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Evaluation of the Signs and Symptoms of Children for Whom a Vitamin D Test Is Requested: In Which Cases Do Pediatricians Want a Vitamin D Test?

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What is already known on this topic?

- *Vitamin D deficiency is a global serious public health problem.*
- *Increasing evidence shows that vitamin D deficiency is associated with many diseases other than bone metabolism diseases.*
- *Reports demonstrate that there is an overscreening, overdiagnosis, and overtreatment for vitamin D deficiency in healthy individuals.*

What this study adds on this topic?

- *While clinical findings are more pronounced in patients with rickets, it is often more difficult to distinguish subclinical vitamin D deficiency.*
- *The results of our study showed that neurological complaints are more likely to be associated with vitamin D deficiency or insufficiency.*

ABSTRACT

Objective: In this study, we aimed to assess the frequency of vitamin D deficiency according to age and sex in children and to investigate their relationship with demographic characteristics, presentation complaints, and accompanying clinical findings.

Materials and Methods: Vitamin D levels and demographic and clinical characteristics of 1505 children aged 2–18 years who applied to the hospital between January 01, 2017, and December 31, 2017, were analyzed. Patients who had a disease that could negatively affect vitamin D absorption and metabolism, who were diagnosed with rickets, or who took vitamin D supplements were excluded from the study.

Results: The median vitamin D level of children was 17.7 ng/mL, and the prevalence of vitamin D deficiency and insufficiency was 26.4% and 33.4%, respectively. Females were the group most at risk for vitamin D deficiency. Another group at risk for vitamin D deficiency was adolescents. Vitamin D deficiency or insufficiency was detected in approximately half of the school-age and preschool children. Of the patients, 18% were admitted to the hospital by their parents to have their vitamin D levels checked. No health problems were detected in 47.7% of the patients whose vitamin D level was checked. Neurological complaints were more common in patients with vitamin D deficiency or insufficiency when compared to the group with normal vitamin D levels ($P < .001$).

Conclusions: The risk of vitamin D deficiency in children is highest in the female sex and adolescent age group. Neurological complaints are more likely to be associated with vitamin D deficiency or insufficiency.

Keywords: Children, vitamin D, 25(OH) vitamin D

INTRODUCTION

Vitamin D, which is endogenously synthesized in response to sunlight or taken from dietary supplements, is a fat-soluble prohormone and is an important determinant of bone health by playing a role in calcium and phosphorus metabolism.[1] In recent years, with the demonstration that vitamin D receptor is found in many tissues other than bone, such as the skin, heart, pancreas, stomach, brain, breast, gonads, T and B lymphocytes, monocytes, and lungs, attention has been directed to the effects of vitamin D in these tissues.[2] While biological and genetic research on the new functions of vitamin D increase, epidemiological studies have revealed that there is an association between vitamin D deficiency and many health problems, such as malignancy, asthma, cardiovascular diseases, autoimmunity, respiratory tract infections, type 1 or type 2 diabetes, depression, and obesity.[3] In particular, examining the clinical features of patients without rickets, who have vitamin D deficiency, identifying

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risky situations in terms of vitamin D deficiency after infancy, and taking these situations into account when asking for examinations may contribute positively to the child's health and may decrease the cost of the test.

Nowadays, vitamin D deficiency is acceded to be a worldwide health problem.[4] Vitamin D testing is not suggested for routine screening in children. However, due to the fact that vitamin D is related to many diseases, the awareness of the media and the public, and especially healthcare professionals, has increased and it has become a frequently requested examination in recent years.[5] Globally, in the last 15 years, there has been a 2-6 fold increase in vitamin D requests.[6] Similarly, it is reported that there is a rapid increase in the requests for vitamin D in Turkey and it constitutes a significant part of the annual health budget.[7] However, recent data show that vitamin D testing is expensive, confusing, and unreliable.[8] According to the regulation on vitamin D tests published by the Ministry of Health in January 2020, the reimbursement of the vitamin D test in primary healthcare institutions by the Social Security Institution has been stopped. Reimbursement of vitamin D tests in secondary and tertiary healthcare institutions, emergency services, and outpatients has been restricted on the basis of specialties, including pediatrics and its subspecialties.[7]

Despite increased testing requests due to the frequent occurrence of vitamin D deficiency, there is a limited empirical investigation of rates of diagnosis of vitamin D deficiency and it is still controversial which patients should be tested for vitamin D deficiency in clinical practice.[9] Furthermore, at the time they apply to the hospital, it remains a mystery which children need to be screened for vitamin D deficiency by their age and sex or whether treatment improves clinical outcomes. Therefore, in this study, we aimed to assess the frequency of vitamin D deficiency according to age and sex in children and to investigate their relationship with demographic characteristics, presentation complaints, and accompanying clinical findings.

