Evidence-Based Effective Interventions for Stunting Prevention in South Sulawesi : A Systematic Literature Review

Dien Abdul Munir*, **Sumardiyono****, and **Nur Hafidha Hikmayani*****
*Master Program Of Nutritional Sciences, Postgraduate School, Universitas Sebelas Maret, Surakarta, Indonesia. dienmunir@student.uns.ac.id
**Occupational Health and Safety Department, Vocation School, Universitas Sebelas Maret, Surakarta, Indonesia. sumardiyono@staff.uns.ac.id
***Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia. hafidha@staff.uns.ac.id

ABSTRACT

Effective interventions to reduce stunting in South Sulawesi require solid empirical evidence. This study aimed to assess the effectiveness of stunting prevention interventions and describe programs that can be applied to the province of South Sulawesi. This literature review used the Preferred Reporting Items for Systematics Reviews and Meta-Analysis (PRISMA) method on PubMed and ScienceDirect search engines. Keywords used for search were "Stunting, Infant Feeding, and Children". The review found a wide range of stunting prevention interventions. Based on nutrition actions, direct nutrition interventions in the health sector, and direct and indirect nutrition interventions in the health sector were able to reduce the prevalence of stunting by 8% and 14–15%, respectively, by intervention platforms, health workers and women's empowerment, mass media and telehealth, and cash transfers. The basic principle of stunting prevention intervention is multisectoral, multi-year (2–5 years), with a reduction in stunting prevalence between 2.2% and 14.5%. The most effective intervention to reduce the prevalence of stunting was a multisectoral intervention focused on behavior change, maternal and child feeding, providing kits, sanitation hygiene, and women's empowerment
Keywords: Stunting, interventions, prevalence changes

INTRODUCTION

The Global SDG targets that by 2025, the number of stunting should have dropped to 107 million worldwide, but in 2020 the number still showed 149.2 million. Fifty-nine percent (59%) of the stunting came from developing countries and 25% came from poor countries. (WHO, 2023).

Stunting in Indonesia has continued to decline since 2018, the percentage of stunting was 30.8%, (Kemenkes, 2018) and in 2023, stunting fell to 21.5% (Kemenkes, 2023). Each year, the decline is estimated at 1.86%. By 2024, stunting in Indonesia is expected to drop to 14% (Percepatan Penurunan Stunting, 2021). This condition is difficult to achieve because of the evidence from studies show that the average reduction in stunting in a combination of various interventions is between 4.3 and 8.4% per year (Hossain et al., 2017). Consistent and improved multi-interventions are needed, both in terms of program coverage and the level of compliance of users of sensitive and specific intervention programs (Bhutta et al., 2013; Ruel & Alderman, 2013).

The gap in Indonesia is the lack of evidence-based community-scale interventions that have significantly reduced stunting. Several separate nutrition improvement interventions in different provinces showed different and inconsistent results (Beatty et al., 2024; Sirajuddin et al., 2021).

A systematic literature review on stunting in Indonesia illustrates that its determinants are premature birth, short birth, not exclusively breastfeeding, short mothers, low education, untreated drinking water sources, improper defecation, limited access to health services, and living in rural areas. (Beal et al., 2018).

The Indonesian and local governments have carried out stunting interventions, but the results have yet to be optimal for the target of 14% by the end of 2024. In South Sulawesi, with the Gammarana project for 2020–2023, through the placement of nutrition assistants in one village, one nutritionist. The stunting trend in South Sulawesi in 2021 was 21.6%; in 2023, it was 27.4%, or an increase of 5.8%. This condition is attractive because the South Sulawesi provincial government has aggressively strengthened stunting interventions since 2020 through the Gammarana project (Sirajuddin et al., 2022). The basis of intervention in South Sulawesi still refers to the basic framework of sensitive and specific interventions, but the results have yet to be optimal.

An optimal intervention evidence base is needed to become a reference for revitalizing stunting interventions in South Sulawesi. This review was conducted to formulate stunting intervention actions to strengthen sensitive and specific interventions running in South Sulawesi. The focus of the articles reviewed was randomized control trial studies between 2018 and 2024. RCT studies were chosen because they have the best study design and evidence base, where bias and control are well controlled.

