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Analysis of the type of intervention for nutritional improvement in toddlers with poor nutritional status: A literature review

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Abstract

Background: Stunting remains a major nutritional problem in Indonesia and significantly impacts human resource quality.

Purpose: to examine various nutritional interventions that influence the reduction of stunting prevalence among toddlers.

Method: A literature review was conducted by searching articles from PubMed, Google Scholar, ScienceDirect, and Research Gate. Literature selection was carried out systematically and analyzed narratively.

Results: A review of 38 articles showed that supplementation interventions such as SQ-LNS, LNS, and RUSF were the most effective in reducing stunting prevalence by 10–16%, especially when provided to children aged 6–24 months along with nutrition education. Locally based supplementary feeding (PMT) also had a positive effect, particularly when combined with fortification and education. Educational and community-based interventions played an important role in improving compliance and the sustainability of nutrition programs.

Conclusion: The combination of nutritional supplementation and education is the most effective strategy for reducing stunting among toddlers.

Keywords: Education; Narrative Literature Review; Nutrition Intervention; Supplementation; Stunting.

INTRODUCTION

The nutritional status of children under five is an important indicator that reflects the nutritional adequacy and health of children in the long term. One of the serious manifestations of chronic nutritional status disorders is stunting. Stunting reflects linear growth failure due to long-lasting malnutrition, exposure to recurrent infectious diseases, and suboptimal treatment during early life. Operationally, this condition is determined through the measurement of height z-score by age (TB/U), with the short category at values below -2 SD and very short at values below -3 SD according to WHO standards

(Latifah, Fajrini, Romdhona, Herdiansyah, Ernyasih, & Suherman, 2024; Agustina & Harahap, 2023).

UNICEF data in 2018 shows that Indonesia occupies the 5th position in the world in the prevalence of this condition¹. WHO in 2021 also reported that globally there are around 149.2 million children or 22% who experience growth stunts. In the Southeast Asian region, Indonesia is in the second highest position after Timor Leste (SetiyawatiArdhiyanti, Hamid, Muliarta, & Raihanah, 2024). Meanwhile, the 2022 SSGI report at the national level shows a decrease in prevalence from

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24.4% to 21.6%. In Makassar, the prevalence was recorded at 18.4%, indicating that the issue of improving children's nutritional status still needs to be a regional priority (Rah, Melse-Boonstra, Agustina, Van Zutphen, & Kraemer, 2021; Ministry of Health of the Republic of Indonesia, 2022).

Growth disorders such as stunting are not just physical problems, but have a wide impact on cognitive, metabolic, and long-term health development. In the early phases of life, growth retardation can cause impaired brain development, decreased learning ability, and changes in the body's metabolic function.⁸ The factors that cause stunting itself are complex, including inadequate protein and micronutrient intake, lack of parental nutritional knowledge, low socioeconomic conditions, a history of low birth weight (BBLR), and inadequate sanitation and environmental quality (Fauziah, Trisnawati, Rini, & Putri, 2024; Wello, Safei, Juniarty, & Kadir, 2021).

Efforts to improve nutritional status and reduce stunting rates require a comprehensive and integrated approach. This study reviewed a variety of interventions that have been shown to be effective, including lipid-based supplementation such as LNS and SQ-LNS that function to increase energy intake, essential fats, and essential micronutrients. In addition, the supplementary feeding program (PMT) plays a role in improving the daily nutritional adequacy of children, especially in families with food insecurity. Behavioral interventions such as infant and child feeding counseling (IYCF) help improve proper feeding practices, from the initiation of early breastfeeding to MP-breastfeeding as needed. The integration of nutritional interventions with sanitation and hygiene (WASH) programs is also an important component, as recurrent infections due to an unclean environment can inhibit nutrient absorption (Madina, Saida, Andari, Mujahida, Fahmi, & Nur, 2022; Dewey, Stewart, Wessells, Prado, & Arnold, 2021; Luby,

Rahman, Arnold, Unicomb, Ashraf, Winch, & Colford, 2018).

RESEARCH METHOD

This research is a Literature Review study, which is a qualitative literature review approach and aims to provide a comprehensive overview of certain topics based on existing research results. The main focus of this study is to evaluate and synthesize information from various scientific publications that discuss the influence of types of interventions for improvement of nutritional status in undernourished toddlers.

This research was conducted through literature search on various scientific databases such as PubMed, Google Scholar, ScienceDirect, and ResearchGate. The literature search and analysis process was carried out from August to September. The literature search uses a combination of keywords that have been compiled based on the main concepts in this study, both in Indonesian and English. Examples of keywords used include "supplements"; "Stunting"; "Nutritional Interventions"; child nutrition"; "Supplementary Feeding"; "child nutrition"; "nutrition intervention"; "stunting prevention".

The literature selection process begins with initial identification through screening titles and keywords to assess the suitability of the topic. Furthermore, an abstract review was carried out to ensure that the article really researched the relationship between dietary supplements and stunting and had adequate data. Articles that pass this stage are then fully reviewed to assess methodological feasibility, clarity of results, and relevance of content. In the final stage, only articles that meet all inclusion criteria and are not included in the exclusion criteria are selected for further analysis. see Figure 1.