MATERIALS AND METHODS

Study Population

This study was conductedas a single-center retrospective study. A total of 1505 patients, aged 2-18 years, who applied to Dr. Sami Ulus Maternity and Children's Health and Diseases Training and Research Hospital between January 01, 2017, and December 31, 2017, and whose serum 25-hydroxy vitamin D (25(OH)D) levels measured were evaluated. The study was approved by Dr. Sami Ulus Maternity and Children's Health and Diseases Training and Research Hospital Ethics Committee (Decision Date/No: 18.02.2019/027).

Among the patients who were admitted to the hospital within 1 year and whose 25(OH)D level was measured, patients who had a disease that could negatively affect vitamin D absorption and metabolism, who were diagnosed with rickets, or who took vitamin D supplements were excluded from the study. Diseases excluded because they may be associated with vitamin D deficiency are chronic kidney disease, liver disease, celiac disease, malabsorption, patients receiving corticosteroid therapy or antiepileptic drugs, neurological patients who were bedridden for a long time, type 1 or type 2 diabetes mellitus patients, oncology patients, and transplantation patients. Except for the specified patient groups, 1505 patients who applied to pediatric outpatient clinics and whose serum 25(OH) vitamin D levels were checked were included in the study.

Clinical Data

Age, sex, serum 25(OH)D levels, presenting complaints, and clinical findings of the patients were analyzed retrospectively via the hospital electronic file records. The patients were classified into 3 groups by age groups, which comprised 2- to 5-year-old patients as the preschool group, 6- to 9-year-old patients as the school-age group, and 10- to 18-year-old patients as the adolescent group.

Laboratory Measurements

The 25(OH)D vitamin was studied from venous blood samples using the tandem mass spectrometry method with an API 3200 mass spectrometer (Applied Biosystem-Sciex, Concord, Canada).

Definitions

The 25(OH)D levels were categorized into 3 groups as follows: <12 ng/mL deficiency, 12-20 ng/mL insufficiency, and >20 ng/mL normal.[10]

Classification of Complaints and Diagnoses

Classification according to the presenting complaints was made as follows: (i) The parent's admission to the hospital to have their child's vitamin D level checked (parent's request), (ii) anorexia, (iii) short stature, (iv) thinness, (v) overweight, (vi) recurrent infections, (vii) gastrointestinal system complaints (abdominal pain, stomach pain, constipation, diarrhea, blood in stool, nausea, vomiting), (viii) neurological system complaints (dizziness, shivering, numbness, first seizure, headache), (ix) musculoskeletal system complaints (general body pain, arm-leg pain, joint complaints, frequent falls), (x) cardiovascular system complaints (palpitations, chest pain), (xi) endocrinological system complaints (increased body hair growth, breast development, menstrual irregularity, early or delayed puberty) (xii) respiratory system complaints (cough, runny nose, wheezing), (xiii) nephrological system complaints (pain during urination, urinary incontinence), and (xiv) unclassifiable complaints (exhaustion, fatigue, sleeping too much, carelessness, rashredness, itching).

All data were reviewed retrospectively from the hospital file record system. Patients who had no pathology in physical examination, had normal vitamin D, or had no problems other than vitamin D deficiency or insufficiency were considered to be physically healthy. Classification according to diagnoses of the patients was made as follows: (i) physically healthy, (ii) malnutrition, (iii) short stature, (iv) obesity, (v) anemia, (vi) gastrointestinal system diseases (constipation, gastroenteritis, gastritis, gastroesophagealreflux, chronic diarrhea), (vii) neurological system diseases (migraine, neuropathy, multiple sclerosis, convulsion), (viii) musculoskeletal system (arthritis, arthralgia, myalgia, growing pain), (ix) cardiovascular system diseases (arrhythmia, congenital heart anomaly, heart valve disorders), (x) endocrinological system diseases (hypothyroidism, hyperthyroidism, precocious puberty, delayed puberty, dysfunctional uterine bleeding, premature thelarche/pubarche/menarche), (xi) respiratory system diseases (upper respiratory tract infection, lower respiratory tract infection (LRTI),

sinusitis, chronic cough, asthma), (xii) nephrological system diseases (urinary tract infection, urinary system anomaly, enuresis nocturna, incontinences), (xiii) immunological system diseases (primary immunodeficiency, hypogammaglobulinemia), and (xiv) diseases associated with other systems (familial Mediterranean fever, juvenile rheumatoid arthritis, hyperlipidemia-dyslipidemia, allergic rhinitis, atopic dermatitis, depression, anxiety, bipolar disorder).

