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Participatory health innovation for stunting prevention: A multi-strategy community engagement model in rural Indonesia

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Abstract

Stunting is a significant public health challenge in Indonesia, particularly in rural areas. Conventional top-down nutritional interventions often overlook community engagement and cultural integration aspects. This study explored participatory health innovation using multiple community-based strategies for stunting prevention. To examine how participatory activities involving local women, youth, and health cadres can foster innovative and sustainable practices for nutrition and health education related to stunting prevention. This qualitative participatory action research was conducted in a rural village in East Java, Indonesia. Three key activities were implemented: (1) a TOGA (Tanaman Obat Keluarga)-based (Family Herbal Gardens) healthy food innovation competition involving six community groups; (2) a gamification-based stunting education activity using a life-sized board game with mother–child pairs; and (3) an anemia awareness session targeting adolescent girls. Data were collected through observations, photo documentation, reflective notes, and product evaluation rubrics. The TOGA competition produced 12 creative food innovations using moringa, katuk, and spinach, demonstrating high community engagement and localized application of nutrition knowledge. The gamified learning activity successfully promoted intergenerational health communication and behavioral awareness through play. Anemia education stimulated critical inquiry among adolescent girls, indicating increased health consciousness. Across all activities, the participants demonstrated ownership, creativity, and active engagement. Participatory health innovation rooted in local culture and knowledge can foster empowerment and sustainable engagement for stunting prevention. This model offers a replicable framework for community-based public health interventions that are aligned with national strategies and SDG 2.2.

Keywords: Stunting Prevention; Participatory Health; Community Empowerment; TOGA; Gamification; Indonesia

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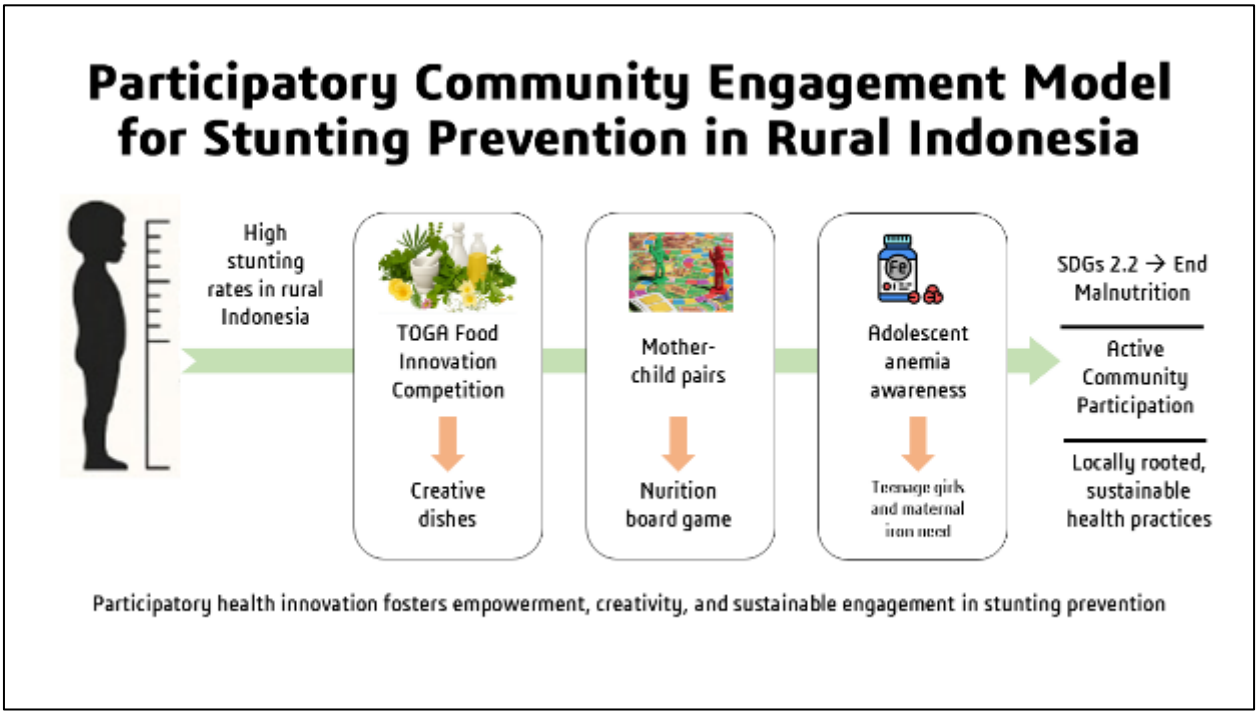
Graphical Abstract



