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LITERATURE REVIEW
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Literature Review: Food Supplement Intervention to Increase Z-Score Height for Age in Stunting Children

Tinjauan Literatur: Intervensi Suplemen Makanan untuk Meningkatkan Z-Skor PB/U pada Balita Stunting

Maya Fernandya Siahaan[1], Auni Rahmatika[1], Siti Rahayu Nadhiroh[1]*

[1]Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

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Correspondent:
Siti Rahayu Nadhiroh
sitinadhiroh@fkm.unair.ac.id

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ABSTRACT

Background: Stunting is a chronic growth disorder that occurs during growth and early development in life. Interventions to prevent malnutrition should be implemented within 1000 days of life. Between 6 and 24 months is essential as children transition from exclusive breastfeeding to complementary feeding.
Objectives: To provide scientifically justifiable information on dietary preventions to prevent stunting.
Discussions: The data were obtained from a study of various literature sources by searching through search engines: Google Scholar, BMC, Pubmed, and ScienceDirect, in the form of research results of reputable and national journals. The articles obtained related to this study were seven articles related to dietary supplement interventions to increase the z-score of Length/height-for-Age in stunted children aged 6-24 months.
Conclusions: There were two types of interventions carried out to increase the HAZ in stunting toddlers by providing a single nutrient (mineral zinc) and a combination of 2-3 types of nutrients (Zinc, Iron, Vitamin B12, Vitamin A, Fat). In contrast, the intervention of the combination of zinc mineral nutrients, prebiotics, and food supplements in the form of micronutrient powder sachets did not show a significant difference in the length gain of toddlers.

INTRODUCTION

Stunting is a chronic growth disorder due to malnutrition in children in the long term, which causes children to fail to reach their potential height according to their age[1]. According to World Health Organization (WHO), the indicator of short nutritional status is if the height for age z-score (HAZ) is less than -2 standard deviation (SD)[2]. The prevalence of stunting in the world (2017) was 150.8 million (22%) toddlers. The incidence of stunting in Asia is 55%, and around 39% is in Africa. There are around 83.6 million stunting toddlers, with the highest number of 58.7% in South Asia and 0.9% in Central Asia[3]. The 2018 Indonesian Basic Health Research (Riskesdas) showed that the prevalence of stunting under five reached 30.8%[4].

Stunting causes the lower development of children's cognitive function and increases the mortality rate related to infectious diseases aged 0-24 months. The impact of stunting also reduces children's performance at school and alleviates work productivity in adulthood[5]. Two factors that play an essential role in causing stunting are infectious diseases and inadequate intake of nutrients. These two things are closely related to parenting, health services, access to food, and environmental sanitation[1]. According to UNICEF Indonesia, one of the main obstacles causing the high prevalence of stunting under-fives is a lack of knowledge and the existence of inappropriate practices of infant and young child feeding (IYCF), such as low levels of exclusive breastfeeding and complementary feeding (MP-ASI) which are still not following nutritional guidelines[6].

Prevention of malnutrition in toddlers must be conducted during the golden age (1000 First Day of Life), between 6 to 24 months. During this period, toddlers' nutritional intake transitions from exclusive breastfeeding to complementary foods. However, poor food quality is still often found during this period, which could lead to a high incidence of stunting in toddlers[7]. If exclusive breastfeeding and complementary feeding are given inadequately, it can cause stunting and impact infectious diseases in toddlers. In addition, research also shows that lack of energy consumption in toddlers can increase the risk of stunting by 1.495 times compared to toddlers who consume enough energy[8]. Providing quality complementary food, breast milk, and supplementing vitamins and micronutrients can optimize height and weight. Foods high in protein, calcium, vitamin A, and zinc can trigger a child's height growth[9].