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RESEARCH RESULTS

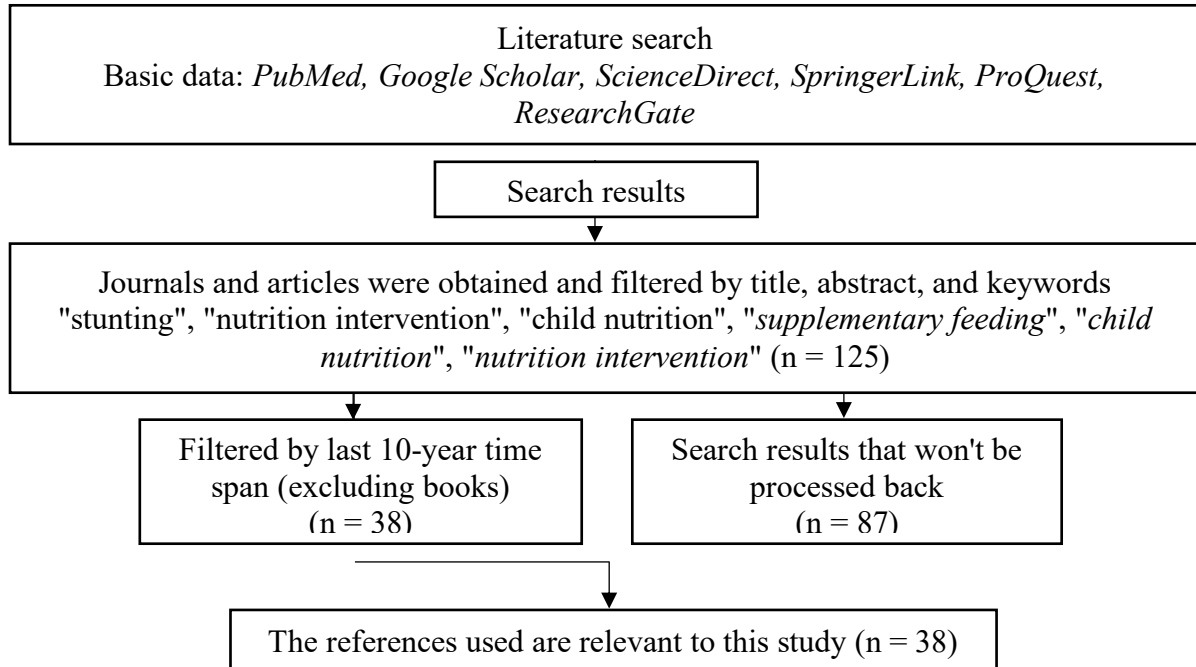


Figure 1. Search strategy flowchart

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Table 1. Supplementary Feeding Based on Local Food

(Author, Years, Country)	Purpose	Method	Results
(Suksesty et al., 2020) (Indonesia)	to determine the effectiveness of the combined supplementary feeding program on changes in the nutritional status of stunted children.	The sampling technique used purposive sampling with a total of 24 toddlers who were given a combination of food interventions for 30 days. This study was a quasi-experimental study with a one-group pre- and post-test design. Rancangan analisis menggunakan uji T dan uji Chi-Square diperoleh 45,8% balita yang mebnjalani perbaikan gizi setelah diberikan kombinasi makanan tambahan.	There is a strong correlation between interventions aimed at changing the weight of toddlers and the values. However, there is no significant difference in the change in height of toddlers with the values.
(Safrina et al., 2022). (Indonesia)	to determine the relationship between supplementary feeding processed from moringa leaves and lumi lumi fish in the form of noodles and nuggets and the risk of stunting.	This is a quasi-experimental study. The research location was in Tanjong Bungong Village, Kaway XIV District, West Aceh Regency from September to November 2021. The population consisted of 30 toddlers. The sample was the total population of 30 toddlers using purposive sampling, a non-random sampling technique. The data collection instruments were questionnaires through interviews and observations. The analysis technique was univariate and bivariate using SPSS. Univariate analysis was used to describe the characteristics of the respondents.	The results of the paired sample t-test showed a p-value smaller than the sig value (α) (0.00 0.05). This means that there was a difference in the average TB/U of toddlers before and after the provision of supplementary food.

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(Fajar et al., 2022) (Indonesia)	to analyze differences in the nutritional status of toddlers based on weight/age, weight/height, height/age, changes in weight, and increases in height before and after supplementary feeding.	The provision of supplementary food was carried out from August 1, 2022, to October 30, 2022. The subjects who received supplementary food were a total sample of 112 stunted toddlers aged 6-23 months. The supplementary food provided was 4 teaspoons of commercial milk twice a day and one egg per day.	There was a change in nutritional status after the provision of supplementary food for toddlers with normal weight of 93.8%, and there was a difference in nutritional status based on weight and length/height between after and before receiving supplementary food (p-value 0.000).
(Anton et al., 2022) (Indonesia)	to determine the effectiveness of rebonshrimp based supplementary feeding on weight and height in malnourished children aged 24-60 months.	study is a quasiexperimental design, involving 88 malnourished children, divided into 2 groups, intervention (n=44) and control (n=44). The intervention group received rebon-shrimp based supplementary food for 90 days, while the control group received a placebo. Height was assessed at baseline and monthly follow-ups until endline at Day 90.	The results of the analysis showed that there was a difference in height gain between the two groups. Children who received rebon products experienced greater height gain (3.94 cm) compared to children who did not receive rebon products (2.92 cm).
(Sidiq et al., 2022) (Indonesia)	Descriptive qualitative	PMT Catfish porridge (68.8 % animal protein) made by the University of Riau Kukerta Team (Duration of Intervention 10 days)	As a result, one toddler experienced a weight gain of 0.8 g, two toddlers experienced a weight gain of 0.2 g, three toddlers experienced a weight loss of 0.1 g, and four toddlers also experienced a weight loss of 0.1 g.