1. Introduction

Stunting, as defined by the World Health Organization (WHO), is impaired growth and development in children due to chronic malnutrition, often occurring within the first 1,000 days of life [1]. Globally, approximately 149.2 million children under five years of age were stunted in 2020, with the highest burden found in low- and middle-income countries [2]. In Southeast Asia, including Indonesia, this condition remains a significant public health challenge. Sustainable Development Goal (SDG) 2.2 aims to end all forms of malnutrition by 2030, emphasizing the urgency of targeted stunting reduction strategies [3].

Indonesia ranks among the top five countries globally with the highest number of stunted children [2]. Although the national prevalence of stunting has declined from 30.8% in 2018 to 21.6% in 2022, rural areas, particularly in provinces such as East Java, still face alarmingly high rates [4]. The Lamongan District consistently recorded rates above the national average. Various national strategies, such as the 1000 Hari Pertama Kehidupan (HPK) movement and Pemberdayaan Keluarga programs, have been implemented to address this issue [3,5].

Despite these interventions, stunting persists due to limited community involvement. Many top-down programs fail to promote long-term local ownership, often overlooking the cultural, environmental, and social determinants of malnutrition [6,7]. This gap underscores the need for community-driven strategies that empower local actors and build participatory models [8].

Participatory health innovation refers to health initiatives co-created with community stakeholders, shifting the paradigm from passive recipients to active agents of change [9]. Unlike traditional health education, this model values local knowledge, collective action, and sustainable behavioral changes [10]. It also improves accountability and ensures culturally appropriate solutions [11].

Taman Obat Keluarga (TOGA), or Family Herbal Gardens, are culturally embedded in Indonesian households. Historically used in traditional medicine, TOGA has evolved as a potential platform for low-cost, nutrition-sensitive stunting prevention by promoting herbal-based complementary feeding [6,12]. Beyond health, TOGA reinforces environmental awareness, women's empowerment and food security [12].

Despite the growing interest in participatory models, few studies have documented community-based innovations involving multiple strategies specifically for stunting prevention [7,12]. There is a clear gap in the analysis of participatory dynamics, quality of engagement, and grassroots outcomes in such health innovations.

This study presents a grassroots participatory health initiative that engages local women, youth, and traditional health groups through three complementary activities: TOGA-based food innovation, gamified health education, and adolescent anemia awareness. Rather than evaluating individual knowledge change, this study explores the patterns, intensity, and quality of community participation across groups such as PKK (women's family welfare organizations), Posyandu (community health posts), TOGA caretakers, and Karang Taruna (village youth groups). It also highlights innovation outcomes, including the development of TOGA-based nutritious food products as culturally rooted solutions.

2. Methods

2.1. Study Design and Setting

This study applied a qualitative participatory action research (PAR) approach, carried out in Desa Kebalanpelang, Kecamatan Babat, Kabupaten Lamongan, East Java, Indonesia. The setting was selected because of its high stunting vulnerability and the presence of active local community organizations. This study aimed to explore participatory health innovations as culturally embedded strategies to enhance community engagement in stunting prevention through a series of collaborative and interactive activities.

