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COMPLEMENTARY FEEDING AND STUNTING: A LITERATURE REVIEW

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ABSTRACT

Approximately 150 million children under the age of five experience stunting. The development of children in the early stages, particularly during the first 1000 days from pregnancy to the age of 2 years, greatly influences an individual's nutrition and health status throughout their life. Objective: To analyze the provision of complementary feeding to breastfeeding in relation to stunting based on theory, risk factors, screening, and interventions provided. Results: The main factors affecting stunting, such as the provision of complementary feeding to breastfeeding, maternal nutritional status, and the family's socio-economic conditions, play a significant role in children's health and development. Conclusion: By optimizing local food resources and involving the community in nutrition programs, it is hoped that sustainable improvements in children's nutrition and health can be achieve

INTRODUCTION

Stunting is a condition of malnutrition that occurs in infants during the first thousand days of life, lasting a long time and affecting brain development as well as the growth and development of children (Andrew Banda1, 2 et al., 2022). Stunting is a problem of chronic malnutrition caused by insufficient nutritional intake over a long period due to feeding that does not meet nutritional needs(Chagwena et al., 2024). Optimal nutrition during infancy and early childhood is crucial to meet the rapid growth and development needs(Cendoya et al., 2024). stunting worldwide shows that in 2022, approximately 148.1 million children under five years old were affected by stunting, contributing to 22.3% of the total population of children in that age group. Although this represents a decrease from 26.3% (177.9 million children) in 2012, global stunting rates still require serious attention, especially due to slow and uneven progress across different regions(Mostafa et al., 2024a). The latest data on the prevalence of stunting in Indonesia indicates that in 2023, the stunting rate was recorded at 21.5%, down from 21.6% in 2022(Esan et al., 2022). In 2022, the

The latest data on the prevalence of

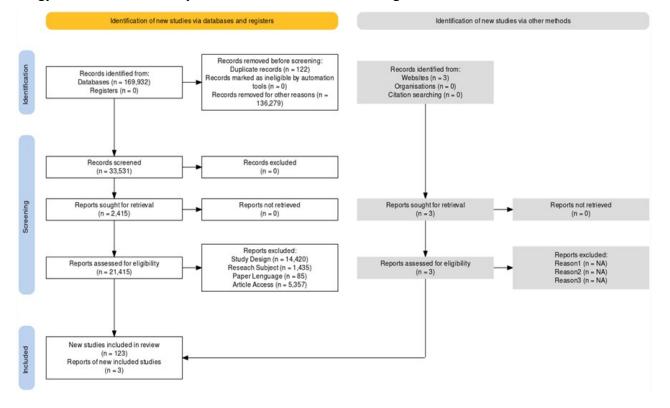
prevalence of stunting in South Sulawesi was recorded at 27.2%, a slight decrease from 27.4% the previous year. Jeneponto Regency recorded the highest rate at 39.8%, followed by Tana Toraja and Pangkajene Kepulauan (Beal et al., 2018; Leroy & Frongillo, 2019; Marquis et al., 2018). In 2022, the prevalence of stunting in Soppeng Regency reached 26.9%, based on data from the Indonesian Health System(Budhathoki et al., 2020; Islam et al., 2024; Nshimyiryo et al., 2019).

Research shows that the provision of complementary foods plays an important role in preventing stunting in children. Effective approaches include education on balanced nutrition and the right timing to introduce these complementary foods. Complementary foods should be introduced at the age of six months, as after this age, exclusive breastfeeding alone is not sufficient to meet the growth needs of the baby(Akombi et al., 2017). After 6 months of breastfeeding, exclusive children require nutritious solid food that is appropriate for their developmental stage, in addition to breast milk, from the age of 6 to 24 months to support the body's needs and rapid brain development(Alaie, N., & Faghihzadeh, 2020). The introduction of complementary foods, when food is introduced to supplement a milk-based diet, usually takes place between the ages of 6 to 23 months. The timing of complementary food introduction is very important because if food is introduced too early or too late, it can adversely affect the child's health both in childhood and in adulthood(Manggala et al., 2018). Intensive complementary food during the first 1000 days of life significantly reduces stunting rates, education about breast milk and complementary foods is very important in preventing stunting, and effective community outreach can lead to significant improvements in knowledge and practices among parents(Muche & Dewau, 2021). Increasing mothers' understanding of balanced nutrition through targeted educational programs can have a major impact on child health, as well as help prevent stunting in Indonesia(Mzumara et al., 2018). Effective education on how to prepare complementary foods can result in better nutritional status in toddlers, which ultimately contributes to efforts to prevent stunting in the community(Kismul et al., 2017). The important role of early nutrition, the right timing to introduce complementary foods, and the importance of birth weight in preventing stunting among toddlers(Putri et al., 2019). Complementary foods in the form of fish powder help improve infant growth in lowincome communities that have low animal protein consumption(Bhutta et al., 2020). The provision of complementary foods along with breast milk plays a crucial role in combating stunting, as well as emphasizing the broader impact of infant nutrition on public health and economic growth(Saleh et al., 2021). It is recommended to provide a variety of nutrientrich foods tailored to local environmental conditions to ensure adequate nutritional intake(Simanjuntak et al., 2019).

