliability and quality of YouTube videos in every field of medicine. A total of 58 YouTube analysis studies has been published only within the last year in PubMed [https://pubmed.ncbi.nlm.nih.gov/?term=youtube&filter=datesearch.y_1 (access date: 15/11/2021)]. Numerous studies have drawn attention to the importance of misleading information in YouTube videos on rheumatic diseases (13-16). However, to our knowledge, there is no study evaluating the content, reliability, and quality of YouTube videos regarding FMF. Therefore, in this study we aimed to investigate the reliability and quality of YouTube videos pertaining to FMF.

## Materials and Methods

The YouTube website was searched for the term "familial mediterranean fever" by two physical medicine and rehabilitation specialists on 10/11/2021. From the filtering feature of YouTube, the "view count" option was selected and the most viewed videos were listed. The search yielded a total of 110 videos pertaining to FMF. Considering that English is viewed as a universal language by many countries in the world, only English videos were included. (10) Irrelevant videos (healing music, mits etc.), non-English, duplicate, and advertisements videos were excluded from the study. As a result, the remaining 42 most vieved videos were included in the study. Since there were only 110 videos regarding FMF, we analyzed all the YouTube videos on this issue. The links of these 42 videos were entered into a Microsoft Excel file and analyzed by the two researchers. The inclusion flowchart of the videos is shown in Figure 1.

The most common methodology in YouTube analysis studies is to focus on a fixed sample size such as "the most commonly viewed 50 videos" or "the first 100 videos" (17). Unlike these studies, we included all possible videos on FMF, but after the exclusion process only 42 relevant videos remained and we completed our analysis with these videos. In order to avoid bias, the evaluation was performed by the two researchers separately in different rooms, but at the same time.

The 42 videos' length, image type, content, qualification of the uploaders, date of upload, time since the upload, view count, the number of daily views, like, dislike and comment counts were recorded. Popularity of an video was determined using the video power index (VPI) as described in the previous studies according to the following formula: (18).

VPI = (like count x 100/ [like count + dislike count]) x 100

The videos included in the study were divided into two groups according to the qualification of the uploaders as professional and non-professional videos and the variables were compared between these two groups. The professional videos included general information about the FMF, while the non-professional videos mainly included patient experience.

Evaluation of the videos was carried out on both a subjective and objective basis. In the subjective evaluation, the two researchers assessed the videos as useful and misleading. The videos containing scientifically unproven information were considered as

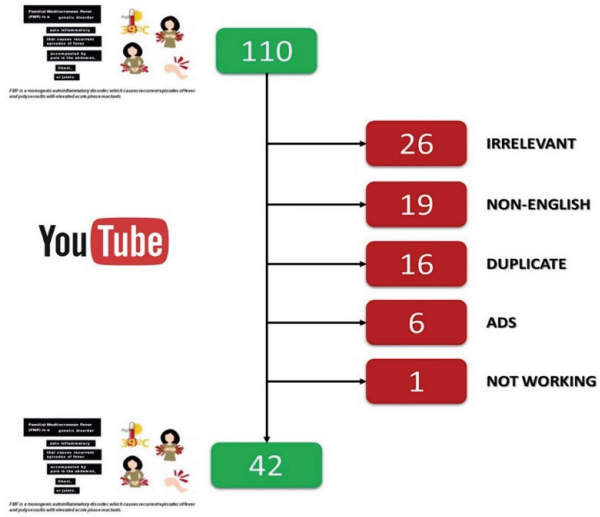


**Figure 1.** Inclusion of the YouTube videos after excluding the irrelevant videos

misleading and those involving scientifically accurate information about the symptoms, clinical presentation, diagnosis, differential diagnosis, treatment, prevention of FMF etc. were accepted as useful. The decision was made with agreement between the two researchers. The objective assessment was made using two commonly used tools DISCERN and global quality scale (GQS). The reliability of the videos was evaluated with DISCERN, while the quality of the videos was evaluated using the GQS. These two instruments have been used commonly for the evaluation of YouTube videos in the previous studies (7,16,19).

**DISCERN scoring:** The DISCERN is a scoring tool used for assessing the reliability of consumer health information on treatment options. In this study, we used the shortened DISCERN tool that was adapted by Singh et al. (13) from the original form. The DISCERN scale includes 5 items scored using a 5-point Likert scale. The DISCERN items investigate the reliability of information sources, additional sources, aims, bias and areas of uncertainty. A video content considered good for DISCERN scores >3 points, moderate for a DISCERN score of 3 and poor for DISCERN scores <3 points (Figure 2) (20).

**GQS:** GQS, which was developed for the first time by Bernard et al. (21) is used to assess the quality of video contents based on the usefulness of the information presented. GQS consists of 5 items that question quality, ease of use and flow of the examined video contents with a 5-point Likert scale. The quality of a video content is scored between 1 point (very poor) to 5 points (excellent) (Figure 3).

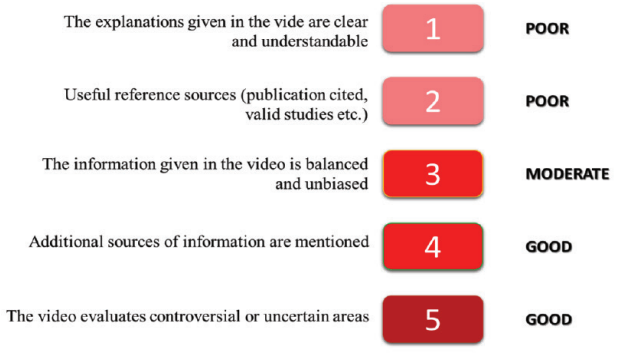


**Figure 2.** Shortened version of the DISCERN scale

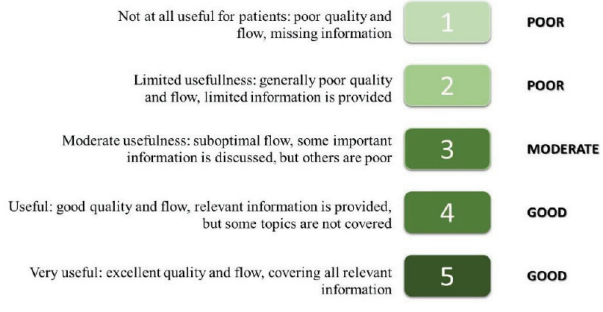


**Figure 3.** Global quality scale

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. The study does not require patient consent.

### Statistical Analysis

The statistical analysis of the data obtained in this study was carried out using SPSS version 24.0 (SPSS, Statistical Package for Social Sciences, IBM Inc., Chicago, IL, USA) statistical software. Normality of the data was analyzed with the Shapiro-Wilk test. Non-normally distributed continuous variables are given as mean ± standard deviation and categorical variables as frequency (n) and percentage (%). Mann-Whitney U was used for the comparison of numerical variables, while chi-square test was used for the comparison of categorical variables between the videos uploaded by professionals and non-professionals. Cronbach alpha coefficients were used to determine the inter-rater agreement consistency. P<0.05 values were considered statistically significant.

## Results

YouTube search on FMF returned a total of 110 videos. Of these, 26 irrelevant videos, 19 non-English videos, 16 duplicate videos, 6 ads and 1 not-working videos were excluded and the remaining 42 videos were subjected to the analysis. Twenty-nine (69.0%) videos were uploaded by the professionals (physicians, health channels, nurses) and 13 (31%) videos by the non-professionals


**Figure 4.** Uploader and quality of the reviewed YouTube videos

(patients, others). As a result of the subjective evaluation of the videos about FMF, 25 (59.5%) videos were found to be useful and 17 (40.5%) videos misleading. Uploaders and general quality of the videos are shown in Figure 4. Image type was found as animation in 1 (2.4%) video, presentations in 19 (45.2%) videos and real images in 22 (52.4%) videos. Video contents were general information about FMF (including symptoms, clinical presentation, diagnosis, treatment, prevention) in 24 (57.1%) videos, congress presentation in 7 (16.7%) videos, patient experience in 6 (14.3%) videos, myth about FMF in 2 (4.8%) videos, case presentation in 1 (2.4%) video, survey about the awareness of FMF in 1 (2.4%) video and relationship between FMF and coronavirus diseaese-19 (COVID-19) in 1 (2.4%) video.

The mean video length was found as 11.27±12.68 minutes. The mean video length was found as 13.5±12.7 minutes in the professional videos and 6.28±12.6 minutes in the non-professional videos. The mean video length was statistically significantly longer in the videos uploaded by professionals (p=0.024). The general characteristics of the reviewed videos are presented in Table 1.

The most viewed video was uploaded by a health channel on November 14, 2012 and included clinical information about FMF that was viewed 36.281 times. The most liked video was uploaded by a physician on December 12, 2020 and included general information on FMF that received 665 likes. The number of views was statistically significantly higher in the videos uploaded by the professionals (4629.59±7819.47) compared to the videos uploaded by the non-professionals (2831.15±3552.77) (p=0.014). The mean daily view was found as 5.41±12.02 in the videos uploaded by the professionals and 1.87±3.71. The mean daily views count was significantly higher in the videos uploaded by the professionals (p<0.001).

The mean VPI value was found as 91.21% in all videos. The mean VPI value was calculated as 95.62% in the useful videos and 85.14% in the misleading videos. The mean VPI value was statistically significantly higher in the videos evaluated as useful (p<0.001). The mean DISCERN score was found as 3.11±1.20 and the mean GQS score as 3.4±1.21 for all videos. The VPI, DISCERN and GQS scores according to the uploaders and general video quality are given in Table 2.

Based on the results of DISCERN scoring, reliability of the YouTube videos on FMF was found as poor in 17 (40.5%) videos, moderate in 4 (9.5%) patients and good in 21 (50%) videos. According to the results of GQS, quality of the videos was found as poor in 12 (28.6%) videos, moderate in 4 (9.5%) videos and good in 26 (61.9%) videos (Figure 5).

The mean DISCERN score given by the researcher 1 was found as 3.02±1.37 and the mean DISCERN score was given by the researcher 2 was found as 3.19±1.15. The mean GQS score given by the researcher 1 was found as 3.43±1.43 and the mean GQS score given by the researcher 2 was found as 3.55±1.06. Accordingly, there was a good agreement between the two independent researchers in terms of the DISCERN and GQS scores (Table 3).

## Discussion

The Internet is the third most trusted source of health related information following physicians and official health care institutions and is considered more reliable compared to the traditional media (22). Hay et al. (23) reported that 87.5% of the patients with rheumatic disease refer to the Internet to obtain information about their condition before seeking medical help from physicians. Furthermore, it has been reported that patients

**Table 1. General characteristics of the reviewed videos according to the groups**

| | Views | Likes | Dislikes | Comments |
|---|---|---|---|---|
| **Uploaders** | | | | |
| Professionals (n=29) | 4629.59±7819.47 | 67.10±123.86 | 2.31±3.54 | 10.79±30.53 |
| Non-professionals (n=13) | 2831.15±3552.77 | 31.62±55.81 | 2.23±2.64 | 15.77±32.58 |
| **Video quality** | | | | |
| Useful (n=25) | 4996.72±7819.47 | 75.28±123.86 | 2.32±3.54 | 12.28±30.53 |
| Misleading (n=17) | 2714.41±3777.92 | 27.94±60.20 | 2.24±2.2,78 | 12.41±34.43 |

**Table 2. VPI, DISCERN and GQS scores according to the uploaders and general quality of the videos**

| | VPI | DISCERN | GQS | p-value |
|---|---|---|---|---|
| **Uploaders** | | | | |
| Professionals (n=29) | 93.36% | 3.62±1.20 | 4.14±1.21 | **<0.001** |
| Non-professionals (n=13) | 86.56% | 1.96±1.22 | 2.04±1.25 | |
| **Video quality** | | | | |
| Useful (n=25) | 95.62% | 3.82±1.20 | 4.32±1.21 | **<0.001** |
| Misleading (n=17) | 85.14% | 2.06±1.21 | 2.26±1.26 | |

VPI: Video power index, GQS: Global quality scale

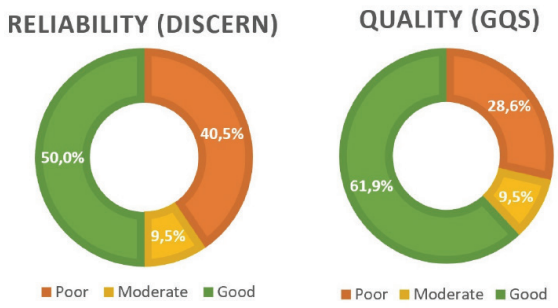


**Figure 5.** Reliability and quality of the YouTube videos regarding FMF according to the DISCERN and GQS scores

*GQS: Global quality scale, FMF: Familial Mediterranean fever*

with more pain tend to resort to the Internet more frequently (23). Because FMF is a painful illness, it is not unusual for these patients to seek information for their condition online. YouTube is an increasingly important source of health related information with a potentişal to influence its users (24). However, the information shown on YouTube lacks scientific inspection and supervision, because everyone can upload such content for free of charge and without being scientifically reviewed. For this reason, YouTube may contain many videos that may be misleading (25).

In the present study, we evaluated the reliability and quality of 42 YouTube videos pertaining to FMF with a total view count of 171,063 and a whole duration of 7.9 hours. In a study by Onder and Zengin (7) on YouTube videos pertaining to gout, the mean views count was reported as over 16 million. The difference may be attributed to FMF being a more specific disease with some ethnic origins. In our study, 69% of the videos were uploaded by health care professionals (physicians, health channels, nurses) and 31% of the videos by non-professionals (patients and others). Majority of the videos uploaded by non-professionals included patient experience as video content. Whereas, the YouTube videos uploaded by the professionals mostly contained general information about FMF, including symptoms, clinical presentation, diagnosis, treatment and prevention. The rate of videos uploaded by health care professionals varies among the studies depending on the characteristics of the disease being searched. Onder and Zengin (7) investigated YouTube videos as a source of information on gout and found that 97% of the videos were uploaded by the professionals (physicians, academic organizations, other healthcare professionals). In our previous YouTube analysis study about Behçet's disease, 46% of the videos were uploaded by the professionals (16). In another study evaluating 42 YouTube videos regarding male infertility, 71.4% of the videos were uploaded by healthcare professionals (26). It is seen that the rate of the videos uploaded by healthcare professionals varies widely among the studies, mainly depending on the health topic searched. Because FMF is an autosomal hereditary inflammatory disease that lasts for a long time, the higher rate of videos uploaded by the professionals compared to patient experience is expected.

**Table 3. Correlation between the two researchers in terms of the DISCERN and GQS scores**

| | Mean | ± SD | r | p-value |
|---|---|---|---|---|
| **DISCERN 1** | 3.02 | 1.37 | 0.845 | p<0.01 |
| **DISCERN 2** | 3.19 | 1.15 | | |
| **GQS 1** | 3.43 | 1.43 | 0.896 | p<0.01 |
| **GQS 2** | 3.55 | 1.06 | | |

GQS: Global quality scale, SD: Standard deviation

In this study, the general quality of the videos was assessed as "useful" or "misleading" based on the consensus achieved by the two researchers. Accordingly, 59.5% of the videos were evaluated as useful and 40.5% as misleading. In a recent study by Andika et al. (27), evaluating the YouTube videos on the COVID-19 pandemic, 23% of the videos were reported to be misleading and 44% useful. The difference between the studies may be resulted from the fact that subjective evaluation of the videos is primarily based on the type of the disease assessed.

In our study, the mean VPI value that shows popularity of a video content was found as 95.62% in the professional videos and 85.14% in the non-professional videos. In the present study, we clearly found that view and like counts were significantly higher in the videos uploaded by the professionals. DISCERN scoring is an important tool indicating the reliability of the videos based on several criteria as mentioned above. According to the DISCERN scoring, the reliability of YouTube videos was poor in 40.5% of the videos. The mean DISCERN score was found as 3.62±1.20 for the videos uploaded by the professionals and 1.96±1.22 for those uploaded by the non-professionals. The significant difference was mainly due to the videos containing patient experiences about FMF that do not make any contribution to the management of the disease. Similar to our results, in the study by Onder and Zengin (7), the mean DISCERN score was found as 2.0 in the videos uploaded by the non-professionals and 3.75 in those uploaded by the professionals. In another study analyzing YouTube videos pertaining to dysphagia, the mean DISCERN score was found as 1.6±1.14 in the low-quality videos and 3.39±0.74 in the high-quality videos (28). In another study by Aydın and Yılmaz (29) investigating YouTube videos about echocardiography, the mean DISCERN score was found as 3.0 for all videos. The results of our study and those of the other studies show higher DISCERN scores for the videos uploaded by the healthcare professionals, that mean a higher reliability.

Quality of the YouTube videos on FMF was measured using the GQS scale. Accordingly, the mean GQS score was found as 4.14±1.21 for the videos uploaded by the professionals and 2.04±1.25 for those uploaded by the non-professionals (p<0.001). In a study by Chang and Park (30) evaluating the most viewed 50 YouTube videos about epidural steroid injection, the mean GQS score of all videos was found as 2.3±1.1. In our previous study on Behçet's disease, the mean GQS score was found as 4.09±0.72 in the videos uploaded by the professionals

and 3.41±0.69 in those uploaded by the non-professionals (16). Cohen's kappa coefficient for inter-rater agreement was found as 0.745 for the DISCERN score, and 0.896 for the GQS scores, indicating near-perfect agreement for both. In the study of Onder and Zengin (31) Cohen's kappa statistic demonstrated an inter-observer agreement of 0.925. In another study by the same author on the validity of health-related information on psoriatic arthritis, inter-rater agreement was 0.783 for the DISCERN score, and 0.862 for the GQS score. In this context, our finding is consistent with the literature.

There are a lot of health related YouTube videos about a wide diversity of diseases and medical conditions. When the previous studies were reviewed, the common aspect of all studies was the fact that the reliability and quality of the video contents uploaded by lay persons were poor. In our analysis there were even healing music videos for treating FMF. This indicates the necessity of regulations for uploading health related content in the Internet and particularly YouTube.

### Study Limitations

Major limitation of the study was including a snap-shot evaluation of the videos at a certain time. Whereas, online information can be uploaded or removed at any time, and even simple searches can give different results depending on the fluctuating popularity of the video content. In addition, the number of viewed videos was relatively small. In addition, to minimize subjective bias in video scoring, future studies may include more reviewers of varying backgrounds such as patients as healthcare consumers and different age groups. It is remarkable that the number of all available videos about FMF was only 110, and 42 videos were eligible for the analysis. Finally, since YouTube video studies are on a wide range of diseases, direct comparison of the results are affected by the disease specific characteristics. For example, since popularity of COVID-19 is much higher than the other medical conditions, it is obvious that comparison of the view, like, dislike counts etc. between nay other disease and COVID-19 would be challenging.

## Conclusion

A considerable portion of YouTube videos pertaining to FMF are of poor quality. The reliability and quality of the videos uploaded by health care professionals are higher. There is an urgent need for regulations/policies for health related YouTube videos. The health related videos on YouTube should be subjected to a professional review process before publishing. Health care professionals, including physical therapy and rehabilitation specialists and rheumatologists should be encouraged to upload reliable video contents to guide patients appropriately.

### Ethics

**Ethics Committee Approval:** Ethics committee approval was not obtained because no human participants or test animals were included in the study.

**Informed Consent:** The study does not require patient consent.

### Footnotes

### Authorship Contributions

Concept: A.K., Y.Ç., Design: A.K., Y.Ç., Data Collection or Processing: A.K., Y.Ç., Analysis or Interpretation: A.K., Y.Ç., Literature Search: A.K., Y.Ç., Writing: A.K., Y.Ç.

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# *Prognostic Nutritional Index in Patients with Both Vertebral and Non-Vertebral Osteoporotic Fractures*

## *Vertebral ve Non-Vertebral Osteoporotik Kırığı Olan Hastalarda Prognostik Nutrisyonel İndeks*

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## *Abstract*

**Objective:** The prognostic nutritional index (PNI) is an index used to evaluate the basic nutritional status of patients with osteoporosis. However, it is not yet clear whether PNI can be used as an indicator of osteoporotic fracture. This study aimed to investigate whether the PNI is different in osteoporotic patients with and without fragility fractures.

**Materials and Methods:** This retrospective study included 58 female patients with osteoporosis. The first group included 28 patients with osteoporotic fractures and 30 patients without fractures. The primary outcome measure was PNI calculated using albumin and lymphocyte values. The secondary outcome measures were bone mineral density (BMD), albumin, lymphocyte, calcium, phosphorus, alkaline phosphatase, parathyroid hormone, calcium/creatine ratio in spot urine, 25-hydroxy vitamin D values, and FRAX® scores.

**Results:** The mean age and body mass index (BMI) were similar in both groups (1st group: age: 67.60±9.78 years; BMI: 27.63±3.89 kg/m$^2$, 2nd group: age: 66.83±7.91 years; BMI: 27.04±4.50 kg/m$^2$). Patients with fragility fractures had a significantly higher risk of FRAX® major osteoporotic fracture (p=0.002) and lower phosphorus levels (p=0.002). There were no significant differences in the PNI and blood albumin levels. Among patients with fragility fractures, albumin levels were significantly lower in patients with vertebral fractures (p=0.049), and corrected calcium values were significantly lower in patients with non-vertebral fractures (p=0.002). Correlation analysis showed that in patients with fragility fractures, there was no correlation between PNI, albumin levels, BMD, and FRAX®.

**Conclusion:** Our results showed no association between PNI and fragility fractures in patients with osteoporosis.

**Keywords:** Osteoporosis, osteoporotic fractures, prognostic nutritional index

## *Öz*

**Amaç:** Prognostik nutrisyonel indeks (PNI), temel beslenme durumunu değerlendirmek için kullanılan bir indekstir ve osteoporozlu hastaların beslenme durumunu değerlendirmek için kullanılabilir. Ancak PNI'nın osteoporotik kırık için bir gösterge olarak kullanılıp kullanılamayacağı henüz belli değildir. Bu çalışmanın amacı kırılganlık kırığı olan ve olmayan osteoporotik hastalar arasında PNI'da fark olup olmadığını araştırmaktır.

**Gereç ve Yöntem:** Bu araştırma, osteoporoz tanısı almış 58 kadın hastanın dahil edildiği retrospektif bir çalışmadır. Birinci grupta osteoporotik kırığı olan 28 hasta, ikinci grupta ise kırığı olmayan 30 hasta yer aldı. Birincil sonuç ölçüsü albümin ve lenfosit değerleri kullanılarak hesaplanan PNI idi. İkincil sonuç ölçütleri kemik mineral dansitometrisi (BMD), albümin, lenfosit, kalsiyum, fosfor, alkalen fosfataz, paratiroid hormonu, spot idrarda kalsiyum/kreatin oranı, 25-hidroksi D vitamini değerleri ve FRAX® skorlarıdır.

