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Empowering Adolescents: Nutrition Awareness Groups as a Stunting Prevention Strategy

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ABSTRACT Stunting remains a major public health issue that negatively impacts physical growth, cognitive development, and long-term productivity. Preventive measures are more effective and sustainable than curative efforts, particularly when initiated during adolescence a critical period for nutritional and reproductive preparation before conception. This community empowerment program aimed to enhance adolescents' knowledge and awareness of nutrition and reproductive health through the formation of Nutrition Awareness Groups as a stunting prevention strategy. The activity was conducted at SMPN 1 Wonoayu, Sidoarjo Regency, involving 37 female students participating in a structured training, mentoring, and evaluation process. Training sessions included lectures, discussions, demonstrations, and simulations covering topics on reproductive health, stunting, and adolescent nutrition. Knowledge assessments were administered before and after the intervention using pretest–posttest questionnaires. The findings showed a significant increase in participants' knowledge: reproductive health knowledge improved from 40.54% (sufficient) to 67.56% (good), knowledge of stunting prevention increased from 51.35% (poor) to 62.16% (good), and understanding of adolescent nutrition as a preventive factor rose from 54.05% (poor) to 72.22% (good). The establishment of Nutrition Awareness Groups also enabled peer-led learning and strengthened community participation in health promotion. These outcomes demonstrate that empowering adolescents through participatory education effectively enhances nutritional literacy and preventive behavior against stunting. Sustained collaboration among schools, health centers, and policymakers is essential to ensure long-term program continuity and broader implementation across communities.

INDEX TERMS Adolescents, Nutrition awareness, Community empowerment, Reproductive health, Stunting prevention

I. INTRODUCTION

Stunting remains a critical public health challenge that continues to threaten child growth and national development in low- and middle-income countries, including Indonesia. Stunting reflects chronic malnutrition that occurs primarily during the first 1,000 days of life, leading to impaired physical growth, cognitive delay, and reduced productivity in adulthood [1], [2]. Globally, the World Health Organization (WHO) estimates that around 22% of children under five experience stunting, with Southeast Asia being one of the most affected regions [3], [4]. In Indonesia, the prevalence of stunting among children under five remains at 21.5% in 2023, despite various governmental interventions [5], [6]. The persistence of this condition indicates that curative and rehabilitative efforts are not sufficient; therefore, preventive approaches need to be strengthened, particularly through early education and adolescent empowerment.

Adolescence is a pivotal period for growth and nutritional preparation before pregnancy. Nutritional deficiencies during this phase can significantly affect future maternal health and fetal development [7], [8]. Evidence suggests that adolescent girls with anemia or malnutrition are more likely to give birth to low-birth-weight or stunted infants [9], [10]. Therefore, interventions that promote nutrition literacy and healthy reproductive behaviors among adolescents are key strategies to prevent intergenerational cycles of stunting [11]. Several state-of-the-art methods have been developed to address adolescent nutrition and stunting prevention, such as school-based nutrition education [12], digital health applications [13], peer-group learning models [14], and community-based empowerment programs [15]. These approaches emphasize participatory and behavior-change techniques to improve nutritional knowledge and practice.

However, despite these advances, many programs still face limitations. Most interventions remain fragmented, focusing solely on knowledge transfer without establishing sustainable peer-support systems [16]. Moreover, few initiatives integrate adolescent empowerment with measurable outcomes related to nutrition and reproductive health literacy [17]. The absence of consistent collaboration between schools, health facilities, and local government agencies further limits the long-term impact of such interventions [18], [19]. Consequently, there is a need for an integrated, community-driven approach that empowers adolescents to act as change agents in promoting nutritional awareness and healthy lifestyles among their peers.

To address this gap, this study aims to empower adolescents through the establishment of *Nutrition*

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Awareness Groups as a community-based stunting prevention strategy. The program emphasizes participatory learning, mentoring, and evaluation activities that focus on reproductive health, adolescent nutrition, and the importance of stunting prevention. This initiative was implemented at SMPN 1 Wonoayu, Sidoarjo Regency, Indonesia, targeting adolescent girls as future mothers and community role models.

The contributions of this study are threefold. First, it introduces a sustainable model of community empowerment that enhances adolescents' capacity to promote nutritional health and prevent stunting. Second, it integrates a peer-learning framework into stunting prevention, fostering collective responsibility and behavioral change among students. Third, it provides empirical evidence of how participatory education can effectively improve knowledge and awareness regarding nutrition, reproductive health, and stunting prevention at the community level.