METHOD AND MATERIAL

This review utilized PubMed and Science Direct search engine sources, with search years restricted from 2018 to 2024. Article searches were conducted using the PRISMA method (Page et al., 2021). A total of 100 articles were then selected using the Population, Intervention, Comparison, and Outcomes (PICO) principle. Eighty five articles were excluded because they did not meet the PICO criteria, leaving 15 articles that met the criteria (Figure.1) The inclusion criteria were original article, publicly available, English language, randomized control trial, subject 0-59 months. The exclusion criteria were qualitative studies, no stunting data or z-scores, no infant feeding data, no location, and no year of study. Based on the above method, it can be summarized through the CONSORT diagram (Figure. 1).

Details of the keyword search history for “Stunting AND Infant Feeding AND children” according to the MeSH terms were as followed : **stunting**: "growth disorders"[MeSH Terms] OR ("growth"[All Fields] AND "disorders"[All Fields]) OR "growth disorders"[All Fields] OR "stunting"[All Fields] OR "stunted"[All Fields]. **infant**: "infant"[MeSH Terms] OR "infant"[All Fields] OR "infants"[All Fields] OR "infant's"[All Fields]. **feeding**: "feeding"[All Fields] OR "feedings"[All Fields] OR "feeds"[All Fields]. **children**: "child"[MeSH Terms] OR "child"[All Fields] OR "children"[All Fields] OR "child's"[All Fields] OR "children's"[All Fields] OR "childrens"[All Fields] OR "childs"[All Fields].

RESULT

This review found 15 eligible articles that met the inclusion criteria (Table 1). Overall, the articles discussed stunting prevention efforts through direct or indirect nutrition action in the health sector channeled through several platforms.

The results in this review are presented based on the recommendations of the Keats et al. study (Keats et al., 2021). The recommendations are divided into two main perspectives: interventions based on nutrition action and interventions based on delivery system.

1. Interventions based on nutrition action

Interventions by nutrition action are presented in terms of direct nutrition interventions in the health sector with 4 related studies, and combined direct and indirect nutrition interventions in the hea *PRISMA flowcharts*