2.2. Participants and Recruitment

Participants were purposively selected from key community groups actively involved in local health and social programs in the area. These included PKK members, Posyandu cadres, Asman TOGA (family herbal garden caretakers), and youth from the Karang Taruna. Approximately 100 individuals participated in all activities. Recruitment was facilitated through existing community structures, with village leaders and health cadres announcing the activities during regular community meetings. Participation was voluntary, and all participants provided informed consent. The cooking competition involved six teams: one team from Karang Taruna, one team from PKK, and four mixed teams (Kelompok Arimbi, Kelompok Anjani, Kelompok Sinta, and Kelompok Srikandi) comprising members from Posyandu cadres and Asman TOGA. The stunting gamification session engaged six mother–child pairs, recruited through Posyandu. The anemia education activity targeted adolescent girls from the Karang Taruna. All activities emphasized inclusivity and community participation.

2.3. Participatory Activities

Three participatory activities were developed to foster grassroots innovation and reflection on nutrition-related issues. Each activity was designed to activate local knowledge, encourage collaboration across generations, and promote health behavior change through engaging activities.

2.3.1. TOGA Healthy Food Innovation Competition

This activity involved six teams from the community: Karang Taruna (youth group), Kelompok PKK (women's family welfare group), and four mixed teams named Kelompok Arimbi, Kelompok Anjani, Kelompok Sinta, and Kelompok Srikandi (comprising Posyandu cadres and Asman TOGA members). Each team was asked to create two nutritious dishes using TOGA ingredients such as moringa leaves, katuk (*Sauropus androgynus*), spinach, and other local herbs. The aim was to produce affordable and culturally appropriate food innovations targeted at children and pregnant women to prevent stunting. The groups were given a two-week advance notice to prepare, allowing time for recipe development and ingredient sourcing.

The products were judged by a panel composed of two health professionals from Puskesmas Babat and two facilitators from Universitas Airlangga using a structured rubric. The rubric assessed five criteria: composition of TOGA ingredients in the product, taste and palatability, visual presentation, suitability for the intended consumer (children/pregnant women), and potential marketability of the product. Each criterion was scored on a scale of 1-5. This activity provided a space for participants to collaboratively apply their knowledge of traditional nutrition and experiment with creative solutions.

2.3.2. Gamification-Based Stunting Education

The second activity was an educational game session using a life-sized adaptation of Ular Tangga (Snakes and Ladders), locally branded as "Ular Tangga Anak Bisa," which aimed to communicate stunting-related messages in an interactive format. Six mother–child pairs participated in the study. In the game, the mother acted as the player and rolled a large die, while the child served as a game token and physically moved across the board.

Each numbered square featured a question or behavioral scenario related to nutrition or early childhood care, with ladders representing positive actions (e.g., exclusive breastfeeding and regular growth monitoring) and snakes symbolizing harmful behaviors (e.g., giving sugary drinks and skipping immunization). The facilitators recorded the engagement levels, observed mother-child interactions, and noted how the participants responded to the prompts. The game was designed to promote bonding, experiential learning, and playful health communication among the participants. A small prize (nutritious snack package) was awarded to the winning pair to reinforce positive participation in the game.

2.3.3. Anemia Awareness Education for Adolescents

The third activity was an anemia awareness session for teenage girls from Karang Taruna. A health educator from the Faculty of Nursing, Universitas Airlangga delivered a presentation covering topics such as the symptoms and causes of anemia, the importance of iron intake, menstrual health, and the relationship between adolescent nutrition and future maternal health.

Although the session began with speaker-led material using presentation slides, it gradually transitioned into an interactive dialogue as the participants asked questions and shared personal insights. The facilitators documented the frequency and quality of inquiries as indicators of cognitive engagement. The session aimed to increase awareness, encourage critical thinking, and foster self-reflection among teenage participants regarding their health and daily habits.

