# PREVALENCE OF VITAMIN D DEFICIENCY AND ASSOCIATED FACTORS IN CHILDREN AGED 6 MONTHS TO 16 YEARS AT SUNGROUP INTERNATIONAL HOSPITAL IN 2024-2025

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**ABSTRACT**

***Objective:*** *To determine the prevalence of vitamin D deficiency and describe associated factors among children aged 6 months to 16 years attending the Pediatrics - Vaccine Department, SunGroup International Hospital, during 2024-2025.*

***Subjects and Methods:*** *A cross-sectional descriptive study was conducted on 120 conveniently selected children. Clinical information, medical history, nutritional and environmental factors were collected, and serum 25-hydroxyvitamin D [25(OH)D] levels were measured at the hospital's Laboratory Department. Vitamin D status was classified according to the Global Consensus Recommendations (2016). Associations were analyzed using Chi-square tests and logistic regression.*

***Results:*** *Among 120 participants, the mean serum vitamin D concentration was 23.7 ± 7.68 ng/ml. Vitamin D deficiency (<20 ng/ml) accounted for 37.7%, insufficiency (20-29 ng/ml) for 46.7%, while only 15.6% of children achieved sufficient levels (≥30 ng/ml). The prevalence of vitamin D deficiency in children aged 6-16 years is 4.88 times higher than that in children aged 6 months to 6 years. Children without vitamin D supplementation were 4.53 times more likely to be deficient than those receiving supplementation. The prevalence of deficiency was higher among exclusively breastfed children compared to those fed formula or mixed feeding. No significant associations were found between vitamin D status and nutritional condition, dyslipidemia, outdoor activity, or screen time.*

***Conclusion:*** *The prevalence of vitamin D deficiency among children attending Sun Hospital in 2024-2025 was 37.7%. Deficiency was more common in children aged ≥6 years, those without supplementation, and those exclusively breastfed.*

***Keywords:*** *Vitamin D, Vitamin D deficiency, Children, 25(OH)D, SunGroup International Hospital.*

## I. INTRODUCTION

Vitamin D is an essential micronutrient playing a crucial role in calcium-phosphorus metabolism, skeletal system development, immune function, and numerous other biological processes. Vitamin D deficiency is a common condition globally, with approximately 1 billion people affected by vitamin D deficiency or insufficiency. In children, vitamin D deficiency increases the risk of rickets, growth retardation, reduced immunity, and may be associated with various chronic diseases [2-3].

In Vietnam, the prevalence of vitamin D deficiency in children ranges from 40-60% depending on the region and age group. Children living in urban areas, with limited

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outdoor physical activity, and without vitamin D supplementation constitute a high-risk group [2-4].

SunGroup International Hospital is a modern medical facility receiving a large number of children for periodic check-ups annually. However, there has been no study evaluating the status of vitamin D deficiency in children visiting the hospital, especially in the context of changing lifestyles and daily habits of urban children.

Therefore, we conducted the study: ***"A survey on the prevalence of vitamin D deficiency and associated factors in children aged 6 months to 16 years at SunGroup International Hospital in 2024-2025"***.

## II. RESEARCH SUBJECTS AND METHODS

### *2.1. Research subjects*

Children aged 6 months to 16 years visiting the Pediatrics - Vaccine Department, SunGroup International Hospital, who underwent serum 25(OH)D testing.

### *2.2. Inclusion and exclusion criteria*

*2.2.1. Inclusion criteria:*

- Children aged 6 months to 16 years.
- Family consented to participate in the study.

*2.2.2. Exclusion criteria:*

- Vitamin D-resistant rickets.
- Currently suffering from acute diseases requiring treatment.
- Currently suffering from acute diseases requiring treatment.
- Children with chronic diseases such as congenital heart disease, congenital lung disease, hepatobiliary diseases, or diseases related to vitamin D metabolism and absorption.
- Congenital or acquired deformities: Exclusion of cases significantly affecting anthropometric indices, including spinal deformities, limb defects, and muscle atrophy.
- Special medical treatment: Exclusion of children undergoing treatments that may affect anthropometric indices.

