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Klinik Çalışmalar/Research Articles

Clinical presentation of health care workers with symptoms of coronavirus disease 2019 at the İzmir tertiary education hospital, during an early phase of the pandemic
Pandeminin erken evresinde İzmir'de bir 3. basamak eğitim araştırma hastanesinde koronavirüs hastalığı belirtileri olan sağlık çalışanlarının klinik durumu
Filiz GÜLDAVAL, Ceyda ANAR, Mine GAYAF, Melih BÜYÜKŞİRİN, Gülru POLAT, Gülistan KARADENİZ, Aylin ALPÖZEN, Aysu AYRANCI, Fatma ÜÇSULAR, Zeynep SEYMENOĞLU, Özgür BATUM

Evaluation of the relationship of serum vitamin D levels in COVID-19 patients with clinical course and prognosis
COVID-19 hastalarında serum vitamin D düzeyinin klinik seyir ve prognozla ilişkisinin değerlendirilmesi
Buğra KERGET, Ferhan KERGET, Ahmet KIZILTUNÇ, Abdullah Osman KOÇAK, Ömer ARAZ, Elif YILMAZEL UÇAR, Metin AKGÜN

Tuberculosis risk in patients with rheumatologic disease treated with biologic drugs
Romatolojik hastalık nedeniyle biyolojik ilaçla tedavi edilen hastalarda tüberküloz riski
Emine ARGÜDER, Güniz YANIK ÜSTÜNER, Remzi EKİCİ, Hatice KILIÇ, Şükran ERTEN, Ayşegül KARALEZLİ

...

Derlemeler/Reviews

Erişkin kronik akciğer hastalıklarında pnömokok infeksiyonu ve aşı ile korunma
Pneumococcal infections and protection with vaccination in adult chronic lung diseases
Gülistan KARADENİZ, Oğuz KILINÇ, Ayşe ÖLMEZ, Mustafa Hikmet ÖZHAN, Tevfik ÖZLÜ, Berna AKINCI ÖZYÜREK, Hüsnü PULLUKÇU, Neşe SALTOĞLU, Abdullah SAYINER

...

Olgu Sunumları/Case Reports

Behcet's disease presenting with pulmonary thromboembolism
Pulmoner tromboemboli ile prezente olan Behçet hastalığı
Seray ABUZAINA, Sevil PEMPECİ, Emine ARGÜDER, Ayşegül KARALEZLİ, H. Canan HASANOĞLU

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Evaluation of the relationship of serum vitamin D levels in COVID-19 patients with clinical course and prognosis

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ABSTRACT

Evaluation of the relationship of serum vitamin D levels in COVID-19 patients with clinical course and prognosis

Introduction: *SARS-CoV-2 (COVID-19), which emerged in Wuhan, China in December 2019, infected more than six million people in a short time. In COVID-19, the relationship of many laboratory parameters to morbidity and mortality has been defined. In our study, we aimed to determine the relationship of serum vitamin D level to clinical course and prognosis.*

Materials and Methods: *This study included 108 patients; 88 patients who stayed in Ataturk University and Erzurum City Hospital between March 24, 2020 and May 15, 2020, who were identified as COVID-19 by real-time PCR method from the nasopharyngeal swab and 20 asymptomatic voluntary medical personnel who tested negative for real-time PCR after routine check-up in our hospital.*

Results: *In statistical analysis conducted between healthy control group and vitamin D levels of patients admitted due to COVID-19, it was observed that patients infected with COVID-19 had a lower level (p= 0.004). In 20 patients developing MAS, a lower level of vitamin D was observed (p= 0.004) compared to 68 patients who did not develop. In the comparison of vitamin D levels*

of the patients (n= 8) who developed exitus in their follow up due to COVID-19, it was observed that vitamin D levels were statistically significantly lower compared to the living (p= 0.009).