Statistical Analysis

Statistical analysis was implemented using IBM Statistical Package for the Social Sciences Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA). Kolmogorov–Smirnov test and Q-Q plot were used to evaluate the normal distribution of the data. As a result of the normality test, it was determined that age and vitamin D levels did not show the normal distribution and were shown as the median (min-max). The categorical variables were given as numbers and percentages. Mann–Whitney *U*-test was used to evaluate the distribution of numerical variables in 2-category groups in independent samples. The distribution of the numerical variables in groups with 3 or more categories was evaluated using Kruskal–Wallis H test. Chi-square tests were implemented to compare categorical data. Spearman correlation analysis was used to determine the relationship between numerical variables. The value of $P < .05$ was received as statistically significant.

RESULTS

Vitamin D Deficiency

The serum 25(OH)D levels were evaluated in a total of 1505 children aged 2-18 years (median age: 8.3 years), comprising 835 females (55.5%) and 670 males (44.5%). The median vitamin D level was 17.7 ng/mL (range: 3.3-93 ng/mL). Vitamin D deficiency or insufficiency was detected in 59.8% (n = 801) of the patients.

Vitamin D Distribution in Age and Sex Groups

While the median vitamin D levels were similar in the preschool and school-age groups, they were higher than that in the adolescents (19.4 vs. 20 vs. 14.9 ng/mL, respectively; $P < .001$). A negative correlation was found between age and vitamin D levels ($r = -0.343$; $P < .001$).Figure 1shows the distribution of vitamin D according to age. The median age was higher in the vitamin D deficiency group than in the normal or insufficient vitamin D group ($P < .001$). The ratio of adolescent age was higher in the vitamin D deficiency group than in the normal or insufficient vitamin D group ($P < .001$). The ratio of females was higher in the vitamin D deficiency group than in the normal or insufficient vitamin D group ($P < .001$). There was no statistical difference between the preschool and school-age groups in terms of vitamin D insufficiency and deficiency, and the distribution of sex ($P > .05$) (Table 1).

Distribution of Complaints and Diagnoses

Of the children, 18% were admitted to have their vitamin D level checked by their parents without having any complaints. This was followed by complaints of anorexia and short stature (Figure 2). No health problems were detected in 47.7% of the patients whose vitamin D level was checked. The second frequency in terms of diagnosis was malnutrition (11.4%) and short stature (11.4%) (Figure 3). Neurological complaints were higher in the patients with vitamin D deficiency or insufficiency when compared to the group with normal vitamin D levels ($P < .001$). There was no significant difference between the vitamin D deficiency and diagnosis distributions ($P > .05$) (Table 2). Table 3 shows the distribution of complaints and diagnoses according to age group.

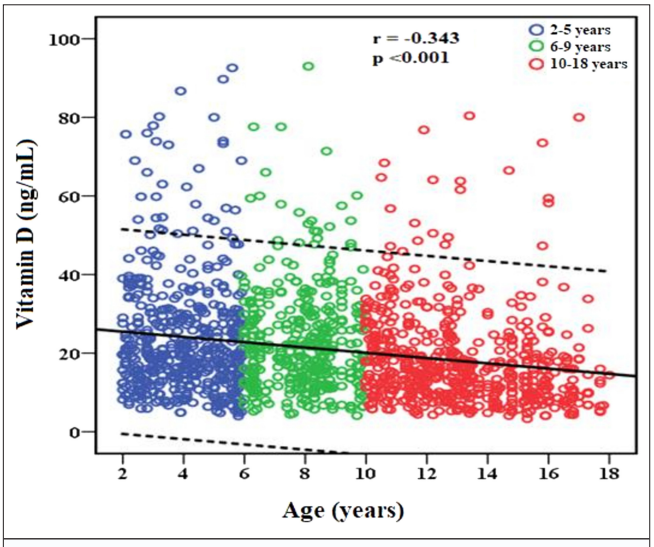

Figure 1. The relationship between age and vitamin D levels.

Table 1. VitaminD Distribution According to Age and Sex

	Vitamin D (ng/mL)			
	Deficiency (12 ng/mL) n = 398	**Insufficiency (12-20 ng/mL) n = 503**	**Normal (20 ng/mL) n = 604**	***P****
Age, years	10.8 (2-17.8)	8.3 (2-18)	7.4 (2-17.3)	**<.001**[a]
Preschool, n (%)	96 (24.2)	176 (35.0)	232 (38.4)	**<.001**[b]
School age, n (%)	77 (19.3)	122 (24.3)	198 (32.8)	
Adolescent, n (%)	225 (56.5)	205 (40.7)	174 (28.8)	
Sex, n (%)				
Female	248 (62.3)	290 (57.7)	297 (49.2)	**<.001**[b]
Male	150 (37.7)	213 (42.3)	307 (50.8)	
Preschool, n (%)				
Female	54 (56.2)	96 (54.5)	119 (51.3)	.671[b]
Male	42 (43.8)	80 (45.5)	113 (48.7)	
School age, n (%)				
Female	43 (55.8)	63 (51.6)	95 (48.0)	.496[b]
Male	34 (44.2)	59 (48.4)	103 (52.0)	
Adolescent, n (%)				
Female	151 (67.1)	131 (63.9)	83 (47.7)	**<.001**[b]
Male	74 (32.9)	74 (36.1)	91 (52.3)	

[a]Mann–Whitney U-test; [b]Chi-square tests. *$P < .05$ is statistically significant.

