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Status of Vitamin D3 Deficiency/Insufficiency in the Children of Southern

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Abstract

Background: Vitamins, particularly vitamin D, are crucial for normal metabolism. Nutritional sources of vitamin D are limited, making sunlight the most significant source. From birth, children have an increased need for vitamin D and require supplementation.

Methods: This study aimed to assess the status of vitamin D deficiency and insufficiency in otherwise healthy children in this region and to emphasize the importance of screening, treatment, and prevention of vitamin D deficiency. Ethical approval for this study was obtained from the Ethics Committee of Shiraz University of Medical Sciences.

Results: Among the 500 children studied, 256 (51.2%) had vitamin D deficiency, 156 (31.2%) had insufficiency, and only 88 (17.6%) had sufficient levels of vitamin D. School-aged children were more likely to be deficient compared to preschool and infant groups. A higher percentage of insufficiency was observed in infants compared to preschool and school-age groups.

Conclusions: Vitamin D screening should be mandatory for all children referred to a pediatrician, and appropriate treatment modalities should be implemented for these children.

Keywords: Vitamin D, Pediatrics, Vitamin D Deficiency, Child

1. Background

Vitamins are chemically distinct families of organic compounds that are essential in small quantities for normal metabolism. With the exception of vitamin D, humans cannot synthesize vitamins and must obtain them through dietary intake to prevent metabolic disorders. Vitamin D functions as a prohormone for calcium regulation. Approximately 95% of vitamin D is derived from sunlight exposure, while the remaining 5% comes from sources such as egg yolk, fatty fish, cod liver oil, enriched dairy products, fortified cereals, and mushrooms.

2. Methods

To assess the status of vitamin D efficiency and deficiency in children in the southern part of Iran, subjects were randomly selected from the first author's office referrals, including patients and those visiting for checkups and follow-ups. Over a 5-year study period, 500 children were evaluated for their vitamin D status. These children were otherwise asymptomatic, with their weight and height measured, and their nutritional status assessed. Vitamin D levels were categorized as follows: Levels < 20 ng/mL (50 nmol/L) were considered deficient, levels between 20 - 30 ng/mL (50 - 75 nmol/L) were labeled as insufficient, and levels > 30 ng/mL (> 75 nmol/L) were categorized as sufficient (Table 1 and Figure 1).

3. Results

The age and sex distribution of the children is presented in Table 2 and Figure 2. There were 285 males and 215 females, resulting in a male-to-female ratio of 1.3:1. Among the participants, 69 (13.8%) were infants, and 130 (26%) were preschool-aged children. A total of 199 (39.8%) were under 5 years of age, 294 (58.8%) were aged 5 - 15, and 7 (1.4%) were older than 15. Table 3 and Figure 3 illustrate the conditions of patients at the time of referral. The majority of patients had upper respiratory

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Table 1. Vitamin D3 Deficiency State [a]

Variables	Value
Deficient (< 20 ngmL ≤ 50 nmol /L)	256 (51.2)
Insufficient (20 - 30 ng/mL = 50 - 75 nmol/L)	156 (31.2)
Sufficient (> 30 mg /mL ≥ 75 nmol / L)	88 (17.6)
Total	500

[a] Values are expressed as No. (%).

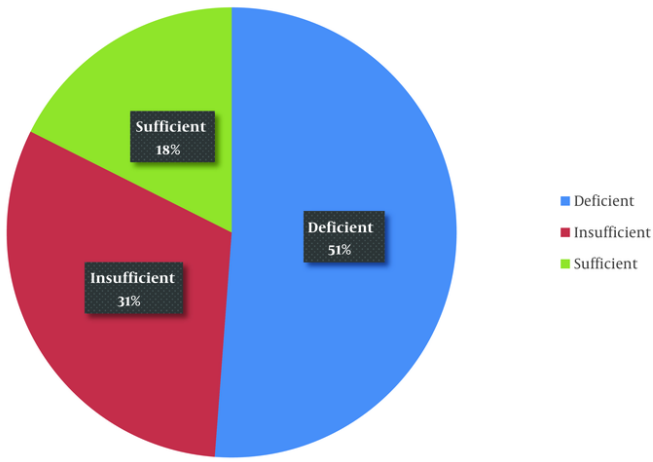

Figure 1. Vitamin D3 deficiency state

tract diseases — 190 (38%). Gastrointestinal diseases were the second most diagnosed condition, affecting 100 (20%) of the patients. Poor weight gain and failure to thrive were observed in 76 (15.2%) patients, and anemia was present in 61 (12.2%). Seventy-three (14.6%) visited only for checkups and follow-ups. Table 4 and Figure 4 display the status of vitamin D3 deficiency and insufficiency according to age group. School-aged children exhibited the highest vitamin D deficiency at 60.8%, compared to 26% in infants and 41.5% in preschool-aged children (P-value < 0.0001). Infants (2 years and under) had the highest rate of insufficient vitamin D status compared to preschool and school-aged groups. Only 8.5% of school children had sufficient vitamin D levels, indicating significantly lower vitamin D levels in school-aged children compared to preschool (P = 0.37, P-value < 0.0001) and infancy (P = 26.9, P-value < 0.0001). Ensuring adequate vitamin D intake for children, particularly those who are school-aged, is essential and should be pursued regularly.