**Bulgular:** Ortalama yaş ve vücut kitle indeksi (VKİ) her iki grupta da benzerdi (1. grup: yaş: 67,60±9,78 yıl; VKİ: 27,63±3,89 kg/m$^2$, 2. grup: yaş: 66,83±7,91 yıl; VKİ: 27,04±4,50 kg/m$^2$). Osteoporotik kırığı olan hastalarda FRAX majör osteoporotik kırık riski anlamlı derecede yüksek (p=0,002) ve fosfor düzeyleri daha düşüktü (p=0,002). PNI ve kan albümin düzeylerinde anlamlı bir fark yoktu. Osteoporotik kırığı olan hastalardan vertebra kırığı olanlarda albümin anlamlı olarak daha düşük (p=0,049), vertebral dışı kırığı olanlarda ise düzeltilmiş kalsiyum değeri anlamlı olarak daha düşüktü (p=0,002). Kırılganlık kırığı olan hastalarda PNI, albümin seviyeleri, BMD ve FRAX® arasında herhangi bir korelasyon bulunmadığı görüldü.

**Sonuç:** Sonuçlarımız osteoporotik hastalarda PNI ile kırılganlık kırıkları arasında bir ilişki bulunmadığını gösterdi.

**Anahtar kelimeler:** Osteoporoz, osteoporotik kırıklar, prognostik nutrisyonel indeks

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## Introduction

A fragility fracture is a fracture that occurs as a result of mechanical forces known as low-energy trauma that would not normally produce a fracture. Osteoporotic fragility fractures occur mainly in bones with low density, such as the vertebral column, hip, forearm, and shoulder (1). Additionally, they may occur in other bones such as tibia and ribs (1,2). Fragility fractures are a strong predictor of future fragility fractures. Within 3 years of a vertebral fracture, half of patients will experience another, with most occurring in the first year (3). Patients who have experienced a previous fracture at any site, have almost a two times greater risk of a future fracture. Besides that, patients with a fragility fracture of radius, femur, humerus and ankle have a four times greater risk for a future fracture (4).

According to the Fracturk study, Turkish men over 50 years old have a 3.5% risk of hip fracture, while Turkish women in the same age group have a higher risk of 14.6% (5). In the ageing population, increasingly frequent osteoporotic fractures not only result in increased morbidity and mortality but also a serious economic burden for countries (6,7). Therefore, it becomes important to reveal the relevant factors in terms of preventing osteoporotic fracture.

Many studies have evaluated the relationship between nutrition and bone density, and significant differences in bone density values have been observed between patients with and without malnutrition (8,9). Saito et al. (10) showed that protein malnutrition reduces bone density measurement independently of other factors. Insufficient calcium intake is another factor that causes a decrease in bone density in older ages (11).

There are various methods of evaluating malnutrition, including body mass index (BMI) and laboratory parameters such as albumin, prealbumin, and transferrin. Prognostic nutritional index (PNI) is a laboratory index calculated using serum albumin and total lymphocyte count (12). Low PNI is associated with increased morbidity and mortality due to malnutrition and poor postoperative outcomes for various malignancies (13,14). Additionally, recent studies have shown that it may be associated with postoperative outcomes in patients with fractures (15,16). However, the relationship between PNI and osteoporotic fragility fractures is not yet well understood.

In previous studies, it has been shown that the PNI is an indicator in determining the nutritional needs of patients with osteoporosis (17). However, in osteoporotic patients with fragility fractures, PNI has not been investigated whether. This study aims to investigate whether the PNI is different in osteoporotic patients with and without fragility fractures.

## Materials and Methods

The file records of female patients, aged 45 years and over, who were registered to the "Osteoporosis Clinic" within the Eskişehir Osmangazi University Faculty of Medicine, Physical Medicine and Rehabilitation Outpatient Service, between August 2022 and 2023, and diagnosed with osteoporosis, were reviewed retrospectively. Patients with secondary osteoporosis, using steroids, having any comorbidity that may cause cancer or malnutrition, or using any protein-containing drug and also missing variables in patient files were excluded. Bone mineral densitometry (BMD) (lumber L1-4, femur total, femur neck), radiographic data (thoracolumbar spine lateral radiographs and extremity radiographs), laboratory parameters including albumin, lymphocyte, calcium, alkaline phosphatase, phosphorus, parathyroid hormone (PTH), calcium/creatine ratio in spot urine, 25-hydroxy vitamin D values were recorded.

The reference range for albumin is between 3.4 and 5.4 g/dL at blood level in adults. Using total serum calcium concentration is not recommended, calcium needs to be corrected with serum albumin level. Corrected calcium= total calcium (mg/dL) +0.8 × (4-albumin value g/dL).

According to the World Health Organization (WHO) international reference standard, low bone mass (osteopenia) is defined as -2.5< T-score in BMD <-1.0 and osteoporosis as T-score ≤-2.5, in the total hip, femoral neck, or lumbar spine. The criteria for classification apply to postmenopausal women and men aged 50 and older (18).

FRAX® is a computer-based algorithm that is a 10-year fracture risk calculation method created by entering the data of BMD and patient characteristics such as age, weight, height, smoking and alcohol history (19,20). WHO recommends FRAX® to detect fracture risk in patients.

BMI was calculated from these equations: BMI: body weight / height²

The PNI was calculated using the values of albumin and lymphocyte count of patients.

### The PNI was Calculated from the Following Equations

PNI= 10× serum albumin (g/dL) 0.005+ × total lymphocyte count (per mm³). If the PNI value is ≥50, it indicates normal malnutrition. A PNI value of less than 50 indicates mild malnutrition, while a value of less than 45 indicates moderate to severe malnutrition. Severe malnutrition is indicated by a PNI value of less than 40 (17).

This study was performed in line with the principles of the Declaration of Helsinki. Ethics approval was granted by Eskişehir Osmangazi University Presidency Non-Interventional Clinical Research Ethics Committee (number: E-25403353-050.04-2400002818, date: 04.01.2024).

### Statistical Analysis

The distribution of each continuous variable was tested for normality using the Shapiro-Wilk test. Non-normally distributed variables were compared using the Mann-Whitney U test and expressed as median values (25-75%). Normally distributed variables were performed using the t-test and they were expressed as mean ± standard deviation. Categorical variables are expressed as frequencies and percentages and they were compared using the chi-square test. The Spearman correlation coefficient was used as the correlation analysis. A p-value of

<0.05 was considered significant. All analyses were performed using the SPSS version 22.0 software (SPSS Inc, Chicago, IL, USA).

We conducted a post-hoc power analysis to determine the expected effect power of our study. We used G*power 3.1.9.7 software to perform post-hoc power analysis. The analysis was performed with an effect size of 0.79, an alpha error rate of 5% and a sample size of 58 participants. A previous comparable study of serum calcium and phosphorus concentration in patients with osteoporotic vertebral fractures yielded a moderate effect size (18). Post-hoc power analysis showed that our study had a 91% probability of detecting the determined effect size.

## Results

A total of 112 female patient files were evaluated. Thirty-four files were excluded due to secondary osteoporosis, 8 patients were excluded due to collagen supplement usage, 10 patients were excluded due to having cancer history, and 2 patients were excluded due to missing variables. Twenty-eight patients with fragility fractures according to radiography and file examinations were accepted as the 1st group. Thirty patients who did not have any fragility fractures were accepted as 2nd group (Figure 1).

Out of 28 patients, 11 (39.2%) had vertebral column fragility fractures and 17 (60.7%) had fractures in extremities (wrist fracture in 8 patients, humerus fracture in 4 patients, ankle in 2 patients, costa/tibia/hip fractures were each in one patient).

Comparing the two groups showed that, patients with fragility fractures have a risk of major vertebral fracture (p=0.002) and significantly lower phosphorous value (p=0.002). Both groups showed similar levels of PNI. PNI values of all patients above 45, none of the patients had moderate or higher malnutrition risk (Table 1).

Patients with fragility fractures were divided into 2 groups: those with vertebral fractures (n=11) and those with non-vertebral fractures (n=17). The average age of individuals with vertebral fractures was significantly higher (p=0.016). Comparing the two groups showed that in patients with a fragility fracture, the corrected calcium value was significantly higher (p=0.002) and the albumin value was significantly lower (p=0.049). Both groups of patients with fragility fractures showed similar levels of PNI and lymphocytes (Table 2).

Correlation analysis showed that, in patients with fragility fractures, there was no correlation between PNI, albumin levels, BMD values, and FRAX® values (Table 3).

## Discussion

This study investigated whether PNI and albumin levels play a role in the development of fragility fractures in osteoporotic patients. However, we did not detect a significant relationship between PNI and osteoporotic fracture. Although we found lower albumin levels in the group with vertebral osteoporotic fractures, there was no significant difference between those with and without fractures.

According to reviews of the literature, it appears that there are limited studies that investigate the relationship between osteoporosis and PNI. Studies have shown that PNI may be a useful indicator in predicting the development of osteoporosis and the prognosis of osteoporotic fracture (16,17). He et al. (22) found PNI superior to albumin alone in evaluating perioperative outcomes of femur fracture. According to our study results, PNI which is one of the malnutrition indicators, were similar between osteoporotic patients with or without fragility fractures. Also, PNI values did not correlate with BMD and FRAX® in patients with fragility fractures. These results may be because PNI and albumin values of all patients were approximately normal range. After all, none of the patients had malnutrition risk in our study population. Contrary to our study, in previous studies, Kul et al. (17) found that patients with a low PNI score had lower total lumbar BMD T-scores.

Calcium and phosphorus are the main elements of bone mineral building. Sufficient amounts of calcium and phosphorus are needed not only to support the mineralization of bone but also to suppress excessive and persistent elevations of circulating PTH, hypothesized as a potential mechanism responsible for low bone mass (23,24). Our study results showed that vitamin D and PTH levels were similar between groups. In addition, in our study, people with osteoporotic fractures had significantly lower phosphorus levels than those without. The use of regular

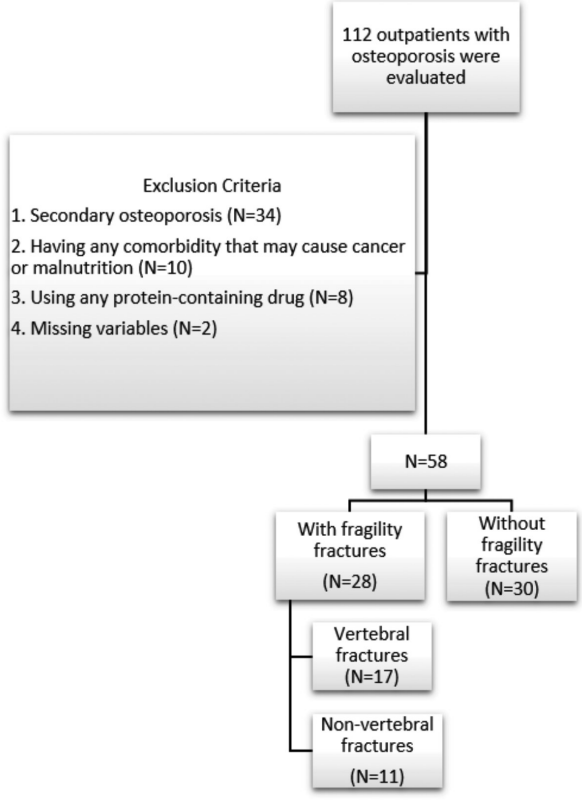


**Figure 1.** Flowchart of the study

| Table 1. Comparison of osteoporosis patients with and without fragility fracture | | | | |
|---|---|---|---|---|
| | | **Osteoporosis with fragility fracture (n=28) (Mean ± SD)** | **Osteoporosis without fragility fracture (n=30) (Mean ± SD)** | **p-value** |
| **Age** | | 67.60±9.78 | 66.83±7.91 | 0.741 |
| **Weight** | | 68.68±10.14 | 65.88±10.44 | 0.337 |
| **Height** | | 157.68±6.88 | 156.26±7.42 | 0.485 |
| **BMI** | | 27.63±3.89 | 27.04±4.50 | 0.618 |
| **PNI** | | 53.84±3.98 | 55.70±4.59 | 0.110 |
| **BMD** | L1-4 | -2.35±0.82 | -2.22±0.76 | 0.621 |
| | Femur neck | -2.09±0.56 | -2.18±0.77 | 0.721 |
| | Femur total | -1.74±0.58 | -1.85±0.78 | 0.815 |
| **FRAX®** | Major osteoporotic fracture | 19.74±7.69 | 12.74±6.45 | 0.002** |
| | Hip fracture* | 4.00 (2.70-6.95) | 2.70 (1.05-5.40) | 0.246 |
| **Laboratory results** | | | | |
| Lymphocyte | | 1.90±0.59 | 2.15±0.66 | 0.150 |
| Creatine | | 0.71±0.12 | 0.70±0.11 | 0.627 |
| Calcium | | 9.55±0.40 | 9.67±0.36 | 0.244 |
| Corrected calcium | | 9.24±0.42 | 9.27±0.34 | 0.774 |
| Phosphorus | | 3.27±0.44 | 3.69±0.50 | 0.002** |
| ALP* | | 71.00 (51-95) | 63.50 (50.50-84.25) | 0.631 |
| Calcium/creatinine ratio in spot sample of urine* | | 0.12 (0.06-0.20) | 0.11 (0.05-0.18) | 0.873 |
| Albumin | | 4.43±0.35 | 4.49±0.23 | 0.451 |
| PTH* | | 46.20 (35.80-57.50) | 34.20 (30.25-55.25) | 0.085 |
| 25-OH vitamin D | | 30.80±10.77 | 35.90±10.46 | 0.421 |

*: Median (25-75%), **: p<0.05
n: Number, SD: Standard deviation, BMI: Body mass index, PNI: Prognostic nutritional index, BMD: Bone mineral density, ALP: Alkaline phosphatase, PTH: Parathyroid hormone

and high amounts of citrate and carbonate salts of calcium may have caused the decrease in dietary phosphorus by binding (25). Furthermore, low dietary intake of phosphorus may not support the effect of high calcium intake on bone growth, thus limiting the benefit of treatment (26).

FRAX® scoring is an important tool to detect fracture risk in osteoporosis and low BMI is one of the risk factors (20,21). However, the FRAX® calculation does not use the serum albumin value, which is commonly used in nutritional indexes to detect malnutrition. As an expected result, in our study, the risk of FRAX® major osteoporotic fracture was significantly higher in patients with fragility fracture. Additionally, out of the two groups observed, the risks of hip fractures were similar in both groups. Supporting the results obtained from the FRAX® analysis, when 28 patients with osteoporotic fractures were examined, it was found that only 1 person had a hip fracture.

The effect of albumin evaluated in PNI on BMD and osteoporotic fracture is controversial in the literature. Serum albumin level is a marker of nutritional status, and poor nutritional status may result in increased osteoporosis and bone fragility (27). Afshinnia et al. (28) found an independent and highly significant relationship between the duration of low albumin and osteoporosis. Other researchers have also suggested that low serum albumin levels increase the risk of future fractures (29,30). However, in our study, we did not detect any difference in albumin levels between those with and without osteoporotic fractures. Also, albumin levels did not correlate with BMD and FRAX®. Similar to our study, Lunde et al. (31) did not find a relationship between low-energy fracture history and albumin levels. Evaluation of a population with different categorical levels of albumin and repeated measurements of albumin levels may better elucidate the relationship between albumin and osteoporotic fracture risk. In our study, we found lower albumin levels in those with vertebral fractures compared to the non-vertebral fracture group. However, the average age was significantly higher in the group with vertebral fractures and we think that the low albumin level may be related to older age.

## Study Limitations

The main limitation of our study was the small sample size, also PNI and albumin values of all patients were in the normal range. None of the patients had malnutrition risk in our study

**Table 2. Comparison of patients with vertebral fragility fractures and patients with non-vertebral fragility fractures**

| | | Fragility fractures in vertebrae (n=11) | Non-vertebral fragility fractures (n=17) | p-value |
|---|---|---|---|---|
| **Age** | | 73.00±9.06 | 64.11±8.78 | 0.016** |
| **Weight** | | 70.27±10.67 | 67.42±9.92 | 0.498 |
| **Height** | | 156.45±5.44 | 158.64±7.89 | 0.402 |
| **BMI** | | 28.62±3.59 | 26.86±4.07 | 0.270 |
| **PNI** | | 52.56±4.14 | 54.67±3.76 | 0.176 |
| **BMD** | L1-4 | -2.05±0.94 | -2.57±0.84 | 0.148 |
| | Femur neck | -1.97±0.78 | -2.09±0.36 | 0.578 |
| | Femur total | -1.61±0.65 | -1.88±0.58 | 0.274 |
| **FRAX®** | Major osteoporotic fracture | 19.44±6.71 | 19.97±8.64 | 0.880 |
| | Hip fracture* | 6.50 (1.40-7.15) | 3.20 (2.92-4.72) | 0.554 |
| **Laboratory results** | | | | |
| Lymphocyte | | 1.97±0.79 | 1.85±0.45 | 0.618 |
| Creatine | | 0.74±0.11 | 0.69±0.13 | 0.304 |
| Calcium | | 9.71±0.33 | 9.45±0.41 | 0.096 |
| Corrected calcium | | 9.54±0.32 | 9.05±0.37 | 0.002** |
| Phosphorus | | 3.40±0.48 | 3.18±0.41 | 0.207 |
| ALP* | | 64 (54-92) | 71.00 (46.00-99.50) | 0.535 |
| Calcium/creatinine ratio in spot sample of urine* | | 0.09 (0.06-0.15) | 0.15 (0.06-0.23) | 0.863 |
| Albumin | | 4.27±0.43 | 4.53±0.25 | 0.049** |
| PTH* | | 38.85 (28.25-47.12) | 50.70 (39.90-83.25) | 0.076 |
| 25-OH vitamin D | | 35.20±14.23 | 27.53±6.50 | 0.093 |

*: Median (25-75%), **: p<0.05
n: Number, SD: Standard deviation, BMI: Body mass index, PNI: Prognostic nutritional index, BMD: Bone mineral density, ALP: Alkaline phosphatase, PTH: Parathyroid hormone

**Table 3. Correlation analysis between prognostic nutritional index, albumin levels, bone mineral density and FRAX® in patients with fragility fractures**

| | Fragility fractures in vertebrae (n=11) | | Non-vertebral fragility fractures (n=17) | | All patients with fragility fractures (n=28) | |
|---|---|---|---|---|---|---|
| | **PNI** | **Albumin** | **PNI** | **Albumin** | **PNI** | **Albumin** |
| **BMD** | | | | | | |
| L1-4 | p=0.627<br>r=-0.176 | p=0.603<br>r=-0.188 | p=0.569<br>r=0.149 | p=0.817<br>r=0.061 | p=0.935<br>r=-0.017 | p=0.801<br>r=0.051 |
| Femur neck | p=0.983<br>r=-0.008 | p=0.907<br>r=0.043 | p=0.381<br>r=-0.227 | p=0.493<br>r=-0.179 | p=0.243<br>r=-0.233 | p=0.475<br>r=-0.143 |
| Femur total | p=0.627<br>r=-0.176 | p=0.365<br>r=-0.321 | p=0.623<br>r=0.128 | p=0.279<br>r=0.278 | p=0.906<br>r=-0.024 | p=0.657<br>r=0.090 |
| **FRAX®** | | | | | | |
| Major osteoporotic fracture | p=0.651<br>r=-0.176 | p=0.932<br>r=0-.033 | p=0.871<br>r=-0.053 | p=0.584<br>r=-0.176 | p=0.893<br>r=0.031 | p=0.929<br>r=-0.021 |
| Hip fracture | p=0.559<br>r=-0.226 | p=0.431<br>r=-0.301 | p=0.201<br>r=-0.397 | p=0.357<br>r=-0.292 | p=0.197<br>r=-0.293 | p=0.196<br>r=-0.294 |

BMD: Bone mineral density, PNI: Prognostic nutritional index

population. We believe this limitation affected our results. There is a need for studies with a large number of osteoporotic patients, including patients with malnutrition and low albumin levels. In future, in the light of future studies, albumin can also be added to the FRAX® tool.

Another limitation is that the average age in the group with vertebral fractures is significantly higher than in the non-vertebral fracture group.

## Conclusion

In conclusion, "PNI" and albumin levels were similar in osteoporotic patients with or without fragility fractures.

### Ethics

**Ethics Committee Approval:** The present study is retrospective and its permission was obtained from Eskişehir Osmangazi University Presidency Non-Interventional Clinical Research Ethics Committee (number: E-25403353-050.04-2400002818, date: 04.01.2024).

**Informed Consent:** This study reviewed retrospectively.

### Footnotes

### Authorship Contributions

Concept: F.B., G.S., Design: F.B., G.S., Data Collection or Processing: F.B., G.S., Analysis or Interpretation: F.B., G.S., Literature Search: F.B., G.S., Writing: F.B., G.S.

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

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# *Osteoporosis Awareness and Effecting Factors: A Descriptive Cross-Sectional Study*

## *Osteoporoz Farkındalığı ve Etkileyen Faktörler: Tanımlayıcı Kesitsel Bir Araştırma*

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## *Abstract*

**Objective:** Osteoporosis is a chronic metabolic bone disease characterized by bone fragility and increased fracture risk. The prevalence of osteoporosis has increased because of demographic changes and lifestyle modifications. Osteoporotic fractures are associated with a previous fragility fracture. This study aimed to determine patients' awareness levels regarding the prevention of new fractures and the necessary precautions for osteoporosis.

**Materials and Methods:** This descriptive cross-sectional study included 112 patients with osteoporotic fractures who met the inclusion criteria. The effect level was 0.632, the confidence interval ($\alpha$) was 0.05, and the power of the test (1-$\beta$) was 0.95 for 110 samples. The patient information form and osteoporosis awareness scale (OAS) were used for data collection.

**Results:** Eighty-three patients (74.1%) were unaware that their fractures were osteoporotic, and 35.7% (n=40) had a history of previous fractures. The mean OAS total score of patients diagnosed with osteoporosis before fracture, those who had a family member diagnosed and treated with osteoporosis, and those who received education about osteoporosis was significantly higher. It was found that there was a moderate positive correlation between educational status and OAS total score (r=451; p<0.001). There was no difference in the OAS total score between patients with and without previous fractures (p=0.817). It was found that 53.5% of patients diagnosed with osteoporosis before the fracture still needed education about osteoporosis.

**Conclusion:** The results showed that patient education successfully increased awareness but did not help develop positive preventive attitudes in patients. Repeated training is necessary for individuals at risk. Bone mineral densitometry scan rates are low even in patients with a history of fragility fractures. The awareness of orthopedic specialists regarding osteoporosis education and diagnosis should be increased. The dissemination of screening tests for early diagnosis of osteoporosis should be part of the public health agenda.

**Keywords:** Osteoporosis, awareness, osteoporotic fractures, education of patients

## *Öz*

**Amaç:** Osteoporoz, kemik kırılganlığına ve kırık riskinin artmasına neden olan kronik bir metabolik kemik hastalığıdır. Demografik değişiklikler ve yaşam tarzı değişiklikleri nedeniyle osteoporoz prevalansı artmıştır. Osteoporotik kırıklar önceki bir kırılganlık kırığı ile ilişkilidir. İlk kez kırılganlık kırığı geçiren bir hastada kırıkların tekrarlama riski çok yüksektir. Kurumumuz acil servis birimine, 65 yaş üstü bireyler, düşmelere ve düşük enerjili travmalara bağlık sıklıkla kalça kırığı nedeniyle başvurmaktadır. Bu çalışmada hastaların yeni kırıkların önlenmesi ve osteoporoz konusunda gerekli önlemlerin alınması konusunda farkındalık düzeylerinin belirlenmesi amaçlanmıştır.

