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ORIGINAL ARTICLE

Vitamin D Status in Turkish Children During the Covid-19 Pandemic; A Single Center Experience

Covid-19 Pandemisi Döneminde Türk Çocuklarinda D Vitamini Durumu; Tek Merkez Deneyimi

[1]Betül Orhan Kılıç, [1]Serhat Kılıç, [2]Eylem Gül Ateş

[1]Department of Pediatrics, Baskent University Faculty of Medicine, Ankara, TURKIYE
[2]Institutional Big Data Management Coordination Office, Middle East Technical University, Ankara, TURKIYE

Correspondence

Betül Orhan Kılıç, Department of Pediatrics, Baskent University Faculty of Medicine, Ankara, TURKIYE

E-Mail: betulorhandr@hotmail.com

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ABSTRACT

Objective: COVID-19-related lockdown decreased the children's exposure to sunlight, and they were susceptible to 25-hydroxyvitamin D [25(OH)D] deficiency. The present study aimed to examine the 25(OH)D levels two years before and during the first year of the pandemic.
Materials and Methods: Children whose Vitamin D levels were checked during well-child visits between October 2018 and March 2021 were included. Vitamin D levels were categorized according to the date vitamin D was checked; 2018 October 2019 March (Group 1), 2019 October, and 2020 March (Group 2), 2020 October, and 2021 March (Group 3). We compared the children's 25(OH)D levels and vitamin D deficiency rates between Groups 1, 2, and 3.
Results: We found that the mean of the children's 25(OH)D levels was lower during COVID-19 than in the last two years before the pandemic (p=0.039). The present study showed that 25(OH) D deficiencies among ages 0-1 and 4-7 were higher during the pandemic than before (p= 0.013, p=0.011).
Conclusion: Reduced sunbathing time during confinement is associated with lower 25(OH)D levels among children aged 4–7. Howeer, the increased rate of 25(OH)D deficiency in infants is worrying.

Keywords: COVID-19, child, vitamin D, confinement, deficiency.

ÖZ

Amaç: COVID-19 ile ilgili karantina, çocukların güneş ışığına maruz kalma oranını azaltmıştır ve çocuklar 25-hidroksivitamin D [25(OH)D] eksikliğine karşı duyarlı hale gelmiştir. Bu çalışma, pandeminin ilk yılında ve pandemi öncesi 2 yıl süresince bakılmış 25(OH)D düzeylerini incelemeyi amaçlamıştır.
Gereç ve Yöntem: Bu çalışmaya 2018 Ekim–2020 Mart tarihleri arasında eşdeğer sağlık kontrolü yaptıran çocuklar dahil edilmiştir ve D vitamini bakılma tarihine göre; 2018 Ekim -2019 Mart (Grup 1), 2019 Ekim ve 2020 Mart (Grup 2), 2020 Ekim ve 2021 Mart (Grup 3) olarak kategorize edilmiştir. Grup 1, 2 ve 3'te çocukların 25(OH)D düzeyleri ile D vitamini eksikliği oranlarını karşılaştırılmıştır.
Bulgular: Çocukların pandemi süresince pandemi öncesi yıllara kıyasla ortalama 25(OH)D düzeylerinin COVID-19 sırasında daha düşük olduğunu bulunmuştur(p=0,039). Çalışmada, 0-1 yaş ve 4-7 yaş grubu çocuklarda 25(OH)D eksikliği oranın pandemi öncesi döneme kıyasla daha yüksek olduğu görülmüştür (p= 0.013, p=0.011).
Sonuç: 4-7 yaş arası çocuklar arasında daha düşük 25(OH)D seviyeleri, karantina sırasında azalan güneşlenme süresi ile ilişkilidir. Ancak 25(OH)D eksikliğinin bebeklerde görülme oranlarının artması endişe vericidir.

Anahtar Kelimeler: COVID-19, çocuk, D vitamini, karantina, eksiklik.

Introduction

The coronavirus infection (COVID-19) pandemic has affected the world. Governments have taken certain precautions against this pandemic to contain the pervasiveness of this infectious virus, primarily through social isolation and distancing (1). As a result of the restrictions on going out, the sunbathing time of children has decreased. The 25-hydroxyvitamin D (25(OH)D) level in children during the COVID-19 outbreak has been a matter of curiosity.

