



The Role of Vitamin D in Stunting Prevention: A Literature Review

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Abstract

BACKGROUND: Nutritional problems in infants under the age of two can inhibit growth and development. This has a negative impact on their subsequent life, increasing the risk of stunting. Vitamins are essential micronutrients in the body's metabolic processes and they have a multi-complex role. One of the micronutrients that affect stunting are vitamin D. It plays an important role in stunting prevention. Stunting countermeasures are carried out by fulfilling the need of adequate nutrition where both macronutrients and micronutrients are needed to avoid the risk of stunting.

AIM: The aim of this literature review was to analyze the role of vitamin D in preventing stunting.

METHODS: The articles were collected through the Google Scholar, PubMed, Proquest, and Ebsco databases using the keywords Vitamin D and Stunting, consisting of both quantitative and qualitative studies. The articles used were only articles with a full text available that were written in English and Indonesian published from 2015 to 2019. Fifteen articles were found that met the criteria.

RESULTS: The literature review results indicate that vitamin D plays an important role in the metabolism of bone formation and growth. It also has the role of increasing the level of immunity in children. Both roles contribute to stunting prevention. Vitamin D is key in regulating the immune function during pregnancy regarding the fetus-mother interaction, representing an important target. Among its non-classical actions include the emphasis of strong immunomodulators, including the induction of antibacterial responses and the modulation of T-lymphocytes to suppress inflammation and increase tolerogenesis. Vitamin D plays an important role in the innate immune function in the decidua by promoting the infection response while simultaneously preventing the excessive elaboration of immune inflammation. The research to date has focused on the potential role of vitamin D in preventing infectious diseases such as tuberculosis, as well as possibly suppressing autoimmune diseases.

CONCLUSION: Vitamin D can also affect the immune function in a manner that is not immediately related to the primary innate response. Stunting can be prevented early on through the adequate intake of macro and micronutrient nutrients. The need for micronutrients is especially important, inclusive of vitamin D as an important element in bone metabolism. It also increases the body's defenses so as to prevent infectious diseases in children.

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Introduction

Stunting is a chronic growth disorder in children due to a lack of nutrition for a long time. Stunting is one of the health problems experienced by toddlers in the world today, not least in Indonesia. In 2017, 22.2%, which is around 150.8 million children under five in the world, experience stunting. Indonesia is included as it is the third country with the highest prevalence in the Southeast Asia Regional (SEAR). The average prevalence of stunting in toddlers in Indonesia in 2005 - 2017 was 36.4% [1]. Stunting is an issue in child nursing that must be prevented because of its very complex and detrimental impact on the various developmental sectors in Indonesia.

The first 1000 Days of Life (HPK) are an important period in stunting prevention, and this is followed by 270 HPK during pregnancy, and 730 HPK in children less than two years old. In the period of 1000 HPK, the need for vitamin D is very necessary in connection to the

process of metabolism for the purposes of bone growth and calcium balance. Vitamin D is a classic secosteroid. According to the Academy of Pediatrics (AAP), the need for vitamin D in infants is as much as 400 IU / day, both in infants who get exclusive breastfeeding and those who get complementary foods (PASI). This is because their vitamin D needs are often not met only by exclusive breastfeeding or formula milk. According to the Center of Disease Control and Prevention (CDC) estimates, only 13 - 15% of infants who are breastfed and 20 - 37% of infants who receive formula milk are vitamin D compliant according to the AAP recommendations.

Vitamin D is processed automatically when the skin is exposed to ultraviolet light. When ultraviolet hits the skin, vitamin D3 (cholecalciferol) is a form of pre-vitamin D that is transferred to the blood and kidneys to be converted into the vitamin D that the body needs. Ultraviolet A has a longer wavelength (320-400 nm) than Ultraviolet B (280-320 nm). The element Ultraviolet A is greater than Ultraviolet B, and its rays are direct and uninterrupted from the sun.

