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Empowering Mothers in Utilizing Local Food Based on Mixed Fish to Prevent *Stunting*: A Reflection Study in Participatory Action Research

Pemberdayaan Ibu dalam Pemanfaatan Pangan Lokal Berbasis Ikan Campur untuk Mencegah Stunting: Sebuah Studi Refleksi dalam Penelitian Aksi Partisipatif

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ABSTRACT

Background: *Stunting* remains a significant public health issue, particularly in low-resource settings where maternal knowledge and dietary practices influence child nutrition. Empowering mothers through participatory approaches is an effective strategy for addressing this challenge.

Objectives: This study examined the reflective process within the Participatory Action Research (PAR) framework to empower mothers to enhance their child nutrition through local food resources. It specifically focuses on the critical reflections that shape the effectiveness of empowerment.

Methods: This study employed PAR with a focus on the reflection stage, to assess the effectiveness of maternal empowerment in utilizing local food for *stunting* prevention. Quantitative assessments including structured questionnaires were administered to 50 randomly selected participants. A paired t-test was conducted to analyze changes in knowledge and attitudes, with statistical significance set at p-value<0.05.

Results: The reflection phase revealed a significant increase in maternal knowledge and attitude post-intervention. The mean knowledge score improved from 14.70±3.09 to 29.60±0.97 (p-value=0.001), while the attitude score increased from 11.50±3.06 to 19.30±1.52 (p-value=0.001). The maternal empowerment program was well received, with trained health cadres and PKK (family welfare movement) mothers playing a crucial role in fostering sustainable behavioral change in *stunting* prevention.

Conclusions: Critical reflection on PAR enhances the effectiveness of maternal empowerment. These findings offer practical insights for policymakers and public health practitioners in designing adaptive community-driven nutritional interventions. Integrating reflective practices ensures that *stunting* prevention programmes are contextually relevant, sustainable, and scalable across diverse sociocultural settings.

INTRODUCTION

Stunting remains a significant public health challenge in Indonesia, posing serious risks to the physical and cognitive development of the affected children. This condition is often exacerbated by socioeconomic disparities and limited access to nutritious foods, which contribute to poor dietary practices among mothers and children, particularly in rural areas[1,2]. Empowering mothers to make informed nutritional choices is essential to address this issue as they play a pivotal role in shaping early nutritional habits. Furthermore, targeted nutrition programs that encourage the use of local food sources offer a sustainable way to combat malnutrition and promote food security, particularly in settings where economic barriers restrict access to diverse nutrient-rich diets[3–6].

The prevalence of *stunting* is a critical issue, with Indonesia ranking 17th among 117 countries, highlighting the urgency of national and international interventions. According to the Basic Health Research report (Riskesdas) in 2018, Indonesia's *stunting* rate was 36.4%, which is considerably higher than that of other Southeast Asian countries such as Malaysia (20%) and Thailand (10.5%)[7]. Although some improvements have been observed, with the *stunting* rate in Sumatera Utara dropping from 32.4% in 2018 to 25.8% in 2021[8], this figure remains alarmingly high, indicating the need for ongoing efforts. Research has consistently shown that the first 1,000 days of life, from conception until the age of two is crucial for preventing *stunting*, as nutrition during this period significantly influences long-term health and development[9].

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Previous studies have examined various interventions to mitigate *stunting* among Indonesian children, often focusing on school-age nutritional programs. For example, a study on the provision of freshwater fish-based meals to elementary school children demonstrated positive outcomes for height growth, indicating that nutritious food programs can have a tangible impact on physical development. However, most of these programs target older children, leaving a gap in interventions specifically designed for children under two years, a period critical for growth and development[10,11]. This gap underscores the need for programs aimed at younger children and their caregivers, particularly by educating mothers on the use of local food sources to meet their nutritional requirements.

Additional studies indicate that many mothers in Indonesia lack adequate skills and knowledge regarding nutritious food preparation, which can lead to misconceptions regarding the cost and accessibility of healthy food. A common belief is that nutritious food is expensive, which deters families from adopting healthier diets. Interventions designed to empower women, particularly in rural areas, have shown promise for enhancing dietary diversity and improving household nutritional security. By addressing economic and knowledge barriers through empowerment initiatives, women can provide a balanced diet for their children[12,13].