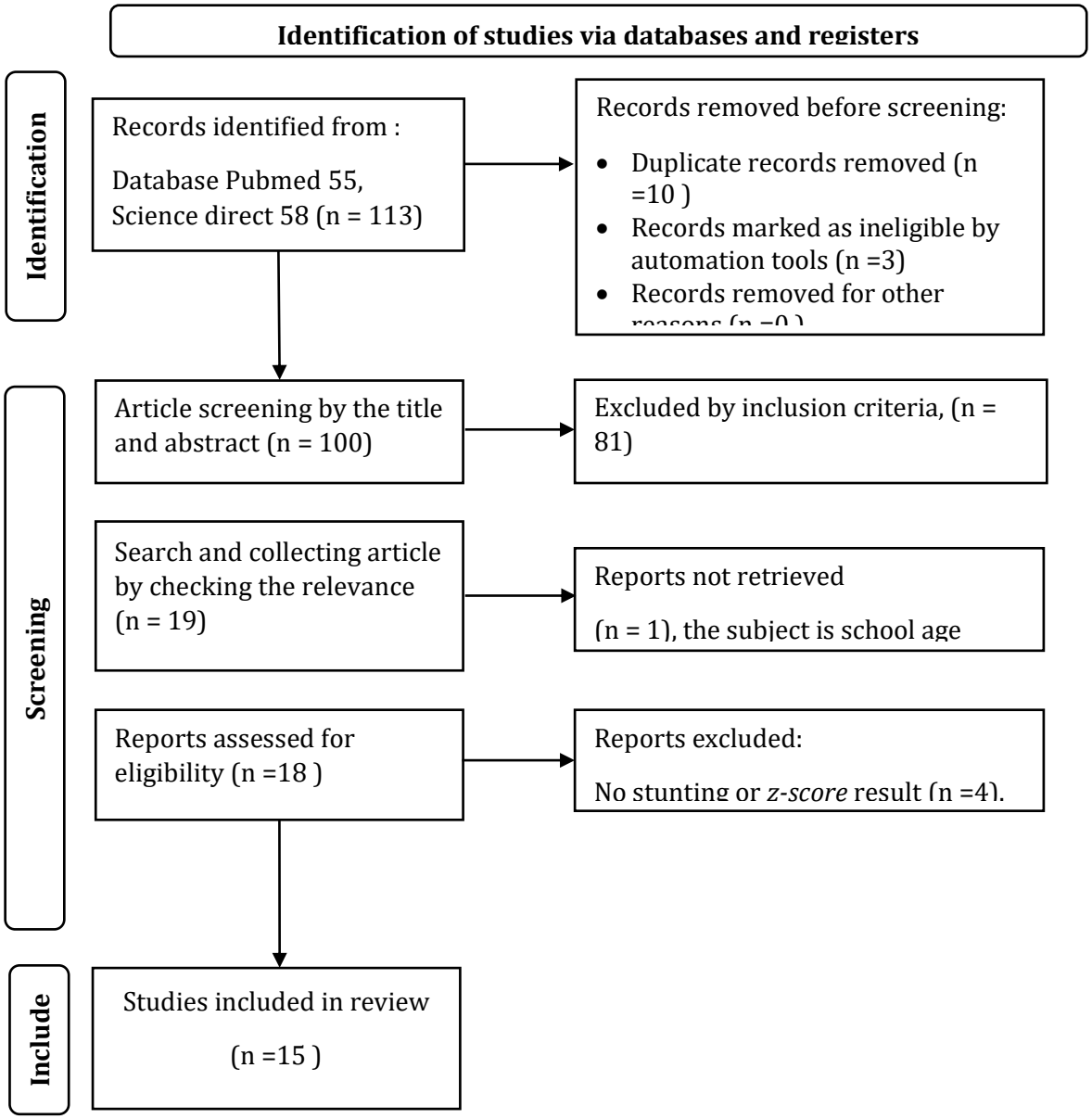

Figure 1. CONSORT Diagram

Direct nutrition intervention in the health sector

In direct nutrition interventions in the health sector, interventions were only conducted in one sector, with 4 studies found in this context (Table 1; numbers 1–4). The interventions included local complementary feeding (MPASI), nutritional supplementation, early breastfeeding initiation, and egg feeding. It was found that direct nutrition interventions in the health sector reduced growth impairment by 0.12 z-scores (Bierut et al., 2021) and resulted in an 8% reduction in stunting prevalence (Mbuya et al., 2019).

lth sector with 11 related studies

Table 1. Stunting Prevention Interventions by Population, Package Name, Package Details and Findings

Number	Intervention, Location	Population	Comparison	Outcomes/Implication	Notes
Direct Nutrition Intervention in The Health Sector					
1.	Local complementary feeding (Agapova et al., 2018), Malawi	Infant (12-23 months)	Corn/soy flour	The reduction in growth disturbance in the first 6 months was **0.30 points** and in the second 6 months **0.1 points.**	Local food base feeding interventions not significant, but all reduced growth impairment
2.	Nutritional supplementation, complementary feeding, provision egg (Bierut et al., 2021), Malawi	Infant (9-12 months)	isoenergetic supplement of corn/soy flour and micronutrient powder	The intervention inhibited growth reduction by **0.12** z-score compared to **0.24** z-score in the control group at 12 months of age (P=0.0011).	Interventions reduce the incidence of growth disorders
3.	Complementary feeding (Jaramillo-Ospina et al., 2022), Chile	Infant (0-24 months)	Human milk (only breastfeeding)	TB/U scores of the intervention group were better on days 180-720 than the control group ($p<0.05$).	• The intervention group had a better z-score than the control group • The cow's milk-based intervention and the protein and fat dense intervention had no difference in z-score

4.	Initiate early breastfeeding (Mbuya et al., 2019), Zimbabwe	Mother and infant (0-18 months)	Standard of care	Reduce stunting rate by **8%**	• Intervention model increased IMD percentage by 22.4% • Model intervensi meningkatkan persentase ASI Eksklusif **50.2%**
Direct and Indirect Nutrition Intervention in The Health Sector					
5.	Anthropometric kits, iron folic acid, water sanitation and hygiene, promotion of infant and young child feeding, health and nutritional counselling, training of growth monitoring (Beatty et al., 2024), Indonesia	Infant (0-35 months)	Usual health services	Stunting prevalence decreased by **7.1%**	

6.	Cash transfer, nutritional supplements, behavior change interventions (Soofi et al., 2022), Pakistan	Infant (6-24 months)	Cash transfer	The combination of cash transfers, nutritional supplements, and behavior change interventions reduced stunting by **14-15%**.	• If the intervention is only nutrient-dense foods and behavior change communication, the results are not different from if it is only cash transfers. • Combinations of interventions are more effective in marginalized income groups, through cash, nutritional supplements, and behavior change communication
7.	Strengthening the health care system, mass media campaigns, promotion of drinking water filters (Fahmida et al., 2020), Indonesia	Infant (3-18 month)	Standard of care	Intervention reduced the rate of increase in stunting by **8.7%** compared to the control group	
8.	Provision of complementary foods, parenting training, agricultural promotion, provision of seeds (Gelli et al., 2018), Malawi	Child (6-72 months)	Parenting education	The intervention reduced stunting by 1% at 36-72 months of age, and reduced stunting by 16% in 6-26 months.	

