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Does the Level of Vitamin D in COVID-19 Patients Affect the Survival and Duration of Hospital Stay?

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ABSTRACT

Objective: This study aimed to evaluate the effect of categorized and normal vitamin D levels on hospital stay and mortality in adult patients with COVID-19.
Methods: One hundred sixty-eight hospitalized patients due to coronavirus disease 2019 were retrospectively evaluated. The study data were collected from medical records (age, gender, comorbidity, vitamin D level, duration of hospital stay, mortality/survival status). Serum 25(OH) vitamin D level ≥ 30 ng/mL is defined as normal, 20-29 ng/mL is an insufficiency level, and less than 20 ng/mL is defined as a deficiency level.
Results: The mean vitamin D level of 168 patients was 18.72 ± 11.18 ng/mL, and 79.4% of patients with vitamin D deficiency had comorbidity. When vitamin D levels were categorized, there was no difference between the groups regarding hospital stay and survival ($P > .05$). However, when the mean vitamin D levels between the deceased and surviving patients were assessed, vitamin D levels were significantly higher in the survivors ($P = .019$). Vitamin D significantly affected survival compared to the univariate model ($P = .044$), while there was no significant effect on the multivariate model ($P > .05$). Even when the factors affecting the vitamin D level were adjusted, no significant results were found.
Conclusion: Among hospitalized COVID-19 patients, vitamin D levels did not support an association between the duration of hospital stay and mortality.

Keywords: COVID-19, duration of hospital stay, mortality, vitamin D

INTRODUCTION

While the new COVID-19 continues its adverse effects globally, the lack of an effective pharmacological treatment in the fight against the disease complicates the process.[1,2] COVID-19 disease causes severe respiratory symptoms and acute respiratory syndrome.[3,4] Age, ethnicity, poverty, crowded environments, medical conditions, and certain occupational groups have been considered risk factors for developing the disease.[5] In addition, comorbidity (e.g., diabetes-hypertension) presence is one of the other factors that adversely affect the course of the disease.[6] The relationship between COVID-19 and vitamin D is based on the fact that vitamin D reduces the risk of infection by various (anti-inflammatory pathways and its role as an immunomodulator) mechanisms.[7,8] The risk groups for COVID-19 disease are also at risk for vitamin D deficiency/insufficiency.[9] Based on the fact that no food is miraculous, vitamin D is not also miraculous to prevent COVID-19 and fight against the disease; it is a component of optimal health.[10,11] However, the increasing pandemic in the winter months and the quarantine period have increased the risk factors for vitamin D deficiency.[12]

Vitamin D, which has chemical forms of ergocalciferol and cholecalciferol, is a micronutrient and prohormone in which intake is limited with foods.[7,13] Vitamin D synthesis is associated with exposure to sunlight, and synthesis occurs through the skin.[7,10,13] The synthesized vitamin D is converted to 25-hydroxyvitamin D in the liver and converted to the active form 1,25-dihydroxy-vitamin D in the kidneys (by the enzyme 25-hydroxyvitamin D-1α hydroxylase).[14] Therefore, hepatic and renal pathologies are among the

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regulatory factors for vitamin D.[15] In addition, vitamin D deficiency is associated with many diseases such as cancer, cardiovascular, and infectious diseases.[14] Vitamin D defic iency/insufficiency is a silent but complex public health problem.[4,16] The elderly, pregnant women, different ethnic groups, obese people, children,[16] and people living in the Northern latitudes in winter are among the risk groups for vitamin D deficiency/insufficiency.[1,7] Seasons, time of sun exposure during the day, clothing style, use of sunscreen cream, skin pigmentation, gastrointestinal tract malabsorptions, obesity, and chronic conditions affect vitamin D synthesis and/or bioavailability.[15] In a Turkish study in which a vitamin D level of 108 742 patients was evaluated, the average level was reported as 21.6 + 13.3 ng/mL.[17] In a meta-analysis, the level of vitamin D deficiency in the Turkish population was stated as 63%.[18] Vitamin D insufficiency has brought different actions to the agenda of the countries in geographical locations that cannot benefit from sunlight. These countries use food enrichment and supplementation to eliminate vitamin D deficiency/insufficiency.[12,16,19]

