Research Article / Araştırma Makalesi
doi: 10.18678/dtfd.1616307

Duzce Med J, 2025;27(2):184-188
Düzce Tıp Fak Derg, 2025;27(2):184-188

The Effects of the COVID-19 Pandemic on the Diagnosis and Follow-up of Osteoporosis

COVID-19 Pandemisinin Osteoporoz Tanı ve Takibi Üzerine Etkileri

Ferda SUREL[1]
0000-0003-3748-3109
Esra ŞAHİNGÖZ BAKIRCI[2]
0000-0002-4610-0440
Gülseren DEMİR KARAKILIÇ[2]
0000-0003-1292-0835

[1]Department of Physical Medicine and Rehabilitation, Ankara Bilkent City Hospital, Ankara, Türkiye

[2]Department of Physical Medicine and Rehabilitation, Yozgat Bozok University Faculty of Medicine, Yozgat, Türkiye

Corresponding Author
Sorumlu Yazar
Esra ŞAHİNGÖZ BAKIRCI
dresrasahingoz@gmail.com

Received / Geliş Tarihi : 13.01.2025
Accepted / Kabul Tarihi : 01.07.2025
Available Online / Çevrimiçi Yayın Tarihi : 31.07.2025

ABSTRACT

Aim: The coronavirus disease 2019 (COVID-19) pandemic has impacted the follow-up and treatment processes of many chronic diseases, including osteoporosis. This study aimed to determine whether 25-hydroxyvitamin D (25(OH)D) levels and bone mineral density (BMD) measurements in patients diagnosed with osteoporosis were affected during the COVID-19 pandemic to assess changes in follow-up and treatment protocols.
Material and Methods: The study included 598 patients diagnosed with osteoporosis between December 1, 2018, and March 1, 2020. The duration of follow-up after the pandemic, femoral neck T-score and BMD value, lumbar vertebrae total (L1-4) T-score and BMD value, 25(OH)D levels, and medical treatments for osteoporosis were recorded retrospectively.
Results: The mean duration of follow-up visits after the pandemic was nearly two years. 25(OH)D levels were significantly higher in the post-pandemic period than in the pre-pandemic period ($p<0.001$). Lumbar total T-scores and BMD values, femoral neck T-scores, and BMD values were higher in the pre-pandemic period ($p<0.001$ for all). There was a statistically significant increase in the frequency of denosumab use in the post-pandemic period compared to the pre-pandemic period in the treatment of osteoporosis ($p<0.001$).
Conclusion: There is a delay in follow-up of patients, a decrease in BMD and T-scores, an increase in 25(OH)D levels, and an increase in treatment only with denosumab compared to the pre-pandemic period. It is essential to develop remote assessment methods for diagnosing and monitoring osteoporosis, particularly when accessing health services is challenging, and to make treatments as accessible as possible at home through patient education.
Keywords: COVID-19; osteoporosis; pandemic; treatment; Vitamin D.

