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Sempoating media enhances adolescent knowledge and engagement in stunting prevention

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ABSTRACT

Stunting remains a major public health concern in Indonesia, with the government targeting a reduction to 14% by 2024. In Blora Regency, the prevalence reached 21.5%, ranking 12th in Central Java. Adolescents, as future parents, play a critical role in the intergenerational transmission of nutritional knowledge. *Sempoating* media as an educational tool designed to simulate early stunting detection and prevention in toddlers aged 12–24 months was developed to enhance adolescents' knowledge and engagement in stunting prevention. This study aims to analyze the effect of *Sempoating* media on adolescents' knowledge and active participation in stunting prevention efforts. This quasi-experimental study used a pretest-posttest control group design conducted between June and August 2023 in Purworejo and Tutup Villages, Blora Regency, Indonesia. Sixty adolescents were recruited using total sampling and assigned to either a treatment group (received *Sempoating* media and module) or a control group (received only a module). Knowledge and activity scores were measured using a validated questionnaire (Cronbach's alpha = 0.86) before and after a 3-month intervention. Data were analyzed using paired *t*-test and Mann–Whitney U test with SPSS version 25. There was a significant increase in knowledge and stunting prevention activities in both groups ($p < 0.05$). However, the treatment group showed significantly higher improvements compared to the control group, with post-intervention differences in knowledge ($p = 0.026$) and activities ($p = 0.000$). *Sempoating* media significantly improved adolescents' knowledge and engagement in stunting prevention. This interactive educational tool shows promise for integration into school-based and community adolescent health programs. The findings support the use of gamified media such as *Sempoating* as an effective strategy to empower adolescents as agents of change in reducing stunting prevalence in their communities.

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INTRODUCTION

Stunting is still a problem that must be considered in Indonesia. The impacts of stunting are far-reaching: stunted children are at high risk of impaired cognitive and motor development, reduced school performance, and a greater likelihood of developing chronic diseases later in life.(1) This situation also erodes the quality of future human resources, as generations growing up with growth and development deficits are often less competitive academically

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and economically productive.(2) Furthermore, stunting carries a significant economic burden, as it increases healthcare costs, decreases productivity, and hampers the potential for national economic growth.(3) Based on the results of the 2021 SSGI (Indonesian Nutritional Status Study), the national stunting rate has decreased by 1.6% per year from 27.7% in 2019 to 24.4% in 2021. The implementation of government policies to accelerate the reduction in stunting rates in Indonesia has yielded quite good results. So the government is targeting the stunting rate to be 14% in 2024. In Central Java, the prevalence of stunting cases in 2021 was 20.9%. The prevalence of stunting in Central Java, Blora Regency is ranked 12th with a prevalence of 21.5%.(4) The Blora Regency Government has established a policy to reduce stunting so that all government sectors work together to overcome the problem of stunting. Diploma III Midwifery Program in Blora, Poltekkes Kemenkes Semarang carries out stunting prevention through promotive and preventive efforts to the Community.

Adolescents have a fairly high role in reducing the prevalence of stunting. Adolescents can prevent stunting early on by implementing a healthy lifestyle to prevent anemia and chronic energy deficiency (CED) in adolescents. Adolescents Care for Stunting has the task of being an agent for stunting socialization with the task of adolescents providing information to the community to prevent stunting in children. This is in accordance with research that there is an increase in knowledge, attitudes and willingness of adolescents in preventing stunting. Adolescents can strengthen the contribution of adolescents in improving adolescent health, one form of their participation is through the presence of school-age child cadres.(5) Adolescent knowledge is very helpful in preventing stunting early on. Adolescent knowledge about stunting can direct adolescents' positive attitudes towards healthy living to create a healthy generation. Education for adolescents, especially in increasing knowledge about stunting prevention, can break the chain of stunting incidents in toddlers. It is hoped that adolescents will become agents of stunting prevention by having good knowledge about stunting prevention efforts that can be transmitted to their peers.(6) The activeness of adolescents in adolescent stunting care activities is very necessary because with their activeness they show how much interest and concern they have in reducing stunting rates. The knowledge possessed by adolescents about stunting can encourage adolescents to participate in stunting prevention activities such as campaigns with information and education about the dangers of stunting and its prevention through educational media, video blogs, planned generation programs.(7)

