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Prevalence of vitamin D deficiency among children in Riyadh city, Saudi Arabia

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Abstract
Objective: To determine the prevalence of vitamin D deficiency among children in Riyadh City, and to investigate the relationship between vitamin D level and age and sex.
Methods: Conducted between January and November 2023, this cross-sectional study included 1000 children aged 2–14 years who were ordered for vitamin D level testing for different reasons. Data on age and sex were recorded, and vitamin D level was measured as serum 25(OH) vitamin D. Vitamin D levels were categorized into three groups: sufficiency (>50 nmol/mL), insufficiency (30–50 nmol/mL), and deficiency (<30 nmol/mL).
Results: Of 1000, 50.9% were boys and 12.6% showed vitamin D deficiency, 43.6% insufficiency, and 43.8% sufficiency. Children aged 2–8 years were less likely to be vitamin deficient compared to those aged > 8 years. Vitamin D deficiency was more prevalent in girls than in boys.
Conclusions: Vitamin D deficiency and insufficiency are common among children in Riyadh City. However, girls are more affected than boys, and age is negatively correlated with vitamin D levels. It is highly recommended to supplement the population with vitamin D, with its fortification in widespread accessible food and improvements in the lifestyles of these children.

Keywords: Children, vitamin D, deficiency, insufficiency, prevalence, Riyadh City

Introduction

Vitamin D plays a pivotal role in bone health by influencing calcium and phosphorus homeostasis and regulating pathways involved in bone mineralization and bone mass acquisition [1, 2]. Although nutritional rickets in infants and children could develop secondary to severe calcium deficiency, vitamin D deficiency is the main cause of this condition [3]. In addition to its central role in bone development, vitamin D is involved in a broad spectrum of possible pleiotropic and extraskeletal implications. In recent decades, vitamin D deficiency, including its effects on the cardiovascular, nervous, and immune systems, and its potential roles in the development of infectious and autoimmune diseases have been investigated [4-7]. Optimal vitamin D levels have been associated with lower incidences of type I diabetes mellitus [8], reduced asthma complications [9, 10], and cancer prevention [11-13], among others. Serum 25(OH)D measurement is usually the analysis of choice to assess vitamin D status in patients due to its stability (serum half-life of 2–3 weeks approximately), concentration in the blood, and resistance to being affected by parathyroid hormone concentration [1, 5, 7]. There are considerable disagreements within the scientific community regarding the establishment of a minimal desired 25(OH)D concentration. Nevertheless, vitamin D hypovitaminosis remains a global health issue for people with low sun exposure, pregnant women, people with increased skin pigmentation, obese individuals, and especially children [1, 5, 14]. Although there is limited data available on vitamin D status in children worldwide, vitamin D hypovitaminosis is considered to be prevalent among this population. This has been attributed primarily to decreased sunlight exposure, which is the source of vitamin D; low milk intake; low consumption of food naturally containing vitamin D; and increased incidence of obesity [11, 14]. Furthermore, the association of skin cancer with ultraviolet rays has contributed to sun exposure avoidance and the use of sun protection strategies, such as sunscreen and protective clothing [7, 15]. Studying vitamin D deficiency is of great interest for medical researchers because of life modernization in the Kingdom of Saudi Arabia (KSA) in the last 70 years. A study [16] in 2017 regarding the prevalence and awareness of vitamin D deficiency found that there was little awareness about the risks of vitamin D insufficiency among Saudi women. This was because most of the women did not regularly check their vitamin D value. An inadequate vitamin D status is associated with considerable public health repercussions, and children are particularly susceptible due to their high bone growth requirement.

Objective

This study aimed to determine the prevalence of hypovitaminosis D among children in Riyadh City, Saudi Arabia, and to investigate the relationship between vitamin D level and age and sex.

Material and Methods

Conducted between January and November 2023, this study included 1000 children of Saudi nationality aged 2–14 years who visited the pediatric clinic in the National Guard Comprehensive Specialized Clinic in Riyadh City for vitamin D level testing, as ordered by their physicians for different reasons. Circulating serum 25(OH) vitamin D is the most reliable and robust measure of vitamin D status. A blood sample was collected from each child, and the tests were performed in the hospital laboratory. Thresholds for vitamin D sufficiency, insufficiency, and deficiency in otherwise healthy children were based upon associations

between 25(OH) D levels. Because of inconsistent evidence, there is an ongoing disagreement within the scientific community regarding the optimal 25(OH)D serum concentration. However, in this study, the following standards were used to define vitamin D status in these children, which are consistent with the 2016 Global Consensus recommendations (similar to the 2011 recommendations from the Pediatric Endocrine Society [17]) and are based on serum concentrations of 25(OH)D: vitamin D sufficiency, 20–100 ng/mL (50–250 nmol/L); vitamin D insufficiency, 12–20 ng/mL (30–50 nmol/L); and vitamin D deficiency, <12 ng/mL (<30 nmol/L). The children were grouped according to their gender. In addition, they were divided into two age groups: 2–8 years and > 8–14 years.

