

REVIEW ARTICLE

Correlation between Vitamin D Status and Stunting Among Children Aged 0-14 Years: A Narrative Review

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ABSTRACT

The problem of stunting in Indonesia has not yet been fully resolved. Vitamin D deficiency in children can cause growth disorder and stunting. This study was aimed at identifying various literature regarding the relationship of vitamin D status with the incidence of stunting in children. The research method used was a narrative review with inclusion criteria including primary research articles, full text, Indonesian or English, published in the last 10 years (2011-2021) with the research sample including children in the age range 0-14 years, and the exclusion criteria covering review research articles concerning children with diseases that can interfere with vitamin D metabolism, articles having an incomplete identity, and articles having unclear stated purpose and research method. Based on the search keywords in the PubMed and Google Scholar databases, eight articles were obtained for further analysis. The results of the study showed various factors affected the incidence of stunting in each region, and sometimes vitamin D status could be the main factor or not when other factors dominated. Through this narrative review, to prevent stunting children's growth, it is known that the parents and the government need to pay attention to children's vitamin D status.

Keywords: Stunting, Vitamin D, Children

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INTRODUCTION

Indonesia has three indicators in the HDI (Human Development Index) to determine the development of its population quality, namely longevity and healthy life/life expectancy, knowledge, and a decent standard of living (1, 2). Life expectancy is an indicator that describes the HDI in the health sector (IPMK) with one of the sub-indicators in it being stunting nutritional status (3). Indonesia is one of the developing countries with a high prevalence of stunting.

At the Indonesia Healthcare Forum (2020), Indonesia was in third place with the average prevalence of stunting in toddlers in 2005-2017 as 36.4%. Based on Studi Status Gizi Balita Indonesia (SSGBI) or Study on the Nutritional Status of Indonesian Toddlers, until 2019 the prevalence was still high with a percentage of 27.7% and only decreased by 3.1% from the previous year (4, 5). Then, in 2021, the prevalence of stunting in Indonesia decreased again to 24.4% with the highest province prevalence being 37.8% (East Nusa Tenggara) and the lowest 10.9% (Bali) (6).

Stunting is a condition in which children have a height that is shorter than their age or based on the results of measurements of height/body length based on age (H/A or BL/A) showing a score of <-2 SD (7). The impact of stunting on children does not only arise in the short term but can also affect children's lives in adulthood (8). Stunting is caused by various factors such as family, environment, nutritional food intake, breastfeeding, and history of infection (9). The causes of stunting in each country can differ from each other due to influencing factors such as economic status and geographical location. According to Atmarita in Buletin Jendela Data Informasi Kesehatan, chronic nutritional inadequacy and a history of infectious diseases are the main factors for stunting in Indonesia (10).

Vitamin D is one of the fat-soluble micronutrients that play an important role in the growth process of children. The body needs vitamin D in the form of 25-hydroxyvitamin D (25(OH)D) to increase the secretion of Insulin-Like Growth Factor-1 (IGF-1) in the liver. The lack of production of IGF-1 secretion in children can cause growth retardation due to IGF-1 resistance in the body (11, 12). Van Stuijvenberg et al. (2014) stated that inadequate calcium and vitamin D were associated with stunting in children aged 2-5 years (13). The greater the need for vitamin D in children which is not met, the greater the chance of children

experiencing stunting (14).

The fulfilment and insufficiency of vitamin D needs in the body can be determined through vitamin D status based on the measurement of serum 25(OH)D levels. Serum 25(OH)D is a vitamin D content stored in the liver and transformed by the hormone 25-hydroxylase. Serum 25(OH)D is chosen because its content can represent all vitamin D in the body, both from the synthesis process, food, and supplementation (Ermawati & Budiman, 2015).

The cases of vitamin D deficiency in children are often found in Indonesia. Oktaria et al. (2020) found that 307 neonates (90%) and 33 infants aged six months (13%) had vitamin D deficiency (56). In the examination of vitamin D status of children aged 7-12 years conducted by Soesanti et al. (2012), it was found that 75.8% had insufficient status and 15% deficient vitamin D (55). Ernawati and Budiman (2015) in their survey of children aged 2-12.9 years found that 157 children experienced insufficiency and 172 children experienced vitamin D inadequacy (15). Compared with the results of a survey of vitamin D status of other countries in the SEANUTS (South East Asia Nutrition Survey), Indonesia has a low prevalence of vitamin D adequacy in children (16). Nurses playing the role as educators are obliged to have knowledge related to the relationship between vitamin D status and the incidence of stunting in order to have broad knowledge in providing health education to patients or to communities. The lack of information about vitamin D status with the stunting incidence in children, especially at the age of 0-14 years, caused the researcher to want to conduct a narrative review study to collect evidence from previous studies.