Vitamin D is a steroid hormone that plays an essential role in calcium homeostasis and bone health (2). The most important source of vitamin D is the sun, and this vitamin can also be taken with food (3). Vitamin D deficiency can cause serious adverse effects on tissues. Thereby, preventing children from vitamin D deficiency and insufficiency is critical. There are no specific cut-offs for serum vitamin D levels in children. The Endocrine Society's clinical practice guidelines recommend that vitamin D status should be divided into deficiency, insufficiency, and sufficiency, corresponding to 25(OH) D levels of <12, 12–20, and ≥20 ng/mL (4). Although a major source of 25(OH)D (90-95%) is synthesized in the skin by sunlight exposure, some food also can provide vitamin D (5). 25-hydroxyvitamin D is synthesized from cholesterol in the liver after exposure to ultraviolet B rays on the skin. This production is the natural and principal source of vitamin D (3,6).

Confinement related to the COVID-19 pandemic was imposed to prevent the spread of the infection (1). Some studies showed increased rates of 25(OH)D deficiency during the quarantine periods (7-9). Some researchers suggested that vitamin D deficiency during the pandemic was associated with lifestyle modification and decreased sunbathing time (9).

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Some researchers suggested that vitamin D deficiency during the pandemic was associated with lifestyle modification and decreased sunbathing time. The present study aimed to examine the children's 25(OH) D levels before and during the pandemic.

Methods

Participants

We retrospectively examined the serum vitamin D levels of the children admitted to our pediatric clinics for well-child-visit between April 2019 and April 2021. We found 450 children whose 25(OH)D levels were checked. Seventy-five children with vitamin D-associated metabolic disorders, such as skeletal or gastrointestinal system diseases, liver or kidney diseases, genetic syndromes, obesity, or malabsorption disorders, were excluded from the study. The rest 375 children were included in the present study. We examined children's serum 25(OH)D Vitamin D levels according to age; 0-11 months, 1-3 years, 4-7 years, 8-11 years, and 12-18 years.

Inclusion criteria: Children aged 0-18 years, who were without chronic disease, and whose vitamin D levels were checked were included in the study. Three hundred and seventy-five children aged 0-18 years old whose vitamin D levels were checked were included in the study.

Before and During the COVID-19 Pandemic

We categorized the vitamin D levels according to the date they checked; Group 1 between 2018 October and -2019 March, Group 2 between 2019 October and 2020 March, and Group 3 between 2020 October and 2021 March. We called Groups 1 and 2 before the COVID-19 pandemic and Group 3 after the pandemic.

The Children's Vitamin D Status

There is no definite threshold value for children's 25(OH) D level. According to the Endocrine Union, vitamin D status is classified based on serum 25(OH) D levels:

- Sufficiency, >20 ng/mL
- Insufficiency, 12-20 ng/mL
- Deficiency, <12 ng/mL (4).

In the present study, we categorized according to the classification mentioned above.

Vitamin D Treatment or Prophylaxis

We extracted data on 25(OH)D treatment or prophylaxis status levels stored in the Hospital Information System. We found in patient records that all 0-1 years except two children used routine vitamin D prophylaxis.

Statistical Analysis:

The conformity of the numerical variables to the normal distribution was examined using the Shapiro-Wilk normality test. The mean±standard deviation and median (minimum-maximum) values are given as descriptive statistics for numerical variables. The Kruskal-Wallis test was used to determine whether there was a statistical difference between the years regarding vitamin D level distributions. The Fisher-Freeman-Halton test was used to compare the categorical variables. Type-I error probability was determined as a=0.05 in all hypothesis tests, and the SPSS v25.0 package program was used for statistical evaluations. The graph was drawn in JASP programme.

Results

We included 375 children who had applied to our pediatric clinics for the last three years and whose 25(OH)D levels had been checked. We found that 27.1% of them (n=102) were checked in 2018-2019 (Group 1), 35.3% (n=133) in 2019-2020 (Group 2), and 37.7% (n=142) in 2020-2021 (Group 3).

The children's ages were not homogeneously distributed; we evaluated the median ages of the participants. The median ages of children were 4, 3, and 4 for Groups I, II, and III, respectively, and we found no difference in age distribution. (p=0.110). We revealed a significant difference between the groups regarding gender distribution (p=0.014). Female/male ratio in terms of gender distribution among Groups I, II, and III was; 39/63, 68/65, and 81/61. We found that the female/male ratio in Group III was higher than in Group I.