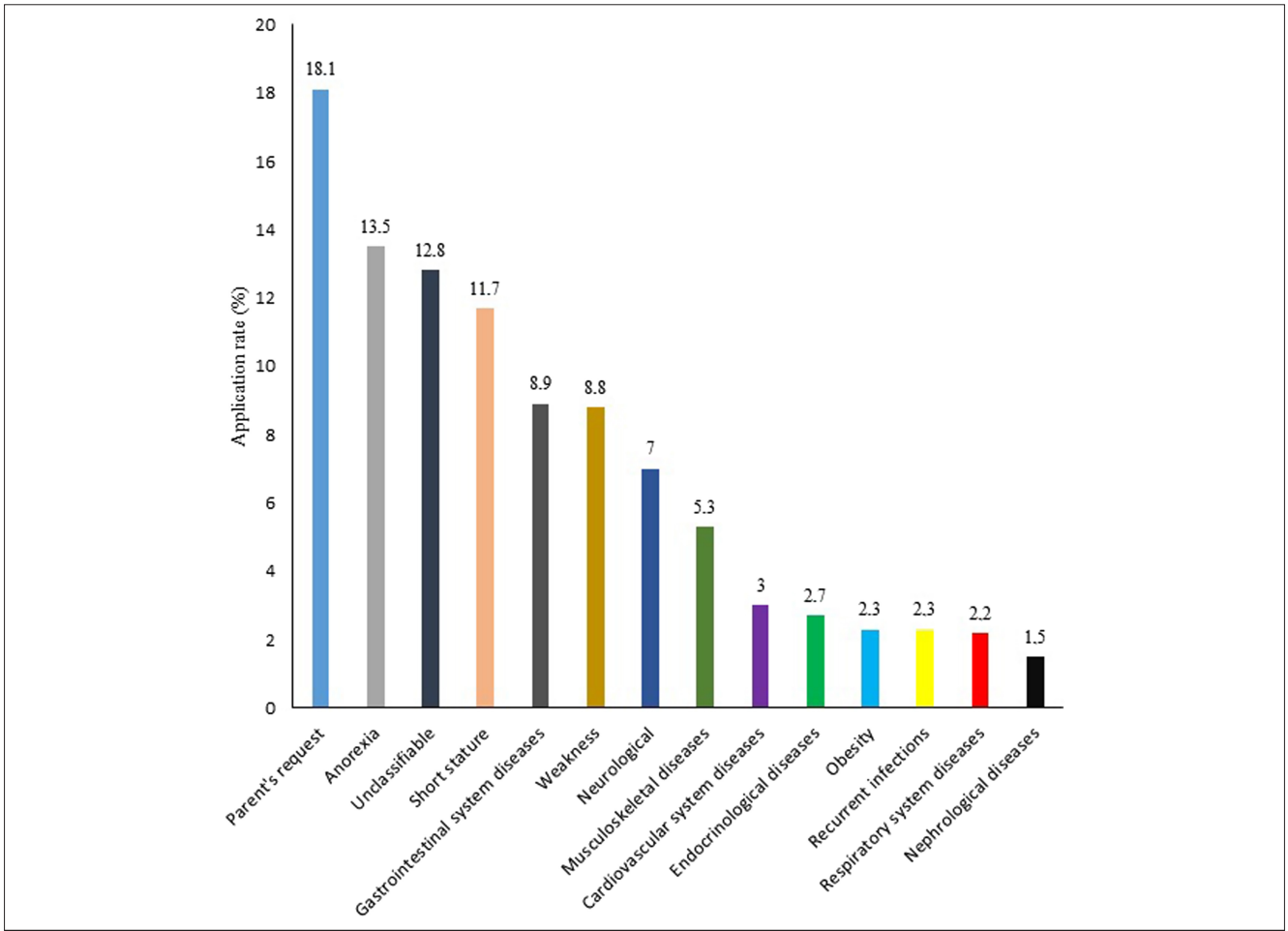

Figure 2. Distributions according to the presenting complaints.