The vitamin D levels in UVA have a longer wavelength (320–400 nm) than UVB (280–320 nm). The term ultraviolet means “beyond purple”, where the word “purple” is the color with the shortest wavelength in visible light. The UVA element is present directly and does not break from the sun. The serum is determined by two main factors, namely food intake and the vitamin D production in the skin when exposed to sunlight (ultraviolet B irradiation, UVB). Full-term babies are born with sufficient vitamin D storage for the next few months, and the half-life of their vitamin D serum is 12 - 20 days. Infant formula milk is often fortified with sufficient vitamin D (> 400 IU / L), whereas breast milk only contains 12-60 IU / L vitamin D. This is far less than the maintenance amount needed (200 IU / day) as recommended by the National Academy of Science (NAS) [2].

Several factors can influence the process of vitamin D formation, namely skin color. People with a dark skin color must be longer exposed to UV light than people with a light skin color because dark skin contains more melanin. Melanin functions to protect the skin from damage due to excessive sun exposure. Melanin acts as a natural sunscreen to protect from the sun’s UV rays in order to prevent skin cancer. The second factor is the duration of exposure to the UV rays. Some studies state that between 30 minutes and 12 seconds is ideal. There are also those that state that 15 minutes is enough, respective of other factors such as age. Being older decreases the ability of the body to produce vitamin D, alongside the thickness of clothing used and how many body parts are exposed to UV light. There are also the factors to do with the sun.

Other factors that influence the production of vitamin D originating from the climate and the environment include cloudy weather meaning that the UV rays not being able to hit the skin, air pollution causing the UV rays to be reflected and the person’s location as the sun’s UV rays cannot penetrate walls. People who work indoors are still vulnerable to vitamin D deficiency.

Research related to vitamin D levels looks at the 1000 HPK obtained from several sources, namely Elsevier. In Tamblyn et al., (2015), research on the immunological role of vitamin D in the maternal-fetal interface shows that the role of vitamin D is very important in pregnancy [3]. Vitamin D is key when it comes to regulating the immune function during pregnancy. The interface between the fetus and mother represents an important target. Among its non-classical actions are strong immunomodulatory effects, including the induction of an antibacterial response and the modulation of T-lymphocytes to suppress inflammation and increase tolerogenesis. Vitamin D therefore plays an important role in the normal decidual immune function by promoting the innate response to infection while simultaneously preventing the excessive elaboration of immune inflammation. The research to date has focused on the potential role of vitamin D in preventing infectious diseases such as tuberculosis, as well as possibly suppressing autoimmune diseases. However,

vitamin D can also affect aspects of the immune function that are not immediately related to the primary innate response. This review summarizes our current review of the decidual immune function with respect of vitamin D metabolism and signaling. This includes how this can be influenced by variations in maternal vitamin D status. Recently, there has been a lot of interest in vitamin D supplementation in pregnant women. Vitamin D is known to be a classic secosteroid due to its key role in bone metabolism and calcium homeostasis. Since the 1980s, there have been many additional ‘non-classical’ frameworks regarding the important functions of vitamin D including anti-proliferation, pro-differentiative, and powerful immunomodulatory actions. The purpose of this literature review was to analyze the role of vitamin D in preventing stunting by identifying the role of vitamin D and identifying the interventions used to promote vitamin D fulfillment as part of stunting prevention.

Methods

The articles were collected through the use of the Google Scholar, PubMed, Proquest, Ebsco databases using the keywords Vitamin D and Stunting, consisting of both quantitative and qualitative studies. The articles used were only the articles with a full text available that were written in English and Indonesian published from 2006 to 2019. Fifteen articles were found that met the criteria. The quality of the methodology was assessed using the Critical Appraisal Skill Program guide and the PRISMA guide. Following this approach, only 5 articles met the criteria.