9.	Promotion of exclusive breastfeeding, strengthening of village health care systems, nutritional supplements, water sanitation and hygiene interventions, and provision of agricultural tools (Humphrey et al., 2019), Zimbabwe	Pregnant mother and infant (0-18 months)	Standard of care	Prevalence of stunting decreased by **8%**	An effective intervention is the combination of infant and young child feeding with water, sanitation and the environment.
10	Behavior change interventions, community mobilization and mass media, agricultural promotion (Kim et al., 2019), Ethiopia	Infant (6-24 months)	Standard interpersonal counseling and agricultural activities, less intensive community mobilization and mass media	Interventions reduced stunting by an average of **6%.**	The intervention significantly improved feeding practices in terms of food frequency, diversity and acceptability, as well as caregiver knowledge.
11	Provision of local complementary foods, promotion of infant and young child feeding, promotion of water, sanitation and environment, provision of nutritional supplements (Ara et al., 2022), Bangladesh	Infant (6-23 months)	Usual health messages	Intervention reduced stunting by 9.41%	
12	Promotion of infant and young child feeding, complementary feeding (Campbell et al., 2018a), Bangladesh	Infant (6-18 months)	Child feeding counseling	Stunting decreased between 2.2% and 6.1%	Values of 14 out of 16 micronutrients measured increased after consumption of complementary food

					supplements in all age groups.
13	Promotion of infant and young child feeding, women's empowerment (Ayalew & Belachew, 2021a), Ethiopia	Infant (6-24 months)	Usual health services	Intervention better at reducing stunting by 7.5% $p<0.05$	
14	Maternal and child nutritional supplements, provision of eggs, agricultural training and products (Wegmüller et al., 2022), Kenya	Infant (6-24 months)	Agricultural training and products	Stunting incidence rate decreased by **9%**	Better height gain in the intervention group than the control group
15	Mass media campaign (Lenel et al., 2022), Indonesia	Child (0-59 months)	No campaign	Stunting incidence rate decreased by **8.8%**	PKH delivery interventions, coupled with SMS behavior change campaigns improved postpartum childcare, hygiene practices, and anemia incidence.

Direct and indirect nutrition interventions in the health sector

The combination of direct and indirect nutrition interventions in this review was multisectoral, and 11 related studies were found (Table 1; numbers. 5–15). The types of interventions were provision of anthropometric kits, iron folic acid, training of growth monitoring, cash transfers, provision of nutrient-dense foods, provision of eggs, provision of nutritional supplements, behavior change interventions, strengthening health care systems, mass media campaigns, promotion of drinking water filters, provision of complementary foods, promotion of exclusive breastfeeding, promotion of infant and young child feeding, parenting training, water sanitation and hygiene interventions, promotion and provision of agricultural equipment, provision of seeds, and empowerment of women. Of the many interventions carried out, this combination of interventions could maximally reduce the stunting rate by 14–15% (Soofi et al., 2022).

2. Intervensions based on delivery system

According to the delivery system, nutrition interventions are the methods used to deliver interventions to target groups. The study found that healthcare workers, the mass media, financial incentives, and local governments deliver interventions.

Health workers

Utilizing health workers as intermediaries to deliver interventions has been used in many studies. Utilizing health workers for breastfeeding education has increased the prevalence of breastfeeding initiation and exclusive breastfeeding during the prenatal and postnatal periods (Mbuya et al., 2019).

Mass media and telehealth

One of the means used for stunting prevention interventions is using mass media and the features of telecommunications equipment. A study that used television media to deliver messages related to nutrition during pregnancy, breastfeeding, and complementary foods. However, it has not been able to encourage mothers to improve breastfeeding practices (Fahmida et al., 2020). Another study used short message service (SMS) to campaign to program beneficiaries. The result was an improvement in the health aspects of pregnancy and the incidence of anemia (Lenel et al., 2022).