Vitamin D has primary functions in calcium and phosphate metabolism and development of the musculoskeletal system and secondary functions in immune-modulatory, anti-inflammatory, and anti-oxidant pathways.[20,21] Vitamin D reduces viral replications through cathelicidins and defensins,[7,13] decreases proinflammatory cytokines, and increases anti-inflammatory cytokines.[7] In addition, it has immune homeostasis protective properties while performing the immunomodulatory role.[7,8] Especially in patients with COVID-19, the cytokine storm associated with a poor prognosis is affected through these pathways,[7] which encouraged the scientists to find the answer to the question "Can there be hope?"[13] In a retrospective study conducted in the USA in 2020, a relationship between COVID-19 disease and vitamin D level in terms of clinical outcomes was not supported in hospitalized patients due to COVID-19.[3] However, a recent systematic review and meta-analysis showed that vitamin D supplementation during the COVID-19 pandemic was associated with favorable clinical results, especially in patients supplemented after the COVID-19 diagnosis.[2] This study aims to assess the effect of vitamin D level (deficiency/insufficiency/normal level) on mortality and duration of hospital stay in adults with COVID-19.

MAIN POINTS

- The mean vitamin D levels of the deceased patients were deficient, and they had a more extended hospital stay.
- Age and comorbidity (especially neurological diseases and renal failure) were among the factors affecting mortality in COVID-19 disease.
- Supplementation of Vitamin D deficiency/insufficiency is an easy, inexpensive, and cost-effective method.

METHODS

The Design of the Study and the Patient Groups

This retrospective and descriptive study was conducted on adult patients who applied to Ankara City Hospitals Neurology-Orthopedics Hospital between 01 August and 31 October 2021 and had positive COVID-19 PCR tests. The study included (n = 181) patients whose serum 25(OH) vitamin D level was analyzed and patients who used drugs that would affect vitamin D absorption, such as corticosteroids, cholesterol-lowering agents, phenytoin-containing agents were excluded (n = 13) from the study (Figure 1). The research was approved by the Ministry of Health of the Republic of Turkey (Approval Number: (Date: May 30, 2021, Approvel Number: 2021-05-28T15_24_52) and the Ethics Committee of Yüksek İhtisas University (2021/07/07) University. Research procedures were conducted based on the Declaration of Helsinki. Since the study was retrospective, verbal consent was obtained by calling the registered phone numbers of the patients/parents/relatives.

Collection of Data

The study data were collected from medical records. The collected data included age, gender, comorbidity, vitamin D level, duration of hospital stay, and mortality/survival situations. The hospital stay duration was calculated by subtracting the date of hospitalization from discharge. Mortality data showed deaths occurring during hospitalization.

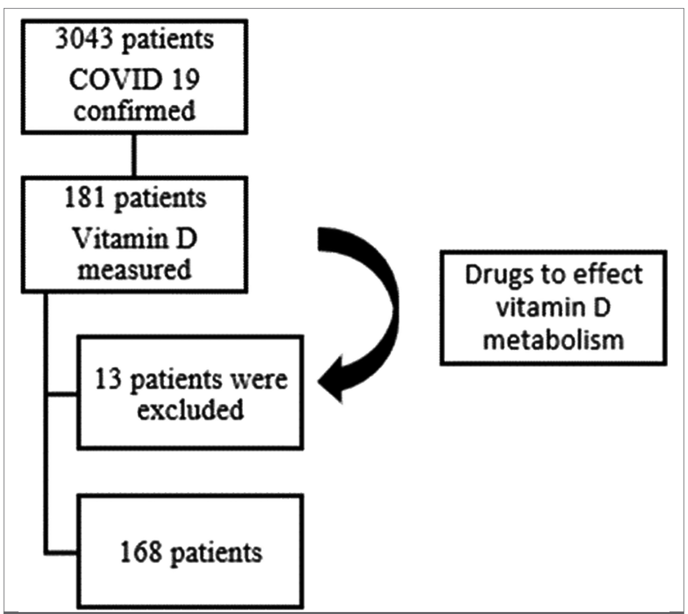

Figure 1. Research design.

