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ORIGINAL ARTICLE

Assessment of vitamin D levels in children who admitted to pediatric outpatient clinics by age, gender and seasons in Şırnak province, Turkey

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ABSTRACT

Background and objective: This study purposes to designate the profile of 25-hydroxy vitamin D [25(OH)D] by evaluating the vitamin D levels of patients attending the pediatric outpatient clinics at the State Hospital in Şırnak, the second city in Turkey in terms of fertility.

Methods: In the study, 4753 patients hospitalized at Şırnak State Hospital were enrolled, and their vitamin D levels were retrospectively examined. Throughout the research, vitamin D concentrations were assessed based on the patients' gender, age, and seasonal variations. Serum vitamin D levels were categorized as severe deficiency at <12 ng/ml, mild-moderate deficiency at 12–20 ng/ml, and normal at 20–100 ng/ml.

Results: The study analyzed the data of 2107 males and 2646 females. For boys and girls, the median serum vitamin D levels were 18.23 ng/ml and 22.42 ng/ml respectively. There was a statistically significant difference in vitamin D levels between different age groups in both genders ($p<0.01$). Vitamin D levels were at their lowest in winter and highest in summer for both genders, and statistically significant variations were observed across the seasons ($p<0.01$). The median vitamin D level was found to be 25.59 ng/ml in patients aged 0–5 years (n=2,272), 18.16 ng/ml in patients aged 6–12 years (n=1,580), and 13.40 ng/ml in patients aged 13–17 years (n=901).

Conclusions: In this study, patients hospitalized at the Şırnak state hospital had severe vitamin D shortages and insufficiency. Vitamin D low levels are believed to be attributed to vitamin D synthesis's lack due to inadequate wintertime sunshine, a lack of outside activities for kids in the area, or vitamin D-deficient foods. As a result of these findings, there is an increased need for supportive therapy.

Keywords 25-hydroxyvitamin D, Hospitalization, Pediatrics, Seasonal variations, Turkey, Vitamin D deficiency

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INTRODUCTION

Vitamin D plays a crucial role in controlling the body's metabolism of phosphorus and calcium, both essential for growth, development, and maintaining a healthy skeletal structure. There are primarily two types of vitamin D: cholecalciferol (vitamin D3) and ergocalciferol (vitamin D2). Vitamin D3 is produced in the skin when exposed to UV radiation, while Vitamin D2 is found in plants. [1,2]

There are thought to be 1 billion vitamin D deficient individuals worldwide. [3] In Turkey, vitamin D inadequacy is widespread. Nutritional rickets, a concern in both developed and developing countries, is reported to occur in 2 to 20% of the population in Turkey. [4,5] It has been hypothesized that vitamin D deficiency, particularly in children, increases the risk of various health issues such as rickets, depression, diabetes, cancer, respiratory tract infections, and autoimmune and cardiovascular diseases. [6–9] According to reports, vitamin D is helpful in preventing bone problems in children. [10] As vitamin D has a lengthy half-life and reveals the body's storage state, it is recommended for measuring serum levels. [11,12] Both the mother's vitamin D levels throughout her pregnancy and the amount of vitamin D the newborn may take in when breastfeeding are thought to have an impact on a child's vitamin D deficiency. [13,14] It is advised to start taking a 400 IU/day vitamin D reinforcement from life's the first days in order to maintain vitamin D levels within healthy ranges due to the insufficiency of food vitamin D sources and insufficient sunshine. [15,16] By ensuring that children having vitamin D inadequate get the daily recommended amount of vitamin D, issues associated to vitamin D deficiency can be avoided. Most of the time, supportive therapies should be administered with medical supervision, without screening, and at dosages based on age groups. In this regard, defining these strategies can be aided by understanding the area common of vitamin D adequate and inadequate. In terms of age, season, gender, and months, this studys' the goal is to assess vitamin D levels in children implemented to the pediatric outpatient clinics of the Şırnak State Hospital between 2021 and 2022.