METHODS

This literature review was conducted

through seven electronic databases, namely PubMed, Scopus, Google Scholar, as well as national and international health reports. The articles reviewed have been published from 2017 to 2024. The search used a Boolean strategy with related keywords, such as 'complementary feeding,' 'stunting,' 'intervention,' 'local food ingredients,' 'innovation in complementary foods for breast milk.' All relevant literature was then organized using Mendeley software to facilitate reference management.



RESULTS

Stunting in children remains a challenge in sub-Saharan Africa, where 34% of children under the age of five experience stunting, negatively impacting both individuals and communities (Nshimyiryo et al., 2019). In Bangladesh, 30% of children under five are stunted (Islam, Anni, and Al Hasan, 2024). The prevalence of stunting among children in the Democratic Republic of Congo (DRC) is among the highest in the world, with stunting rates significantly higher in boys than in girls (Kismul et al., 2017). In Zambia, the prevalence of stunting has exceeded 40% and remains at an alarmingly high and unacceptable level (Mzumara et al., 2018). In Ethiopia, stunting is the most common form of malnutrition. A child's age, sex, maternal height, age, education level. household wealth index, and administrative region significantly are associated with severe stunting (Muche and Dewau, 2021). Poor infant feeding practices are common in Pakistan. One in three children experiences delays in the introduction of complementary foods and insufficient feeding frequency. The majority of children (78%) have poor dietary diversity, and only 15% receive a minimally acceptable diet (Na et al., 2017).

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No	Judul Artikel	Metode	Tujuan	nproving the practice of providing comple Hasil	Keterbatasan
1	The Government Policy for Stunting Countermeasure Strategy in Indonesia	Literature study of national policy	Describes the Indonesian government's strategy to reduce stunting	Implementation of RAN-PASTI has the potential to reduce stunting prevalence to 14% by 2024	The study relies only on secondary data and policy documents.
2	Optimizing the Role of the Family in Preventing Stunting	Community empowerment program through family- based interventions	Improving family knowledge about stunting prevention	Family knowledge increased by 28 points after the intervention	No longitudinal evaluation was conducted to see the impact of the intervention on stunting prevalence.
3	trends, determinants, and drivers of decline	analyze the relationship between changes in the main determinants of children's linear growth and changes in linear growth outcomes over time.	drivers of national decline in stunting prevalence. Compare the relative effects of key	Improvements in household asset index scores (socioeconomic status) and parental education are the main factors that predict improvements in children's linear growth. The role of these determinants differs across countries, reflecting the need for approaches that are tailored to each context.	
4	Stunting-Free Child Growth and Development	Using a questionnaire to measure participants' knowledge about stunting before and after counseling. Involving interactive education,discussion, and question and answer.	U 1	Increase in participant knowledge from 57% (pre-test) to 85% (post-test) after counseling.	The study may have been limited in the number of participants and location, which may affect the generalizability of the results.

Table 1. Study of stunting as a problem that must be addressed, one of which is by improving the practice of providing complementary foods.

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5	Effects of malnutrition on child development: Evidence from a backward district of India	This study used a cross-sectional comparative analytical design with a multistage data collection procedure. Anthropometric measurements were conducted to assess the nutritional status of children, including weight, height, length, and arm circumference.	assess the nutritional status	The results show that children in rural areas experience significant developmental problems.	The main limitation is that the data were only taken from hospital records and did not include data from private SNCUs, making it difficult to generalize the findings to the entire district.
6	Implementation of Stunting Prevention Policy in Sepedas Village, Pasir Panjang Subdistrict, Karimun Regency	The stunting socialization activity was carried out in Sepedas Village by involving the Meral Barat District Health Center as a resource person. The community service team conducted observations and coordination with the local Neighborhood Association and Citizens Association before the socialization.	The purpose of this activity is to provide information and education to the community regarding stunting.	The results of the activity showed that many people in Sepedas Village did not know about stunting, and this socialization was very much needed. The activity went smoothly with active participation from the participants.	Research limitations include time, energy, and cost limitations, so that socialization can only be carried out in one location.