II. METHODS

A. STUDY DESIGN

This study employed a community-based participatory approach with a pretest–posttest quasi-experimental design to evaluate the effectiveness of adolescent empowerment through the formation of *Nutrition Awareness Groups* as a stunting prevention strategy. The intervention was conducted from March to May 2024 at SMPN 1 Wonoayu, located in Semambung Village, Wonoayu District, Sidoarjo Regency, East Java, Indonesia. The program emphasized preventive and promotive efforts by involving adolescents in structured educational and mentoring activities related to nutrition, reproductive health, and stunting prevention.

B. STUDY POPULATION AND SAMPLING

The target population consisted of female students aged 13–15 years enrolled in grades X and XI at SMPN 1 Wonoayu. Inclusion criteria included female students who were members of the Youth Red Cross (Palang Merah Remaja, PMR) extracurricular program, actively participating in school activities, and willing to complete all stages of the intervention. Exclusion criteria included students with chronic illness or those absent during either the pretest or posttest phase.A total of 37 participants were selected using a purposive sampling technique, based on their involvement in PMR activities and their availability for continuous participation. All participants and school authorities provided informed consent before data collection.

C. MATERIALS AND EQUIPMENT

The materials used in this program included audiovisual aids such as LCD projectors, laptops, and educational modules designed by the research team to facilitate participatory learning. Health examination tools consisted of hemoglobin (Hb) testing kits, digital weight scales, height meters, LILA (mid-upper arm circumference) measuring tapes, and body mass index (BMI) calculators. Additional materials included PSC (Pediatric Symptom Checklist) forms for psychological assessment and anthropometric measurement instruments for nutritional evaluation. The educational modules contained concise, illustrated content on reproductive health, adolescent nutrition, and stunting prevention.

D. RESEARCH PROCEDURES

The community service intervention was implemented in three stages: preparation, implementation, and evaluation.

1. Preparation Stage:

During this phase, coordination meetings were conducted with the Wonoayu Health Center and SMPN 1 Wonoayu management. The research team reviewed adolescent health data from local health reports and designed a participatory education model involving interactive lectures, simulations, and peer learning. Educational materials were validated by public health and midwifery experts before being distributed to participants.

2. Implementation Stage:

The intervention consisted of three main meetings held over four weeks.

a) First Session: Included an opening ceremony, pretest, and introductory sessions on reproductive health and stunting using lectures, Q&A, and brainstorming techniques.
b) Second Session: Focused on practical training on adolescent nutrition, including the importance of micronutrient and macronutrient balance, menstrual health, and nutritional needs during puberty. Demonstrations, role-playing, and peer discussions were applied to reinforce learning.
c) Third Session: Emphasized the formation of Nutrition Awareness Groups (five groups with 5–6 members each), peer mentoring, and posttest evaluation. Each group developed an internal communication channel to sustain peer education activities.

3. Evaluation Stage:

Evaluation was conducted through both process evaluation (monitoring student participation, engagement, and feedback) and outcome evaluation (measuring changes in knowledge using pretest–posttest questionnaires). Process evaluation involved discussions between facilitators and students, while outcome evaluation measured improvements in understanding of reproductive health, stunting prevention, and nutrition awareness.

E. DATA COLLECTION AND ANALYSIS

Data were collected through structured questionnaires administered before and after the intervention. The instruments assessed participants' knowledge of three domains: reproductive health (10 items), stunting and its prevention (10 items), and adolescent nutrition (10 items). Each item was scored on a three-level scale (good, sufficient, poor). Physical health data were collected using standard anthropometric procedures following WHO growth references. Hemoglobin levels were assessed using a portable Hb analyzer, and BMI was calculated as weight (kg)/height (m^2).

Data were processed and analyzed using descriptive statistics to summarize the demographic characteristics and knowledge scores. Comparative analyses between pretest and posttest results were performed using the paired t-test to determine significant changes in participants' knowledge levels before and after the intervention. The confidence level

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was set at 95% ($p < 0.05$). Statistical analyses were conducted using SPSS version 26.0.

