

# Vitamin D deficiency in children in Aegean Region in Turkey

## Türkiye’de Ege Bölgesi’ndeki çocuklarda D vitamini eksikliği

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**Conflict of interest:** None declared.

### SUMMARY

**Objective:** Although vitamin D deficiency have been suggested in children is widespread recently, the data about vitamin D status of Turkish children is limited. The objective of the present study was to determine prevalence of vitamin D deficiency in children in Aegean region and to show effect of age, gender and seasons on vitamin D levels. The data from hospital information system was examined retrospectively.

**Method:** Between January 2011 and February 2013, children admitted to department of paediatrics our hospital for health examination was taken blood for vitamin D measurement. Serum vitamin D levels were determined by electrochemiluminescent method and categorized as <20 ng/mL is deficiency and <30 ng/mL is insufficiency.

**Results:** A total of 2909 children aged 1 month to 17 years participated in this retrospective study. All the subjects were divided into subgroups according to their age: 0-3 years old, 4-6 years old, 7-12 years old and 13-17 years old representing infancy and toddler, preschool, school age and adolescence stages respectively. The highest mean level of serum vitamin D was found in the 0-3 years old stage and the lowest one was found in 13-17 years old stage.

**Conclusion:** In Turkish children, the prevalence of vitamin D deficiency and insufficiency (61%) is considerable size. We suggest that the recommendation for vitamin D supplementation after the first year of life could be beneficial especially for school children and adolescents.

**Keywords:** Vitamin D deficiency, vitamin D insufficiency, children, season

### ÖZET

**Amaç:** Tüm dünyada D vitamini eksikliği çocuk, genç yetişkin ve yaşlılarda çok fazla araştırılmasına rağmen ülkemizdeki çocuk ve adolesan grup ile ilgili veriler sınırlıdır. Hastanemizde D vitamini ölçümü yapılan çocuklarda D vitamini eksikliği prevalansını belirlemeyi; yaş, cinsiyet ve mevsimlerin etkisini görmeyi amaçladık.

**Yöntem:** Hastanemize sağlık kontrolü için Ocak 2011-Şubat 2013 tarihleri arasında başvuran ve vitamin D (25-OH) ölçümleri yapılan 2909 çocuğun vitamin D düzeyleri hastane bilgi sisteminden retrospektif olarak incelendi. D vitamini durumları, vitamin D düzeyleri 20 ng/mL’den düşük ise eksiklik; 30 ng/mL ise yetersizlik olarak sınıflandırıldı. Ayrıca yaşlarına göre çocuklar 0-3 yaş, 4-6 yaş, 7-12 yaş ve 13-17 yaş olarak dört alt gruba bölündü.

**Bulgular:** Tüm çocukların (1653 erkek, 1256 kız) vitamin D sonuçları ortalaması 28,00 ± 15,55 ng/mL bulundu. En yüksek serum D vitamini 0-3 yaş grubunda ve en düşük düzey 13-17 yaş grubunda bulundu. Kız ve erkek çocuklarda mevsimler arasında D vitamini ölçümlerinde anlamlı fark saptandı. Tüm yaş gruplarında D vitamini eksikliği yüksek oranda bulundu.

**Sonuç:** İncelediğimiz tüm çocukların yaklaşık %61’inin D vitamini yetersizliği ve eksikliğinin bulunması, yaşamın ilk yılında sağlık politikasında da yer alan D vitamini desteğinin daha sonraki yaşlarda ve özellikle adolesan dönemde devam ettirilmesinin uygun olacağı düşünüldü.

**Anahtar sözcükler:** D vitamini eksikliği, D vitamini yetersizliği, çocuklar, mevsim

## INTRODUCTION

Vitamin D is a steroid hormone which regulate mainly calcium and phosphorus metabolism. There is two nature vitamin D source. The main source is cutaneous synthesis after exposure to sunlight<sup>1</sup>. Second but limited nature source is taking from the diet such as especially fish oil, eggs and liver. Also human get this vitamin from fortified dairy products such as milk and some orange juices, yogurts and cereals are fortified with vitamin D3 or vitamin D supplements<sup>2</sup>. Solar ultraviolet B radiation penetrates the skin and converts 7-dehydrocholesterol to previtamin D3, which is rapidly converted to vitamin D3. Vitamin D from the skin and diet is metabolized in the liver to 25-hydroxyvitamin D. The 25-hydroxyvitamin D is metabolized in the kidneys by the enzyme 1 $\alpha$ -hydroxylase to its active form, 1,25-dihydroxyvitamin D.