Women's empowerment is consistently linked to improved health and nutritional outcomes for their children. Research has demonstrated that mothers who actively engage in nutritional decision making are more likely to prioritize the health and well-being of their children. Community-based programs that educate mothers about local food resources and enhance their decision-making power are instrumental in reducing *stunting*[14]. The participatory action research (PAR) model, which emphasizes community engagement and self-efficacy, is particularly effective in achieving sustainable improvements in maternal and child health outcomes[15].

Although many previous studies have been conducted, there remains a lack of research specifically evaluating the impact of locally sourced food-based nutritional interventions on preventing *stunting* among infants and toddlers. This study addresses this gap by focusing on a participatory empowerment approach that educates mothers on the preparation and use of mixed local fish as a source of affordable, high-quality nutrition. This approach is designed to enable mothers to make informed choices that contribute to improved health outcomes for their children, especially those under the age of two years.

In this study, we hypothesized that empowering mothers through targeted nutritional education and skill-building would lead to significant improvements in their knowledge, attitudes, and practices related to toddler nutrition. The primary objective of this study was to evaluate the impact of maternal empowerment on *stunting* prevention, specifically by examining how the use of local food resources in nutritional practices can mitigate *stunting* rates. To address this gap, this study sought to provide actionable insights into effective *stunting* prevention strategies that leverage local resources and foster sustainable community engagement.

METHODS

Research Design and Approach

This study utilized a PAR approach, a methodological framework that emphasizes collaboration and reflection between researchers and participants to produce actionable knowledge.[15,16]. This study employs PAR, with a specific focus on the reflection stages, to analyze the effectiveness of maternal empowerment in utilizing local food to prevent *stunting*. The PAR model was selected for its suitability in engaging mothers as active participants in nutritional interventions, empowering them to make sustainable changes in their dietary practices.

This study was conducted in Sei Nagalawan Village, Perbaungan District, Deli Serdang Regency, Sumatera Utara Province, Indonesia**.** This location was specifically chosen because of its high prevalence of *stunting* among toddlers, which presents a critical public health issue that demands targeted nutritional interventions. Sei Nagalawan's community is primarily dependent on fishing and other low-income livelihoods, which limits access to diversified diets and increases the vulnerability of children to nutritional deficiencies. Furthermore, the village represents a rural Indonesian setting where access to health services, educational resources, and consistent nutritional support is limited, thereby providing an ideal context for studying the effectiveness of local community-based nutrition interventions**.**

By selecting this village, this study aimed to address both the scientific and practical challenges related to preventing *stunting* in underserved communities. This site also provides a unique opportunity to evaluate the potential of local resources, such as readily available fish, to serve as a sustainable dietary supplement for families with a limited income. Studying the impact of empowering mothers in such a setting can generate insights applicable to similar communities across Indonesia and other low-resource settings globally, where local food sources can be leveraged to mitigate *stunting* and improve child-health outcomes.

Selection Criteria for Participants and Study Context

Participants were selected on the basis of the following inclusion criteria: mothers of toddlers aged 0–5 years who resided in the village and regularly visited local Posyandu (community health posts). The selection was based on the village's socioeconomic profile, with a focus on mothers from households with limited access to diverse food sources, which heightens the risk of *stunting* in children. This selection enabled the study to address the local challenges related to nutrition and child development. The participatory nature of this study ensured that the participants were directly involved in both intervention planning and implementation, enhancing the contextual relevance of the findings.

Population and Sample

The target population for this study was the mothers of toddlers residing in the village of Sei

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Nagalawan. From this population, 50 mothers were randomly selected to participate in the PAR impact evaluation phase. Additionally, ten mothers who drove the family welfare and empowerment organization (PKK) and health cadres were trained as agents of change within the community. This sampling strategy aimed to provide a representative subset of the village, ensuring that the findings could be generalized to similar rural settings facing nutritional challenges.

Research Procedure

In this study, PAR approach was employed to empower mothers to utilize local food to prevent *stunting*. A fundamental component of PAR is reflection, which occurs in several key stages.

1. **Initial Reflection**

   This initial reflection serves as the first step in PAR, aiming to assess the community's baseline conditions and the challenges that they face. Problem identification was conducted through preliminary data collection using observation methods, interviews, and focus group discussions with the mothers of toddlers and community health cadres. This stage identified factors contributing to *stunting*, barriers to using local food, and mothers' knowledge and attitudes toward child nutrition, which were measured using a pretest questionnaire.