F. ETHICAL CONSIDERATIONS, STUDY TYPE, AND REPICABILITY

This community-based intervention complied with ethical principles of the Declaration of Helsinki. Approval for the study was obtained from the Ethics Committee of the Poltekkes Kemenkes Surabaya (approval number: 019/KEPK/III/2024). Participants and their parents provided written informed consent. The confidentiality of participant data was strictly maintained, and participation was voluntary without any financial incentives.

This study was a prospective, quasi-experimental community service project emphasizing empowerment and education as preventive health measures. The intervention model training, mentoring, and evaluation using peer group formation is designed for replication in similar educational settings. Future researchers can adapt this model by maintaining equivalent parameters: (1) adolescents as target participants, (2) three-session intervention design, (3) validated educational modules, and (4) pretest–posttest knowledge evaluation.

III. RESULTS

Figure 1 Hemoglobin Level Examination

Community service activities were conducted at SMPN 1 Wonoayu, Sidoarjo Regency, with a total of 37 female student respondents, with the following characteristic data. In the first stage of this activity, a physical health examination was conducted, including an assessment of reproductive health status, nutrition, and early detection of psychological disorders. The results shown in TABLE 2 indicate that 95% of respondents have experienced menstruation, with 29% having a duration of more than 7 days, 20% having irregular menstrual cycles, 60% experiencing menstrual pain, 92% having leucorrhea, and 9% of them feeling itchy and having an odor. Respondents with severe anemia account for 27% and mild anemia 40%, with only 40% having a normal BMI, 22% testing positive for RLPP, 10% testing positive for PSC, and 57% having a Mid-Upper Arm Circumference (MUAC) of less than 23.5. This data indicates that the respondents' status requires further action to prepare them early for entering the conception period with good quality, so that stunting can be effectively and efficiently prevented. FIGURE 2 shows the laboratory examination activity, namely the hemoglobin (HB) levels in peripheral blood, targeting adolescent girls, conducted as an effort to detect anemia in adolescent girls, Anemia has become one of the parameters for detecting nutritional status in adolescents.

Figure 2 Presentation of training materials related to the importance of nutrition

This method is simple, the results are quick and accurate, and participants can independently perform the measurement themselves. Hb measurement using an Hb stick. FIGURE 1 shows the stages of delivering the training material. The training provided includes 3 topics, namely reproductive nutrition, reproductive health, and stunting prevention in adolescents. This training emphasizes the importance of proper preparation during adolescence, including physical, nutritional, and psychological readiness. FIGURE 3 and FIGURE 4 show documentation of the formation of nutrition awareness groups. The output of this activity resulted in the formation of 5 groups that can serve as ambassadors of the nutrition awareness group within their class or cohort. Each

TABLE 1
The Schedule of Community Service Activities is Listed in the Table Below

Meeting	Material	Method
1	1. Opening 2. Pre-Test 3. Reproductive Health Material 4. Stunting Material	Lecture with Q&A, brainstorming session
2	1. Material on stunting and adolescent nutrition 2. Role-playing	Lecture with Q&A, brainstorming, review, demonstration, simulation
3	1. Formation of groups 2. Peer group 3. Post-test	Review, Demonstration, simulation

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group consists of 5-6 members from different classes. The classes involved are female students from grades X and XI, and it is expected that they will have enough time to share knowledge with their peers.

The activity of training female students to measure anthropometry independently using simple tools. The female students then practice measuring each other within their groups under supervision until they are deemed capable of doing it independently. The measurement of RLPP and LILA is an early detection of nutritional fulfillment disorders and Pre-Menstrual Syndrome. The evaluation stage of the community service activities is based on the pretest scores and posttest achievements after the activities are completed. Here are the evaluation data: This community service activity provided training to a group of teenagers, resulting in changes in knowledge related to reproductive nutrition as follows:manyshows that in the pre-activity phase, the majority of female students had sufficient knowledge about reproductive health, at 40.54%, and post-training, there was an increase to the majority frequency in the good category, at 67.56%. This increase in knowledge related to reproductive health is expected to foster good behavior, so that during adolescence, the status of reproductive health is in an optimal condition.

This activity also provided training related to knowledge about stunting, and there was a change in knowledge pre- and post-activity as shown in the table below. TABLE 3 above shows that in the pre-activity phase, the knowledge of female students about stunting and its prevention was mostly in the poor category, at 51.35%, and post-training, there was an increase to the most frequent category of good at 62.16% can be seen on TABLE 4. This improvement in understanding related to stunting and prevention efforts will be able to shape behaviors that prioritize a healthy lifestyle, thereby minimizing the risk of stunting effectively. In the training related to adolescent nutrition as an effort to prevent stunting, the following changes were observed: The TABLE 5 above shows that in the pre-activity, the knowledge of female students about the role of adolescent nutrition as an effort to prevent stunting was mostly in the insufficient category, at 54.05%, and post-training, there was an increase to the most frequent category of good at 72.22%.