ÖZ

Amaç: Koronavirüs hastalığı 2019 (coronavirus disease 2019, COVID-19) pandemisi, osteoporoz gibi birçok kronik hastalığın takip ve tedavi sürecini etkilemiştir. Bu çalışmanın amacı, osteoporoz tanısı alan hastaların 25-hidroksivitamin D (25(OH)D) düzeyleri ve kemik mineral yoğunluğu (KMY) ölçümlerinin COVID-19 pandemisi sırasında etkilenip etkilenmediğini belirleyerek takip ve tedavi protokollerindeki değişiklikleri saptamaktır.
Gereç ve Yöntemler: Çalışmaya 1 Aralık 2018 ile 1 Mart 2020 tarihleri arasında osteoporoz tanısı almış 598 hasta dahil edildi. Pandemi sonrası takip süresi, femur boynu T-skoru ve KMY değeri, lomber vertebra toplam (L1-4) T-skoru ve KMY değeri, 25(OH)D düzeyleri ve osteoporoz için uygulanan medikal tedaviler geriye dönük olarak kaydedildi.
Bulgular: Pandemi sonrası ortalama takip süresi 2 yıl olarak belirlendi. Pandemi sonrası dönemde 25(OH)D düzeyleri pandemi öncesine göre anlamlı olarak daha yüksekti ($p<0,001$). Lomber toplam T-skorları ve KMY değerleri, femur boynu T-skorları ve KMY değerleri pandemi öncesi dönemde daha yüksekti (hepsi için $p<0,001$). Osteoporoz tedavisinde pandemi sonrası dönemde denosumab kullanım sıklığında pandemi öncesi döneme göre istatistiksel olarak anlamlı bir artış saptandı ($p<0,001$).
Sonuç: Pandemi öncesi döneme kıyasla hasta takibinde gecikme, KMY ve T-skorlarında azalma, 25(OH)D düzeylerinde artış ve yalnızca denosumab ile tedavide artış gözlenmiştir. Özellikle sağlık hizmetlerine erişimin zorlaştığı dönemlerde, osteoporoz tanı ve takibi için uzaktan değerlendirme yöntemlerinin geliştirilmesi ve hasta eğitimi yoluyla tedavilerin evde mümkün olduğunca erişilebilir hale getirilmesi büyük önem taşımaktadır.
Anahtar kelimeler: COVID-19; osteoporoz; pandemi; tedavi; D vitamini.

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is classified by the World Health Organization (WHO) as an illness resulting from a newly identified strain of the coronavirus. In the early months of 2020, the WHO declared the outbreak a pandemic due to the rapid global spread of the virus (1). The pandemic led to disruptions in chronic disease management due to lockdowns, patient reluctance to attend follow-up visits due to concerns about infection, and the postponement of elective medical services in favor of emergency care (2).

Osteoporosis is the primary condition impacting bone health and is characterized by decreased bone mineral density (BMD) and an increased risk of fractures (3). The frequency of BMD assessments should be tailored to the individual patient's clinical condition. It is recommended to measure BMD one year after initiation or change of treatment, at longer intervals after therapeutic effect is detected (4). Monitoring 25-hydroxyvitamin D (25(OH)D) concentrations and calcium levels is also essential in the management of osteoporosis. Low 25(OH)D concentrations can lead to secondary hyperparathyroidism, stimulate bone resorption via osteoclast activity, and worsen the progression and severity of osteopenia and osteoporosis in adults (5).

This study aimed to evaluate the impact of the pandemic on the scheduling of follow-up appointments and management strategies for osteoporosis. Additionally, we sought to investigate whether home isolation influenced patients' vitamin D levels and BMD measurements, and to provide recommendations based on these findings.

MATERIAL AND METHODS

This retrospective study involved individuals aged 18 and above who had been diagnosed with osteoporosis between December 1, 2018, and March 1, 2020. Patient follow-up records from November 2018 to June 2022 were retrospectively reviewed. Data on patient age, gender, admitting clinic, and the time elapsed between the onset of the pandemic and follow-up visits were recorded. Femoral neck T-score and BMD value (g/cm^2), lumbar vertebrae total (L1-4) T-score and BMD value (g/cm^2), 25(OH)D levels, and medical treatments for osteoporosis in BMD measurements performed with DXA were recorded for both pre- and post-pandemic periods. Patients who did not come for follow-up after the pandemic (those who did not attend for two years) and who were diagnosed with secondary osteoporosis were excluded from the study.

The study was conducted in accordance with ethical guidelines and approved by Ankara Bilkent City Hospital Ethics Committee (no: E2-22-2354, date: 07.09.2022).