METHOD

The method used a narrative review with the process of articles searching and selecting based on the PRISMA chart which consisted of identification, screening, eligibility, and inclusion stage.

Determining the keywords, databases, and criteria (inclusion and exclusion) is a step in the identification stage to ease the process of finding articles suitable for the topic. The researchers conducted a search process on Google Scholar and PubMed databases with the keywords as association AND vitamin D status OR vitamin D levels AND stunting AND children. Then, for the selection of the articles, the inclusion criteria were full-text articles, published in the last 10 years (2011-2021), according to keywords, Indonesian/English article, and original research articles whereas the exclusion criteria were type of review article, children as sample having comorbidities that interfere with vitamin D metabolism, incomplete article identity (number, year, and publisher), and unclear purpose and method.

After the searching process, 2, 540 articles were obtained to be examined for duplication and then the title and abstract of the article were screened. There were 50 duplicate articles and 1,536 articles that were excluded for the next stage because of inappropriate title and abstract. In the eligibility stage, 954 articles that passed the screening stage were re-examined according to the inclusion and exclusion criteria to obtain article suitable to the topic research, of which eight articles fit to this study (Figure 1).

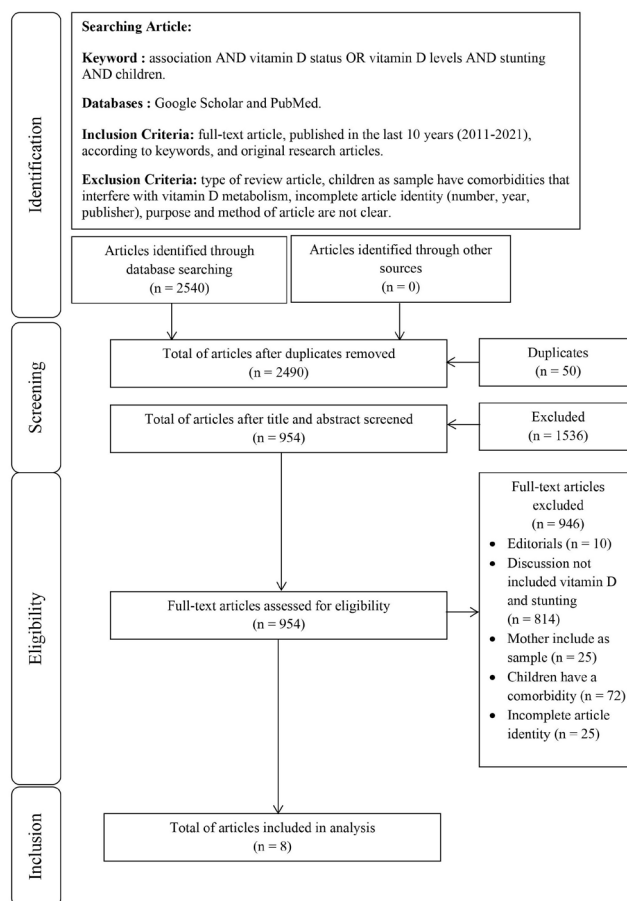


Figure 1: Process of searching and filtering article

RESULTS

The total number of articles obtained through search keywords in the Google Scholar database was 2,350 Indonesian articles and 1, 870 English articles, and the PubMed database was 190 articles published in the years 2011-2021. Based on the inclusion and exclusion criteria through identifying the title and abstract, there were eight articles selected for further analysis (Table I). The results of the study of these articles showed that each article had various results and could not be generalized. Of the total number of articles studied, there were only two articles that showed the vitamin D status as a main factor of stunting incidences while six articles showed that, there are other factors which have a greater impact on stunting than vitamin D status.