MATERIALS AND METHODS

Study design, subjects and investigations

The study protocol was authorized by the Şırnak University Scientific Research and Publication Ethics Council (dated 28 November 2022 and numbered 53108). The study looked at patients who applied to the pediatric outpatient clinics at the Şırnak state hospital between November 2021 and November 2022 and their targeted vitamin D levels. Data obtained from electronic health records. Retrospective analysis of the patient records in the hospital database was performed. Patients were unable to sign the informed consent form as a result. 4753 people who applied to the hospital were entered in this research.

Vitamin D levels in patients were calculated, considering variables such as gender, age, season, and month. All identifying details, such as patient names, were kept confidential to maintain privacy, with data analysis strictly adhering to ethical guidelines. The Roche Cobas device and Immunoassay equipment were utilized to measure serum vitamin D levels employing the electrochemiluminescence technique. Vitamin D levels in serum were classified as follows: severe deficiency was defined as less than 12 ng/ml, mild to moderate deficiency ranged from 12–20 ng/ml, and levels between 20-100 ng/ml were considered within the normal range. [17] The study population comprised children, aged between 0 to 17 years, who visited pediatric outpatient clinics. For the purposes of analysis, this age range was further segmented into three groups: 0–5, 6–12, and 13–17 years. [18]

Statistical analysis

The statistical analysis was carried out using the SPSS 21.0 software package. The suitability of the data for normal distribution was evaluated using the Kolmogorov-Smirnov test. As the data did not conform to a normal distribution, non-parametric tests were used instead. The Mann-Whitney U test was utilized to determine whether there was a significant gender difference in children's serum 25-hydroxyvitamin D [25(OH)D] levels. To evaluate the significance of the differences among age groups, seasons, and months, the Kruskal-Wallis test was deployed. Descriptive statistics provided include frequency distributions, quantities, medians, as well as minimum and maximum values. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Patients who attended Şırnak State Hospital were grouped according to age, gender, season, and month. Descriptive statistics, including median values, minimum, and maximum values, were presented in tabulated format. Table 1 displays patients' median serum 25-hydroxyvitamin D [25(OH)D] levels along with demographic data. Considering gender, the study population consisted of 55.7% females and 44.3% males. The overall median [25(OH)D] level was calculated to be 18.23 ng/ml for females and 22.42 ng/ml for males. At a significance level of $p<0.01$, [25(OH)D] levels were found to be significantly lower in females than in males (Table 1).

Table 1. Patient demographics and median 25-hydroxyvitamin D [25(OH)D] levels.

Gender	N	Median (ng/ml)	Min-Max	*P*
Male	2107	22.42	3-100	<0.01
Female	2646	18.23	3-100	

Data are given as median and minimum-maximum.

Table 2 presents the [25(OH)D] levels by age. The median [25(OH)D] level for patients aged 0 to 5 years was 18.16 ng/ml (n=2272), 25.59 ng/ml for those aged 6 to 12 years (n=1580), and 13.40 ng/ml for individuals between 13 and 17 years (n=901). Regression analysis indicated age as a significant factor, with the highest [25(OH)D] levels observed in the 0-5 age group. The *p*-value was statistically significant ($p<0.01$).

Table 2. Variation in 25-hydroxyvitamin D [25(OH)D] levels according to patient age.

Age Group	N	Median (ng/ml)	Min-Max	Comparison & *P*
Group 1	2272	25.59	3-100	Group 1-2: <0.01
Group 2	1580	18.16	3-100	Group 1-3: <0.01
Group 3	901	13.40	2.6-100	Group 2-3: <0.01

Data are given as median and minimum-maximum. Group 1= 0-5, group 2= 6-12, and group 3= 13-17 years.

To examine seasonal variations, patients were divided into four groups based on seasons, with differences analyzed using the Kruskal-Wallis test. Notable statistical differences were identified across the seasons. Levels were found to be lowest in winter and highest in summer, with statistically significant differences between seasons ($p<0.01$, Table 3).