### *2.3. Research setting and duration*

Research setting: Pediatrics - Vaccine Department, SunGroup International Hospital. Tests in the study were performed at the Laboratory Department, SunGroup International Hospital.

The research duration is from November 1, 2024 to October 31, 2025.

### *2.4. Research methods*

*2.4.1. Research design: Cross-sectional descriptive study*

*2.4.2. Sample size and sampling technique*

** Sample size:* Applying the formula for estimating a population proportion:

$$n = Z^2_{1-\frac{\alpha}{2}} \times \frac{p\,(1-p)}{(p\varepsilon)^2}$$

Substituting into the formula yields n = 103. Adding 10% for potential dropouts, the estimated sample size is 120 children.

** Sampling technique:* Convenient sampling (selecting all patients meeting the inclusion criteria during the study period).

*2.4.3. Research variables and indices*

Children participating in the study had general information collected, including age, gender, residential area, nutritional status, breastfeeding history, sun exposure habits, level of outdoor activity, and screen time. Additionally, nutritional factors (vitamin D supplementation level, diet), clinical characteristics (signs suggesting vitamin D deficiency such as muscle pain, fatigue, night sweats, signs of rickets), and subclinical indices including total calcium, phosphorus, PTH, ferritin, iron and zinc were recorded.

Vitamin D concentration was evaluated via quantitative testing of 25-hydroxyvitamin D [25(OH)D], the major circulating form in the body and the most accurate indicator reflecting the child's vitamin D status. The test was performed using the electrochemiluminescence immunoassay (ECLIA) method on a modern automated system at the Laboratory Department, SunGroup International Hospital.

*Evaluation of serum 25(OH)D concentration results:*

Vitamin D status was classified according to guidelines:[8]

- < 10ng/ml: Severe vitamin D deficiency
- 10 - 19 ng/ml: Vitamin D deficiency
- 20 - 29 ng/ml): Vitamin D insufficiency.
- ≥ 30 ng/ml: Sufficient vitamin D levels.

*2.4.4. Data analysis and processing*

The figures are encoded and processed using SPSS 20.0 software. Qualitative variables are presented as percentages; quantitative variables are described as mean ± standard deviation for normal distributions, or median and min-max range for non-normal distributions. Differences between two means were compared using the Independent sample T-test or Paired sample T-test; ANOVA was applied when comparing multiple groups. Statistical significance was defined as $p < 0.05$. Univariate logistic regression was used to evaluate the association between risk factors and study outcomes.

*2.4.5. Ethical considerations*

The study did not intervene in diagnostic or treatment procedures and caused no harm to participants. Personal information was kept strictly confidential. The research proposal was approved by the Ethics Council of SunGroup International Hospital under Decision No. 21a/QD-SGH dated April 1, 2025.

## III. RESEARCH RESULTS

### *3.1. Survey of the prevalence of vitamin D deficiency in children aged 6 months to 16 years examining at the Pediatrics - Vaccine Department, SunGroup International Hospital in 2024-2025*

**Table 1.** General characteristics of the research team

| Characteristics of children examined (n= 122) | Number of children (n) | Percentage (%) | P |
|---|---|---|---|
| Age | 6 months to 6 years | 18 | 14.8 |
| | 6 years to 16 years | 104 | 85.2 |
| | Mean<br>Min - Max | 10.38 ± 3.61<br>0.77 - 15.71 | 0,75 |
| Gender | Male | 67 | 54.9 |
| | Female | 55 | 45.1 |
| Geography | Urban | 122 | 100 |
| | Rural | 0 | 0 |
| Region | North | 110 | 90.1 |
| | Central | 4 | 3.3 |
| | South | 8 | 6.6 |
| School | Public | 71 | 58.2 |
| | Private | 51 | 41.8 |

*Comment:* The age of children was predominantly in the older group (>6 years), accounting for 85.2%. The mean age of subjects was 10.38 ± 3.61 years. The male/female ratio was 1.22/1. The majority of children lived in the Northern region (90.1%), mostly in Hanoi. Children attending public schools accounted for 58.2%, and 100% of children were of Kinh ethnic group.