Statistical Analysis

The data were analyzed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp®, 2020, Armonk, New York, USA). The normality of the numerical data distribution was evaluated with the Kolmogorov-Smirnov test. For non-normally distributed variables, data were summarized as medians, interquartile ranges (25th-75th percentiles), and minimum-maximum values. Categorical data were reported as frequencies and percentages. The Wilcoxon signed-rank test was applied to compare repeated measures with non-parametric distributions. The McNemar test was used to analyze categorical data between two groups, while the marginal homogeneity test was employed for categorical variables with more than two categories. A 95% confidence interval was used, and a 5% margin of error was considered acceptable. Statistical significance was set at a p-value of less than 0.05.

RESULTS

A total of 598 patients diagnosed with osteoporosis between December 1, 2018, and March 1, 2020, participated in this study. The population characteristics and clinical data were summarized in Table 1. Almost all of them were female patients who were examined in outpatient clinics. The majority of patients, about three-quarters, were assessed by the physical medicine and rehabilitation department, followed by internal medicine, orthopedics, and gynecology. The time between the two visits before and after the pandemic was nearly two years.

The osteoporosis treatment agents showed a significant change before and after the pandemic (p=0.022). The difference was attributed to denosumab in pairwise comparisons (Table 2). The frequency of other treatments showed no difference when comparing the periods before and after the pandemic (calcium and vitamin D: p=0.791; zoledronic acid: p=0.052; oral ibandronic acid: p=0.296; subcutaneous ibandronic acid: p=0.791; and alendronic acid: p=0.086). The frequency of denosumab use increased significantly after the pandemic (p<0.001).

Table 1. Demographic and clinical data of the patients

Characteristics	**(n=598)**
Age (years)	64 (57-71) [21-92]
Gender, n (%)	
Female	582 (97.3)
Male	16 (2.7)
Hospitalization, n (%)	
Inpatient	4 (0.7)
Outpatient	594 (99.3)
Clinic, n (%)	
Physical Medicine and Rehabilitation	444 (74.2)
Internal medicine	80 (13.4)
Gynecology and obstetrics	35 (5.9)
Orthopedics	35 (5.9)
Other	4 (0.7)
Duration between two visits* (months)	26 (21-32) [12-48]

*: the duration between two visits before and after the pandemic, numerical data was presented as median (25th-75th percentile) [minimum-maximum]

Table 2. Comparison of the frequency of agents used before and after the COVID-19 pandemic

Treatment Agents	**Before Pandemic**	**After Pandemic**	**p**
Calcium and vitamin D	455 (76.1)	458 (76.6)	0.791
Zoledronic acid	42 (7.0)	30 (5.0)	0.052
Oral ibandronic acid	30 (5.0)	23 (3.8)	0.296
Subcutaneous ibandronic acid	18 (3.0)	16 (2.7)	0.791
Alendronic acid	50 (8.4)	37 (6.2)	0.086
Denosumab	3 (0.5)	34 (5.7)	**<0.001**

COVID-19: coronavirus disease 2019

Vitamin D concentrations and BMD results of the patients were presented in Table 3. Lumbar total T-scores, lumbar BMD values, femur neck T-scores, and femur BMD values were higher for the visit before the pandemic ($p<0.001$ for all). Consequently, vitamin D concentrations were significantly higher after the pandemic ($p<0.001$).

DISCUSSION

Osteoporosis is a disease with an increasing prevalence as age increases. The prevalence among individuals aged 50 and above was calculated to be 22.2% for males and 27.2% for females in Türkiye (6). In the present study, the median patient age was 64 years, with 97.3% of patients being female and 2.7% male. The proportion of male patients diagnosed with osteopenia or osteoporosis after BMD assessment was lower than the study by Kirazlı et al. (6). The majority of understanding of the pathophysiology of osteoporosis comes from studies on females, with most research focusing primarily on osteoporosis in females (7). This may be because male patients were less frequently assessed for osteoporosis, and those who did not attend follow-up visits after the pandemic were excluded from the study. Male osteoporosis occurs at older ages and is more age-dependent than female osteoporosis (8). The present study also included a younger age range, which may have contributed to the lower frequency of male patients.