Vitamin D levels according to Groups 1,2,3 are represented in Table 1 and Figure 1. We found that the 25(OH)D levels were lower during COVID-19 than in the last two years before the pandemic (p=0.039). The rates of vitamin D deficiency (vitamin D level <12 ng/mL) were higher during the COVID-19 pandemic (p=0.010). The proportion of the vitamin D status is shown in Table.2.

The vitamin D status from 2018 to 2021 according to age groups is shown in Table 3. We found increased rates of vitamin D deficiency in 0-1 age and 4-7 age during the COVID-19 pandemic compared with before the pandemic (p=0.013, p=0.011).

Table 1. The Mean Values of Serum 25(OH)D Levels for the Last Three Years.

Year	Serum 25(OH)D Level		p-value
	$\bar{X}\pm S$	(min-max)	
Group I	22.4±12.7	19.4 (5.4-80.2)	
Group II	21.4±8.2	21 (3.5-43.6)	**0.039**
Group III	19.1±8.5	18.4 (5.3-41.1)	

p<0.05 statistically significant.

Group I: 2018 October -2019 March, **Group II:** 2019 October -2020 March, **Group III:** 2020 October -2021 March.

Table 2. The Categorized Serum 25(OH)D Levels for the Last Three Years

Year	Vitamin D Status			p-value
	Deficiency n (%)	İnsufficiency n (%)	Sufficiency n (%)	
Group I	22 (21.6)	32(31.4)	48(47.0)	
Group II	17 (12.9)	37 (28.0)	78(59.1)	0.030
Group III	35 (24.6)	49 (34.5)	58(40.9)	

*****: Row percentage. *p<0.05* statistically significant.

Group I: 2018 October -2019 March, **Group II:** 2019 October -2020 March, **Group III:** 2020 October -2021 March.

Table 3. Children's Vitamin D Status From 2018 to 2021.

Children's Age	Date of Vitamin D	25(OH)D categories* Deficiency n(%)	İnsufficiency n(%)	Sufficiency n(%)	p
0-11 months	Group I	-	3 (23.1)	10 (79,6)	0.013
	Group II	3 (10.3)	2 (6.9)	24 (82.8)	
	Group III	4 (25)	6 (37.5)	6 (37.5)	
	Total	7 (12.1)	11 (19.0)	40 (69.0)	
1-3 years	Group I	6 (27.3)	3 (13.6)	13 (59.1)	0.070
	Group II	4 (8.7)	15 (32.6)	27 (58.7)	
	Group III	9 (20.9)	17 (39.5)	17 (39.5)	
	Total	19 (17.1)	35 (31.5)	57 (51.4)	
4-7 years	Group I	12 (24.5)	21 (42.9)	16 (32.7)	0.011
	Group II	-	8 (29.6)	19 (70.4)	
	Group III	13 (22.0)	22 (37.3)	24 (40.7)	
	Total	25 (18.5)	51 (37.8)	59 (43.7)	
8-11 years	Group I	1 (9.1)	5 (45.5)	5 (45.5)	0.364
	Group II	5 (45.5)	3 (27.3)	3 (27.3)	
	Group III	4 (36.4)	2 (18.2)	5 (45.5)	
	Total	10 (30.3)	10 (30.3)	13 (39.4)	
12-18 years	Group I	3 (42.9)	-	4 (57.1)	0.122
	Group II	5 (26.3)	9 (47.4)	5 (26.3)	
	Group III	5 (38.5)	2 (15.4)	6 (46.2)	
	Total	13 (33.3)	11 (28.2)	15 (38.5)	

p<0.05 statistically significant.

Group I: 2018 October -2019 March, **Group II:** 2019 October -2020 March, **Group III:** 2020 October -2021 March.