The plasma parathyroid hormone levels and serum calcium and phosphorus levels regulate this form's production. The active form, 1,25-dihydroxyvitamin D markedly increases the efficiency of intestinal calcium and phosphorus absorption<sup>3</sup>.

The enzyme 24-hydroxylase catabolizes both 25-hydroxyvitamin D and 1,25-dihydroxyvitamin D into biologically inactive, water-soluble calcitric acid<sup>4</sup>.

Vitamin D is one of the most researched issues about, recently. At lots of points as its metabolism, symptoms of deficiency, therapeutic dosages, sources of vitamin D, prevalence of vitamin D deficiency was researched. The reason of this attractive is that is seen, vitamin D play a role in the ethology of some cancers, multiple sclerosis, Type 1 diabetes, Crohn diseases, autoimmune diseases and granulomatous diseases as tuberculosis<sup>5</sup>. Reference value was considered, treatment scheme was made, health politics were developed. Despite numerous preventive strategies, vitamin D deficiency has remained a global health problem among children and adolescent. Not only undeveloped countries, it is also developed countries' problem such as Canada, Australia, the United Kingdom and the United States.

İzmir is located in a mostly sunny region, situated at a latitude of north 38.30, mean sunny hours in a day is very high. Even in winter at least 4 hours sunshine reaches the ground, nevertheless in summer it raises to twelve hours in a day<sup>6</sup>.

In Turkey, exposure to sunlight represents the main source of vitamin D. The remained part of the total vitamin D comes from dietary intake. At first-aged children there is other source which is vitamin D supplement which is a free vitamin D supplementation campaign nationwide of the Ministry of Health in Turkey. Fortified food with vitamin D is negligible in Turkey. The prevalence of vitamin D deficiency is considerable size is seen in our country<sup>7</sup> as overall the world. The objective of the present study was to determine prevalence of vitamin D deficiency in children whose serum vitamin D levels measured in our laboratory and to show effect of age, gender and seasons on vitamin D levels.

## MATERIAL AND METHODS

Vitamin D levels of children patients, who admitted our hospital between January 2011 and February 2013, were investigated retrospectively through the hospital information system. Our hospital is a tertiary Education and Researching Hospital which serves a large area, not only our city and also the neighbour cities in Aegean region in Turkey. A total of 2909 children, who aged 1 month to 17 years, participated in this study. All the subjects were divided into subgroups according to their age: 0-3 years which is represent the infancy and toddler stage, 4-6 years which is represent the preschool stage, 7-12 years which is represent the school age stage and 13-17 years which is represent the adolescence stages. Serum vitamin D levels were measured at same day with venipuncture at Cobas E 411 (Roche Diagnostics) using an electrochemiluminescent method (ECLIA) by using original reagent, control materials and calibrator. Measured vitamin D is total vitamin D. The intra-assay and inter-assay CVs were 3.7% and 2.9% respectively. The lower detection limit of the assay was 3 ng/mL.

Here are the generally accepted cut off points for measurements of vitamin D, Vitamin D deficiency is below 20 ng/mL, Vitamin D insufficiency is below 30 ng/mL<sup>8,9</sup>.

March, April, May was conducted as spring; June, July, August was conducted as summer; September, October, November was conducted as autumn; December, January, February was conducted as winter.