Table 3. Seasonal variation in median 25-hydroxyvitamin D [25(OH)D] levels among patients.

Season	N	Median (ng/ml)	Min-Max	Comparison, *P*
Group 1	1347	22.99	3-100	Group 1-2: <0.01; Group 1-3: <0.01;
Group 2	770	12.41	3-100	Group 1-4: >0.05
Group 3	1339	16.87	2.6-100	Group 2-3: <0.01; Group 2-4: <0.01
Group 4	1297	23.88	3.6-100	Group 3-4: <0.01

Data are given as median and minimum-maximum. Group 1= autumn, group 2= winter, group 3= spring, group 4= summer.

The association between [25(OH)D] levels and month was investigated using the Kruskal-Wallis test ($p<0.01$, Table 4). An increase in [25(OH)D] levels was observed from April through September. In January and September, the [25(OH)D] levels were 8.91 ng/ml and 26.54 ng/ml, respectively (Figure 1).

DISCUSSION

Vitamin D deficiency (<20 ng/ml) and insufficiency (20-30 ng/ml) have reached pandemic proportions, with clear links to a host of health problems, including rickets in infants, autoimmune diseases, asthma, various infectious diseases, cardiovascular diseases, and an increased risk for certain malignancies and neurological disorders. [19,20] It is well established that dietary intake of vitamin D, coupled with environmental factors such as direct sunlight exposure, geographical location, air pollution, seasonal variations, and clothing style, significantly impacts vitamin D levels.

This study retrospectively evaluated the vitamin D statuses of pediatric outpatients at Şırnak State Hospital. Statistically, girls' vitamin D levels were significantly lower than those of boys. This finding aligns with previous research by Topal et al., who reported median vitamin D levels of 19.9 ng/ml in boys and 17.6 ng/ml in girls. [21] Furthermore, a separate study

Table 4. **The 25-hydroxyvitamin D [25(OH)D] levels according to month.**

Month	N	Median (ng/ml)	Min-Max	P
January	201	8.91	3- 69.97	<0.01
February	362	14.18	3-100	
March	460	12.82	2.60-60.68	
April	478	18.14	5.53-91.74	
May	401	20.7	3-100	
June	534	22.09	5.85-100	
July	208	22.69	5.40-100	
August	532	26.15	3.96-81.59	
September	577	26.54	3-100	
October	375	22.65	3-71.74	
November	418	17.93	3-100	
December	207	12.51	3-69.22	

Data are given as median and minimum-maximum.