Conclusion: *Due to COVID-19, pandemic, long-running quarantines caused insufficient use of sunlight and worsening of vitamin D deficiency. We wanted to draw attention again with our study to vitamin D which can be responsible for the heavy clinical course of COVID-19 and whose replacement is easy to apply.*

Key words: *Acute respiratory distress; COVID-19; vitamin D*

ÖZ

COVID-19 hastalarında serum vitamin D düzeyinin klinik seyir ve prognozla ilişkisinin değerlendirilmesi

Giriş: *Aralık 2019 tarihinde Çin'in Wuhan kentinde ortaya çıkan SARS-CoV-2 (COVID-19) kısa süre içinde altı milyonu aşkın insanı enfekte etti. COVID-19'da birçok laboratuvar parametresinin morbidite ve mortaliteyle ilişkisi tanımlanmıştır. Çalışmamızda serum vitamin D düzeyinin klinik seyir ve prognozla ilişkisini tespit etmeyi amaçladık.*

Materyal ve Metod: *24 Mart 2020-15 Mayıs 2020 tarihleri arasında Atatürk Üniversitesi Göğüs Hastalıkları Kliniğinde yatmış nazofarengeal sürüntüsünden real-time PCR yöntemiyle COVID-19 tespit edilmiş 88 hasta ve hastanemizde rutin kontrol sonrasında real-time PCR'si negatif çıkan asemptomatik 20 gönüllü sağlık personeli kontrol grubu olmak üzere 108 kişi çalışmamıza dahil edildi.*

Bulgular: *COVID-19 nedeniyle yatırılan hastaların sağlıklı kontrol grubu ile vitamin D düzeyleri arasında yapılan istatistiksel analizinde COVID-19 ile infekte hastalarda daha düşük düzeyde olduğu gözlendi (p= 0.004). MAS gelişen 20 hastada gelişmeyen 68 hastaya nazaran daha düşük düzeyde vitamin D düzeyi gözlendi (p= 0.004). COVID-19 nedeniyle takiplerinde eksitus gelişen hastaların (n= 8) hastaneye geliş vitamin D düzeylerinin yaşayanlarla yapılan karşılaştırılmasında ise eksitus gelişen hastalarda istatistiksel olarak anlamlı düzeyde düşük olarak gözlendi (p= 0.009).*

Sonuç: *COVID-19 pandemisi nedeniyle uzun süren karantinalar güneş ışığından yeterli istifade edilememesine ve vitamin D eksikliğinin daha da ağırlaşmasına neden oldu. COVID-19 ağır klinik seyirden sorumlu olabilecek ve replasmanın kolay uygulanabilir olduğu vitamin D'ye çalışmamız ile tekrar dikkat çekmek istedik.*

Anahtar kelimeler: *Akut solunum yetmezliği; COVID-19; vitamin D*

INTRODUCTION

Coronavirus (COVID-19), which emerged in Wuhan, China in December 2019 and spread to many parts of the world in a short time, has infected more than eight million people and the number continues to increase day by day (1). COVID-19 is present with mild symptoms such as loss of smell and taste, sore throat, weakness, joint pain or asymptomatic in most infected patients. However, it can be severe in cases where hypertension can reduce immunity at an advanced age, diabetes, HIV, patients who have to receive immunosuppressive treatment for a long time, and pregnancy (2,3).

Acute respiratory failure syndrome and macrophage activation syndrome (MAS), which are characterized by hypoxic respiratory failure, are among the primary severe clinical manifestations (4). Proinflammatory cytokines expressed extensively in both clinical cases can cause endothelial dysfunction, causing damage to vital organs, especially the lungs. In this case, which is defined as cytokine storm syndrome, the most important cell that plays a role in the withdrawal of the trigger is Thelper 1 (Th1) (5,6). The failure to adequately establish proinflammatory anti-inflammatory balance in the body is the most important cause of morbidity and mortality in COVID-19 patients (4).

It is a known fact that vitamin D holds an important place in anti-inflammatory balance. Vitamin D receptors have been expressed in many organs and tissues, including heart, lungs, kidneys, liver, nervous system, intestine, bone, parathyroid gland, cardiovascular system and myocardium (7,8). Vitamin D shows anti-inflammatory effectiveness by suppressing the level of Th1. In addition, TNF-alpha, IFN-gamma, IL-2 and nuclear factor-κB significantly reduce the formation (9,10). During viral infection, it was shown that the inactive vitamin D form could be converted into an active form by alveolar epithelial cells, and the gene expression of the host defense cathelicidine increased. Cathelicidine has been shown to have a protective effect against hyperoxia-related lung damage (11). It has also been determined that ACE-2 receptor level, which plays an important role in linking the virus in COVID-19, increases with vitamin D effect. This has raised doubts that vitamin D can increase predisposition rather than its protective activity (12). In the literature, different findings such as this and similar have been present all the time and have been an indication of the need for extensive research.

In our study, we aimed to evaluate the relationship of vitamin D, which plays an important role in anti-inflammatory balance, to clinical course and prognosis in COVID-19 patients.