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According to The Indonesian National Agency of Drug and Food Control (BPOM) 2004, food supplements are products that meet the nutritional needs of food containing minerals, amino acids, vitamins, and/or other ingredients (plant and non-plant), where these materials have nutritional value and physiological effects in a certain amount. Ahmad (1999) stated that food supplements are all types of food in the form of capsules, tablets, powders, or syrups that have efficacy or not and are used as an addition to meet the needs of daily nutrition[11]. The results of an experimental study in Pasar Kliwon District, Surakarta, Central Java, Indonesia, in 2016, which was conducted on infants aged 36-60 months by providing zinc supplementation, showed that 38.9% of subjects who were initially stunted turned into normal nutritional status by showing an increase in height with an average of 2.8 cm and an average HAZ of 0.2 SD[12]. Giving zinc supplementation to infants aged 6-24 months in Iran in 2019 also showed an increase in growth and the average length of children aged 6-24 months[13]. Moreover, other research evidence on infants aged 6-23 months in Laos in 2019 stated that giving zinc for nine months did not increase growth in children[14].

Many studies have been conducted on feeding interventions to prevent stunting and have been published with varying results. So the purpose of this journal review is to determine several kinds of interventions, according to the research method and their nutritional content, and their significant role in increasing height and HAZ in stunting toddlers.

DISCUSSION

This literature review was done using Google Scholar with the keywords "stunting nutritional supplementation intervention 6-24 months", PubMed, BMC, and ScienceDirect with the keywords "intervention, supplementation, and stunting age 6-24 months". Articles found using Google Scholar will be subject to a selection process according to the selection of articles, including the inclusion criteria for experimental research, full text, and journals with a minimum Indonesian national accreditation (Sinta). The exclusion criteria for journals published >10 years in the past. Articles on PubMed, BMC, and ScienceDirect were selected by establishing inclusion criteria for reputable journals based on ranking categories of reputable SCIMAGOJR journals and full-text articles in PDF format. Exclusion criteria were published in> the last ten years. This literature review explains experimental research using quasi-experimental methods, randomized control trials, and non-randomized control trials. This study was from the results of studies in various countries regarding interventions in providing food supplements containing one type of nutrient or a combination of 2-3 types of nutrients to tackle the problem of stunting. The results of a literature review on the type of supplementary intervention in increasing toddler body length obtained seven articles (Table 1).

Stunting in the 1000 years of life period can hamper toddlers' growth and development process. The impact of malnutrition can be seen in decreased physical growth, less than optimal mental and intellectual development, and affect the nutritional status and health of toddlers in adulthood. The intervention of food supplementation is one of the efforts to overcome the problem of stunting in Indonesia.

The literature review results show that supplementary interventions containing fat can increase the body length of toddlers. Research by Iannotti et al. in Haiti regarding the provision of modified Lipid nutrient supplement (LNS) made from food ingredients such as peanuts, sugar, soybean oil, nonfat milk powder, whey, maltodextrin, lecithin emulsion, as well as vitamins and minerals every day for six months in infants aged 6-11 months, showed a significant impact on increasing the HAZ infants by 0.13 ± 0.05[18]. In line with the intervention of providing fortified foods made from lentils, chickpeas, and a combination of soybean-wheat nuts for every day of the year, the slowing of the growth in length of infants aged 6-18 months is lower compared to the control group. The modified food content in this study could meet 20-30% of the needs of infants aged 12-18 months, and the results indicate that the average growth in length of a baby's body increases by up to 0.30 cm for 18 months[17].

Several studies have shown that providing ready-to-use therapeutic food (RUTF) or ready-to-use food and Lipid nutrient supplement (LNS) products could improve the HAZ for stunting toddlers. A study showed an increase in the z-score value of 0.03 every month by giving 46 g of ready-to-use food for four months of intervention[19]. Lipid nutrient supplement (LNS) intervention improves micronutrient status in toddlers and reduces the prevalence of diarrheal diseases[18]. Making Lipid Nutrient Supplement products is done by reducing the water content to inhibit the growth of microorganisms so that they can be stored without a refrigerator and for a specific time. The basic ingredients for making LNS are essential fats, usually consisting of vegetable oil, peanut sauce, and milk powder. LNS is also usually given in moderation called Small Quantity Lipid Nutrient Supplements (SQ-LNS) to meet a minimum of one-third of the proportion of children's energy content (250-500 kcal) every day according to age to get the energy needs of children[20].