Table 1: Article Analysis

Title	Purpose	Place	Sample	Method	Vitamin D Status and Stunting	Result	Weakness and Strength
Vitamin D status is associated with underweight and stunting in children aged 6-36 months residing in the Ecuadorian Andes Author: Rana R. Mokhtar, et al (2017)	Aim to evaluate the vitamin D status of children in low socio-economic status (SES) and identification the relationship between vitamin D status, stunting, and underweight	Ecuador Andes	516 children aged 6-36 months	Cross-sectional secondary analysis	Children sample blood were measured for sample 25-hydroxyvitamin D using an automated enzyme immunoassay. Distribution of Vitamin D status based on three classification in this article: - Study-specific for undernutrition: Low (<42,5 nmol/L): 96 children or 18,6%. Referent (≥42,5 nmol/L): 420 children or 81,4%. - Institute of Medicine (IOM): Risk deficiency (<30 nmol/L): 18 children or 3,5%. Risk inadequacy (30-47,5 nmol/L): 163 children or 31,6%. Sufficient (≥50 nmol/L): 335 children or 64,9%. - Endocrine Society Practice Guidelines: Deficient (<50 nmol/L): 181 children or 35,1%. Insufficient (50-72,5 nmol/L): 229 children or 44,4%. Sufficient (>72,5 nmol/L): 106 children or 20,5%. Height for Age z-score (HAZ): - Normal: 61 children or 11,8% - Mildly stunted: 89 children or 17,2%. - Stunted: 321 children or 62,2%. Most of the children has level serum 25(OH)D under 42,5 nmol/L is stunting (76 children or 79,2%).	Level serum 25-hydroxyvitamin D <42,5 nmol/L significantly associated with stunting in low-SES children.	Weakness: These research result just describe about the association of vitamin D status and stunting in low-SES setting. Strength: Classification of vitamin D status in this article was analyzed by author, to obtain a good interpretation.
Vitamin D Deficiency Is Not Associated with Growth or The Incidence of Common Morbidities Among Tanzanian Infants Author: Christopher R. Sudfeld et al (2017)	To examine risk factors of vitamin D deficiencies and determine the association between vitamin D status with child growth and incidence of common morbidities	Tanzania	581 infants born to HIV-uninfected mothers and had 25(OH)D assessed at age 6 weeks and 6 months with follow-up measurement of LAZ, WAZ, and WLZ every 3 months until 18 months aged.	Prospective cohort study	The mean of 25-hydroxyvitamin serum in 6 weeks and 6 months infant is 14,5 ng/ml and 26 ng/ml. There are 76,4% 6 weeks infants and 21,2% 6 months infants had deficiency vitamin D (25-hydroxyvitamin serum <20 ng/ml). Level serum of 25-hydroxyvitamin D in stunting infants: - 6 weeks <10 ng/ml (45 infants); 10-20 ng/ml (72 infants); >20 ng/ml (39 infants). - 6 months <20 ng/ml (23 infants); 20-30 ng/ml (42 infants); >30 ng/ml (37 infants).	This study indicated that vitamin D status cannot be the main indicator of Tanzanian infant's body height because there is no significant improvement in LAZ score in children with sufficient vitamin D status.	Weakness: This article just explain the two type of classification vitamin D status (deficiency and severe deficiency status) and there is not any explanation about how to measure the 25-hydroxyvitamin level serum. Strength: The authors compared the result of this study with their previous study was used a sample of HIV-infected infants.
Association of Vitamin D, Retinol, and Zinc Deficiencies with Stunting Toddlers: Finding from A National Study in Iran Author: Y. Sharif, et al (2019).	Aim to investigate the association between 25-hydroxyvitamin D serum levels (vitamin D), retinol (vitamin A), and zinc with stunting in Iran toddlers.	Iran	4,261 toddlers aged 10-36 months.	Cross-sectional-study	25-hydroxyvitamin serum levels was measured by electro-miluminescence immunoassay on Roche Elecsys system from 5 ml non-fasting blood sample. There are 249 boys (11%) and 156 girls (7,8%) had a HAZ <-2 SD/ stunting. Serum 25-hydroxyvitamin D levels mean is 31,19±15,62 ng/mL.	The analysis in this study showed differences in vitamin D levels in children with (P-trend 0.01) or without (P-trend 0.09) vitamin D supplementation. Vitamin D levels in children with vitamin D supplementation have a big impact on the occurrence of stunting in children.	Weakness: The association of vitamin D status and stunting in this article can not be concluded because there are two different analysis. Strength: Variable in this article is a quite complete (urban/rural, family members, birth weight, and additional nutrition supplement.