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(Sada et al., 2022) (Indonesia)	To see the effectiveness of giving PMT in the form of manufactured biscuits and a combination of yellow sweet potato flour and oci fish flour.	A quasi-experimental study with a completely randomized design (CRD) pre and post test.	The provision of local PMT based on traditional foods is effective in improving the nutritional status and linear growth of children under five by utilizing local food ingredients such as rice, beans, and affordable sources of vegetable and animal protein.
(Haq et al., 2023) (Indonesia)	To determine the effect of the Supplementary Feeding Program on nutritional status	Qualitative descriptive method. The purpose of presenting a complete description of the forms of posyandu services in Summersuko Village using this type of research is to explore and clarify the realities or phenomena that occur socially. Children aged 1-5 years who received services at the Posyandu in Summersuko Village were part of the research subjects. The study observation was conducted by obtaining data from all interview results and observations with midwives, several Posyandu cadres, and all parents of children who were part of the sample.	The results of the study explain that the Supplementary Feeding program is one of the most effective and effective ways to improve children's nutritional status. and as an effort to reduce stunting rates.
(Andriani et al., 2023) (Indonesia)	To analyze the nutritional benefits of supplementary feeding with granola moringa in undernourished children; measure and analyze changes in the nutritional status and development of children; prepare recommendations for the	Quantitative methods with a quasi-experimental approach with a control group. The data collection instruments were interview guides and observation sheets. Data analysis used the sample paired t-test.	The results of the analysis showed that there was a difference in the average weight of children after being given moringa granola. This means that the local feeding has an effect as an additional food to prevent stunting in undernourished toddlers, with an effectiveness rate of 0.4 which is included in the medium category

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	sustainability of the granola moringa supplementary food program.		
(Susianto et al., 2023) (Indonesia)	To determine the effect of tempeh nugget supplementation on weight and height gain in children aged 24-59 months	Quasi-experimental research with a pre-test and post-test control group design. Sample selection used the Consecutive Sampling method. The research sample consisted of 24-59 month old toddlers in Karangmuncang Village, Cigandamekar District, Kuningan Regency who met the inclusion criteria. The sample size was 60 toddlers, 30 for the intervention group and 30 for the control group. The form of intervention in the study was the provision of tempeh nuggets to toddlers suffering from stunting. The control group of toddlers only received toddler health services from local health workers. The form of intervention was that the intervention group was given tempeh nuggets every day for 1 month, in the amount of 50 grams (toddlers > 12 months).	The results of the analysis showed that there was a significant difference in height between before and after being given tempeh nugget supplements. In addition, a correlation coefficient of 0.998 showed a very strong association with height increase
(Dewi et al., 2023) (Indonesia)	To determine the effect of giving jagaq porridge on the body weight and height of stunted toddlers aged 12-24 months.	Quantitative research with a quasi-experimental research design with a one group pre-post test design. The population in this study were 11 stunted toddlers aged 12-24 months who were at the Dempar Health Center in 2022. The sampling	Based on the results of the study, the administration of jagaq porridge has an effect on the increase in weight and height of stunted toddlers aged 12-24 months.

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		technique used was total sampling. Data analysis technique using paired t-test.	
(Susanti et al., 2023) (Indonesia)	to determine the effect of giving supplementary food a combination of mung bean porridge and boiled eggs on changes in weight and height status in stunting toddlers.	The design of this research is quasiexperimental using the one group pretestposttest design model. The population in this study were toddlers who came to visit the Barong Tongkok Health Center from September to November 2021 with a total of 67 toddlers. Sampling in this study using purposive sampling technique and obtained as many as 18 respondents. Data analysis techniques using paired t-test to determine the effect between variables.	The results of the hypothesis test obtained a p-value of 0.000 (< 0.05) so that there was an effect of giving supplemental feeding on the BB of stunting toddlers, while a p-value was obtained of 0.390 (> 0.05) so that there was no effect of giving supplemental feeding on height of stunting toddlers.
(Astuti et al., 2023) (Indonesia)	To improve understanding of stunting and malnutrition in toddlers through the provision of supplementary food.	The method used in this community service was the provision of supplementary food in the form of green beans and healthy snacks. The partners in this community service were children .	The result of this community service activity is to increase the understanding of stunting and malnutrition under five through Supplementary Feeding.
(Patmawati et al., 2024) (Indonesia)	To determine how dietary supplements affect the weight, height, and upper arm circumference of children with stunting.	Experimental design with one pre- and post-test group. The research method was quantitative and involved calculating the number of samples that met the inclusion and exclusion criteria from 19 participants who received supplemental food. Using the T-test.	The results showed that supplemental feeding had an effect on increasing weight, height, and upper arm circumference in children who were stunted.

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(Khadijah et al., 2025) (Indonesia)	To analyzing the effect of supplementary feeding on the nutritional status of toddlers.	The type of research is quantitative research with a pre-experimental design using a one group pre-post test design approach. The population in this study were toddlers who attended the toddler health center in Jenengan Maguwoharjo Hamlet, totaling 29 toddlers. The sampling technique used was purposive sampling. Data collection began with the distribution of questionnaires to determine the characteristics of the toddlers, then assessing their nutritional status through documentation in the KIA book as a pre-test. This was followed by an intervention in the form of supplementary feeding activities. Then, within a period of 3 months, an assessment of nutritional status was carried out as a post-test. The data was analyzed using the Wilcoxon test to compare the nutritional status of the toddlers.	Nutritional status of toddlers based on the BB/U anthropometric index before treatment and after no significant changes. The nutritional status of toddlers based on the anthropometric index PB/U before and after treatment did not change statistically significantly.
(Imanah et al., 2025) (Indonesia)	To determine the effectiveness of supplementary feeding on weight gain in toddlers at risk of stunting.	This study used a quasi-experimental design with a one-group pretest-posttest design with a sample of all toddlers at risk of stunting in Maos District, totaling 89 children. This study used a total sampling technique.	Dietary supplements have been shown to be effective in increasing weight in toddlers at risk of stunting. The provision of this intervention helps improve the nutritional status of children, so that it can be one of the efforts to prevent stunting through improving nutritional intake

