



## THE ROLE OF VITAMIN D IN ENCHANCING IMMUNE SYSTEM AND PREVENTING STUNTING IN PEDIATRIC PATIENTS: LITERATURE REVIEW

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### ABSTRACT

The problem of stunting in Indonesia is a problem that has become a national concern. Stunting is caused by a lack of macro and micro nutrients. Vitamin D is one of the micronutrients that is important for growth in pediatric patients. Objectives of the study determine and examine the relationship between vitamin D and the immune system and prevention of stunting in pediatric patients. Methods: Literature searches were obtained through reference sources from Google Scholar, PubMed, Proquest, EBSCOhost. Inclusion criteria for the literature review were original articles, published in Indonesian and English, and receiving vitamin D therapy. A review of the literature highlights the crucial role of vitamin D in bone metabolism, growth, and immune system regulation, particularly in children. These functions contribute to the prevention of stunting. During pregnancy, vitamin D is essential for immune modulation in the fetus-mother interaction, making it a key regulatory factor. Its non-classical roles include acting as a strong immunomodulator by enhancing antibacterial defenses and regulating T-lymphocytes to reduce inflammation and promote immune tolerance. In the decidua, vitamin D supports innate immunity by enhancing infection response while preventing excessive immune-related inflammation. Current research has explored its potential in reducing the risk of infectious diseases like tuberculosis and in modulating autoimmune conditions. Vitamin D influences immune function beyond its direct role in the primary innate response. Early prevention of stunting requires sufficient intake of both macronutrients and micronutrients. Micronutrients, particularly vitamin D, play a vital role in bone metabolism and contribute to strengthening the body's defense mechanisms, helping to reduce the risk of infectious diseases in children.

Keywords: children; immunity; pediatric; stunting; vitamin D

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## INTRODUCTION

One of the primary indicators of the second Sustainable Development Goal, Zero Hunger, is the reduction of child stunting, which is the first of six objectives in the Global Nutrition Targets for 2025. Approximately 37% of Indonesian children are stunted, a significant incidence that has persisted over the last ten years. It remains uncertain whether Indonesia's current strategies for reducing childhood stunting align with the available scientific data (Beal et al., 2018). Children in Indonesia experience the twin burden of malnutrition and stunting, necessitating policies that address both chronic undernutrition and overnutrition (Rachmi et al., 2016). The issue of stunting in Indonesia has become a national concern, with a target to reduce stunting prevalence to 14% by 2024, whereas in 2022, it remained at 24.4%. Various efforts have been undertaken by

the Indonesian government at both the central and regional levels, yet they have not significantly reduced stunting rates (Rahman et al., 2023).

Malnutrition and stunting, whether due to inadequate or excessive food intake, often lead to inflammation, weaken the child's immune system, and increase susceptibility to infection and mortality. Understanding immune changes in malnourished children is crucial. Cost-effective nutritional interventions are essential for preventing or reversing malnutrition, including stunting, to ensure children's long-term health and development. Specific nutrients, such as vitamins and trace elements, play a key role in strengthening children's immune responses (Ibrahim et al., 2017). Stunting results from a deficiency in both macro- and micronutrients, with vitamin D being one of the critical micronutrients necessary for growth. Administration of vitamin D may prevent stunting and promote growth in children (Millward, 2017). Vitamin D deficiency can interfere with child development and disrupt inflammatory processes (Aranow, 2011). To date, no literature review has specifically and comprehensively discussed the relationship between vitamin D, the immune system, and stunting in pediatric patients. This study aims to provide a more comprehensive understanding, supported by scientific evidence, regarding the correlation between vitamin D and the immune system in pediatric patients, particularly in cases of stunting. Furthermore, this study seeks to analyze the role of vitamin D in strengthening the immune system and its potential impact on preventing stunting in pediatric patients by reviewing current literature and clinical evidence.