2.4. Data Collection and Analysis

Data collection included structured facilitator observation sheets, photographs, participatory artifacts (food products, game boards, presentation materials), scoring rubrics, and informal verbal reflections recorded during and after the sessions. All activities were documented in real-time by two trained research assistants. Thematic analysis was used to identify patterns of participation, collaboration, and engagement. As this study focused on participation quality and community engagement rather than measuring individual knowledge change, no pre- or post-intervention assessments were conducted.

3. Results and Discussion

3.1. TOGA Healthy Food Innovation Competition

The cooking competition involved six teams: Karang Taruna, PKK, Arimbi, Anjani, Sinta, and Srikandi, each challenged to create two food products using TOGA plants such as moringa, katuk leaves, and spinach. The resulting 12 innovations were displayed in a community forum (Figure 1A) and judged based on TOGA content, taste, presentation, target audience suitability, and market potential. Each team introduced their product to a panel of judges (Figure 1B), with some presenting not only the nutritional function but also packaging ideas for local marketing purposes.

Figure 1 Community TOGA Food Innovation Competition

(A) Creative herbal-based food products presented by six community groups. Each team produced two menu items. (B) Interaction between participants and judges during the evaluation, focusing on product taste, TOGA composition, packaging, and commercialization potential.

Participants creatively adapted local herbs into puddings, drinks, and child-friendly dishes. For instance, the Karang Taruna team created spinach chicken noodles with boba and a refreshing drink using ginger and butterfly pea flower. The PKK team prepared corn-moringa nuggets and moringa botok (a traditional steamed dish). The Arimbi team developed arrowroot pudding and katuk cendol. The Anjani team prepared spinach dim sum and katuk soya milk. The Sinta team created moringa takoyaki and moringa okonomiyaki. The Srikandi team produced spinach crackers and moringa crepes. Teams explained their rationale during presentations; for example, the takoyaki and okonomiyaki adaptations demonstrated how familiar Japanese-inspired street foods could be enriched with local nutritious herbs to appeal to children and teenagers.

During the judging process, one judge noted: "These products show that communities understand their target audience well. The spinach chicken noodle with boba appeals to children with its fun presentation, the spinach crackers can be a healthy snack alternative, and products like arrowroot pudding and moringa takoyaki show creative fusion of traditional and modern foods." The products received total scores ranging from 52 to 78 points based on five evaluation criteria: TOGA composition, taste, presentation, target consumer suitability, and marketability. The Arimbi team's arrowroot pudding achieved the highest score (78 points) and won first place, while the Sinta team's moringa takoyaki (71 points) secured second place. Both winning products demonstrated excellent integration of TOGA ingredients with innovative and youth-friendly food concepts.

The observations revealed strong collaboration within the teams. The groups divided the tasks; some focused on cooking, while others focused on presentation and packaging design. Several teams brought handmade labels and even discussed pricing strategies for potential sales at Posyandu or local markets. One Karang Taruna member stated during the presentation, "We want to show that healthy food for children does not have to be expensive or complicated. Everything can come from our gardens."

These results illustrate more than culinary success; they reflect an emergent transformation in community engagement around nutrition. According to national policy, food-based approaches during the 1000 HPK are essential for reducing chronic undernutrition (Kementerian Kesehatan, 2022) [3]. The activity positioned community members not as passive recipients of information but as active designers of locally appropriate solutions. By integrating TOGA into family friendly foods, the participants translated traditional knowledge into practical stunting prevention efforts.

Moreover, the activity fostered ownership and potential sustainability of the program. Several participants expressed interest in continuing to develop their recipes for use in Posyandu kitchens and community events. Two teams inquired about food safety certifications for small-scale commercialization. This aligns with the findings in the community health literature that grassroots participation fosters innovation that is culturally embedded and potentially scalable [12]. It also highlights the potential of these products to support microentrepreneurship in nutrition-sensitive businesses, which can enhance household economic resilience, another protective factor for stunting [5].

