SERUM 25-(OH)D AND ASSOCIATED FACTORS IN 12–36-MONTH-OLD CHILDREN AT DR. NUTRI, 2023–2024

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Received: 29/10/2025; Reviewed: 17/11/2025; Revised: 23/11/2025; Accepted: 26/12/2025
DOI: *https://doi.org/10.58902/nckhpt.e-v1i1.308*

Abstract

Vitamin D plays an important role in bone development and child health; however, vitamin D deficiency and supplementation practices in the community have not been fully described. This cross-sectional descriptive study aimed to determine the prevalence of vitamin D deficiency, assess vitamin D supplementation levels from different sources, and analyze the association between supplementation dose and serum 25-hydroxyvitamin D [25-(OH)D] concentrations in children aged 12–36 months who visited Dr. Nutri Nutrition Clinic during October 2023–April 2024. A total of 175 eligible children were included. The results showed that 24.6% of children had vitamin D deficiency, while 75.4% reached the sufficient threshold. Regarding vitamin D supplementation, 14.9% of children received supplementation below recommendations, 58.3% received recommended supplementation, and 26.8% received supplementation above recommendations. There was a statistically significant association between supplementation dose and serum 25-(OH)D concentrations ($p < 0.001$). The study confirms that vitamin D supplementation in accordance with recommendations contributes to improving vitamin D status in young children.

Keywords: *Serum 25-hydroxyvitamin D concentration; vitamin D supplementation; children aged 12–36 months.*

1. Introduction

Vitamin D plays a critical role in bone development and remodeling through the activity of osteoblasts and osteoclasts. This vitamin is essential for maintaining calcium, phosphate, and magnesium homeostasis by regulating intestinal absorption and renal reabsorption/excretion processes (Allgrove, 2009).

In clinical practice, vitamin D status is assessed by measuring serum 25-hydroxyvitamin D concentrations. This is the major circulating metabolite of vitamin D and is considered the most reliable biomarker reflecting the body's vitamin D stores. A global review reported that vitamin D deficiency is highly prevalent, with 47.9% (95% CrI: 44.9–50.9%) of the population having serum 25-hydroxyvitamin D levels below 50 nmol/L (Cui et al., 2023).

In Vietnam, a study conducted at the National Children's Hospital showed that 63.89% of children had vitamin D levels within the normal range (75–250 nmol/L), yet 35.19% still had levels below the optimal threshold (Pham Van Duong & Nguyen Thi Dieu Thuy, 2021).

For children aged 12–36 months, natural dietary sources of vitamin D are very limited, and intake mainly relies on supplements and infant formula. This situation increases the risk of inadequate or excessive vitamin D supplementation in this age group. According to the Recommended Dietary Allowances for Vietnamese people, the vitamin D requirement is 400 IU/day for children under 1 year of age and 600 IU/day for children aged 1 year and older (Le Danh Tuyen et al., 2016).

Although several studies have investigated vitamin D status in Vietnamese children, most were conducted in hospital settings among specific disease groups. Evidence on vitamin D status and vitamin D use in the community remains limited, particularly among healthy children attending routine check-ups at primary healthcare facilities. Therefore, this study was conducted to assess serum 25-hydroxyvitamin D

concentrations and factors related to vitamin D use among children aged 12–36 months visiting Dr. Nutri Nutrition Clinic during 2023–2024.tại phòng khám dinh dưỡng Dr. Nutri trong giai đoạn 2023–2024.

2. Literature Review

Vitamin D deficiency is common and has been documented in many studies across different population groups (Nair & Maseeh, 2012). Multinational studies indicate wide variation in the prevalence of vitamin D deficiency among children across regions. In Europe, the prevalence ranges from 22.8% in Western Europe to more than 50% in some Eastern European countries (Cashman et al., 2016). A study of school-aged children in the Netherlands found that 29.8% had 25-(OH)D levels below 50 nmol/L, with a markedly higher prevalence in winter (51.3%) than in summer (10.3%), and higher prevalence among children of African, Asian, Turkish, and Moroccan origin (54.5%) compared with children of Dutch or Western European origin (17.6%) (Voortman et al., 2015).