Measurement of Serum 25(OH) Vitamin D Levels and Vitamin D Groups

In the study, vitamin D ranges in the pandemic hospital biochemistry laboratory reflected the vitamin D levels of the patients; as of hospitalization, the first measured serum 25(OH) vitamin D level was recorded. Serum 25(OH) vitamin D level was defined as ≥30 ng/mL normal, 20-29 ng/mL insufficient, and less than 20 ng/mL as deficiency level.

Statistical Analysis

In the data of 168 patients included in the study, mean ± SD, median (IQR: 25th-75th percentiles) minimum–maximum values were given for numerical variables, and number and per cent values were given for categorical variables. The vitamin D level is categorized into 3 groups (deficiency, insufficiency, and normal level). The Kolmogorov–Smirnov and Shapiro–Wilk tests were used to determine the suitability of the characteristics for the normal distribution. After comparing the quantitative features with normal distribution between the 3 groups with the ANOVA test, the Tukey test was used as the post hoc test. The Kruskal–Wallis test and the Mann–Whitney *U*-test with Bonferroni correction were used to compare the characteristics that did not have a normal distribution. The chi-square test was used to assess differences between the groups regarding the distribution of qualitative variables. The relationship between 25(OH) vitamin D level and 20 ng/mL deficiency status with independent variables were examined by logistic regression analysis. The Statistical Package for the Social Sciences Windows version 25.0 package program was used for statistical analysis, and $P < .05$ was considered statistically significant.

RESULTS

Patient Characteristics and Vitamin D Status

According to vitamin D levels, the patient characteristics are shown in Table 1. Of the patients, 90 (53.6%) were male and 78 (46.4%) were female. The vitamin D level of patients was 63.7% (n=107) deficiency, 25.6% (n=43) insufficiency, and 10.7% (n=18) normal. According to the patient's categorized vitamin D (deficiency/insufficiency/normal) levels, the mean age was 63.44 ± 16.9 years, 59.88 ± 15.1 years, and 60.39 ± 12.2 years, respectively. The main reasons for admission to the hospital were dyspnea (53.2%) and cough (38.3%). Eighty-five (79.4%) patients with deficient vitamin D levels and 29 (67.4%) patients with insufficient vitamin D levels had comorbidity. The most common comorbidities were hypertension, diabetes mellitus (DM) and cardiovascular diseases (CVD). Although the duration of hospital stay and vitamin D levels were not significantly associated, it was primarily observed in the deficiency group; the median was 13 (IQR:6-23) days ($P > .05$). There was no difference between the groups in terms of categorized vitamin D levels and duration of hospital stay ($P > .05$) (Table 1).

The clinical characteristics of the patients according to their survival and exitus status are shown in Table 2. During the research period, 32 out of 168 patients (19%) lost their lives, and the mean mortality age was 72.97 ± 11.93 (75 years; IQR: 65-81.75 and $P = .0001$). When the deceased and surviving patients were compared regarding mean vitamin D levels, the vitamin D levels of the surviving patients were significantly higher in their favor ($P = .019$). In addition, it was observed that the presence of comorbidity (especially DM, CVD, chronic renal failure (CRF), and neurological disease) and the duration of hospital stay were significantly higher in the patients who lost their lives compared to the survivors ($P < .05$). According to vitamin D level, the exitus was highest in the deficiency group (76.6%), and it was shown that there was no difference between the groups when compared to the patients who died ($P > .05$). However, when vitamin D levels were categorized, there was no difference between the groups in terms of survival and hospital stay ($P > .05$).

When the factors that impact survival are assessed using the logistic regression method, it has been observed that increasing age and comorbidities such as CRF, DM, CVD, and neurological diseases have a significant and elevating effect on the exitus (Table 3). Vitamin D significantly affected survival compared to the univariate model ($P = .044$), with no significant effect on the multivariate model ($P = .323$).

When the patients' vitamin D levels, age, gender, duration of hospital stay, and survival factors were adjusted, there was no significant difference ($P > .05$) (Table 4).