Table 1: Article Analysis

Title	Purpose	Place	Sample	Method	Vitamin D Status and Stunting	Result	Weakness and Strength
High Pregnancy, Cord Blood, and Infant Vitamin D Concentration May Predict Slower Infant Growth Author: Helena H. Hauta-alus, et al (2019).	To investigate the association of vitamin D status in pregnancy, umbilical cord blood (UCB), or infants with infant growth.	Helsinki, Finlandia	798 healthy infants aged 0-12 months with their mothers.	Cohort study	The blood sample for measuring 25-hydroxyvitamin D level serum was taken 3 times at 11 weeks of gestation, infant birth, and 12-months infant. The level serum of 25-hydroxyvitamin D was measured by IDS-ISYS fully automated immunoassay system with chemiluminescence detection with intra-assay detection <7% for pregnancy and infant; <13% for UCB and PTH. The mean of body length and body weight infants in 6 and 12 months are normal. Level serum of 25-hydroxyvitamin D in infants showed a sufficient status (≥ 50 nmol/L) (99% at birth and 96% at 12 months old) and there are 671 infant mother's have sufficient vitamin D status at pregnancy. On the other side, there are 2% pregnancy, 4% UCB, and 17% infants have an increased 25-hydroxyvitamin D serum level (>125 nmol/L).	The result analysis showed, there is an association between sufficient level of 25-hydroxyvitamin D serum in pregnancy, UCB, and infants with slowed infants growth at 6 and 12 months old. In separate analysis, 25-hydroxyvitamin D sufficient level have an association with smaller or thinner arm circumference, body weight, body height, and head circumference at 12 months-old.	Weakness: This study has not been able to explain the causes of vitamin D sufficiency status that relates to the children growth deceleration. Strength: The regression analysis process in this article was carried out with three models.
Vitamin D Status in Early Childhood is Not Associated with Cognitive Development and Linear Growth at 6-9 Years of Age in North Indian Children: A Cohort Study Author: Ranadip Chowdhury, et al (2020).	To examine the association of vitamin D deficiencies in infants and early childhood with cognitive development and linear growth at age school.	Delhi, North India.	716 children aged 6-9 years, who had a result of vitamin D status from previous study (a randomized double-blind placebo-controlled trial on the effect of two recommended daily allowances (RDA) of vitamin B12 and/or folic acid daily for 6 months in Delhi, North India).	Cohort study	Vitamin D status was measured by 3 ml children blood sample with quantitative electrochemiluminescence binding assay tools. The result of vitamin D status was classified in three categories: - Sufficient vitamin D (>20 ng/ml) : 154 or 21,5% children. - Inadequate vitamin D (12-20 ng/ml) : 234 or 32,7% children. - Deficient vitamin D (<12 ng/ml) : 328 or 45,8% children. The mean of stunting in children based on distribution of vitamin D status classification: - Sufficient vitamin D : 59 children - Inadequate vitamin D : 86 children - Deficient vitamin D : 128 children	Data analysis in this study explained that vitamin D status of children at 6 months aged could not determine the child's height at the 6-9 years old because vitamin D status could change.	Weakness: The research time span from first step to the second step is too long. Strength: The impact of vitamin D status for physical growth in early childhood can be known through this article.
Vitamin D Insufficiency and Its Association with Biochemical and Anthropometric Variables of Young Children in Rural Southwestern China Author: Shan-Shan Geng, et al (2016).	To identification the vitamin D status in children age 18 months in seasonal variation and analysed the relationship between biochemical indices with anthropometric data in rural Southwestern China.	Rural area in Southwestern China	177 children aged 18-months, who lives in Yunnan Province, Southwestern China.	Cross-sectional study	The blood sample was taken from children by venipuncture as much as 5 ml for measuring the 25-hydroxyvitamin level serum in high-performance liquid chromatography-tandem mass spectrometry tools. The mean of 25(OH)D ₂ and 25(OH)D ₃ level serum is $26,61 \pm 7,26$ ng/ml (range: 7,70 – 58,50 ng/ml). There are 29,4% children have level serum >30 ng/ml (sufficiency), 70,64% children have 20-30 ng/ml (insufficiency), and 16,4% have <20 ng/ml (deficiency). The level serum between boys and girls has not shown any difference. The level serum of 25-hydroxyvitamin D in each season: (mean) - Spring : $25,28 \pm 7,14$ ng/ml - Summer : $26,71 \pm 6,47$ ng/ml - Autumn : $28,51 \pm 8,38$ ng/ml - Winter : $25,99 \pm 6,43$ ng/ml and didn't show a significant difference in the four season.	This is caused by another factor that is the low economy, which can affect various factors causing stunting (one of them is vitamin D status).	Weakness: This article has only analyzed the body anthropometry, but not the stunting condition. Strength: Data acquisition in this article is presented clearly (include: number of stunting children).