Multiple factors increase the risk of vitamin D deficiency in children. Biological factors include darker skin pigmentation (requiring longer sun exposure to synthesize the same amount of vitamin D), obesity (fat-soluble vitamin D being sequestered in adipose tissue), and certain conditions that affect vitamin D absorption or metabolism (Earthman et al., 2012; Turer et al., 2013). Environmental and lifestyle factors also play an important role. Higher latitudes (above 37° north or south), air pollution, winter season, and limited outdoor time reduce cutaneous vitamin D synthesis (Hoel et al., 2016).

Socioeconomic factors are also significant. Children from low-income families, with parents of lower educational attainment, and without health insurance have a higher risk of vitamin D deficiency, possibly due to limited access to vitamin D–rich foods, supplements, and preventive healthcare services (Voortman et al., 2015). Modern lifestyles characterized by more indoor time, increased use of electronic devices, and reduced outdoor physical activity may further contribute to higher rates of vitamin D deficiency in children (Chaugule et al., 2025).

The period from 12 to 36 months is a critical stage for nutrition and development. During this time, children transition from breast milk or formula to a family diet, creating a high risk of micronutrient gaps (Dewey, 2013). Growth remains rapid, and vitamin D requirements for bone mineralization are high; however, vitamin D supplementation practices often decline as children grow older than 12 months. A systematic review on the safety of high-dose vitamin D supplementation in children aged 0–6 years indicated that supplementation is generally safe, but strong evidence regarding optimal dosages for specific age groups—particularly 12–36 months—remains limited (Brustad et al., 2022).

In Vietnam, while some studies have reported vitamin D status in children in general and in specific disease groups, data on healthy community-dwelling children aged 12–36 months remain scarce. Notably, no study has comprehensively assessed the total vitamin D intake from all sources (formula, dietary supplements/functional foods, and diet) and examined the relationship between total intake and serum 25-(OH)D concentrations under real-world conditions in Vietnam.

Therefore, this study was conducted to: (1) determine the prevalence of vitamin D deficiency among children aged 12–36 months attending a private nutrition clinic; (2) evaluate vitamin D supplementation practices from all sources in this age group; and (3) explore the association between vitamin D supplementation dose and serum 25-(OH)D concentrations under real-world conditions in Vietnam. The findings will provide important evidence to inform clinical practice and public health policy regarding vitamin D supplementation for young children.

3. Methods

Study population: Children aged 12–36 months who visited Dr. Nutri Nutrition Clinic from October 2023 to April 2024.

Inclusion criteria: Children attending for nutrition consultation who agreed to serum 25-hydroxyvitamin D [25-(OH)D] testing; families agreed to participate in the study; families provided clear information on vitamin D use history, product type, dosage of medicines/dietary supplements containing vitamin D, and vitamin

D–fortified formula and complementary foods.

Exclusion criteria: Children not within the target age range; children without serum 25-(OH)D testing; children with chronic diseases such as anemia, hemolysis, chronic infections, or chronic hepatitis.

Study design: Cross-sectional descriptive study. Convenience sampling was applied by including all patients who met the eligibility criteria.

Study variables and indices: Data collected included age, sex, serum 25-(OH)D concentrations, and total daily vitamin D supplementation dose. Analyses included age and sex distribution, serum 25-(OH)D levels, and the association between total vitamin D supplementation dose and serum 25-(OH)D concentrations.

Laboratory methods and assessment criteria: Serum 25-hydroxyvitamin D was quantified using electrochemiluminescence immunoassay on an Elecsys cobas e immunoassay analyzer. Vitamin D deficiency was defined as 25-(OH)D < 75 nmol/L (<30 ng/mL); normal vitamin D status was defined as 75 nmol/L to <250 nmol/L (30–100 ng/mL); vitamin D excess was defined as >250 nmol/L (Holick, 2009). Age, sex, and 24-hour vitamin D dose were obtained from information on the current vitamin D product dosage, the amount of formula consumed, and other vitamin D–containing products reported in the questionnaire.