## **METHOD**

Literature search was obtained through various databases such as Google Scholar, PubMed, Proquest, and EBSCOhost. The researcher did not provide a time limit for the study taken. The literature was searched using the keywords "Vitamin D", "Immunity", "Stunting", "Pediatric", and "Children" with synonyms. The authors included primary study literature that discussed the relationship between vitamin D and the immune system and stunting in children and was published in Indonesian and English. Literature review articles, systematic reviews, meta-analyses, and letters to the editor were excluded. Studies with insufficient data were excluded. Furthermore, the initial search results were reviewed by reading the title and abstract to assess the relevance of the literature. After reading the text thoroughly, relevant studies were evaluated and assessed based on their compliance with the inclusion and exclusion standards. Five authors (MS, KP, CK, MI, NP) reviewed the search results, and if there were any differences, the 6th author (KT) would resolve them through discussion. Discussions were conducted to resolve disagreements between the authors. To resolve disagreements during the review process, the following procedure was implemented: First, the five primary authors (MS, KP, CK, MI, NP) independently reviewed the search results and assessed the eligibility of articles based on the predefined inclusion and exclusion criteria. If discrepancies arose, each author presented their justification for including or excluding a particular study. A preliminary discussion was then conducted among the authors to reach a consensus by evaluating the scientific evidence and relevance of the articles to the study's objectives. If disagreements persisted after discussion, the sixth author (KT) acted as an arbitrator. KT independently reviewed the disputed articles, considered the arguments from both sides, and made a final decision based on methodological rigor and scientific relevance. The final selection of articles was documented, ensuring transparency and objectivity in the literature review process.

## **RESULT**

## **Vitamin D**

Vitamin D is a fat-soluble vitamin that is primarily obtained through sunlight via endogenous production in the skin. In addition to its well-known role in regulating mineral and bone metabolism, vitamin D also plays a crucial role in enhancing immunity in children, affecting both the innate and adaptive immune systems (Aranow, 2011; Hewison, 2012). Furthermore, vitamin D contributes to immune function during pregnancy and can influence anthropometric measurements of newborns (Ao et al., 2021; Wagner & Hollis, 2018). Vitamin D exerts its effects through its active form, calcitriol, which interacts with the vitamin D nuclear receptor (nVDR) expressed in nearly all immune system cells, including B and T lymphocytes, neutrophils, monocytes, and dendritic cells. The presence of vitamin D stimulates the production of key endogenous antimicrobial peptides, such as cathelicidin, and regulates immune signaling pathways (Hewison, 2012; Ao et al., 2021). Several studies have reported high rates of vitamin D deficiency and insufficiency in pediatric populations, with prevalence rates ranging from 40% to 75%, even in developed countries (Crowe et al., 2021). Consequently, both international and national guidelines recommend vitamin D prophylaxis for all infants during their first year of life to prevent early-life deficiency. Specifically, all children within the first 1,000 days of life (HPK) should receive oral vitamin D supplementation (Gallo et al., 2016).

## **Malnutrition and Stunting Definition and Prevalence**

The prevalence of malnutrition among children in Indonesia is 3.9% (Ministry of Health Indonesia, 2018). In Indonesia's rural communities, stunting and malnutrition remain significant public health concerns. A previous study reported that the prevalence of stunting and malnutrition in Indonesia was 22.2% compared to 37.5% in the treatment group and 9.7% versus 4.2% in the control group (Susanto et al., 2019). According to a study by Susanto et al. (2021), in agricultural areas, the prevalence of stunted, wasted, and malnourished children under five was 5%, 18.9%, and 3%, respectively. Ethnicity and family type were significantly correlated with height-for-age z-score (HAZ) ( $p = 0.007$ ). Additionally, weight-for-age z-score (WAZ) was significantly correlated with children's age ( $r = 0.106$ ,  $p < 0.05$ ). Family quality of life (FQOL) also showed significant associations with both WAZ ( $r = 0.260$ ,  $p < 0.01$ ) and HAZ ( $r = 0.290$ ,  $p < 0.01$ ) (Susanto et al., 2021).

## **Risk Factor for Stunting**

Lower birth weight, breastfeeding for six months or longer, having parents who were underweight or short in stature, and mothers who never attended school were all associated with stunting and underweight. Additionally, stunting was more prevalent in rural regions. Being in the youngest age group (2–2.9 years), male, having parents who were overweight or obese, or having fathers with a university degree were strongly associated with being at risk of overweight or obesity (Rachmi et al., 2016). Determinants of stunting include genetic factors, economic status, birth spacing, history of low birth weight (LBW), maternal anemia, hygiene, and environmental sanitation. Stunting decreases with improved nutrition, as evidenced by: (1) Positive relationships between skinfold thickness and height standard deviation scores (hSDS), indicating that the fat stores of less stunted children are less depleted; (2) Positive associations between parents' educational attainment and hSDS, suggesting that higher parental education may reduce the incidence of malnutrition in children; and (3) One or more obvious clinical indicators of malnutrition are present in stunted children (Beal et al., 2018).

