Original Article

Assessment of Vitamin D Levels in Children Attending Outpatient Clinics of Johns Hopkins Aramco Healthcare, Saudi Arabia

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ABSTRACT

Background: Vitamin D deficiency is a common global public health issue, particularly among children, yet there is considerable variation in definitions, screening, and supplementation guidelines. This study aimed to assess vitamin D levels in children attending pediatric primary care clinics in Saudi Arabia, evaluate testing practices, and compare findings with existing recommendations.

Methods: A retrospective descriptive study was conducted using electronic health record data for all children ≤14 years old who underwent 25-hydroxyvitamin D (25-OH vitamin D) testing between January and December 2024. Data on age, gender, and vitamin D levels were analyzed using SPSS and stratified by age groups.

Results: A total of 1,448 tests were performed for 1,346 patients, of whom 54% were females (analysis based on patient-level data). Mean vitamin D levels were highest in children under two years (44.3 ng/mL, 95% confidence interval 40.3-47.4), lower in those aged 2–5 years (28 ng/mL, 95% confidence interval 26.4-28.9) and lowest in children over five years (17.4 ng/mL, 95% confidence interval16.9-17.8). Overall, 57% of patients were vitamin D deficient (<20 ng/mL), including 7% with severe deficiency (<10 ng/mL), while 40% had normal levels (20–50 ng/mL). Elevated levels (>50 ng/mL) were observed in 3% of patients, predominantly in children under two years, with no clinical evidence of toxicity.

Conclusion: Vitamin D deficiency remains highly prevalent among children in Saudi Arabia. Standardized, context-specific guidelines are needed. We recommend universal supplementation for children under 14 years, limiting testing to high-risk groups, and establishing clear protocols for monitoring and retesting.

Keyword: Vitamin D deficiency; Pediatrics; Saudi Arabia; 25-hydroxyvitamin D; Screening; Supplementation; Primary care.

Introduction

Vitamin D is a fat-soluble vitamin that is essential for growth and skeletal development in children. It is required for the absorption of calcium and phosphorus, which are important for bone calcification. Its deficiency in early life is related to multiple health issues, such as rickets, which is characterized by impaired bone mineralization during childhood, leading to skeletal deformities and delayed growth [1].

Additionally, Vitamin D deficiency has been associated with motor development delay [2]. Furthermore, some researchers have reported an association between Vitamin D deficiency and respiratory infections and asthma exacerbations, although this causality needs to be confirmed [3,4]. Globally, vitamin D deficiency is widespread, with studies in the US and Europe reporting prevalence rates up to 40% among children [5,6].

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In Saudi Arabia, prevalence has been estimated at 78–81% [7,8]. This is the first study of vitamin D to be conducted at JHAH. Several international organizations have published guidelines [9–16], yet consensus on definitions and screening is still lacking. This study aimed to evaluate vitamin D levels among children attending Johns Hopkins Aramco Healthcare (JHAH) primary care clinics and compare current practice with global guidelines, aiming to standardize our practice and make necessary recommendations to better align with the established guidelines.

Methods

This is a retrospective descriptive study conducted in our primary care clinics in Saudi Arabia. The study was registered with the Research and Development Office, and Institutional Review Board (IRB) approval was obtained, the approval number 25-05-204. All 25-hydroxyvitamin D (25-OH Vit D) tests performed for children aged 14 years and younger between January and December 2024 were identified. Data was extracted from the electronic health records (Epic), including patient age, gender, test date, and serum 25-OH Vit D result. Data was compiled and analyzed using Excel and SPSS. Patients with high vitamin D levels, defined as >50 ng/mL, and those who had repeated tests were reviewed separately. The analysis was first carried out for the entire cohort and then stratified by age. Infants younger than two years were analyzed independently, as they routinely receive vitamin D supplementation during immunization visits. The remaining children were grouped into two categories: young children (2–5 years) and older children (5–14 years). Vitamin D status was defined according to our hospital cut-off values: severe deficiency <10 ng/mL, mild to moderate deficiency 10–19 ng/mL, optimum levels 20–50 ng/mL, increased risk of hypercalciuria 51–80 ng/mL, and toxicity >80 ng/mL.