The patients in the study had a median follow-up period of 26 months following their diagnosis. After the diagnosis and initiation of treatment for osteoporosis, the patient should be re-evaluated approximately 1 or 2 years later, depending on the clinical condition. The COVID-19 pandemic has impaired routine screening methods, including BMD measurement, worldwide. Several studies have indicated that the use of DXA has decreased by 50% since the onset of the pandemic (9). Follow-up durations for patients have been lengthened in Turkey as well as globally.

The study revealed that BMD values, including those for the femoral neck and lumbar spine, were significantly lower after the pandemic compared to before. Apart from the prolonged observation period of patients, there are suggestions that proinflammatory cytokines produced during COVID-19 infection may contribute to increased bone destruction in individuals infected (10,11). Several studies showing that the SARS-CoV-2 virus affects bone metabolism and contributes to osteoporosis by acting directly or indirectly on osteoblasts and osteoclasts have been published (12-14). Glucocorticoids have been widely used to suppress the severe systemic inflammation that develops during COVID-19 infection (15). The decline in BMD values of patients after the pandemic may also be attributed to those who were infected with COVID-19 and received glucocorticoids during this period. Bone loss caused by glucocorticoids typically occurs within the first few years and is thought to elevate the risk of fractures, even at doses within the physiological range (16).

Vitamin D concentrations in the study participants were markedly higher than those observed during the period before the pandemic. In fact, during the pandemic, due to the risk of transmission, it was expected that home isolation would reduce people's exposure to sunlight, thereby lowering their vitamin D concentrations. During the pandemic, studies indicated that COVID-19 infection was more prevalent and severe in individuals with insufficient 25(OH)D levels, leading to recommendations for 25(OH)D supplementation (17,18). Some reports suggest that 25(OH)D supplements at a daily dose of 20-50 µg should be taken in the period following the pandemic (19). In a study conducted in Ireland, it was observed that serum 25(OH)D levels increased by a factor of three during the pandemic, accompanied by a rise in the availability of vitamin D supplements on the market (20). The effect of wearing a mask and staying isolated at home on 25(OH)D levels was examined in a study conducted on females in Türkiye. The 25(OH)D concentrations were below the normal range in the quarantine year of 2020, as well as in the two years preceding it, with no significant difference between the two periods (21). Similarly, in this study, 25(OH)D concentrations were below before and after the pandemic (18.05 and 20.99 ng/ml, respectively).

The present study revealed that, when evaluating changes in osteoporosis treatments used by patients, only the utilization of denosumab increased compared to the period before the pandemic. In another study, it was found that osteoporosis treatments, including bisphosphonates, denosumab, and teriparatide, administered to 1,997 females did not affect the risk of hospitalization, admission to the intensive care unit, or mortality due to COVID-19 infection. Therefore, osteoporosis treatment should not be discontinued during COVID-19 infection (22). In addition, one of the most important factors determining the success of medical treatment in osteoporosis is the continuity of treatment (23).

The pandemic has presented challenges in the treatment of osteoporosis, particularly in the administration of parenteral therapies (10). Therefore, it was emphasized that the decision for parenteral treatment should be made considering the patient's accessibility to the health institution and their chronic diseases. Subcutaneous denosumab is one of the parenteral treatment modalities for osteoporosis, administered every six months, and should be applied promptly (24). In this study, since patients with loss of follow-up visits were excluded, the medications in the patients who continued osteoporosis treatment regularly

Table 3. Bone mineral density results and 25-hydroxyvitamin D levels of the patients before and after the pandemic