**Gereç ve Yöntem:** Tanımlayıcı ve kesitsel olan bu çalışmaya osteoporotik kırığı olan 112 hasta dahil edildi. Verilerin toplanmasında hasta bilgi formu ve osteoporoz farkındalık ölçeği (OFÖ) kullanıldı.

**Bulgular:** Hastaların 83'ü (%74,1) kırıklarının osteoporotik olduğundan habersizdi ve %35,7'sinde (n=40) daha önce kırık öyküsü vardı. Kırık öncesi osteoporoz tanısı alan, ailesinde osteoporoz tanısı alıp tedavi edilen ve osteoporoz konusunda eğitim alan hastaların OFÖ toplam puan ortalaması anlamlı olarak yüksek bulundu. Eğitim durumu ile OFÖ toplam puanı arasında orta düzeyde pozitif korelasyon olduğu belirlendi (r=451; p<0,001). Daha önce kırığı olan ve olmayan hastalar arasında OAS toplam skoru açısından fark yoktu (p=0,817). Kırık öncesinde osteoporoz tanısı alan hastaların %53,5'inin halen osteoporoz konusunda eğitime ihtiyaç duyduğu belirlendi.

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## Öz

**Sonuç:** Hasta eğitiminin farkındalığı artırdığı ancak hastalarda olumlu koruyucu tutumlar geliştirememiş olması risk grubundaki kişiler için tekrarlanan eğitimlerin gerekliliğini göstermiştir. Kemik mineral dansitometrisi tarama oranları, kırılganlık nedeniyle kırık öyküsü olan hastalarda bile düşüktür. Ortopedi uzmanlarının osteoporoz eğitimi ve tanısı konusunda farkındalıkları artırılmalıdır. Osteoporozun erken tanısına yönelik tarama testlerinin yaygınlaştırılması bir halk sağlığı politikası olarak gündemde olmalıdır.
**Anahtar kelimeler:** Osteoporoz, farkındalık, osteoporotik kırıklar, hastaların eğitimi

## Introduction

Osteoporosis is characterized by decreased bone mineral density and deterioration of the microarchitecture of bone tissue; it is the most common chronic metabolic bone disease that causes bone fragility and an increased risk of fractures (1). In the development of osteoporosis, there are non-modifiable risk factors such as age, race, gender, and hormone levels, as well as modifiable risk factors such as nutrition, sedentary life, exercise, alcohol, cigarette, and coffee consumption (2).

With the extension of life expectancy, the increasing proportion of the elderly population and lifestyle changes have significantly increased the prevalence of osteoporosis and will continue to do so. Osteoporosis does not cause clinical symptoms until a fracture occurs, and osteoporotic fractures, which are common in the older age group, are associated with increased dependency, morbidity, and mortality (1). While it was stated that 158 million people were at high risk of fracture in 2010, it is estimated that this number will double by 2040 due to demographic changes (3). It is estimated that one in three women and one in five men over 50 years of age will experience osteoporotic fractures in their lifetime (4). Additionally, studies have shown that osteoporotic fracture increases the risk of future fractures (5,6). The risk of suffering a subsequent fracture is highest in the two years following the first fragility fracture (7,8). Therefore, informing patients at risk of fracture before a fracture occurs and raising awareness in society are considered significant public health strategies to protect patients at risk (9). The report prepared by the International Osteoporosis Foundation Capture the Fracture® program in collaboration with leading Turkish osteoporosis experts emphasizes the need for action to stop the increasing number of fragility fractures. Recognition of osteoporosis as a chronic and progressive condition, establishment of more fracture liaison service to increase post-fracture screening, diagnosis, treatment rates, and follow-up, including falls prevention services, prioritization of fragility fractures within healthcare management, improve the education of healthcare professionals, management of frailty to prevent falls, work both centrally and regionally is recommended in the report (10).

This study aimed to determine the awareness levels of patients treated for osteoporotic fractures regarding preventing new fractures and taking the necessary precautions regarding osteoporosis.

## Materials and Methods

The research was conducted in descriptive and cross-sectional types. The study was conducted after obtaining approval Medical School Dean's Office Clinical Research Ethics Committee and securing institutional permission from the hospital where the data was collected (date: 20.04.2022, decision no: 09). The study was conducted according to the principles of the Declaration of Helsinki.

This study, conducted between August 2022 and July 2023, included patients who applied to the Orthopedics and Traumatology outpatient and inpatient clinics of Uşak Training and Research Hospital due to osteoporotic fractures. The reference study (9) was examined, and the effect level for the osteoporosis awareness scale (OAS) was calculated as 0.632, the confidence interval ($\alpha$) was 0.05, the power of the test (1-$\beta$) was 0.95, and the number of samples was determined as 110. Patients aged 18 years and over who applied for osteoporotic fractures, whose fracture occurred due to a fall in the same plane or similar low-energy trauma (osteoporotic fracture), and who were planned for surgical or conservative follow-up (n=349) were included in the study. Patients with active malignancy, speech or hearing impairment, Alzheimer's/dementia, or psychiatric problems and patients who did not agree to participate in the study were excluded. The study's sample comprised 112 patients meeting the inclusion criteria (Figure 1).

Data were collected from patients who filled out the voluntary consent form through face-to-face interviews at the outpatient clinic where the fracture was diagnosed when they came for a check-up or at the bedside in case of surgical hospitalization. Patient Information Form and OAS were used for data collection.

**Patient information form:** The form prepared by the researchers consists of 21 questions and includes sociodemographic characteristics, as well as questions about general health conditions such as past diseases, habits, medications used, and health conditions related to the etiology of osteoporosis and their knowledge about osteoporosis.

**OAS:** "OAS", developed by Choi et al. (11) in 2008, consists of a total of 31 items and five sub-dimensions. The scale, adapted to Turkish by Aktürk et al. (12), was reduced to 27 items and consists of five sub-dimensions. The scale is evaluated on a 4-point Likert scale and is scored as "I know very well (4 points)", "I know (3 points)", "I know a little (2 points)", "I do not know at all (1 point)". Although there is no reverse item or cut-off point in the scale, it indicates that awareness of osteoporosis

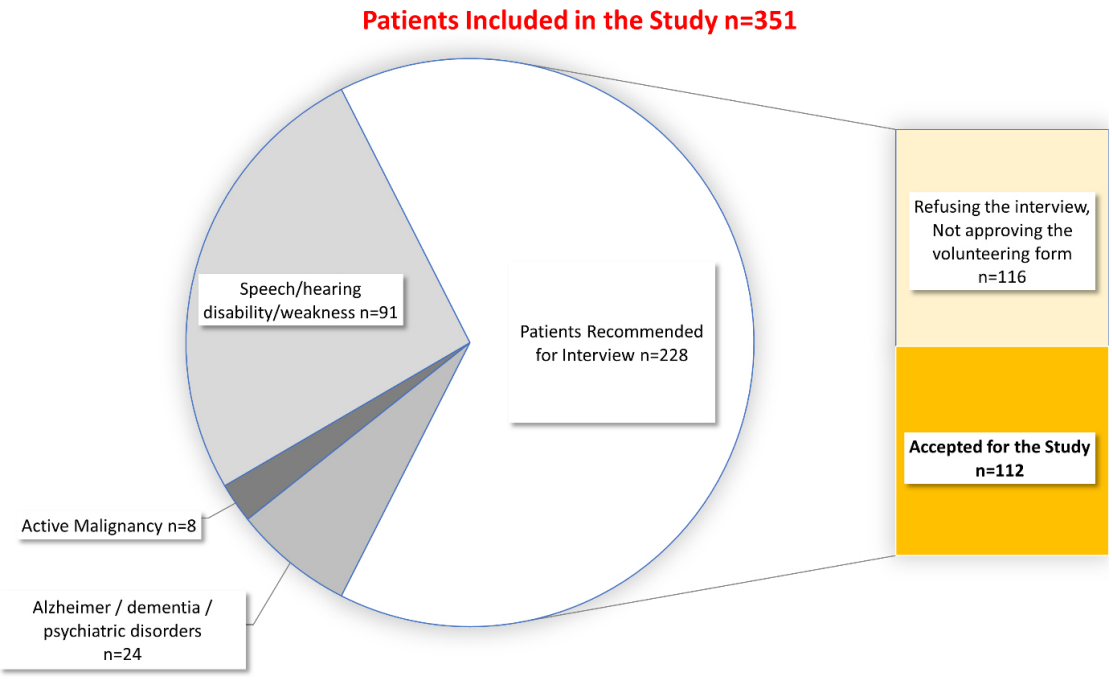


**Figure 1.** Flow chart

increases as the calculated score [minimum (min)] 27, maximum [max) 108)] increases. The scale includes "bone physiology" (items 22-27), "protective behaviors" (items 4, 5, 7, 8, 9, 10 and 21), "risk factors" (items 11-15), "exercise" There are sub-dimensions (items 1, 2, 3 and 6) and "features of osteoporosis" (items 16-20). The Cronbach alpha reliability coefficient of the scale is 0.949; cronbach's alpha reliability coefficient in this study was calculated as 0.916.

### Statistical Analysis

The research data were analyzed statistically using the Statistical Package for Social Science 26.0 (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). The descriptive data of the study were evaluated as mean ± standard deviation for numerical variables or percentage for categorical variables. In subgroup analyses, the Student's t-test was used for numerical variables, and the chi-square test was used for categorical variables. Pearson correlation analysis was used to evaluate the relationships between variables.

## Results

The study included 112 patients admitted due to osteoporotic fracture, and data regarding the demographic and clinical characteristics of the patients are presented in Table 1. The average age of the patients is 77.25±9.75, and 68.8% (n=77) are women. Patients use an average of 3±2.59 (median 2; min 0-max 10) medications daily; 82.1% (n=92) had a chronic disease. Most of the fractures (83.9%) were hip fractures; the most common cause of fracture was reported as "falling while walking" (58.9%), followed by "falling at home" (32.1%). It was determined that 38.4% of the patients had a bone scan (bone mineral densitometry) before the fracture, and 38.4% were diagnosed with osteoporosis before the fracture. When these data were examined, it was determined that 36 of the 43 patients who had a bone scan before the fracture and 7 of the 69 patients who were not scanned were diagnosed with osteoporosis before the fracture. It was found that 65% of patients with previous fractures did not have a bone scan. It was determined that 74.1% (=83) of the patients were not aware that their fractures were osteoporotic, and 35.7% (n=40) had a history of previous fractures (Table 1).

When behaviors related to the prevention of new fractures are evaluated, 27.7% (n=31) of the patients received education about osteoporosis, 26.8% (n=30) did regular physical activity, 40.2% (n=45) received regular sunlight and 62.5% (n=30) n=70) was determined to consume dairy products regularly. In the analysis investigating the relationship between receiving education about osteoporosis and these behaviors, no statistically significant difference was found between those who received education and those who did not (Table 2, p>0.05). Twenty of 43 patients (46.5%) diagnosed with osteoporosis before the fracture stated that they received education about osteoporosis (Table 2).

The average OAS total score was 42.69±11.45. The highest mean score (2.25±0.88) is in question number 4 of the scale (Anchovies and dairy products are good sources of calcium to prevent osteoporosis), the lowest mean score (1.16±0.48) is in question number 12, which is about the relationship between

| Table 1. Demographics and clinical data | | |
|---|---|---|
| | **n** | **Avg ± SD** |
| Age | 112 | 77.25±9.75 |
| BMI | 112 | 26.07±5.00 |
| Number of medications used | 112 | 3.00±2.59 |
| **Frequency** | | |
| Gender | Female | 77 (68.8%) |
| | Male | 35 (31.3%) |
| Marital status | Married | 62 (55.4%) |
| | Single/widowed/divorced | 29 (25.9%) |
| Educational background | Illiterate | 24 (21.4%) |
| | Literate/primary school graduate | 74 (66.1%) |
| | Secondary/high school graduate | 10 (8.9%) |
| | University graduate | 4 (3.6%) |
| Working status | Working | 5 (4.5%) |
| | Not working | 107 (95.5%) |
| Presence of chronic disease | Yes | 92 (82.1%) |
| | No | 20 (17.9%) |
| Continuous drug use | Yes | 91 (81.3%) |
| | No | 21 (18.8%) |
| Smoking | Yes | 9 (8%) |
| | No | 103 (92%) |
| Alcohol usage | Yes | 0 (00.0%) |
| | No | 112 (100.0%) |
| Fracture location | Hip | 94 (83.9%) |
| | Wrist | 18 (16.1%) |
| Trauma pattern | Falling while walking | 66 (58.9%) |
| | Falling inside the house | 36 (32.1%) |
| | Falling while going up and down stairs | 4 (3.6%) |
| | Falling while getting on/off public transportation | 6 (5.4%) |
| Bone mineral densitometry before this fracture | Yes | 43 (38.4%) |
| | No | 69 (61.6%) |
| Diagnosis of osteoporosis before this fracture | Yes | 43 (38.4%) |
| | No | 69 (61.6%) |
| Awareness of having an osteoporotic fracture | Yes | 29 (25.9%) |
| | No | 83 (74.1%) |
| Family history of osteoporosis diagnosis and treatment | Yes | 28 (25%) |
| | No | 84 (75%) |
| History of previous fractures | Yes | 40 (35.7%) |
| | No | 72 (64.3%) |
| Previous fracture site | None | 73 (65.2%) |
| | Hip | 14 (12.5%) |
| | Elbow | 7 (6.3%) |
| | Wrist | 7 (6.3%) |
| | Shoulder | 5 (4.5%) |
| | Tibia | 3 (2.7%) |
| | Hand finger | 2 (1.8%) |
| | Humerus | 1 (0.9%) |

BMI: Body mass index, Avg: Average, SD: Standard deviation

gastrectomy and risk of osteoporosis. The values determined for the OAS sub-dimensions and total score are shown in Table 3. When subgroup analyses were conducted between men and women, the rate of awareness that their fracture was osteoporotic was higher in women (11.4% vs. 32.5%), and this difference was statistically significant (p=0.014). It was determined that the rate of men receiving regular sunlight was significantly higher (32.5% vs. 57.1%) (p=0.012). No difference was detected between the two genders in terms of other parameters.

OAS total scores were found to be significantly higher in those who were diagnosed with osteoporosis before the fracture than in those who were not, in those who had a family member diagnosed with osteoporosis and treated compared to those who did not, and in those who had received education about osteoporosis compared to those who had not. There was no difference in the OAS total score between patients with and without previous fractures (p=0.817) (Table 4). In addition, it was observed that the awareness rate of osteoporotic fracture was higher in those diagnosed with osteoporosis before the fracture, in those who had a family member diagnosed and treated with osteoporosis, and in those who received education about osteoporosis (Table 5). It was found that 53.5% of patients diagnosed with osteoporosis before the fracture still needed education about osteoporosis.

The correlation analysis showed a moderately negative relationship between age and OAS total score (r=-341; p<0.001). In addition, a low negative correlation was found between educational status and the number of medications used (r=-218; p=0.021), and a moderate positive correlation was found between the OAS total score (r=451; p<0.001).

## Discussion

Osteoporosis is a significant public health problem due to the increasing elderly population in the world and our country. Increasing awareness of osteoporosis is necessary for osteoporosis prevention and treatment programs (13). In this study conducted on patients treated for osteoporotic fractures, it was found that the patients' awareness levels regarding osteoporosis and the prevention of new fractures were relatively low.

**Table 2. Information on preventing osteoporosis**

| | Education about osteoporosis | | P-value |
|---|---|---|---|
| | Yes (n=31) | No (n=81) | |
| **Regular physical activity** | 9 (29.0%) | 21 (25.9%) | 0.74 |
| **Regular consumption of dairy products** | 22 (71.0%) | 48 (59.3%) | 0.252 |
| **Regular sunlight exposure** | 12 (38.7%) | 33 (40.7%) | 0.844 |

**Table 3. Distribution of OAS total and sub-dimension average scores**

| Sub-dimension | Minimum | Maximum | Avg ± SD |
|---|---|---|---|
| **Bone physiology** | 6 | 21 | 8.82±2.9 |
| **Protective behaviors** | 7 | 28 | 12.26±3.6 |
| **Risk factors** | 5 | 15 | 6.68±2 |
| **Exercise** | 4 | 15 | 6.46±2.6 |
| **Features of osteoporosis** | 5 | 20 | 8.64±3.2 |
| **Total score** | 27 | 96 | 42.87±11.4 |

OAS: Osteoporosis awareness scale, Avg: Average, SD: Standard deviation

**Table 4. Factors associated with OAS score**

| | | n | OAS total score (Avg ± SD) | Median | P-value* |
|---|---|---|---|---|---|
| **Diagnosis of osteoporosis before this fracture** | Yes | 43 | 45.46±10.2 | 46 | **0.003*** |
| | No | 69 | 40.96±11.9 | 38 | |
| **History of previous fractures** | Yes | 40 | 42.5±10.03 | 40 | 0.817 |
| | No | 72 | 42.76±12.23 | 41 | |
| **Family history of osteoporosis diagnosis and treatment** | Yes | 28 | 48.57±15.94 | 47 | **0.019*** |
| | No | 84 | 40.73±8.78 | 39 | |
| **Education about osteoporosis** | Yes | 31 | 49.61±14.37 | 47 | **<0.001*** |
| | No | 81 | 40.04±8.87 | 38 | |

OAS: Osteoporosis awareness scale, Avg: Average, SD: Standard deviation, *Mann-Whitney U test, p<0.05

| Table 5. Factors associated with osteoporotic fracture awareness | | | | |
|---|---|---|---|---|
| | | Awareness of having an osteoporotic fracture | | P-value* |
| | | Yes | No | |
| **Diagnosis of osteoporosis before this fracture** | Yes | 20 (46%) | 23 (53%) | **<0.001*** |
| | No | 9 (13%) | 60 (87%) | |
| **Awareness of having an osteoporotic fracture** | Yes | 13 (33%) | 27 (68%) | 0.234 |
| | No | 16 (22%) | 56 (78%) | |
| **Family history of osteoporosis diagnosis and treatment** | Yes | 14 (50%) | 14 (50%) | **<0.001*** |
| | No | 15 (17.9%) | 69 (82.1%) | |
| **Education about osteoporosis** | Yes | 14 (45%) | 17 (55%) | **0.004*** |
| | No | 15 (19%) | 66 (81%) | |
| *Chi-Square test, p<0.05 | | | | |

In our study, most of the fractures were hip fractures. In our country, the incidence of hip fracture increases exponentially with age. Around the age of 50, the probability of experiencing a hip fracture in the remaining lifetime is calculated to be 3.5% in men and 14.6% in women (14).

It was observed that only 38.4% of the patients had a bone scan before the fracture; even among patients with prior fractures, the proportion receiving a bone scan was similar (35%). This finding suggests that orthopedic specialists who first encounter fractures do not always think of the diagnosis of osteoporosis. In the study conducted to determine orthopedic doctors' awareness of osteoporosis (n=166), It was determined that while 36.1% of doctors evaluated patients over 65 with fractures, 63.9% did not assess these patients regarding osteoporosis (15). Another study on distal radius fractures (DRF) reported that 57.5% of patients had bone mineral density measurements after fracture. The authors stated that this rate is insufficient and that this measurement should be requested from every patient undergoing low-energy DRF (16). In a study conducted with 583 women in the risk group living in rural areas, 37.2% of the participants (17); in another study, including 70 patients with spinal cord injuries (9), it was determined that 30% of the patients had bone mineral measurements before the injury. These results show that we are inadequate in measuring bone minerals, and this will cause an increase in the incidence of osteoporotic fractures. It is essential for orthopedic specialists, who are usually the first to come across osteoporotic fractures, to investigate and diagnose the presence of osteoporosis, as noted by Matzkin et al. (18).

The results obtained in our study support Lo and Kok (19), who stated that behavioral change associated with osteoporosis is a complex cognitive process. So much so that the rate of implementing behaviors to prevent new fractures, other than regular dairy product consumption, was relatively low. Neglecting to educate diagnosed patients may explain this situation. However, there is no significant difference in behavior change between those who received training on osteoporosis and those who did not. More is needed beyond this theoretical knowledge to achieve positive behavioral change.

It was observed that the average OAS total score of the patients was 42.69±11.45, where the lowest total score could be 27 and the highest total score was 108. This value corresponds to an average of 1.58 points (between "do not know at all" and "know a little") out of 4 for each question. This relatively low value shows that our patients' awareness of osteoporosis is insufficient. The study conducted in China with 368 participants over 18 determined that osteoporosis awareness was moderate (20). However, in a study conducted in Switzerland with 9065 patients, patients' awareness of osteoporosis was low (21).

Although the OAS total score averages did not show a significant difference between men and women, the rate of awareness that their fractures were osteoporotic was significantly higher in women. Studies by Özişler et al. (22) and Şahin et al. (16) investigated osteoporosis awareness and showed that gender did not significantly affect the rate of patients with awareness. However, in the study conducted by Büyükvural Şen et al. (9) on patients with spinal cord injury, it is emphasized that awareness is significantly higher in women than in men (59.8±11.4 vs. 52.5±11.7; p=0.031).

Osteoporosis awareness was found to be high in our patients who were diagnosed with osteoporosis before the fracture and who had family members diagnosed and treated for osteoporosis; this suggests that familiarity with the diagnosis leads to increased selective interest in the disease. In the study by Akyol et al. (23) in which they compared the level of osteoporosis knowledge and awareness in premenopausal and postmenopausal women, in the subgroup of postmenopausal women, no statistically significant difference was found between individuals with and without a family history of osteoporosis.

The high level of awareness among those who have received education about osteoporosis shows that patient education has achieved its purpose. Notably, 53.5% of patients diagnosed with osteoporosis before the fracture did not receive education

about osteoporosis, and it shows that patient education needs to be given more importance in healthcare institutions. The study conducted by Fahmy et al. (24) showed that the training program positively affects older patients' knowledge, attitudes, and beliefs regarding the prevention and treatment of osteoporosis. Additionally, more than half of the patients who received osteoporosis education (n=17, 55%) were unaware that their current fracture was osteoporotic, suggesting that the training should be repeated; this result supports the results of Fahmy et al. (24).

The fact that there was no difference in the OAS total score between patients with and without a previous fracture and that there was no difference in awareness of having an osteoporotic fracture between patients with and without a previous fracture suggests that a fracture does not increase awareness of osteoporosis. Kraus et al.'s (25) study emphasized that the awareness of osteoporosis risks was higher in patients who underwent elective hip replacement than in patients with proximal femur fractures. However, they were younger and at lower risk.