Vitamin D Levels in Diagnosis According to Age and Sex

No significant difference was found in terms of the median vitamin D level (17.3 vs. 17.9 ng/mL; *P* = .634), vitamin D deficiency (25.9% vs. 26.9%; *P* = .301), and vitamin D insufficiency (35.4% vs. 31.6%; *P* = .301) in the children who were regarded as healthy when compared to other diagnoses. When the physically healthy children and the children with other diagnoses were examined, the adolescents in both groups were the age group in which vitamin D deficiency was the most common, and in terms of sex, vitamin D deficiency was more common in females than males (Table 4).

DISCUSSION

Until recently, vitamin D deficiency has been a significant health problem in Turkey, especially in infancy. The Ministry of Health has been providing 400 IU of vitamin D, free of charge to all children under the age of one, regardless of their diet, from the first day of life in order to prevent nutritional rickets.[11] Following this practice, nutritional rickets in children younger than 3 years of age were reduced to below 1%.[12] This study is the first to assess the association between complaints and findings with vitamin D deficiency in children whose 25(OH)D level was examined and who did not have risk factors for vitamin D deficiency after infancy. The results of this study can be a guideline in terms of which signs and symptoms should be considered with higher suspicion in the presence of vitamin D deficiency, except for patient groups without signs of rickets and groups that are at risk in point of vitamin D.

Increasing evidence has indicated that the frequency of vitamin D deficiency increases with age and is less of a concern, particularly for preschool and school-age children than adolescents.[13-15] Age was conversely related to vitamin D level in children, even after adjusting for sun exposure, physical activity, fat mass index, and puberty.[16] Although female adolescents are the riskiest group in terms of vitamin D deficiency after infancy, it was seen that vitamin D levels are below normal in almost more than half of preschool and school-age children. This may be related to the amount of daily sun exposure, way of dressing, or diet.[15] The cause for the low level of vitamin D in adolescents may be the decrease in green areas, especially in metropolitan cities, and accordingly, young people prefer shopping malls or indoor areas instead of activities through which they benefit from sunlight. In addition, the frequent use of social communication tools by adolescents may contribute to a sedentary life and a decrease in outside activities. Since this study was retrospective, these aspects could not be examined.

In recent years, there has been a significant increase in the requisition for vitamin D-level tests, both in outpatient clinic admissions and in research, and this has led to increased costs.[5,6]