The PRISMA assessment diagram to determine the literature is as follows Figure 1:

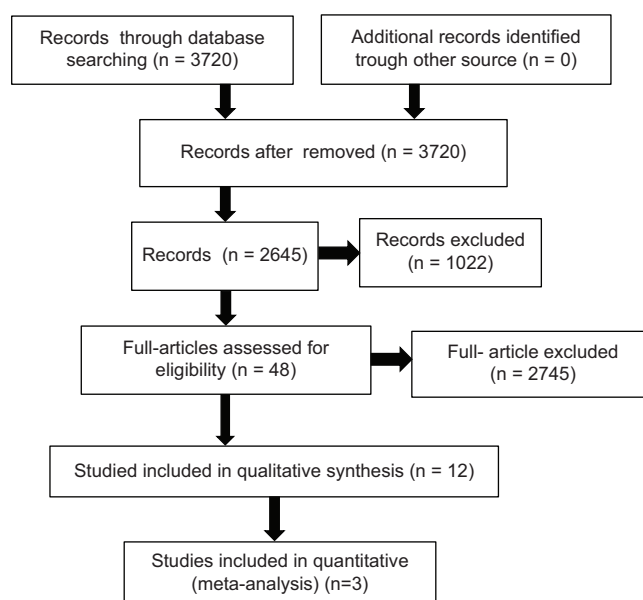


Figure 1: The PRISMA assessment diagram to determine the literature

Results

The search results through the selected databases found 48 articles. Only 15 articles met the full criteria, specifically looking into the relationship between stress and the quality of life of mothers with thalassemic children. Chronic illnesses in children have a stunting effect besides the other psychological, social, spiritual, cultural, and economic impacts. Vitamin D has a very important role as it increases the mechanical defenses by increasing

the level of immunity in children. The problem that is often faced today is that some people still do not take advantage of UVB sun exposure to fulfill their need for vitamin D. Some things that need to be considered in the process of vitamin D formation have not been socialized such as skin color, UVB exposure being unable to penetrate the walls of most houses, and the time of exposure. All of these factors affect the metabolism of vitamin D in the body.

The following is a table of characteristics of articles that meet the inclusion criteria:

Table 1: Characteristics of articles that meet the inclusion criteria

No.	Authors/years/place of study	Title	Participant	Method, intervention, and results
1	Annie WC Kung, Ka Kui Lee, 2006, BMC Public Health, http://www.biomedcentral.com Hongkong, China [14].	Knowledge of Vitamin D and perceptions and attitudes toward sunlight among Chinese middle age and elderly women: A population survey in Hongkong.	547 participants, middle age, and elderly Chinese in Hongkong	Telephone interviews, random sampling The survey results showed that 62.3% did not like going in the sun and 66.7% of respondents spent an average of 6–10 h indoors, between 6.30 am and 7.00 pm during weekdays. However, 58% of people thought that they had enough exposure to sunlight
2	Rana R Mokhtar, Michael F Holick1, Fernando Sempértegui, Jeffrey K Griffiths, Bertha Estrella, Lynn L Moore, Matthew P Fox and Davidson H Hamer (2017)	Vitamin D status is associated with underweight and stunting in children aged 6–36 months residing in the Ecuadorian Andes	Children (n 516) aged 6–36 months	Cross-sectional analysis Nutritional status Children aged 12–36 months Anthropometric Measurement: Body weight, height/length, blood sample Instrument: Anthropometric devices for weight and height measurements are calibrated annually for accuracy by the Ecuadorian National Standards Bureau. WAZ, Z height for age (HAZ) score and Z weight for height (WHZ) score were calculated using WHO 2007 growth standards The average serum concentration of 25 (OH) D is 580 (SD 177) nmol/l. Sensitivity analysis revealed a cut-off of 25 (OH) D specific malnutrition <425 nmol/l; 186% of children have serum 25 (OH) D <425 nmol/l. Children who are underweight are more likely to have serum 25 (OH) D <42.5 nmol/l (adjusted OR (aOR) = 20; 95% CI 12, 33). Children with low serum levels of 25 (OH) D are more likely to be inhibited (aOR = 28; 95% CI 16, 47). Conclusion: Low serum D (OH) 25 levels are more common in Ecuador children who are thin and stunted
3	Dang Van Chuc, Nguyen Xuan Hung, Vuong Thi Trang, Dang Viet Linh, and Pham Minh Khue Tahun: 2019	Nutritional Status of Children Aged 12–36 Months in a Rural District of Hungyen Province, Vietnam	1160 children aged 12–36 months in the commune to be reached. the final number is 327 children	The multistage sampling process is selected. Five communes (Ngocanh, Vinhxa, Hungan, Hiepcong, and Dongthinh) were randomly selected among 22 communes in the Kimdong district while the research subjects were selected by the sampling method. systematic sample The prevalence of underweight, obstructed, wasted, and overweight/obese children was 7.6%, 23.5%, 6.7%, and 1.2%, respectively. The prevalence of anemia and Vitamin D deficiency was 33.3% and 47.7%, respectively. Malnutrition, anemia, and Vitamin D deficiency are not statistically different by sex. Malnutrition and Vitamin D deficiency do not differ statistically by age group, but anemia by age group there are significant differences
4	Lan T. Ho-Pham, Mai T. T. Nguyen, (2012) Vietnam [13]	Survey on knowledge and attitudes on Vitamin D and sunlight exposure in an urban population in Vietnam	Total Participants 1536 respondents with age between 18 and 85 years of age were surveyed	Knowledge, behavior, and attitudes of Vietnamese men and women toward Vitamin D and sun exposure A total of 1536 individuals aged 14–85 years participated in this study. Fifty-three percent of the participants did not like being exposed to the sun. On average, most are reported to be around 14 h/week in the sun. The majority (81%) reported that they had heard of Vitamin D from newspapers (32%), friends (20%) or radio and television (13%). However, their knowledge of Vitamin D sources was inadequate: 37% thought that Vitamin D came from the sun, 28% came from food and sun, while 17% did not know the source of Vitamin D. Analysis of the determinants of Vitamin D knowledge suggested that only the level of education is a significant predictor of Vitamin D knowledge
5	Khem Pokhrel, Keiko Nanishi Krishna C. Poudel Kalpana Gaulee Pokhrel Kalpana Tiwari Masamine Jimba (2016) [17]	Undernutrition Among Infants and Children in Nepal: Maternal Health Services and Their Roles to Prevent it	Performed on a mother-child couple (ages 6–23 months) in the Makawanpur district, Nepal. Nearly 400,000 people live in this district, including 18,000 children aged 0–23 months Selected 400 mother-child pairs in rural Nepal	Cross-sectional study Results The absence of ANC ($b = -1.01$, $p = 0.011$) and the absence of PNC ($b = -1.01$, $p = 0.011$) were negatively related to ICFI scores. In addition, the absence of ANC was positively associated with underweight (AOR 3.37; 95% CI 1.42–9.92 for children)
6	Daniel E. Roth1, Alison D. Gernand, Shaun K. Morris, Brendon Pezzack, M. Munirul Islam, Michelle C. Dimitris, Shaila S. Shanta, Stanley H. Zlotkin, Andrew R. Willan, Tahmeed Ahmed, Prakesh S. Shah, Kellie E. Murphy, Rosanna Weksberg, Sanaa Choufani, Rashed Shah and Abdullah Al Mahmud (2015)	Maternal Vitamin D supplementation during pregnancy and lactation to promote infant growth in Dhaka, Bangladesh (MDIG trial): study protocol for a randomized controlled trial	A total of 1300 pregnant women will be randomized, with the target of allocating 260 women in each group	Randomized control trial The role of Vitamin D in the health of mothers and infants is still unresolved. This trial is expected to contribute unique insights about the impact of increasing maternal-infant Vitamin D status in low-income environments where inhibited and detrimental perinatal outcomes represent a significant public health burden.