MATERIALS and METHODS

In our study, patients who admitted to the emergency department of Ataturk University and Erzurum Regional Education Research Hospital with complaints of primarily fever, cough, shortness of breath, weakness, sudden taste and smell, who had returned from their visit abroad in the last 14 days and who had been in contact with suspected COVID-19 patient were include in the study. The approval of the local ethics committee was obtained for our study, in which the patients and the control group were evaluated prospective.

Posterior-anterior pulmonary graphs of high-risk patients were taken in terms of COVID-19, and in the event of suspicious lesions, the findings were evaluated in detail with high-resolution computed thorax tomography. Patients were diagnosed with COVID-19 by real time PCR method by taking nasopholyaringeal swap.

The first positive case that admitted to Ataturk University was on March 24, 2020 while the first case admitted to Erzurum City Hospital was on March 20, 2020 and 88 patients followed by the Chest Diseases and Infectious Diseases clinic from this period until May 15, 2020 and 20 voluntary non-symptomatic health workers who tested negative in real-time PCR during routine COVID-19 screening in our hospital were included in our study.

After admission to the clinic, biochemical parameters, clotting parameters, ferritin, D-Dimer, troponin-I, CRP, and arterial blood gas parameters and in addition hematological parameters, liver and kidney function tests were observed. The current parameters of the patients were repeated daily.

In the control group, subjects with autoimmune disorders, any neoplasms, metabolic bone disorders (osteopenia, osteoporosis), renal or liver dysfunctions and with recent vitamin D supplementation were excluded.

Definitions and Treatment

The axil measurement of temperature in patients which was above 37.3 C was defined as fever. Showing a new pathogen and a positive culture sample with endotracheal aspirators or sputum from the lower respiratory tract, which is characterized by bacterium or pneumonia symptoms was defined as a secondary bacterial infection. Treatment was planned in accordance with the existing guidelines for patients diagnosed with pneumonia associated with ventilator or as hospital-induced. The diagnosis and rating of acute respiratory failure was done according to the Berlin 2015 diagnostic criteria. If the daily level of cardiac specific troponin was observed above normal, echocardiography was evaluated in terms of newly developed cardiac pathologies. In coagulopathy, prothrombopathy was defined 3 seconds above normal in time and 5 seconds above normal at the level of partial thrombophlasty. According to the weight of the patients, the treatment was performed according to the COVID-19 adult diagnosis and treatment guide of the Ministry of Health of the Republic of Turkey. In the event of ongoing resistant fever, persistent high or increasing CRP and ferritin values, cytopenia in the form of D-dimer height, lymphopenia and thrombocytopenia, deterioration in liver function tests, hypofibrinogenemia or elevation in triglyceride values, patients were followed up in terms of MAS. In the event that there is an increase in consecutive measurements taken daily in these parameters and this condition cannot be explained by secondary bacterial infections, patients were applied 400 mg tocilizumab if there is no contraindicated condition for MAS. After 24 hours, the appropriate clinic and laboratory response was not repeated in patients who received the appropriate clinical and laboratory response. However, in the event of a lack of proper clinical and laboratory response, the same dose was repeated.

Measurement of Biochemical Markers

After 15 minutes of rest in half supine position, blood samples were taken from the antecubital vein to tubes containing ethylenediaminetetraacetic acid (EDTA) to prevent clotting. Troponin-I concentrations were measured by chemiluminescence immunoanalysis using Immulite 2500 (Siemens Medical Solutions, Erlangen, Germany). IL-6 and vitamin D were measured by enzyme-linked immunosorbent analysis (Elabscience human ELISA kit, UK).

Statistical Analysis

The data were analyzed using IBM SPSS Statistics for Windows version 20.0 (IBM Corp., Armonk, NY). Pearson's chi-square test and Mann-Whitney U test were used for intergroup comparisons of parametric data and nonnormally distributed numerical data, respectively. Independent-samples t test was used to compare demographic data and laboratory parame-

ters between the groups. Wilcoxon analysis was used for intragroup comparisons of laboratory values during follow-up. Pearson correlation analysis was used to evaluate relationships between vitamin D levels and CRP, and PaO_2/FiO_2. A p-value less than 0.05 was considered statistically significant.