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(Gusman et al., 2025) (Indonesia)	To evaluate the Supplementary Feeding Program to reduce stunting rates in toddlers.	a qualitative approach with a case study method to evaluate the effectiveness of Supplementary Feeding in reducing stunting rates.	The results of the study show that the success of the program is highly dependent on nutrition education, the quality of additional foods, and the involvement of health workers and the community.
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Tabel 2. Supplementasi Lipid-Based Nutrient Supplements (LNS / SQ-LNS / RUSF) / Micronutrient Powder (MNP) / Multivitamin

(Author, Years, Country)	Purpose	Method	Results
(Mangani et al., 2015) (Finland)	To test a hypothesis that dietary complementation with lipid-based nutrient supplements (LNS) promotes linear growth and reduces the incidence of severe stunting among at-risk infants.	A total of 840 6-month-old healthy infants in rural Malawi were enrolled to a randomised assessor-blinded trial. The participants received 12-month supplementation with nothing, milk-LNS, soy-LNS, or corn-soy blend (CSB). Supplements provided micronutrients and approximately 280 kcal energy per day.	• Broadly speaking, the milk-LNS group showed the lowest incidence of severe stunting and very severe stunting compared to control and CSB. • LAZ change between 9-12 months: milk-LNS almost kept LAZ -0.02, much better than the other three groups that showed a larger decline.
(Goyena et al., 2018) (Philippines)	To evaluate the effects of micronutrient powders (MNP) containing 15 versus nine nutrients, with or without complementary food blend (BigMo), on the nutritional status of	The study was conducted for 6 months among 126 rural children aged 6-17 months in four villages selected by cluster randomisation. Children were randomised into four groups: VitaMix with 15 micronutrients plus Bigas (BigMo) (n=31); VitaMix without BigMo	Providing interventions has been proven to have a significant impact on children's nutritional status. The combination of MNP + BigMo also contributed to increased linear growth, which was reflected in the increase

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	rural young children in the Philippines.	(n=31); Micronutrient Growth Mix (MGM) with nine micronutrients plus BigMo (n=29); and MGM without BigMo (n=31). Blood samples were collected at baseline and endline to determine haemoglobin, ferritin, retinol, and zinc concentrations. Intervention compliance, weight, length, and dietary intakes were collected every month. One-way ANOVA was used to compare changes in the mean estimates across groups. McNemar and Pearson's χ^2 tests were used to compare changes in the proportion estimates within groups and across groups, respectively.	in the length of the child's body compared to the control group.
(Luby et al., 2018) (Bangladesh)	To assess whether water quality, sanitation, and handwashing interventions alone or combined with nutrition interventions reduced diarrhoea or growth faltering.	The WASH Benefits Bangladesh cluster-randomised trial enrolled pregnant women from villages in rural Bangladesh and evaluated outcomes at 1-year and 2-years' follow-up. Pregnant women in geographically adjacent clusters were block-randomised to one of seven clusters: chlorinated drinking water (water); upgraded sanitation (sanitation); promotion of handwashing with soap (handwashing); combined water, sanitation, and handwashing; counselling on appropriate child nutrition plus lipid-based nutrient supplements (nutrition); combined water, sanitation, handwashing, and nutrition; and control (data collection only). Primary outcomes were caregiver-reported	The nutrition group (counselling $\pm$ supplements) showed increased linear growth relative to controls at some point in time; The combination of nutrition + WASH does not necessarily amplify the growth effects further than nutrition alone.

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		diarrhoea in the past 7 days among children who were in utero or younger than 3 years at enrolment and length-for-age Z score among children born to enrolled pregnant women. Masking was not possible for data collection, but analyses were masked. Analysis was by intention to treat.	
(Galasso et al., 2019) (Madagascar)	To examine the impact of nutritional supplementation and home visits on the growth and development of young children in Madagascar: a cluster-randomized controlled trial	We randomly allocated 125 programme sites to five intervention groups: standard-of-care programme with monthly growth monitoring and nutrition education (T0); T0 plus home visits for intensive nutrition counselling through an added community worker (T1); T1 plus LNS for children aged 6–18 months (T2); T2 plus LNS for pregnant or lactating women (T3); or T1 plus fortnightly home visits to promote and encourage early stimulation (T4). Pregnant women (second or third trimester) and infants younger than 12 months were enrolled in the trial. Primary outcomes were child growth (length-for-age and weight-for-length Z scores) and development at age 18–30 months. Analyses were by intention to treat.	Interventions combining LNS supplementation and home visits showed improved indicators of child development and some signs of improvement in growth (reduced stunting/improved developmental scores) compared to controls
(Becquey et al., 2019) (Burkina Faso)	To determine the impact of integrating preventive nutrition packages into facility-based screening for acute malnutrition	A cluster-randomized controlled trial and allocated 16 health centers to the intervention group and 16 to a comparison group. Both groups had access to standard CMAM and	Package integration with SQ-LNS increased screening participation and coverage (more children came in for screening) but did not show a consistent decrease in the