One limitation was uneven participation in some teams. In mixed-age groups, older women tended to dominate cooking decisions, while younger members focused more on presentation. This suggests that future activities might benefit from a more structured role distribution to ensure that all voices contribute to the innovation process.

3.2. Gamification-Based Stunting Education

In the second activity, six mother–child pairs participated in a giant Ular Tangga Anak Bisa game—a snakes-and-ladders adaptation in which the child acted as the token and the mother answered health questions to guide movement (Figure 2A). The game board featured messages promoting good practices (e.g., exclusive breastfeeding for six months, regular weighing at Posyandu, and consuming vegetables daily) and warnings against harmful behaviors (e.g., giving formula without medical indication, lack of handwashing, and infrequent deworming). Winners were rewarded with small nutritious snack packages (Figure 2B).

Figure 2 Gamified Health Education on Stunting Prevention

(A) The "Ular Tangga Anak Bisa" game engaged six mother–child pairs in an embodied educational activity. The child became the moving piece, while the mothers guided decision-making based on nutrition-themed tiles. (B) Awarding prizes to winners, reinforcing positive behavior change, and active learning around stunting prevention.

During the activity, the observers noted the children's lively engagement and emotional responses. Mothers debated correct answers among themselves before responding, children visibly celebrated when climbing "ladders," and both mothers and children showed disappointment (followed by laughter) when a wrong answer resulted in sliding down a snake. Facilitators observed mothers spontaneously explaining health messages aloud to their children during play, effectively transforming the game into a verbal health lesson.

One particularly illustrative moment occurred when a mother landed on a square asking: "What should a 6-month-old baby eat besides breast milk?" She answered incorrectly (saying "rice porridge only"), resulting in her child sliding down the snake. The child protested: "But Ibu, the Posyandu lady said we need vegetables too!" This prompted discussions among all participating mothers about appropriate complementary feeding, demonstrating peer-to-peer learning during play.

Children actively engaged with the game mechanics, with some younger participants (ages 3-5) requiring parental guidance to move to the correct squares, while older children (ages 6-8) moved independently and even corrected their mothers' answers. This intergenerational dynamic created powerful moments of role reversal, in which children became educators and mothers became learners.

The success of this activity lies in its integration of education, emotion, and interaction. Games that embed health messages in fun and collaborative experiences are more likely to be retained and modeled in daily life, particularly in low-literacy settings, where abstract messages often fail to translate into practice [13,14]. The visual and movement-based format allowed children to connect behaviors with consequences in a concrete and memorable way.

From a stunting prevention standpoint, this intervention contributes directly to behavior change communication (BCC) within families, a critical element of the 1000 HPK strategy [3]. The use of gamification fosters communication between mothers and children, reinforcing health literacy and empowering mothers to become proactive health educators within their households [2]. Research shows that playful learning methods strengthen household decision-making about food, hygiene, and care practices—all key determinants of stunting risk [14].

However, it should be noted that this was a single session activity. Although engagement was high and participants reported enjoying the experience, actual behavior change could not be assessed without longitudinal follow-up. One mother suggested at the end: "We should have this game at every Posyandu meeting so all mothers can learn." This indicates the perceived value and potential for integration into existing health infrastructure.

3.3. Anemia Awareness Education for Adolescents

The final activity focused on teenage girls, engaging them in an anemia awareness session that included a presentation and an interactive discussion (Figure 3A). The speaker explained iron deficiency symptoms (fatigue, dizziness, pale skin), causes (inadequate dietary iron, heavy menstrual bleeding), and the connection between adolescent anemia and future pregnancy outcomes, specifically the increased risk of low birth weight and maternal complications.

Figure 3 Adolescent Anemia Awareness Session

(A) Teenage girls from Karang Taruna participated in an interactive session on anemia education, where speakers addressed the symptoms, prevention, and long-term impacts of adolescent anemia. (B) Open discussion and question sessions reflected high enthusiasm and cognitive engagement, evident through personal inquiries into menstrual health and nutrition.