Research in Pakistan by providing Small Quantity Lipid Nutrient Supplements (SQ-LNS) or Wawamun for local people, as much as 50 grams every day for two years, showed a significant reduction in the risk of stunting and anemia status in children. This finding showed that children who received supplementary interventions during the 1000 HPK period experienced better growth than those without supplementation at all[16]. Research in Pakistan by providing Small Quantity Lipid Nutrient Supplements (SQ-LNS) or wawamun for local people as much as 50 grams to infants aged 6-18 months every day for two years shows there is a significant reduction in the risk of stunting and anemia status in children. Supplement interventions carried out during the 1000 HPK period showed that children experienced better growth than those without supplementation at all[16].

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2 **Table. 1** Search results article intervention of stunting prevention food supplements

Journal Title, Author, and Identity	Research design	Number of Samples	Intervention	Research result
Local Food-Based Prebiotic Formulas Can Increase H/A Z-Scores in Stunted Children Waliyo et al., Action: Aceh Nutrition Journal (2020)[15]	Quasi Experiments	40 children aged 12-24 months in Sei Ambawang District, Kubu Raya Regency, West Kalimantan, Indonesia	Two prebiotic food supplement formulas that have different protein and energy content, consisting of fern, Kepok bananas, skimmed milk flour, garlic, and chicken eggs, were given to each group for 30 days	There was an increase in the H/A z-score by 0.12 ± 0.33 SD in the group that received formula one and by 0.08 ± 0.16 SD in the group that received formula 2. There was no difference in the mean z value - PB/U scores significantly after being given Formula-1 (MF-1) and Formula-2 (MF-2) food (p>0.05).
Zinc Supplementation is an Effective and Feasible Strategy to prevent growth retardation in 6 to 24 Months Children: A pragmatic double-blind, randomized trial Abdollahi M. et al., Heliyon 5(2019)[13]	Randomized Control Trial	682 infants aged 6-24 months in Iran	Given zinc sulfate supplementation of as much as 5 ml (containing 5 mg zinc) for six months	There was a significant difference between the intervention group (5.79 ± 2.18 cm) and the control group (5.23 ± 2.19 cm) in the PB/U z-score in toddlers after being given zinc sulfate supplementation.
Effects of Daily Zinc, Daily Multiple Micronutrient Powder or Therapeutic Zinc Supplementation for Diarrhea Prevention on Physical Growth, Anemia, and Micronutrient Status in Rural Laotian Children: A Randomized Controlled Trial Maxwell A. Barffour et al., The Journal Of Pediatrics(2019)[1,4]	Randomized Control Trial	3,407 children aged 6-23 months in Laos were randomly divided into four groups (1= zinc supplementation group, 2= micronutrient powder group, 3= therapeutic zinc supplementation group, 4= placebo control group)	The intervention was done over nine months, which included: (1) Given 7 mg zinc tablets and a placebo therapeutic for diarrhea; (2) Micronutrient powder, which contains 10 mg zinc, 6 mg iron, and 13 other micronutrients, as well as placebo therapy tablets for diarrhea, (3) Therapeutic zinc supplementation, containing 20 mg for ten days for the treatment of diarrhea (4) Placebo control group.	The preventive zinc supplementation group and the micronutrient powder group showed no change in toddler height. However, giving micronutrient powder can increase zinc levels and reduce the incidence of anemia in toddlers.
Effect of Lipid Supplement-Medium Quantity on reduction of stunting in Children 6-23 months of age in Sindh, Pakistan: A Cluster randomized controlled Trial Khan et al., Plos One (2020)[16]	Randomized controlled Trial	870 infants aged 6-18 months in Thatta and Sujawal Districts in Pakistan	Providing moderate amounts of Lipid-based nutrient (LNS) interventions called Wawamun as much as 50 grams daily for two years. Wawaumum is made from chickpeas, vegetable oil, dry skimmed milk powder, sugar, micronutrients, emulsifiers, and antioxidants	There was a significant reduction in the risk of stunting (p<0.01, RR = 0.91, 95% CI; 0.88-0.94), wasting, and anemia status in children.
Complementary Food Supplementation with a Small-Quantity of Lipid-based Nutrient	Non-randomized Control Trial	168 children aged >6 months on Madura Island, East Java, Indonesia	Intervention for six months was divided into three groups: (1) give 20	Giving SQ-LNS (lipid-based nutrient supplements) increases linear growth and reduces the incidence of stunting

