Vitamin D status of children aged 5-15 years in Zonguldak, Turkey

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Abstract

Aim: The study aimed to determine vitamin D status of children aged 5-15 years living in Zonguldak, Turkey.
Methods: A total of 153 healthy individuals (81 girls, 72 boys) whose age ranged from 5 to 15 years, were included in the study at the ends of winter and summer. The subjects were divided into two groups according to age-group: 5-10 and 11-15 years. Plasma 25-hydroxyvitamin D (25[OH]D) levels were determined by HPLC method and categorized as <15 (deficient), 15-29 (insufficient), and ≥30 ng/ml (sufficient).
Results: Our data showed that the plasma 25[OH]D levels decreased when the children got older (p=0.016). Mean plasma 25[OH]D levels were significantly higher in boys than in girls in each age-group (5-10 age group, p=0.004; 11-15 age group, p=0.04). There was a marked seasonal effect on 25[OH]D levels (p=0.03). The prevalence of vitamin D deficiency and vitamin D insufficiency were 19% and 42%, respectively. The prevalence of vitamin D deficiency and insufficiency showed significant difference in relation to age and season. However, the prevalence of vitamin D deficiency was higher in girls than in boys for the age group 11-15 years (p=0.006).
Conclusion: Turkish adolescent girls are at a significant risk of vitamin D deficiency, especially in winter. Therefore, we suggest that vitamin D supplementation should be recommended to Turkish adolescent girls in winter. However, the main problem is the increasing risk of vitamin D insufficiency in all children regardless of their sex.

Keywords: children, Turkey, vitamin D deficiency, vitamin D insufficiency.

Introduction

Vitamin D functions as a hormone and it is important in the maintenance of normal bone mass turnover (1). Additionally, several studies showed the important role vitamin D plays in decreasing the risk of many chronic diseases, including diabetes mellitus type 1, hypertension, multiple sclerosis, and cancer (2).

Vitamin D is obtained from two main sources: Exposure to UV-B rays in natural sunlight and dietary intake. 25[OH]D level is the most commonly measured indicator of vitamin D status. Low 25[OH]D levels are still reported as a frequent problem in children and adolescents worldwide (3,4). Therefore, the American Academy of Pediatrics guideline to prevent vitamin D deficiency recommends an intake of 400 IU/day. The supplementation should start during the first 2 months of life and continue throughout childhood and adolescence (5,6).

In our country, there are limited data on the prevalence of vitamin D deficiency among healthy Turkish children and adolescents. The aim of the present study was therefore to assess vitamin D status in Turkish children and adolescents living in Zonguldak, Turkey.

Methods

This study was conducted in Zonguldak at the latitude of 41, which is located in West Black Sea. We retrospectively reviewed the records of a total of 153 children living in Zonguldak from the pediatric outpatient clinic of the hospital of the Bulent Ecevit University. All subjects were designed to include 153 children (81 girls, 72 boys), they were divided into the following age groups: children in 5-10 years (38 girls, 29 boys), and adolescents in 11-15 years (43 girls, 43 boys). Data collection took place during two seasons in 2013, at the end of winter (February through March) and at the end of summer (September through October). Children were excluded from the study if they had liver disorders, kidney diseases, parathyroid gland diseases, or calcium-related disorders based on biochemistry and clinical history. The protocol of the present study was approved by the Ethics Review Committee of the Bulent Ecevit University, and it conformed to the Declaration of Helsinki.

Venous blood samples were taken from the antecubital region between 08:00-11:30 a.m. for determination of plasma 25[OH]D level. Plasma 25[OH]D levels were assessed by high-performance liquid chromatography (HPLC) (Zivak, Gebze, Turkey). The intra- and interassay coefficients of variation for the 25[OH]D assay were 2.7% and 3.1 %, respectively. The detection limit was 2.4 ng/ml. Plasma vitamin D levels were classified into vitamin D deficiency (15 ng/ml), vitamin D insufficiency (15-29 ng/ml), and sufficient vitamin D level (>30 ng/ml) (6).

Ethics committee approval was received for this study from the ethics committee of Bulent Ecevit University, Faculty of Medicine.