All analyses were performed by using SPSS software (version 15.0, SPSS Inc., Chicago, IL). For all data sets, the Kolmogorov-Smirnov test of normality was used to determine whether the distribution of values was normal ( $p > 0.05$ ) or not normal ( $p < 0.05$ ) and to indicate whether parametric or nonparametric statistical analysis should be used to analyse test results. None-normally distributed data would be analysed by the Wilcoxon's rank sum test,

**Table 1: The mean vitamin D levels, the prevalence of deficiency and insufficiency according to genders and seasons.**

	n	The mean vitamin D (ng/mL)	Vitamin D deficiency (%)	Vitamin D insufficiency (%)
Boys	1653	27.88±15.15	35.3	62.4
Girls	1256	28.16±16.05	35.0	59.6
Summer	559	31.70±16.04	31.3	58.0
Autumn	646	26.64±14.65	42.6	66.9
Winter	1091	25.77±15.40	38.2	64.6
Spring	613	29.24±16.05	25.3	52.4

\*P value of gender is 0.28, p value of seasons is 0.00.

When looked the difference between genders at four season, there is no significant difference. In summer, the mean serum vitamin D level was  $28.80 \pm 16.09$  ng/mL in boys; the mean serum vitamin D level was  $29.73 \pm 16.01$  ng/mL in girls ( $p: 0.49$ ). In autumn, the mean serum vitamin D level was  $25.71 \pm 15.52$  ng/mL in boys; the mean serum vitamin D

and normally distributed data would be analysed using two-tailed independent samples t test. Differences among three or more mean values were evaluated with One-Way ANOVA analysis of variance. Descriptive results are expressed as percentages, mean and standard deviations (SD), and minimum to maximum values as appropriate. Rates and 95% confidence intervals are presented for the pooled results. Differences were considered significant if  $p < 0.05$ .

This study is a monocentric and retrospective study.

## RESULTS

The final data was composed of 2909 children (1653 boys; 1256 girls), aged between 0 and 17 years old ( $5.7 \pm 5.6$ ). The mean serum vitamin D of the whole group was  $28.00 \pm 15.55$  (3.00-93.49) ng/mL.

level was  $25.84 \pm 15.27$  ng/mL in girls ( $p: 0.92$ ). In winter, the mean serum vitamin D level was  $26.10 \pm 13.72$  ng/mL in boys; the mean serum vitamin D level was  $27.42 \pm 15.87$  ng/mL in girls ( $p: 0.14$ ). In spring, the mean serum vitamin D level was  $32.65 \pm 15.36$  ng/mL in boys; the mean serum vitamin D level was  $30.41 \pm 16.84$  ng/mL in girls ( $p: 0.09$ ).

**Table 2: Distribution of the prevalence of vitamin D deficiency according to the season at four stages**

	The prevalence of vitamin D deficiency (%)			
	The infancy and toddler	The preschool	The school	The adolescence
	(n=292)	(n=91)	(n=304)	(n=335)
Spring	12.7	14.3	14.8	17.9
Summer	13.4	12.1	18.8	20.3
Autumn	28.8	26.4	28.0	24.5
Winter	45.2	47.3	38.5	37.3

**Table3: Genders mean vitamin D values, the prevalence of deficiency and insufficiency at four different stage.**

	The mean vitamin D (ng/mL)	Deficiency (%)	Insufficiency (%)
<b>The infancy and toddler (n=1539)</b>	34.65±16.22	19.0	41.5
Boys (n=873)	33.77±16.22	21.3	44.3
Girls (n=666)	35.82±16.16	15.9	37.7
<b>The preschool (n=219)</b>	23.86±10.64	41.6	69.9
Boys (n=121)	23.41±10.86	46.3	70.2
Girls (n=98)	24.41±10.38	35.7	69.4
<b>The school (n=610)</b>	22.10±10.83	49.8	82.5
Boys (n=359)	22.10±10.83	48.2	81.9
Girls (n=251)	20.62±10.53	52.2	83.3
<b>The adolescence (n=541)</b>	18.15±9.89	61.9	89.8
Boys (n=300)	19.49±9.63	56.0	88.7
Girls (n=241)	16.49±9.99	69.3	91.3
<b>Total (n=2909)</b>	28.01±15.54	35.1	61.2

P values of gender at the infancy and toddler stage is 0.01, at preschool stage is 0.49, at the school stage is 0.10 and at the adolescence stage is 0.00.