The implementation of the community empowerment program was conducted in three structured sessions, as summarized in TABLE 1. The first session focused on introductory material about reproductive health and stunting, accompanied by a pretest to assess baseline knowledge. The second session emphasized adolescent nutrition through lectures, demonstrations, and simulations to enhance participants' practical understanding. The final session involved the formation of *Nutrition Awareness Groups* and a posttest evaluation to measure knowledge improvement.

Figures 3 Formation of Nutrition Awareness Groups

Figures 4 Anthropometric Measurement Training

Stunting prevention must be carried out early during adolescence. The formation of follicles that are ovulated each month during the menstrual cycle occurs 6 months prior, and these follicles will subsequently be fertilized and develop into a fetus. Preparing during adolescence is the most appropriate time to prevent fetal growth failure, including stunting. The next evaluation achievement stage will be conducted at each adolescent posyandu activity in collaboration with health workers from the Wonoayu Sidoarjo Health Center.

IV. DISCUSSION

A. INTERPRESTATION OF FINDINGS

The results of this community empowerment program indicate that the formation of nutrition awareness groups significantly increased adolescents' knowledge regarding reproductive health, stunting, and the importance of nutrition during adolescence. The pre–post evaluation results showed a substantial rise in knowledge: reproductive health knowledge increased from 40.54% to 67.56%, knowledge of stunting and its prevention rose from 16.22% to 62.16%, and awareness of the role of adolescent nutrition improved from 10.81% to 72.22%. These results demonstrate that peer group-based participatory learning, combined with health education and mentoring, effectively enhances adolescents' cognitive understanding and health literacy.

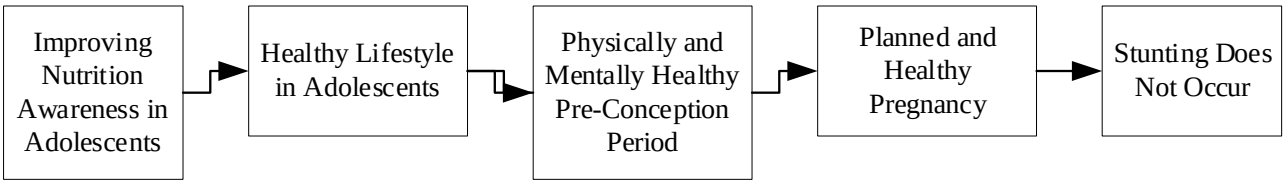

Figure 1 Problem-Solving Solution Diagram [7]

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TABLE 2
Characteristics of Respondents at SMPN 1 Wonoayu, Sidoarjo

Characteristic	n	Frekuensi (%)
Status of Menstruation		
already	35	95
not yet	2	5
Period of Menstruation		
< 7 day	6	17
> 7 day	29	83
Cycle of Menstruation		
Reguler	28	80
Irreguler	7	20
Dismenorrhoe		
Yes	21	60
No	14	40
Fluor Albus		
Yes	34	92
No	3	8
Fluor Albus (itchy)		
Yes	3	9
No	31	91
Fluor Albus (smell)		
Yes	3	9
No	31	91
Hb Check		
Severe Anemia	10	27
Mild Anemia	15	40
Normal	12	33
Body Mass Index		
Skinny Weight	12	32
Light Weight	5	13
Normal	15	40
Light Obes	2	5
Skinny Obes	3	8
RLPP		
Positive	8	22
Negative	29	78
PSC		
Positive	4	10
Negative	33	90
LILA		
< 23,5	21	57
≥ 23,5	16	43

The empowerment model implemented through structured stages training, mentoring, and evaluation proved to be an efficient approach in fostering adolescents' active participation. The inclusion of interactive methods such as simulation, role-playing, and group discussion encouraged participants to internalize health information and apply it within their peer groups. This result aligns with educational theories emphasizing that experiential learning stimulates deeper understanding and behavioral change [36].