In our study, there was a moderate negative relationship between age and the OAS total score; it was found that there was a moderate positive correlation between educational status and the OAS total score. Considering that there is an increase in osteoporosis awareness as the education level increases (educational status x OAS total score r=451; p<0.001), It is understood that the relationship between age and OAS total score is related to the lower level of education in older adults rather than age. To check this result, when correlation analysis was performed separately within the educational status categories, no significant relationship was observed between age and the OAS total score in any education category. This result indeed shows that the age correlation emerges from educational attainment. Studies have shown that osteoporosis awareness is associated with graduate level (16,26).

One weakness of this study is that it was conducted in a single center and a limited community with similar cultural characteristics. Because of the cross-sectional design, we cannot make causal inferences about the association between the OAS and related factors. Moreover, not determining physician awareness in parallel with patient awareness is considered a limitation.

## Conclusion

According to the results of the present study, the awareness of patients with osteoporotic fractures about osteoporosis needs to be increased. Still, the awareness of those who received osteoporosis education was significantly higher. It has been observed that osteoporosis education alone cannot develop positive protective attitudes in patients, and patients at risk need repeated education, whether they are educated or not. Orthopedic specialists encountering osteoporotic fractures for the first time should be encouraged to diagnose the presence of osteoporosis. Bone mineral densitometry scanning rates are low even in patients with a history of fragility fractures, suggesting that expanding screening tests for early diagnosis of osteoporosis should be a public health policy priority. In addition, healthcare professionals should conduct frequent awareness programs in the community, which is crucial in sensitizing the general population about osteoporosis and its complications. Studies planned as multicenter and include health professionals in the same centers can be planned. In addition, prospective randomized studies on the possible effect of repetitive training on developing positive protective attitudes will contribute to literature.

### Ethics

**Ethics Committee Approval:** The study was conducted after obtaining approval Medical School Dean's Office Clinical Research Ethics Committee and securing institutional permission from the hospital where the data was collected (date: 20.04.2022, decision no: 09).

**Informed Consent:** Data were collected from patients who filled out the voluntary consent form through face-to-face interviews at the outpatient clinic where the fracture was diagnosed when they came for a check-up or at the bedside in case of surgical hospitalization.

### Footnotes

### Authorship Contributions

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

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# *Evaluation of Pain, Activities of Daily Living, Mood Changes, and Stress Levels in Frail Individuals*

## *Kırılgan Bireylerde Ağrı, Günlük Yaşam Aktiviteleri, Duygu Durum Değişikliklerinin ve Stres Düzeylerinin Değerlendirilmesi*

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## *Abstract*

**Objective:** This study aimed to evaluate pain, activities of daily living, depression, anxiety, and stress levels in frail individuals.
**Materials and Methods:** This descriptive cross-sectional study was conducted with 264 people who applied to family medicine outpatient clinics between February and March 2023. Strength, assistance with walking, rising from a chair, climbing stairs, and falls (SARC-F) questionnaire and Frail scale; pain levels using the visual analog scale; mood changes and stress levels using the depression anxiety stress scale; and functionality and autonomy in daily life using the Katz activities of daily living Scale (KATZ-ADL) and instrumental activities of daily living scale (IADL). Participants were diagnosed as frail according to the results of the Frail scale and divided into groups (frail, pre-frail, non-frail). p<0.05 was considered statistically significant.
**Results:** Among the participants, 28.8% were frail, 48.5% were pre-frail, and 22.7% were non-frail. The median age was 73.15±6.13 years in the frail group, 71.43±5.09 years in the pre-frail group and 69.63±4.93 years in the non-frail group. SARC-F was significantly higher in the frail group (p<0.05). KATZ-ADL and IADL scores were significantly lower in the frail group than in the non-frail or pre-frail group (p<0.05). DASS-anxiety (p=0.413) and DASS-stress (p=0.068) did not show a significant difference between the frail and non-frail groups, while there was a significant difference in other group comparisons (p<0.05).
**Conclusion:** Autonomy in daily life was found to be lower and pain, negative mood changes, and stress levels were higher in vulnerable individuals in our study.
**Keywords:** Frailty, pain, mood changes, stress, activities of daily living

## *Öz*

**Amaç:** Bu çalışmada kırılgan bireylerde ağrı, günlük yaşam aktiviteleri, depresyon, anksiyete ve stres düzeylerinin değerlendirilmesi amaçlanmıştır.
**Gereç ve Yöntem:** Çalışma 264 kişi ile gerçekleştirildi. Katılımcıların SARC-F ve Frail skalası ile kırılganlıkları; vizüel analog skala ile ağrı düzeyleri; depresyon anksiyete stres skalası ile duygu durum değişiklikleri ve stres düzeyleri; Katz günlük yaşam aktiviteleri ölçeği (KATZ-GYA) ve Lawton-Brody enstrümental günlük yaşam aktiviteleri ile günlük yaşamlarındaki fonksiyonellik ve özerklik durumları değerlendirildi. Katılımcılar Frail skalası sonuçlarına göre kırılganlık tanısı aldı ve gruplara (kırılgan, pre-kırılgan, kırılgan olmayan) ayrıldı ve gruplar arası veriler karşılaştırıldı. Yapılan istatistiksel analizlerde p<0,05 anlamlı kabul edildi.
**Bulgular:** Katılımcıların %28,8'i kırılgan, %48,5'i pre-kırılgan ve %22,7'si kırılgan olmayan olarak saptandı. Kırılgan grupta ortalama yaş 73,15±6,13 yıl, pre-kırılgan grupta 71,43±5,09 yıl ve kırılgan olmayan grupta 69,63±4,93 yıldı. SARC-F skoru kırılgan grupta anlamlı olarak daha yüksekti (p<0,05). KATZ-GYA ve LGYA skorları kırılgan grupta kırılgan olmayan veya pre-kırılgan gruba göre istatistiksel olarak anlamlı düşüktü (p<0,05). DASS-anksiyete (p=0,413) ve DASS-stres (p=0,068) değerleri kırılgan ve kırılgan olmayan grup arasında anlamlı bir farklılık göstermezken, diğer grup karşılaştırmalarında anlamlı farklılık mevcuttu (p<0,05).
**Sonuç:** Çalışmamızda kırılgan bireylerde günlük yaşamda özerklik daha düşük, ağrı düzeyleri, olumsuz duygudurum değişiklikleri ve stres düzeyleri daha yüksek bulunmuştur. Kırılgan bireylerde yaşam kalitesini artırmak amacıyla günlük yaşamda özerkliğin artırılması, ağrıyı azaltmaya yönelik tedavilerin planlanması, duygu durum değişikliklerine ve stres artışına yönelik önlemlerin alınması faydalı olacaktır.
**Anahtar kelimeler:** Kırılganlık, ağrı, duygu durum değişiklikleri, stres, günlük yaşam aktiviteleri

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## Introduction

A new term, "frailty", has gained attention due to the rise in the number of old people worldwide (1). This concept has emerged as a result of the fact that individuals of the same chronological age do not show the same characteristics when evaluating the elderly. Frailty is characterized by the deterioration of the homeostasis mechanism as a result of the decrease in physiological reserves with aging. It is affected by genetic, environmental and epigenetic factors and has physical, cognitive and social components (2).

In the literature, it is seen that the prevalence of frailty varies between 4% and 59.1%, and increases with age (3,4). Gale et al. (5) also reported that this rate was 6.5% in adults aged 60-69 years and increased to 65% in people over 90 years of age.

The frailty criteria were published in the early 2000s by Dent et al. (6) According to these criteria, three or more of the following factors indicate frailty: Weight loss, motor slowness, decreased physical activity, fatigue and weakness. Concepts such as frailty, sarcopenia, polypharmacy and malnutrition, which are components of the geriatric syndrome, negatively affect the quality of life. Studies have shown that the presence of malignancy, chronic diseases, and rheumatological diseases increase frailty and also are a source of pain (7). Furthermore, people with chronic pain are twice as likely to be frail in the following year compared to people in the same age group, suggesting that chronic pain contributes to the development of frailty (8). Depression and anxiety in the elderly are different from other age groups. Agitation, hypochondriacal and somatic complaints are expressed more frequently, and impairment in activities of daily living, sleep and appetite problems are more common compared to other age groups (9,10).

Frailty includes a range of symptoms including biological, psychological, cognitive and sensory problems. In addition, conditions such as pain, depression and anxiety have also been associated with frailty in studies (11,12). Considering the increase in pain with age as a normal process and ignoring it may lead to an increase in frailty and a decrease in daily functionality. In addition, frailty, which starts as a physiologic factor, may affect the social life of the elderly and psychologically affect depression, anxiety and stress levels. Sedentary life together with pain brings sarcopenia. Sarcopenia in the elderly can lead to impaired balance and falls. Many conditions including fractures and consequent bed dependency, pressure sores or cerebrovascular events may occur as a result of falls. For this reason, pain and physical performance level should be questioned in the elderly. Managing pain and frailty not only improves patients' quality of life, but also reduces the financial burden on the government as it can reduce immobility. Ensuring healthy ageing will also prevent a range of comorbidities. Therefore, in our study, we planned to investigate pain, physical frailty, social and psychological conditions in geriatric patients.

## Materials and Methods

### Study Design

This research was intended to be a cross-sectional descriptive investigation and was conducted between February and March 2023 in Family Medicine Outpatient Clinic of a Health Sciences University. The study Kütahya Health Sciences University Rectorate Non-Interventional Clinical Research Ethics Committee Presidency (date: 11.01.2023, decision no: 2023/01-06). All participants who participated in the study approved the informed consent form.

A total of 264 people who met the inclusion criteria and volunteered were included in the study. Post-hoc power analysis calculated with G*Power 3.1 software was based on instrumental activities of daily living scale (IADL) scale scores [non-frail=7.60±0.84 (n=60), pre-frail=7.26 (n=128), frail=6.52, (n=76)]. Effect size Cohen's f=0.406 was calculated. When $\alpha$ error=0.05, total sample size=264, number of groups=3, Power (1-$\beta$)= 99% was obtained. In addition, all participants had comorbidities. Individuals with cognitive function to understand the questionnaires and scales and no communication barriers were included in the study, while fully dependent or semi-dependent patients and patients with progressive and severe cerebrovascular, cardiovascular and rheumatologic diseases were excluded. Based on the Frail scale, patients were categorized into three groups: Frail group, pre-frail group, and non-frail group.

### Data Collection

A sociodemographic form questioning the age, gender, years of education and marital status of the patients was developed by us. The SARC-F and Frail scale to assess the frailty of patients, depression anxiety stress scale-21 (DASS-21) to assess the mood changes and presence of stress of patients, Katz daily living activities scale (Katz-ADL) and Lawton-Brody IADL were utilized to evaluate the patients' level of independence in their everyday activities.

### SARC-F

The SARC-F questionnaire, which consists of five components (strength, walking assistance, chair lifting, stair climbing and falls), is used to identify people who may be at risk of developing sarcopenia. The total score of the scale ranges from 0 to 10. A score between 0-2 is given for each of the five components. A total score of 0-3 means healthy; 4 and above means at risk for sarcopenia. Bahat et al. (13) conducted the validity and reliability of this questionnaire in Turkey.

### Frail Scale

The scale assesses weight loss, aerobic capacity, fatigue, muscle resistance and disease burden. The total score is between 0-5 points. Classification based on total score: 0 points= not frail, 1-2 points= pre-frail, 3-5 points= frail (14). Hymabaccus et al. (15) conducted the validity and reliability of this questionnaire in Turkey.

### DASS-21

The DASS-21 is a 21-item scale with 7 items for each subscale (depression, anxiety, and stress) and each item is scored on a 4- point Likert scale. As the DASS-21 is a short-form version of the DASS-42, the result is multiplied by two for each subscale. The assessment for anxiety (DASS-A) is as follows: >19- extremely severe, 19-15= severe, 14-10= moderate, 9-8= mild, 7-0= no anxiety. Evaluation for depression (DASS-D) is as follows: >27= extremely severe, 27-21= severe, 20-14= moderate, 13-10= mild, 9-0= no depression. The evaluation for stress (DASS-S) is as follows: >33= extremely severe, 33-26= severe, 25-19= moderate, 18-15= mild, 14-0= no stress. The Turkish validity and reliability of this questionnaire were performed by Yılmaz et al. (16).

### Katz-ADL

The Katz-ADL index consists of 6 questions questioning the status of bathing, dressing, toileting, movement, excretion, and nutrition. According to the score obtained from the scale, 0-2 is classified as dependent, 3-4 as semi-dependent, and 5-6 as independent. The Turkish validity and reliability of this questionnaire were performed by Özkan Pehlivanoğlu et al. (17).

### Lawton-Brody Instrumental Activities of Daily Living Scale

IADL is a questionnaire consisting of 7 questions about using the telephone, preparing food, shopping, doing daily housework, laundry, transport, and financial affairs. "1 point" if the individual performs the activities independently; if he gets help or cannot do it at all, he gets "0 points". The score range is 0-8. Low scores indicate a high level of dependency. The Turkish validity and reliability of this questionnaire were performed by Tel et al. (18).

### Statistical Analysis

SPSS 26 (IBM®, Chicago, USA) was used for statistical analysis. Normal and abnormal distribution of the variables were analyzed with the "Shapiro-Wilk test". In descriptive statistics, mean and standard deviation were used for normally distributed numerical data and median (minimum-maximum) was used for non-normally distributed data. Nominal data were expressed as number and percentage and chi-square test was used in their analysis. Student's t-test; one-way ANOVA; Mann-Whitney U test; Kruskal-Wallis test were used in the analysis of numerical variables according to their distribution status and number of groups. P-value below 0.05 was considered statistically significant.

## Results

The study included 264 participants. All participants were classified according to the Frail scale. There were 76 (28.8%) in the frail group, 128 (48.5%) in the pre-frail group and 60 (22.7%) in the non-frail group. The median age was 67 (65-80) years in the frail group, 71.5 (65-86) years in the pre-frail group and 67 (65-80) years in the non-frail group. When compared in terms of age, there was no significant difference between the pre-frail group and the frail group (p=0.057); however, the mean age was significantly lower in the non-frail group compared to the other groups (p<0.05). Frail group was 78.9% female, pre-frail group was 54.7% female, non-frail group was 36.7% female. There was a significant difference between the groups in terms of gender and the female gender was significantly lower in the non-frail group compared to the other groups (p<0.05).

Pain duration was significantly lower in the non-frail group compared to the frail group (p<0.005). There was no statistically significant difference between the prefrail and frail group and between the non-frail group and the pre-frail group. Pain intensity at rest was significantly higher in the frail group than in the non-frail group or the pre-frail group (p<0.001 & p<0.001). When pre-frail and non-frail groups were compared, pain intensity at rest was significantly higher in the pre-frail group (p<0.001). Pain intensity with activity was significantly higher in the frail group than in the non-frail group or the pre-frail group (p<0.001 and p<0.001). There was no statistically significant difference between pre-frail and non-frail groups (p<0.001). The intensity of pain at night was significantly higher in the frail group than in the non-frail group or the pre-frail group (p<0.001 and p<0.001). There was no statistically significant difference between pre-frail and non-frail groups (p<0.001).

The sociodemographic conditions and pain characteristics of the participants according to their frailty are summarised in Table 1. There was a significant difference between the groups in terms of SARC-F scores in pairwise comparisons (p<0.001). The frail group's IADL and KATZ-ADL scores were significantly lower than those of the non-frail and pre-frail groups (p<0.001). DASS-21 total scores and DASS-D were significantly higher in the frail group than in the non-frail and pre-frail group (p<0.001 and p<0.001). DASS-A and DASS-S didn't show a significant difference between the frail group and the pre-frail group, while there was a significant difference in other group comparisons (p<0.001).

The distribution of questionnaire scores according to the frailty of the participants is shown in Table 2.

Pain frequency, duration, intensity and scale scores were compared according to gender based on frailty classification.

In both female and male, pain was found to occur every day in the group with frailty (p=0.014 and p=0.002). While there was no statistically significant difference between the groups in terms of pain duration in women, pain duration in the frail group in men was significantly higher than the other group comparisons. Again, pain intensity (at rest and at night) was significantly lower in the non-frail group compared to the other group comparisons in both genders (p<0.05). In both female and male, SARC-F score was significantly higher and IADL was significantly lower in the frail group compared to other group comparisons (p<0.05). Although there was no significant difference between frail and pre-frail in terms of DASS-21 total score and subscores in female, scale scores were lower in the non-frail group compared to other groups (p<0.05). In men, DASS-A and DASS-S scores were significantly lower in the non-frail group compared to the other groups, but no difference was

observed in the comparison between prefrail and frail. There were significant differences between all groups in terms of DASS-21 total score and DASS-D subscore.

Scale comparisons based on frailty classification according to gender are shown in Table 3.

## DISCUSSION

With the increase in the elderly population worldwide, geriatric syndromes such as frailty, depression, pain and other conditions that affect the quality of life have gained importance. Studies have also suggested that these geriatric syndromes are interrelated and result in a vicious circle of cause and effect with common pathogenetic mechanisms (19). Therefore, in our study, we examined the effects of frailty in the elderly on independence in activities of daily living, pain and mood changes.

Although there are differences between studies, the prevalence of frailty varies between 13-50% and increases with age, and differences can be seen according to gender and ethnicity (20,21). It can be said that the differences in the scale or cut-off

**Table 1. Sociodemographic and pain characteristics according to their frailty**

| | Non-frail (n=60) | Pre-frail (n=128) | Frail n=76) | p-value |
|---|---|---|---|---|
| **Age (years)¥** | 69.63±4.93 | 71.43±5.09 | 73.15±6.13 | A*B*C** |
| **Gender¥¥** | | | | A*B*C* |
| Female | 22 (36.7) | 70 (54.7) | 60 (78.9) | |
| Male | 38 (63.3) | 58 (45.3) | 16 (21.1) | |
| Education level¥¥ | | | | A*B*C** |
| No education | 2 (3.3) | 24 (18.8) | 12 (15.8) | |
| Primary school | 36 (60) | 84 (65.6) | 60 (78.9) | |
| Middle-high school | 14 (23.3) | 12 (9.4) | 2 (2.6) | |
| University | 8 (13.3) | 8 (6.3) | 2 (2.6) | |
| **Pain characteristics¥¥** | | | | |
| Pain frequency | | | | A*B*C* |
| Every day | 18 (40.9) | 68 (63) | 64 (84.2) | |
| Once a week | 18 (40.9) | 20 (18.5) | 8 (10.5) | |
| Once a month | 8 (18.2) | 20 (18.5) | 4 (5.3) | |
| Pain duration (year)¥ | 2.05 (0.41-15) | 3 (0-40) | 4.12 (0.12-30) | A**B*C* |
| **Pain intensity (VAS)¥** | | | | |
| At rest | 2 (0-5) | 3 (0-9) | 5 (0-8) | A*B*C* |
| At night | 1 (0-7) | 2 (0-9) | 5 (0-9) | A*B*C* |
| With activity | 5 (0-8) | 5 (0-9) | 7 (3-110) | A**B*C* |

*p<0.05; **p≥0.05. ¥Median (minimum-maximum) - Kruskal-Wallis, ¥¥n (%) - chi-square
VAS: Visual analog scale, A: Comparison between non-frail and pre-frail, B: Comparison between non-frail and frail, C: Comparison between frail and pre-frail

**Table 2. Distribution of questionnaire scores according to their frailty**

| | Non-frail (n=60) | Pre-frail (n=128) | Frail (n=76) | p-value |
|---|---|---|---|---|
| **SARC-F¥** | 1 (0-5) | 2 (0-7) | 5.5 (1-10) | A*B*C* |
| **KATZ-ADL¥¥** | 6±0 | 5.87±0.33 | 5.65±0.70 | A*B*C* |
| **IADL¥¥** | 7.60±0.84 | 7.26±1.12 | 6.52±1.69 | A*B*C* |
| **DASS-21¥** | 10 (0-36) | 24 (0-74) | 34 (0-106) | A*B*C* |
| DASS-A | 2 (0-12) | 6 (0-26) | 7 (0-40) | A*B*C** |
| DASS-D | 2 (0-16) | 6 (0-26) | 13 (0-32) | A*B*C* |
| DASS-S | 4 (0-16) | 8 (0-42) | 10 (0-36) | A*B*C** |

*p<0.05; **p≥0.05. ¥Median (min-max)-Kruskal-Wallis; ¥¥Mean SD-ANOVA
Katz-ADL: Katz activities of daily living scale, IADL: Lawton-Brody instrumental activities of daily Living scale, DASS-21: Depression anxiety stress scales-21, DASS-A: Depression anxiety stress scales-anxiety, DASS-D: Depression anxiety stress scales-depression, DASS-S: Depression anxiety stress scales-stress, A: Comparison between non-frail and pre-frail, B: Comparison between non-frail and frail, C: Comparison between frail and pre-frail, SD: Standard deviation

**Table 3. Distribution of survey scores by gender according to vulnerability classification**

| **Female** | **Non-frail (n=18)** | **Pre-frail (n=62)** | **Frail (n=60)** | **p-value** |
|---|---|---|---|---|
| Pain frequency | | | | A*B*C* |
| Every day | 8 (44.4) | 42 (67.7) | 48 (80) | |
| Once a week | 8 (44.4) | 10 (16.1) | 8 (13.3) | |
| Once a month | 2 (11.1) | 10 (16.1) | 4 (6.7) | |
| Pain duration (year)¥ | 5 (0.58-15) | 3 (0-40) | 3.7 (0.12-30) | A**B**C** |
| Pain intensity (VAS)¥ | | | | |
| At rest | 1.5 (0-5) | 3 (0-9) | 5 (0-8) | A*B*C** |
| At night | 1 (0-7) | 4 (0-9) | 5 (0-9) | A*B*C** |
| With activity | 6 (0-8) | 6 (0-9) | 7 (5-10) | A**B*C* |
| **SARC-F**¥ | 2 (0-5) | 3 (0-7) | 6 (1-10) | A**B*C* |
| **KATZ-ADL**¥¥ | 6±0 | 5.88±0.32 | 5.63±0.75 | A**B*C** |
| **IADL**¥¥ | 7.54±0.91 | 7.31±0.95 | 6.46±1.79 | A**B*C* |
| **DASS-21**¥ | 14 (0-32) | 30 (2-74) | 34 (0-106) | A*B*C** |
| DASS-A | 2 (0-12) | 8 (0-26) | 9 (0-40) | A*B*C** |
| DASS-D | 4 (0-16) | 12 (0-30) | 10 (0-36) | A*B*C** |
| DASS-S | 4 (0-10) | 10 (0-26) | 15 (0-32) | A*B*C** |
| **Male** | **Non-frail (n=26)** | **Pre-frail (n=46)** | **Frail (n=16)** | **p-value** |
| Pain frequency | | | | A*B*C* |
| Every day | 10 (38.5) | 26 (56.5) | 64 (100) | |
| Once a week | 10 (38.5) | 10 (21.7) | 0 | |
| Once a month | 6 (23.1) | 10 (21.7) | 0 | |
| Pain duration (year)¥ | 1 (0.41-11) | 3 (0.50-40) | 4.75 (3-30) | A*B*C** |
| Pain intensity (VAS)¥ | | | | |
| At rest | 2 (0-5) | 2 (0-8) | 3.5 (3-8) | A**B*C* |
| At night | 2 (0-6) | 1 (0-8) | 5 (2-7) | A**B*C* |
| With activity | 3 (0-8) | 4.5 (0-8) | 6.5 (3-8) | A**B*C* |
| **SARC-F**¥ | 0 (0-5) | 2 (0-5) | 4 (2-9) | A*B*C* |
| **KATZ-ADL**¥¥ | 6±0 | 5.86±0.34 | 5.75±0.44 | A*B*C** |
| **IADL**¥¥ | 7.63±0.81 | 7.20±1.30 | 6.75±1.23 | A**B*C** |
| **DASS-21**¥ | 8 (0-36) | 16 (0-60) | 26 (12-74) | A*B*C* |
| DASS-A | 2 (0-10) | 4 (0-20) | 4 (0-22) | A*B*C** |
| DASS-D | 2 (0-16) | 4 (0-24) | 12 (4-28) | A*B*C* |
| DASS-S | 4 (0-16) | 8 (0-42) | 9 (4-28) | A*B*C** |

*p<0.05; **p≥0.05. ¥Median (min-max)-Kruskal-Wallis; ¥¥Mean SD-ANOVA
Katz-ADL: Katz activities of daily living scale, IADL: Lawton-Brody instrumental activities of daily living scale, DASS-21: Depression anxiety stress scales-21, DASS-A: Depression anxiety stress scales-anxiety, DASS-D: Depression anxiety stress scales-depression, DASS-S: Depression anxiety stress scales-stress, A: Comparison between non-frail and pre-frail, B: Comparison between non-frail and frail, C: Comparison between frail and pre-frail, SD: Standard deviation

values used to determine frailty in studies affect the prevalence of frailty. In a study by Chong et al. (21) that evaluated 210 patients with the Frail scale, frailty prevalence was determined as 50%. In another study conducted on 11,344 individuals, the Frail index was used and frailty prevalence was found to be 30.4% (22). In the study of Bulut et al. (23), it was stated that the prevalence of frailty was 28.3% and it could be associated with increasing age. In our study, the prevalence of frailty was found to be 28.8%, which is consistent with the literature, and increased with age.