RESULTS

Of the patients included in our study, 47 (53.4%) were female and 41 (46.6%) were male. Of the patients in the control group, 12 (60%) were female and 8 (40%) were male. The mean age of the patients was 49.1 ± 21.1 and the control group was 35.2 ± 6.9. No statistically significant difference between gender and age was observed between the patient groups (p= 0.196).

Of the patients involved in the study and developed MAS, 10 had hypertension, 8 had diabetes mellitus, 8 had chronic obstructive pulmonary disease, 1 had epilepsy, 1 had an infarct in the temporoparietal region, and 1 had chronic kidney failure. All patients with MAS had ARDS, and the other 15 patients had hypertension, 3 had asthma and 1 had chronic renal failure. Of the 63 patients who did not develop ARDS and MAS, 5 had diabetes mellitus and 2 had diabetes.

The laboratory parameters taken on the 5th day of admission to hospital and treatment from Covid-19 patients included in the study came are shown in Table 1. The laboratory parameters taken on the 5th day of admission to hospital and treatment from patients who developed MAS were shown in Table 2. In 20 patients developing MAS, a lower level of vitamin D was observed (p= 0.004) than 68 patients who did not develop. Laboratory parameters taken on the 5th day of admission and treatment from patients who were been observed and not observed to have ARDS are shown on Table 3. A significant difference was not observed in the vitamin D level of 35 patients who were observed to have ARDS compared to those who did not (p= 0.102).

Comparison vitamin D levels of patients in which MAS and ARDS was observed and not observed, with the control group has been shown in Table 4. Vitamin D levels of patients with MAS and ARDS were statistically significantly lower than the control group (p= 0.001, p= 0.001). Exitus developed in 8 out of 88 patients who were followed due to COVID-19. The

Table 1. Comparison of laboratory parameters of COVID-19 patients at admission and on day 5 of treatment

	Admission (n= 88) (Mean ± SD)	Day 5 of treatment (n= 88) (Mean ± SD)	p
WBC (/µL)	7239.7 ± 4023.8	7158.7 ± 3370.7	0.82
Lymphocytes (/µL)	1573.2 ± 888.4	1823.2 ± 906.8	**0.003**
Neutrophils (/µL)	4987.3 ± 3614.9	4685.1 ± 3250.1	0.206
NLR	5.3 ± 8.4	4.3 ± 8.4	**0.03**
AST (U/L)	32.9 ± 20.5	31.9 ± 34.1	0.189
ALT (U/L)	30.6 ± 25.2	31.3 ± 23.4	0.225
LDH (U/L)	311.7 ± 159.1	305.1 ± 199.9	0.275
GGT (U/L)	39.9 ± 34.2	40.6 ± 35.7	0.317
ALP (U/L)	79.1 ± 41.2	69.2 ± 27.5	**0.003**
Sodium (mmol/L)	138.8 ± 3.9	140.7 ± 4.6	**0.007**
Potassium (mmol/L)	4.2 ± 0.5	4.4 ± 0.5	**0.001**
Creatine (mg/dL)	1.1 ± 0.9	1.1 ± 0.9	0.319
Prothrombin time (s)	15.9 ± 6.8	14.6 ± 5.1	**0.001**
CRP (mg/dL)	63.3 ± 83.5	27.5 ± 27.4	**0.001**
Troponin-I (ng/dL)	67.1 ± 297.8	149.7 ± 1185.2	**0.001**
PaO_2/FiO_2	294.3 ± 69.1	323.9 ± 47.6	**0.001**
D-Dimer (ng/mL)	1151.7 ± 1809.5	666.7 ± 925.5	**0.001**

WBC: White blood cells, NLR: Neutrophil/lymphocyte ratio, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, LDH: Lactate dehydrogenase, GGT: Gamma glutamyl transferase, ALP: Alkaline phosphatase.

Table 2. Comparison of laboratory parameters at admission COVID-19 patients who did and did not develop macrophage activation syndrome (MAS)