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7	This study used cross-sectional,		stunting, 6.3% for wasting, and 13.7% for underweight.	Ecological Study Design: Because of the use of ecological study design (aggregated data), findings may be subject to bias and confounding from ecological fallacy.
8	This study uses a systematic literature review approach. The literature search was conducted on two databases, namely PubMed and ScienceDirect, using relevant keywords.	was to identify stunting management that can improve the nutritional and cognitive status of children, and to provide recommendations for	micronutrient supplementation, and maternal	Indirect Observation: Food consumption patterns are reported by participants, rather than directly observed by researchers, which may lead to bias in reporting.

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9	Indonesia: A systematic review and meta-analysis	This study used a systematic literature review and meta- analysis approach. Data were collected from various observational studies (cross-sectional and longitudinal) published between 2010 and 2021.	the main risk factors that	The main risk factors contributing to stunting	Ecological Study Design: Because of the use of ecological study design (aggregated data), findings may be subject to bias and confounding from ecological fallacies.
10	complementary food variations for breast milk	This study uses a community service method with an educational approach through socialization. This activity involved 139 participants living in five villages in Jatigede District, Sumedang Regency, West Java.	to provide education to the community in Jatigede District, Sumedang, about the importance of providing appropriate breastfeeding and complementary feeding to prevent stunting in	Increased Knowledge: Of the 139 participants, 118 (85%) experienced increased knowledge about breastfeeding and complementary feeding after participating in the socialization, 19 (14%) had the same knowledge before and after the socialization, and 2 (1%) experienced a decrease in post- test scores due to several factors, including not completing the post-test questionnaire.	Indirect Observation: Food consumption patterns are reported by participants, rather than directly observed by researchers, which may lead to bias in reporting.

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			assess the effectiveness of	Difference-in-differences analysis showed that the intervention did not significantly reduce the overall prevalence of stunting (DID = -5.1, $p = 0.079$).	Limited Duration of Intervention: Nutrition interventions of short duration cannot effectively reduce stunting.
12	The Implementation of Complimentary Food on Stunted Children	This study used a descriptive qualitative study design, focusing on in-depth interviews and observations to collect data on the implementation of complementary food for stunted children aged 6-24 months		The study found that all respondents struggled with implementing responsive feeding practices effectively.	

Other risk factors for stunting include low paternal education, maternal height less than 150 cm, high-risk maternal age, low birth weight, and short birth length (Alaie & Faghihzadeh, 2020; Aryastami et al., 2017; Manggala et al., 2018). Improving maternal health education and responsive stimulation, maternal nutritional status, maternal and newborn care, as well as reducing birth rates or increasing birth spacing are key drivers of change (Bhutta et al., 2020; Bimpong et al., 2020; Esan et al., 2022; Jeyakumar et al., 2023; Mihrshahi et al., 2022; Putri, Nuzuliana, and Kurniawati, 2019). Early improvement of maternal nutrition is essential to prepare the mother's body for the prenatal phase of fetal development, which continues through infancy, early childhood, and adolescence. This is a golden period where the mother's role is crucial in preventing stunting in children (Saleh et al., 2021; Rahayu et al., 2019).

There is a link between maternal nutrition practices and the nutritional status of toddlers (aged 12–59 months) through the use of traditional food sources rich in micronutrients such as iron, vitamin A, and vitamin C. The optimization of local food means that ingredients are more accessible and relatively affordable (Simanjuntak et al., 2019). Providing complementary feeding based on local foods can improve children's nutritional status (Susanto et al., 2017).

Complementary feeding refers to solid or semi-solid foods given to infants in addition to breast milk or formula (White et al., 2017). It is the period when infants begin consuming foods other than milk while gradually reducing milk intake (either breast milk or formula) until they transition to the family diet (Dipasquale, Valeria, 2020). A diverse diet can help children meet their nutritional needs for healthy growth and development (White et al., 2017). The timing and type of complementary foods introduced in infancy affect future nutritional and health outcomes (Wang et al., 2019). Complementary foods (solids and liquids other than breast milk or formula) should not be introduced before 4 months of age but also should not be delayed beyond 6 months (Fewtrell et al., 2017). Early introduction of complementary foods may reduce the risk of food allergies in high-risk infants (Skjerven et al., 2020). Inappropriate complementary feeding practices can lead to adverse outcomes, including growth failure and death (Munde and Save, 2012).