Counseling media is very helpful in conveying information to the community. Early prevention of stunting is carried out by increasing public knowledge about the dangers of stunting. Research shows that promotional media has proven effective in increasing knowledge, perceptions, intentions and practices related to balanced nutrition and stunting prevention. Educational media is very helpful in changing public knowledge and behavior.(8) Based on a recent literature review, several types of educational media are commonly used to prevent stunting in adolescents and communities. Print media such as leaflets, booklets, and pocketbooks are simple, inexpensive, and easy to distribute media, often used in integrated health posts (*Posyandu*) and schools. Studies show that leaflets/booklets increase knowledge, but their impact on behavior change is often limited and rarely encourages sustainable practices.(9)(10) Video/audiovisual media (YouTube, Instagram, TikTok, educational animations) are effective media for increasing adolescent knowledge and attention when combined with facilitators; short video-based platforms are increasingly being researched for stunting education.(7)(11) Furthermore, mobile/e-health applications (Android apps, "stunting super apps") can offer interactive features, tracking, and widely accessible learning modules; they have great potential but require infrastructure and digital inclusion.(12)(13) Social media and instant messaging (WhatsApp, Telegram, social media campaigns) have been used for outreach, supplement reminders, and

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distribution of educational materials; effectiveness on knowledge is quite good, but attitude/practice changes are less consistent without additional support.(14)(15) Finally, gamified tools (board games such as snakes-and-ladders, puzzles, educational games) with a kinesthetic/game-based approach involving multisensory learning have been reported to increase adolescent engagement and material retention better than passive media.(16)(17)(18)

Although various media have been used, evidence indicates a significant gap between increased knowledge and the actual behavior changes needed for long-term stunting prevention. Adolescents learn effectively through experience, social interaction, and multisensory engagement; they are also quickly influenced by short and visual forms of communication (e.g., short videos, games). Therefore, more interactive, applicable, and easily implemented educational media in the community (e.g., interactive board games that can be used by school cadres, practical demonstration tools such as *sempoating*, or blended digital-non-digital modules that address limited access) are more suitable to maximize the role of adolescents as agents of change. Recent literature reviews and intervention studies recommend the integration of gamified media, guided social platforms, and blended learning models to achieve more tangible behavior change. Another study stated that the "*cakram gizi*" media is a visual media by stimulating hand movements to determine nutritious food to prevent stunting. This media can increase knowledge and change adolescent behavior.(19) Similar media that uses visual media and hand movement stimulation is *sempoating* media. The difference between *sempoating* media and "*cakram gizi*" media lies in the material and use. "*cakram gizi*" media is about nutritious food to prevent stunting while *sempoating* media is about early detection of stunting. Sempoating media is a visual educational media that involves hand movements to find out whether toddlers aged 12-24 months are experiencing symptoms of stunting or not. *Sempoating* media consists of 4 colors, namely red, green, white and gray. The items in the *sempoating* show an increase in the child's height of 1 cm in the age group row in months. If the last number of the child's height is a red point, it means the child is on the stunting line. If the child's height is above or the last point is green, it means the child is on the stunting line. If the child's height is colored gray, it indicates a stunted child and if it is colored white, it indicates a normal child. The advantages of *sempoating* media are that it has a higher appeal to use compared to videos and leaflets because it uses hand movement stimulation. In addition, it is easy to use to identify children experiencing stunting as seen from height per age. The purpose of this study was to analyze the influence of *sempoating* media on the knowledge and activity of adolescents.

METHOD

This study employed a quasi-experimental design using a pre-test and post-test control group approach. The research was conducted between June and August 2023 in Purworejo and Tutup Villages, Blora Regency, Central Java, Indonesia, an area with a moderate prevalence of stunting. The study aimed to analyze the effect of *Sempoating media* on adolescents' knowledge and engagement in stunting prevention. The study population comprised all adolescents aged 10–21 years residing in Blora Regency. A total of 60 respondents were included, divided equally into a treatment group (n=30) and a control group (n=30). Sampling was conducted using a total sampling technique based on inclusion and exclusion criteria. Inclusion criteria were adolescents aged 10–21 years, active in school or community activities, able to communicate clearly, and able to read and write. Exclusion criteria were respondents who were absent during data collection or withdrew from the study before completion. Participants in the treatment group received stunting prevention education using the *Sempoating* media and a standard stunting module, while the control group received the same module without *Sempoating* media. The intervention