**Table 2.** Distribution of 25(OH)D concentrations of children

| 25(OH)D concentration | Number of children (n) | Percentage (%) |
|---|---|---|
| < 10 ng/ml | 0 | 0 |
| 10 - 19 ng/ml | 46 | 37.7 |
| 20-29 ng/ml | 57 | 46.7 |
| ≥30 ng/ml | 19 | 15.6 |
| Mean<br>(Min - Max) | 23,7 ±7.68<br>10,61- 53,23 | |

*Comment:* The majority of children had vitamin D insufficiency, accounting for 46.7%. The prevalence of vitamin D deficiency was 37.7%. Only 15.6% of examined children achieved sufficient 25(OH)D levels (≥ 30 ng/ml). The mean vitamin D concentration was 23.7 ± 7.68 ng/ml.

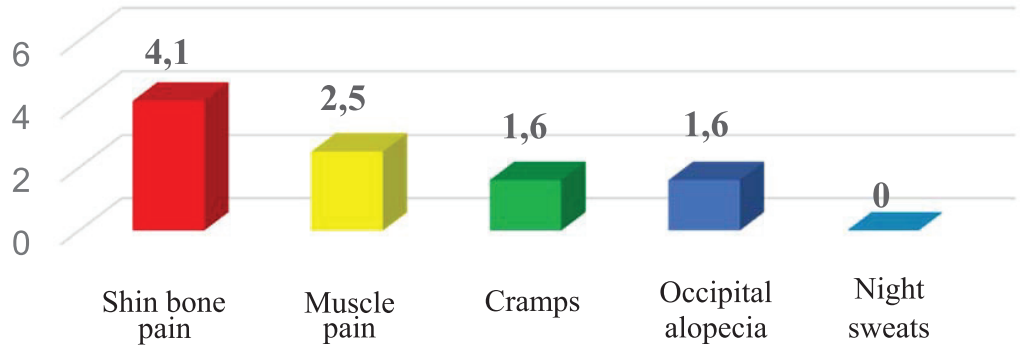


**Figure 1.** Clinical symptoms of vitamin D deficiency

*Comment:* Clinical manifestations of vitamin D deficiency were primarily long bone pain (shin bone), at 4.1%. Muscle pain accounted for 2.5%, while cramps and occipital alopecia accounted for a low percentage.

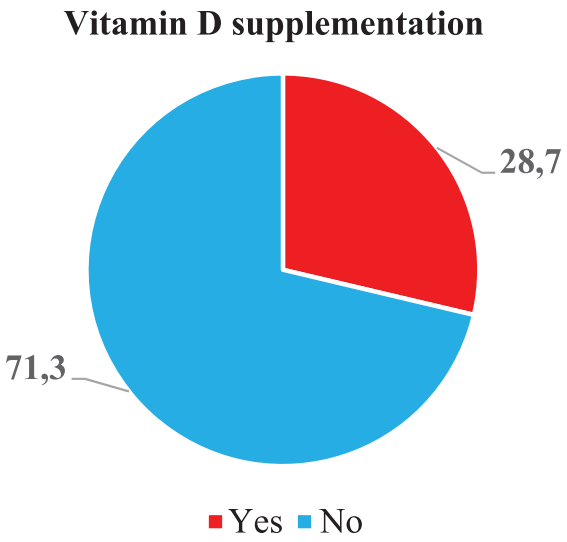


**Figure 2.** Vitamin D supplementation in the past 2 months

*Comment:* In the research group, approximately 28.7% of children received vitamin D supplementation in the past 2 months. The number of children not receiving daily vitamin D supplementation reached 71.3%.