Table 1: Article Analysis

Title	Purpose	Place	Sample	Method	Vitamin D Status and Stunting	Result	Weakness and Strength
Vitamin D Levels in Malnourished Children under 5 Years in A Tertiary Care Center at Muhimbili National Hospital, Dar es Salaam, Tanzania-A Cross-sectional Study Authors: Nahida Z. Walli, et al (2017).	To evaluate the vitamin D deficiency in malnourished children under 5 years in Tertiary Care Center, Muhimbili National Hospital, Dar es Salaam, Tanzania.	Tanzania	134 malnourished children aged <5 years (HAZ/LAZ <-2SD)	Cross-sectional study	There are two classification of malnutrition viz. severe acute malnutrition (marasmus, kwashiorkor, and marasmic kwashiorkor) and chronic malnutrition (severe stunting, moderate stunting, and mild stunting). The measured of 25-hydroxyvitamin D level serum were measured with children's blood sample using an enzyme-like immunoassay. There are 64 children have severe stunting and 38 children have moderately stunting. Children's 25-hydroxyvitamin D serum levels showed: - Deficiency (<50 nmol/l) : 41 (30.6%) children - No deficiency (≥50 nmol/l) : 93 (69.4%) children Vitamin D status in children with stunting: - Severe stunting Deficiency : 20 children (31.2%) Not-deficiency : 44 children (68.8%) - Moderate stunting Deficiency : 8 children (21.6%) Not-deficiency : 29 children (78.4%) - Mild stunting Deficiency : 8 children (34.8%) Not-deficiency : 15 children (65.2%)	This study showed that malnourished children have a high chance of stunting, however not all stunted children have vitamin D deficiency status (p-value 0.34).	Weakness: The explanation of the relationship between vitamin D status and stunting in this article is only described in the analysis table. Moreover, the sample used is only limited to malnourished children. Strength: Although this article doesn't show a relationship between vitamin D status and stunting but, this article can prove that vitamin D deficiency has an impact on children's nutritional status.
The Vitamin D Status in 6-14 Years Old Children Attending Tertiary Care Teaching Hospital in South India Authors: Bindusha S, et al (2017).	To identification of vitamin D status in children aged 6-14 years-old, who attend to Tertiary Care Teaching Institute of South India and analyze the factors that affect the occurrence of vitamin D deficiency in children	South India	92 children aged 6-14 years (51 boys and 41 girls)	Cross-sectional study	The measured of 25-hydroxyvitamin D levels serum with children's blood sample used a monoclonal anti-25-hydroxyvitamin D antibody based ELISA test. There are 76 children have normal body height and 16 children stunting. Stunting children distribution based on Waterlow classification: - 1 st degree : 11 (12%) children - 2 nd degree : 1 (1,1%) children - 3 rd degree : 31 (33.7%) children The mean of vitamin D levels is 31.00±14.13 ng/ml (boys : 31.87±13.54 ng/ml and girls : 29.98±13.54 ng/ml) with 48 children (52.2%) have optimal levels serum (>30 ng/ml), and 44 children (47.9%) have insufficient levels serum (<30 ng/ml).	This article showed that insufficiency of vitamin D (25-hydroxyvitamin D levels serum <30 ng/ml) had an association with stunting (p=0.003).	Weakness: There is no distribution table of sample characteristic data that becomes a variable. Strength: Research analyse in this article state an association between insufficiency vitamin D status with stunting.