The seasonal distribution of cases is presented in Table 5. Deficient and insufficient cases were more prevalent in the summer, accounting for 40%, and generally occurred more frequently during the warm seasons. In contrast, the number of sufficient cases remained consistent across all four seasons.

4. Discussion

In addition to being an essential nutrient for healthy bones and regulating calcium levels in the blood, vitamin D may help prevent other diseases. Vitamin D deficiency can lead to seizures and cardiomyopathy in infants, rickets and poor growth in children, and muscle weakness at any age (1). There are three groups particularly at risk of vitamin D deficiency (2).

4.1. Increased Need

This includes pregnant and breastfeeding women, twins and multiple pregnancies, premature infants,

Table 2. Age and Sex Distribution of Patients [a, b]

Variables	Value
0 - 6 (mo)	4(0.8)
6 - 12 (mo)	10 (2)
12 - 24 (mo)	55 (11)
Infancy (0 - 24); (mo)	69 (13.8)
Preschool (2 - 5); (y)	130 (26)
School age (5 - 15); (y)	294 (58.8)
> 15 (y)	7 (1.4)
Total	500

[a] Values are expressed as No. (%).
[b] Male 285, female 215, M: F 1.3:1.

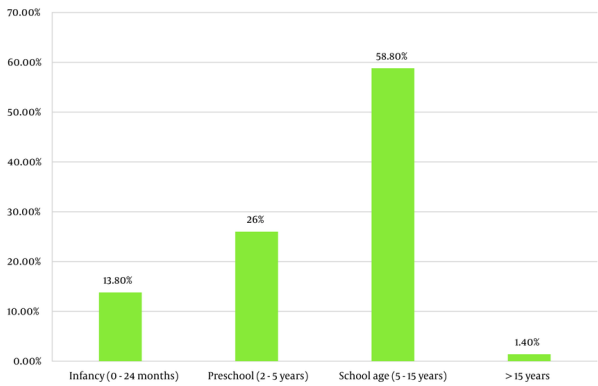

Figure 2. Age distribution of patients

Table 3. Associated Disease and/or Conditions in Patients [a]

Variables	Value
URT diseases	190 (38)
GI diseases	100 (20)
Poor weight gaining & F.T.T	76 (15.2)
Anemia	61 (12.2)
Checkup, follow up	73 (14.6)
Total	500

[a] Values are expressed as No. (%).

adolescents, and individuals with obesity (3).

4.2. Limited Sun Exposure

This group includes individuals living at northern latitudes or during winter months, those with darker skin, individuals with immobility such as inpatients or those with conditions like cerebral palsy, and those using excessive amounts of sunblock. Although sunshine is the most important source of vitamin D, children in school in the southern part of our country,

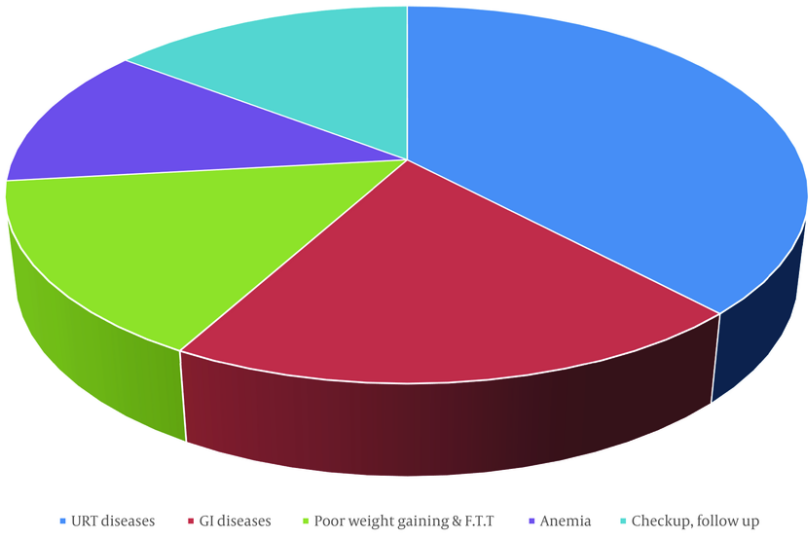

Figure 3. Associated disease and/or conditions in patients

Table 4. Vitamin D Deficiency/Insufficiency in Subgroups of Age [a]

Variables	Total	Deficient	Insufficient	Sufficient
Infancy (0 - 24) (mo)	69	18 (26)	25 (36.2)	26 (37.6)
Preschool (2 - 5) (y)	130	54 (41.5)	41 (31.5)	35 (26.9)
School age (5 - 15) (y)	294	179 (60. 8)	90 (30.6)	25 (8.5)
> 15 (y)	7	5 (71.4)	0	2 (28.5)
Total	500	256 (51.2)	156 (31.2)	88 (17.6)

[a] Values are expressed as No. (%).

despite abundant sunshine, do not get enough sun exposure (4).