2. **Action Planning**

   Following the problem identification, the next stage involved designing an intervention through community participation. This planning process involves various stakeholders, including health cadres, mothers of toddlers, and healthcare professionals to ensure that the intervention is both relevant and feasible. The action plan consisted of training health cadres and Family Welfare Movement (PKK) mothers as agents of change, with a focus on sustainability by involving local leaders. In addition, PKK cadres and mothers provide educational sessions on the use of local fish as a source of protein. This stage also includes the development of educational media and effective communication strategies to increase awareness and promote improved nutritional practices.

3. **Action Implementation**

   The intervention was implemented by involving PKK cadres and mothers as community-based agents of change. The activities included training sessions on the benefits of local food, hands-on cooking demonstrations featuring nutritious meals based on local fish, and educational discussions on the importance of animal proteins in preventing *stunting* (Table 1). Furthermore, PKK cadres and mothers conduct nutrition promotion sessions through counseling at Posyandu (integrated health service posts) and religious gatherings, such as "*perwiritan*," to reinforce healthy dietary practices. Nonformal educational approaches, including interpersonal communication, have also been employed to enhance engagement and disseminate knowledge. The targets for this activity were mothers who had babies/toddlers in Sei Nagalawan Village. The activity method includes lectures, questions, and answers. Partners become agents of change in infant/toddler nutrition to prevent or overcome *stunting*. Promotion of *stunting* was carried out by partners using counseling methods at Posyandu and interpersonal communication (peer educators) with the mothers of toddlers. The intervention in the form of nutritional education on the use of mixed fish, which was carried out formally and informally, was conducted for two months.

4. **Re-Reflection**

   Post-intervention, a re-reflection process was conducted to evaluate the effectiveness of the implemented actions one month after all activities had been completed. This evaluation compared pre- and post-intervention data by using questionnaires. The purpose of re-reflection is to measure the impact of the intervention on improving mothers' knowledge and attitudes toward child nutrition, while also identifying potential challenges encountered during program implementation.

5. **Action Revision and Improvement**

   Based on the re-reflection findings, necessary revisions and improvements were made to enhance the program effectiveness. If barriers to implementation can be identified, alternative strategies can be formulated to address these challenges. Program enhancements may include refining educational methods, strengthening cadres' communication skills, and reinforcing community support systems to ensure sustainability and maximize the program's long-term impact. This systematic and participatory approach fosters community engagement and empowerment, ultimately contributing to sustainable efforts to prevent *stunting* through locally driven nutritional interventions.

Table 1. Community service partner training materials

Day	Material
First (1)	Nutrition Education to Prevent and Overcome *Stunting* - Understanding *Stunting* - Targets at Risk of *Stunting* - The Importance of Preventing and Overcoming *Stunting* - How to Prevent *Stunting* - How to Overcome *Stunting*

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Day	Material
	- Prevent *stunting* with local food - Prevent *stunting* with Animal Protein Review of Nutrition Education to Prevent and Overcome *Stunting*. How to Prevent and Overcome *Stunting*
Second (2)	Training on Preparing and Processing a Mixed Fish Menu as a supplementary feeding for Recovering Babies/Toddlers from the Risk of *Stunting* - A brief explanation of supplementary feeding - How to Arrange a Menu - How to Prepare a Mixed Fish Menu - Modification of mixed fish recipe as PMT Recovery
Third (3)	Agent of Change for *Stunting* Prevention and Management - Understanding Change Agent for *Stunting* Prevention and Control - Duties and responsibilities of change agents for *stunting* prevention and control - Discussion of work plans for agents of change to prevent and overcome *stunting* using mixed local fish food ingredients Mentoring (nutrition promotion practices to prevent and overcome *stunting* for targets)

Research Instruments

Data were collected using structured questionnaires developed to assess knowledge, attitudes, and practices (KAP) concerning toddler nutrition. The questionnaire was validated by a panel of nutrition and public health experts to ensure clarity and relevance. Observation sheets were used during the intervention phase to monitor participant engagement and adherence to training protocols.

