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Vitamin D Deficiency in 7 - 11 Year Old Children in Eastern Iran

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Background: Vitamin D deficiency is a health problem in different countries. Vitamin D deficiency is an important health problem in both developed and developing countries. Recent reports on extra skeletal effects of vitamin D have led to increased interest in prevalence studies on states of deficiency/insufficiency of vitamin D.
Objectives: The aim of this study was to determine the prevalence of vitamin D deficiency in children in city of Birjand, east of Iran.
Patients and Methods: This cross-sectional study was carried out in winter of 2012 and comprised 238 students of primary schools aged between 7 and 11 years. Sampling was done through randomized multiple stage method. The data were obtained using a questionnaire consisting of questions about weight, height and serum level 25 (OH) vitamin D. Serum level 25 (OH) D < 20 ng/mL was defined as deficient, level 20 - 30 ng/mL as insufficient and the level > 30 ng/mL as sufficient.
Results: Of the total number of 238 children surveyed, 110 (46.2%) were males and 128 (54.8%) females. Vitamin D levels in the subjects ranged from a minimum of 4.3 to a maximum of 63.1 ng/dL, with mean value of 15.4 ± 8.1 ng/dL. The deficient, insufficient and sufficient levels of vitamin D were found in 76.9%, 18.5%, and 4.6% of the students, respectively. Moreover, vitamin D deficiency was significantly higher in the females.
Conclusions: In regard to the protective role of vitamin D in preventing many chronic diseases, immediate intervention in the form of nutritional supplement is needed to overcome the high prevalence of vitamin D deficiency in children.

Keywords: Prevalence; Vitamin D Deficiency; Children; Iran

1. Background

Vitamin D deficiency is a health problem in different countries (1-3) and is highly prevalent among children worldwide (4). It has been reported to have spread in many Asian countries (5) and even, to have increased in its prevalence in North America, Europe, Australia, and New Zealand (6-8). Vitamin D is generated from cholesterol 7-dehydroxylation by exposure of the skin to UV. Another source of the vitamin D is nutrition. The active form of the vitamin is produced during two processes of hydroxylation of vitamin D to 25 (OH) D and 1.25 (OH) D taking place in the liver and in the kidney, respectively (9). Vitamin D deficiency, in addition to causing osteolysis known since the beginning of the 19th century, causes rickets in severe cases (10). The positive role played by vitamin D has been substantiated in the immune system, cytodifferentiation and ant carcinogenic activity regarding leukemia, colon carcinoma, prostate cancer and breast cancer (10). Besides, it is believed that vitamin D deficiency predisposes individuals to chronic diseases such as type 1 diabetes mellitus (T1DM), asthma and autoimmune diseases such as lupus, rheumatoid arthritis and multiple sclerosis. Also, lack of enough vitamin D is known as a risk factor to CVD and hypertension (11-16). Vitamin D deficiency in the public and in children is not yet assessed, but it is estimated that, at least one billion of the world population suffer from the vitamin D deficiency that may be due to lack of enough exposure to the sun, use of barrier creams and following a diet deficient in vitamin D (13). Even in sunny countries like Qatar (13) and The United Arab Emirates (17) and Saudi Arabia (18) the prevalence of vitamin D deficiency is reported to be high in school age children. In Iran, different studies have shown high prevalence of vitamin D deficiency, which is present in 86% of school-age children in Tehran (19) and in 46.2% among 14 - 18 years old children in Isfahan (20). Since it is possible to easily prevent complications arising from vitamin D deficiency by nutritionally enriched vitamin D supplements.

2. Objectives

The present study was carried out to assess the level of vitamin D in elementary school children in city of Birjand in 2012.

3. Patients and Methods

The present cross-sectional and descriptive analytical study was done on elementary school children in Birjand using randomized multistage sampling method. Initially, the city was divided into 4 socially and economically similar regions. The samples were then selected through multiple-cluster sampling. Considering the distribution of elementary schools in different districts of the city, the study included 4 girl and 4 boy elementary schools. The students from each class were then selected based on the population of each school and its ratio to the total population of elementary school students.