	MAS patients (n= 20) (Mean ± SD)	Non-MAS patients (n= 68) (Mean ± SD)	
	Admission	**Admission**	**p**
Age (year)	70.1 ± 12.7	43.4 ± 18.1	**0.001**
WBC (/µL)	9133.7 ± 7270.7	6760.1 ± 2324.1	0.17
Lymphocytes (/µL)	821.1 ± 405.9	1794.7 ± 872.5	**0.001**
Neutrophils (/µL)	7513.2 ± 6404.7	4316.3 ± 1896.9	**0.04**
NLR	13.3 ± 15.1	3.1 ± 2.6	**0.008**
AST (U/L)	42.2 ± 19.7	30.3 ± 20.3	**0.02**
ALT (U/L)	36.4 ± 28.3	29.2 ± 24.5	0.273
LDH (U/L)	451.3 ± 304.3	270.5 ± 118.5	**0.001**
GGT (U/L)	57 ± 47.1	33.3 ± 23.2	**0.04**
ALP (U/L)	81.7 ± 33.9	77.1 ± 42.3	0.66
Sodium (mmol/L)	137.5 ± 6.1	139.1 ± 3.1	0.3
Potassium (mmol/L)	4.2 ± 0.6	4.2 ± 0.4	0.8
Creatine (mg/dL)	1.8 ± 1.8	0.9 ± 0.5	**0.04**
Prothrombin time (s)	20.4 ± 12.4	14.7 ± 3.5	**0.04**
CRP (mg/dL)	176.7 ± 75.7	27.7 ± 38.7	**0.001**
Troponin-I (ng/dL)	276.1 ± 607.3	8.9 ± 15.3	**0.001**
PaO_2/FiO_2	209.8 ± 67.7	318.9 ± 47.6	**0.001**
D-Dimer (ng/mL)	2529.9 ± 3111.7	766.6 ± 955.2	**0.03**
Ferritin (ng/mL)	1094.4 ± 1559.9	346.7 ± 144.1	**0.001**
Vitamin D (ng/ml)	11.9 ± 5.7	22.1 ± 15.1	**0.004**
IL-6 (pg/ml)	114.5 ± 60.5	36.2 ± 30.4	**0.001**

MAS: Macrophage activation syndrome, WBC: White blood cells, NLR: Neutrophil/lymphocyte ratio, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, LDH: Lactate dehydrogenase, GGT: Gamma glutamyl transferase, ALP: Alkaline phosphatase, IL-6: interleukin 6.

vitamin D level of the patients who developed exitus was 7.48 ± 3.g ng/ml, while it was 21.1 ± 14.2 ng/ml in patients who did not develop. Statistically significant difference was observed between vitamin D levels of both groups (p= 0.009)

In the correlation analysis of vitamin D level with laboratory parameters, negative correlation was observed only with CRP and positive-directional correlation with PaO_2/FiO_2 ratio (r= -0.297, p= 0.01, r= 0.262, p= 0.05) (Figure 1).

DISCUSSION

In our study, we observed that serum vitamin D levels are significantly lower than control group patients who are tracked due to COVID-19. On the other hand, in the evaluation of patients who were admitted and followed by COVID-19 among themselves, we found that vitamin D levels of patients developing MAS were lower than patients who did not develop. In our service, exitus developed after the 5^{th} day of treatment for various reasons in 8 patients. The vitamin D level in patients with exitus was significantly lower compared to patients who did not develop.

In December 2019, a new virus was discovered in Wuhan, China, and the International Committee on Virus Taxonomy called it COVID-19 in connection with Coronavirus 2 (SARS-CoV-2) and the World Health Organization (WHO) (1). SARS-CoV-2 is closely related to SARS-CoV and MERS-CoV, which are responsible for past outbreaks with significant morbidity and mortality (13). The rapid spread of COVID-19 has caused the Chinese outbreak and is currently spreading globally. So far, the number of people infected due to COVID-19 is said to be over eight million (14).

Table 3. Comparison of laboratory parameters at admission COVID-19 patients who did and did not develop acute respiratory distress syndrome (ARDS)