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Journal Title, Author, and Identity	Research design	Number of Samples	Intervention	Research result
Supplements Prevents Stunting in 6-12-Month-Old Infants in Rural West Madura Island, Indonesia Muslihah, et al., Asia Pacific Journal of Clinical Nutrition (2016)[7]			g of SQ-LNS (one sachet) per day, (2) 30 g of biscuits per day, (3) control	
Effect of Fortified Complementary Food Supplementation on Child Growth in Rural Bangladesh: A Cluster-Randomized Trial Christian et al., International Journal Of Epidemiology (2015)[17]	Cluster-randomized trial	5,320 children aged 6-18 months in Bangladesh	Administration of two ready-to-use local feeds (bean and lentil-based) and fortified mixed feeds (wheat-soy-blend++, WSBþþ) compared to Plumpy'doz given over 12 months	Daily fortified complementary foods for one year slightly increased linear growth and reduced stunting at 18 months.
Linear Growth Increased in Young Children in An Urban Slum of Haiti: A Randomized Controlled Trial of A Lipid-Based Nutrient Supplement Iannotti, LL et al., The American Journal of Clinical Nutrition(2014)[18]	Randomized Control Trial	589 children aged 6-11 months in Haiti, Latin America	Providing Lipid-based nutrient supplement (LNS), which contains 108 kcal and other nutrients, including vitamin A, vitamins B-12, iron, and zinc, for 3-6 months	There was an increase in the PB/U z-score value (0.13 ± 0.05) in toddlers after being given LNS supplements

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Giving food supplementation of as much as 20 g of SQ-LNS (small quantity of lipid nutrient supplementation), which contains energy, essential fatty acids, protein, and 22 vitamins and minerals, to children aged 6-12 years for six months shows a significant impact on increasing the baby's body length by 8.57cm[7]. According to WHO (2006), the ideal body length gain for male and female babies for the first six months after birth is 8.1 cm[21]. The results of this study indicate that the content of SQ-LNS fortified food can increase the growth rate and the length of the baby's body according to standards WHO (2006) to catch up growth in stunting children (catch up growth)[7]. A study in Burkina Faso also states that the intervention group given SQ-LNS with additional zinc for nine months significantly increased the length of infants aged 18 months and decreased the prevalence of stunting[22]. The fat contained in SQ-LNS is the largest source of energy that can meet the needs of stunting children under five. The meta-analysis study also showed that SQ-LNS reduced the prevalence of stunting by 12%, so nutrition intervention in the form of SQ-LNS is an effective program to reduce stunting in toddlers[23]. In contrast, a study in Malawi that gave LNS additional milk, soybeans, and corn for 12 months showed no significant difference in the baby's body length gain[24].

In addition to fortified food in the form of LNS, supplementation in the form of other nutrients, especially the mineral zinc, is needed to reduce the prevalence of stunting. Zinc mineral deficiency in under-fives is often associated with growth retardation, decreased immunity, and increased susceptibility to infection[25]. Giving zinc sulfate supplements as much as 5 ml daily to infants aged 6-24 months for six months showed an average weight gain of 5.79 cm. This study showed a significant increase in the length of the baby's body after being given zinc supplements and decreased the incidence of stunting[13]. The results of the meta-analysis study also suggested an association between zinc supplementation and the growth in the body length of toddlers.