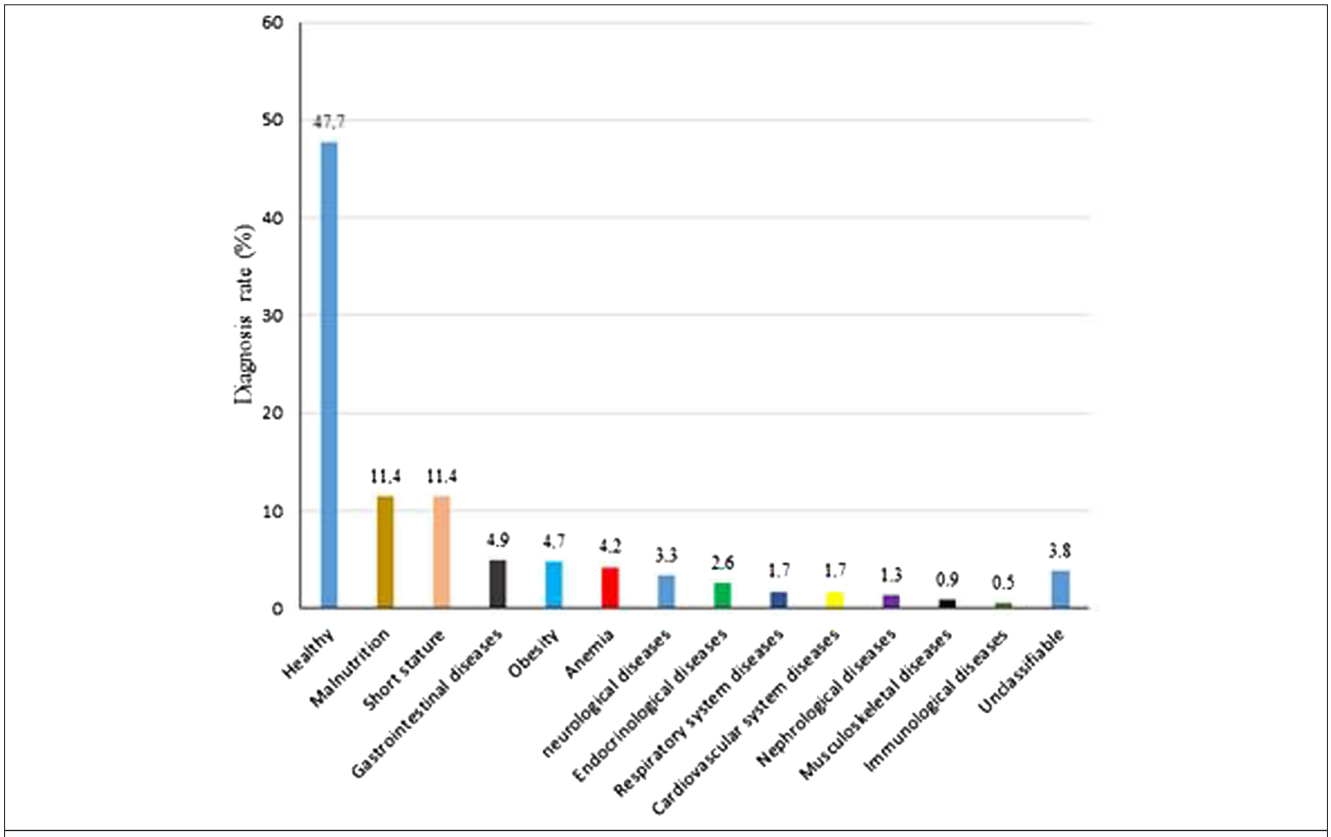

Figure 3. Distributions according to the diagnoses.

Despite the increasing test requests, limited empirical studies exist on determining the correct group for which vitamin D testing should be performed and identifying selective risk factors in clinical practice.[9] In a study directed in Turkey, the vitamin D demands of 9 hospitals were evaluated between 2015 and 2017, a gradual increase was detected over the years, and it was shown that there was an approximately 3-fold increase in 2017 compared to 2015.[17] Although vitamin D testing is not recommended for routine screening in healthy individuals, 18% of outpatient clinic admissions were children brought in by their families for vitamin D testing. The reason behind this may be the increased awareness and concerns of families as a result of the fact that the signs and symptoms of vitamin D deficiency and related diseases have been emphasized more frequently in health programs in the media in recent years.

Clinical manifestations of vitamin D deficiency in childhood include hypocalcemic convulsions, fractures, lower extremity deformities, abnormal teeth structure, and developmental delays.[18] Evident rickets may be just the tip of the iceberg in children with severe vitamin D deficiency.[2] Actually, most people with vitamin D deficiency are asymptomatic or the condition may present itself with nonspecific symptoms.[19] Vitamin D deficiency may be related to nonspecific complaints, such as muscle-joint pain or obesity in adolescents, while it may cause conditions such as growth retardation or muscle weakness in younger children.[2] In the present study, no health problems were found in approximately half of the children whose vitamin D levels were examined. Malnutrition was observed in 12.1% of children with vitamin D deficiency, and short stature in 8.8%. In this study, the rate of short stature did not differ significantly between age groups. While the malnutrition rate was higher in the preschool group compared to the adolescent group, there was no statistically significant difference compared to the school-age group. Moreover, when the children with vitamin D deficiency and insufficiency were compared with those with normal vitamin D, no significant difference was found. This result suggested that vitamin D deficiency is a widespread problem in the whole population.

In this study, the frequency of neurological diseases was observed to be higher in the patients with vitamin D deficiency, both in the presenting complaint and in the diagnosis distributions. The effect of vitamin D in neurological diseases is controversial.[20] However, rats born to mothers with vitamin D deficiency have been shown to have morphologically altered brains, with a longer and extended lateral ventricle and a thinner cortex when compared to the control newborns. This demonstrates the effect of vitamin D in the regulation of neuroprogenitors, differentiation and proliferation of nerve tissue.[21] Vitamin D deficiency has been shown to cause severe deficiencies in the regulation of as many as 36 proteins used in important chemical pathways in the brain. Some of these are oxidative phosphorylation proteins, proteins related to calcium metabolism, proteins related to neurotransmission and synaptic plasticity, and there are studies showing that these deficiencies continue in adult life.[22] The volume increase in lateral ventricles, decrease in neuron growth factors, and decrease in the expression of genes included in neuronal structures and neurotransmission are findings obtained from adult studies.[23]

Table 2. Distribution of Complaints and Diagnoses According to the Vitamin D Status