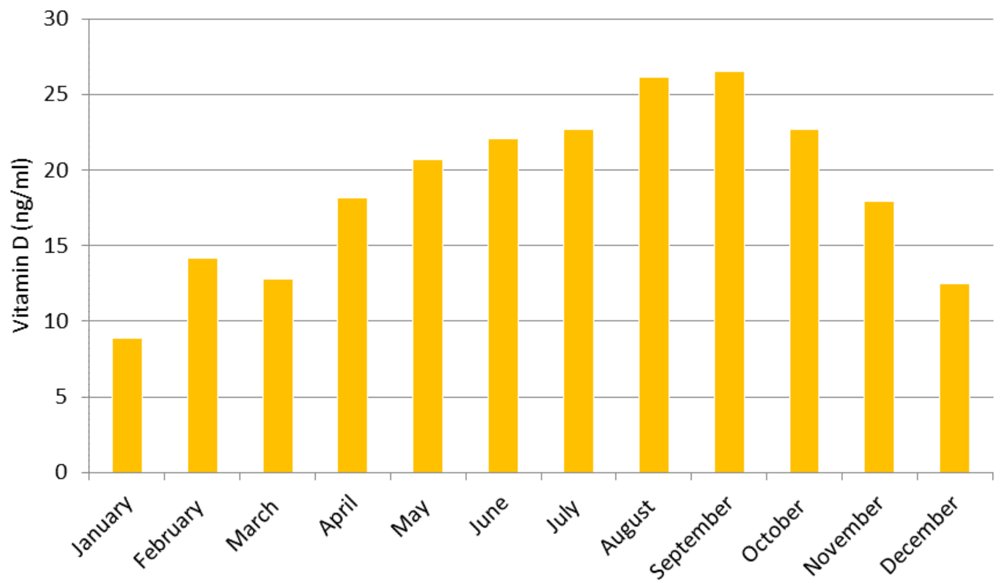

Figure 1 **The 25-hydroxyvitamin D [25(OH)D] levels by month.**

by Yakaris and colleagues demonstrated that girls had higher rates of vitamin D insufficiency and deficiency than boys. [17] Consistent with these studies, our findings showed median vitamin D levels of 18.23 ng/ml in girls and 22.42 ng/ml in boys. The literature substantiates these results, indicating that girls tend to have lower vitamin D levels than boys. In our study, the lower vitamin D levels in girls might be attributed to socio-cultural factors in the Şırnak region that lead to females spending less time outdoors. [22] However, further research is needed to explore the exact causes.

In one study, vitamin D levels were reported to decrease with age, showing levels of 23.6 ng/ml in children aged 1-4 and 15.3 ng/ml in teenagers aged 15-18. [23] In our study, we found similar results: vitamin D levels of 25.59 ng/ml in the 0-5 age group, 18.16 ng/ml in the 6-12 age group, and 13.40 ng/ml in the 13-17 age group. Numerous studies have found a negative correlation between age and vitamin D levels. [24,25] The decline in vitamin D levels with age may be attributed to an increased need for calcium and vitamin D during the growth spurts of adolescence. Additional factors, such as poor dietary habits and reduced outdoor activities, may further contribute to this decline.

Seasonal variation in vitamin D levels has also been noted in the literature. A study conducted by Telo et al. in Turkey found that vitamin D [25(OH)D] levels were highest in the autumn and summer and lowest in the spring and winter. [26] These findings are echoed by Topal et al., who reported the highest and lowest vitamin D levels in the summer and autumn, respectively. [21] A study in Portugal revealed significant seasonal variation in mean serum [25(OH)D] levels, with a peak in the summer and a trough in the winter. [27] Our research corroborates these findings, with [25(OH)D] levels lowest in the spring and winter and highest in the autumn and summer. However, vitamin D levels were below optimal in all four seasons, possibly due to insufficient vitamin D intake and lack of vitamin D production in winter.

An analysis of monthly distributions revealed an increase in vitamin D levels from April through September. Nevertheless, median values for all months were inadequate or deficient, emphasizing the necessity for attention to vitamin D status, especially during the summer months when sunlight is most intense.

As our study was retrospective in nature, its design introduced several limitations. Notably, we lacked information about the patients' living conditions, dietary preferences, health complaints, duration of sun exposure, skin color, and usage of vitamin D supplements and sunscreen. In addition, the study's single-center nature curtails the generalizability of our findings. The use of hospital information systems for data collection also resulted in limited access to comprehensive demographic details about the study participants. Another significant constraint is the lack of knowledge regarding whether the patients were undergoing any form of supplementation therapy at the time of the study. Such considerations must be borne in mind in future studies.

CONCLUSIONS

As a result of this investigation, it was determined that children in Şırnak experienced a significant prevalence of both vitamin D sufficiency and insufficiency, and this frequency increased with age. We discovered that individuals of both genders suffered from considerable vitamin D deficiencies throughout the year, particularly during winter and markedly among females. Therefore, to avoid potential implications, it may be advantageous to prevent vitamin D insufficiency in children by adopting preventive lifestyles and conducting periodic monitoring.

LIST OF ABBREVIATIONS

25(OH)D: 25-hydroxyvitamin D, WHO: World Health Organization.

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DECLARATIONS

Conflict of interest

None.

Data availability

The data that support the findings of this study is available from the corresponding author, upon reasonable request.

Ethical approvals

The study protocol was approved by the Şırnak University Scientific Research and Publication Ethics Council (No.: 53108, on 28 November 2022).

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