Sample size was based on the prevalence estimated by other study (20) and included 235 subjects. Initially, the demographic information about every student was recorded in the respective questionnaire, and the height of each student was then measured using a standard method by means of German Seca height measure, having an error ranging between +0.5 and -0.5 centimeter. In addition, each student was weighed in a standard manner, with light clothing, by German Seca scale with an error of ± 50 grams. BMI of every student was measured and in order to pinpoint overweight and obesity in them the percentiles presented by the centre for diseases control were applied. Thus, percentiles 85 - 95 were taken as overweight and percentiles > 95 as obesity regarding age and sex.

Patients with a history of a chronic disorder or those on any medication that may alter vitamin D metabolism were excluded from the study. Five mL blood was then taken from the radial vein of each student which was tested by means of ROCHE Elecsys 2010 applying chemical electroluminescence. The serum concentrations of calcium and phosphorus were determined using ROCHE COBAS INTEGRA automated analyzer and Specific ROCHE kits. The serum levels of 25 (OH) D less than 20 ng/mL, 20 - 30 ng/mL and more than 30 ng/mL were considered deficient, insufficient and sufficient, respectively. The data obtained were analyzed statistically using SPSS version V.15, χ^2, Fisher and Mann-Whitney tests and $\alpha = 0.05$ was considered as significant.

4. Results

The present study was done on 238 elementary students aged from 7 to 11 years with mean age 8.7 ± 1.3 years. The number of males was 110 (46.2%). Mean BMI of the subjects was 16.1 ± 3 kilograms. Of the subjects studied, 16 students (6.7 %) were obese and 20 (8.4%) were overweight. Vitamin D levels in the subjects ranged from a minimum of 4.3 to a maximum of 63.1 ng/dL with mean value of 15.4 ± 8.1 ng/dL. Vitamin D deficiency, insufficiency and sufficiency were found in 183 cases (76.9%), (71.6 - 82.2 CI 95%), 44 cases (18.5%), (13.6 - 23.4 CI 95%) and 11 cases (4.6%), (1.94 - 7.26 CI 95%), respectively. As shown in Table 1, the prevalence of vitamin D deficiency was significantly higher in females (92.9.4% vs. 58.2%). Vitamin D deficiency in 7 - 9 years old students was 95.2% and in 10 - 11 years old it was 95.7% (Table 2). But, there was no significant difference in the prevalence of vitamin D deficiency between overweight, obese and subjects with normal BMI (P = 0.12). There was no significant difference between the prevalence of vitamin D deficiency and period of exposure to sun, job and educational level of parents; and living in a villa or an apartment (P > 0.05) mean of total calcium and phosphorus was 9.6 mg/dL and 4.9 mg/dL, respectively. There was no significant difference in regard to gender (P > 0.05).

Table 1. Comparison of Vitamin D Deficiency Prevalence Between Male and Female Students [a]

Vitamin D Status	Gender		P Value χ^2 and Mann Whitney Tests
	Male	Female	
Deficient	64 (58.2)	119 (92.9)	$\chi^2 = 40.31$
Insufficient	37 (33.6)	7 (5.5)	P < 0.001
Sufficient	9 (8.2)	2 (1.6)	-
Vitamin D levels	19.7 ± 8.6	11.7 ± 5.2	P < 0.001

[a] The values are presented as No. (%) or mean ± SD.

Table 2. Comparison of Vitamin D Deficiency in the Students Regarding Age [a]

Vitamin D Status	Age, y		P Value χ^2 and Mann Whitney Tests
	7 - 9	10 - 11	
Deficient	124 (73.8)	59 (84.3)	$\chi^2 = 3.4$
Insufficient	36 (21.4)	8 (11.4)	P = 0.18
Sufficient	8 (4.8)	3 (4.3)	-
Vitamin D levels	16.1 ± 8.4	13.9 ± 6.9	P = 0.06

[a] The values are presented as No. (%) or mean ± SD.