During the initial presentation phase, the participants sat quietly and listened. However, when the Q&A session opened, engagement increased markedly (Figure 3B). Teenage participants asked reflective and specific questions, demonstrating personal concern and critical thinking:

- "If I often feel dizzy during menstruation, does that mean I have anemia?"
- "Besides liver, what other foods contain iron? I don't like liver."
- "Can anemia make it harder to concentrate in school?"
- "My friend takes iron tablets but says they make her nauseous. Is that normal?"
- "If I have anemia now, will my baby definitely be stunted later?"

Observers reported active note-taking throughout the session, with several girls photographing the presentation slides with their phones. Follow-up discussions continued informally after the formal session ended, with clusters of participants asking the facilitator additional questions about menstrual health, dietary sources of iron beyond meat (such as dark leafy vegetables, beans, and fortified foods), and how to recognize symptoms in themselves and their friends.

One participant remarked, "I never knew that what I eat now could affect my future children. We always think about pregnancy health, but not before that." Another stated, "I often skip breakfast because I wake up late for school. Now I understand why I feel weak during class." These reflections demonstrate not only information absorption but also personal application, which are indicators of internalized learning.

When adolescents are given the opportunity to participate in health conversations rather than passively receive lectures, they develop self-efficacy and a stronger sense of body awareness [15]. The girls also expressed appreciation for being included in a topic typically reserved for maternal settings, suggesting an unmet need for early intervention in adolescent health education.

The educational value of this session is directly linked to the prevention of upstream stunting. Many cases of child stunting begin with maternal malnutrition during adolescence [8,16]. By raising awareness and building early health agencies, this activity addresses the issue before pregnancy begins. This aligns with national priorities on adolescent nutrition and supports the SDG goal to eliminate malnutrition in all forms by 2030 [3].

Additionally, this activity built trust between health facilitators and youth, potentially opening future channels for peer education and anemia screening in rural communities [11,15]. Several participants asked whether similar sessions could be held regularly, and some volunteered to help organize future health activities for their peers. This indicates the potential for youth-led health promotion, which research suggests is essential for sustainable stunting prevention, requiring not only medical interventions but also social infrastructure and youth empowerment [6].

One limitation of this study was its single-session format. While the session successfully raised awareness and stimulated inquiry, actual dietary changes or health-seeking behaviors (such as anemia screening) could not be assessed in this study. Future programs should include follow-up sessions and potentially link adolescent participants directly to health services for Hb testing.

3.4. Cross-Cutting Observations and Integration

Several common themes emerged regarding the quality and nature of participation across all three activities. Participants demonstrated active ownership by taking the initiative beyond what was explicitly requested. Cooking teams developed packaging designs unprompted, game participants spontaneously facilitated peer learning, and adolescents requested additional resources and future sessions. These activities successfully bridged age groups through intergenerational engagement. Older Posyandu cadres collaborated with young Karang Taruna members, mothers learned from children during gameplay, and adolescent education laid the groundwork for future maternal health. Using TOGA as a culturally familiar concept, traditional games like Ular Tangga, and addressing locally relevant concerns such as anemia and child feeding created immediate cultural resonance and lowered the barriers to participation. Participants did not merely receive information; they actively applied it through cooking, game strategy, and reflective questioning, demonstrating deeper cognitive engagement and knowledge-to-practice translation. These observations suggest that participatory approaches, when culturally grounded and activity based, can achieve meaningful community engagement, even within short-term interventions.

3.5. Recommendations for Future Implementation

The participatory activities implemented in this initiative offer several important insights into the future development of community-based stunting prevention programs. First, integrating TOGA innovation into health and nutrition strategies opens a low-cost, culturally rooted channel for dietary diversification, especially during the 1000 HPK period [12]. This model should be scaled up through structured competitions at the district level and embedded within the Posyandu agendas, encouraging routine culinary innovation using local herbal resources. Partnerships with local agricultural extension services could provide technical support for TOGA cultivation and food safety certification for commercialization.