	ARDS patients (n= 35) (Mean ± SD)	Non-ARDS patients (n= 53) (Mean ± SD)	
	Admission	**Admission**	**p**
Age (year)	67.9 ± 12.2	38.3 ± 15.6	**0.001**
WBC (/µL)	8109.1 ± 5749.5	6665.5 ± 2151.8	0.1
Lymphocytes (/µL)	960 ± 467.3	1978.1 ± 870.3	**0.001**
Neutrophils (/µL)	6411.4 ± 5117.7	4046.8 ± 1572.3	**0.002**
NLR	9.8 ± 11.9	2.3 ± 1.1	**0.001**
AST (U/L)	42.9 ± 25.1	26.4 ± 13.4	**0.001**
ALT (U/L)	34.1 ± 30.6	28.5 ± 20.9	0.3
LDH (U/L)	434.4 ± 180.1	230.7 ± 65.6	**0.001**
GGT (U/L)	55.2 ± 44.6	29.9 ± 20	**0.001**
ALP (U/L)	90.1 ± 55.1	71.8 ± 26.9	0.07
Sodium (mmol/L)	137.3 ± 4.9	139.7 ± 2.8	**0.005**
Potassium (mmol/L)	4.1 ± 0.6	4.2 ± 0.4	0.171
Creatine (mg/dL)	1.3 ± 1.4	0.9 ± 0.5	**0.04**
Prothrombin time (s)	19.1 ± 9.6	13.8 ± 2.1	**0.001**
CRP (mg/dl)	132.1 ± 92.4	17.9 ± 28.3	**0.001**
Troponin-I (ng/dl)	160.5 ± 460.3	5.4 ± 7.6	**0.001**
PaO_2/FiO_2	228.5 ± 58.8	337.8 ± 29.5	**0.001**
D-Dimer (ng/ml)	2113.2 ± 2622. 2	534.9 ± 243.8	**0.001**
Ferritin (ng/ml)	742.4 ± 1204.9	359.7 ± 143.1	**0.02**
Vitamin D (ng/ml)	16.8 ± 10.5	21.8 ± 15.8	0.102
IL-6 (pg/ml)	91.6 ± 63.4	39.4 ± 30.7	**0.001**

ARDS: Acute respiratuar distress syndrome, WBC: White blood cells, NLR: Neutrophil/lymphocyte ratio, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, LDH: Lactate dehydrogenase, GGT: Gamma glutamyl transferase, ALP: Alkaline phosphatase, IL-6: Interleukin 6.

Table 4. Comparison of Vitamin D levels between COVID-19 patients who did and did not develop MAS, ARDS and control group

	MAS		ARDS			
	+ (n= 20) (mean ± SD)	**- (n= 68) (mean ± SD)**	**+ (n= 35) (mean ± SD)**	**- (n= 53) (mean ± SD)**	**Control (n= 20) (mean ± SD)**	**p***
Vitamin D (ng/ml)	11.9 ± 5.7*	22.1 ± 15.1	16.8 ± 10.5*	21.8 ± 15.8	25.6 ± 7.8 *	**0.001**

When laboratory tests are examined, lymphopenia is observed in most patients (15). This result suggests that 2019nCoV can have an impact on lymphocytes, especially T lymphocytes, such as SARS-CoV. Virus particles emitted from the respiratory mucosa and transmitted to other cells form a cytokine storm in the body. T lymphocyte damage is thought to be an important part of the cytokine storm formation.

Therefore, it is thought that lymphopenia may be a reference parameter that can be used in the diagnosis of COVID-19. After the cytokine storm, many proinflammatory cytokines, especially TNF-alpha, IL-1, IL-2, IL-6, nitric oxide, are revealed. These cytokines can cause an increase in vascular permeability, causing deterioration in tissue perfusion, as well as endothelial damage and microtombus formation (16). This

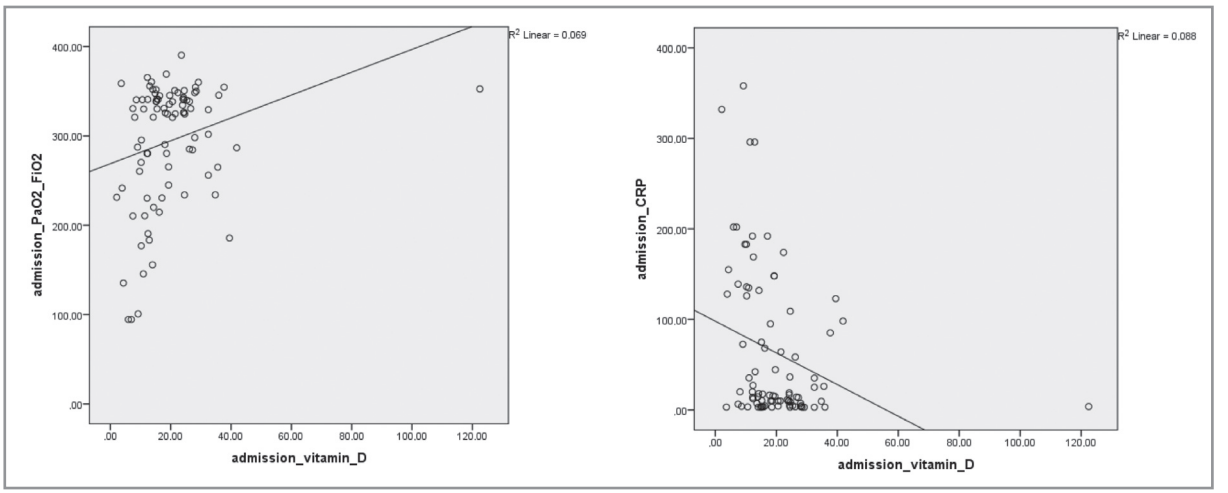


Figure 1. Correlation analysis between Vitamin D level and CRP and PaO_2/FiO_2.