Zinc supplements can reduce the incidence of diarrheal diseases that can cause infections in children[26]. Another study on 64 infants in Surabaya, Indonesia, showed that most (65.6%) of stunted infants consumed insufficient zinc, while non-stunting infants had sufficient zinc intake (71.9%)[27]. Zinc deficiency led to the disruption of receptors on Growth Hormone (GH) receptors and decreased synthesis of Liver Insulin Growth Factor (IGF-1), as well as in the protein carried (binding protein) called IGFB-3. Large zinc intake in toddlers is needed for growth processes such as during pregnancy, infancy, and puberty[28]. Other research evidence also supports that the intervention of giving zinc supplements of 10 mg for 24 weeks also increases the length of the baby's body by 0.25 cm[29].

Research in Laos by giving 7 mg of zinc supplements and micronutrient powder sachets containing 10 mg of zinc and 13 other micronutrients for nine months showed no significant impact on toddlers' body length[14]. This study explains that the intervention can increase the concentration of zinc status in the body but does not affect growth which can be caused by other factors that are not responsive to zinc supplementation. Consistent with previous West African studies, giving zinc sulfate supplements of 12.5 mg did not show a significant difference in the length of the toddler's body compared to the control group[30]. The effect of growth hormone (IGF-1), which decreases when protein intake is insufficient, is another factor that must be considered. Until now, several studies have shown that other micronutrients besides zinc significantly influence the growth and development of toddlers. Stunted toddlers from families with poor socioeconomic status are prone to other nutritional deficiencies, and giving one micronutrient is insufficient to see the effect on a toddler's body length[31].

Based on the study's results, it was stated that stunting toddlers are prone to experiencing chronic inflammation due to disruption of the hormonal pathways that regulate the activity of the long bone growth plates, causing stunting and development disruption in children. In theory, the high prebiotic food content improves the digestive tract in stunted children. Intestinal inflammation can increase metabolic disturbances in the absorption of food nutrients by the intestinal microbiota and can affect linear growth in children[32]. Prebiotic food such as ferns, bananas, and garlic containing essential oils prevent the growth of pathogens in the digestive tract. In this study, the provision of protein in the form of eggs is given to the food formulations that can support brain development, the immune system, and muscle development in children. Consumption of good quantity and quality protein can affect the insulin growth factor (IGF-1) levels, which also plays a vital role in bone formation[15].

The results of a quasi-experimental study on toddlers by giving two types of prebiotic food formulas in the form of flour mixed with several local food ingredients such as fern vegetables, Kepok bananas, garlic, and eggs for 30 days showed that the two types of food formulas had no difference in increasing the value of z-score PB/U in stunting babies. However, each intervention group differed in the average z-score value. Feeding formula-1 (MF-1) given to the group experienced an increase of 0.12 ± 0.33 SD. Meanwhile, the group on formula-2 (MF-2) food experienced an increase of 0.08 ± 0.16 SD before and after being given the intervention. This finding showed no significant difference before and after the intervention in the MF-1 group ($p>0.05$)[15].

The growth and development of children are multifactor caused by both nutritional and environmental factors. Providing food interventions to overcome stunting by providing one type of nutrient, a combination of 2-3 nutrients, can positively impact the body length of stunted children. In addition, supplementing nutrients such as LNS, zinc, and prebiotics, exclusive breastfeeding and complementary breastfeeding, and counseling during pregnancy must also be carried out to reduce the prevalence of stunting in toddlers.

CONCLUSIONS

Two interventions were carried out to increase the H/A z-score in toddlers by giving one type of nutrient, such as zinc, and/or a combination of 2-3 types of nutrients, such as zinc, iron, vitamin B12, vitamin A, and fat. Meanwhile, the combination intervention of zinc

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mineral nutrition, prebiotic formula food, and food supplements in the form of micronutrient powder sachets did not show a significant difference in the increase in the body length of toddlers. Nutritional interventions in efforts to prevent stunting under-fives must be started as early as possible during pregnancy and continued during infancy, especially in groups of under-fives prone to malnutrition.

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