	Before Pandemic	After Pandemic	p
Lumbar total T-score	-1.7 (-2.5 – -0.7) [-6.9 – 5.3]	-1.8 (-2.5 – -0.9) [-4.5 – 3.3]	**<0.001**
Lumbar BMD value (g/cm^2)	0.94 (0.8 – 1.1) [0.3 – 1.8]	0.93 (0.8 – 1.1) [0.6 – 1.6]	**<0.001**
Femur neck T-score	-1.1 (-1.8 – -0.4) [-7.3 – 3.1]	-1.4 (-2.0 – -0.6) [-6.4 – 3.5]	**<0.001**
Femur BMD value (g/cm^2)	0.82 (0.73 – 0.90) [0.1 – 1.3]	0.81 (0.7 – 0.9) [0.2 – 1.4]	**<0.001**
25-hydroxyvitamin D (ng/ml)	17.8 (12.1 – 24.0) [3.0 – 123.9]	20.6 (14.5 – 27.3) [3.3 – 102.0]	**<0.001**

BMD: Bone mineral density, numerical data was presented as median (25^{th}-75^{th} percentile) [minimum-maximum]

were examined. The rise in the frequency of denosumab treatment may be due to the drug being administered subcutaneously every six months. Additionally, it can be self-administered in primary healthcare centers and at home, provided the patient has received proper training. Another reason for the preference for denosumab may be that, unlike bisphosphonates, it does not affect renal function tests, and therefore, patients do not need to be closely monitored.

There are several limitations to this study, including its retrospective design, the focus solely on lumbar and femoral BMD, T-scores, and 25(OH)D levels for the diagnosis and follow-up of osteoporosis, and the lack of consideration for other potential risk factors associated with the condition. Additionally, the lack of information on whether patients had a history of COVID-19 or used glucocorticoids during the monitoring phase was another limitation of the study. The high number of patients evaluated over a prolonged period is a significant strength of the study.

CONCLUSION

Patient follow-up was delayed compared to the pre-pandemic period, accompanied by a reduction in BMD and T-scores, an elevation in 25(OH)D levels, and a higher frequency of denosumab treatment. The follow-up of patients can be done with applications such as remote consultations and telehealth services. There is a need for multicenter and comprehensive studies on new recommendations and algorithms for osteoporosis diagnosis and treatment follow-up in periods when access to the hospital is difficult or impossible.

Ethics Committee Approval: The study was approved by the Clinical Research Ethics Committee of Ankara City Hospital (07.09.2022, E2-22-2354).

Conflict of Interest: None declared by the authors.

Financial Disclosure: None declared by the authors.

Acknowledgments: None declared by the authors.

Author Contributions: Idea/Concept: FS; Design: FS, EŞB, GDK; Data Collection/Processing: FS, EŞB, GDK; Analysis/Interpretation: EŞB, GDK; Literature Review: FS, GDK; Drafting/Writing: FS; Critical Review: EŞB.