Results

At our hospital, the total pediatric population aged 0–14 years was 8403 children. Of these, 1364 were under the age of 2 years, and 1927 were between 2 and 5 years old. During the study period, 1,329 unique patients, representing 16% of the 8,403 total pediatric population, had a Vitamin D test performed. As some patients had more than one test, the total number of tests was 1448. Of these 1329 patients, 724 were female (54%). Patients' ages ranged from 10 months to 14 years. Seventy patients (5%) were younger than two years, 317 (24%) were between two and five years, and 942 (71%) were older than five years. Overall, 57% of patients were vitamin D deficient (<20 ng/mL), including 7% with severe deficiency (<10 ng/mL), while 40% had normal levels (20–50 ng/mL). Elevated levels (>50 ng/mL) were observed in 3% of patients (Figure 1). The mean vitamin D level was 43.8 ng/mL (95% CI: 40.3-47.4) in patients less than 2 years old, 27.6 ng/mL (95% CI: 26.4-28.9) in patients between the ages of 2 and 5, and 17.4 ng/mL (95% CI: 16.9-17.8) in older patients older than 5 years, as shown in (Figure 2). The average level was 22.9 ng/mL in males and 19.6 ng/mL in females, as shown in (Figure 3). No significant monthly variation in vitamin D levels was observed throughout the study period (Figure 4). Only minor fluctuations were observed with no consistent seasonal trend. Similar age-related patterns were observed in both boys and girls, with higher vitamin D levels in younger children and lower levels in older age groups across both genders (figure 5). The mean level was higher in the infant group due to regular supplementation during the immunisation and well child visits. The results of the study are summarised in (Table 1). A total of 36 tests from 31 patients (20 boys and 11 girls) showed elevated vitamin D levels above 50 ng/mL. This represents 2.5% of all tests performed during the study period. Among these, 2 patients had levels greater than 90 ng/mL; 1 patient had levels between 81–90 ng/mL; 4 had levels between 71–80 ng/mL; 9 had levels between 61–70 ng/mL; and 20 had levels between 51–60 ng/mL. Two-thirds (65%) of these children with high levels were infants. No patient had documented clinical features of vitamin D toxicity, and no further laboratory investigations, such as calcium or alkaline phosphatase, were required. Among the 31 patients with elevated results, supplementation was discontinued in 26 cases, reduced in 1 case, and no advice was documented in 4 cases. Overall, 119 repeat vitamin D level tests were performed on 93 patients (7% of the studied population). Of those 93 patients, 1 had the test repeated 5 times, unnecessarily. Fifty three patient had the test repeated once, 16 patients got twice, 9 patients repeated three times, 3 patients repeated 4 times while one child had the test repeated 5 times. In most of the 119 patients, a repeat test was not indicated. (Figure 6).

Discussion

Vitamin D deficiency is highly prevalent worldwide, and our findings indicate that Saudi Arabia is no exception. In our cohort, more than half of the children (57%) were vitamin D deficient, including 7% with severe deficiency. These results are consistent with global trends. For example, the National Health and Nutrition Examination Survey (NHANES) 2011–2014

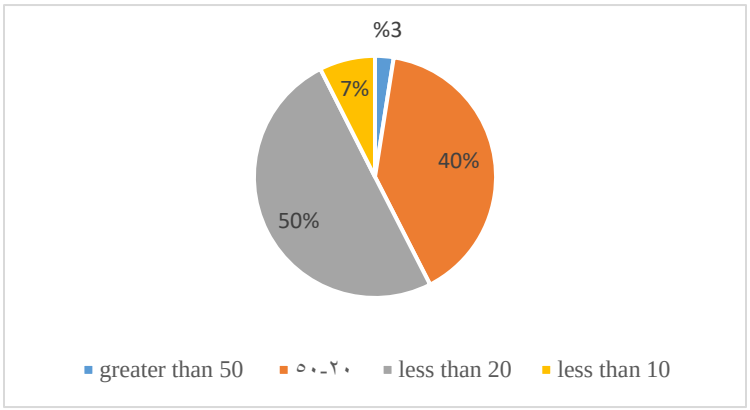

Figure 1: Distribution of patients by age.

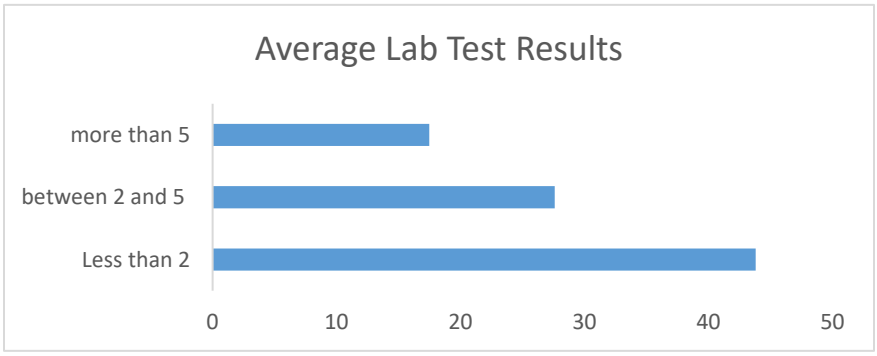

Figure 2: Mean 25-hydroxyvitamin D levels by age group.