increase in vascular permeability causes fluid accumulation in lung tissue and interstitial field to form a table of acute respiratory failure as a result. Positive results have been reported on the use of IL-6 antagonist tocilizumab used in the prevention of the formation of this clinical table (17,18).

Vitamin D, which is primarily involved in bone and calcium metabolism, has an important role in ensuring anti-inflammatory balance. Vitamin D plays an important role in the hemostasis of congenital and acquired immune system cells. Predisposition to bacterial, viral infections and chronic obstructive lung disease which is one of the leading chronic lung diseases detected in patients with vitamin D deficiency and low vitamin D levels detected in patients with asthma are associated with low FEV_1 and frequent recurrent episodes have been the most concrete example of this (19-22). CalciTriol (1.25-dihydroxyvitamin D3) causes an increase in ACE2 expression via ACE2/Ang (1-7)/MasR pathway (23). ACE2's receptors on the host cell mediate the SARS-CoV-2 infection. This has also raised questions that vitamin-D can create predisposition. However, it has been found to have played a role in the development of MAS in COVID-19 and expressed by Th1 cells IL-6, IL-8, IL-12, and IL-17 proinflammatory cytokines suppressing, antimicrobial peptide, cathelicin and defensive induction that play a role in the alveoli, this view has caused the contrary opinions to dominate (24,25). In European studies, the relationship between low vitamin D and mortality also supports this (12,26).

In our study, which evaluated the follow-up of SARS-CoV-2 patients, we observed that the duration of the prothrombin, CRP, troponin-ı, and D-Dimer levels associated with clinical course and prognosis, decreased with high levels of the disease and with treatment. We found that the initial vitamin D levels of patients followed by COVID-19 were lower than the control group, while in patients with COVID-19, a higher rate of MAS developed in patients with low vitamin D levels.

This was observed to support the work done on the anti-inflammatory activity of vitamin D. The failure to observe a significant difference in the correlation analysis between IL-6 level and vitamin D level, which plays a role in the development of MAS, can be interpreted depending on the fact that many proinflammatory cytokines are active in MAS development. COVID-19 is one of the most important causes of mortality such as ARDS MAS. While the vitamin D-level detected in patients with ARDS was significantly lower than the control group, there was no significant difference between patients developing and not developing ARDS, unlike in MAS. The lack of intensive proinflammatory cytokine discharge, as in the development of MAS, may have caused vitamin D, which plays a role in the synthesis of cytokines that play an antiinflammatory balance in these patients, not to come to the fore as well as in MAS. Failure to observe a correlation between age and vitamin D level, which plays an important role in the development of ARDS, and the association of patients developing ARDS with advanced age and

comorbid diseases can also be among the causes of this condition.

The most important limitation of our study was the inability to provide homogeneous age range in patients with ARDS and MAS. However, the observation of ARDS and MAS development in COVID-19 patients in people of more advanced age and comorbid disease will constitute the most important limiting factor for the studies in which this is wished to be realized.

CONCLUSION

As a result, the lack of adequate sunlight in the community quarantined at home for a long time during the course of COVID-19 may have caused the most common vitamin D deficiency to deepen. Therefore, in patients tracked with COVID-19, vitamin D can easily be accessible, which can be a fast-enforceable medical treatment that can change the clinical course and prognosis of patients.

CONFLICT of INTEREST

There is no conflict of interest related to this study.

Ethics Committee Approval: The approval for this study was obtained from Ataturk University Ethics Committee (Decision No: B.30.2.ATA.0.001.00/458 Date: 26.06.2020).

AUTHORSHIP CONTRIBUTIONS

Concept/Design: BK, FK, MA

Analysis/Interpretation: BK, AOK, FK

Data Acquisition: AK, BK

Writting: BK, FK, MA

Critical Revision: MA, EYU, ÖA

Final Approval: MA, EYU, ÖA, BK

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