The frequency of multifaceted and persistent pain increases in later life. Untreated or inadequate treatment of pain reduces the quality of life of patients and has a negative impact on their activities of daily living. Pain is an important component

of "the frailty syndrome". Although pain is frequently observed in frail individuals in clinical practice, it has not been adequately investigated in scientific studies (24,25). In our study, it was observed that resting, activity and night pain levels of frail elderly were higher than non-frail elderly. Pain may be an important cause of sarcopenia, functional dependence and mood disorders reported in frail elderly. Due to the cross-sectional design of our study, causality could not be assessed, but the effect of pain on frailty-related outcomes can be evaluated in future studies. With effective management of pain, the negative consequences on vulnerable individuals can be reduced.

Frailty is a multifactorial condition affecting many systems such as the endocrine system, cognitive functions, immunity and the musculoskeletal system. Malnutrition that occurs with advancing age and subsequent sarcopenia may lead to a decrease in exercise capacity and physical functions. Therefore, the elderly may become dependent in their daily life functions (26). The relationship between frailty and independence in activities of daily living has been examined in many studies in the literature and found to be related (27,28). Studies have shown that women become more dependent in their daily lives due to many reasons such as vitamin and mineral deficiencies developing due to nutritional disorders in advanced age, decreased bone mineral density, falls and fractures (29,30). In addition, the fact that osteoporosis is more common in women may lead to a higher prevalence of frailty in women. Therefore, in our study, female gender was more common in the frail group, while male gender was significantly higher in the non-frail group. In frailty studies, frailty is more common in the female gender than in the male gender in the population over 65 years of age (31). Similarly, in a meta-analysis of 240 studies, the prevalence of female gender was found to be higher in frail individuals (32).

Depression in geriatric individuals is one of the geriatric symptoms associated with increased frailty, mortality and morbidity. The rate of comorbidity in the senior population is 41.6% in those with anxiety symptoms and 44.2% in those with depressive symptoms (33). Many factors such as negative life experiences, bereavement, and illness can cause depression and anxiety. There are many studies in the literature showing the relationship between frailty and depression or anxiety (34,35). Zhao et al. (33) used the geriatric depression scale and the generalized anxiety disorder scale in their study and found that depression and anxiety were higher in frail individuals. In our study, depression, anxiety, and stress levels were evaluated in frail individuals with DASS-21, and it was found that depression, anxiety, and, in addition, stress levels in the frail group were significantly higher in accordance with the literature.

### Study Limitations

Our study has some limitations. Our study was conducted with a relatively small sample size. In addition, the duration and duration of pain were questioned, but the affected area was not evaluated. No scale for pain type was used. Another limitation is comorbidities. Exclusion criteria were strict to minimise the effects of comorbidity; however, these criteria were not very effective because the study population was elderly. In our study, all questionnaires were conducted through face-to-face interviews and only the levels of depression, anxiety and stress symptoms were determined. Therefore, a full psychometric evaluation study may be needed to better understand the mood of individuals. Future studies with larger sample sizes and more rigorous assessment of pain and comorbidities are needed.

## Conclusion

As a result, independence in activity of daily life was found to be lower, and pain levels, negative mood changes and stress levels were higher in frail individuals in our study. The lower physical capacity of frail individuals may lead to increased hospital admissions and progression of existing chronic diseases. In addition, individuals may enter a vicious circle with the negative emotional state and social restriction it brings. Management of pain and frailty is important for the prognosis of old age. Questioning elderly patients with simple and easily applicable frailty scales in the outpatient clinic, early diagnosis of frailty and pain management are important for both the individual's morbidity and the country's economy.

### Ethics

**Ethics Committee Approval:** The study Kütahya Health Sciences University Rectorate Non-Interventional Clinical Research Ethics Committee Presidency (date: 11.01.2023, decision no: 2023/01-06).

**Informed Consent:** All participants who participated in the study approved the informed consent form.

### Footnotes

### Authorship Contributions

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

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# *Femoral Neck Fractures: A New Risk Assessment Method Using CT Hounsfield Measurement*

## *Femur Boyun Kırıkları: BT Hounsfield Ölçümü ile Yeni Bir Risk Değerlendirme Yöntemi*

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## *Abstract*

**Objective:** Hip fractures, which are a serious consequence of osteoporosis, lead to a decrease in life expectancy. Computed tomography (CT) Hounsfield unit (HU) measurements have been clinically utilized to assess fracture risk.
**Materials and Methods:** This retrospective study, conducted between 2020-2023, analyzed 99 patients with femoral neck fractures and 62 controls who underwent pelvic CT. Two radiologists conducted bone density measurements using CT, with specific measurements at the femoral head, fracture level, and lesser trochanter. Statistical analyses, including Mann-Whitney U tests, Wilcoxon tests, chi-square tests, ROC curve analysis, and logistic regression analysis, were performed using SPSS version 28.0.
**Results:** The study revealed significant differences in bone density measurements between the fractured and control groups. Proximal, middle, and distal values demonstrated significant differences in distinguishing between patients with and without fractures. The distal measurement was the most effective measure, with an area under the curve of 0.918.
**Conclusion:** This study emphasizes the potential of CT HU measurements for predicting femur fracture risk, particularly the distal measurement at the minor trochanter level. Further research with larger samples and comparisons with other methods, such as dual X-ray absorptiometry or quantitative CT, are needed to validate these findings and their clinical significance.
**Keywords:** Bone density, computed tomography, femur, Hounsfield unit, osteoporosis

## *Öz*

**Amaç:** Osteoporozun ciddi bir sonucu olan kalça kırıkları, beklenen yaşam süresinde azalmaya yol açmaktadır. Bilgisayarlı tomografi (BT) Hounsfield ünitesi (HU) ölçümleri kırık riskini değerlendirmek için klinik olarak kullanılmaktadır.
**Gereç ve Yöntem:** 2020-2023 yılları arasında gerçekleştirilen bu retrospektif çalışmada, femur boynu kırığı olan 99 hasta ve pelvik BT çekilen 62 kontrol hastası analiz edildi. İki radyolog, BT taramalarını kullanarak femur başı, kırık seviyesi ve küçük trokanterde spesifik ölçümler ile kemik yoğunluğu ölçümleri yaptı. İstatistiksel analizler, Mann-Whitney U testleri, Wilcoxon testleri, ki-kare testleri, ROC eğrisi analizi ve lojistik regresyon analizi dahil olmak üzere, SPSS 28.0 sürümü kullanılarak gerçekleştirildi.
**Bulgular:** Çalışma, kırık ve kontrol grupları arasında kemik yoğunluğu ölçümlerinde anlamlı farklılıklar olduğunu ortaya koydu. Proksimal, orta ve distal değerler, kırığı olan ve olmayan hastaları ayırt etmede önemli etkiler göstermiştir. Distal ölçümün 0,918'lik eğri altındaki alan ile en etkili ölçüm olduğu kanıtlanmıştır.
**Sonuç:** Bu çalışma, BT HU ölçümlerinin femur kırığı riskini öngörmedeki potansiyelini, özellikle de minör trokanter seviyesindeki distal ölçümü vurgulamaktadır. Bu bulguların ve klinik önemlerinin doğrulanması için daha büyük örneklemlerle yapılacak araştırmalara ve dual X-ray absorbsiyometri veya kantitatif BT gibi diğer yöntemlerle karşılaştırmalara ihtiyaç vardır.
**Anahtar kelimeler:** Kemik yoğunluğu, bilgisayarlı tomografi, femur, Hounsfield ünitesi, osteoporoz

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## Introduction

As the population ages, osteoporosis has become a global health problem, affecting more than 200 million people worldwide (1). Low bone mineral density is a disease of the skeletal system that leads to fractures as a result of deterioration in the microarchitecture of bone. It is silent until a fracture occurs. Osteoporotic hip fractures cause a 20% decrease in life expectancy and approximately half of the patients become dependent on walking in their later life (2,3). The rate of hospitalization due to hip fracture is high in the elderly population and the most common cause is low-energy trauma such as simple falls. Hip fractures and other accompanying comorbidities impose a great burden on both the patient and the healthcare system. Therefore, it is very important to detect osteoporosis before fracture and to take the appropriate precautions (4). Dual-energy x-ray absorptiometry (DXA) is currently considered the gold standard for quantifying bone mineral density and has been shown to have a strong correlation with fracture risk and the efficacy of therapeutic treatments (5). However, in patients over 65 years of age, DXA is performed in approximately 30% of women and approximately 4% of men. In addition, some of the fractures occur in the osteopenia stage. For this reason, computed tomography (CT), which is one of the alternative methods, can be seen as an opportunity for osteoporosis screening (6). CT value measurements have been used clinically to assess fracture risk for patients (7-9).

The primary aim of our study was to investigate the potential of CT density measurements to assess the risk of femur fracture in elderly patients and to investigate whether we can make a preliminary assessment of fracture risk.

## Materials and Methods

Our study was retrospective and was approved by the University of Health Sciences Turkey, Ümraniye Training and Research Hospital, Clinical Research Ethics Committee (number: B.10.1.T KH.4.34.H.GP.0.0.01/462, date: 23.11.2023). Between January 2020 and August 2023, 99 patients with femoral neck fractures admitted to our hospital were included. Patients who were over 55 years of age, had femoral neck fractures secondary to low-energy trauma, and underwent CT scans in the acute period (first 24 hours) were included in the study. Patients with major trauma, endocrine and metabolic diseases affecting bone mineral density, pathological fractures (osteomyelitis or multiple myeloma), metal implants, and unilateral CT scans were excluded. As a control group, 62 patients who underwent pelvic CT for another reason and did not have a femur fracture were evaluated.

All CT scans were performed in the same 128-multidetector CT scanner, GE Healthcare, without using contrast media. All bilateral measurements in the patient and control groups were performed by two radiologist (10 and 21 years experience) independently. A 1.00 $cm^2$± 3.00 $cm^2$ elliptical ROI was used to assess bone mineral density. Measurements were taken at the level of the femoral head, fracture level, and lesser trochanter. The region of interest (ROI) was placed to include trabecular bone and marrow, avoiding cortical bone. The mean density for each measurement was recorded in Hounsfield units (HUs) (Figure 1-3). The measurement taken at the level of the femoral head is referred to as "proximal", measurement taken excluding the fracture site is labeled as "middle", and measurement taken at the level of the lesser trochanter is termed "distal".

### Statistical Analysis

Mean, standard deviation, median, minimum, maximum value frequency, and percentage were used for descriptive statistics. The distribution of variables was checked with the Kolmogorov-Smirnov test. Mann-Whitney U test was used for the comparison of quantitative data. Wilcoxon test was used for the repeated measurement analysis. The chi-square test was used for the comparison of the comparison of qualitative data. We used the intraclass correlation efficient (ICC) test to evaluate the interrater reliability for the measurements of two reviewers. ROC analysis was used to show the effect level. Logistic regression analysis was used to show the effect level. SPSS 28.0 was used for statistical analysis.

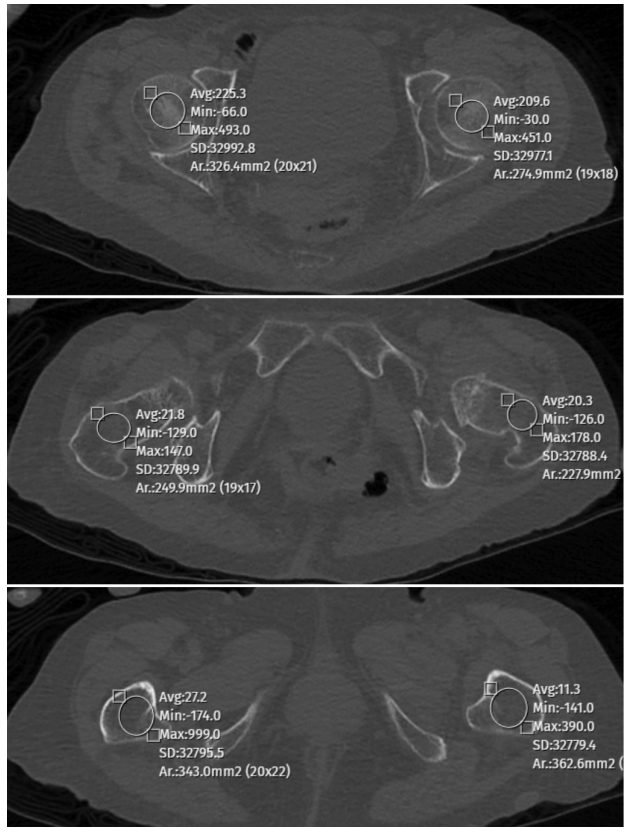


**Figure 1-3.** Examples of ROI, each 1.00-3.00 $cm^2$ in size and elliptical in shape, were outlined at three locations: proximally in the femoral head (proximal), at the site of the fracture (middle), and distally at the level of the lesser trochanter (distal). It's important to note that similar analyses were performed on the contralateral, non-fractured side, as well as bilaterally on the control patients

## Results

The analysis of our study revealed intriguing findings regarding femur density measurements and their association with fracture risk. The ICC values showed high reliability at all measured levels, indicating strong agreement between the two graders. Specifically, the ICC for the proximal level was 0.852 (95% CI: 0.820 to 0.880, p<0.001), for the mid level was 0.869 (95% CI: 0.840 to 0.895, p<0.001), and for the distal level was 0.883 (95% CI: 0.860 to 0.904, p<0.001). The average ICC across all levels was 0.868 (95% CI: 0.845 to 0.890, p<0.001), demonstrating the reliability and repeatability of the measurements in assessing bone quality. When comparing patients with and without fractures, there were no significant differences in age and gender distribution (p>0.05) (Table 1). In the fractured group, the proximal value was significantly lower than the control group (p<0.05), and it was also lower than the non-fractured side (p<0.05). Similarly, in the fractured group, the middle and distal values were significantly lower than the control group (p<0.05) and the non-fractured side (p<0.05) (Table 1). The results of logistic regression analysis show that decreased density values in the proximal, middle and distal regions of the femur are statistically significant in the assessment of femur fracture risk. Proximal and middle density values had similar effects [odds ratio (OR)=0.980 and OR=0.976, respectively; p<0.001], whereas distal density values were associated with a more significant decrease (OR=0.959; p<0.001). Especially the decrease in distal zone density value has a critical importance in predicting fracture risk (Table 2).

In the ROC curve analysis, the area under the curve (AUC) value obtained for the distal femur showed the highest accuracy in relation to fracture risk with 0.918 (95% CI: 0.875-0.961; p<0.001). On the other hand, the AUC values of the proximal and middle regions were calculated as 0.836 and 0.765, respectively, and although these measurements contribute to the assessment of risk, they are not as decisive as the distal measurement. Specifically, the distal value demonstrated significant independent effectiveness (p<0.05) in distinguishing between patients with and without fractures (Table 3). These results demonstrate the importance of the distal region in predicting the risk of femur fracture.

Analysis based on cut-off values revealed that the distal femur region, with a cutoff value >83.5, demonstrated a sensitivity of 82.8%, positive predictive value (PPV) of 92.1%, specificity of 88.7%, and negative predictive value (NPV) of 76.4%, marking it as the most accurate predicting the risk of femur fractures. In the proximal region, with a cutoff >282, sensitivity was 74.7% and specificity was 79.0%; whereas in the middle region, with a cut-off >93.5, sensitivity reached 87.9% but specificity was at 53.2%. The high PPV and NPV values in the distal region underscore its reliability in assessing fracture risk. (Table 4).

## Discussion

Osteoporosis, a condition characterized by decreased bone mass and structural deterioration, poses a significant public health concern globally due to its association with an increased risk of fractures, particularly in weight-bearing bones like the femur (10).

**Table 1. The results obtained from the fixed region of interest (ROI) measurements are presented in this table, showing the mean and standard deviation values for the average Hounsfield unit (HU) densities measured both proximal, middle and distal on both sides in both the case and control groups**

| | | Fracture (+) | | | Fracture (-) | | | |
|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD / n% | | Median | Mean ± SD / n% | | Median | p-value |
| **Age** | | 77.1±12.7 | | 80.0 | 75.1±8.6 | | 78.0 | 0.081[m] |
| **Gender** | Female | 69 | 69.7% | | 35 | 56.5% | | 0.087[X²] |
| | Male | 30 | 30.3% | | 27 | 43.5% | | |
| **Proximal** | | | | | | | | |
| Fracture side | | 232.3±67.2 | | 229.0 | 324.6±67.4 | | 332.0 | **0.000**[m] |
| Other side | | 267.5±66.4 | | 264.0 | | | | **0.000**[m] |
| Intra group p | | **0.000**[w] | | | | | | |
| **Middle** | | | | | | | | |
| Fracture side | | 57.1±35.8 | | 50.0 | 97.6±44.2 | | 99.0 | **0.000**[m] |
| Other side | | 44.7±32.9 | | 41.0 | | | | **0.000**[m] |
| Intra group p | | **0.002**[w] | | | | | | |
| **Distal** | | | | | | | | |
| Fracture side | | 49.9±37.3 | | 40.0 | 138.5±52.7 | | 136.5 | **0.000**[m] |
| Other side | | 70.3±43.5 | | 65.0 | | | | **0.000**[m] |
| Intra group p | | **0.000** | | [w] | | | | |

[m]Mann-whitney u test, [X²]Chisquare test, [w]Wilcoxon test

**Table 2. Univariate and multivariate models showing odds ratios (OR), 95% confidence intervals (CI), and p values for proximal, middle, and distal regions in logistic regression analysis**

| | Univariate model | | | | Multivariate model | | |
|---|---|---|---|---|---|---|---|
| | **OR** | **%95 CI** | **p-value** | | **OR** | **%95 CI** | **p-value** |
| Proximal | 0.980 | 0.974-0.987 | **0.000** | | | | |
| Middle | 0.976 | 0.967-0.985 | **0.000** | | | | |
| Distal | 0.959 | 0.948-0.971 | **0.000** | | 0.959 | 0.948-0.971 | **0.000** |
| Logistic Regression (Forward LR) | | | | | | | |

**Table 3. Area under the curve (AUC) values with 95% confidence intervals (CI) and p values for the distal, proximal and middle regions in the ROC curve analysis**

| | **AUC** | **% 95 CI** | **p-value** |
|---|---|---|---|
| Distal | 0.918 | 0.875-0.961 | **0.000** |
| Proximal | 0.836 | 0.771-0.901 | **0.000** |
| Middle | 0.765 | 0.689-0.841 | **0.000** |
| ROC Curve | | | |

**Table 4. Sensitivity, positive predictive value (PPV), specificity and negative predictive value (NPV) for the distal, proximal and middle regions in the fracture (-) and fracture (+) groups based on a comparison of cut-off values**

| | | **Fracture (-)** | **Fracture (+)** | **Sensitivity** | **PPV** | **Specificity** | **NPV** |
|---|---|---|---|---|---|---|---|
| Distal | >83.5 | **55** | 17 | 82.8% | 92.1% | 88.7% | 76.4% |
| | ≤83.5 | 7 | **82** | | | | |
| Proximal | >282 | **49** | 25 | 74.7% | 85.1% | 79.0% | 66.2% |
| | ≤282 | 13 | **74** | | | | |
| Middle | >93.5 | **33** | 12 | 87.9% | 75.0% | 53.2% | 73.3% |
| | ≤93.5 | 29 | **87** | | | | |

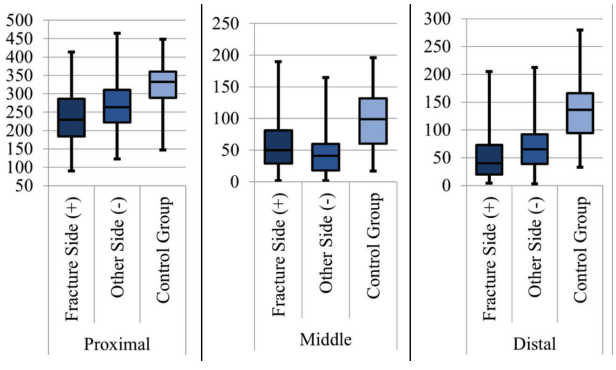


**Figure 4.** Box-and-whisker plots illustrating the Hounsfield Unit (HU) densities of both the case and control groups are provided, depicting the distributions of these densities, including any outliers, in the regions proximal, middle, and distal