## **Clinical Manifestation and Diagnosis**

Malnutrition due to either inadequate or excessive dietary intake often leads to inflammation, weakens the child's immune system, and increases their susceptibility to infections and death. Understanding the immune changes in malnourished children is crucial. Cost-effective nutritional interventions are essential to prevent or reverse malnutrition, ensuring children's health and long-term development. Specific nutrients, such as vitamins and oligoelements, play a key role in strengthening children's immune responses (Morales et al., 2024). The clinical manifestations of a disease encompass a range of symptoms that vary in severity depending on the underlying condition. These may include physical changes, biochemical imbalances, and physiological disturbances that affect different organ systems. Patients may present with general symptoms such as fever, fatigue, or weight loss, while specific diseases exhibit characteristic signs that aid in diagnosis (Beal et al., 2018; Morales et al., 2024). Recognizing these manifestations early is crucial for prompt medical intervention and effective management.

Diagnosis involves a comprehensive approach that includes a detailed medical history, physical examination, and various diagnostic tests. Laboratory investigations, imaging techniques, and specialized assessments help confirm the presence of a disease and determine its severity. Accurate diagnosis is essential for guiding treatment decisions, monitoring disease progression, and improving patient outcomes. Early and precise identification of clinical manifestations enhances the effectiveness of medical interventions and prevents complications (Morales et al., 2024).

### **Diagnosis of Stunting and Malnutrition**

Stunting is identified by assessing a child's height-for-age and comparing it to standard growth charts, such as those from the World Health Organization (WHO). A child is considered stunted if their height-for-age Z-score (HAZ) is below -2 standard deviations from the reference median. The diagnostic process includes evaluating maternal and child nutrition, birth weight, feeding habits, recurrent infections, and socioeconomic factors. A physical examination may reveal signs of malnutrition or other health conditions affecting growth. Further tests, including laboratory investigations, may be required to detect nutritional deficiencies, chronic infections, or hormonal imbalances. Early diagnosis is essential to prevent long-term effects on cognitive development, immune function, and overall well-being (Beal et al., 2018; Susanto et al., 2021).

The diagnosis of malnutrition involves a comprehensive assessment of a patient's nutritional status through clinical evaluation, anthropometric measurements, and laboratory tests. Key indicators include body mass index (BMI), weight-for-age, height-for-age, and mid-upper arm circumference (MUAC), which help determine the severity of malnutrition. A detailed medical history is essential to identify underlying causes such as inadequate dietary intake, chronic diseases, or socioeconomic factors affecting nutrition. Physical examination may reveal signs of nutrient deficiencies, such as muscle wasting, edema, or skin and hair changes. Laboratory tests, including serum albumin, prealbumin, electrolyte levels, and micronutrient assays, can provide further insights into nutritional deficiencies. Early detection and intervention are crucial to prevent complications, improve health outcomes, and enhance overall quality of life (Morales et al., 2024).

### **Role of Vitamin D for Stunting and Malnutrition Treatment**

The role of vitamin D in the immunity of stunted children is primarily through its ability to modulate adaptive immune cells that have a higher expression of vitamin D receptors. Vitamin D also inhibits the secretion of pro-inflammatory cytokines by monocytes, making it an essential anti-inflammatory micronutrient. Stunting prevention is most effective within the

first 1,000 days of life. Proper nutritional status during childhood significantly impacts the development of an optimal immune system (Okudur et al., 2021). Research indicates that vitamin D levels tend to be low in young children, pregnant women, and toddlers. A study conducted by Judistiani et al. (2021) examined the relationship between cholecalciferol, ferritin, and anemia in pregnant women. Their cohort study, which investigated vitamin D status and its impact during pregnancy and early childhood in Indonesia, included 203 participants. Among them, 195 women (96.06%) experienced hypovitaminosis D, with 52 (75%) classified as vitamin D deficient and 43 (21%) reporting inadequate vitamin D intake. Vitamin D plays a crucial role in regulating calcium and phosphorus levels in the body. As a fat-soluble secosteroid, it functions as a key modulator in growth and calcium homeostasis. The American Academy of Pediatrics (AAP) recommends that infants and children consume at least 400 IU of vitamin D daily from dietary sources and supplements. Research suggests that a daily intake of 700 to 800 IU can significantly reduce fracture risk in adults. For individuals with vitamin D deficiency, treatment typically involves oral ergocalciferol (vitamin D<sub>2</sub>) at a dose of 50,000 IU per week for several weeks. Once vitamin D levels are restored, the maintenance dose of cholecalciferol (vitamin D<sub>3</sub>) is usually increased to 800–1,000 IU per day, sourced from both diet and supplements (Sapartini et al., 2023, Hardi et al., 2024).

