Journal of Pioneering Medical Sciences
Received December 19, 2023 Accept February 01, 2024 Publish February 29, 2024.
Volume 13, Issue 1, Pages 42-46

DOI https://doi.org/10.61091/jpms202413107

Prevalence of Vitamin D Deficiency among Children Visiting King Khalid University Hospital in Riyadh, Saudi Arabia

Ibrahim H. Al-Ayed[1,*], Seba mohammed alharbi[1], Mashael Abdullah Alzanbagi[1], Sadeem Mesfer Alqahtani[1] and Abdulmalik Abdulaziz Alharbi[1]
[1]Department of Pediatric, King Khalid university hospital, Saudi Arabia.

Corresponding author: Ibrahim H. Al-Ayed (e-mail: ialiyed@ksu.edu.sa).

Abstract **Background:** Vitamin D deficiency (VDD) is a widespread issue, especially in Saudi Arabia, with implications for various health conditions. The study aimed to evaluate VDD's prevalence and associated factors among children visiting King Khalid University Hospital (KKUH) in Riyadh, Saudi Arabia, to inform public health strategies. **Methods:** Employing a retrospective study design, medical records from 391 pediatric patients aged 1-14 who visited KKUH from April 2023 to October 2023 were analyzed for vitamin D levels, demographic data, comorbidities, and supplementation status. Based on established thresholds, vitamin D levels were categorized into normal, insufficiency, and deficiency. Statistical analyses, including chi-square tests, assessed the association between vitamin D levels and independent variables. **Results:** Out of the 391 subjects, 56.8% had normal vitamin D levels, 17.6% were deficient, and 25.6% were insufficient. Treatment or prophylaxis was reported in 75.2% of those with normal levels. The prevalence of VDD was not significantly related to gender ($p = 0.635$) but was significantly associated with age ($p < 0.001$), with higher deficiency rates observed in older children (10-14 years). Most children (84.4%) were asymptomatic, while specific symptoms like bone ache and fatigue were less commonly reported. **Conclusions:** The study highlighted a substantial prevalence of vitamin D insufficiency and deficiency among children in a Saudi Arabian tertiary care setting, with age identified as a significant correlate. These findings emphasize the need for regular screening and targeted vitamin D supplementation strategies in pediatric healthcare practice to mitigate the risks associated with VDD.

Key Words Homocysteine, Hyperhomocysteinemia, Cardiovascular disease

1. Introduction

Vitamin D is indispensable for children and vital for bone growth, immune function, and overall development. Despite its critical role, vitamin D deficiency remains an alarmingly common issue in pediatric health, with numerous studies across various geographies reporting its high prevalence [1]. Its impact spectrum ranges from severe rickets to subtler influences on immune competence and potential long-term health outcomes [2].

The pervasiveness of this deficiency has been documented globally [3]. A systematic review and meta-analysis conducted in Iran highlighted the widespread nature of the problem, revealing that a substantial proportion of healthy children had inadequate levels of vitamin D. This concern extends beyond geographical boundaries traditionally associated with deficiency [4]. This suggests that factors beyond natural sunlight exposure contribute to vitamin D status in children, warranting a more in-depth exploration of the root causes [4].

In Saudi Arabia, where one might expect sunlight to mitigate vitamin D deficiency, the reality is contrary. Research, including that of Al-Shaikh et al., reveals that Saudi children, much like their Iranian counterparts, are also affected by low vitamin D levels [5]. This deficiency poses a particular concern in regions like Riyadh, where, despite ample sunlight, cultural and lifestyle factors significantly limit exposure, thus contributing to the deficiency seen in pediatric populations.

The causes of vitamin D deficiency in children are multifaceted, ranging from indoor lifestyle choices and dietary limitations to cultural practices such as wearing extensive clothing that limits skin exposure to sunlight [6]. In the Middle East, such cultural practices are prevalent and play a considerable role in the observed vitamin D deficiency [7]. This highlights the need for public health interventions that consider cultural sensitivities and promote vitamin D through exposure and dietary intake.