The findings also reveal the significance of early intervention in adolescence as a preparatory stage before conception. By strengthening adolescents' nutritional and reproductive knowledge, the program indirectly supports long-term stunting prevention. Adolescence is a critical period when nutritional habits, reproductive maturity, and lifestyle behaviors are formed. Therefore, interventions at this stage have a multiplier effect, influencing future maternal and child health outcomes. Moreover, the data showing 27% of participants with severe anemia, 60% experiencing dysmenorrhea, and 57% with low MUAC values emphasize the need for early preventive measures [37].

The results further illustrate that empowerment through peer-led groups enhances self-efficacy and a sense of responsibility among adolescents. The establishment of five peer nutrition awareness groups facilitated peer-to-peer learning, creating an environment conducive to continuous knowledge transfer. This structure aligns with health promotion principles that prioritize community participation and sustainability. Thus, the intervention not only increased individual knowledge but also fostered collective awareness that can influence the broader school community [38].

B. COMPARISON WITH PREVIOUS STUDIES

The outcomes of this study are consistent with several recent findings on adolescent health promotion and community-based stunting prevention. Similar peer-led education programs have demonstrated significant improvements in adolescent health literacy and preventive behaviors. Alvanita et al. [39] found that peer-teaching programs enhanced communication skills and engagement among young learners, resulting in better retention of educational material. Likewise, Andari and Sulastri [40] demonstrated that peer group education models improved mothers' awareness and practices related to early cancer detection.

In line with the current findings, Nuttall and Mancini [41] reported that multidisciplinary, peer-led reproductive health education in France improved both knowledge and attitudes toward sexual and reproductive health among adolescents. Similarly, Parida et al. [42] revealed that school-based reproductive health programs significantly increased adolescent girls' understanding of reproductive health and encouraged healthier practices. These studies confirm that the peer-based approach is highly effective in adolescent

TABLE 3
Respondents' Knowledge Pre and Post Training on Reproductive Health

Knowledge	Pre		Post	
	n	%	n	%
Good	9	24.32	25	67.56
Enough	15	40.54	10	27.02
Lack	13	35.14	2	5.42
Total	37	100	37	100

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education, as it leverages shared social identity and mutual trust among peers.

Furthermore, the results align with Thurstans et al. [43], who emphasized the interconnection between wasting, stunting, and nutritional status, underscoring the importance of preventive strategies targeting adolescents. In the same vein, Hetherington and McNally [44] highlighted that early nutrition education plays a pivotal role in forming healthy habits that influence future reproductive outcomes. The present findings also echo the argument by Xiong et al. [45], who warned that both nutritional deficiencies and excessive intake during adolescence could adversely affect growth and long-term health. Thus, interventions must be balanced, emphasizing adequate and diverse nutrition rather than over-supplementation.

On a policy level, these findings resonate with the recommendations of Roediger et al. [46], who advocated for integrative, multisectoral approaches to reduce stunting through a combination of education, policy reform, and health services. The inclusion of schools as a platform for community-based health education as implemented in this program represents a cost-effective and sustainable model for stunting prevention. In Indonesia, where adolescent health literacy remains a challenge, such empowerment-based strategies fill an essential gap by integrating education, health, and social support within one framework.

However, compared to large-scale national programs, this intervention remains limited in scope and duration. While similar studies have shown sustained improvements after six months or more of continuous education [47], the current program was conducted in a relatively short timeframe. Therefore, long-term implementation and continuous mentoring are necessary to maintain the observed improvements in knowledge and translate them into sustainable behavioral change.

C. LIMITATIONS AND IMPLICATIONS

Several limitations should be noted in interpreting the findings of this study. First, the sample size was relatively small, comprising only 37 adolescent female students from one junior high school in Sidoarjo. This limited scope reduces the generalizability of the results to other populations or regions with different socioeconomic or cultural characteristics. Second, the intervention was conducted over a short period, which constrained the ability to measure long-term behavioral outcomes or the sustainability of the knowledge gained. Third, the evaluation relied primarily on self-reported questionnaires, which may introduce bias in measuring actual understanding and behavioral change. Future studies should incorporate mixed-method approaches, including qualitative observations, interviews, and longitudinal tracking to assess long-term impact.

Despite these limitations, the implications of this study are significant for both policy and practice. The positive outcomes of this intervention reinforce the importance of incorporating community-based empowerment strategies into adolescent health education. The establishment of peer-led nutrition awareness groups within schools offers a sustainable and scalable model for promoting stunting prevention. Health educators, teachers, and local health authorities can adopt similar frameworks to foster early health awareness, particularly among vulnerable adolescent populations.