Providing а complete range of complementary foods from diverse sources is the best approach to improve infant nutrition (Nurrizka, Wenny, and Amalia, 2021). Offering varied foods with appropriate texture and consistency, without added salt and sugar, according to the child's developmental stage, supports the formation of healthy food preferences and meets nutritional needs (Campoy et al., 2018). Complementary foods rich in high-quality protein and nutrients can be formulated using local food supplements in powder form, enabling young children to receive nutrient-dense meals (Chagwena et al.,

2024). Complementary feeding methods not only ensure dietary adequacy but also support optimal behavioral and skill development related to food (Boswell, 2021). As long as the food provided is age-appropriate in texture, nutritionally adequate, and prepared using good hygiene practices, there is no strong evidence linking complementary feeding with negative health outcomes (Castenmiller et al., 2019).

One method of complementary feeding is Baby-led Weaning (BLW), an approach where infants self-feed solid foods, giving them control over the eating process. BLW can be an alternative method for complementary feeding without increasing the risk of iron deficiency, choking, or growth faltering (Dogan et al., 2018; Taylor et al.. 2017). Appropriate complementary feeding practices in early childhood contribute to healthier food preferences and positive long-term health outcomes (Gatica-Domínguez et al., 2021).

Integrated agriculture and nutrition implemented interventions through early childhood education platforms have a positive impact on children's diets and help reduce stunting in preschool-aged children. Nutritional supplementation behavior and change communication targeting pregnant women, breastfeeding mothers (up to 6 months postpartum), and children aged 6-23 months during the first 1,000 days have successfully reduced stunting and underweight prevalence among children aged 24-59 months (Ashraf et al., 2024).

The quality and quantity of protein and fat in complementary foods affect child growth (Marquis et al., 2018; Michaelsen, Grummer-Strawn, and Bégin, 2017). Complementary foods using catfish and carrots in nugget form have potential health and developmental benefits for children (Putri et al., 2024). Children receiving MDCF-2 (Microbiotadirected complementary food) showed significant reductions in stunting (Mostafa et al., 2024). Complementary foods rich in iron, including meat products and/or iron-fortified foods, should be given to all children (Na et al., Petrikova, 2017; 2022). Inappropriate complementary feeding practices affect children's nutritional and health status due to several demographic, biological, behavioral, psychosocial, and social factors (Wang et al., 2019).

DISCUSSION

Risk factors for stunting include various aspects, one of which is the low level of paternal education, which can affect knowledge about child health and appropriate parenting practices. In addition, a maternal height of less than 150 cm is often associated with nutritional deficiencies during the mother's growth period, potentially affecting fetal development. The mother's age is also a significant factor, especially if she is under 20 or over 35 years old, as these ages increase the risk of pregnancy complications and suboptimal fetal growth. Low birth weight, often caused by poor maternal nutrition during pregnancy or other medical complications, contributes greatly to the risk of stunting, as low birth weight infants tend to experience slower growth. Moreover, birth length below normal standards is an early indicator of fetal growth disturbances during pregnancy (Alaie, N., & Faghihzadeh 2020; Aryastami et al. 2017; Manggala et al. 2018).

Improving maternal health education, particularly regarding balanced nutrition, proper parenting, and responsive stimulation, is an important step in promoting significant changes in maternal and child health. Optimal maternal nutritional status during pre-pregnancy, pregnancy, and breastfeeding significantly influences fetal development and infant growth, making it a priority for health interventions. Furthermore, intensive care for pregnant women and newborns, including better access to health services and routine monitoring, is crucial to ensure optimal health outcomes. On the other hand, reducing birth rates and increasing the spacing between pregnancies can lower the risk of maternal health complications and give the body time to recover, thereby contributing to a more supportive environment for child growth and development. The combination of these factors is key to driving positive changes in maternal and child health quality (Bhutta et al. 2020; Bimpong et al. 2020; Esan et al. 2022; Jeyakumar et al. 2023; Mihrshahi et al. 2022; Putri et al. 2019).

Maternal nutrition strengthening must begin before pregnancy to ensure that the mother's body is prepared for the prenatal phase, during which fetal development highly depends on adequate nutrient intake. Optimal nutrition during this period is essential not only for physical growth but also for brain and vital organ development. After birth, proper nutrition should continue through exclusive breastfeeding, which is rich in essential nutrients for infant growth. Subsequently, during the toddler years, children's nutritional needs should be met through balanced diets to support optimal physical and mental growth. Adolescence is also a critical phase due to rapid growth and development. This entire span constitutes the "golden period" of child development, in which the mother's role is crucial, particularly in stunting prevention. By focusing on early nutrition, mothers can help ensure their children grow up healthy, achieve appropriate height, and avoid stunting risks (Rahayu et al. 2019; Saleh et al. 2021).