	Vitamin D (ng/mL)			
	Deficiency (12 ng/mL) n = 398	Insufficiency (12-20 ng/mL) n = 503	Normal (20 ng/mL) n = 604	*P*
Presenting complaint, n (%)				
Parent's request	58 (14.6)	87 (17.3)	127 (21.0)	<.001[a]
Anorexia	58 (14.6)	72 (14.3)	73 (12.1)	
Short stature	31 (7.8)	47 (9.3)	98 (16.2)	
Gastrointestinal system	24 (6.0)	48 (9.5)	62 (10.3)	
Thinness	29 (7.3)	42 (8.3)	61 (10.1)	
Neurological diseases	44 (11.1)	41 (8.2)	21 (3.5)	
Musculoskeletal system	28 (7.0)	32 (6.4)	20 (3.3)	
Cardiovascular system	17 (4.3)	14 (2.8)	14 (2.3)	
Endocrinological diseases	9 (2.3)	13 (2.6)	18 (3.0)	
Obesity	9 (2.3)	11 (2.2)	14 (2.3)	
Respiratory system	11 (2.8)	7 (1.4)	15 (2.5)	
Recurrent infections	6 (1.5)	20 (4.0)	9 (1.5)	
Nephrological diseases	5 (1.3)	7 (1.4)	11 (1.8)	
Unclassifiable	69 (17.3)	62 (12.3)	61 (10.1)	
Diagnosis, n (%)				
Healthy	186 (46.7)	254 (50.5)	278 (46.0)	.416[a]
Malnutrition	48 (12.1)	49 (9.7)	75 (12.4)	
Short stature	35 (8.8)	56 (11.1)	80 (13.2)	
Gastrointestinal system Diseases	12 (3.0)	30 (6.0)	31 (5.1)	
Obesity	21 (5.3)	21 (4.2)	29 (4.8)	
Anemia	15 (3.8)	25 (5.0)	23 (3.8)	
Neurological diseases	20 (5.0)	14 (2.8)	16 (2.6)	
Endocrinological diseases	12 (3.0)	10 (2.0)	17 (2.8)	
Respiratory system diseases	6 (1.5)	8 (1.6)	12 (2.0)	
Cardiovascular system diseases	8 (2.0)	8 (1.6)	9 (1.5)	
Nephrological diseases	7 (1.8)	5 (1.0)	8 (1.3)	
Musculoskeletal system diseases	5 (1.3)	3 (0.6)	5 (0.8)	
Immunological diseases	1 (0.3)	3 (0.6)	3 (0.5)	
Unclassifiable	22 (5.5)	17 (3.4)	18 (3.0)	

[a]Chi-square tests.

Table 3. Distribution of Complaints and Diagnoses According to Age Group

	Preschool (n = 504)	School Age (n = 397)	Adolescent (n = 604)	*P*
Presenting complaint, n (%)				
Parent's request	102 (20.2)	72 (18.1)	98 (16.2)	<.001[a]
Anorexia	93 (18.5)	54 (13.6)	56 (9.3)	
Unclassifiable	65 (12.9)	47 (11.8)	80 (13.2)	
Short stature	34 (6.7)	54 (13.6)	88 (14.6)	
Gastrointestinal system diseases	53 (10.5)	32 (8.1)	49 (8.1)	
Thinness	54 (10.7)	34 (8.6)	44 (7.3)	
Neurological diseases	25 (5.0)	23 (5.8)	58 (9.6)	
Musculoskeletal system diseases	31 (6.2)	21 (5.3)	28 (4.6)	
Cardiovascular system diseases	9 (1.8)	2 (0.5)	34 (5.6)	
Endocrinological diseases	2 (0.4)	18 (4.5)	20 (3.3)	
Obesity	1 (0.2)	9 (2.3)	24 (4.0)	
Respiratory system diseases	13 (2.6)	11 (2.8)	9 (1.5)	
Recurrent infections	16 (3.2)	10 (2.5)	9 (1.5)	
Nephrological diseases	6 (1.2)	10 (2.5)	7 (1.2)	
Diagnosis, n (%)				
Healthy	250 (49.6)	190 (47.9)	278 (46.0)	<.001[a]
Malnutrition	62 (12.3)	38 (9.6)	72 (11.9)	
Short stature	49 (9.7)	41 (10.3)	81 (13.4)	
Gastrointestinal system diseases	28 (5.6)	18 (4.5)	27 (4.5)	
Obesity	7 (1.4)	24 (6.0)	40 (6.6)	
Anemia	24 (4.8)	17 (4.3)	22 (3.6)	
Neurological diseases	16 (3.2)	17 (4.3)	17 (2.8)	
Endocrinological diseases	3 (0.6)	16 (4.0)	20 (3.3)	
Respiratory system diseases	14 (2.8)	9 (2.3)	3 (0.5)	
Cardiovascular system diseases	10 (2.0)	2 (0.5)	13 (2.2)	
Nephrological diseases	6 (1.2)	8 (2.0)	6 (1.0)	
Musculoskeletal system diseases	7 (1.4)	3 (0.8)	3 (0.5)	
Immunological diseases	4 (0.8)	2 (0.5)	1 (0.2)	
Unclassifiable	24 (4.8)	12 (3.0)	21 (3.5)	

[a]Chi-square tests.