5. Discussion

This study shows vitamin D level of serum in school-age children, which is low and particularly critical in 10 - 11 years old girls. This calls for more attention on the part of pediatricians and primary care physicians. The results of the present study were consistent with those of Neyestani et al. (19) where the prevalence of vitamin D deficiency was found to be 91.7% in 9 - 12 years old students in Tehran. In another study on 7 - 18 years old students in Tehran, 52% were vitamin D deficient, of whom 26% suffered vitamin D insufficiency (21). Also, vitamin D deficiency was 65.2% among 14 - 18 years old students in a similar study from Isfahan (20). Furthermore, our findings were in agreement with studies conducted in Qatar (13) the United Arab Emirates (17), Brazil (22) and also those reported from Asia, Europe, Middle East, Africa and North America conducted on a wide ranging age groups (23-25), where vitamin D deficiency was shown to be a great universal health problem. Vitamin D insufficiency may

be due to low exposure to sunlight, skin pigmentation, air pollution, covered skin and low vitamin D intake. The human diet does not usually provide sufficient amounts of vitamin D. In North America, despite higher intakes of dairy products and availability of milk supplemented with vitamin D, the prevalence of vitamin D insufficiency is more than expected (26). This could be, at least in part, due to insufficient intakes of dairy products. The American academy of pediatrics (AAP) guidelines have suggested that vitamin D supplement should be provided for neonates since birth and the supplementation must be maintained throughout period of childhood (27). In Iran, except for breast-fed babies, the enrichment of foods with vitamin D is not yet a routine procedure in the public health care planning. According to the results of the present study on females, the prevalence of vitamin D deficiency was significantly higher (93% vs. 58.2%). This finding is in line with some other studies (3, 13, 19, 20) and may be related to Islamic veil for females or their less exposure to external activities. Recent studies suggest that vitamin D deficiency is particularly common among young women who wear concealing clothing (22, 23). These young women are also at increased risk for osteoporosis (24, 25). Moreover, it was found that the prevalence of vitamin D deficiency in 10 - 11 years old age group was more than younger children. Other studies also showed age related vitamin D deficiency (3, 21). Perhaps one of the reasons for this increase is the children's approaching puberty and the stage of peak bone mass in adolescents; and a higher need for vitamin D in this age group. Apparently, this point must be taken into consideration regarding school public health planning. Although based on the present study all obese children were deficient of vitamin D, no significant relationship was found between this deficiency and BMI. However, other studies reported a significantly inverse relationship between vitamin D deficiency and BMI (3, 19, 20, 26). The underlying reason seems to be due to the effect of fat mass on the available source of vitamin D. Perhaps one of the reasons for the lack of significant relationship between BMI and vitamin D in this study was the limited number of subjects studied. Although our findings were in agreement with those of other studies which did not find any associations of BMI and/or fat mass with 25 (OH) D levels in the pediatric population (28, 29). This study was performed during cold seasons in which vitamin deficiency is highly critical. An inverse correlation was found between the levels of 25 (OH) and seasons of respiratory tract infection (30). There are some reports of a higher occurrence of type one diabetes mellitus T1DM and multiple sclerosis MS during the cold seasons which was related to the lower vitamin D status (12-14). Vitamin D deficiency is reported to be associated with increased incidence of ear and lung infections in children. It seem that healthy children and adolescents should be encouraged to consume vitamin D containing foods including fish, eggs and dairy products and have adequate outdoor activities with exposure to sunlight. The supplementation of foods with vitamin D should be adopted policies. The strength of the study was the sample size, nevertheless this study had some limitations. For example, serum PTH was not measured and also did not evaluate all risk factors involved.

The high prevalence of vitamin D deficiency in children seems to be due to living in a region with low longitude and the type of foods for children with insufficient sources of vitamin D. Regarding vitamin D protective role in preventing many chronic diseases, immediate intervention is necessary to include sufficient vitamin D in the diet.

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Authors' Contributions

Mahmoud Zardast and Kokab Namakin designed the research. All authors contributed in data gathering, data analysis and preparing the manuscript.

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