The implications of vitamin D deficiency extend to children with chronic illnesses, where the risk is often higher due to various factors, including decreased mobility or nutritional deficits [3]. Systematic reviews such as that by Iniesta et al. [2] have underscored the prevalence of deficiency in pediatric cancer patients, suggesting a compounded challenge in managing the health of children with such severe conditions. Even in acute medical settings, such as intensive care units, vitamin D status can be a concern. The study by Sankar et al. [3] found an association between more extended pediatric intensive care unit stays and lower vitamin D levels, possibly due to limited exposure to sunlight and dietary variations during hospitalization. This could suggest that hospital environments might inadvertently contribute to or exacerbate existing deficiencies.

The recurrent identification of vitamin D deficiency in children signals a clear need for proactive health measures. However, diagnosis can be challenging, as clinical presentations are often nonspecific and may need to be recognized with routine screening [8]. Therefore, healthcare providers must maintain a high index of suspicion and consider regular screening and supplementation strategies.

To address these significant public health concerns, this study aims to assess the prevalence of vitamin D deficiency among children visiting King Khalid University Hospital (KKUH) in Riyadh City, Saudi Arabia. By identifying the extent and contributing factors of vitamin D deficiency in this particular pediatric population, this study seeks to inform public health strategies and healthcare practices to improve vitamin D levels among children in this region, where such data are critically needed.

2. Methodology

A. Research Design

The research adopted a retrospective study design to assess the prevalence of vitamin D deficiency among pediatric patients. This approach involved analyzing existing medical records for a set period to gather data on vitamin D levels and related factors without influencing the outcome or implementing new protocols.

B. Population of the Study

This study's population comprised pediatric patients aged 1 to 14 who visited King Khalid University Hospital (KKUH) in Riyadh, Saudi Arabia, from April 2023 to October 2023. These patients were chosen based on their presentation to the hospital and subsequent testing for vitamin D levels during that period.

C. Sampling and Sample Size

A random sampling technique was employed to select study participants. To calculate the sample size, a confidence level of 95

Assuming a margin of error of 5%, and after adjustments for non-responses and incomplete records, a final sample size of 391 patients was deemed adequate to provide statistically significant results.

A computer-generated list of random numbers was used to randomize the selection of the sample participants from the hospital's pediatric visitation records. This list corresponded to patient identification numbers, ensuring every child had an equal chance of being selected.

D. Data Collection

After obtaining ethical approval from the Institutional Review Board (IRB) at King Saud University (KSU) (project No. E-23-7830), data were retrospectively collected from medical records, which included patients' age, gender, the presence of comorbidities, measured vitamin D levels, whether they were receiving vitamin D therapeutics or prophylaxis, and any documented symptoms indicative of vitamin D deficiency or insufficiency.

This classification clearly distinguished between sufficient, insufficient, and deficient vitamin D levels, facilitating the analysis of prevalence rates [9].

E. Data Processing

Data was processed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were applied to summarize the characteristics of the study population, including mean and standard deviation for continuous variables and frequencies and percentages for categorical variables. The chi-square test of independence was used to investigate the association between vitamin D levels and various independent variables such as age, gender, and presence of comorbidities. This test helped determine whether there were any statistically significant differences or relationships between categorical variables in the study.

3. Results

The study sample consisted of 391 pediatric subjects, with no cases omitted due to missing data. The average age of the children involved in the study was 7.59 years, with a standard deviation of approximately 3.92 years. This variation indicates a broad age range within the study population. The youngest participant was one year old, and the oldest was 14.

In terms of gender distribution, the sample was evenly divided with 196 males, making up 50.1% of the participants, and 195 females, accounting for 49.9%. This parity ensures a gender-balanced analysis in the study's further examination of vitamin D deficiency.

The frequency of comorbidities within the sample was low; 333 children, or 85.2%, reported no comorbid conditions, while 58 children, corresponding to 14.8%, had at least one comorbidity. This indicates that most of the children sampled for the study were not affected by comorbid conditions that could influence the prevalence of vitamin D deficiency.

Variable	F (%)
Age (M±SD)	7.59±3.92
Gender	
1. Male	196 (50.1%)
2. Female	195 (49.9%)
Presence of any comorbidity	
1. Yes	58 (14.8%)
2. No	333 (85.2%)

Table 1: Baseline characteristics of the recruited pediatric patients (n=391)

Table 2 investigated the prevalence of vitamin D deficiency in 391 pediatric patients. Vitamin D levels were categorized into normal, deficient, and insufficient. Among the participants, the majority, 56.8%, had vitamin D levels within the normal range. Additionally, 17.6% of the children were found to be vitamin D deficient, while 25.6% fell into the insufficient category.