DISCUSSION

The results of this study, in which we retrospectively examined the effect of vitamin D deficiency/insufficiency on hospital stay and mortality in adult patients diagnosed with COVID-19, are presented later.

In this study, we retrospectively analyzed the association between vitamin D deficiency/insufficiency and duration of hospital stay and mortality of adult COVID-19 patients.

In the COVID-19 patients included in the study, vitamin D insufficiency was 25.5%, deficiency level was 63.6%, and vitamin D level was below normal in 89.2% of the patients. In a study by Campi et al.[22] 35% of the entire cohort had vitamin D deficiency.[22] In two studies in Turkey on vitamin D and COVID-19, the deficiency rate was determined by

Table 1. Characteristic Features of Patients According to Vitamin D Levels

	Vitamin D Level			
	Deficiency < 20 ng/mL (n=107)	**Insufficiency 20-29 ng/mL (n=43)**	**Normal ≥ 30 ng/mL (n=18)**	***P*****
Age				
Mean ± SD	63.44 ± 16.9	59.88 ± 15.1	60.39 ± 12.2	.417
Med (IQR)	65 (52-77)	61 (51-71)	61 (52.75-65.25)	
	n/%	n/%	n/%	
Gender				
Female	53/49.5	16/37.2	9/50	.37
Male	54/50.5	27/62.8	9/50	
Reason for hospitalization				
Dyspnea	57 (53.2%)	17 (39.5%)	8 (44.4%)	.19
Cough	41 (38.3%)	13 (30.2%)	6 (33.3%)	.51
Fever	40 (37.3%)	14 (32.5%)	6 (33.3%)	.73
Weakness	21 (19.6%)	17 (39.5%)	7 (38.8%)	**.02**
Nausea-vomiting	12 (11.2%)	5 (11.6%)	3 (16.6%)	.74
Myalgia	8 (7.4%)	7 (16.2%)	3 (16.6%)	.23
Diarrhea	5 (4.6%)	2 (4.6%)	3 (16.6%)	.19
Sore throat	5 (4.6%)	2 (4.6%)	1 (5.5%)	.97
Comorbidity†	85/79.4	29/67.4	16/88.8	.13
HT	57/53.2	17/39.5	11/61.1	.20
DM	43/40.1	10/23.2	8/44.4	.11
CVD	26/24.3	11/25.5	6/33.3	.73
Thyroid disease	15/14.0	3/6.9	0	.05
Cancer	10/9.3	3/6.9	1/5.5	.79
Neurological	9/8.4	4/9.3	1/5.5	.88
CRF	9/8.4	1/2.3	3/16.6	.13
Asthma	8/7.4	3/6.9	4/22.2	.18
Other*	18/16.8	10/23.3	4/22.2	.62
Duration of hospital stay (days)				
Med (IQR)	13 (6-23)	9 (6-14)	11.5 (6.5-17)	.24

CRF, chronic renal failure; CVD, cardiovascular diseases; DM, diabetes mellitus; HT, hypertension; Med (IQR), median (25th-75th percentiles).
*Other: liver, gout, dermatological, inflammatory bowel diseases, transplantation, rheumatologic, psychiatric diseases.
** $P < .05$, χ^2, chi-square test; kw, Kruskal–Wallis; *z*, Mann–Whitney *U*-test f: One Way Analysis of Variance
†More than 1 answer given.

Table 2. Comparison of Clinical Characteristics of Survival and Deceased Individuals