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	during well-baby consultations on acute malnutrition in children: A cluster-randomized controlled trial in Burkina Faso.	CNS services; caregivers in the intervention group also received age-appropriate monthly BCC and SQ-LNS for children >6 months of age.	prevalence/incidence of acute malnutrition across all outcomes.
(Stewart et al., 2020) (Madagascar)	Evaluated the effectiveness of daily LNS supplementation on child anemia and micronutrient status in Madagascar within the context of an existing, scaled-up nutrition program.	cluster-randomized 125 communities to (T0) a routine program with monthly growth monitoring and nutrition education; (T1) T0 + home visits for intensive nutrition counselling; (T2) T1 + LNS for children aged 6–18 mo; (T3) T2 + LNS for pregnant/lactating women; or (T4) T1 + parenting messages. Pregnant women and infants aged <12 mo were enrolled in 2014 and followed for 2 y.	Programs that included LNS showed a 40% reduction in the prevalence of anemia and a substantial reduction in iron deficiency in children compared to controls; Evidence of improvement in micronutrient status is strong in the context of scaled programs.
(Borg et al., 2020) (Kamboja)	To development and testing of locally-produced ready-to-use therapeutic and supplementary foods (RUTFs and RUSFs) in Cambodia: lessons learned	This paper draws on project implementation records and semi-structured interviews to describe the partnership between the Cambodian Ministries of Health and Agriculture, Forestry and Fisheries, UNICEF, the French National Research Institute for Sustainable Development (IRD), universities, and Vissot factory. It discusses the project implementation and lessons learned from the development and trialling process, and insights into positioning nutrition on the health agenda in low and middle-income countries.	Ready-to-Use Supplementary Food (RUSF)-based interventions may improve children's nutritional status through increased upper arm circumference, which suggests improvements in muscle mass and energy reserves, although they do not necessarily have a significant impact on linear growth or weight.

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(Dewey et al., 2021) (California)	Small-quantity lipid-based nutrient supplements (SQ-LNSs) were designed to provide multiple micronutrients within a food base that also provides energy, protein, and essential fatty acids, targeted towards preventing malnutrition in vulnerable populations.	Previous meta-analyses demonstrated beneficial effects of SQ-LNSs on child growth, anemia, and mortality. To further examine the efficacy and effectiveness of SQ-LNSs, and explore study-level and individual-level effect modifiers, we conducted an individual participant data meta-analysis of 14 randomized controlled trials of SQ-LNSs provided to children 6–24 mo of age (n > 37,000).	The prevalence of stunting, wasting, and underweight was 12-14% lower in the SQ-LNS group than the control Children who received SQ-LNS were 16-19% less likely to be in the lowest decile for language, motor, and social-emotional development compared to the control
(Adams et al., 2021) (Uganda)	To estimate the cost and cost-effectiveness of SQ-LNS and applied the framework in the context of rural Uganda.	We adapted costs from a costing study of micronutrient powder (MNP) in Uganda, and based effectiveness estimates on recent meta-analyses and Uganda-specific estimates of baseline mortality and the prevalence of stunting, wasting, anaemia and developmental disability.	• Linear growth: The prevalence of stunting was lower in the SQ-LNS group (12% lower than controls). The risk of severe stunting and wasting decreased significantly. • The decrease in the prevalence of underweight is around 14%.
(Abbeddou et al., 2022) (Burkina Faso)	Public health interventions to address stunting and wasting should be evaluated for possibly contributing to obesity risk. The present study tested the hypothesis that small-quantity lipid-based nutrient supplements (SQ-LNS) might increase fat	Using a two-stage, cluster-randomized trial design, 34 communities were randomly assigned to the intervention cohort (IC) or non-intervention cohort (NIC), and family compounds within the IC were randomly assigned to receive different amounts of zinc (0, 5 or 10 mg zinc) incorporated in SQ-LNS or 5 mg zinc in the form of dispersible tablets	The intervention showed an increase in fat-free mass (FFM) and an increase in weight compared to non-intervention, but there was no increase in body fat proportion (%FM) which means that SQ-LNS promotes healthy growth without encouraging excess fat accumulation.

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	deposition, and that additional zinc provided via SQ-LNS or in the form of dispersible tablets would increase fat-free mass (FFM) accretion.	along with treatment for diarrhea, malaria and fever. Body composition was assessed in a subset of IC (n = 201) and NIC (n = 74) children at 9 and 18 months using the deuterium dilution method. A mixed linear model was used to examine average change in FFM and % fat mass (%FM) among intervention groups and by cohort.	
(Wang et al., 2022) (Malaysia)	To assess the trial's general feasibility and preliminary benefits of daily micronutrient supplementation for iron storage and anthropometric outcomes in under-5 children.	Those with history of premature births, congenital abnormalities, or baseline hemoglobin <70 g/L were excluded. Participants received baseline deworming and were simply randomized in a 1:1 ratio to either micronutrient (4-month daily micronutrient packets) or control (no micronutrient supplementation) groups. Information on anthropometric, erythrocytic, and iron storage endpoints were collected. Overall, 45 (25 micronutrient and 20 controls) participants were enrolled and completed 4-month endpoint assessments.	The administration of micronutrient sachets containing 15 micronutrients has been proven to increase ferritin levels and improve MCV values, so that it is effective in preventing and overcoming iron deficiency in children under five.
(Mbabazi et al., 2023) (Uganda)	To assess the effects of MP and WP in lipid-based nutrient supplement (LNS), and of LNS itself, on linear growth and body composition among stunted children.	A randomized, double-blind, 2 × 2 factorial trial among 12 to 59 months old stunted children in Uganda. Children were randomized to 4 formulations of LNS with MP or soy protein isolate and WP or maltodextrin (100 g/day for 12 weeks) or no supplementation.	• LNS supplements increased hemoglobin (Hb) compared to controls. Serum ferritin increased by 43%, soluble transferrin receptor (sTfR) decreased. • Improvements were also in the status of cobalamin (vitamin B12) and folate. Decrease in methylmalonic acid (P-