7	Mie Shiraisihi, Megumi Haruna, Massayo Matsuzaki, Ryoto Murayama, Sachiko Kitanaka, 2015, Maternal and Child Nutrition [18]	Validity of self-administered diet history questionnaire for estimating Vitamin D intake of Javanese Pregnant women	245 healthy pregnant women in second trimester	Investigated the validity and test-retest reliability of self-administered diet history questionnaire (DHQ) and Using serum marker To assess the test-retest reliability of the DHQ, 58 pregnant women completed it twice within a 4–5 week interval. Significant positive correlation between intake and serum concentration of Vitamin D Serum samples were stored at –20°C in a light-resistant bottle before biochemical testing at Green-Cross Laboratory, Seoul, Korea. Serum concentration of 25 OHD 3 was measured by radioimmunoassay (25OH-VIT.D3-RIA-CA kit, BioSource, Europe; coefficient of intra-assay and interassay variation, 4.7 and 5.3, respectively and PTH (iPTH) intact by electrochemiluminescence intact (reference: 15–65 pg/dL) The research design used was cross sectional, the study was conducted in Tanah Datar District Taking blood from the mother using disposable syringes through the vein mediana cubiti. Before the examination is done, the blood that has been taken is inserted into a centrifuge tube with a speed of 3000 rpm and allowed to stand for 15 min until it freezes. The blood sample is coded, then sent to the Biomedical laboratory for examination of levels of 25 (OH) D using a Human 25 (OH) D ELISA KIT Distribution of respondents based on maternal age, weight of pregnant women, height of pregnant women, Vitamin D Status of Pregnant Women Trimester III, Average Vitamin D Levels in Trimester III Pregnant Women and Average Vitamin D Levels in newborns. The average value of Vitamin D levels in pregnant women is 25.44 ng/ml with a standard deviation of 10.49 ng, and the average value of Vitamin D levels in newborns is 3066.67 ± 328.15 randomly assigned to 1 of 3 dietary Vitamin D targets (control; EAR: 400 IU/d; or RDA: 600 IU/d) for 12 week (January to April 2014). Anthropometric measurements, demographic characteristics, dietary intakes, fasting serum parathyroid hormone, 25-hydroxyvitamin D[25(OH)D], and ionized calcium were compared using mixed model ANOVA Participants' mean 6 SD age was 5.1, 61.9 years; 54.5% were boys with body mass index z scores of 0.50 6 0.85. Compliance was 85% overall. No differences were observed in baseline dietary Vitamin D intakes or serum 25(OH)D. At 12 weeks, the EAR and RDA groups had significantly higher Vitamin D intakes (median [IQR]: control, 227 [184–305] IU/d; EAR, 410 [363–516] IU/d; and RDA, 554 [493–653] IU/d; p, 0.05) and serum 25(OH)D concentrations (control: 55.8 6 12.3 nmol/L; EAR: 64.1 6 10.0 nmol/L; and RDA: 63.7 6 12.4 nmol/L; p, 0.05) than the control group. Ninety-six percent of children in the EAR and RDA groups and 67% of the control group had 25(OH) D concentrations at ≥50 nmol/L. Conclusion: Increasing the Vitamin D intakes of young children through fortification of alternative dairy products results in significantly higher serum concentrations of 25(OH)D and a significantly greater proportion of children with serum 25(OH) D ≥50 nmol/L during periods of minimal ultraviolet B radiation exposure. This trial was registered at clinicaltrials.gov as NCT02097160 and had Health Canada Temporary Marketing Authorization Letters for both products (TM-13-0432 and TM-13-0433).
8	Mi-Jung Kim, MD Departemen Pediatri, Rumah Sakit Universitas Nasional Chungbuk, 410 Sungbong-ro, Heungduk-gu, Cheongju 361–711, Korea.	Vitamin D Nutritional Status and Effects of Vitamin D Supplementation on Breastfeeding Infants in Korea	74 newborns and their mothers	
9	Nidya Ikha Putri, Nur Indrawaty Lipoeto, Rauza Sukma Rita, Arif Sabta Aji e-mail: nidyaikhap@gmail.com [20]	Relationship of Vitamin D Levels in Pregnant Women with Birth Weight of Babies in Tanah Datar District and Solok of District	Pregnant women who met the inclusion and exclusion criteria with a total of 60 respondents. Inclusion criteria include, pregnant women with gestational age ≥28 weeks, pregnant women aged 20 years to reach 35 years, pregnancy spacing >2 years, and are willing to become respondents	
10	Neil R Brett, Paula Lavery, Sherry Agellon, Catherine A Vanstone, Jonathon L Maguire, and Hope A Weiler Frank Rauch. (2016) [16]	Dietary Vitamin D dose-response in healthy children 2–8 years of age: a 12-week randomized controlled trial using fortified foods)	Participants aged 2–8 years (n = 77; Montreal, Canada)	
11	M. E. van Stuijvenberg, J. Nel, S. E. Schoeman, C. J. Lombard, L. M. du Plessis, and M. A. Dhansay [19]	Low intake of calcium and Vitamin D, but not zinc, iron or Vitamin A, is associated with stunting in 2–5-year-old children	Children's dietary intake was assessed by a single 24-h recall. Heights and weights were measured and information was obtained on breastfeeding history, the child's habitual milk intake, as well as substance use by the mother during pregnancy (n = 150).	Results: The overall prevalence of stunting was 36.9% (CI 29.2, 44.6) and increased with age, being 49% in the 4–5-year-old age category. Birth weight correlated significantly with height-for-age z scores (HAZ; r ¼ 0.250, p ¼ 0.003), and was lower in children whose mothers smoked and used alcohol during pregnancy than in children whose mothers abstained (p < 0.0001). Median intake of energy, carbohydrate and protein was adequate. Median intake for all micronutrients was at least 90% of the estimated average requirement, except for calcium, Vitamin D and Vitamin E, which was 21%, 15%, and 32%, respectively. Intake of fat, calcium, phosphorous, Vitamin D, riboflavin, and Vitamin B12 (nutrients that typically occur in milk) was significantly lower in stunted than in non-stunted children (p < 0.05). When excluding children with low birth weight, intake of calcium, Vitamin D, and riboflavin were still significantly lower (p < 0.05). HAZ was higher in children who habitually drank milk compared to those who did not (p = 0.003) May 2010 and August 2011
12	Ni Nengah Ariati, Arma Fetria, Ida Ayu Eka Padmiari, ugiyani, Ni Nyoman Suari. Bali Medical Journal (Bali med J) 2018 volume 7 [9]	Description stunting children in early childhood education program in Bali-Indonesia	53 children in early childhood programs	The research was observational with cross-sectional design. This research showed that 35.85% sample underweight, 60.38% well-nourished, and 3.77% overweight. The data after height/ age measurement has shown that 9.43% sample were short 73.58% normal and 16.98% tall