Furthermore, this study highlights the critical role of cross-sector collaboration in tackling stunting. The education and health sectors must work synergistically to integrate health literacy into school curricula. Policymakers should provide structural support through training materials, monitoring systems, and resource allocation particularly for nutritional supplementation such as iron and folate to ensure adolescents are well-prepared before entering reproductive age [48].

The success of this community empowerment approach also suggests the potential to extend the model to other health promotion domains, such as anemia prevention, menstrual health management, and mental well-being. By empowering adolescents as active participants rather than passive recipients, this approach can foster lifelong healthy behaviors that ultimately contribute to breaking the intergenerational cycle of malnutrition and stunting.

TABLE 4

Respondents' Pre and Post Knowledge about Stunting and Its Prevention

Knowledge	Pre		Post	
	n	%	n	%
Good	6	16.22	23	62.16
Enough	12	32.43	10	27.03
Lack	19	51.35	4	10.81
Total	37	100	37	100

TABLE 5

Respondents' Pre and Post Knowledge about the Importance of Maintaining Nutrition During Adolescence

Knowledge	Pre		Post	
	n	%	n	%
Good	4	10.81	26	72.22
Enough	13	35.14	8	22.22
Lack	20	54.05	2	5.56
Total	37	100	37	100

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In summary, while the study faced certain methodological limitations, its findings contribute valuable evidence to the growing body of literature supporting peer-based and empowerment-oriented health education models. These results underscore that early, participatory, and context-specific interventions targeting adolescents can effectively improve health literacy, strengthen community resilience, and serve as a foundation for sustainable stunting prevention at the grassroots level.

V. CONCLUSIONS

This community empowerment initiative was designed with the primary aim of enhancing adolescents' knowledge and awareness of nutrition and reproductive health as an early strategy to prevent stunting. The program implemented a participatory learning model through the establishment of peer-led nutrition awareness groups and structured training activities conducted among 37 female students at SMPN 1 Wonoayu, Sidoarjo Regency. Quantitative evaluations revealed significant improvements across all indicators of knowledge. Specifically, understanding of reproductive health increased from 40.54% to 67.56% (good category), awareness of stunting and its prevention rose from 16.22% to 62.16%, and comprehension of the role of adolescent nutrition in stunting prevention improved from 10.81% to 72.22%. These results affirm that the combination of education, mentoring, and peer-based engagement is an effective and low-cost approach for strengthening adolescent health literacy. The formation of nutrition awareness groups successfully established sustainable peer-learning networks, enabling adolescents to serve as agents of change in promoting healthy lifestyles. The findings also highlight the crucial role of adolescence as a preparatory phase for future reproductive health and maternal outcomes, reinforcing the importance of early intervention before conception. However, the limited sample size and short duration of the program call for future community-based studies involving larger populations, mixed-gender participants, and longitudinal follow-up to assess behavioral and health outcomes. Future work should also explore digital health education platforms to expand the reach of adolescent nutrition programs. Strengthening intersectoral collaboration between health, education, and policy institutions is essential to institutionalize adolescent health promotion within the school curriculum and ensure sustainability in stunting prevention efforts.

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DATA AVAILABILITY

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

Evi Pratami conceptualized and designed the study, coordinated field implementation, and drafted the manuscript. Evi Yunita Nugrahini managed training delivery and data acquisition. Kasiati contributed to data analysis and interpretation. Sukesi provided methodological and technical guidance for reproductive health education. Titi Maharrani supervised the evaluation process and critically revised the manuscript for intellectual content. All authors reviewed, approved, and agreed to the final version of the paper prior to submission.

DECLARATIONS

ETHICAL APPROVAL

This community service program was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and received approval from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya, Indonesia. Prior to participation, all adolescent participants and their parents or legal guardians were informed about the purpose, procedures, potential benefits, and confidentiality of the study. Written informed consent was obtained from both the students and their guardians to ensure voluntary participation. The anonymity of all participants was maintained throughout the data collection and reporting processes, and no identifying information was disclosed in any part of this publication.

CONSENT FOR PUBLICATION PARTICIPANTS.

Informed consent was obtained from all participants and their legal guardians prior to participation in this activity.

COMPETING INTERESTS

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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