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(Ow., 2021) (Vietnam)	To recognize that poor nutrition in childhood is associated with increased morbidity, mortality, and high socioeconomic costs.	Supporting Pediatric GRowth and Health OUTcomes (SPROUT) is a randomized, controlled trial evaluating the effects of an oral nutritional supplement (ONS) with dietary counseling (DC; n = 164) compared to a DC-only group who continued consuming their habitual milk (n = 166; NCT05239208). Children aged 24–60 months who were at risk or with undernutrition, as defined by weight-for-age [WAZ] < -1 and height-for-age [HAZ] < -1 according to the WHO Growth Standards, and who also met the criterion of weight-for-height [WHZ] < 0, were enrolled in Vietnam.	MMA) metabolites, an indicator of cobalamin deficiency, 33%. Increased growth in height and weight of children compared to the nutrition counseling group alone. Energy and protein intake was higher in the ONS group, with significant improvements in muscle mass, bone mineral density, and vitamin D and K status.
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Table 3. Educational/Counseling/Community Interventions

(Author, Years, Country)	Purpose	Method	Results
(Rawat et al., 2019) (Vietnam)	Cluster-randomized, nonblinded evaluation; cross-sectional surveys	• Interpersonal Counseling (IPC) • Mass Media Campaign (MM) or national media campaign. • Community Mobilization (CM) (Duration of intervention 4 years)	Hail has not shown significant differences in child feeding practices in general, but there is a trend towards improving the quality of diet, especially in dietary diversity and daily dietary adequacy.
(Galasso et al., 2019) (Madagascar)	Multi-arm cluster-randomized controlled trial	• Responsive parenting / stimulation visits) and	Interventions combining LNS supplementation and home visits showed

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(Stewart et al., 2020) (Madagascar)	Multi-arm cluster-RCT	- Multi-component including the administration of lipid-based nutrient supplements (LNS) (Duration of intervention 12 months) - Home visits / parenting messages / education - LNS for children (6–18 months) ± LNS for pregnant/lactating women (Duration of intervention 2 years)	improved child development indicators and some signs of growth improvement (reduced stunting/increased developmental score) compared to controls. Programs that included LNS showed a 40% reduction in the prevalence of anemia and a substantial reduction in iron deficiency in children compared to controls, evidence of strong micronutrient status improvement in the context of a scaled program.
(Ow et al., 2021) (Vietnam)	Systematic review dan Individual Participant Data (IPD)	Kombinasi Oral Nutritional Supplement (ONS) + Dietary Counseling (DC). (Duration of intervention 240 days)	The administration of small-quantity lipid-based nutrient supplements (SQ-LNS), micronutrient powders (MNPs), and fortified foods has been proven to be effective. A stronger impact was seen in the ≥12-month intervention and in children from high-risk families.
(Beatty et al., 2024) Indonesia)	Cluster RCT, 95 treatment vs 95 control sub-districts;	- Community-driven development grants. - Infant and Young Child Feeding (IYCF) training and growth monitoring, community-led total sanitation (CLTS) (Duration of intervention 4 years)	Although no significant reduction in stunting was found, the program had a positive impact on a number of supporting aspects that are very important for maternal and child health. This program has succeeded in encouraging exclusive breastfeeding practices, increasing pregnant women's compliance in consuming iron tablets, and improving the feeding frequency of children aged 6–23 months.

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(Latifahanun yet al., 2024) (Indonesia)	Quasi-experiments with pretest and posttest methods	• Community-driven development grants • Infant and young child feeding (IYCF) training and growth monitoring, community-led total sanitation (CLTS) (Duration of intervention 1 year)	The results of the study showed that there was an effect of supplemental feeding on the increase in height of stunted toddlers in Jragan Village, Temanggung.
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DISCUSSION

Local food-based Supplementary Feeding interventions are widely researched in Indonesia through quasi-experimental studies and community-based programs. The main focus of this intervention is the use of food ingredients that are easy to obtain, affordable, and in accordance with regional potential, such as boiled eggs, tempeh nuggets, grit, moringa granola, to processed fish and shrimp. This Supplementary Feeding program plays a role in increasing adequacy and improving the nutritional status of children through the use of local food resources that are easily accessible (Becquey, Huybregts, Zongrone, Le Port, Leroy, Rawat, & Ruel, 2019; Abbeddou, Jimenez, Hess, Somé, Ouédraogo, & Brown, 2022).

Providing additional food to malnourished children in the form of safe, highly nutritious, and high-quality food must also pay attention to food safety, ingredient quality, labels, and expiration dates. The content of animal and plant proteins is a major focus because they play an important role in the synthesis of enzymes, growth hormones (such as IGF-1), as well as the formation of muscle and bone tissue. Lack of protein intake can lead to linear growth disorders, low muscle mass, and metabolic disorders, which are the main risk factors for stunting (Stewart, Fernald, Weber, Arnold, & Galasso, 2020).

However, Supplementary Feeding is not the only contributing factor. Other factors such as daily diet, children's food preferences, and menu variations also play an important role. An unvaried menu leads to a nutritional imbalance, and in the long run increases the risk of growth disorders (Meilasari & Adisasmito, 2024).