Cash transfers

Studies that provided cash incentives to targets were shown to reduce the prevalence of stunting, although they had to be combined with other direct nutrition interventions (Soofi et al., 2022). In addition, one study financed an intervention program to procure anthropometric equipment, transportation, or incentives for presenters. The results helped reduce the prevalence of stunting (Beatty et al., 2024).

DISCUSSION

In general, this study showed that stunting reduction interventions would be maximized if they were carried out in a multi-sectoral manner rather than if they were carried out in a single sector. This is following the concept of stunting prevention, which must be integrated with other sectors to overcome the various causes of stunting that do not only come from nutritional factors (Tamir et al., 2024).

From this concept, a combination of interventions between multisectors reduces the prevalence of stunting by 14–15%. The interventions are the provision of direct cash transfer, nutritional supplements, and behavior change interventions (Soofi et al., 2022).

Although the overall majority concluded that the interventions could reduce the prevalence of stunting or inhibit the growth disorder rate, some studies showed different results. Research conducted in Kenya showed that stunting decreased in both the intervention and control groups (Wegmüller et al., 2022).

The results of this review found basic themes for the interventions carried out, such as behavior change interventions, feeding interventions and nutritional supplements for mothers and children, agricultural interventions, water sanitation and hygiene interventions, provide a kits, and women's empowerment.

Behavior change communication is the underlying principle of all stunting prevention interventions. Behavior change targets parents, cadres, mothers or caregivers, and health workers for intervention. One study utilized cadres to train and deliver child nutrition and stimulation messages. The result was a 16% reduction in stunting prevalence in a specific group (Gelli et al., 2018). Another study provided interventions to village midwives, health workers, and posyandu cadres to strengthen the healthcare system with the Baby-Friendly Hospital Initiative/BBFI. As a result, the rate of increase in stunting incidence of 8.7% was inhibited (Fahmida et al., 2020).

In addition, interventions can also use community actors such as religious leaders, agricultural workers, and others as intermediaries to deliver intervention messages. As a result, the average stunting rate decreased (Kim et al., 2019).

This review found many studies that conducted stunting prevention interventions in the form of feeding and nutritional supplements for children and mothers. These interventions in all studies have the same effect, which could reduce the prevalence of stunting or inhibit growth decline. Child feeding utilizes many types of ingredients and sources as the main ingredient. Feeding with some combination of basic ingredients, such as those based on nuts or fats and those based on grains (Campbell et al., 2018b). In addition, basic ingredients that can also be utilized are from cow's milk by utilizing the whey protein-lipid concentrate content (Jaramillo-Ospina et al., 2022). The other side of feeding children can also utilize local foods to be modified, such as *suji firni* and *suji halwa* snacks made from eggs and cow's milk (Ara et al., 2022). Feeding is accompanied by providing nutritional supplements for children in *micronutrient powder* (Bierut et al., 2021). Nutritional supplements for mothers are given during the second trimester of pregnancy every day until the child is six months old (Wegmüller et al., 2022).

We also found one study that provide an anthropometric kits. The kits were provided is used for growth monitoring training on cadres (Beatty et al., 2024).

Other stunting prevention interventions include water, sanitation and hygiene interventions. These interventions are carried out in combination with other nutrition interventions. It can include providing sanitation facilities, clean water management products, latrine construction, monthly liquid soap distribution, and creating safe open spaces for children (Humphrey et al., 2019).

The last type of intervention is women's empowerment. In the results of this study, women's empowerment was carried out by placing women as nutrition-related messengers (Ayalew & Belachew, 2021b).

The limitation of this study's findings is that most of the research was conducted outside of Indonesia. This provides a different socio-cultural context from Indonesia, so implementing the same type of intervention requires adjustments in Indonesia, especially in South Sulawesi. The

solution is to replicate the central theme and modify the implementation according to the program beneficiaries' context or the recipient community's social conditions.

CONCLUSION

Stunting prevention interventions must prioritize multisectoral nutrition actions so that the effectiveness of interventions will achieve optimal results. Some intervention programs that can be replicated from the study's results include providing nutritional supplements for children or mothers, providing anthropometric kits, providing modified local complementary foods, providing eggs, initiating early breastfeeding, providing an anthropometric kits, and promoting infant and young child feeding practices. All intervention programs must apply an attitude and behavior change approach using extension, counseling, mass media campaigns, training, and mentoring. Interventions are also synchronized with beneficiaries of social protection packages such as cash transfers, and they intervene in aspects of water, sanitation, and the target environment. The last was to improve service standards by strengthening facilities, health personnel and skilled health workers.

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