Vitamin D is naturally present in fish, certain vegetables, and select types of meat, poultry, and dairy products that have not undergone fortification. In addition to dietary sources, the body can synthesize vitamin D through sun exposure. Spending at least 37 minutes and 12 seconds outdoors between 11:00 AM and 1:00 PM allows the skin to absorb ultraviolet B (UVB) rays, which penetrate the epidermis and convert provitamin D<sub>3</sub> (cholecalciferol) into previtamin D<sub>3</sub>. This form then binds to vitamin D-binding proteins for transport through the bloodstream or storage in fat, where it can be utilized as needed (Wagner et al., 2018). Vitamins play a crucial role in the treatment of malnutrition by supporting essential bodily functions, promoting recovery, and preventing complications. Deficiencies in key vitamins, such as vitamin A, vitamin D, and B-complex vitamins, can lead to impaired immunity, poor growth, and metabolic imbalances (Saleem et al., 2018). Vitamin A is vital for vision, immune defense, and cell regeneration, while vitamin D contributes to bone health and calcium absorption. B-complex vitamins, including B1 (thiamine), B6 (pyridoxine), and B12 (cobalamin), are essential for energy metabolism, nervous system function, and red blood cell production (van Stuijvenberg et al., 2015).

Effective management of malnutrition includes vitamin supplementation to correct deficiencies and restore overall health. In cases of severe malnutrition, medical professionals may administer high-dose vitamin therapy to accelerate recovery. Fortified foods, dietary adjustments, and nutritional education are also essential in ensuring long-term improvements in nutritional status (Mulligan et al., 2010). Addressing vitamin deficiencies through a well-balanced diet and supplementation helps strengthen the immune system, enhance cognitive development, and improve overall well-being in individuals affected by malnutrition (Okudur et al., 2021, Sapartini et al., 2023, Hardi et al., 2024, Gwela et al., 2019, Oktaria et al., 2022, Finkelstein et al., 2012).

## **CONCLUSION**

Vitamin D plays a role in immune function beyond its immediate impact on the innate immune response. Preventing stunting at an early stage requires an adequate intake of both macronutrients and micronutrients. Among these, vitamin D is especially important for bone metabolism and enhancing the body's immune defenses, which helps lower the risk of infectious diseases in children.