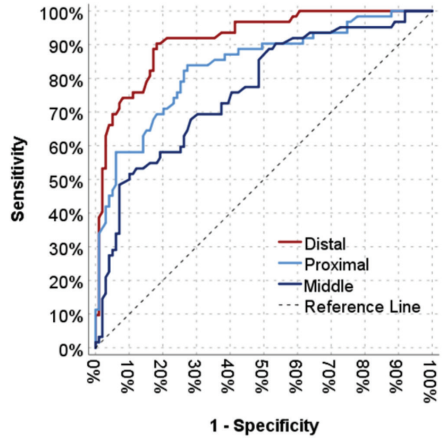


**Figure 5.** Sensitivity, specificity and PPV/NPV for fractures and anatomcal areas

Femoral neck fractures, which occur with minor trauma in the elderly population, are a major problem for both the patient and the healthcare system. Although DXA is the gold standard for diagnosis and screening, it is still not common enough. In CT taken for any other reason, radiologists can determine which patients are at high risk of femur fracture and benefit from DXA scanning by measuring bone density with the HU. This allows clinicians to diagnose osteoporosis earlier and treat it more effectively (11-13). In the field of radiology, the term opportunistic imaging refers to an application that is not related to clinical symptoms, but is usually performed for the purpose of preventing a disease and creating a risk profile or detecting the relevant disease without symptoms by utilising the imaging data

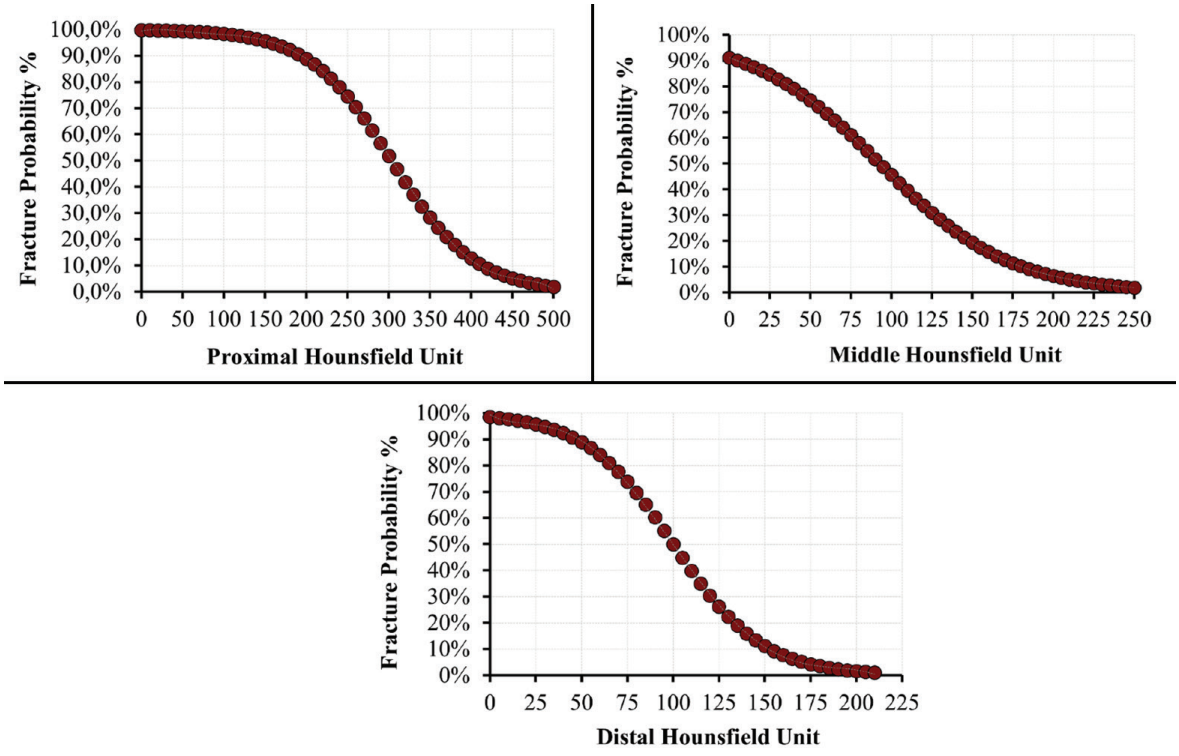


**Figure 6-8.** Relationship between the density values of the proximal, middle and distal femur and the probability of fracture

obtained. In this context, most studies have been conducted in the field of osteoporosis screening.

There are many studies that evaluate the risk of bone fracture with opportunistic BT. These studies are mainly related to vertebral bone and compression fractures (14-20). Numerous studies have shown that proximal femur density measurements correlate strongly with the femoral neck T-score. This measurement shows that patients with osteoporosis can be detected by opportunistic imaging and CT density assessment can be used in clinical practice.

Our study investigates the direct correlation between neck fractures and bone density by analyzing CT HU values and their crucial role in fracture risk assessment.

The absence of significant differences in age and gender distribution between fractured and non-fractured groups underscores the specificity of our findings, emphasizing the unique relevance of femur density measurements in fracture risk assessment.

The proximal measurement, notably lower in the fractured group, signifies the vulnerability of the femoral head, a region crucial for weight-bearing and mobility. The middle measurement, reflecting density in the femoral neck, further accentuates the complexity of fracture risk assessment. However, it is the distal measurement showcasing remarkable effectiveness in distinguishing between fractured and non-fractured patients.

Narayanan et al. (21)'s study showed that the patient group's density measurement at the level of the fractures was significantly higher than that of the non-fractured side. This is thought to be caused by trauma-related hemorrhage and an increase in trabecular bone density associated with a fracture. In our study, the density measurement on the fractured side was significantly lower than on the opposite side. This finding may be associated with the time that has passed from the fracture to the CT. In our study, CT was performed during the acute period (the first 24 hours). Therefore, the density increase may not be high.

Ye et al. (22) analysed 680 patients and proved that the proximal femur CT HU value correlated well with the femoral neck t-score and the lower the density value on CT, the worse the bone quantity. Based on this evidence, we have demonstrated the difference in CT density in the fracture and non-fracture groups and suggest that CT HU values may also play an important role in predicting osteoporosis and fracture risk. In addition to this study, we wanted to investigate which femur level density measurements would be more instructive.

Christensen et al. (23) similarly investigate the potential of opportunistic screening to address the increasing problem of osteoporosis. They demonstrate that proximal femur CT HU measurement correlates positively with DXA results regardless of age and time difference between scans. These findings support the wide applicability of HU measurements in osteoporosis screening.

In the context of osteoporosis, our study's findings gain heightened relevance. Osteoporotic fractures, often linked to diminished bone mineral density, lead to substantial morbidity and mortality, imposing a considerable burden on healthcare systems. The efficacy of femur density measurements,

particularly the distal value, in predicting fractures could revolutionize osteoporosis management. Our study shows that the density of 83.5 HU at the lesser trochanter level has high sensitivity and specificity in determining the risk of fractures. Ye et al. gave a cut-off value of 67 HU, Christensen et al. (23) did not give a cut-off but stated the mean density as 56±29 HU. These values are similar to our results.

Our study has several important limitations. First, the study was retrospective and performed in a single centre. Second, HU measurements could not be compared with DXA or QCT because CT examinations performed under emergency conditions were evaluated. This limits the opportunity to verify the accuracy of the measurements. Thirdly, as the patients did not have regular follow-up imaging, changes in the interval period could not be analysed. This prevents us from obtaining information about long-term results and changes in bone density. Fourth, the number of patients is small and limited due to our current inclusion criteria. This may raise questions about its applicability to the general population. Although HU values were lower in patients with fractures than in patients without fractures in our study, it should be taken into consideration that the measurements obtained from different CT devices may be different. Therefore, studies using different CT devices, larger patient population and collecting data from different centres group may improve the accuracy and applicability of our results. In conclusion; our study suggests a low attenuation value associated with the femoral fracture in elderly patients. Our findings may be integrated into existing osteoporosis diagnostic protocols and the HU values obtained from CT scans may allow the identification of patients at high risk of fracture. This may be considered as a complement to DXA scans. In addition, evaluation of CT imaging obtained during emergency department visits in this respect offers a proactive screening opportunity especially for elderly patients at high risk for osteoporotic fractures. In conclusion, the results of our study provide valuable information that will support clinical decision-making processes and provide opportunities for further research in the field of osteoporosis screening and management.

## Conclusion

In conclusion, this study highlights the potential for the use of opportunistic CT imaging in the early diagnosis and management of osteoporosis. Our findings suggest that HU values obtained on CT examinations may be a valuable tool to rapidly and practically identify elderly patients, especially those at high risk of fracture, thus contributing to the reduction of fracture-related morbidity and mortality.

### Ethics

**Ethics Committee Approval:** Our study was retrospective and was approved by the Ministry of Health Istanbul Health Sciences University Umraniye Training and Research Hospital Clinical Research Ethics Committee (number: B.10.1.TKH.4.34.H.GP.0.0.01/462, date: 23.11.2023).

**Informed Consent:** Since this study was retrospective, patient consent was not required.

### Footnotes

### Authorship Contributions

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

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

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# *Epicardial Adipose Tissue Thickness and Related Factors in Patients with Ankylosing Spondylitis*

## *Ankilozan Spondilit Hastalarında Epikardial Adipoz Doku Kalınlığı ve İlişkili Faktörler*

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## *Abstract*

**Objective:** This study aimed to investigate epicardial adipose tissue thickness (EATT) and related factors in patients with ankylosing spondylitis (AS) and to compare the results with those of healthy controls.

**Materials and Methods:** This cross-sectional study included 30 patients diagnosed with AS based on the modified New York criteria. The control group consisted of 31 healthy volunteers. Demographic characteristics were recorded, and EATT was measured by transthoracic echocardiography. The Bath AS Disease Activity Index (BASDAI), Bath AS Functional Index (BASFI), Bath AS Metrology Index (BASMI), AS Disease Activity Score (ASDAS), AS Quality of Life (ASQoL), and International Physical Activity Questionnaire Short Form were used. Functional capacity was assessed using the six-minute walk test (6-MWT).

**Results:** The mean age was 41.67±7.56, and 21 (70%) participants were male in the AS group. The mean disease duration was 10.0 (standard deviation ±7.2) years in the AS group. The mean EATT values were 4.40±1.65 mm and 2.85±1.12 mm in the AS and control groups, respectively ($p<0.001$). A notable negative correlation was observed between EATT and erythrocyte sedimentation rate (ESR) ($p<0.05$). Significant positive correlations were also observed between EATT and body mass index (BMI), BASFI, and BASMI. Additionally, EATT was linearly associated with the severity of sacroiliitis ($r=0.400$, $p=0.028$). There were no significant correlations between EATT and disease duration, C-reactive protein levels, blood lipid levels, ASDAS, ASQoL, IPAQ, and 6-MWT ($p>0.05$).

**Conclusion:** EATT values were higher in patients with AS than in those without AS. The factors related to EATT were BMI, ESR, BASFI, BASMI, and the severity of sacroiliitis.

**Keywords:** Ankylosing spondylitis, atherosclerosis, epicardial adipose tissue thickness, body mass index, sacroiliitis

## *Öz*

**Amaç:** Bu çalışmanın amacı, ankilozan spondilit (AS) hastalarında epikardiyal adipoz doku kalınlığı (EATT) ve ilişkili faktörleri incelemek ve elde edilen sonuçları sağlıklı kontrol grubunun bulguları ile karşılaştırmaktır.

**Gereç ve Yöntem:** Bu kesitsel çalışma, modifiye New York kriterlerine dayanarak AS tanısı almış olan 30 hastayı içermektedir. Kontrol grubu ise 31 sağlıklı gönüllüden oluşmaktadır. Çalışma başlangıcında demografik özellikler kaydedildi. EATT transtorasik ekokardiyografi ile ölçüldü. Bath AS Hastalık Aktivite İndeksi (BASDAI), Bath AS Fonksiyonel İndeksi (BASFI), Bath AS Metroloji İndeksi (BASMI), AS Hastalık Aktivite Skoru (ASDAS), AS Yaşam Kalitesi (ASQoL), Uluslararası Fiziksel Aktivite Anketi Kısa Formu kullanıldı. Fonksiyonel kapasitenin değerlendirilmesi ise altı dakikalık yürüme testi (6-MWT) kullanılarak gerçekleştirildi.

**Bulgular:** AS grubunda ortalama yaş 41,67±7,56 idi ve bu grupta 21 kişi (%70) erkekti. Ortalama EATT değerleri sırasıyla AS ve kontrol gruplarında 4,40±1,65 mm ve 2,85±1,12 mm idi ($p<0,001$). EATT ile eritrosit sedimantasyon hızı (ESR) arasında anlamlı bir negatif korelasyon bulundu ($p<0,05$). EATT ile vücut kitle indeksi (VKİ), BASFI ve BASMI arasında istatistiksel olarak anlamlı pozitif korelasyon mevcuttu. EATT ve sakroileit derecesi arasında lineer bir korelasyon vardı ($r=0,400$, $p=0,028$). EATT ile hastalık süresi, C-reaktif protein, kan lipitleri, ASDAS, ASQoL, IPAQ ve 6-MWT arasında anlamlı korelasyon saptanmadı ($p>0,05$).

**Sonuç:** Bu çalışmada, EATT değerlerinin AS hastalarında kontrol grubuna göre daha yüksek olduğunu bulunmuştur. EATT ile ilişkili faktörler VKİ, ESR, BASFI, BASMI ve sakroileitin şiddeti olarak belirlendi.

**Anahtar kelimeler:** Ankilozan spondilit, ateroskleroz, epikardial adipoz doku kalınlığı, vücut kitle indeksi, sakroileit

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## Introduction

Ankylosing spondylitis (AS) is a long-term systemic inflammatory disease that primarily involves the spinal column and sacroiliac joints and is often linked to extra-articular manifestations (1). Individuals with AS often display features of metabolic syndrome, such as obesity, elevated blood pressure, abnormal lipid levels, insulin resistance, and disrupted glucose metabolism (2). In addition to these traditional vascular risk factors, chronic inflammation is also linked to an elevated risk of atherosclerosis in patients with AS. The prevalence of atherosclerosis is 1.5 times higher in AS than in healthy individuals. Cardiac involvement is seen in 10-30% of patients with AS (3).

Atherosclerosis involves a prolonged inflammatory response in the vascular wall, resulting in the gradual formation of multifocal plaques within arteries. Persistent inflammation is widely recognized as a standalone risk factor contributing to the advancement of atherosclerosis. Proinflammatory alterations in epicardial adipose tissue (EAT) could be pivotal in the progression of coronary atherosclerosis (4). EAT refers to the layer of superficial fat located on the myocardium's surface. Compared to other adipose tissues, increased inflammatory responses in EAT are a stronger marker of coronary artery disease (4).

Atherosclerosis is believed to contribute notably to mortality in AS patients. Cardiac involvement tends to be more prevalent among those with a longer disease duration (3). Rheumatologists must be aware of cardiovascular involvement signs in AS patients and regularly monitor them for cardiac issues (5). Recognition of subclinical atherosclerosis in asymptomatic patients is important for prevention. EAT, which can be used as an indicator of subclinical atherosclerosis, is now more frequently studied in AS patients. EAT, located around the heart and coronary arteries, functions in both endocrine and paracrine capacities as a form of visceral fat. It is proposed that EAT may impact the progression of coronary atherosclerosis through the release of various pro-inflammatory and anti-inflammatory cytokines and chemokines. (6).

Measurement of EAT thickness (EATT) using echocardiography has the potential to reveal early signs of atherosclerosis in AS patients. Studies have reported increased EATT levels in patients with AS when compared to those in the healthy control group (7, 8). Moreover, chronicity of the disease, body mass index (BMI), inflammatory markers, lipid profile, Bath AS Functional Index (BASFI) (9), and Bath AS Disease Activity Index (BASDAI) (10) have been suggested as factors related to EATT. Despite the long-standing initial findings suggesting that EATT could be a marker of atherosclerosis and cardiovascular risk in AS patients, there are still limited studies on this topic in the literature (7).

This study set out to examine EATT and its related factors in patients with AS, with comparisons made to a healthy control group. Additionally, while previous research typically examined the correlation between EATT and clinical and blood parameters that indicate disease activity (7,8), this study is novel in examining the relationship between EATT and the severity of sacroiliitis, as well as physical activity levels evaluated by The International Physical Activity Questionnaire Short Form (IPAQ-SF) and the 6-minute walk test (6-MWT).

## Materials and Methods

### Participants

The study was designed as a cross-sectional clinical study. The medical records of 240 patients with AS in the Istanbul Physical Medicine Rehabilitation Training and Research Hospital outpatient clinic were screened between August 2015 and January 2016. The inclusion criteria were a disease duration of more than one year, being 18 years or older, and having a diagnosis of AS according to the modified New York Criteria (11). The exclusion criteria included illiteracy, being over 65 years old, and having a history of ischemic heart disease, hypertension, chronic kidney failure, or endocrinopathies such as diabetes mellitus, hypothyroidism, cerebrovascular disease, Cushing's syndrome, and primary hyperlipidemia. A total of 200 subjects were excluded due to the above-mentioned exclusion criteria. Out of the remaining 40 patients, 10 chose not to participate in the study. Therefore, 30 patients were included, and the control group consisted of 31 age-matched healthy volunteers. The estimated sample size was 22 participants for each group (12).

### Ethics

Ethical approval was granted by the Local Ethics Committee of Bakırköy Dr. Sadi Konuk Education and Research Hospital and subsequently approved by the Turkish Ministry of Health (decision no: 2016/03/10, date: 11.04.2016). Informed consent, both oral and written, was obtained from each patient before their participation in the study.

### Demographics and Measurements

Demographic features, including age, gender, body weight, and height, were documented. BMI was calculated (kg/m$^2$). The duration of disease, smoking history, and any additional illnesses were also noted. All patients underwent a physical examination. Serum fasting blood sugar, triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) values were obtained from the patients' follow-up records within the last month. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were also recorded. Very LDL-C (VLDL) levels were calculated using the Friedewald formula. Standard anteroposterior pelvic roentgenograms from the patients' follow-up records in the past month were reviewed by the same physiatrist. Sacroiliitis was graded according to the New York Criteria (11). The BASDAI was used to assess disease activity (10), while the Bath AS Metrology Index (BASMI) measured activity limitation (13). BASFI was utilized to evaluate functional status (9), and quality of life was assessed using the AS Quality of Life (ASQoL) questionnaire (14). Additionally, the AS Disease Activity Score with CRP (ASDAS-CRP) (15) was used alongside BASDAI to assess disease activity.

IPAQ-SF (16) was employed to evaluate physical activity levels over the previous 7 days. IPAQ helps measure physical activity in AS patients (16). The 6-MWT was performed by walking a 30-meter flat path marked with return points. Both pretest and posttest heart rate, blood pressure, oxygen saturation levels, and walking distance were recorded. The 6-MWT serves as a prognostic and predictive measure for cardiovascular disease and can also be used to assess function in patients with AS (17). All assessments were conducted by the same physiatrist.

Transthoracic echocardiography [Vivid 7 Dimension by GE Vingmed Ultrasound, located in Horten, Norway (Model N-3190)] using a 2.5 MHz probe was performed to examine the heart in all participants. EATT was measured using parasternal long axis images obtained from the right ventricular free wall at the end of systole while the patients were positioned in the left lateral decubitus position (18). The average of three measurements was calculated. All echocardiograms were conducted by the same cardiologist.

### Statistical Analysis

Data analysis was performed with IBM SPSS version 10.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics [mean, standard deviation (SD), median (minimum-maximum), frequency, and percentage] were utilized. The distribution of variables was evaluated using the Kolmogorov-Smirnov test, revealing a deviation from normality. Consequently, non-parametric tests were applied. The Mann-Whitney U test was applied for analyzing quantitative data, and Spearman correlation analysis was conducted to assess relationships. Statistical significance was set at p-values less than 0.05. Sample size estimation was performed using MedCalc Statistical Software. The estimation was based on EATT values, anticipating a group difference of more than 1.04 mm, with a false-positive rate of 5% ($\alpha$= 0.05) and a minimum power of 80% ($\beta$= 0.20), as described in Ustun et al. study (12).

## Results

Demographic characteristics and EATT values are shown in Table 1. No significant differences were found regarding age, gender, smoking status, and BMI between the patients and the control group. The mean EATT value was statistically significantly higher in the AS group (p<0.001). The mean disease duration in the AS group was 10.0 SD± 7.2) years. Eleven patients (36.7%) had comorbidities, and almost one-third were smokers. Nine patients (30%) were using nonsteroidal anti-inflammatory drugs, 4 (13.3%) were taking sulfasalazine, and 21 (70%) were using anti-tumor necrosis factor (TNF) therapy.

**Table 1. Demographic variables and EATT**

| Variable | AS | Healthy controls | p-value |
|---|---|---|---|
| | n=30 | n=31 | |
| Mean age (years) | 41.67±7.56 | 44.10±14.90 | 0.799 |
| Gender (male, %) | 70 % (n=21) | 45.2 % (n=14) | 0.088 |
| Smoking | 33% (n=10) | 25.8% (n=8) | 0.13 |
| Body mass index, kg/m$^2$ | 26,58±4.33 | 25.6±4.5 | 0.7 |
| Mean EATT, mm | 4.40±1.65 | 2.85±1.12 | <0.001 |

EATT: Epicardial adipose tissue thickness, AS: Ankylosing spondylitis

Demographic and clinical features in AS patients, along with correlations between EATT, are shown in Table 2. Statistically significant positive correlations were found between EATT and BMI, BASFI, and BASMI (p<0.05) (Table 3). There was a significant negative correlation between EATT and ESR (p=0.037). No significant correlations were found between EATT and disease duration, ASDAS, ASQoL, CRP, blood lipids, 6-MWT, or IPAQ (p>0.05) (Table 2).

Clinical characteristics were compared based on gender and are summarized in Table 3. BASFI, BASMI, and EATT were significantly higher in men compared to women (p<0.05). However, no significant differences were observed between the sexes with respect to ASDAS, BASDAI, ASQoL, IPAQ, and 6-MWT (p>0.05) (Table 3).

According to the New York criteria, sacroiliitis was graded on standard anteroposterior pelvic roentgenograms as follows: one patient (3.3%) had Grade 1, five patients (16.7%) had Grade 2, twelve patients (40%) had Grade 3, and twelve patients (40%) had Grade 4 sacroiliitis. A linear correlation was found between EATT and the grade of sacroiliitis (F= 5.344, p= 0.028 regression analysis; correlation r= 0.400, p= 0.028) (Figure 1).

## Discussion

In this investigation, the mean EATT value demonstrated a significant elevation within the AS group, corroborating findings from previous research that similarly reported elevated EATT values among AS patients. This consistency lends further credence to our own results. Moreover, our study revealed a positive correlation between EATT and BMI, BASFI, and BASMI, while a negative correlation was observed between EATT and ESR. Additionally, we identified a linear correlation between EATT and the severity of sacroiliitis (7).

Previous studies have implicated various factors such as disease duration, BMI, inflammatory markers, lipid profile, BASFI, and BASDAI in relation to EATT. Notably, our study uncovered a negative correlation between EATT and disease activity, as indicated by ESR levels, although no significant correlation was found with CRP in our cohort. The literature regarding the association between atherosclerosis and disease activity in AS patients presents conflicting findings. Some studies have reported a positive correlation (19) between carotid intima-media thickness (CIMT) and ESR in AS patients, while other studies found no correlation (7). Conversely, a negative correlation between CIMT and ESR has been reported previously (20, 21). Additionally, some studies revealed no

significant correlations between CRP and CIMT (20, 22). In our study, we observed a significant negative correlation between EATT and ESR, a laboratory marker of disease activity. This result is consistent with previous studies (20). However, as ESR reflects the present status of disease activity, it may not accurately represent the overall inflammatory burden of the disease. Disease activity markers often reflect recent inflammation levels but may not capture the cumulative level of inflammation over time.