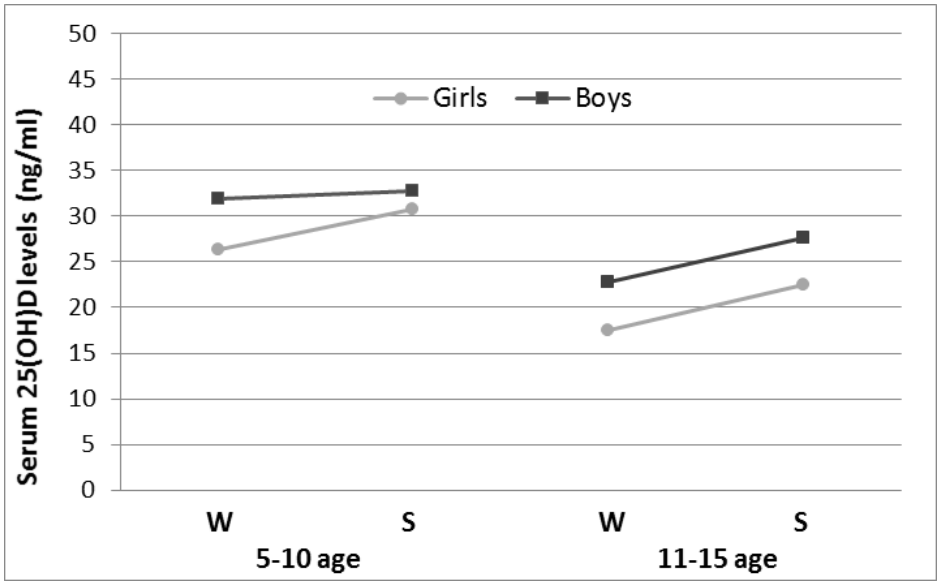
Statistical analysis was performed using SPSS, version 13 (SPSS, Chicago, IL, USA). Results were expressed as mean values ± SD. Comparisons of means between 2 groups were done using Student's t-tests for normal distribution and the Mann-Whitney U-test for non-normal distribution. Chi-square test or Fisher exact test (two-tailed) were used to compare the prevalence rates between groups. Differences were considered significant at ≤ 0.05.

Results

Mean ± SD plasma 25[OH]D levels were 23.3 ± 8.88 ng/ml at the end of winter and 27.9 ± 8.27 ng/ml at the end of summer. The 25[OH]D levels were higher at the end of summer than at the end of winter (p=0.03). Children aged 5-10 years had a higher mean level of 25[OH]D compared to older children (5-10 age group: 29.9 ± 7.00 ng/ml; 11-15 age group: 22.4 ± 8.77 ng/mL; p=0.016). Mean plasma 25[OH]D levels were significantly higher

in boys than in girls, both in the 5-10 age group (girls: 28.3 ± 6.41, boys: 32.4 ±7.27, p=0.004) and the 11-15 age group (girls: 20.6 ± 8.87, boys: 24.7 ± 8.13, p=0.04) (Figure 1).

Figure 1. Plasma 25[OH]D levels in different ages, genders and seasons



We determined that the prevalence of vitamin D deficiency was 19% and the prevalence of vitamin D insufficiency was 42% in the population investigated. The prevalence of vitamin D deficiency and insufficiency significantly differed in relation to age and season. There were no statistically important differences in vitamin D deficiency and insufficiency between girl and boy children (Table 1).

Table 1. The prevalence of vitamin D deficiency and insufficiency in relation to season, age and gender

Variable	Deficiency	Insufficiency	Normal	p
Age:				
5-10 years	6%	36%	58%	0.005
11-15 years	27%	47%	26%	
Gender:				
Girls	26%	43%	31%	> 0.05
Boys	10%	42%	48%	
Season:				
Winter	22%	52%	26%	0.01
Summer	14%	33%	53%	

Although there were no overall differences in vitamin D deficiency and insufficiency between girls and boys, the prevalence of vitamin D deficiency among the 11-15 age group was significantly higher in girls than in boys (girls: 43%, boys: 13%, p=0.006).

Discussion

The present study is the first one to investigate vitamin D status among the pediatric population in Zonguldak, Turkey.

Recent studies on vitamin D status in children have

suggested that vitamin D deficiency is prevalent in Turkey (Table 2). Few studies conducted in Turkey have assessed the prevalence of Vitamin D deficiency in both younger children and adolescents (7,9,11). Therefore, in this study, prevalence of Vitamin D deficiency was analyzed in children aged 5-10 years and 11-15 years. We found that the plasma 25[OH]D levels decreased when the children became older, and the prevalence of vitamin D deficiency increased at the same time. This is in accordance with other reports from countries around the World. They reported high prevalence in older children because of spending more time in indoor activity (watching television, playing video games, or using computers) and less time exposed to sunlight (6,12,13). We also analyzed the vitamin D status at both ends of the winter and the summer. In this study, season strongly influences vitamin D status, as observed in some studies performed in our country (11,12). The possible reasons for seasonal variations are that children spend more time indoors and the amount of skin exposed to the sun is lower.