Further analysis was conducted on the subset of patients with normal vitamin D levels to ascertain their exposure to vitamin D treatment or prophylaxis. Among the 222 patients with normal levels, a significant proportion, 167 (75.2%), reported receiving either treatment or prophylaxis for vitamin D deficiency. In contrast, 55 (24.8%) of these patients with normal levels had not received such interventions. This finding highlights the potential impact of vitamin D supplementation or prophylaxis in maintaining adequate vitamin D status in the pediatric population.

Symptomatology was also recorded, with the predominant finding being that the vast majority of the children, 330 (84.4%), were asymptomatic. Specific symptoms were less commonly reported: bone ache was present in 8 (2%) of the children, headache in 4 (1%), and failure to thrive in 1 (0.3%). Additionally, fatigue was reported by 3 (0.8%) of the participants, muscle aches by 1 (0.3%), and other symptoms were noted by 44 (11.3%).

Table 3 illustrates the prevalence of vitamin D deficiency among pediatric participants based on their demographic characteristics. The relationship between vitamin D levels and gender was not statistically significant (p = 0.635), with males representing 51.4% and 49% in the standard and insufficient categories, respectively, and females comprising a similar distribution with 48.6% in the normal category and 49% in the insufficient category. However, vitamin D deficiency was found to be significantly related to age (p < 0.001), which is considered statistically significant at $\alpha \geq 0.05$.

Specifically, within the normal vitamin D level group (222 patients), the age distribution was as follows: 36.9% were aged 1-4 years, 38.3% were 5-9 years, and 24.8% were 10-14 years. This indicates a relatively even distribution across the younger age groups.

For the deficiency category (69 patients), there was a notable increase in prevalence with age: only 5.8% were aged 1-4 years, but this increased to 37.7% for ages 5-9 years and further to 56.5% for ages 10-14 years. This trend suggests that vitamin D deficiency becomes more prevalent as children grow older.

In the insufficient category (100 patients), the age group distribution was 11% for ages 1-4 years, 51% for 5-9 years, and 38% for 10-14 years. This shows a higher concentration of vitamin D insufficiency in the middle age group (5-9 years), compared to the youngest and oldest age groups.

4. Discussion

In the present study, the prevalence of vitamin D deficiency among 391 pediatric patients was explored, revealing that 17.6% of subjects were deficient and 25.6% were insufficient in vitamin D. These findings appear to diverge from the markedly higher prevalence rates reported in the Saudi pediatric population in the study by Al-Shaikh et al., [5] where 95.3% of the subjects exhibited vitamin D deficiency or insufficiency. The disparity between these findings may be due to geographical, nutritional, cultural, and environmental factors affecting vitamin D synthesis from sunlight exposure and dietary intake.

Furthermore, while the current study did not find a significant gender difference in vitamin D levels (p = 0.635), the research by Al-Shaikh et al. [5] observed a higher prevalence of combined vitamin D deficiency and insufficiency in females (97.8%) compared to males (92.8%), which was statistically significant (p<0.001). This gender difference in the Saudi cohort might be attributed to cultural practices such as clothing and less outdoor activity among females, which reduce sunlight exposure essential for vitamin D synthesis.

The longitudinal study by Al-Daghri et al. [10] documents a decreasing trend in vitamin D deficiency in Saudi Arabia from 2008 to 2017, attributing it to successful public health campaigns and possibly increased awareness and supplementation. Comparatively, the current study shows that a significant proportion (75.2%) of pediatric patients with normal vitamin D levels had received treatment or prophylaxis, indicating a possible effect of medical interventions on improving vitamin D status, which aligns with the notion of effective public health strategies seen in Al-Daghri et al.'s findings [10].

Age was a significant factor in vitamin D levels in the current research, with older children showing a higher prevalence of deficiency and insufficiency. This contrasts with Al-Shaikh et al.'s [5] findings, which did not stratify vitamin D status by age groups for comparison.