Data collection and analysis: Data from questionnaires and clinical measurements were entered and analyzed using SPSS version 25. Descriptive statistics were reported as percentages/proportions and mean ± standard deviation (Mean ± SD). The chi-square (χ^2) test was used, with statistical significance defined as $p < 0.05$.

Ethics: The study was approved by the professional council of the healthcare facility. Families/guardians were clearly informed about the study objectives and significance, could withdraw at any time, and all study information was kept confidential.

4. Results and Discussion

The study enrolled 175 children aged 12–36 months who met the eligibility criteria and whose families agreed to participate. According to Table 1, children aged 25–36 months accounted for 53.7%, higher than those aged 12–24 months (46.3%). The proportion of boys was 1.3 times higher than girls: boys accounted for 57.7% and girls for 42.3%.

Table 1. General characteristics of the study participants

Variable		Quatity (n)	Rate (%)
		175	100
Age	12-24 months	81	46,3
	25-36 months	94	53,7
Sex	Male	101	57,7
	Female	74	42,3

Table 2. Serum 25-(OH)D concentrations in children aged 12–36 months

Serum 25-(OH)D (nmol/L)	Quatity (n)	Rate (%)	Mean concentration
<75	46	26,3	63,8±10,5 nmol/l
75-250	129	73,7	89,2±28,4 nmol/l
>250	0	0	0
Sum	175	100	83,7±26,1 nmol/l

Serum 25-hydroxyvitamin D concentrations in children aged 12–36 months are presented in Table 2. The results showed that 46 children (26.3%) were vitamin D deficient, with a mean concentration of 63.8 ± 10.5 nmol/L, whereas 129 children (73.7%) had sufficient vitamin D status, with a mean

concentration of 89.2 ± 28.4 nmol/L. No cases exceeded the toxicity threshold (>250nmol/L). The overall mean serum 25-(OH)D concentration was 83.7 ± 26.1 nmol/L.

Table 3. Daily vitamin D supplementation dose by age group

(Total vitamin D from dietary supplements/functional foods, formula, and other products; unit: IU)	Total	Rate (%)	Age group			
			12-24 months (n=81)		25-36 months (n=94)	
	175	100	N	%	N	%
<600UI	28	16,0	8	9,6	20	21,7
=600UI	104	59,4	48	57,8	56	60,9
>600UI	43	24,6	27	32,5	16	17,4
Mean dose (IU)	628±165		655±150		604± 176	
P	[a]p<0,05					

Variables are presented as Mean ± SD. a χ^2-test.

Comment: The proportion of children not receiving adequate vitamin D supplementation according to recommendations was 16.0%; 59.4% received adequate supplementation, and 24.6% received supplementation above recommendations. Children older than 24 months had a higher proportion of supplementation below recommendations than those younger than 24 months; this difference was statistically significant between the two age groups ($p < 0.05$).

Table 4. Association between serum 25-(OH)D concentration and daily vitamin D supplementation dose

Serum 25-(OH)D (nmol/L)		Daily vitamin D supplementation dose			P
		<600 UI (n=26)	=600UI (n=102)	>600 UI (n=47)	
<75 (n=43)	N	16	22	8	p[a]<0,05
	%	34,8	21,2	18,6	
≥75 (n=132)	N	12	82	35	
	%	65,2	78,8	81,4	

[a]*χ^2-test*

Comment: Children receiving adequate vitamin D supplementation had a higher proportion of serum 25-(OH)D concentrations meeting the sufficient threshold. The findings indicated a statistically significant association between serum 25-(OH)D concentration and daily vitamin D supplementation dose ($p < 0.05$)..