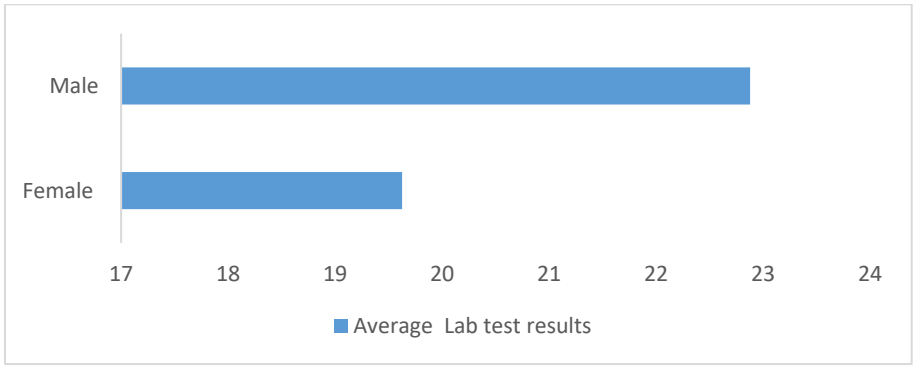

Figure3: Mean 25-hydroxyvitamin D levels by gender.

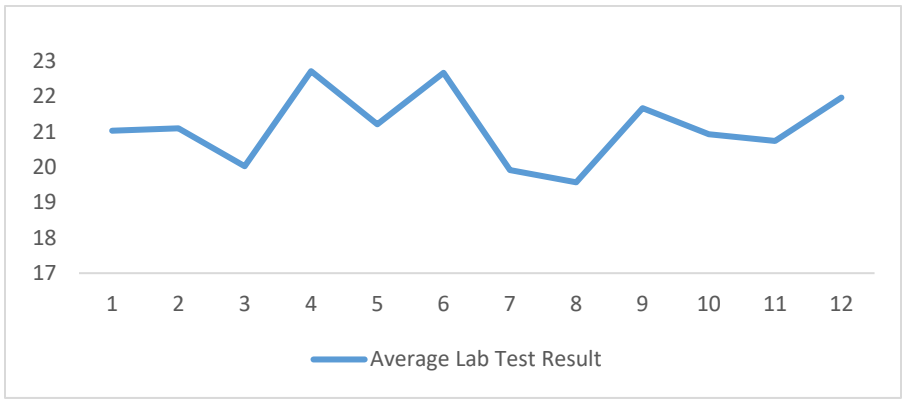

Figure 4: Mean vitamin D levels by month.

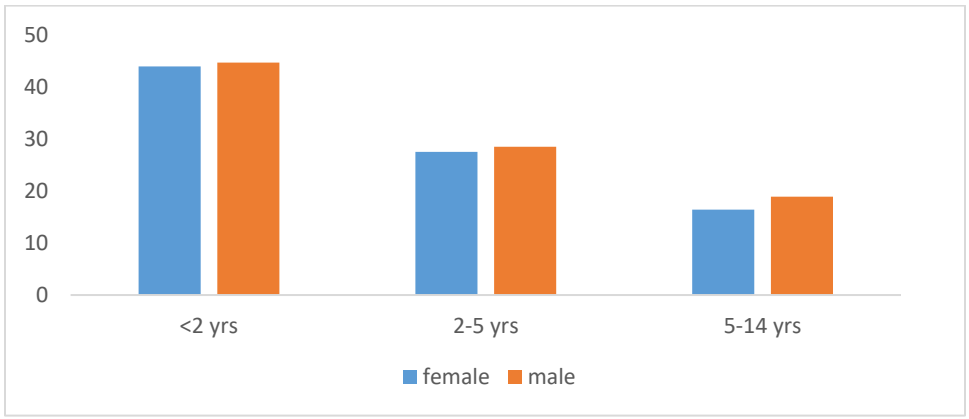

Figure 5: Vitamin D levels by age and gender.

Table 1: Shows a summary of the results by gender group, age and by gender and age group.