	Survival (n = 136)	Deceased (n = 32)	*P**	
Age				*t*
Mean ± SD	59.67 ± 15.88	72.97 ± 11.93	**.0001***	
Med (IQR)	61 (51- 69)	75 (65- 81.75)		
Vitamin D level (ng/mL)				***z***
Mean ± SD	19.54 ± 11.67	15.25 ± 8.06	**.019***	
Med (IQR)	17 (13-23.75)	14 (10-17)		
Duration of hospital stay (days)				***z***
Mean ± SD	15.13 ± 16.19	21.06 ± 18.22	**.027***	
Med (IQR)	10.5 (6-17)	18.5 (7.25-26.5)		
	n (%)	n (%)		
Gender	136 (81)	32 (19)		
Female	63 (46.3%)	15 (46.9%)		χ^2
Male	73 (53.7%)	17 (53.1%)	.955	
Comorbidity	100 (73.5%)	30 (93.7%)	**.014***	χ^2
HT	64 (47.0%)	21 (65.6%)	.059	χ^2
DM	44 (32.3%)	17 (53.1%)	**.028***	χ^2
CVD	30 (22.0%)	13 (40.6%)	**.03***	χ^2
Thyroid disease	13 (9.5%)	2 (6.2%)	.739	χ^2
Cancer	10 (7.3%)	4 (12.5%)	.309	χ^2
Neurological	9 (6.6%)	9 (28.1%)	**.002***	χ^2
CRF	7 (5.1%)	7 (21.8%)	**.006***	χ^2
Asthma	10 (7.3%)	3 (9.3%)	.715	χ^2
Other	26 (19.1%)	6 (18.8%)	.962	χ^2
Vitamin D level				χ^2
≥30 ng/mL	15 (83.3%)	3 (16.7%)	.109	
20-29 ng/mL	39 (90.7%)	4 (9.3%)		
<20 ng/mL	82 (76.6%)	25 (23.4%)		
Duration of hospital stay (days) according to vitamin D level				
Med (IQR)	12.4 ± 9.5	15.67 ± 10.07	.574	*z*
≥30 ng/mL	11 (7- 5)	17 (5-25)		
Med (IQR)	13.1 ± 15.47	16 ± 9.09	.299	*z*
20-29 ng/mL	9 (6-14)	18 (6.5-23.5)		
Med (IQR)	16.58 ± 17.42	22.52 ± 19.99	.095	*z*
<20 ng/mL	11.5 (6-19.5)	20 (7.5-29.5)		

χ^2, chi-square test; CRF, chronic renal failure; CVD, cardiovascular diseases; DM, diabetes mellitus; HT, hypertension; Med (IQR), median (25th-75th percentiles); *t*, independent samples *t*-test; *z*, Mann–Whitney *U*-test.
**P* < .05 is statistically significant.

Table 3. Logistic Regression Analysis of Factors Affecting Mortality

Logistic Regression Analysis				
	Univariate Analysis		Multivariate Analysis	
Variable	OR (95% CI)	*P*	OR (95% CI)	*P*
Gender (female)	1.02 (0.47-2.21)	.955		
Age	1.07 (1.03-1.10)	**.0001***	1.05 (1.01-1.09)	**.012***
Comorbidity	5.4 (1.22-23.75)	**.026***		
HT	2.14 (0.96-4.79)	.062		
DM	2.37 (1.08-5.17)	**.031***	2.03 (0.80-5.11)	.131
CVD	2.41 (1.07-5.45)	**.033***	1.98 (0.74-5.26)	.169
Thyroid disease	0.63 (0.13-2.94)	.558		
Cancer	1.8 (0.52- 6.15)	.349		
Neurological	5.52 (1.98-15.39)	**.001***	4.27 (1.25-14.57)	**.02***
CRF	5.16 (1.66-16.00)	**.004***	4.16 (1.36-15.61)	**.014***
Asthma	1.30 (0.33-5.03)	.701		
Other diseases	0.97 (0.36-2.61)	.962		
Vitamin D level (ng/mL)	0.94 (0.89-0.99)	**.044***	0.97 (0.91-1.02)	.323
Hospital stay (days)	1.01 (0.99-1.03)	.085		

CI, confidence interval; CRF, chronic renal failure; CVD, cardiovascular diseases; DM, diabetes mellitus; HT, hypertension.
**P* < .05 statistically significant; logistic regression analysis; Absent class was accepted as reference class in all examinations.