In this study, EATT was significantly related to BMI; however, previous studies have not reported significant cholesterol (TC), between EATT and BMI in AS patients (7, 8). There were no significant correlations between EATT and total cholesterol(TC), TG, LDL-C, or HDL-C levels in our study. Surucu et al. (8) reported negative correlations between EATT and either TC or LDL cholesterol in patients with AS. Tekaya et al. (23) and Resorlu et al. (7) reported that EATT was significantly correlated with TG, but there were no significant correlations between EATT and

**Table 2. Correlations with EATT in patients with AS**

| Variables of AS patients | Mean±SD | EATT r | p-value |
|---|---|---|---|
| Age (years) | 41.67±7.56 | 0.334 | 0.07 |
| Disease duration (years) | 10.03±7.19 | 0.03 | 0.791 |
| Weight (kg) | 76.87±16.50 | 0.383 | **0.037** |
| BMI (kg/m$^2$) | 26.58±4.33 | 0.428 | **0.018** |
| BASDAI | 3.73±1.78 | 0.036 | 0.811 |
| BASFI | 3.39±2.39 | 0.475 | **0.008** |
| BASMI | 4.64±2.19 | 0.359 | **0.05** |
| ASDAS | 2.46±1.01 | 0.165 | 0.384 |
| ASQOL | 6.23±4.81 | 0.174 | 0.357 |
| C-reactive protein (mg/dL) | 7.34±8.12 | 0.218 | 0.248 |
| Erythrocyte sedimentation rate (mm/h) | 15.73±15.54 | -0.382 | **0.037** |
| Total cholesterol (mg/dL) | 193.43±39.68 | -0.111 | 0.559 |
| LDL cholesterol (mg/dL) | 117.57±29.95 | -0.048 | 0.801 |
| HDL cholesterol (mg/dL) | 47.13±10.44 | -0.125 | 0.510 |
| Tryglyceride (mg/dL) | 193.43±71.94 | 0.004 | 0.982 |
| Atoregenic Index (Log 10TG/HDL) | 0.42±0.24 | 0.089 | 0.640 |
| 6-minute walking (m) | 433.33±63.04 | -0.0159 | 0.402 |
| IPAQ (MET-min/wk.) | 1832.16±2822.92 | 0.265 | 0.158 |
| EATT (cm) | 0.44±0.16 | 1 | |

BASDAI: The Bath AS Disease Activity Index, BASMI: the Bath Ankylosing Spondylitis Metrology Index, BASFI: The Bath AS Functional Index, BMI: Body-mass index, ASQoL: Ankylosing Spondylitis Quality of Life Questionnaire, ASDAS: AS Disease Activity Score, IPAQ: The International Physical Activity Questionnaire, MET: The metabolic Equivalent, EATT: Epicardial adipose tissue thickness, Spearman correlation

**Table 3. Relationship between clinic varriables and gender**

| Variables of AS patients | Male n=21 | | Female n=9 | | p-value |
|---|---|---|---|---|---|
| | Mean±SD | Median | Mean±SD | Median | |
| Age (years) | 42.24±6.572 | | 40.33±9.823 | | **<0.001** |
| ASDAS | 2.6±1.1 | 2.4 | 2.1±0.8 | 2.0 | 0.213 |
| BASDAI | 3.8±2.0 | 4.3 | 3. 6±1.3 | 3.4 | 0.786 |
| BASFI | 4±2.5 | 3.6 | 2.0±1.4 | 1.8 | **0.030** |
| BASMI | 5.2±2.3 | 5.6 | 3.3±1.1 | 3.2 | **0.030** |
| ASQOL | 6.8±5.4 | 5.0 | 5.0±2.7 | 5.0 | 0.699 |
| IPAQ (MET-min/wk.) | 2080±3138 | 693 | 1253±1931 | 537 | 0.415 |
| EATT (cm) | 0.5±0.1 | 0.5 | 0.3±0.1 | 0.3 | **<0.001** |
| 6-minute walking (m) | 432±68 | 450.0 | 436.7±52.3 | 450 | 0.927 |

ASDAS: AS Disease Activity Score, BASDAI: The Bath AS Disease Activity Index, BASFI: The Bath AS Functional Index, BASMI: The Bath Ankylosing Spondylitis Metrology Index, ASQoL: Ankylosing Spondylitis Quality of Life Questionnaire, IPAQ: The International Physical Activity Questionnaire, MET: The metabolic Equivalent, EATT: Epicardial adipose tissue thickness. Mann-whitney u test

either LDL-C or HDL-C in patients with AS. Iacobellis et al. found a significant correlation between EATT and LDL-C, adiponectin, and arterial blood pressure (24). However, a previous study reported no significant correlations between CIMT and blood lipids in AS (21). Considering other studies (7, 8, 21) and our results, which did not find significant correlations between lipid levels and EATT, the exclusion of patients with atherosclerotic risk factors at the beginning of the study may explain this common finding. On the other hand, in the study by Iacobellis et al. (24), individuals with coronary artery disease were included, which makes their results inconsistent with our study. This finding supports the idea that the increase in EATT is secondary to AS pathogenesis and independent of the lipid profile.

EATT exhibited a positive correlation with both BASFI and BASMI in our study. However, no significant correlations were observed between EATT and ASDAS, BASDAI, or ASQoL. Previous research has reported significant correlations between BASFI and either EATT or CIMT, which is consistent with our findings (8, 20). However, some studies did not find significant correlations between EATT and either BASDAI or BASFI (7, 12). Similarly, Gupta et al. (21) reported no correlations between CIMT and either BASDAI or BASFI, but noted a significant positive correlation between CIMT and BASMI in the same study. These conflicting results may be attributed to the differing sensitivities of disease activity measures. BASDAI and ASDAS primarily reflect recent disease activity, while metrological and functional indices provide more objective indicators of disease progression and damage.

In this investigation, BASFI and BASMI scores were significantly higher in men compared to women. This finding aligns with a study conducted by Shahlaee et al.(25), which also reported significantly higher BASMI scores in male AS patients. Furthermore, our study revealed that EATT was significantly higher in men than in women. This observation may be explained by the widely recognized fact that male gender is a risk factor for coronary artery disease at younger ages, providing a plausible rationale for our findings (26).

In this study, we did not observe a significant correlation between EATT values and the 6-MWT. The 6-MWT is an important measure for assessing the functional capacity of patients with cardiac diseases (27). Carvalho et al. (28) reported a correlation between the 6-MWT and cardiopulmonary test in patients with heart failure. Given that the 6-MWT was found to be practical, well-tolerated, and cost-effective, it is proposed as a suitable alternative to cardiopulmonary testing. To our knowledge, no studies have yet investigated the association between the 6-MWT and subclinical atherosclerosis in AS patients. However, studies with larger sample sizes are needed to draw definitive conclusions about this correlation.

Similarly, no correlation was observed between EATT and IPAQ in this study. Notably, we did not identify any studies exploring the correlation between the IPAQ-Short Form and EATT. In line with this, a prior study found no significant correlations between EATT and either disease activity or the functional status of patients (29). Tekaya et al. (30) found that radiographic structural damage was a predictor of increased EATT in spondyloarthritis. While previous studies have explored the relationship between disease activity and EATT (7, 8), few have compared radiographic findings with EATT. In our study, a correlation was found between EATT and the grade of sacroiliitis. Sacroiliitis, a hallmark of AS, represents ongoing local inflammation in the sacroiliac joints (31). It is well-known that chronic inflammation in AS affects not only the joints but also other tissues, including cardiovascular structures. EAT is recognized as a highly inflammatory fat depot, capable of secreting pro-inflammatory cytokines such as interleukin-6 and TNF-$\alpha$, which are central to the pathophysiology of AS (32). These cytokines may contribute to both joint and cardiovascular inflammation, providing a potential link between sacroiliitis and increased EATT (31, 32).

Additionally, the severity of sacroiliitis may reflect a higher overall inflammatory burden in AS, which could contribute to subclinical atherosclerosis, as indicated by increased EATT. The chronic inflammatory state in AS may promote adipose tissue dysfunction, leading to ectopic fat deposition, including in the epicardial region (32, 33). This inflammatory process could explain why patients with more severe sacroiliitis tend to have higher EATT values. Further studies are needed to clarify whether controlling sacroiliitis through treatment could also reduce cardiovascular risk, as reflected by changes in EATT.

## Study Limitations

There are several strong points and some limitations in this study. This study is limited by its relatively small sample size and absence of a follow-up period, which may affect the robustness of the findings. It is important to acknowledge that magnetic resonance imaging (MRI) is currently regarded as the gold standard diagnostic method for assessing epicardial fat thickness. However, our study did not employ MRI, which stands as a limitation. Nonetheless, it is worth noting that the widespread use of MRI for evaluating epicardial fat on a large scale is not practical. In this context, echocardiography presents itself as a practical, objective, non-invasive, and cost-effective alternative to MRI. Another limitation is the gender imbalance within the AS group, where the prevalence of AS is approximately twice as high in males compared to females (1). This disparity may potentially impact the results when comparing male and female participants within the AS group. Additionally, there is a marginal difference in gender distribution between the study and control groups. While this difference is not statistically significant, it could still impact the study results. We recommend that future studies use gender-matched control groups to minimize potential bias and further validate these findings.

Key strengths of our study include having a control group, echocardiographic evaluations in AS patients conducted by field experts, and the use of diverse analyses enabling a comparative examination. All transthoracic echocardiography was performed by the same cardiologist, and the cardiac examinations were

reviewed by two cardiologists, ensuring more precise and consistent results.

## Conclusion

As a result, EATT values were higher in AS patients compared to those of the controls in this study. The factors related to EATT were BMI, ESR, BASFI, BASMI, and the grade of sacroiliitis. No significant correlations were identified between EATT and functional capacity, as measured by either the 6-MWT or IPAQ. Since BASFI and BASMI are better markers of chronic inflammation, patients with functional and mobility limitations may benefit from early cardiologic follow-up. It is recommended to conduct further studies with larger sample sizes to confirm our findings.

### Ethics

**Ethics Committee Approval:** Ethical approval was granted by the Local Ethics Committee of Bakırköy Dr. Sadi Konuk Education and Research Hospital and subsequently approved by the Turkish Ministry of Health (decision no: 2016/03/10, date: 11.04.2016).
**Informed Consent:** Informed consent, both oral and written, was obtained from each patient before their participation in the study.

### Footnotes

### Authorship Contributions

Concept: A.S., N.K., B.U., A.Y., Design: A.S., N.K., D.B., N.P., Data Collection or Processing: A.S., B.U., N.P., Analysis or Interpretation: N.K., D.B., A.Y., Literature Search: N.K., D.B., B.U., A.Y., N.P., Writing: A.S., N.K., A.Y.

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*Case Report / Olgu Sunumu*

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# *A Case with an Unusual Presentation of Tennis Leg*

*Tenisçi Bacağının Alışılmadık Sunumu Olan Bir Olgu*

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## *Abstract*

The rupture of the fascia at the junction of the medial head of the gastrocnemius muscle and the soleus is called the tennis leg. It mostly occurs when the muscle is overstretched during sports or general daily activities and is often seen in middle-aged and physically active person. This report presents the management of an unusual case of a 61-year-old male who presented with a swelling in his calf and was diagnosed with a tennis leg by imaging methods. The fluid between the medial head of the gastrocnemius and soleus muscles was drained 4 times with ultrasound (US) at intervals of 2 weeks. The patient received two US-guided steroid injection and used non-steroidal anti-inflammatory drug (celecoxib 200 mg/day) for one month. The swelling and pain in his calf disappeared and no fluid collection was detected on US at the 3-month follow-up. US may be preferred as a useful tool in evaluating the specific reason of calf injury, guessing the severity of the damage, and monitoring the recovery process.
**Keywords:** Tennis leg, imaging methods, management

## *Öz*

Gastrokinemius kasının medial başı ile soleusun birleşim noktasında fasyanın yırtılmasına tenisçi bacağı denir. Çoğunlukla spor veya genel günlük aktiviteler sırasında kasın aşırı gerilmesi sonucu ortaya çıkar ve sıklıkla orta yaşlı ve fiziksel olarak aktif kişilerde görülür. Bu yazıda baldırında şişlik şikayeti ile başvuran ve görüntüleme yöntemleriyle tenisçi bacağı tanısı konulan 61 yaşındaki erkek hastanın alışılmadık bir olgusunun yönetimi sunulmaktadır. Gastrokinemius medial başı ile soleus kasları arasındaki sıvı 2 hafta arayla 4 kez ultrason (US) ile boşaltıldı. Hastaya iki kez US rehberliğinde steroid enjeksiyonu yapıldı ve hasta bir ay boyunca non-steroid anti-enflamatuvar ilaç (selekoksib 200 mg/gün) kullandı. Üç aylık takibinde baldırındaki şişlik ve ağrı kayboldu ve US'de herhangi bir sıvı toplanmasına rastlanmadı. US, baldır yaralanmasının spesifik nedeninin belirlenmesinde, yaralanmanın ciddiyetinin tahmin edilmesinde ve iyileşme sürecinin izlenmesinde yararlı bir araç olarak tercih edilebilir.
**Anahtar kelimeler:** Tenisçi bacağı, görüntüleme yöntemleri, tedavi

## Introduction

The gastrocnemius medial head distal muscle-tendinous junction damage is called tennis leg. Although tennis leg is seen in people who are involved in different sports, especially tennis, it can also occur during participation in common daily activities. While the damage was initially paid attention to be a rupture of the plantaris tendon, it has recently been shown that the most common lesion is actually gastrocnemius injury. Even though the injury can appear anywhere from the proximal origin to the mid-abdominal and soleus-facial junction, it is often seen at the junction of the fascia between the medial head of the gastrocnemius and the soleus. Fluid accumulation occurs between the medial head of the gastrocnemius and the soleus muscle (1,2).

Tennis leg is acute mid-calf pain caused by an injury that occurs during forced dorsiflexion of the ankle and forced extension of the knee during sports or common daily activities as well as namaz praying. This position causes simultaneous contraction and passive stretching of the gastrocnemius muscle, contributing to the occurrence of injury. It most commonly occurs in middle-aged adult males in the fourth to sixth decades of life. A sudden pain, usually starting in the calf, with a popping or tearing sensation as if kicking the back of the leg are characteristic symptoms. The pain is often accompanied by difficulty walking. On physical examination, there is ecchymosis and localized tenderness. Severe pain and swelling usually improve in 1-2 days of damage. Imaging methods such as magnetic resonance imaging (MRI) or ultrasound (US) might aid in confirming the

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diagnosis and assessing the extent of the injury. In the differential diagnosis, Achilles tendon rupture, deep vein thrombosis (DVT), ruptured Baker's cyst, thrombophlebitis, hematoma, arthritis, bursitis, infection/abscess, vascular abnormality, stress fracture, and tumor should be considered (1-3). This report presents the management of an unusual case of a 61-year-old male who presented with a swelling in his calf and was diagnosed with a tennis leg by imaging methods.

## Case Report

A 61-year-old male patient complained of pain and swelling in the left leg for 20 days. He had no history of trauma and strain or bleeding and coagulation disorders. The individual was no physically active. The pain and swelling had appeared after kneeling for a long time. He was experiencing pain with activity such as stairs, walking and jogging. He had no chronic disease. On physical examination, there was swelling in the left leg (Figure 1). His left knee and ankle had normal strength and range of motion but there was pain in the mid-calf with palpation while the ankle is passively dorsiflexion with the knee maximal extension. Moreover, there was pain in the calf with forced ankle plantar flexion with the knee in maximum extension. The pain disappeared when the knee was brought to maximum flexion. Left leg US was performed on the patient. There was no DVT in the popliteal and calf veins on doppler US imaging but there was a longitudinal partial tear of the medial head of gastrocnemius muscle. Also, a 24 cm long hypoechogenic area (haematoma) extending from the myotendinous junction to the Achilles tendon was detected between the soleus and the medial head of the gastrocnemius (Figure 2). All surrounding structures and the myotendinous junction was normal. Under US guidance, a 21 gauge needle was inserted into the fluid collection area and 300 mL of hemorrhagic fluid was aspirated. Dramatic pain reduction was observed after aspiration. Afterwards, the patient was started on a non-steroidal anti-inflammatory drug (NSAID, celecoxib, 200 mg/day). Moreover, passive and active stretching exercises together with ice, leg elevation and rest were recommended. Since fluid accumulation was detected again by US in the follow-up two weeks later, a 21 gauge needle was inserted into the fluid collection area under US guidance again, and 150 mL of serosal fluid was aspirated. Then, US guided steroid injection (1 mL of 20 mg triamcinolone hexacetonide) was applied. In the follow-up two weeks later, a 21-gauge needle was inserted into the fluid collection area under US guidance, since fluid accumulation was detected again by US. At this time, 30 mL of hemorrhagic fluid was aspirated. Therefore, left cruris MRI was performed. MRI releaved 13 cm long hematoma at the myotendinous junction between the medial head of the gastrocnemius muscle and the soleus muscle and partial gastrocnemius rupture (Figure 3). At this time, 30 mL of serosal fluid was aspirated. Then, US guided steroid injection (1 mL 20 mg triamcinolone hexacetonide) was administered for the second time. The patient was advised to use a elastic bandage and do isometric exercises. In the 3-month follow-up, almost complete improvement was obtained. The swelling and pain in his calf disappeared and no fluid collection was detected on US. The patient returned to normal physical activity such as stairs, walking and jogging.


**Figure 1.** Clinical images of the patient's left calf and aspirated hemorrhagic and serosal fluids

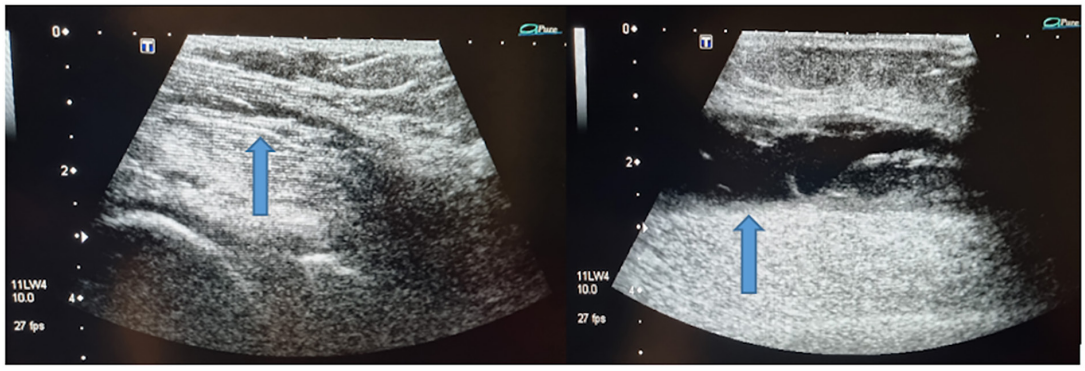


**Figure 2.** Longitudinal ultrasound images of the left calf (left picture: a partial tear of the medial head of gastrocnemius muscle; right picture: a hypoechoic haematoma between the medial head of gastrocnemius and the soleus muscle)

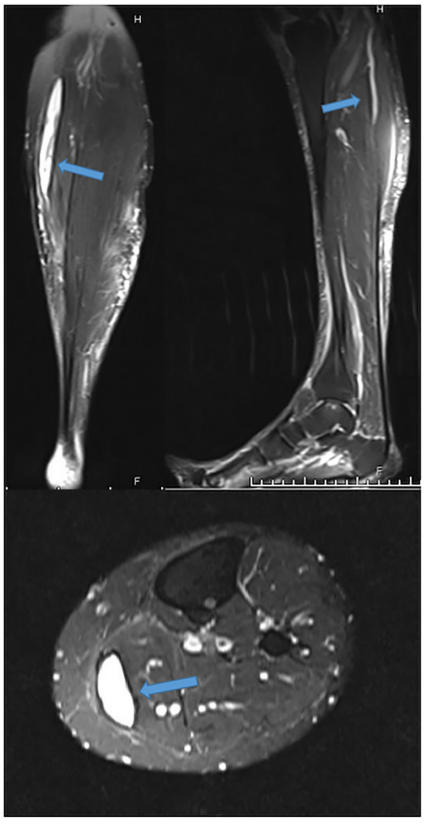

**Figure 3.** Magnetic resonance images of the left calf (a partial tear of the medial head of gastrocnemius muscle together with a hyperintense fluid collection between the medial head of the gastrocnemius and soleus on T2-weighted sequences) (up picture: coronal and sagital images; down picture: axial image)

## Discussion

Since the gastrocnemius muscle owns a great rate of fast-twitch muscle fibers allowing strong contractions and crosses two joints (knee and ankle), it exposed to a high risk of injury (4,5). The medial head of the gastrocnemius is the third most frequently strained muscle in athletes, after the biceps femoris and rectus femoris, and is the most frequently wounded muscle of the posterior segment of the leg (1,5). Both MRI and US are beneficial in diagnosing damages to the medial head of the gastrocnemius, as well as determining the presence of co-existing hematoma (6). In our case, tennis leg developed without any history of injury and the diagnosis of tennis leg was confirmed first by US and then by MRI.

US is an easy, painless and rapid imaging modality that can be used in the assessment of muscle trauma such as partial and complete muscle ruptures (6,7). Sonographically, rupture of the medial head of the gastrocnemius appears as deterioration of the normal parallel linear hyperechoic and hypoechoic aspect of the tendon at insertion. This evidence is paired with the uncertainty of the narrowing distal end of the tendon at insertion. Moreover, fluid collection between the gastrocnemius and soleus muscles can be seen sonographically as a hypoechoic area, especially at the muscle belly or muscle-tendinous junction. Axial US image showing the whole medial head in the same plane is very beneficial in distinguishing partial and complete muscle ruptures. Healing of the tear can also be followed by US and can be seen as heterogeneous echogenicity in the fibrous tissue between the gastrocnemius and soleus muscle (7). US can be used not only to diagnose but also to evaluate response to treatment. Various stages of recovery can be viewed after injury (2,7). In our case, US was used for diagnosis, follow-up and the evaluation of response to treatment. Since DVT may be present in up to 10% of patients with the classic clinical presentation of the tennis leg, doppler US is also required to rule out thrombosis (8). In our case, DVT was ruled out with Doppler US. Pedret et al. (9) found that hematomas are often associated with injuries involving the gastrocnemius aponeurosis at the level of the myoaponeurotic junction, but not the injuries of the myoaponeurotic junction without involvement of the gastrocnemius aponeurosis and the free gastrocnemius aponeurosis (the area free of muscle fibers just proximal to the junction of the gastrocnemius aponeurosis and soleus aponeurosis). In our case, there was a damage to the gastrocnemius aponeurosis at the level of the myoaponeurotic junction and a secondary hematoma between the medial head of the gastrocnemius and the soleus.