Vitamin D deficiency in children is prevalent around Mediterranean countries, especially in developing countries including Turkey (Table 3). In a study conducted in Italy, vitamin D deficiency and insufficiency were detected at a level of 82% in the age-group 10-21 years (13). This is compatible with our estimates, as we found that the prevalence of vitamin D deficiency and vitamin D insufficiency were 74% in adolescents. In the Italian study it was not found any significant differences between boys and girls. In our study, Vitamin D deficiency was found to be higher in girls than boys in the adolescent group. However, girls are at risk in Muslim countries, because of the traditional covered clothing. In Iran, more than 80% of children had a 25[OH]D level at <15 ng/ml (15). Although this style of clothing is less common in Turkey when compared to Iran, prevalence ratios are still high in Turkey (11,12).

Table 2. Vitamin D status in different studies conducted in Turkey

Reference	City (Latitude)	Age	N (Sex)	Season	Mean ± SD (ng/ml)	<15 ng/ml	< 20 ng/ml	20-29 ng/ml
Andıran et al. (7)	Ankara (39)	0-16 5-10 11-16	440		 20.5 ± 8.7 18.7 ± 11.5		 64% (girl), 51%(boy)	
Olmez et al. (8)	İzmir (38)	14-18	64 (girl)	Summer Winter	26.1 ± 11.5 23.8 ± 9.76	25% 59%		
Akman et al. (9)	Ankara (39)	1-16 > 7	420	Winter	37.99 ± 17.4		8%	26%
Hatun et al. (10)	Kocaeli (40)	13-17	89 (girl)	Winter			65%	
Karagüzel et al. (11)	Trabzon (41)	11-18	746 325 (167 girl, 208 boy) 371 (182 girl, 189 boy)	 Spring Autumn	13.7 ± 7.32 8.9 ± 4.2, 11.4 ± 6.8 14.6 ± 8.1, 16.2 ± 7.4	 82% (girl 89%, boy 75%) 48% (girl 59%, boy 38%)		
Erol et al. (12)	İstanbul (41)	3-17	280 (146 girl, 134 boy)	Winter Summer	11.43 ± 5.86 20.76 ± 9.01	80% 23%		

The prevalence of vitamin D deficiency and vitamin D insufficiency in our city were 19% and 42%, respectively. The results from this study confirm that the prevalence of vitamin D insufficiency is higher than vitamin D deficiency in children living in Zonguldak. Our findings also show that in children, there is an increasing risk of vitamin D deficiency in older age and winter seasons, especially girls. Our results are in accordance with the some studies in our country (7,9,12). The incidence of child vitamin-D deficiency is much lower in Zonguldak than in many other areas of the Turkey. Zonguldak is a small city located in the northwest of Turkey, Black Sea area. This can be

Table 3. Vitamin D status in different studies in Mediterranean and neighboring countries

Reference	City (Latitude)	Age	N (Sex)	Season	Mean ± SD (ng/ml)	< 10 ng/ml	<15 ng/ml	< 30 ng/ml
Vierucci et al (13)	İtaly (43)	10-21	427 (214 girl, 213 boy)		20.2, 19.3			83% (girl), 81% (boy)
Lapatsanis et al (14)	Greece (39)	3-10	78	Winter	18.5 ± 1.3	14%		
				Summer	29.4 ± 1.8	15%		
		11-14	56	Winter	21.0 ± 1.9	13%		
				Summer	26.6 ± 1.4	9%		
Saki et al (15)	Iran (35)	9-18	477				81%	
Oren et al (16)	Israel (32)	5-20	195 (100 girl, 95 boy)		22.53 ± 9.09		26%	79%

explained by the fact that it has facilities related to outdoor activities such as beaches, street games, and the like, when compared with children living in the metropolis who are limited in outdoor activities. The reason will need to be explored in the future.

But there are still some limitations in the present study. The subjects were not sampled from the whole pediatric population in Zonguldak, and other possible relating factors of vitamin D status, including intake of supplements, children's BMI, the time of sun exposure and physical activities were not collected.

In conclusion, Turkish adolescent girls are at significant risk of vitamin D deficiency especially in winter. Therefore, we suggest that vitamin D supplementation should be recommended to Turkish adolescent girls in winter. However, a main problem is the increasing risk of vitamin D insufficiency in all children. This is an important health problem that requires focus and preventive strategies.

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Conflicts of interest: None declared.

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