13	Helve, Viljakainen Holmlund-Suila, Rosendahl, Hauta-Alus, Enlund-Cerullo, Valkama, Heinonen, Räikkönen, Hytinen, Mäkitie, Andersson. (2017) [21]	Toward evidence-based Vitamin D supplementation in infants: Vitamin D intervention in infants (VIDI)		Study design and methods of a randomized controlled double-blinded intervention study) Double-blind randomized testing was performed on infants ranging from 2 weeks to 24 months. Participants recruited randomly received daily 10 mg (400 IU) or 30 mg (1200 IU) of Vitamin D supplementation. Both groups were assessed at age 6 months for calcium homeostasis and 12 months were related to bone strength, growth, development, atopic disease, genetic Epidemiological studies and randomized trials show conflicting results. For example there are quite a lot of effects of Vitamin D supplements on children's infections and neurocognitive function. The results of this study are likely to produce new evidence-based information to improve Vitamin D status in children.
14	Nandita Perumal, Abdullah Al Mahmud, Abdullah H Baqui, Daniel E Roth (2015)	Prenatal Vitamin D supplementation and infant Vitamin D status in Bangladesh)	Infants born to pregnant women (n 160)	Prenatal Vitamin D supplementation and infant Vitamin D status in Bangladesh. The findings in this study indicate that in considering the potential for Vitamin D in postnatal babies as regulated in Bangladesh, an increase of 25 (OH) D in the absence of Vitamin D supplementation must be recognized. Future research should aim to address the effects of Vitamin D supplementation on pregnant women for infant health METHOD: Double-blind randomized trial of 132 respondents. At the age of 1 month respondents were randomly assigned to receive oral Vitamin D3 support for up to 12 months. 87 babies were returned for follow-up at the age of 3 years. At the age of 1 month, participants randomly received oral cholecalciferol (Vitamin D3) supplements 400, 800, 1200, or 1600 IU/day until 12 months of age. Spinal lumbar 1-4 (LS) bone mineral density (BMD), LS and all bone mineral content (BMC), and mineral accretion are measured by double-energy X-ray absorptiometry at 3 years Instrument: Stadiometer (Secca 213, Secca Medical Scale, and Measuring System). Calibrate scale (Detecto). Results: There were no significant differences at 25 (OH) D concentrations. No differences between the Vitamin D treatment groups were recorded for BMC, BMD, or BMD Z scores. There was no effect of Vitamin D status on 3 years of bone related biomarkers including ionized calcium. At follow-up, the treatment group was similar in terms of diet, sun exposure, and demographics. There were no significant differences between groups in LS or whole body BMC, BMD, or accretion. Although, 25 (OH) D concentrations did not differ between groups, higher doses (1200 and 1600 IU/day) reached a higher D (OH) D area under the curve from 1 to 36 months versus 400 IU/day This is the first longitudinal follow-up of an infant Vitamin D dose-response study which examines bone mineralization at 3 years of age. Dosages higher than 400 IU/day do not appear to provide additional benefits to the bone at follow-up. Larger studies with more ethnically diverse groups are needed to confirm these results
15	Gallo T. Hazell C. A. Vanstone S. Agellon G. Jones M. L'Abbé C. Rodd H. A. Weiler Email (2016) [22]	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)	132 respondents	