## DISCUSSION

The main source of vitamin D is cutaneous synthesis by the ultraviolet B rays way. A severe vitamin D deficiency could be reason of hypocalcaemia, bone fractures, bone deformities, rickets, and osteomalacia<sup>10</sup>. If this source is limited because of different reasons as wearing style, sun block, season, skin colour, vitamin D should receive through the intake of supplements and foods. In some developed countries, commercial fluid dairyproducts (excluding yogurt drinks) are fortified with vitamin D through regulated public health policy in accordance with published guidelines. It has recommended human milk is the ideal nutrition source in the first year of babies. But it has not enough vitamin D to satisfy infant's requirement. It has recommended that infants and children should receive 400 IU of vitamin D per day through diet or supplementation<sup>11</sup>. Vitamin D levels were investigated in several studies conducted also in Turkey, especially in pregnant mothers and their babies' studies have shown a high rate of vitamin D deficiency<sup>12-14</sup>. The Turkey Ministry of Health has also issued guidelines for a uniform dose of vitamin D 400 IU/day for all infants during their first year of life. There are no recommendations for vitamin D supplementations beyond 1 year. In our study investigated Vitamin D levels in children who's Vitamin D measured in our laboratory, the average vitamin D levels were found below 30 ng/mL. For vitamin D insufficiency when cut off point is accepted as 30 ng/mL, prevalence of insufficiency was 61% (n=1.781). For vitamin D

deficiency when cut off point is accepted as 20 ng/mL, prevalence of deficiency was 35% (n=1.023). In this study, the prevalence of vitamin D insufficiency (<30 ng/mL) of 0-3 age group data is similar to findings from Gordon and colleagues study of 0-2 age group in America were found was 40%. Breastfeeding was associated with risk of vitamin D deficiency<sup>15</sup>. In this age group the prevalence of sufficiency was 58%, but by age older the prevalence of sufficiency becomes lower. In adolescence stage (13-17 years) only 10% of children had sufficient vitamin D. In other study conducted in America and New Zealand, the prevalence of vitamin D insufficiency (<30 ng/mL) in adolescence age group higher than in early age groups were shown<sup>16,17</sup>.

Saintonge and colleagues studied in adolescent population (13-17 years) in America boys could intake more vitamin D from food than girls so boys could receive higher vitamin D levels<sup>18</sup>. Contrast in our study, in the same age group vitamin D level is higher girls seen. However the prevalence of vitamin D deficiency in boys was 89%; in girls 91%, these were still very high.

The another study in which is searched season effects, study in Estonia which was based on random society, at the end of the summer, vitamin D levels were higher in both genders to winter<sup>18</sup>. This is similar to our study vitamin D levels higher in summer measurements than winter's.

Vitamin D status in childhood and adolescence may play a role in the prevention of

osteoporosis. Even adequate status may reduce the adult risk of diabetes, ischaemic heart disease, hypertension and tuberculosis<sup>19</sup>. On the other hand because of the relation of sun exposure to skin cancer, public has been awarded about sunlight exposure and the risks of various skin cancers. Moreover, it has recommended that infants younger than 6 month not be exposed to the sun and that all children and adolescents use sunscreens and clothing to protect them from ultraviolet B radiation exposure and to prevent skin cancer<sup>20</sup>. This recommendation is useful for protected from a bad survey cancer as skin cancer but this situation makes the vitamin D deficiency come. At the last risk of some diseases known relationship between vitamin D deficiency and some cancers, multiple sclerosis, type 1 diabetes, Crohn diseases, autoimmune diseases and infection diseases as tuberculosis may able to increase.

In conclusion; the prevalence of vitamin D deficiency and insufficiency among children in Aegean Region in Turkey is high, especially in adolescent's stage. We recommend that all children and adolescents should have vitamin D supplementation also after the first year of life. The government must develop public policies for the fortification of milk, milk products, and fruit juices with vitamin D for providing sufficient levels to a healthy future.

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