Moreover, when juxtaposing our findings with those of Wei et al. [11] in their study, we observe notable differences in dietary patterns that may contribute to varying vitamin D levels across populations. It can be postulated that as children grow older, their dietary habits tend to include more fast food and junk food, which are typically low in essential nutrients like vitamin D. This shift in eating habits, coupled with potential decreases in outdoor activities due to academic pressures or lifestyle changes, might further contribute to the reduced synthesis of vitamin D, thus affecting its levels in young youth and adults.

Characteristics	F (%)
Vitamin D Level	
1. Normal between 50-250 nmol/L	222 (56.8%)
2. Deficiency less than 37.5 nmol/L	69 (17.6%)
3. Insufficient 37.5-50 nmol/L	100 (25.6%)
If normal level, did the patient receive vitamin d therapeutic level or was on prophylaxis (n=222)	
1. Yes	167 (75.2%)
2. No	55 (24.8%)
Symptoms	
1. Asymptomatic	330 (84.4%)
2. Bone Ache	8 (2%)
3. Headache	4 (1%)
4. Failure to thrive	1 (0.3%)
5. Fatigue	3 (0.8%)
6. Muscle ache	1 (0.3%)
7. Other	44 (11.3%)

Table 2: Prevalence of Vitamin D deficiency

Vitamin D levels				
	Normal between 50-250 nmol/L	Deficiency less than 37.5 nmol/L	Insufficient 37.5-50 nmol/L	P-value
Gender				
1. Male	114 (51.4%)	31 (44.9%)	51 (49%)	0.635
2. Female	108 (48.6%)	38 (55.1%)	49 (49%)	
Age				
1. 1-4 Years	82 (36.9%)	4 (5.8%)	11 (11%)	0.000*
2. 5-9 Years	85 (38.3%)	26 (37.7%)	51 (51%)	
3. 10-14 Years	55 (24.8%)	39 (56.5%)	38 (38%)	
*Statistically significant at ($\alpha \geq$0.05)				

Table 3: Prevalence of Vitamin D deficiency based on recruited participants' demographic characteristics

Carakushansky et al. [12] study is particularly pertinent when discussing comorbidities. In this research, 70% of children with type 1 diabetes mellitus (T1DM) showed reduced levels of vitamin D, a concern echoed by our study's finding that 14.8% of children with at least one comorbidity were part of the study cohort. While the present study did not specifically investigate the relationship between T1DM and vitamin D deficiency, Carakushansky et al. study findings highlight the importance of vitamin D status in children with chronic diseases, such as T1DM [12].

The predominance of asymptomatic cases in the current study (84.4%) conducted among children visiting King Khalid University Hospital in Riyadh, Saudi Arabia, is notable. It suggests that vitamin D deficiency and insufficiency may often go undetected in the pediatric population without routine screening. This underscores the importance of preventive measures and raising awareness. In Saudi Arabia, where cultural practices and environmental factors may limit sun exposure, a key source of vitamin D, routine screening becomes exceptionally crucial. Additionally, considering dietary habits and potential genetic predispositions in the Saudi population, recommendations should include fortifying common foods with vitamin D, promoting outdoor activities in safer sun exposure periods, and possibly supplementing vitamin D, especially in high-risk groups. These steps are vital as asymptomatic deficiency may still have long-term skeletal and possibly non-skeletal effects, emphasizing the need for proactive healthcare approaches tailored to the Saudi pediatric population.

One notable limitation of the current study is the need for comprehensive data on dietary vitamin D intake and the extent of sun exposure for pediatric patients. These factors are critical determinants of vitamin D status, as they directly affect the synthesis and dietary sources of vitamin D. Without this information, it is challenging to fully understand the etiology of the vitamin D deficiency observed in the study subjects. Additionally, the cross-sectional nature of the study design precludes the establishment of causality. This means that while associations between vitamin D levels and certain demographic or health factors can be identified, it is impossible to determine whether these factors directly caused the observed deficiencies or insufficiencies in vitamin D.