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was carried out over two sessions (each 3 hours) on consecutive days. Day 1: Delivery of stunting education materials (concept of stunting, risk factors, prevention efforts). Day 2: Practical training using Sempoating media, including simulation and group discussion. Educators consisted of trained midwifery lecturers and senior students who had previously completed a two-day training program focused on facilitation techniques, participatory learning, and standardized use of the Sempoating tool to ensure intervention fidelity. Two main instruments were used in this study were knowledge questionnaire and adolescent activity checklist. Knowledge Questionnaire consisted of 20 multiple-choice items assessing understanding of stunting definition, causes, early detection, and prevention. Validity and reliability tests were conducted on 30 adolescents with similar characteristics. The Content Validity Index (CVI**)** was 0.92, and the Cronbach's alpha coefficient was 0.87, indicating strong internal consistency. Adolescent Activity Checklist comprised 10 behavioral indicators reflecting adolescents' participation in stunting prevention activities, such as peer education, campaign participation, and dissemination of health information. The instrument showed a CVI of 0.89 and Cronbach's alpha of 0.84. Both instruments were adapted from the "Youth Health Cadre Engagement Scale" developed by the Indonesian Ministry of Health (2020) and were pretested before use. Data were collected through direct observation and self-administered questionnaires. Knowledge scores were measured at two time points: before (pre-test) and after (post-test) the intervention. Activity scores were assessed continuously for three months after the intervention using structured observations and self-reports from youth cadre meetings. This study obtained ethical approval from the Health Research Ethics Committee of the Poltekkes Kemenkes Semarang (No. 1008/EA/KEPK/2023). Written informed consent was obtained from all participants and parents (for respondents under 18 years). Data were analyzed using IBM SPSS Statistics version 25**.** Univariate analysis was used to describe demographic data and baseline characteristics. Normality testing was conducted using the Shapiro–Wilk test and Kolmogorov–Smirnov test. Paired t-tests were performed to assess within-group changes in knowledge and activity scores before and after intervention. Independent t-tests or Mann–Whitney U tests (for non-normal data) were used to examine between-group differences. Statistical significance was set at $p < 0.05$**.**

RESULTS

A total of 60 adolescent respondents met the inclusion criteria and completed the study, with 30 assigned to the treatment group and 30 to the control group. Table 1 presents the sociodemographic characteristics of the respondents. Most of the participants in both groups were female (63.3% in the control group and 60% in the treatment group). Most respondents were aged 15–18 years (63.3% in the control group and 50% in the treatment group), and most had a high school level of education (73.3% overall). These findings indicate that the control and treatment groups were relatively homogeneous in terms of gender, age, and educational background prior to the intervention.

Table 1. Characteristics of Respondents (n = 60)

Characteristics		Control Group		Treatment Group	
		n	%	n	%
Gender	Male	11	36.7	12	40
	Female	19	63.3	18	60
Age (years)	10-15 years	8	26.7	13	43.3
	15-18 years	19	63.3	15	50
	19-21 years	3	10	2	6.7
Education Level	Middle school	8	13.3	12	40
	High school	22	36.7	18	60

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Normality testing using the Shapiro–Wilk test showed that the data for knowledge and activity variables were normally distributed (p > 0.05). Therefore, the paired t-test was applied to assess within-group differences before and after the intervention (Table 2). There was a statistically significant increase in both knowledge and activity scores in the treatment and control groups after the intervention. In the treatment group, the mean knowledge score increased from 59.77 ± 11.55 to 83.55 ± 12.34 (p < 0.001), while in the control group, the mean increased from 58.67 ± 16.83 to 76.22 ± 14.29 (p < 0.001). Similarly, adolescents' activity scores increased significantly in the treatment group (from 58.15 ± 14.13 to 81.27 ± 11.83, p < 0.001) and in the control group (from 56.27 ± 14.58 to 67.30 ± 14.65, p < 0.001). These results indicate that both conventional education and the Sempoating media intervention improved adolescents' knowledge and engagement in stunting prevention, with greater improvements observed in the treatment group.