Data Processing and Analysis

Data were processed and analyzed using SPSS software version 25.0. Paired t-tests were used to evaluate changes in knowledge and attitudes before and after the intervention, with statistical significance set at $p < 0.05$. The analysis focused on comparing pre- and post-intervention data to determine the effectiveness of empowerment-based nutritional interventions in improving maternal knowledge and attitudes regarding toddler nutrition.

Data analysis followed a systematic approach to ensure a comprehensive interpretation. Descriptive statistics were used to summarize the demographic information, and inferential statistics were used to assess the impact of the intervention. The findings are presented in tables and graphs to facilitate understanding and provide a clear visual representation of changes in knowledge and attitudes. In addition, qualitative data from the observation sheets were analyzed thematically to identify the key factors that influenced participant engagement and success in adopting new dietary practices.

Ethical Considerations

Informed consent was obtained from all participants before data collection, and the researchers explained the study purpose, procedures, and confidentiality protocols. Participants were informed of their right to withdraw at any time without penalties. This study was approved by the Medical Ethics Commission of Poltekkes Kemenkes Medan, Indonesia (approval number 01.25614/KEPK/POLTEKKES KEMENKES MEDAN 2024 on April 19, 2024).

RESULTS AND DISCUSSIONS

PKK and Cadres as Agents of Change

Efforts to prevent *stunting* in Sei Nagalawan Village, Perbaungan District, and the Serdang Bedagai Regency have been successful. Empowering mothers of toddlers to prevent *stunting* is carried out by providing promotions on toddler nutrition to partners who are trained as agents of change. Mothers play an important role in the development of nutritional problems in children. The knowledge and attitudes of mothers with babies/toddlers influence their mothers by providing menus to toddlers every day.

Maternal empowerment is a key factor in preventing and overcoming *stunting* in infants and toddlers. Maternal empowerment can influence all the factors related to nutritional problems among empowerment partners. Empowered women have the ability to control decision-making in various aspects of life, including sociocultural, family, and infant/toddler nutrition dimensions. They could independently make decisions regarding their children's health[17–19].
The empowered mothers controlled their knowledge and finances. In this way, they can change the composition of household consumption purchases, increase household food security, and increase the diversity of diets and nutritional status of their children[3]. Empowering mothers is the main driver for achieving health goals and improving the nutrition of infants and toddlers. Maternal empowerment was significantly related to the incidence of *stunting*. This is supported by several similar research results[20–22].

Agent of change in preconception nutrition (agent of change) refers to the concept taken from the Ottawa Charter (World Health Organization, 1986) which emphasizes strengthening the potential of the community so that it can become a weapon in solving the problems that the community has [23,24]. Strengthening community action refers to community resources that provide social support and self-help to the community (i.e., community helps itself). Strengthening community actions also seeks to develop a flexible system to strengthen maternal participation in empowerment through nutritional promotion. Using this concept in implementing community service has the potential to make this community service program sustainable, which

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in turn continues to make this village a sustainable partner in *stunting* prevention[25].

The targets of this training were PKK and cadres, with the characteristics shown in Table 2. From Table 2, it can be seen that although PKK and cadres generally had a service period of more than five years (60%), they had never received training on *stunting* before and had never received training on health promotion methods (100%). All PKK mothers and cadres who are trained to become agents of change are housewives so that they do not interfere with their work.

Table 2. Characteristics of partners participating in agent of change training in Sei Nagalawan Village in 2024

Partner Characteristics	Total (n)	Percentage (%)
Age		
32-39 Years	4	40
41-51 Years	4	40
54-57 Years	2	20
Work		
Not Working (Housewife)	10	100
Education		
Elementary-Middle School	5	50
Senior High School	4	40
University (Undergraduate)	1	10
Task		
Health Cadre	5	50
Mother who drives family welfare and empowerment organization (PKK)	5	50
Duration of Assignment		
12 Years	4	40
>5 Years	6	60
Stunting Training History		
Once	4	40
Never	6	60
Nutrition Education and Training History		
Once		
Never	10	100

To assess the success of the training, before and after the training, a pre-test and post-test were conducted to measure the level of knowledge and attitudes of preconception nutrition change agent training participants, using a questionnaire. To monitor the success of the training, the service team used a trainee observation sheet that was filled out daily during training. Training participants were declared to have passed if they had a questionnaire score >80, and the training participant's daily observation sheet was in the good category. Before carrying out the training, the change agents were first pretested and then trained. After completing the training, the *stunting* prevention and control change agent conducted a post-test on knowledge and attitudes. The influence of *stunting* prevention and control change agent training on the average knowledge and attitudes of partners is shown in table below.