Second, gamification should be further developed as a core educational strategy for family health promotion [13,14]. Its success in triggering emotional engagement and intergenerational dialogue suggests that it can be a replicable tool for community health workers and educators [7]. Standardized game templates, health message tiles in the local language, and facilitation guides could support local governments in adopting the model widely. The game can be adapted for different health topics (hygiene, immunization, maternal care) and scaled to regional health programs.

Third, adolescent-focused education must begin before marriage or pregnancy [8,16]. The anemia awareness session showed that youth are not only interested in reproductive health but are eager to engage when the environment supports their curiosity [15]. Future directions should include peer-led health ambassador programs within Karang Taruna and school-based health units to ensure early investment in health literacy. Linking education directly to services, such as free hemoglobin testing or iron supplementation programs, would strengthen the intervention pathway.

Fourth, sustainability mechanisms require deliberate planning [9]. While these activities generate enthusiasm, sustaining engagement requires institutional integration. Recommendations include incorporating TOGA cooking demonstrations into monthly Posyandu schedules, training cadres to facilitate gamification activities independently, establishing adolescent health clubs with regular programming, and creating monitoring systems to track participation and innovation outcomes over time.

Finally, local governments and academic partners should collaborate to evaluate the long-term outcomes of participatory models [10,11]. This includes follow-up studies on changes in dietary patterns, anemia incidence, and stunting rates in the intervention areas. Monitoring tools tailored to qualitative participatory outcomes, such as innovation tracking, participant reflection journals, and community satisfaction surveys, should complement traditional quantitative indicators.

These directions align with the integrated strategy of SDG 2.2 and the National Strategy to Accelerate Stunting Prevention [3,4], supporting Indonesia's vision of community-led sustainable health improvement.

4. Conclusion

This study demonstrates the potential of participatory health innovation as a practical strategy for engaging rural communities in the prevention of stunting. By involving diverse community groups—mothers, youth, and health cadres—in co-creating TOGA-based food innovations, interactive education, and adolescent health awareness, the program moved beyond passive information delivery to cultivate active participation, creativity, and local ownership of the program. The integration of traditional herbal knowledge with modern nutritional goals has created culturally resonant solutions that community members find meaningful and applicable. These activities successfully sparked emotional engagement, critical thinking, and intergenerational learning—three elements essential for effective health promotion. The participants demonstrated enthusiasm, collaborative problem-solving, and expressed interest in continuing these activities beyond the research period. Although this study did not measure long-term behavior changes or health outcomes, it provides preliminary evidence that participatory, culturally grounded approaches can achieve high levels of community engagement in rural settings. The model offers a replicable framework for community-based public health interventions aligned with national stunting reduction goals and SDG 2.2. Future research should include longitudinal follow-ups to assess sustained participation, actual dietary and health behavior changes, and eventual impacts on stunting prevalence. Ultimately, when communities actively participate rather than passively receive, they create health innovations that are locally meaningful and programmatically viable for broader implementation.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflicts of interest related to this study's findings

Statement of ethical approval

This study was approved by the Research Ethics Commission of the Faculty of Pharmacy, Universitas Airlangga (approval no. 37/LE/2024). The study was conducted in collaboration with local village authorities of Desa Kebalanpelang and Dinas Kesehatan Kabupaten Lamongan.

Statement of informed consent

Written informed consent was obtained from all participants, including co-signed parental consent for adolescent participants aged < 18 years. All identities were anonymized in the documentation and reporting. Photographs were used with explicit permission for research and publication.

References

[1] UNICEF / WHO / World Bank Group. Levels and Trends in Child Malnutrition.; 2021.