### *3.2. Assessment of some factors associated with vitamin D deficiency status*

| Factor | Vitamin D deficiency | | | | OR (95% CI) | p |
|---|---|---|---|---|---|---|
| | Yes (<30 ng/ml) | | No (≥30 ng/ml) | | | |
| | n | % | n | % | | |
| **Age** | | | | | | |
| ≥ 6 years old | 92 | 75.4 | 12 | 9.8 | 4.88(1.58-14.3) | 0.008 |
| < 6 years old | 11 | 9 | 7 | 5.7 | | |
| **Gender** | | | | | | |
| Boys | 57 | 46.7 | 10 | 8.2 | 1.12 (0.42-2.97) | 0.83 |
| **Calcium concentration** | | | | | | |
| Decreased calcium | 2 | 66.7 | 1 | 33.3 | | 0.401 |
| Decreased ionic calcium | 17 | 89.5 | 2 | 10.5 | | 0.18 |
| **Nutritional status** | | | | | | |
| Wasting | 4 | 3.3 | 0 | 0 | | |
| Normal | 81 | 66.4 | 17 | 13.9 | | 0.76 |
| Overweight-Obese | 18 | 14.8 | 2 | 2 | | |
| **Clinical symptoms** | | | | | | |
| Shin bone pain (+) | 5 | 4.1 | 0 | 0 | 2.18 ( 0.12- 39.7) | 0.422 |
| Muscle pain (+) | 3 | 2.5 | 0 | 0 | 1.36 (0.07 - 27.7) | 0.599 |
| Cramps (+) | 2 | 1.6 | 0 | 0 | 0.96 ( 0.04-23.3) | 0.712 |
| Occipital alopecia (+) | 2 | 1.6 | 0 | 0 | 0.96 ( 0.04-23.3) | 0.712 |
| **Diet in first 6 months** | | | | | | |
| Exclusive breastfeeding (+) | 10 | 55.6 | 2 | 11.1 | | |
| Formula milk (+) | 1 | 5.6 | 2 | 11.1 | | 0.01 |
| Mixed feeding (+) | 0 | 0 | 3 | 16.7 | | |
| General | 11 | 61.2 | 7 | 38.9 | | |
| **Blood LDL** | | | | | | |
| ≤2.8 mmol/l | 42 | 47.2 | 4 | 4.5 | 3.18 (0.92-11.1) | 0.059 |
| **Vitamin D supplementation** | | | | | | |
| Yes | 24 | 19.7 | 11 | 9 | 4.53 (1.62-12.7) | 0.02 |
| No | 79 | 64.8 | 8 | 6.5 | | |
| **Outdoor activities** | | | | | | |
| Frequent | 45 | 36.9 | 6 | 4.9 | | |
| Infrequent | 49 | 40.9 | 10 | 8.2 | | 0.467 |
| None | 9 | 7.4 | 3 | 2.5 | | |
| **TV/phone watching time** | | | | | | |
| None | 1 | 0.8 | 0 | 0 | | |
| Infrequent | 16 | 13.1 | 6 | 6 | | 0.25 |
| Frequent | 86 | 70.5 | 13 | 13 | | |

*Comment:* Vitamin D deficiency was more common in children aged ≥6 years and those without vitamin D supplementation. Exclusive breastfeeding in the first 6 months was also associated with a higher prevalence of deficiency. Other factors such as gender, blood calcium, nutritional status, clinical symptoms, outdoor activity, and screen time showed no statistically significant association.