All tests			
Lab results group	**Total**	**%**	
> 50 ng/dL	36	3%	
20-20 ng/dL	579	40%	
10-20 ng/dL	725	50%	
< 10 ng/dL	108	7%	
	1448	100%	
Results by age group	**Mean 25 OH Vit D level (ng/mL)**	**No. of subjects**	**95% Confidence interval (lower-upper)**
< 2 yrs	43.9	61	(40.3-47.4)
2-5 yrs	27.6	295	(26.4-28.9)
> 5yrs	17.3	973	(16.9-17.8)
All	20.8	1329	(17.9-21.2)
Mean results by gender	**Mean 25 OH Vit D level (ng/mL)**	**No. of subjects**	**95% Confidence interval (lower-upper)**
Male	22.8	606	(21.9-23.7)
Female	19.2	723	(18.5-20.0)
All	20.8	1329	(17.9-21.2)
By age groups	**Mean 25 OH Vit D level (ng/mL)**		
< 2 yrs. Female	41.2	37	(35.1- 47.3)
< 2 yrs. Male	45.6	24	(41.3- 49.8)
2-5 yrs. Female	27.0	145	(25.3-28.7)
2-5 yrs. Male	28.3	150	(26.5-30.1)

> 5 yrs. Female	16.3	554	(15.7-16.9)
> 5 yrs. Male	18.8	419	(18.1-19.4)
Total		1329	

N.B Results shown do not include repeat tests.

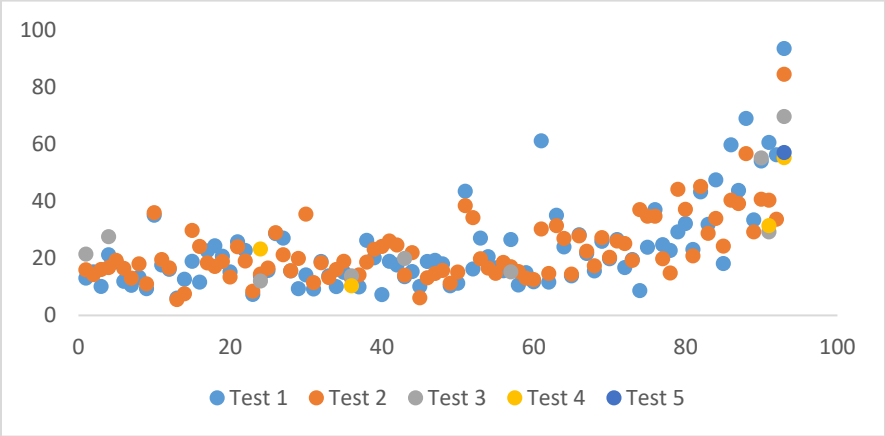

Figure 6: Distribution of repeat vitamin D testing.

Table 2: Summary of international guidelines for vitamin D definitions, screening, and supplementation in children.

Organization	Levels				Routine screening in asymptomatic children	Universal supplementation
	Deficiency ng/ml	Insufficiency ng/ml	Sufficiency ng/ml	Toxicity ng/ml		
The Endocrine Society, USA [9]	<20	20-29	30	N/A	No	Recommends empiric supplementation for children and adolescents

SACN U.K [10]	<10	N/A	>20	N/A	No	N/A
AAFP, USA [11]	<20	N/A	N/A	N/A	No	N/A
Council of Health Insurance, KSA [12]	<12.5 ng/mL	Moderate 12.5-29 Mild 30-49	>50	N/A	No	Infants 400 IU/day
RCH, Australia [13]	<12.5 ng/mL	N/A	>=20 ng/mL	>100 ng/mL	No	N/A
RCPCH, U.K [14]	<10 ng/mL	10-20 ng/mL	20-30 ng/mL	N/A	N/A	Newborn -1 month-300-400 IU, 1month-18 years 400-1000 IU
PES, USA [15]	<15 ng/mL	15-20 ng/mL	20-100 ng/mL	>150 ng/mL	No	400 IU of vitamin D/day
(NICE) U.K [16]	<10 ng/mL	10-20 ng/mL	20-30 ng/mL	N/A	No	Up to 4 years and to high-risk groups

Abbreviations: AAP, American Academy of Pediatrics; AAFP, American Academy of Family Physicians; RCH, Royal Children's Hospital (Australia); RCPCH, Royal College of Pediatrics and Child Health (UK); NICE, National Institute for Health and Care Excellence; SACN, Scientific Advisory Committee on Nutrition; DAMAN, Council of Health Insurance (Saudi Arabia); PES, Pediatric Endocrine Society.