DISCUSSION

Vitamin D status is an indicator used to determine the level of adequacy of vitamin D levels in the body by measuring serum levels of 25-hydroxyvitamin D (25(OH)D). Vitamin D in the body can stimulate growth hormone sensitivity in carrying out its role in the linear growth of school children (12). Nurhayati et al. (2020) state that vitamin D deficiency status can increase the risk of stunting in children (14). In line with these concepts and statements, Mokhtar et al. (2017) in their article found that children with low vitamin D status (<42.5 nmol/l) living in the mountainous Andes region of Ecuador, South America, had a strong relationship with the condition of stunted height (18). The article considered that the high prevalence of vitamin D deficiency status in underweight children is caused by a lack of macro and micro nutrients intake (one of which is vitamin D). When viewed from the point of view of where the research took place, the intensity of exposure to sunlight or UV obtained by the children should be sufficient or exceeding the needs because of its location in the highlands. The higher an area is above sea level, the higher the level of UV radiation (19). However, the type and model of clothing worn by children due to the cold climate causes sun exposure to only reach a small part of the body surface, so the amount of vitamin D synthesized is less than the requirement. According to Chang and Lee (2019), the synthesis of vitamin D in the body is influenced by the intensity or duration of exposure to sunlight and the surface area (body surface area) exposed (20). The longer duration of exposure to sunlight/UVB will increase the amount of vitamin D synthesized in the body (21). Sun exposure to all parts of the body or the upper body can increase the total serum 25(OH)D level significantly if compared to the face and hands (22).

Bindusha et al.'s (2017) findings are in line with the concept that the status of vitamin D insufficiency in children in South India who undergo outpatient treatment at a tertiary care teaching hospital is related to the incidence of stunting (23). It is known that of the 16 children included in the stunting category, 13 had vitamin D insufficiency status. The research in this article was undertaken in the State of Kerala in South India. Kerala's location near the equator makes this area get a high intensity of sun exposure. UV levels in tropical areas (around or right at the equator) are higher than other regions because of the position of the sun perpendicular to the equator (24). However, the results of the analysis in this article state that there is no relationship between the duration of outdoor activities as an indicator of the duration of sun exposure and body parts exposed to the vitamin D status of children, because there is no significant difference in the number of children in duration and body parts exposed among groups of children with insufficiency and normal vitamin D status. The duration of outdoor activity and body

surface area does not show a relationship with 25(OH)D levels in areas that have several seasons (winter, summer, autumn, and spring) (25).

Another article using a sample of children from patients at a tertiary care hospital is by Walli et al. (2017) with results that do not show a relationship between vitamin D deficiency status and the incidence of stunting (26). In this article, it is known that more than 50% of malnourished children were stunted with the majority of vitamin D status not being deficient (≥ 50 nmol/l) both in the severe acute malnutrition (marasmus and kwashiorkor) and chronic malnutrition (stunting) groups. Children with malnourished nutritional status in Uganda also showed that most children had normal 25(OH)D serum levels (≥ 30 ng/ml) (27). There are as many as 134 children (91%) out of 150 malnourished children included in the stunting category in Karaachi, Pakistan. Stunting conditions can be initially from mild chronic malnutrition status that worsens with accompanying infectious diseases such as diarrhea, respiratory tract infections, and measles (28). Compared to the malnutrition status of children, vitamin D deficiency status in this article is not a major factor in the occurrence of stunting in children in tertiary care Tanzania.

In contrast with the results of Bindusha et al.'s (2017) analysis, Chowdhury et al. (2020) in their cohort study article stated that there was no relationship between vitamin D status of children aged 6-30 months and the incidence of stunting at the age of 6-9 years in North India (29). When compared to South India, North India has an unstable UVB index. The index increases rapidly from March-October and again declines rapidly in November (30). In addition to the intensity of sun exposure and the surface area of the skin exposed to the sun, the deficiency of the quantity of food sources of vitamin D intake can also affect the status of vitamin D deficiency. Salmon, mackerel, and blue fish (oily fish types) are known to have very good sources of vitamin D₃. However, this type of fish is a difficult to find or limited numbers food source in North India (31, 32). According to Green et al. (2016), the population of North India has a diet that tends to consume more fruit, vegetables, rice, and beans (33). Therefore, vitamin D deficiency status is often found not only in stunted children but also in children with underweight and wasted nutrition.