Another limitation is the potential selection bias inherent in the patient population, which consists of individuals attending a healthcare facility for various reasons. This sample may not accurately represent the general pediatric population, as children with health concerns or those who regularly visit the hospital may have different vitamin D levels due to their health conditions or greater health vigilance by their caregivers. Furthermore, the study did not account for seasonal variations in vitamin D levels, which are known to fluctuate with changes in sunlight exposure. This omission could have led to an underestimation or overestimation of vitamin D deficiency prevalence if the data collection coincided with periods of particularly high or low sun exposure.

5. Conclusion

In conclusion, the present study highlights that while vitamin D deficiency is a global concern, its prevalence and the factors contributing to it can vary significantly by region. These findings suggest a need for localized public health policies tailored to the specific needs of the population, considering age, gender, cultural practices, and the presence of comorbidities. Continued efforts in public health strategies for vitamin D supplementation and health education are imperative, especially for at-risk groups such as older children and those with chronic diseases.

Conflict of interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

Authors Contribution

All authors contributed equally in this paper.

References

[1] Jazayeri, M., Moradi, Y., Rasti, A., Nakhjavani, M., Kamali, M., & Baradaran, H. R. (2018). Prevalence of vitamin D deficiency in healthy Iranian children: A systematic review and meta-analysis. Medical journal of the Islamic Republic of Iran, 32(1) :480-485

[2] Iniesta, R. R., Rush, R., Paciarotti, I., Rhatigan, E. B., Brougham, F. H. M., McKenzie, J. M., & Wilson, D. C. (2016). Systematic review and meta-analysis: Prevalence and possible causes of vitamin D deficiency and insufficiency in pediatric cancer patients. Clinical Nutrition, 35(1), 95-108.

[3] Sankar, J., Lotha, W., Ismail, J., Anubhuti, C., Meena, R. S., & Sankar, M. J. (2016). Vitamin D deficiency and length of pediatric intensive care unit stay: a prospective observational study. Annals of Intensive Care, 6(1), 1-9.

[4] Meena, P., Dabas, A., Shah, D., Malhotra, R. K., Madhu, S. V., & Gupta, P. (2017). Sunlight exposure and vitamin D status in breastfed infants. Indian Pediatrics, 54, 105-111.

[5] Al Shaikh, A. M., Abaalkhail, B., Soliman, A., Kaddam, I., Aseri, K., Al Saleh, Y., ... & Mukhtar, A. M. (2016). Prevalence of vitamin D deficiency and calcium homeostasis in Saudi children. Journal of Clinical Research in Pediatric Endocrinology, 8(4), 461-467.

[6] Roth, D. E., Abrams, S. A., Aloia, J., Bergeron, G., Bourassa, M. W., Brown, K. H., ... & Whiting, S. J. (2018). Global prevalence and disease burden of vitamin D deficiency: A Roadmap for Action in Low and Middle income Countries (Vol. 1430, No. 1, pp. 44-79).

[7] Goyena, E. A., Maniego, M. L. V., Ducay, A. J. D., Tandang, N. A., Talavera, M. T. M., & Barba, C. V. C. (2019). Complementary feeding practices and determinants of micronutrient status of rural young children in the Philippines. Philippine Journal of Science, 148(4), 689-703.

[8] Alonso, M. A., Mantecón, L., & Santos, F. (2019). Vitamin D deficiency in children: a challenging diagnosis!. Pediatric Research, 85(5), 596-601.

[9] Marrone, G., Rosso, I., Moretti, R., Valent, F., & Romanello, C. (2012). Is vitamin D status known among children living in Northern Italy?. European Journal of Nutrition, 51, 143-149.

[10] Al-Daghri, N. M., Hussain, S. D., Ansari, M. G., Khattak, M. N., Aljohani, N., Al-Saleh, Y., ... & Alokail, M. S. (2021). Decreasing prevalence of vitamin D deficiency in the central region of Saudi Arabia (2008-2017). The Journal of Steroid Biochemistry and Molecular Biology, 212, 105920.

[11] Wei, J., Zhu, A., & Ji, J. S. (2019). A comparison study of vitamin D deficiency among older adults in China and the United States. Scientific Reports, 9(1), 19713.

[12] Carakushansky, M., Patel, P., Khallouq, B., & Gurnurkar, S. (2020). Prevalence of Vitamin D Deficiency in Children with Type 1 Diabetes Mellitus. Cureus, 12(4), e7836-e7836.