Table 4. Examination of Factors Affecting the Vitamin D Level

Outcome	Unadjusted Std. B_{vitD}	Standard Error	*P**	95% CI Lower	95% CI Upper
Age	–0.131	0.054	.09	–0.197	0.015
Gender	–0.151	1.715	.051	–6.765	0.008
Duration of hospital stay (days)	–0.096	0.052	.214	–0.167	0.038
Survival	–0.151	2.178	.051	–8.588	0.014
Outcome	Adjusted Std. B_{vitD}	Standard Error	*P*	95% CI Lower	95% CI Upper
Age	–0.55	0.058	.512	–0.153	0.077
Gender	–0.154	1.726	**.048***	–6.842	–0.025
Duration of hospital stay (days)	–0.081	0.053	.310	–0.16	0.51
Survival	–0.121	2.29	.135	–7.959	1.085

CI, confidence interval; Std. B, standardized beta coefficient.
**P* < .05 statistically significant; linear regression analysis.

Karahan et al.[23] by 69.1%, Demir et al[24] found to be 44% (0-10 ng/mL) and 32% (10-20 ng/mL).

Vitamin D sufficiency is essential for health maintenance at every stage of life, due to its effects on optimal muscle strength, bone mineral density, risk reduction in some types of cancer, and its role as an immune modulator.[11,25] Vitamin D deficiency is an essential public health problem,[13] and its optimal dose is controversial.[26] Therefore, deprivation of sunlight, the major primary source of vitamin D, due to quarantine conditions has raised concerns about inadequate vitamin D intake in the body.[10] However, the latitude of the place of residence, the duration and time of sun exposure, the incidence of sunlight, and genetic and ethnic characteristics play a role in ensuring the optimal dose of vitamin D level.[10] A study specific to Turkey showed that the difference between seasonal transitions (increase with the summer season and decrease with autumn) rather than gender is essential.[27] On the other hand, vitamin D deficiency in acute-inflammatory response is associated with a decrease in vitamin D carrier receptors, hemodilution, and increasing conversion from 25(OH) D to 1,25-dihydroxy vitamin D.[28]

Of the patients included in the study (n=168), 77.3% (n=130) had at least 1 comorbidity, and 19% lost their lives. The diseases contributing to mortality (DM, CVD, neurological, CRF) were also compatible with the literature.[29] More than half of the patients who died (n=32) were due to circulatory disorders (56.25%) and due to respiratory diseases (34.38%). Decreased induction of antimicrobial peptides, decreased pulmonary vascular barrier, and increased lung inflammation through neutrophils are thought to cause this situation.[22] On the other hand, excessive increase in immune activation and induction of cytokine storm in infected cells are among the other causes.[13] The increase in the risk of thrombosis in infections and the low level of vitamin D affecting vascular resistance and extracellular fluid homeostasis via the renin–angiotensin system are among the factors affecting circulation.[13]

Low vitamin D levels are associated with increased disease severity, morbidity, and mortality in intensive care patients.[26] Most deaths from COVID-19 disease are associated with at least 1 comorbidity.[30] Diabetes, CVDs, cancer, chronic obstructive pulmonary disease, chronic kidney failure, and some neurological diseases are risk factors for COVID-19.[5] In addition, it is stated that the presence of hypertension concurrently with CVD in a patient increases the mortality odds ratio 40 times.[30] The presence of advanced age and comorbidity in this study (respectively, $P < .0001$ and $P = .014$) confirm the above hypothesis. However, the 19% mortality rate despite advanced age, presence of comorbidities, and low vitamin D levels suggest that the severity of the disease, the effectiveness of the treatment methods, and appropriate interventions (intubation, parenteral/enteral nutrition/appropriate pharmacological therapy) at the right time are important factors affecting this outcome. In addition, this result is based on the fact that the study was carried out in the summer, the latitudes of the geography we are in, the quarantine process is partially alleviated, and more sunlight is benefited.

The mean vitamin D level ($P = .019$) was higher in survivors with COVID-19 than in individuals who died. It suggests a potential protective effect of vitamin D on survival. However, when vitamin D levels were categorized, the difference between serum 25(OH) vitamin D level and duration of hospital stay and survival was insignificant.