Discussion

Based on the results of the literature review, the articles contain several concepts focused on UVB exposure and Vitamin D.

The role of Vitamin D

Vitamin D is a fundamental nutrient in the building of bone mineral. This study has enabled the evaluation of the short- and long-term effects of supplemental vitamin D on growth, immune functions, and the skeletal and developmental parameters in infants. This is as well as the effects of the genetic factors involved. The results enable the drawing up of evidence-based guidelines for vitamin D supplementation in infancy.

According to Otto Helve, Heli Viljakainen, Elisa Holmlund-Suila et al., biologically inactive vitamin D3 (cholecalciferol) is produced in the skin after solar UVB exposure. It is bound to the vitamin D binding protein

(DBP) and transported to the liver for conversion into 25-hydroxy-vitamin D (25-OHD). This is the most abundant circulating metabolite of vitamin D. In the kidneys, 25-OHD is further hydroxylated into the active form of calcitriol, 1,25-OH₂D. This contributes to the metabolism of calcium.

UVB exposure and Vitamin D

Because the exposure of the skin to solar UVB radiation and therefore skin-based vitamin D production are the main sources of vitamin D for most people, areas with a low latitude should theoretically have a low prevalence of vitamin D. Vitamin D deficiency is of particular concern in growing children. Limited data is available on the relationship between vitamin D and nutritional status. One study found that children who are underweight (defined by their BMI Z-score) have a higher risk of vitamin D deficiency. This is supported by the research conducted by Mokhtar, et al, (2017). Based on their quantitative research, it was identified that it is possible to measure the prevalence of vitamin D deficiency against the socio-economic status (SES)

of a child's body weight [4]. The children were aged 6-36 months living in the Andes of Ecuador. Their vitamin D status was assessed differently depending on whether they were underweight or of a normal weight. It was determined that there were lower vitamin D levels among the children who were more likely to be stunted.