AAFP does not provide specific numeric thresholds for vitamin D deficiency but generally considers levels <20 ng/mL as deficient. Toxicity is defined as serum 25-hydroxyvitamin D >250 nmol/L with hypercalcemia and suppression of parathyroid hormone (PTH), RCH Australia defines Toxicity as serum 25-hydroxyvitamin D >250 nmol/L with hypercalcemia and suppression of parathyroid hormone, RCPCH Sufficiency levels are not clearly defined, PES defines Excess as >250 ng/mL., .

in the United States reported that 21% of children aged 1–11 years had levels below 20 ng/mL, with one-quarter of those below 12 ng/mL [5]. Similarly, in Europe, 40% of children and adolescents had 25-hydroxyvitamin D levels below 20 ng/mL in a study of over 55,000 participants [6]. Studies in Asia have also reported high rates of deficiency among school-age children and adolescents, particularly in areas with limited sunlight exposure [17]. Collectively, these data underscore vitamin D deficiency as a global public health concern. In Saudi Arabia, a recent systematic review estimated that 81% of children and adolescents were deficient [7]. Another large cross-sectional study of more than 7,900 children similarly demonstrated a deficiency in approximately 78%, with a higher prevalence in older children [8], mirroring our findings. Limited sun exposure due to extreme heat, cultural clothing practices, and dietary habits low in vitamin D are the likely explanations for these results. These findings highlight the considerable prevalence of vitamin D deficiency among Saudi children and adolescents. Multiple guidelines regarding vitamin D testing and supplementation have been published, yet no universal consensus exists on the definitions of deficiency, sufficiency, elevated levels, or testing. A summary of current recommendations, including cut-off values, testing practices, and supplementation strategies, is provided below (Table 2). A variety of factors influence vitamin D status, including sunlight exposure, geographical location, cultural habits, and dietary intake [17,18]. These differences partly explain the variability in guideline recommendations for older children. In addition, certain patients are at higher risk of developing vitamin D deficiency. These include patients with chronic renal or liver diseases, which affect natural vitamin D absorption, those with malabsorption diseases, obese children and those on certain medications such as antiepileptics and steroids [19]. Nevertheless, several international organizations advocate for universal vitamin D supplementation, particularly in infancy. For infants up to one year of age, 400 IU/day is recommended, as higher doses do not provide additional benefit [19,20]. The European Society of Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) recommends supplementation up to 1000 IU/day in preterm infants [21]. Although fortified foods may provide sufficient intake in early childhood [22], organizations such as the Endocrine Society clinical practice guidelines recommend daily supplementation of 600–1000 IU for children and adolescents aged 1–18 years [9]. In the Saudi context, where climate and cultural practices limit sun exposure, supplementation for all children under 18 years should be strongly encouraged. Concerns regarding toxicity from universal supplementation should be minimal. Clinical manifestations of vitamin D intoxication are rarely observed at serum levels below 150 ng/mL [23]. In our cohort of 1329 children, only two patients had a level above 90 ng/mL, and none above 120 ng/mL, and no child demonstrated clinical signs or symptoms of toxicity. As reflected in (Table 2), routine screening for vitamin D in otherwise healthy children is not recommended [9-16]. Consequently, monitoring and repeat testing should be reserved for selected high-risk groups rather than performed routinely. Limitations: This study was limited to children of Aramco employees and their families, which may introduce selection bias. Most participants were Saudi children from middle- to high-socioeconomic backgrounds. Additionally, this study was conducted in the eastern region of the Saudi Kingdom, which has a much hotter climate than the rest of the Kingdom, potentially affecting exposure to sunlight. Furthermore, dietary and sun exposure were not studied and could influence Vit. D levels.

Conclusion

Our findings confirm that vitamin D deficiency is prevalent among children in Saudi Arabia. While multiple national and international guidelines recommend against routine testing, 7% of our cohort underwent repeat measurement of 25-OH vitamin D, most often as follow-up to initial deficiency. Since monitoring levels do not alter management in most cases, such testing should be limited to children at high risk. By contrast, universal supplementation for all children represents a more efficient and cost-effective strategy, as recommended by several guidelines. In our cohort, only 2.5% (31 children) had vitamin D levels above 50 ng/mL, and none demonstrated clinical signs of toxicity. The majority, in fact, had insufficient levels. These findings suggest that universal supplementation is unlikely to cause harm and could address a major preventable health issue. We therefore recommend adopting a no-testing policy combined with universal supplementation in populations with a high prevalence of vitamin D deficiency, such as ours, and reserving testing for high-risk groups. Although toxicity is rare, monitoring high-risk groups is needed.

Conflict of Interest

None

Funding
None

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