There is a relationship between maternal dietary practices and the nutritional status of children aged 12–59 months through the use of traditional food sources rich in micronutrients such as iron, vitamin A, and vitamin C. The optimization of local food means that food materials are readily available and relatively affordable (Simanjuntak et al. 2019). The provision of complementary foods based on local food sources can improve children's nutritional status (Susanto et al. 2017).

One of the key parameters in monitoring infant growth and development is stunting, which serves as a critical indicator of underlying problems from early life (Herman, Mansur, and Chang 2023). The age of 6 to 23 months is a crucial period for timely, safe, nutritious, and

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adequate complementary feeding alongside breast milk to support children's growth and development (Frongillo 2017). During this time, brain development occurs rapidly, meaning the timing, quantity, and type of nutrients given can significantly affect a child's development both positively and negatively (Lutter, A.-L. M. Grummer-Strawn, and Rogers 2021).

One complementary feeding practice is Baby-led Weaning (BLW), an approach that allows babies to take control of their eating process when introduced to solid foods. BLW can be a viable alternative method for introducing complementary foods without increasing the risk of iron deficiency, choking, or growth failure (Dogan et al. 2018; Taylor et al. 2017). Appropriate complementary feeding practices during early childhood contribute to healthier food preferences and positive longterm health outcomes (Gatica-Domínguez et al. 2021).

Social interventions and behavior change through various platforms can be effectively resulting implemented, in improved complementary feeding (CF) practices and a reduction in child stunting within two years (Kim et al. 2019; Rawat et al. 2017). Complementary feeding using local food sources for children is strengthened by enhanced caregiver nutrition education (Martinez et al. 2018). Educating caregivers on complementary feeding practices can help improve infant nutrition in both food-secure and food-insecure populations (Harrison et al. 2023). Most mothers' feeding practices do not align with

WHO recommendations, necessitating targeted nutrition education interventions for mothers in rural areas (Zaragoza-Cortes et al. 2018). Counseling can assist parents in understanding the importance of providing more nutritious food to their children at specific ages (Yao et al. 2022).

Women's empowerment, dissemination of nutrition-related information through mass media, promotion of childbirth in health facilities, and improved utilization of maternal health services are essential to enhancing complementary feeding practices among infants and young children as a strategy to combat stunting (Mekonen 2024; Mekonen, Zegeye, and Workneh 2024). Community-based participatory nutrition promotion programs have proven effective in improving child growth, with a reported 8.1% reduction in stunting prevalence (Kang et al. 2017).

Although various studies have shown the importance of providing complementary foods (MP-ASI) in preventing stunting, there are still several research gaps that need to be considered. First, most of the literature reviewed is descriptive or systematic reviews, while community-based experimental studies with a direct intervention approach to providing local MP-ASI are still limited. This makes it difficult to draw causal conclusions regarding the effectiveness of MP-ASI interventions based on local food ingredients on children's nutritional status and linear growth.

Second, most of the existing studies have not described in depth the differences in

responses to MP-ASI interventions based on the socio-cultural context and economic level of the community. In fact, regional and local cultural variations greatly influence the acceptance and success of nutrition interventions. Third, the use of innovative approaches such as digital in nutrition technology education and monitoring the provision of MP-ASI has not been widely developed, especially in rural contexts and areas with a high prevalence of stunting.Fourth, there are still limited long-term studies that assess the impact of local MP-ASI interventions not only on physical growth indicators such as height, but also on children's cognitive development and long-term endurance. Finally, most studies have not fully involved the active participation of families and local health cadres designing in and implementing interventions, so that program sustainability and community acceptance are still challenges. By identifying this gap, it is hoped that further research can be directed to produce stronger, more applicable, and contextual evidence in efforts to prevent stunting through optimizing local food-based complementary foods.

SUGGESTION

Future research development should focus

experimental studies that test the on effectiveness of local food ingredients as complementary foods to breast milk (MPASI) in reducing stunting rates. So far, many studies have been descriptive or literature reviews, but there are still limited intervention studies that directly test the impact of consuming local foodbased MPASI on children's nutritional status. Therefore, it is important to conduct controlled trials, both in the form of randomized controlled trials (RCTs) and quasi-experiments, to evaluate the effect of providing local MPASI on children's linear growth, especially height-forage (HAZ) as an indicator of stunting. THANK-YOU NOTE

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