[2] Valeriani D, Prihardini Wibawa D, Safitri R, Apriyadi R. Menuju Zero Stunting Tahun 2023 Gerakan Pencegahan Dini Stunting Melalui Edukasi pada Remaja di Kabupaten Bangka. *J. Pustaka Mitra (Pusat Akses Kaji. Mengabdi Terhadap Masyarakat)*. 2022;2(2):84-88.

[3] Badan Kebijakan Pembangunan Kesehatan Kementerian Kesehatan RI. Hasil Survei Status Gizi Indonesia (SSGI) 2022. *Kemenkes*. Published online 2022:1-150.

[4] Kementerian PPN/Bappenas. Final Report Formative Evaluation of the National Strategy To Accelerate Stunting Prevention. UNICEF; 2023.

[5] Achmad Nur Sutikno. Bonus Demografi Di Indonesia. *VISIONER J. Pemerintah. Drh. di Indones.* 2020;12(2):421-439.

[6] Nurdiansah F, Pardede SA, Munir D, et al. Laporan Penelitian Korelasi ekspresi Cyclooxygenase-2 (COX-2) dan

TNF- $α$ sebagai mediator cancer-related inflammation pada karsinoma nasofaring Medan Epstein barr virus (EBV) dan akhir-akhir ini Sitokin merupakan suatu molekul mediator untuk respon . 2013;43(2):91-100.

[7] Wahyudianto (Heri, Prasetyo A, Fuada N, et al. Synergies to Address for Stunting 14 Des 2023. 2023;(December).

[8] Setiyawati ME, Ardhiyanti LP, Hamid EN, Muliarta NAT, Raihanah YJ. Studi Literatur: Keadaan Dan Penanganan Stunting Di Indonesia. *IKRA-ITH Hum. J. Sos. dan Hum.* 2024;8(2):179-186.

[9] Brekke HK, Ludvigsson JF, van Odijk J, Ludvigsson J. Breastfeeding and introduction of solid foods in Swedish infants: the All Babies in Southeast Sweden study. *Br. J. Nutr.* 2005;94(3):377-382.

[10] Alyami HS, Orabi MAA, Aldhabbah FM, et al. Knowledge about COVID-19 and beliefs about and use of herbal products during the COVID-19 pandemic: A cross-sectional study in Saudi Arabia. *Saudi Pharm. J.* 2020;28(11):1326-1332.

[11] Sa`diyah H, Syarafina AL, Firdaus DA, Murti MD. Stunting prevention: balanced nutrition education, fill my plate, and complementary food variations for breast milk. *Abdimas J. Pengabdi. Masy. Univ. Merdeka Malang*. 2024;9(2):271-282.

[12] Listiani EI, Patriani I, Tanjungpura U, Author C. Stunting Melalui Kegiatan Gizi Puskesmas Kebong. :1-15.

[13] Asmawati, Nur Elly, Annuril KF, Ratnadhiani A, Efendi P, Yosephine B. Optimalisasi Peran Kader dalam Pencegahan Stunting melalui Peningkatan Nutrisi Baduta dan Ibu Menyusui. *Din. J. Pengabdi. Kpd. Masy.* 2023;7(3):852-863.

[14] Romadona MR, Febrianda R, Dinaseviani A, Budiansyah A. Management of innovation in functional food products for stunting prevention as a research dissemination in Institution X. *Proc. First Aust. Int. Conf. Ind. Eng. Oper. Manag.* Published online 2022:20-21.

[15] Fristiwi P, Nugraheni SA, Kartini A. Effectiveness of Stunting Prevention Programs in Indonesia : A Systematic Review. *J. Penelit. Pendidik. IPA*. 2023;9(12):1262-1273.

[16] Natasya D, Tunggeng MGR, Annisa PR, et al. Socialization, cultivation, and utilization of empty land for family medicinal plants. *Abdimas J. Pengabdi. Masy. Univ. Merdeka Malang*. 2024;9(3):555-563.