The same can be seen in the research of Chuc, et al., (2019) [11] on the nutritional status of children aged 12 to 36 months in a rural district of Hungyen Province, Vietnam. It is said that malnutrition can influence their physio-psychological development which leads to a lower level of performance and productivity as the children grow [5]. The most common form of malnutrition is stunting. This affects 156 million children on a worldwide scale today.

Maternal vitamin D supplementation during pregnancy and lactation to promote infant growth in Dhaka, Bangladesh (MDIG trial), used a protocol as part of a randomized controlled trial [6]. They determined that vitamin D regulates bone mineral metabolism and bone development. Prenatal vitamin D deficiency increases the risk of adverse pregnancy and / or adverse birth outcomes. Little is known about the effect of maternal vitamin D status on the infant's linear growth in communities in South Asia where stunting is very prevalent and where the maternal-infant vitamin D status is generally suboptimal [12].

Stunting and Vitamin D

The children's height is one indicator of stunting alongside the chronic diseases that accompany it. Height in children can indicate the stunted growth of their bones. One important element in bone growth is vitamin D. Levels of 25-hydroxyvitamin are a benchmark of a person with vitamin D deficiency. Deficiency is determined if the serum 25-hydroxyvitamin D level is less than 20 ng per mL (50 nmol per L).

In addition to vitamin D, bone growth is focused through the use of calcium and phosphorus. Vitamin D is an essential vitamin. It is a class of fat-soluble secosteroids and it is incorporated as a modulator that is needed in the process of growth and calcium balance. The American Academy of Pediatrics determined that infants and children should receive more than 400 IU per day from their diet and supplements. Evidence shows that vitamin D supplementation of at least 700 to 800 IU per day reduces the risk of fracture at a decreased rate in adults. In people with vitamin D deficiency, treatment may include oral ergocalciferol (vitamin D2) at 50,000 IU per week for weeks. After their vitamin D levels become normal, experts increase the maintenance dose of cholecalciferol (vitamin D3) from 800 to 1,000 IU per day from both their food sources and additives. [15]

Several studies have shown that the vitamin D levels are low in children who are not adolescents, as well as pregnant women and infants under five years

old (toddlers). According to Judistiani RDT et al, 2018 in the research on the association of colecalciferol, ferritin, and anemia among pregnant women, the results from their cohort study on Vitamin D status and its effects during pregnancy and childhood in Indonesia showed that 203 women were recruited. Out of this total, 195 (96, 06%) suffered from hypovitaminosis D, 52 (75%) had vitamin D levels that were deficient, and 43 women (21%) had an inadequate intake of vitamin D.

Vitamin D is found in fish and some vegetables, as well as select meat, poultry, and dairy products (without fortification). Apart from food sources, vitamin D can also be obtained by basking in the sun during the day between 11:00am to 13:00pm for 37 minutes and 12 seconds minimum. Daytime sunlight contains ultraviolet B (UVB) that penetrates the epidermis and changes the provitamin D3 (cholecalciferol) response into previtamin D3. This binds to the vitamin D binding proteins that are to be transported through the blood circulation or stored in fat and used to help the liver [8].

Conclusion

The analysis of the fifteen articles that have been reviewed concludes that the findings of all studies show that stunting has a significant impact on children under five. The impact that appears in this literature is caused by several factors. The factors cause stress to the parent / mother, meaning that the quality of life of the mother becomes no better during the process of caring for their child with thalassemia due to the pressure experienced. This research might be useful in terms of increasing the available information about thalassemia and raising the awareness of nurses and other healthcare individuals.

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