MRI often shows both partial or complete rupture of muscle fibers and intramuscular hematoma and fluid collection with a variable degree of surrounding subcutaneous soft tissue edema located between the medial head of the gastrocnemius and the soleus muscles. A high signal intensity could be obserced on T2-weighted images both at the myotendinous junction and within the muscle fibers. The fluid collection might include bleeding with a suitable hyperintense signal at T1-weighted images. MRI can define macroscopic foci of scar tissue with focal tendon thickening and peritendinous muscle atrophy in chronic cases (3,10). Dai et al. (11) divided the injury into three distinct groups: Grade 1-edema, but no architectural deterioration or macroscopic tear, Grade 2-hematoma or partial disruption of the muscle with local disruption of musculature, and Grade 3-a local hematoma or tendon filling the tear space complete disruption of the muscle with its rupture. They proposed that the tendon rupture opening of the gastrocnemius and/or soleus can be detected by MRI, since it is difficult to show the anatomical structure of soft tissues with US. They also suggested that repair tissue at the distal myotendinous junction of the medial head of the gastrocnemius might be an significant specific indicator of chronic tennis leg (11). Moreover, the accompanying tears of both the soleus and gastrocnemius are probable. A combination of palpation, stretching, and strength testing can help to distinguish strains of the soleus and gastrocnemius (12). US can not rule out a co-existing soleus injury, as only ~30% of soleus injuries are seen on US. MRI is the gold standard for diagnosing soleue tears (13). Although our case had pain in the mid-calf with palpation, with passively ankle dorsiflexion and with forced ankle plantar flexion with the knee in maximum extension, MRI was performed to detect possible a co-existing soleus injury. The MRI of our case was compatible with radiological grade 2 and there was no soleus tear.

Treatment is activity restriction and rest. As conservative treatment, passive and active stretching exercises together with elevation, ice, NSAID and neoprene case sleeves can be preferred (1,7,10). US guided hematoma evacuation and steroid/analgesic injections can also be applied. In the existence of compartment syndrome, fasciotomy can be applied as a surgical method. In addition, surgical treatment can be performed in patients who do not improve with conservative treatment (1). Healing of a muscle tear is slow and can take 3 to 16 weeks to complete. For this reason, activity restriction should be applied for 4 to 12 weeks, depending on the size of the tear, until pain-free walking is achieved (7). It is thought that an intense muscle tear being treated conservatively may possibly recover with fibrotic scar tissue, thus increasing the risk of re-damage. It has also been suggested that the superior anatomical and functional results may occur after surgical maintenance compared to conservative treatment. Surgical treatment should also be considered in large intramuscular hematomas (3,5). Therefore, Pereira et al. (5) recommended surgery at 3-4 weeks after the damage without too much delay in patients with severe gastrocnemius medial head muscle injury that did not improve after a short-term conservative treatment. The paper of Pereira et al. (5) involved two active young individuals with complete muscle tears, which are not representative of the patient in this case. Our case was an inactive elderly person with a partial muscle tear and accompanying hematoma and no history of trauma. Therefore, no surgery was initially considered. The fluid between muscles was drained 4 times with US at intervals of 2 weeks. Moreover, the patient used NSAID (celecoxib 200 mg/day) for one month. Celecoxib was preferred due to its lack of antiplatelet effect (12). Although corticosteroid applications have a blunting effect on the tissue healing response, treatment doses in clinical practice are generally below the level required to inhibit wound healing. It has been shown in animal studies that low-dose and short-term corticosteroid applications have no a negative effect on wound healing (14). In this case, corticosteroid injection was applied twice during serous fluid drainage and no negative effect on wound healing due to the application was observed. Kwak et al. (15) demonstrated that early compressive therapy reduces the amount of bleeding and allows for early ambulation. Therefore, the patient used an elastic bandage for one month. Moreover, the patient was initially recommended passive and active stretching exercises followed by isometric exercise. He recovered within 3 months with a close follow-up.

## Conclusion

Even if it is suggested that tennis leg etiology may result from injuries of various tissues alone or in combination, medial gastrocnemius rupture is the most widespread damage of the posterior compartment of the lower extremity. US and MRI provide very useful information in diagnosing the disease, defining the degree of the damage, and in the differential diagnosis of other possible conditions. Moreover, US may be preferred as a useful tool in evaluating the specific reason of calf injury, guessing the severity of the damage, and monitoring the recovery process. The superior anatomical and functional results may occur after surgical maintenance compared to conservative treatment in patients with younger physically active and complete muscle ruptures. However, we think that a conservative treatment applied appropriately could give a good result in patients with older physically inactive and muscle tears.

### Ethics

**Informed Consent:** Written informed consent was obtained for publication of the case report and accompanying images.

### Footnotes

### Authorship Contributions

Surgical and Medical Practices: E.Y., M.A.İ., Concept: E.Y., Design: E.Y., Data Collection or Processing: E.Y., M.A.İ., Analysis or Interpretation: E.Y., M.A.İ., Literature Search: E.Y., Writing: E.Y.

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# *Ankylosing Spondilitis in a Patient with Hepatitis Reactivation Treated with Anti-tumor Necrosis Factor Alpha: A Case Report*

## *Anti Tümör Nekroz Faktörü Alfa ile Tedavi Edilirken Hepatit Reaktivasyonu Gelişen Ankilozan Spondilit Hastası: Olgu Sunumu*

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## *Abstract*

Ankylosing spondylitis (AS), a type of spondyloarthropathy, is an autoimmune disease characterized by inflammation that mostly affects soft tissues, such as the axial skeleton, sacroiliac joint, tendons, and ligaments. The aims of AS treatment are to restore spinal flexibility, improve posture, relieve symptoms, prevent limitations in range of motion, and decrease complications. In medical treatment steps, patients with high disease activity despite treatment with non-steroidal anti-inflammatory drugs are recommended to be treated with biologic agents, including anti-tumor necrosis factor-alpha and interleukin-17 inhibitors. The risk of serious infection should be considered in patients treated with biologic agents. Anti- tumor necrosis factor (TNF)- agents administered without appropriate antiviral prophylaxis in patients with chronic hepatitis-B virus infection have been shown to induce viral reactivation. Therefore, they should be used in combination with antiviral therapy. However, rare cases of hepatitis reactivation although antiviral prophylaxis are reported in the literature. We aimed to present a case of hepatitis-B reactivation despite the use of a prophylactic antiviral drug with an anti-TNF- agent.

**Keywords:** Hepatitis-B infection, spondyloarthropathy, ankylosing spondylitis, hepatitis reactivation, anti-tumor necrosis factor-alpha

## *Öz*

Spondiloartropatinin bir türü olan ankilozan spondilit (AS), esas olarak aksiyel iskelet, sakroiliak eklem, tendonlar ve bağlar gibi yumuşak dokuları etkileyebilen enflamasyonla karakterize otoimmün bir hastalıktır. AS tedavisinin amaçları omurga esnekliğini geri kazandırmak, postürü iyileştirmek, semptomları hafifletmek, fonksiyonel kısıtlamaları önlemek ve komplikasyonları azaltmaktır. Farmakolojik tedavi basamaklarında, non-steroid anti-enflamatuvar ilaçlarla tedaviye rağmen yüksek hastalık aktivitesi olan hastaların anti-tümör nekroz faktörü (TNF)-alfa ve interlökin-17 inhibitörlerini içeren biyolojik ajanlarla tedavi edilmesi önerilmektedir. Biyolojik ajanlarla tedavi edilen olgularda ciddi enfeksiyon riski göz önünde bulundurulmalıdır. Kronik hepatit B enfeksiyonu olan hastalarda uygun antiviral profilaksi olmadan verilen anti-TNF-alfa ajanlarının viral reaktivasyonu indüklediği gösterilmiştir. Bu nedenle, antiviral tedavi ile birlikte kullanılmaları önerilmektedir. Ancak literatürde antiviral profilaksiye rağmen hepatit reaktivasyonunun görüldüğü nadir vakalar bildirilmiştir. Biz de anti TNF-alfa ajanının profilaktik bir antiviral ilaç ile birlikte kullanılmasına rağmen hepatit-B reaktivasyonu gelişen bir olguyu sunmayı amaçladık.

**Anahtar kelimeler:** Hepatit-B enfeksiyonu, spondiloartropati, ankilozan spondilit, hepatit reaktivasyonu, anti tümör nekroz faktör alfa

## Introduction

Ankylosing spondylitis (AS), a type of spondyloarthropathy, is an autoimmune disease characterized by inflammation which can mostly affect soft tissues such as the axial skeleton, sacroiliac joint, tendons and ligaments. This inflammation may lead to fibrosis and calcification, leading to loss of flexibility and fusion of the spine in some severe cases (1). AS is a rheumatological disease that usually occurs in the third decade of life and rarely after the age of 45, and its prevalence is assumed to be between 0.1% and 1.4% worldwide, based on studies (2). The goals of AS treatment are to restore spinal flexibility, improve posture, relieve symptoms, prevent range of motion limitations, and decrease complications. In medical treatment steps, patients with high disease activity despite treatment with non-steroidal anti-inflammatory drugs (NSAIDs) are recommended to be treated with biologic agents including anti-tumor necrosis factor (TNF)-alpha and interleukin- 17 inhibitors. The risk of serious infection should be considered in cases treated with biologic

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agents. While determining the indications and contraindications of biologic agents, the comorbidities of the patients should be evaluated in detail (3). Hepatitis-B virus (HBV) infection is a global health problem and one of the main causes of liver diseases. The Global Hepatitis Report published in 2017 revealed that 257 million people worldwide were living with HBV in 2015 (4). In a study conducted in Turkey in AS patients, the prevalence of HBV infection was found to be 5.7%(5). The updated American Association for the Study of Liver Disease guideline for the prevention, diagnosis, and treatment of chronic hepatitis-B defined HBV reactivation in HBsAg and anti-HBc positive patients as follows: 100- fold IU/mL increase in HBV-DNA compared to baseline level, In a patient whose HBV-DNA positivity could not be detected before, at least 1000-fold U/mL increase in HBV DNA or at least 10,000-fold IU/mL increase if the initial HBV-DNA value was not present (6). Anti TNF-alpha therapy is effectively used in the treatment of many chronic inflammatory rheumatic diseases. It is recommended to combine anti-TNF-alpha agents with antiviral treatments in rheumatology patients with chronic hepatitis-B infection (7). It has been shown that anti-TNF-alpha agents administered without convenient antiviral prophylaxis can contribute to viral reactivation in patients with chronic hepatitis-B infection. However, rare cases of hepatitis reactivation despite antiviral prophylaxis have been reported in the literature (7) We aimed to present a case of hepatitis-B reactivation despite using a prophylactic antiviral drug with an anti TNF-alpha agent.

## Case Report

A 49-year-old male patient has been diagnosed with AS for 25 years, and was followed up in an external center for 5 years with Sulfasalazine 2x2 and NSAIDs treatment after the first diagnosis.He has been followed up in our rheumatic diseases outpatient clinic since 2016. When the patient applied to us, he was being treated with NSAIDs and had not responded to treatment recently; visual analogue scale (VAS) (0-10) pain score: 5, Bath AS Disease Activity Index (BASDAI) score: 6.3, Bath AS Functional Index (BASFI) score:4.2, HLA-B 27: Negative, sacroiliac magnetic resonance imaging showed unilateral sacroiliitis (Figure 1).

When blood values were examined, acute phase reactants were normal. Systemic examination was unremarkable. Modified schober: 5 cm, occiput wall distance: 5 cm, tragus wall distance: 14 cm, sacroiliac tests were negative, inflammatory low back pain was described. The patient was being followed up in the gastroenterology department with the diagnosis of chronic hepatitis B. Anti-TNF treatment was planned for the patient, the gastroenterology clinic was consulted for antiviral agent before the treatment and Lamivudine was recommended to be started. Etanercept 50 mg/wk treatment was started by us in the first month of lamivudine treatment. In the 3rd month of etanercept treatment, the patient's VAS pain score: 1 BASDAI score: 0.9 BASFI score regressed to 1 values. The patient was being followed in remission with etanercept and lamivudine treatments for the last 5 years. In his routine examinations 2 months ago; alanine aminotransferase (ALT): 371 U/L (<33), aspartate aminotransferase (AST): 147 U/L (<32), Sedimentation (ESR): 26 mm/h (2-20), C-reaktif protein: 6.68 mg/L (0-5) levels. Etanercept use was discontinued because ALT and AST were more than 3 times higher, and the patient was referred to the gastroenterology clinic. In the examinations made in gastroenterology; HBsAg:2027S/CO, HBV-DNA:8055491 IU/mL, considering hepatitis reactivation, (the patient's HBV-DNA value was higher than 105 IU/mL before etanercept treatment) antiviral agent lamivudine used by the patient was discontinued and Tenofovir treatment was started instead. After the decrease in ALT and AST levels in the first month of tenofovir use, the patient's condition was evaluated as resistance to lamivudine treatment and we were informed that etanercept treatment could be continued. Etanercept treatment was started again for the patient and in the 2nd week of the treatment; AST:16, ALT: 19, ESR:16 mm/hr, VAS: 2, BASDAI:1.5, BASFI:0.8. The disease activity of the patient is in remission and he is being followed up by our clinic with etanercept and tenofovir treatment. Patient's consent has been obtained.

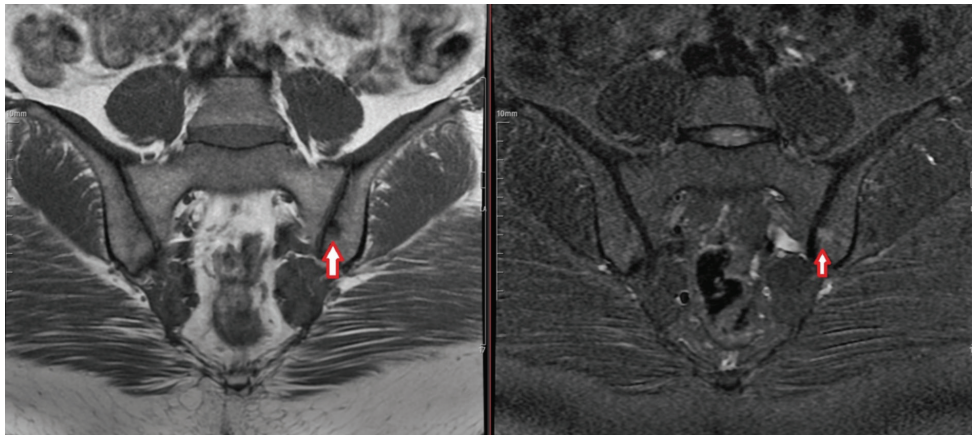

**Figure 1.** There is an increase in STIR signal consistent with sacroiliitis on the left sacroiliac joint 1/2 inferior iliac face

## Discussion

The management of patients with chronic hepatitis-B infection with AS is complex and requires the attention and care of specialists from various fields. Since it is known that immunosuppression treatments to be applied in AS may lead to HBV reactivation, HBV serology should be checked before the treatment and the patient should be re-evaluated according to these results (8). There is a consensus in the literature which whole patients who start immunosuppressant therapy should be tested for HBsAg, anti-HBs and anti-HBc total. This is a measure to protect patients against hepatitis reactivation (9). Prophylactic treatment in patients who will receive anti TNF-alpha therapy; provided by nucleoside analogues such as lamivudine, adefovir, tenofovir, and entecavir. Entecavir (0.5 mg/day) is the first-line treatment for prophylaxis in hepatitis-B patients with inflammatory rheumatic disease. This indication is a conclusion of entecavir's strong antiviral effect, low resistance ratios, and its relationship with rheumatic drugs in long-term studies (10). When evaluated for HBV reactivation, HBsAg positive patients are at higher risk for HBV reactivation but the highest risk is in patients with HBV-DNA higher than 105 IU/mL copies (11). The case we presented also had HbsAg positivity, and the HBV-DNA value was higher than 105 IU/mL copies before anti-TNF-alpha treatment and had the risk factors for HBV reactivation in the literature. In the literature, it has been seen that lamivudine is the most commonly used antiviral drug prophylactically together with anti TNF-alpha. (12). One study showed that prophylactic usage of an oral antiviral agent can preserve from HBV reactivation in the majority (>90%) of patients with chronic HBV infection treated with an anti-TNF-alpha agent. In this study, viral reactivation developed in just one patient (7%) because of a Lamivudine-resistant strain during anti-TNF-alpha therapy (7). In another study, it was shown that the probability of developing resistance to lamivudine is higher compared to other antivirals. For this reason, treatment with drugs that are less likely to develop resistance to antivirals such as entecavir and tenofovir is recommended in suitable patients (13). In a meta-analysis evaluating the efficacy of antiviral prophylaxis compared to no treatment, it was shown that HBsAg positive patients benefited more from antiviral treatment (14). In our case, viral reactivation developed despite prophylaxis with lamivudine and contrary to the literature, although HbsAg was positive, it did not benefit from prophylactic treatment. In the literature, infliximab has been associated with a higher ratio of induced liver disease (elevated transaminase levels, viral reactivation, and acute liver failure) compared to etanercept (15). Between TNF-alpha inhibitors, reactivation has been reported more with infliximab and adalimumab than with etanercept (16). Although etanercept was preferred as an antiviral agent in our case, reactivation developed. When anti-TNF-alpha agents are used alone without antiviral prophylaxis, the risk of reactivation varies between 1% and 10%, depending on the hepatitis B serology of the patient (16). Lamivudine has been used in 90% of reported HBsAg positive cases treated with anti TNF-alpha agents. Up-to-date international guidelines for the management of HBV infection offer that lamivudine alone should be sufficient for patients taking immunosuppressive therapy for less than 6 months. In our case, lamivudine was started by gastroenterology considering the current guidelines. However, it remains unclear whether lamivudine provides benefit in patients requiring long-term immunosuppressive therapy, as is generally the case with anti-TNF-alpha therapy. Longer-term lamivudine prophylaxis has been associated with the occurrence of lamivudine resistant HBV strains (17). Most of the cases reported in the literature are HBV reactivations that develop in patients who do not use antiviral prophylaxis together with anti-TNF-alpha agents (16,18). Expert opinions are that antiviral therapy should be started 1 month before anti-TNF-alpha therapy is given to chronic HBV patients (19). Our case is HBV reactivation that developed despite using antiviral prophylaxis.

## Conclusions

In patients with a diagnosis of chronic HBV and using anti-TNF-alpha, liver enzymes should be monitored at regular intervals. It should be kept in mind that hepatitis reactivation may develop in patients followed up with anti-TNF-alpha therapy despite receiving antiviral prophylaxis. This case reinforces the importance of current recommendations for periodic monitoring of chronic HBV patients receiving anti-TNF-alpha therapy and planning appropriate therapy.

### Ethics

**Informed Consent:** Patient's consent has been obtained.

### Footnotes

### Authorship Contributions

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

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# *Improper Injection Depth and Localization During Vaccination May Cause Shoulder Pathologies: A Few Patients from the Covid Pandemic*

## *Aşılamada Yanlış Enjeksiyon Derinliği ve Lokalizasyonu Omuz Patolojilerine Neden olabilir: Kovid Pandemisinden Birkaç Hasta*

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**Dear Editor;**

Shoulder injury linked to vaccine administration (SIRVA), is a well-known but underreported problem phenomenon within the medical literature. It is defined as shoulder pain and/or decreased range of motion subsequent to the receipt of a vaccination intended for intramuscular administration within the upper arm. It's hypothesized to ensue when vaccination is inadvertently injected into the shoulder joint or subdeltoid bursa, triggering an inflammatory cascade that damages the surrounding structures (1). It has been seen following tetanus, pneumococcus, and papillomavirus vaccinations, and has been recorded more frequently with influenza vaccinations due to their widespread utilization (2).

In the wake of a pandemic that necessitated widespread vaccination campaigns on a global scale, SIRVA has emerged as a subject of significant concern. A spectrum of shoulder pathologies like subacromial and subdeltoid bursitis, supraspinatus tendinitis, massive shoulder effusion and synovitis, calcific tendinitis, Parsonage-Turner syndrome, quadrilateral space inflammation are reported afterward. (3, 4).

We want to mention individuals who presented with the complaint of shoulder pain to our outpatient clinic between January and June 2022, among 1352 patients documented through international classification of diseases codes related to shoulder pain, a subset of 14 patients have reported an onset of shoulder pain subsequent to receiving the coronavirus disease 2019 (COVID-19) vaccine. Eight out of 14 patients were male and the mean age was 51.7 years. All of the patients had left shoulder involvement. Three patients had limited shoulder range of motion in addition to shoulder pain. The mean and standard deviation of pain intensity evaluated by visual analouge scale was 6.64±1.44. Regarding the temporal aspects of these cases, the initiation of shoulder pain exhibited a range spanning from a few hours to a duration of 4 weeks, with a calculated mean onset time of 7.6 days. The mean interval between the onset of pain and the point of hospital presentation was noted to be 5.7 months. None of the patients described a history of rigorous and strenuous activity prior to the manifestation of their shoulder pain. They had no prevaccination shoulder pain or shoulder pathology proven by clinical examination or imaging. Only two patient had inactivated virus vaccination. For the remaining individuals, the mRNA vaccination was the cause of their shoulder pain. Six patients reported that their shoulder pain began after receiving the second dosage of the immunization, and three patients reported that their shoulder pain began following the first and third doses of the vaccination. Supraspinatus, subscapularis, bicipital tendinosis and bursitis are the most common abnormalities which were found in the majority of our patients evaluated with shoulder magnetic resonance imaging (MRI). Reactive arthritis manifested solely in one patient. This individual exhibited tenderness in the acromioclavicular joint, without any concomitant limitations in range of motion. Laboratory analysis yielded unremarkable results. MRI findings were evaluated as compatible with reactive arthritis of the acromioclavicular joint (Figure 1).

In light of the extensive vaccination campaigns precipitated by the COVID-19 pandemic, SIRVA is highlighted, as a condition that can potentially manifest following various immunization interventions. Within the scope of routine public health practice, it is important to maintain awareness of SIRVA as a possible

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**Figure 1.** Reactive arthritis was diagnosed based on the increased effusion in the Acromioclavicular joint shown in the shoulder MRI.

complication arising from vaccination. To mitigate risk, healthcare practitioners are encouraged to rigorously adhere to the protocols outlined in guidelines regarding to the administration of intramuscular vaccines. Of particular import is the selection of an appropriate needle size in accordance with the recipient's physiological constitution. Furthermore, it is advised to refrain from administering the vaccine into the upper third of the deltoid muscle, opting for injection placement that aligns with a 90-degree angle relative to the surface of the skin. By upholding these recommended practices, healthcare professionals can contribute to the minimization of SIRVA occurrences and ensure the safe and effective administration of vaccines (1, 5).

**Keywords:** COVID-19, shoulder, sirva, vaccine
**Anahtar kelimeler:** COVID-19, omuz, sirva, aşı

### Ethics

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### Authorship Contributions

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