Sudfeld et al. (2017) also state that vitamin D deficiency status (<10 ng/ml) in children with environmental enteric dysfunction at six weeks or six months has no effect on stunting in Tanzanian children at 18 months (34). Environmental enteric dysfunction (EED) is a disorder of small intestine function that often occurs in children in tropical and low-middle income countries (35, 36). This disorder is one of the factors that determine stunting conditions, especially in children with low socioeconomic status and living in slums (37). Mechanistically, EED conditions in children

can cause several changes in the absorption process of the small intestine such as increased intestinal permeability, chronic inflammation in the intestine, villous atrophy, changes in the intestinal ecosystem, macro and micronutrient deficiencies, and intestinal bacterial translocation (38). Owino et al. (2016), in a review article, state that inadequate or inconsistent energy intake, recurrent infections, and local or systemic inflammation due to EED are factors that contribute to growth failure and postnatal stunting (39).

In the previous article, it has been revealed that the economic status of poor families (middle-lower) affects the quality of children's nutritional intake and the environment they live in. In line with this, Geng et al. (2016) state that low socioeconomic status is a major factor in the occurrence of child stunting in Southeast China (40). A study conducted by Ngaisyah (2015) in Kanigoro Village, Saptosari, Gunung Kidul, showed that most of the families of stunted children had incomes below the minimum wage (41). Similarly, the results of a study in the working area of the Wilangan Health Center, Nganjuk Regency, show that there is a relationship between family income and the incidence of stunting in toddlers (42). The nutritional status of parents and the socioeconomic status of the family are the biggest determining factors for stunting in children in lower-middle income countries (43).

Another factor causing stunting in children is the lack of nutritional intake (macro and micro). However, there are several types of nutrients that greatly affect the incidence of stunting based on their function or role in the body. The article by Sharif et al. (2019) stated that micronutrient levels of vitamin A (retinol) are associated with stunting, whereas vitamin D (serum 25(OH)D) and zinc showed the opposite in both urban and rural children (44). Sulistianingsih and Yanti (2016) also stated that low intake of protein, vitamin A, and iron in children in Tanjung Baru Village, Bandar Lampung City, had a relationship with stunting (45). In contrast, Langi et al.'s (2019) analysis showed that the nutritional intake associated with the incidence of stunting was iron intake, while the intake of energy, protein, and vitamin A was not related (46). This is because the lack of vitamin A levels in the body will interfere with the process of maturation of new cells so that it has an impact on the child's growth process.

Then, in the last article, by Hauta-alus et al. (2019), something new was found, namely vitamin D sufficiency status related to the slow growth process of children (47). This statement applies to children in Finland whose mothers have vitamin D content >125 nmol/l (sufficiency). Until now there has been no article that can explain the mechanism of slowed growth due to vitamin D sufficiency status. In general, based on the results of previous studies, vitamin D can cause linear growth process in children who have slow growth

process and if the need for vitamin D has not been met (status deficiency or vitamin D insufficiency), it make children's height shorter than their age. The growth process of a child from a mother who has vitamin D deficiency status will fail to grow after one month of age (48). Low levels of vitamin D (<50 nmol/l) in early and late pregnancy can affect fetal development and growth (49).

Differences in the results of the analysis of the relationship between vitamin D status and the incidence of stunting in each article occur due to the various factors causing stunting in each region of the country. Maywita (2018) stated that most stunting toddlers aged 12-59 months in Kampung Baru Village, Lubuk Begalung Padang District, did not receive exclusive breastfeeding, had poor parenting, low family socioeconomic level, a history of infectious diseases, did not utilize health services with good parenting, poor nutrition, and were living with a large family (family members >5 people) (50). The low level of education of fathers and mothers is the main factor in the occurrence of stunting in children aged 25-60 months in Sukorejo Blitar District (51). The case in Makassar showed that the main causes of stunting in children aged 6-60 months were zinc levels and low birth weight (LBW) (52). The limitation of this study is about the wide-topic discussion because the inclusion criteria arrange focus on the vitamin D status of children with or without vitamin D supplementation correlation with stunting.

CONCLUSION

Of the eight articles, there were two which stated that there was a relationship and five that vitamin D status was not related to stunting while one stated that vitamin D sufficiency status was associated with linear growth of children who have slow growth. Based on the conclusions from the analysis of the articles, it was found that the various factors causing stunting in children caused vitamin D status tare not always the main factor on the incidence of stunting in children. Therefore, there was a condition in certain areas that made vitamin D status as one of major influential factors on the incidence of stunting in children.

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