Results

Of 1000 children, 50.9% were boys and 49.1% were girls. Table 1 shows the vitamin D status of the children (prevalence of vitamin D deficiency, insufficiency, and sufficiency), using the cut-off values for serum vitamin D concentrations. Of the total, 12.6% of the children presented with vitamin D deficiency, 43.6% had insufficiency, and 43.8% presented with sufficiency. The serum 25(OH) vitamin D concentrations were stratified according to age and sex. The findings showed that vitamin D deficiency was more prevalent in girls than in boys (p-value < 0.00001) and significantly higher in children aged ≥8 years than in those <8 years (p-value < 0.00001) (Table 2).

Table 1: Vitamin D status of the children

Category	Number of children (%)
Deficiency	126 (12.6 %)
Insufficiency	436 (43.6%)
Sufficiency	438 (43.8%)

Table 2: Serum 25(OH)D levels in children stratified by sex and age

Variables	Status of vitamin D			
	Deficiency	Insufficiency	Sufficiency	p-value
Sex				
Male	18	182	309	<0.00001
Female	110	235	146	
Age				
2–8 years	54	145	382	<0.00001
>8–14 years	72	291	56	

Discussion

Infancy, childhood, and puberty are periods of rapid growth. During these stages, vitamin D is vital for skeleton formation, and its deficiency can lead to skeletal and extraskeletal abnormalities. This study determined the prevalence of vitamin D deficiency and insufficiency in Saudi children. The findings showed that 43.6% and 12.6% of the children had insufficient and deficient levels of vitamin D, respectively, which is a high combined prevalence of 56.4%. This finding supports the data on the global endemicity of vitamin D deficiency. High levels of vitamin D deficiency have been reported globally in various studies. For instance, African and Asian [18] countries reported a higher deficiency rate than Europe, the United States, and Canada. Interestingly, Middle Eastern countries have also reported a high prevalence of vitamin D deficiency despite the sunny climate throughout the year [19]. Specifically, studies from KSA have reported high levels of vitamin D insufficiency and deficiency, ranging from 28%–75% in various age groups. Regarding the differences in vitamin D levels according to sex, some studies pointed towards an increased prevalence of hypovitaminosis D among females. This finding is in line with the present study, with a statistically significant p-value. This increased prevalence among females may be attributed to less sun exposure because of limited outdoor activities, conservative clothing, and the use of sunscreen products for cosmetic reasons. Regarding age, a statistically higher prevalence of hypovitaminosis D was observed in children aged >8 years than their younger counterparts, in line with previous studies. Some studies suggested that this higher prevalence of hypovitaminosis D with increasing age could be attributed to factors such as low vitamin D supplementation in older children, supplementation with an inadequate dosage, changes in diets or lifestyles, decreased sun exposure, and less time spent outdoors, resulting in an imbalance between intake and requirements during growth. Despite the high prevalence of hypovitaminosis D, a generalized screening for vitamin D status at the population level is usually not recommended due to its high cost. Some studies have pointed out that strategies such as the promotion of food fortification programs, implementation of oral vitamin D supplementation to the affected population, and moderate sun exposure are more cost-effective. At present, several international organizations recommend vitamin D supplementation regardless of the presence of risk factors. The current recommended range is 600–1000 IU per day for children aged 12 months to 18 years. The Endocrine Society's recommendation may be employed as a guide to implement a supplementation plan at the national level. Furthermore, it is worth emphasizing that the risk for vitamin D intoxication associated with supplementation is negligible in children of this age group.

Conclusion

Vitamin D deficiency is a very common problem among children in Riyadh City. This study showed that girls were more affected than boys, and age was negatively correlated with vitamin D levels. Therefore, it is important to work on strategies to supplement and improve the fortification of vitamin D in widely accessible foods in Riyadh city. In addition, it is necessary to implement major holistic improvements in lifestyle behaviors, with particular emphasis on sun exposure among children.

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