Karahan and Katkat,[23] in a study with moderate and critical COVID-19 patients, showed that the results of both categorical and mean vitamin D levels of patients who survived and died were significant ($P < .001$). In a study conducted with 329 COVID-19-positive patients, it was shown that there was a meaningful relationship between vitamin D levels and duration of hospital stay ($P = .007$).[31] However, Pecina et al[32] found results that support the converse of this theorem. In a multicenter, prospective study, while there was no relationship between decategorized 25(OH) vitamin D and duration of hospital stay ($P = .120$), vitamin D levels in patients below <10 ng/mL 9 days (95% CI:6.4-11.6)) has been shown that there is a greater tendency for ($P = .057$), but this has not reached statistical significance in modeling.[33] In this study, there was no significant relationship between categorized vitamin D levels and duration of hospital stay. It is thought that COVID-19 disease (need for mechanical ventilation, the severity of the disease, inflammatory responses) and patient-related factors (age, gender, ethnicity, obesity, pregnancy, comorbidities) may be effective in this situation rather than vitamin D level.

In the multivariate model, age effected on mortality (OR:1.05 95% CI: 1.01-1.09; $P < .05$) from due to COVID-19, while vitamin D level had no effect (OR: 0.97, 95% CI: 0.91-1.02; $P > .05$). It supports the hypothesis that the elderly have a higher mortality rate for COVID-19 disease.[13]

As a result, the elderly are at risk for vitamin D deficiency,[16] and it is based on the fact that with age, the synthesis decreases due to lifestyle and physiological changes.[11] Szeto et al.[3] in a retrospective study conducted with 93 patients, found that individuals with vitamin D deficiency did not show any significance in any outcomes (deceased and duration of stay, discharge status) compared to individuals with normal vitamin D levels. A meta-analysis by Chen et al[34] showed that vitamin D level did not affect disease-related mortality (OR: 0.65, 95% CI: 0.40-1.06, $I^2 = 79\%$). However, a meta-analysis (OR: 1.80; 95%CI: 1.72-1.88) also shows that vitamin D deficiency/insufficiency is 80% more likely to get COVID-19 infection than individuals with adequate levels.[35]

Contrary to our study, there is evidence regarding the relationship between vitamin D and COVID-19.[22,31] This heterogeneity might be attributed to the different categorizations of vitamin D levels and the inability to adjust the influencing factors.

Many confusing factors such as age, obesity, ethnicity, genetic polymorphism, geography, and comorbidities will affect the prognosis and clinical results between vitamin D deficiency/insufficiency and COVID-19 disease.[3]

Vitamin D reduces the pro-inflammatory response by suppressing inflammatory cytokines, increasing the production of anti-inflammatory cytokines. The production of antimicrobial peptides forms a line of defense by up-regulating the angiotensin-converting enzyme 2, a receptor mediator, in the placement of the virus in the host.[28,36] On the other hand, the effect of vitamin D on COVID-19 disease has not yet been clarified. The difference in sample groups, the disease severity, the dose, and the duration of vitamin D supplementation have also led to heterogeneity in the studies. In addition, the socioeconomic status of the countries, the number of health professionals, and the quality of health care are other factors that affect the whole process of the disease.

Study Limitations

Our study has some limitations. The limited number of vitamin D level data did not allow us to determine the situation in individuals with COVID-19 and normal vitamin D levels. The study's other limitations are the severity of the disease, vitamin D level in patients who need mechanical ventilation, pre-hospitalization vitamin D levels, and lack of data on the use of supplements.

In this study, we retrospectively investigated the association between vitamin D deficiency/insufficiency, duration of hospital stay, and mortality of adult COVID-19 patients. The categorized vitamin D level does not impact the hospital stay and mortality. However, the mean vitamin D level supports this hypothesis regarding mortality. Considering the inflammatory, immunomodulatory, and antiviral effects of vitamin D, it is crucial to screen COVID-19 patients for vitamin D levels. In terms of being a cheap, feasible, and accessible method of eliminating vitamin D deficiency, the patient's health would benefit the triangle of the workforce of health professionals and the national economy. In addition, the inclusion of vitamin D in countries' nutrition policies through food enrichment should take its place among other applicable methods.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Yüksek İhtisas University (Date: July 7, 2021, Number: 2021/12/01).

Informed Consent: Written informed consent was obtained from patient and patients' parents who participated in this study.

Peer-review: Externally peer-reviewed.

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