Supplementation is the intervention with the strongest scientific evidence for stunting prevention, as almost all trials are conducted in the form of Randomized Controlled Trials (RCTs) or individual data meta-analyses (IPDs). This intervention includes SQ-LNS, LNS, RUSF, ONS, and MNP. The results of RCTs and IPD meta-analyses consistently showed a decrease in stunting prevalence by 10–16%, including a reduction in severe stunting, wasting, and anemia (Dewey, Stewart, Wessells, Prado, & Arnold, 2021; Adams, Vosti, Arnold, Engle-Stone, Prado, Stewart, & Dewey, 2023; Mbabazi, Pesu, Mutumba, Filteau,

Lewis, Wells, & Grenov, 2023). The mechanism is to provide solid energy, protein, essential fatty acids, and more than 20 micronutrients that support linear growth. The effectiveness is highest when given from the age of 6-24 months, with a duration of ≥ 12 months, and accompanied by IYCF counseling.

Prove that ONS is able to improve linear catch-up growth as well as body composition (muscle mass and bone density) (Ow, Tran, Berde, Nguyen, Tran, Jablonka, & Huynh, 2025). This effect is more significant than counseling alone, thus confirming the importance of combining macronutrient supplementation with behavioral education (Sukiman, Bamahry, Irwan, Laddo, & Arifin, 2022; Abbeddou et al., 2023). MNP interventions have been shown to be effective in reducing anemia and iron deficiency (Goyena, Barba, Talavera, Paunlagui, Rola, & Tandang, 2018; Wang, Jalal, Song, Teo, Tan, Heng, & Lum, 2022). However, its impact on linear growth is inconsistent, so it is more appropriately positioned as a complement to macronutrient interventions, rather than a single solution to stunting.

Educational and community interventions are important components in stunting prevention. The forms include IYCF counseling, Interpersonal Counseling (IPC), Behavior Change Communication (BCC), mass media campaigns, Community-Led Total Sanitation (CLTS), and home visits (Rawat, Nguyen, Tran, Hajeebhoy, Nguyen, Baker, & Menon, 2017; Galasso, Weber, Stewart, Ratsifandrihamanana, & Fernald, 2019; Stewart, Fernald, Weber, Arnold, & Galasso, 2020; Beatty et al., 2024; Latifahanun et al., 2024). Although the direct effect on reducing the prevalence of stunting is often not as strong as nutritional supplementation, these interventions serve as a reinforcer that ensures the success and sustainability of the program.

Nutrition education to mothers or caregivers through Infant and Young Child Feeding (IYCF) counseling plays an important role in improving knowledge and practices of child feeding, including exclusive breastfeeding, frequency, and diversity of consumption (Rawat et al., 2017). Community approaches such as Community-Led Total Sanitation (CLTS) have helped improve family behaviors in terms of nutrition and hygiene, thereby reducing the

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risk of recurrent infections that contribute to stunting (Galasso et al., 2019). In addition, education through Interpersonal Communication (IPC), Behavior Change Communication (BCC), and home visits has been proven to increase compliance with supplementation consumption such as local LNS, MNP, and PMT, because nutritional interventions accompanied by education are much more effective than providing unaccompanied products (Beatty et al., 2024). Community-based programs also empower posyandu cadres to be able to monitor growth, provide nutrition counseling, and sanitation education, thereby expanding the reach and strengthening community ownership of the program (Galasso et al., 2019).

Although effective in improving nutritional behavior, the direct impact on reducing stunting prevalence is not always consistent as some studies have shown only short-term improvement with no significant changes in children's height (Rawat et al., 2017, Stewart et al., 2020). The success of the program is highly dependent on the quality of implementation, especially the intensity of the visit, the skills of the facilitators, and the involvement of families (Stewart et al., 2020). In addition, behavior change requires a long time and sustained support to produce a real impact on children's linear growth (Beatty et al., 2024).

The results of the study showed that local food-based Supplementary Feeding (PMT) interventions contributed significantly to improving the nutritional status and growth of toddlers in Indonesia. Based on a meta-analysis of 38 journals, local PMT was shown to increase weight and in some studies also had an impact on increasing children's height. This success is mainly due to the high energy and protein content that is easily absorbed by the body, as well as the use of food ingredients that are familiar and easily accepted by the public, such as boiled eggs, tempeh nuggets, jagaq porridge, moringa granola, to processed fish and shrimp.

This approach is superior because the ingredients are easy to obtain, cheap, and can be produced sustainably by local communities, so that in addition to being a specific nutrition intervention, it also supports local economic empowerment. The effectiveness of PMT will increase when combined

with nutrition and health education, including Infant and Young Child Feeding (IYCF) counseling, hygiene and sanitation promotion, and support for exclusive breastfeeding, as these combinations encourage changes in family eating behavior and ensure adequate intake of animal and plant proteins to support child growth (Abbeddou et al., 2022).

The results also showed that interventions based on IYCF counseling education, behavior change communication (BCC), home visits, and community mobilization had an effect on direct stunting reduction that was not statistically significant (Rawat et al., 2017, Beatty et al., 2024, Latifahanun et al., 2024). Nevertheless, educational interventions have a fundamental role in creating sustainable behavior change. This may be related to the limitations of these interventions if they are done separately from some of the main interventions. Some studies have shown that education, counseling, IYCF, BBC, or Home visits without supplementation or vice versa are less than optimal (Astuti et al., 2023, Gusman et al., 2025, Luby et al., 2018, Galasso et al., 2019, Becquey et al., 2019, Stewart et al., 2020, Dewey et al., 2021, Adams et al., 2021, Galasso et al., 2019, Stewart et al., 2020, Ow et al., 2021). while the combination of the two results in improved eating practices, consumption adherence, and better linear growth. Linear growth with a reduction in the risk of stunting by 12% and severe stunting by 16%. The prevalence of stunting was lower in the SQ-LNS group (12% lower than the control) Severe stunting & wasting (Dewey et al., 2021, Adams et al., 2021).