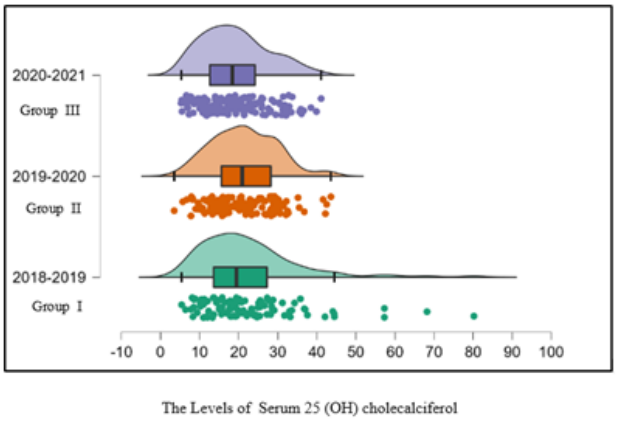

Figure 1. Serum 25(OH)D levels of children before and during the COVID-19 pandemic.

Group I: 2018 October -2019 March, **Group II:** 2019 October -2020 March, **Group III:** 2020 October -2021 March.

Discussion

During the COVID-19 pandemic, which affects the whole world, it has been wondered how vitamin D levels were affected due to social restrictions and reduced sunbathing times. In recent years, it has been known that vitamin D deficiency has been associated with many diseases other than skeletal system and bone mineralization disorder (6). In this respect, it is essential to determine children's vitamin D deficiency and treat them appropriately.

Our present study found that the rates of vitamin D deficiency in children during the pandemic were significantly higher than before. This situation may have occurred due to lifestyle modification and decreased sunbathing time. Unlike our study, Lippi et al. (2021) showed that quarantine did not produce clinically significant effects on vitamin D levels among adults (7). As in adults, the COVID-19 pandemic was not a risk factor for adolescent vitamin D deficiency (8). Similarly, Meoli et al. found no difference in 25(OH)D levels of children aged 15-19 between 2014-2016 and 2020 (8). On the other hand, some researchers found that pandemic-related confinement had different effects on 25(OH)D levels among children of different ages. In a study conducted in China, 3-6 years children's vitamin D levels were lower compared to 0-3 years (9).

The other critical findings in our study are that increased rates of vitamin D deficiency in infants were higher during the pandemic. Rustecka et al. (2021) showed that children's 25(OH)D levels, except for infants, were lower during the pandemic (10). On the contrary, Wong et al. (2021) found significant decreases in average vitamin D levels, especially in 2–6-month-old babies, during the COVID-19 pandemic (11). In conclusion, there is no clear evidence of infants' vitamin D status during the pandemic.

D vitamin deficiency has been associated with the severity of many infectious diseases, including COVID-19. Yılmaz and Sen (2020) found that COVID-19 disease was associated with lower vitamin D levels in Turkish children (12). Some researchers have also reported that vitamin D supplementation might be critical to preventing and treating COVID-19 disease in pediatric and adult patients (13). In this respect, protecting 0-12-year-old children who have not been vaccinated against COVID-19 infection in our country is critical. Health professionals must pay attention to vitamin D prophylaxis and monitor the vitamin D status.

Study Limitations

Our study has several limitations. The first limitation of this study is that we did not know the precise sunbathing time and the other causes of children's vitamin D deficiency during the lockdown. The second limitation is that the data of our study were from a single-center study. Future studies with larger samples are needed. Future studies must monitor whether children aged 0-1 years receive vitamin D prophylaxis regularly.

Conclusion

The present study found increased rates of vitamin D deficiency in infants and children during the lockdown related to COVID-19. It can be expected that increased rates of vitamin D deficiency in infants reduce the sunbathing time during the pandemic. However, the lower serum vitamin D levels of the 0-1 years children who take routine vitamin D prophylaxis are worrying.

Availability of Data and Material

Raw data are available upon reasonable request (correspondence author).

Abbreviations

Serum 25-hydroxyvitamin D: 25(OH)D

Coronavirus Infection: COVID-19

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Consent to Participate

The participant has consented to the submission to this journal.

Consent For Publication

The participant has consented to the submission to this journal.

Ethics Approval

This study was approved by our university Medical and Health Science Research Committee (Project number: KA21/191).

Conflicts of Interest

The authors declare no competing interests.

Author Contributions

Conception: B.OK., S. K., Data Collection and Processing: B.OK. Design: S.K., Supervision: B.OK, Analysis and Interpretation: E.GA, Literature Review: B.OK, E.GA, Writer: B.OK., Critical Review: B.OK

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