Table 3. Average distribution of knowledge and attitudes of change agent training participants in *stunting* prevention and control before and after training

Variable	Mean±SD	Mean Change±SD	p-value*
Knowledge			
Before	14.70±3.09	-14.90±2.81	0.001
After	29.60±0.97		
Attitude			
Before	11.50±3.06	-7.80±3.79	0.001
After	19.30±1.52		

* Differences within groups (before and after) were determined using a paired t-test at a significance level of 5%.

Table 3 shows that after the *stunting* prevention and control agent of change training was carried out for three days, there was an increase in the average knowledge score of 14.90 and all training participants were in the good knowledge category about *stunting* and local mixed fish food ingredients. to prevent *stunting*. Regarding attitude, there was also an increase in the mean attitude value (7.80), and all training participants had good attitudes. The results of the statistical test using the paired t-test showed that there was a difference in the average knowledge and attitudes of change agent training participants regarding *stunting* prevention and control before and after training (p-value<0.05).

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Promotion of Toddler Nutrition by Agents of Change through Promotion of Toddler Nutrition to Prevent *Stunting* using Interpersonal Communication Methods

Agents of change according to experts: According to Soerjono Soekanto, parties who want change are called Agents of Change; namely, a person or group of people who are trusted as leaders of one or more social institutions. In Havelock's in 1973 formulation, an agent of change is a person who helps to implement social change or planned innovation. According to Robbins and Coulter, a change agent is a person who acts as a catalyst and manages changes that occur. According to Griffin and Pareek, a broader definition is a professional person whose job is to help a community or group plan development or reshape goals, focus on problems, look for possible solutions, organize assistance, plan actions aimed at improving the situation, overcome difficulties, and evaluate the results of planned efforts. It can be concluded that a change agent is an individual or a team that works together to influence society or other targets, both internally and externally, to make changes as expected [23,26]. The function of a Change Agent or agent of change is as a catalyst (liaison), namely moving society to make changes; as a solution giver (providing a solution), namely providing a solution to solve a problem that occurs as a process helper (assisting), namely as a figure who helps in the change process; and as a resource linker (sources), namely as a liaison with the resources needed to solve problems that occur [20].

Every nutrition change agent carries out informal nutrition education in the form of interpersonal communication, such as with neighbors or fellow mothers when they are shopping at the stall. Each of these agents also takes advantage of the village custom of sitting and telling stories in front of the house to provide nutrition promotion. To promote toddler nutrition to prevent *stunting*, each agent was provided with nutrition promotion media, namely, leaflets and animated videos. Efforts to monitor the implementation of interventions that have been carried out by each agent mean that each agent makes a note of the implementation of the intervention or lookbook every time they carry out an intervention for further discussion with the team and researchers. However, in practice, each agent who carries out nutrition education directly discusses with researchers via the WA what will and has been done. The process of discussion and feedback on what has been done also takes place personally through the WA.

Counseling was conducted at Sei Nagalawan Village Hut. After completing the Posyandu at the village office, the mothers of the toddlers were gathered at the Sei Nagawalan village hut. The mothers of toddlers who were targeted for counseling came from 3 Posyadu in Sei Nagawalan Village. Counseling was performed by using change agents. Places and facilities for the outreach infrastructure were prepared using change agents. Those who provide counseling materials are also agents of change. Counseling was carried out once and before the nutrition promotion activities by the agents, and pre-test data were collected regarding the knowledge and attitudes of mothers of toddlers.

Reflection Results from the PAR Process

The reflection results showed that post-intervention, a structured reflection process was conducted to optimize the effectiveness of the implemented actions. This evaluation compared pre- and post-intervention data using questionnaire assessments with the characteristics of respondents, and the results of the reflections are presented in Tables 4 and 5. The use of local foods is well accepted, as evidenced by the increased knowledge and attitudes toward processing local food ingredients, particularly fish, into a variety of nutritious and contemporary toddler foods. This program also offers sustainable opportunities by empowering health cadres, and mothers who drive family welfare and empowerment organizations (PKK) as agents of change are recognized as local leaders and come from the local community. Their role is crucial in strengthening sustainable behavior modification and highlighting the significance of empowerment dynamics in ensuring the long-term impact of the program.