5. Discussion

Rition Clinic from October 2023 to April 2024. The characteristics of the study sample … healthy children in the community compared with hospitalized children with bronchiolitis.

Vitamin D status in children aged 12–36 months

The study recorded that 26.3% of children had vitamin D deficiency (serum 25-(OH)D < 75 nmol/L) with a mean concentration of … 28.4 nmol/L, reflecting greater variability in the degree of vitamin D sufficiency.

Compared with domestic studies, the prevalence of vitamin D deficiency in our study was … in our study, 35.7% of children had concentrations < 75 nmol/L.

A noteworthy point is that although 73.7% of children reached the sufficient threshold for vitamin D, … the optimal level for bone development and overall health in children.

Vitamin D supplementation practice and its association with 25-(OH)D concentrations

The results showed that 16.0% of children received vitamin D supplementation below the recommended level (< 600 IU/day), 59.4% met the recommended level, … shifting to a more diverse diet but one with low vitamin D content.

The study identified a highly statistically significant association between vitamin D supplementation dose and serum 25-(OH)D concentrations, … emphasizing the importance of adhering to the recommended dosage.

However, one notable finding is that within the vitamin D–deficient group, … possibly due to adequate sun exposure or vitamin D obtained from natural food sources.

This result is consistent with the study by Tran Thuy Nga et al., … underscoring the importance of adequate supplementation in maintaining serum 25-(OH)D concentrations at an optimal level.

Limitations and directions for further research

This study has several limitations. First, the sample size was relatively small (n = 175) due to resource constraints, which may affect … real-world parental adherence to vitamin D supplementation for children.

Future studies should expand the sample size and geographic coverage to improve representativeness, and conduct … vitamin D status among Vietnamese children in community settings.

6. Conclusion

Vitamin D deficiency remains common among children aged 12–36 months in the community, predominantly at a mild level … continuous vitamin D supplementation, particularly for children older than 24 months.

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NỒNG ĐỘ 25-HYDROXYVITAMIN D VÀ YẾU TỐ LIÊN QUAN Ở TRẺ 12–36 THÁNG TẠI PHÒNG KHÁM DR. NUTRI, 2023-2024

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Ngày duyệt đăng: 26/12/2025
DOI: *https://doi.org/10.58902/nckhpt.e-v1i1.308*

Tóm tắt:

Vitamin D có vai trò quan trọng đối với sự phát triển xương và sức khỏe trẻ nhỏ, tuy nhiên tình trạng thiếu vitamin D và mức độ bổ sung trong cộng đồng vẫn chưa được mô tả đầy đủ. Nghiên cứu mô tả cắt ngang này nhằm xác định tỷ lệ thiếu vitamin D, đánh giá mức độ bổ sung vitamin D từ các nguồn khác nhau và phân tích mối liên quan giữa liều bổ sung và nồng độ 25-hydroxyvitamin D [25-(OH)D] huyết thanh ở trẻ 12–36 tháng đến khám tại phòng khám dinh dưỡng Dr. Nutri giai đoạn 10/2023–4/2024. Nghiên cứu ghi nhận 175 trẻ đủ tiêu chuẩn. Kết quả cho thấy 24,6% trẻ thiếu vitamin D, trong khi 75,4% đạt ngưỡng đủ. Về bổ sung vitamin D, 14,9% trẻ được bổ sung dưới khuyến nghị, 58,3% đủ và 26,8% cao hơn khuyến nghị. Có mối liên quan có ý nghĩa thống kê giữa liều bổ sung và nồng độ 25-(OH)D huyết thanh ($p < 0,001$). Nghiên cứu khẳng định bổ sung vitamin D theo khuyến nghị có ý nghĩa cải thiện tình trạng vitamin D ở trẻ nhỏ.

Từ khóa: *Nồng độ 25-hydroxyvitamin D huyết thanh, bổ sung vitamin D, trẻ em 12-36 tháng tuổi*