## REFERENCES

- Beal, T., Tumilowicz, A., Sutrisna, A., Izwardy, D., & Neufeld, L. M. (2018). A review of child stunting determinants in Indonesia. *Maternal & Child Nutrition*, 14(4), e12617.
- Rachmi, C. N., Agho, K. E., Li, M., & Baur, L. A. (2016). Stunting, underweight, and overweight in children aged 2.0–4.9 years in Indonesia: Prevalence trends and associated risk factors. *PLoS ONE*, 11(5), e0154756.
- Rahman, H., Rahmah, M., & Saribulan, N. (2023). Upaya penanganan stunting di Indonesia: Analisis bibliometrik dan analisis konten. *Jurnal Ilmu Pemerintahan Suara Khatulistiwa*, 8(1), 44-59.
- Ibrahim, M. K., Zambruni, M., Melby, C. L., & Melby, P. C. (2017). Impact of childhood malnutrition on host defense and infection. *Clinical Microbiology Reviews*, 30(1), 1–30. <https://doi.org/10.1128/cmr.00119-16>
- Millward, D. J. (2017). Nutrition, infection and stunting: The roles of deficiencies of individual nutrients and foods, and of inflammation, as determinants of reduced linear growth of children. *Nutrition Research Reviews*, 30(1), 50–72.
- Aranow, C. (2011). Vitamin D and the immune system. *Journal of Investigative Medicine*, 59(6), 881–886.
- Hewison, M. (2012). Vitamin D and the immune system: New perspectives on an old theme. *Rheumatic Disease Clinics*, 38(1), 125–139.
- Ao, T., Kikuta, J., & Ishii, M. (2021). The effects of vitamin D on the immune system and inflammatory diseases. *Biomolecules*, 11(11), 1624
- Ministry of Health Indonesia. (2018). Hasil utama riset kesehatan dasar (RISKESDAS).
- Susanto, T., Yunanto, R. A., Rasny, H., Susumaningrum, L. A., & Nur, K. R. M. (2019). Promoting children's growth and development: A community-based cluster randomized controlled trial in rural areas of Indonesia. *Public Health Nursing*, 36, 514–524.
- Susanto, T., Rasni, H., & Susumaningrum, L. A. (2021). Prevalence of malnutrition and stunting among under-five children: A cross-sectional study family of quality of life in agricultural areas of Indonesia. *Mediterranean Journal of Nutrition and Metabolism*, 14(2), 147–161. <https://doi.org/10.3233/MNM-200492>
- Vollmer, S., Bommer, C., Krishna, A., Harttgen, K., & Subramanian, S. V. (2017). The association of parental education with childhood undernutrition in low- and middle-income countries: Comparing the role of paternal and maternal education. *International Journal of Epidemiology*, 46, 312–323.
- Morales, F., Montserrat-de la Paz, S., Leon, M. J., & Rivero-Pino, F. (2024). Effects of malnutrition on the immune system and infection and the role of nutritional strategies regarding improvements in children's health status: A literature review. *Nutrients*, 16(1), 1.
- Crowe, F. L., Mughal, M. Z., Maroof, Z., Berry, J., Kaleem, M., Abburu, S., Walraven, G., Masher, M. I., Chandramohan, D., & Manaseki-Holland, S. (2021). Vitamin D for growth and rickets in stunted children: A randomized trial. *Pediatrics*, 147(1).
- Gallo, S., Hazell, T., Vanstone, C. A., Agellon, S., Jones, G., L'Abbé, M., et al. (2016). Vitamin D supplementation in breastfed infants from Montréal, Canada: 25-hydroxyvitamin D and bone health effects from a follow-up study at 3 years of age. *Osteoporosis International*, 27(8), 2459–2466.
- Wagner, C. L., & Hollis, B. W. (2018). The implications of vitamin D status during pregnancy on the mother and her developing child. *Frontiers in Endocrinology*, 9, 500. <https://doi.org/10.3389/fendo.2018.00500>
- Mulligan, M. L., Felton, S. K., Riek, A. E., & Bernal-Mizrachi, C. (2010). Implications of vitamin D deficiency in pregnancy and lactation. *American Journal of Obstetrics & Gynecology*, 202(5), 429.e1–9.

- van Stuijvenberg, M. E., Nel, J., Schoeman, S. E., Lombard, C. J., du Plessis, L. M., & Dhansay, M. A. (2015). Low intake of calcium and vitamin D, but not zinc, iron or vitamin A, is associated with stunting in 2- to 5-year-old children. *Nutrition*, 31(6), 841–846.
- Saleem, J., Zakar, R., Zakar, M. Z., Belay, M., Rowe, M., Timms, P. M., Scragg, R., & Martineau, A. R. (2018). High-dose vitamin D3 in the treatment of severe acute malnutrition: A multicenter double-blind randomized controlled trial. *The American Journal of Clinical Nutrition*, 107(5), 725–733.
- Okudur, S. K., & Soysal, P. (2021). Excessive daytime sleepiness is associated with malnutrition, dysphagia, and vitamin D deficiency in older adults. *Journal of the American Medical Directors Association*, 22(10), 2134–2139.
- Sapartini, G., Wong, G. W., Indrati, A. R., Kartasasmita, C. B., & Setiabudiawan, B. (2023). The association between vitamin D, interleukin-4, and interleukin-10 levels and CD23+ expression with bronchial asthma in stunted children. *Biomedicines*, 11(9), 2542.
- Hardi, R., Yusrawati, Y., & Afdal, A. (2024). The role of vitamin D to prevent children's stunting. *World Journal of Advanced Research and Reviews*, 21(3), 341–348.
- Gwela, A., Mupere, E., Berkley, J. A., & Lancioni, C. (2019). Undernutrition, host immunity and vulnerability to infection among young children. *The Pediatric Infectious Disease Journal*, 38(8), e175–e177.
- Oktaria, V., Putri, D. A., Ihyauddin, Z., Julia, M., Sulistyoningrum, D. C., Koon, P. B., Danchin, M., & Murni, I. K. (2022). Vitamin D deficiency in South-East Asian children: A systematic review. *Archives of Disease in Childhood*, 107(11), 980–987.
- Finkelstein, J. L., Mehta, S., Duggan, C., Manji, K. P., Mugusi, F. M., Aboud, S., Spiegelman, D., Msamanga, G. I., & Fawzi, W. W. (2012). Maternal vitamin D status and child morbidity, anemia, and growth in HIV-exposed children in Tanzania. *The Pediatric Infectious Disease Journal*, 31(2), 171–175.