Moreover, in a research on patients with multiple sclerosis, it was determined that the group taking vitamin D supplements had fewer relapses when compared to the group taking the placebo.[4] These findings suggest that vitamin D deficiency may have a potential role in neurological disorders. Therefore, it may be important to keep vitamin D at an adequate level.

In genetic and epidemiological research, it has been shown that vitamin D plays an important and complex role in the

Table 4. Vitamin D Levelsof the Healthy Children and the Children in the Other (Documented Diagnosis of any Disease) Diagnosis Groups in Terms of Age and Sex

Diagnosis	Group	Median	*P**	Deficiency, n (%)	Insufficiency, n (%)	Normal, n (%)	*P**
Healthy	Preschool	19.5 (4.9-77.9)	**<.001[c]**	41(16.4)	93 (37.2)	116 (46.4)	**<.001[b]**
	School age	19.2 (4.1-77.6)		41(21.6)	59 (31.1)	90 (47.4)	
	Adolescent	14.6 (4.1-80.4)		104(37.4)	102 (36.7)	72 (25.9)	
Other	Preschool	19.4 (4.0-92.6)	**<.001[c]**	55(21.7)	83 (32.7)	116 (45.7)	**<.001[b]**
	School age	20.4 (4.4-93.0)		36(17.4)	63 (30.4)	108 (52.2)	
	Adolescent	14.9 (3.3-76.8)		121(37.1)	103 (31.6)	102 (31.3)	
Healthy	Female	15.8 (4.1-80.0)	**.002[a]**	116(29.4)	140 (35.5)	138 (35.0)	**.026[b]**
	Male	18.7 (4.1-80.4)		70(21.6)	114 (35.2)	140 (43.2)	
Other	Female	16.5 (3.3-92.6)	**<.001[a]**	132(29.9)	150 (34.0)	159 (36.1)	**.003[b]**
	Male	19.6 (4.0-93.0)		80(23.1)	99 (28.6)	167 (48.3)	

[a]Mann–Whitney U-test; [b]Chi-square tests; [c]Kruskal–Wallis H test. *$P < .05$ is statistically significant.

defense of the host against respiratory tract infection in addition to immune system function and regulation.[24] It has been shown that locally active vitamin D can be produced in the lungs by the enzyme lα-hydroxylase, which is secreted by the alveolar macrophages, lymphocytes, dendritic cells, and airway epithelium in the lungs, which ensures active vitamin D production when the serum vitamin D level is sufficient. Thus, it has been reported that vitamin D has many protective impacts on the lungs. These include increasing the production of adenosine monophosphate (AMP)and especially cathelicidin in the epithelial cells, increasing the cytotoxic effect of natural killer cells and superoxide formation from monocytes, reduction of chemokine, and inhibition of dendritic cells. It was hypothesized that during the winter months, the production of vitamin D decreases related to the reduction of ultraviolet B rays, and as a result, the frequency of LRTIs increases.[25] In addition, decreased response to corticosteroids in vitamin D deficiency may conduce to asthma attacks. In relation to these mechanisms, vitamin D may also have a therapeutic effect in reducing asthma attacks.[26] Vitamin D deficiency may be associated with the development of LRTIs or a more severe prognosis in children without any chronic disease.[27] In this study, the rate of patients diagnosed with respiratory system diseases was 1.7%, and no significant difference was found in the point of the vitamin D level. This may have been due to the fact that this study was not conducted in certain patient groups. However, considering the results of other studies, it enounced that vitamin D deficiency may be a risk factor for LRTIs.

The present study has some limitations. The vitamin D levels were evaluated in children over the age of 2 who were admitted to the hospital in which this study took place because vitamin D prophylaxis was administered during infancy in Turkey, and the results did not reflect the country's overall status. Furthermore, since this study was carried out as a retrospective analysis via file records, factors such as the duration of sun exposure, indoor lifestyle, clothing style, whether or not the patients took vitamin D supplements, seasonal changes, medication history, nutritional properties, and environmental pollution that could affect vitamin D deficiency could not be questioned. More detailed studies are needed to specify the risk factors for vitamin D deficiency.

CONCLUSION

It was determined that pediatricians included the vitamin D level in tests for children who were admitted with very different complaints. This may be the result of increasing studies in recent years that have shown that vitamin D deficiency is a widespread problem and is related to many non-bone-related diseases. This study showed that neurological complaints may be more related to vitamin D deficiency or insufficiency. Female sex and adolescent age group are most at risk for vitamin D deficiency or insufficiency. Parents' desire to have their children's vitamin D levels checked was quite high compared to the reasons for vitamin D being checked for other complaints. This may be related to increased awareness of parents but could result in a significant increase in healthcare spending. In addition, vitamin D deficiency or insufficiency seems to be an important problem after infancy. More illuminating studies are needed on which patients should be tested for vitamin D.

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Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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