4.3. Limited Dietary Sources

This includes vegetarians, those with prolonged breastfeeding even if the mother has sufficient vitamin D levels, individuals on exclusion diets (e.g., milk allergy), those with malabsorption, celiac and inflammatory bowel disease, liver and renal diseases, and those using certain drugs (e.g., anticonvulsants, anti-tuberculosis drugs, glucocorticoids, and some antifungal drugs).

The clinical manifestations of vitamin D deficiency primarily include rickets in growing children and osteomalacia in adolescents and adults (5). In our study, 15% of children exhibited poor weight gain and failure to thrive, and 12% had anemia. Only one patient showed clinical evidence of rickets (6). None of these children displayed signs or symptoms related to bone and joint diseases, and nearly 15% came for checkups and follow-ups (7). There were no biochemical changes such as reduced calcium and phosphorus, so no further workup was conducted. Efforts focused on providing sufficient vitamin D intake — 400 IU (10 micrograms) daily for infants and 600 IU (15 micrograms) for those aged 1 - 18 years (8). For high-risk populations, such as those in Mediterranean and Middle Eastern regions, northern latitudes, and children on anticonvulsants, glucocorticoid therapy, and HIV medications, up to 2000 IU/day of vitamin D may be necessary to raise 25(OH)D levels to > 30 ng/mL (75 nmol/L) (9).

In Shiraz, a very warm city with plenty of sunshine year-round, children are less likely to go outdoors

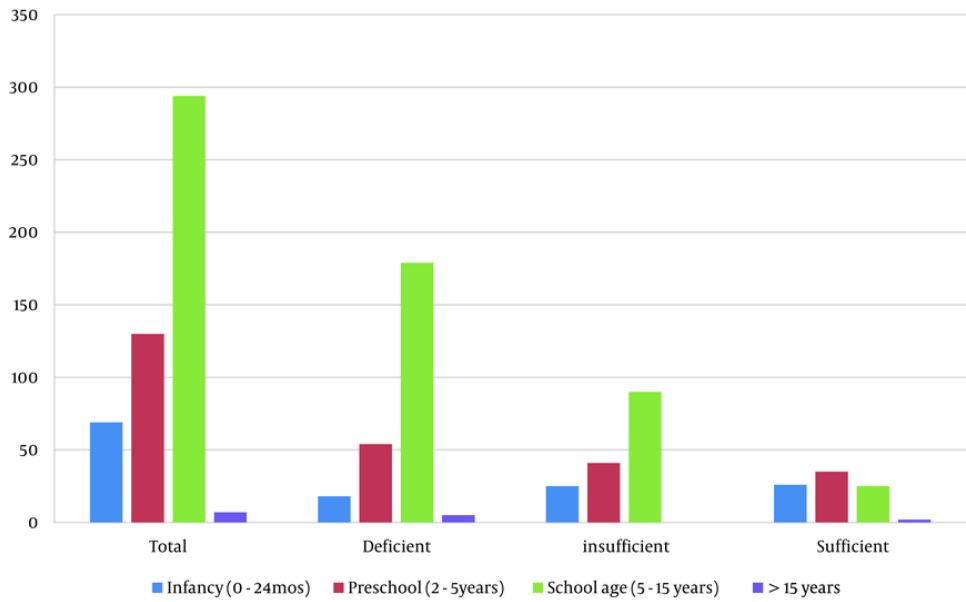

Figure 4. Vitamin D deficiency/insufficiency in subgroups of age number

Table 5. Seasonal Distribution of Vitamin D State Cases [a]

Variables	Spring	Summer	Fall	Winter	Total
Deficient	52 (17)	120 (39.5)	84 (27.6)	48 (15.7)	304 (100)
Insufficient	24 (14.6)	64 (39)	44 (26.8)	32 (19.7)	164 (100)
Sufficient	8 (25)	8 (25)	8 (25)	8 (25)	32 (100)
Total	84 (16.8)	192 (38.4)	136 (27.2)	88 (17.6)	500 (100)
Total	Warm seasons 276 (55.2)		Cold season 224 (44.8)		-

[a] Values are expressed as No. (%).

during the day in spring and summer due to the very hot weather, resulting in reduced sun exposure.

4.4. Conclusions

Given that only 17.6% of children in this region of Iran have sufficient levels of vitamin D, it is recommended that every child seen by a pediatrician or general physician be screened for vitamin D deficiency and receive appropriate treatment if necessary.

Footnotes

Authors' Contribution: Study concept and design: E. S.; Acquisition of data: E. S.; Analysis and interpretation of data: E. S.; Drafting of the manuscript: E. S.; Critical revision of the manuscript for important intellectual content: A. A.; Statistical analysis: E. S.; Administrative, technical, and material support: E. S.; Study supervision: E. S.

Conflict of Interests Statement: The authors declared no conflict of interests.

Data Availability: The data presented in this study are openly available at www.uptodate.com .

Ethical Approval: IR.SUMS.REC.1402.440 .

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Informed Consent: Verbal informed consent was obtained from the participants.

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