REFERENCES

1. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(18):1708-20.
2. Rosenbaum L. The untold toll - the pandemic's effects on patients without Covid-19. N Engl J Med. 2020;382(24):2368-71.
3. Yu EW, Tsourdi E, Clarke BL, Bauer DC, Drake MT. Osteoporosis management in the era of COVID-19. J Bone Miner Res. 2020;35(6):1009-13.
4. Schousboe JT, Shepherd JA, Bilezikian JP, Baim S. Executive summary of the 2013 International Society for Clinical Densitometry Position Development Conference on bone densitometry. J Clin Densitom. 2013;16(4):455-66.
5. Holick MF. Optimal vitamin D status for the prevention and treatment of osteoporosis. Drugs Aging. 2007;24(12):1017-29.
6. Kirazlı Y, Atamaz Çalış F, El Ö, Gökçe Kutsal Y, Peker Ö, Sindel D, et al. Updated approach for the management of osteoporosis in Turkey: a consensus report. Arch Osteoporos. 2020 Aug 29;15(1):137.
7. Madeo B, Zirilli L, Caffagni G, Diazzi C, Sanguanini A, Pignatti E, et al. The osteoporotic male: overlooked and undermanaged? Clin Interv Aging. 2007;2(3):305-12.
8. Rochira V, Balestrieri A, Madeo B, Zirilli L, Granata AR, Carani C. Osteoporosis and male age-related hypogonadism: role of sex steroids on bone (patho)physiology. Eur J Endocrinol. 2006;154(2):175-85.
9. Peeters JJM, van den Berg P, van den Bergh JP, Emmelot-Vonk MH, de Klerk G, Lems WF, et al. Osteoporosis care during the COVID-19 pandemic in the Netherlands: A national survey. Arch Osteoporos. 2021;16(1):11.
10. Hampson G, Stone M, Lindsay JR, Crowley RK, Ralston SH. Diagnosis and management of osteoporosis during COVID-19: systematic review and practical guidance. Calcif Tissue Int. 2021;109(4):351-62.
11. Fuggle NR, Singer A, Gill C, Patel A, Medeiros A, Mlotek AS, et al. How has COVID-19 affected the treatment of osteoporosis? An IOF-NOF-ESCEO global survey. Osteoporos Int. 2021;32(4):611-7.
12. Obitsu S, Ahmed N, Nishitsuji H, Hasegawa A, Nakahama K, Morita I, et al. Potential enhancement of osteoclastogenesis by severe acute respiratory syndrome coronavirus 3a/X1 protein. Arch Virol. 2009;154(9):1457-64.
13. Awosanya OD, Dalloul CE, Blosser RJ, Dadwal UC, Carozza M, Boschen K, et al. Osteoclast-mediated bone loss observed in a COVID-19 mouse model. Bone. 2022;154:116227.
14. Mi B, Xiong Y, Zhang C, Zhou W, Chen L, Cao F, et al. SARS-CoV-2-induced overexpression of miR-4485 suppresses osteogenic differentiation and impairs fracture healing. Int J Biol Sci. 2021;17(5):1277-88.
15. Zhou W, Liu Y, Tian D, Wang C, Wang S, Cheng J, et al. Potential benefits of precise corticosteroids therapy for severe 2019-nCoV pneumonia. Signal Transduct Target Ther. 2020;5(1):18.
16. Buckley L, Humphrey MB. Glucocorticoid-induced osteoporosis. N Engl J Med. 2018;379(26):2547-56.
17. Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, et al. Evidence that vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths. Nutrients. 2020;12(4):988.

18. Teshome A, Adane A, Girma B, Mekonnen ZA. The impact of vitamin D level on COVID-19 infection: systematic review and meta-analysis. Front Public Health. 2021;9:624559.
19. Jolliffe DA, Camargo CA Jr, Sluyter JD, Aglipay M, Aloia JF, Ganmaa D, et al. Vitamin D supplementation to prevent acute respiratory infections: a systematic review and meta-analysis of aggregate data from randomised controlled trials. Lancet Diabetes Endocrinol. 2021;9(5):276-92.
20. McKenna MJ, Lyons OC, Flynn MA, Crowley RK, Twomey PJ, Kilbane MT. COVID-19 pandemic and vitamin D: rising trends in status and in daily amounts of vitamin D provided by supplements. BMJ Open. 2022;12(8):e059477.
21. Satış S, Yetişgin A. Did wearing mask and lockdowns affect vitamin D levels during the coronavirus disease-2019 pandemic? Turk J Osteoporos. 2021;27(2):109-13.
22. Atmaca A, Demirci I, Haymana C, Tasci I, Sahin I, Cakal E, et al. No association of anti-osteoporosis drugs with COVID-19-related outcomes in women: a nationwide cohort study. Osteoporos Int. 2022;33(1):273-82.
23. Özşahin M, Büyükkaya R, Kaya E, Baki AE, Aydin Y, Çelebi E, et al. The comparison of effectiveness of teriparatide and alendronate sodium in postmenopausal osteoporosis treatment. Duzce Med J. 2013;15(3):30-3.
24. Girgis CM, Clifton-Bligh RJ. Osteoporosis in the age of COVID-19. Osteoporos Int. 2020;31(7):1189-91.