Table 4. Characteristics of respondents in evaluation of the impact of empowering mothers of toddlers (PAR Reflection) in Sei Nagalawan Village in 2024

Variables	Total (n)	Percentage (%)
Mother's Characteristics		
Mother's Age		
20-30 Years	29	58
31-43 Years	21	42
Mother's Job		
Not Working (Housewife)	50	100
Mother's Education		
Elementary-Middle School	9	18
Senior High School	41	82
Father's Characteristics		
Father's Age		
21-30 Years	16	32
31-40 Years	23	46
41-62 Years	11	22
Father's Job		
Farmer	7	14
Laborer/Driver	4	8

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Variables	Total (n)	Percentage (%)
Fisherman	22	44
Businessman	9	18
Scrambling	8	16
Number of children		
1-2	20	40
3-5	30	60
Child's Age (Months)		
6	2	4
7-12	21	42
13-24	10	20
25-48	13	26

From the results of measuring knowledge and attitudes, an increase in average knowledge and attitudes was observed before and after nutrition promotion. The results of statistical tests using paired t-test statistics showed that there was a difference in the average knowledge and attitudes of mothers who had babies/toddlers before and after being given nutritional promotion by change agents (p-value<0.05).

Table 5. Average distribution of knowledge and attitudes of mothers who have babies/toddlers before and after nutrition promotion (n=50)

Variable	Mean±SD	Mean Change±SD	p-value*
Knowledge			
Before	13.53±3.94	-14.64±3.79	0.001
After	28.18 ±3.14		
Attitude			
Before	12.04±3.57	-6.80±3.11	0.001
After	18.84±2.56		

* Differences within groups (before and after) were determined using a paired t-test at a significance level of 5%.

The results of this study demonstrated a significant increase in maternal knowledge and attitudes toward toddler nutrition following the intervention. Mothers trained as change agents as well as those receiving nutritional education from these agents showed marked improvement. This finding aligns with Rogers' in 2003 Diffusion of Innovations Theory, which underscores knowledge as a critical precursor to behavioral change. Increased knowledge can empower mothers to make better-informed choices about nutrition, suggesting that this educational intervention has the potential to support healthier eating habits in children[27,28].

This outcome is consistent with prior research highlighting the value of community-driven health interventions[14]. This study fostered a sense of ownership and responsibility for dietary practices by equipping mothers with essential nutritional information and engaging them in active participation. Moreover, improved knowledge and attitudes among mothers are likely to impact long-term health outcomes, as these attributes have been shown to influence dietary choices, and consequently, children's health[13,29]. Thus, this study provides meaningful insights into public health strategies by reinforcing the importance of targeting maternal knowledge as a mechanism to combat *stunting* in underserved communities.

The intervention emphasized the use of local fish as a nutrient-dense food source, promoting a practical, culturally relevant strategy for addressing nutritional deficiencies. This approach resonates with the findings of Naja et al. in 2016, who emphasize that locally sourced nutrition solutions are often more sustainable and accessible in rural settings. Local fish not only provide essential proteins and nutrients but also serve as an affordable alternative to commercially processed foods, which are often inaccessible in low-income communities. By incorporating locally available food resources, this study addressed a critical gap in nutrition programs that typically rely on imported or expensive supplements. The use of local ingredients aligns with sustainable practices and can be integrated into community health programmes. This approach provides a replicable model that can be adapted to similar settings, underscoring the role of culturally relevant resource-based interventions in public health.

The study's use of PKK mothers and health cadres as change agents proved effective in disseminating nutrition education and promoting positive health behaviors within the community. As community members, these agents have a unique social influence that has been shown to facilitate the acceptance and adoption of new behaviors. These findings support the value of leveraging community-based leaders in health promotion, particularly in areas with limited health services[30].

The community empowerment models in this study were praised for their sustainability and effectiveness in health interventions[31,32]. By training community members as agents of change, the intervention not only extends the reach of nutrition education, but also builds the local capacity to sustain these practices. This model can inspire further community-based initiatives that engage local stakeholders as health advocates, creating a long-lasting impact on public health outcomes.