## IV. DISCUSSION

The study was conducted on 122 children visiting the Pediatrics - Vaccine Department at SunGroup International Hospital, characterized by a majority of school-aged children living in urban areas. This created a unique characteristic for the study population, as these children tend to have less sun exposure, dense academic schedules, and limited outdoor activities—factors that can significantly impact vitamin D status. The prevalence of vitamin D deficiency/insufficiency accounted for 84.4%, with mild and moderate deficiency being the majority, and only 15.6% of children achieving sufficient levels. This result is significantly higher than the study by Luu Thi My Thuc (2018), which recorded a deficiency rate of 44.5% and sufficiency rate of 31.6% [8]. This discrepancy can be explained by differences in location (mostly urban children with little sun exposure), lifestyle characteristics (strict sun protection), as well as inconsistent adherence to vitamin D supplementation.

Total calcium concentrations were nearly normal in most children, consistent with reports by Torkaman (2016) and Yoon (2011) [7]. However, the rate of decreased ionic calcium was quite high (15.6%) and primarily found in the vitamin D deficient group, suggesting that ionic calcium is a sensitive indicator for detecting consequences of chronic vitamin D deficiency

*Factors associated with vitamin D deficiency*

Children aged 6-16 years were nearly 5 times more likely to be vitamin D deficient than the group aged <6 years. This result aligns with Luu Thi My Thuc's study, which also noted that school-aged children (6-11 years) had significantly lower 25(OH)D levels. This may stem from reduced parental attention to nutrition as children grow older, alongside reduced sun exposure due to dense study schedules.

There was no difference in the prevalence of vitamin D deficiency between males and females, similar to many domestic and international studies. This reflects comparable levels of sun exposure and vitamin D supplementation between genders in the urban community.

Exclusively breastfed children had a higher rate of vitamin D deficiency, consistent with studies in Turkey (İhsan Gül) and Mexico [5,7], due to lower vitamin D concentrations in breast milk compared to formula. However, the sample size of children under 6 years in this study was limited, necessitating larger studies for confirmation.

Lack of vitamin D supplementation increased the likelihood of deficiency by 4.53 times. This result is consistent with the Global Consensus Recommendations (2016) and numerous international intervention studies, showing that supplementation significantly improves 25(OH) D levels.[1]

No association was recorded between outdoor activity and vitamin D status. This differs from Luu Thi My Thuc's study (rural children exposed to more sun had less deficiency) and Phan Thi Dieu Ngoc's study (longer sun exposure reduced deficiency risk). This may be because most children in the study, despite limited outdoor activity, consumed vitamin D-fortified milk or received regular supplementation from parents.

There was no association between TV/phone time and vitamin D deficiency, similar to the study at the National Children's Hospital [3]. This result is in contrast to research by Rishub Karan Das, which found that children who spent more than 5 hours a day on electronic devices were twice as likely to be deficient in vitamin D. The difference may be due to the fact that the group of children in the study had better nutritional conditions and higher levels of vitamin D supplementation than the general population.

## V. CONCLUSION

The study on 122 children visiting the Pediatrics - Vaccine Department at Sun Hospital showed that the mean serum 25(OH)D concentration was 23.7 ± 7.68 ng/ml, with prevalence rates of deficiency/insufficiency at 37.7%/46.7%, while only 15.6% achieved sufficient levels. Vitamin D deficiency was significantly more common in children over 6 years old. Children aged 6-16 years were 4.88 times more likely to be deficient than younger children. Children without vitamin D supplementation were 4.53 times more likely to be deficient compared to those receiving supplementation. The prevalence of deficiency in children exclusively breastfed in the first 6 months was higher than in those fed formula or mixed feeding. No statistically significant association was found between vitamin D deficiency and nutritional status, dyslipidemia, outdoor activity levels, or screen time. The results indicate that vitamin D deficiency is a common condition among urban children and is influenced by age and vitamin D supplementation.

## VI. RECOMMENDATIONS

Consider routine vitamin D supplementation for children to contribute to reducing the prevalence of vitamin D deficiency. Periodic quantitative vitamin D testing is recommended to detect deficiency early and provide supplementation protocols to optimize height and comprehensive development. Further in-depth studies with larger sample sizes regarding the relationship between vitamin D and associated factors are needed to establish standard recommendations for clinical practice.

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