An important addition in this context is that protein has a major role in the child's linear growth and stunting prevention. Protein is a basic component for the formation of body tissues, including muscle, bone, enzymes, and growth hormone (GH and IGF-1). Lack of quality protein intake, especially animal protein, has been shown to correlate with linear growth disorders and an increased risk of stunting.

Local protein sources such as chicken eggs (6.5–7 g/grain), tempeh (20 g/100 g), catfish, shrimp (66.4 g/100 g), and moringa contain essential amino acids that support cell growth and tissue differentiation. In addition, the ingredient is rich in iron, zinc, and vitamin B12 which play an important role in energy

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metabolism, red blood cell formation, and child brain development.

Overall, nutritional supplementation is one of the most consistent and scientifically proven interventions in reducing the prevalence of stunting and severe stunting in toddlers. The results of meta-analysis from various studies (Dewey et al., 2021, Adams et al., 2021, Mbabazi et al., 2023) show that nutritional supplementation either in the form of multivitamins, iron, zinc, or a combination of micronutrients can reduce stunting rates by 10–16%. The highest effectiveness is achieved in children aged 6–24 months, which is the golden period of growth that is most sensitive to nutritional intake. Longer duration of administration (≥ 12 months) has also been shown to result in a more meaningful improvement in children's linear growth.

This positive impact is stronger when supplementation is combined with nutrition education and infant and child feeding counseling (IYCF), as the combination not only improves nutritional status through increased intake of micro and macronutrients, but also changes family eating behavior in a more sustainable manner. Thus, nutritional supplementation serves a dual function—correcting nutrient deficiencies directly while encouraging changes in consumption behavior at the household level.

The meta-analysis findings report that SQ-LNS can reduce the prevalence of stunting by ± 12 –14% and increase the length-for-age z-score (LAZ) by about +0.09 SD. In addition, LNS has also been shown to increase ferritin, folate, and vitamin B12 levels and significantly reduce the prevalence of anemia. The positive effects of LNS are not only seen in improving nutritional status, but also in catch-up growth, as well as children's cognitive and motor development.

Supplementary Feeding is an important intervention in the prevention and treatment of stunting in toddlers, with the aim of meeting the nutritional needs of children, especially those at risk or experiencing stunting, in order to achieve the ideal weight and height according to their age (Wati, 2020). Supplementary Feeding plays a role in meeting nutritional needs, supporting recovery from infection, and improving overall nutritional status so that it is

effective in preventing wasting and stunting. Research shows that Supplementary Feeding is able to increase children's weight and height, as well as improve the nutritional status of toddlers through increased intake of energy, protein, and micronutrients (Imanah & Sukmawati, 2025; Salsabila, Nawangsari, Soeliyono, & Ifadah, 2023).

The effectiveness of PMT interventions is also strengthened by the use of lipid-based nutrient supplements (LNS), especially small-quantity LNS (SQ-LNS) which has been shown to reduce the prevalence of stunting by ± 12 –14% and increase the LAZ score by around +0.09 SD (Muhlshoh, Hidayati, & Muwakidah, 2025; Rawat et al., 2017). Studies in Malawi show that milk-LNS provides the most protective effect against severe stunting at 9–12 months of age, while other studies (Stewart et al., 2020; Mbabazi et al., 2023) report that LNS also improves ferritin, folate, and vitamin B12 levels and decreases the prevalence of anemia (Borg et al., 2019; Beatty et al., 2024). These findings confirm that PMT, especially LNS-enriched ones, is an effective strategy and has great potential in the sustainable prevention of stunting.

CONCLUSION

Based on the results of a literature review of 38 relevant scientific articles and journals regarding the influence of various types of interventions for improving nutritional status in stunting toddlers, including nutritional supplementation such as SQ-LNS, LNS, RUSF, and ONS; Supplementary Feeding (PMT) based on local food; food fortification; as well as educational, counseling, and community empowerment interventions. Nutrition education and counseling interventions are widely used both as a single approach and in combination with other interventions, with a focus on increasing knowledge, changing nutritional behaviors, and adherence to balanced nutritious feeding. The results of the analysis showed that the intervention with the greatest influence on improving nutritional status and reducing the prevalence of stunting was nutritional supplementation based on SQ-LNS/LNS/RUSF, especially when given from an early age and for a long period of time. Local food-based PMT continues to play an important role as a sustainable, adaptive, and

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regionally contextual strategy, but its effectiveness increases significantly when combined with education, counseling, or community-based approaches.

SUGGESTION

It is recommended that efforts to combat stunting be carried out in an integrated manner. The government needs to expand the scope and quality of nutrition intervention programs, integrate them with other health services, and strengthen cross-sectoral cooperation for food security. Health workers are expected to monitor the growth of toddlers and provide balanced nutrition education to parents. Researchers are then advised to conduct quantitative studies to assess the effectiveness of interventions in various regions. Meanwhile, the community needs to raise awareness of the importance of balanced nutrition and the implementation of clean and healthy living behaviors to prevent stunting.

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