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Utilization of Local Food to Prevent *Stunting*

The concept of using local food is a theme of community services. Fish are a source of proteins necessary to prevent *stunting*. The community service is located on the beach, where the main livelihood of the community is fishing. As a fish-producing village, it has great potential to prevent *stunting* through the use of mixed local fish food. Diversity (*diversification*) in food consumption is one of the main pillars of efforts to reduce food and nutrition problems. The development of diversity in food consumption cannot be separated from the level of knowledge regarding food and nutrition [28–30]. Limited knowledge and information regarding local food means that people are less concerned about the existence of local food sources in the villages. Strengthening community understanding and transforming knowledge have become entry points for fostering community awareness, interest, and behavior in developing and utilizing local food sources. Utilizing homestead land through integrated programs will help communities to develop local food sources [29]. Considering the conditions and opportunities for food consumption diversification, it is possible to change more varied food consumption patterns by considering the local food availability, knowledge, and purchasing power of the community.

Learning from PAR reflection results

The results showed a significant increase in the knowledge and attitudes of toddler mothers regarding the use of local food to prevent *stunting*. Based on interviews and surveys, most participants reported an increase in their understanding of the importance of animal proteins in child growth. Limited knowledge about the nutrition of local fish and variations in serving local food-based menus increased after the actions taken by cadres and PKK mothers as agents of change. Communication established in the community through interpersonal communication reinforced mothers, where, previously, the problem of child nutrition was a problem for the mother, which they thought was their failure. However, with this action, mothers felt strong in the presence of sharing with agents of change and other mothers.

In addition, cadres who had been trained as agents of change showed an increased capacity to provide nutrition education to the community. This can be observed by the increasing frequency of interpersonal communication. This also revealed that the program's sustainability is highly dependent on community support and the availability of local food ingredients that are easily accessible to the community. By implementing the stages of reflection in this PAR, mothers can be empowered to use local food to prevent *stunting* more effectively, participatory, and sustainable. The results of this study indicate that the reflective process in PAR can increase the awareness, knowledge, and nutritional practices of toddler mothers, ultimately contributing to more comprehensive efforts to prevent *stunting*.

The findings of this study have valuable implications for public health interventions aimed at preventing *stunting* through maternal empowerment and local food utilization. This study highlights the potential of community-based interventions to enhance maternal knowledge and dietary practices, leading to improved child nutrition. The involvement of PKK cadres and mothers as agents of change fosters community ownership, which is essential for the sustainability of nutrition programmes. Policymakers and stakeholders should consider integrating participatory approaches into broader public health strategies to address malnutrition at a grassroots level.

This study presents a novel approach that focuses on the reflection process within a PAR framework. Unlike conventional interventions, this study emphasizes iterative learning and adaptive strategies that emerge from community-driven reflections. The unique integration of local food as a primary nutritional intervention provides an innovative model for leveraging indigenous resources to combat *stunting*. This study has limitations, namely the results of the study only provide an overview of the effectiveness of reflection in empowering mothers, namely evaluating changes in mothers' knowledge and attitudes in the short term after the intervention, but not evaluating the long-term impact of the intervention carried out. There has been no long-term follow-up to determine whether there is a real effect on children's nutritional status in preventing *stunting*. Future studies should explore the long-term impacts of participatory maternal empowerment programs on childhood nutritional outcomes. Further research is needed to examine the scalability of this model in different sociocultural settings and assess the role of digital technology in enhancing maternal education and knowledge dissemination.

CONCLUSIONS

This study shows that the implementation of PAR with a focus on critical reflection significantly improves mothers' knowledge and attitudes toward utilizing local food based on mixed fish to prevent *stunting*. This finding confirms that reflection on PAR plays an important role in strengthening the effectiveness of empowerment programmes. In addition, the involvement of health cadres and PKK mothers as agents of change is a key factor in strengthening sustainable behavior modification. The results of this study also show that community-based interventions with a reflective approach can increase community acceptance and involvement in *stunting* prevention programs. Therefore, reflective transmission practices in nutrition empowerment programs are needed to become more adaptive, contextually relevant, and sustainable. Further research is needed to explore the effectiveness of this model in various sociocultural contexts and assess its long-term impact on improving children's nutritional status.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

All authors contributed to this work. RD: conceptualization, investigation, methodology, supervision, writing review, and editing; EN: methodology, formal analysis, writing original draft; AC: formal analysis and resources.

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