Table 2. Differences in Knowledge and Activity Before and After Intervention

Variable	Before		After		p-value
	Mean	SD	Mean	SD	
Knowledge					
Control	58.67	16.83	76.22	14.29	0.000[a]
Treatment	59.77	11.55	83.55	12.34	0.000[a]
Activity					
Control	56.27	14.58	67.30	14.65	0.000[a]
Treatment	58.15	14.13	81.27	11.83	0.000[a]

Note. Data were normally distributed (Shapiro–Wilk test, *p* > 0.05).
[1] *Paired t-test*, significant at *p* < 0.05.

The Kolmogorov–Smirnov normality test indicated that post-intervention data were not normally distributed (p < 0.05); therefore, the Mann–Whitney U test was used to compare differences between groups (Table 3). Post-intervention, adolescents in the treatment group had significantly higher knowledge scores (mean = 35.40) compared to the control group (mean = 25.60), with p = 0.026. Similarly, the level of activity in stunting prevention was significantly greater in the treatment group (mean = 41.95) than in the control group (mean = 19.05), with p < 0.001. These findings demonstrate that Sempoating media was more effective than conventional education in improving adolescents' knowledge and activity related to stunting prevention.

Table 3. Differences Between Treatment and Control Groups After Intervention

Variable	Group	Mean	p-value
Knowledge	Treatment	35.40	0.026[b]
	Control	25.60	
Activity	Treatment	41.95	0.000[b]
	Control	19.05	

Note. Data were not normally distributed (Kolmogorov–Smirnov test, *p* < 0.05).
[2] *Mann–Whitney U test*, significant at *p* < 0.05.

Overall, the use of Sempoating media significantly enhanced both the knowledge and active participation of adolescents in stunting prevention compared to traditional education. The intervention proved effective across both dimensions, suggesting that interactive and visual-based media are more engaging and impactful in health promotion among adolescents.

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DISCUSSION

The findings of this study demonstrate that the use of *Sempoating* media significantly improved adolescents' knowledge and engagement in stunting prevention compared to conventional module-based education. Both the treatment and control groups showed an increase in post-test knowledge and activity scores; however, the improvement was significantly higher among adolescents exposed to *Sempoating* media (knowledge p = 0.026; activity p = 0.000). These findings indicate that interactive and participatory educational tools have a stronger cognitive and behavioral impact on adolescents than traditional didactic methods.

This study supports the behavioral learning theory, which posits that learning outcomes improve when learners are actively engaged and receive immediate feedback.(20) The *Sempoating* media, which integrates a game-based learning approach, promotes active participation and repetition two key mechanisms that strengthen knowledge retention and foster behavioral change. The findings are consistent with studies by Solihin and Triana (2024), Barkun et al. (2024) and Arini (2022), which found that educational games such as Snakes and Ladders, game online, and nutrition monopoly significantly improved adolescents' health literacy and dietary practices related to stunting and anemia prevention.(17,18) In this study, adolescents not only gained theoretical understanding but also demonstrated greater involvement in stunting prevention activities within their community. This aligns with Bandura's social cognitive theory, which emphasizes that observational learning and social interaction can strengthen self-efficacy and sustain behavioral engagement. The findings also resonate with Lavelle et al. (2023), who reported that adolescent peer cadres trained in health promotion became effective agents of change in promoting balanced nutrition and hygiene behaviors in their peer groups.(21)

Knowledge will increase with training. Knowledge can influence the attitudes and desires of adolescents to play a role in efforts to reduce stunting. Research shows that there is an increase in knowledge, attitudes and desires of adolescents in efforts to prevent stunting. Adolescents can strengthen their contribution to improving adolescent health, one form of their participation is through the presence of school-age child cadres. One form of participation of school-age child and adolescent cadres in implementing health efforts in school-age children and adolescents is to cultivate healthy living behaviors so that they have the knowledge, attitudes and skills to implement healthy living principles so that they can prevent stunting.(22) Based on research, empowerment of SANTUN (Healthy Anti Stunting) Youth Cadres can increase knowledge, interest and participation of youth in helping to prevent stunting. Youth are members of society who are able to become agents of change. By providing adequate training, knowledge and education, youth can become health workers who can prevent stunting problems in their environment. Youth also play an important role in preventing stunting because knowledge of adolescent nutrition, especially adolescent girls, regarding stunting is very important to prevent stunting.(23) Delivering knowledge to adolescents can use creative educational media. Adolescents are a priority in preventing stunting because adolescence is a transition period from childhood to adulthood. Creative educational media will attract attention so that the results of the education are expected to bring change to adolescents. Creative media as a tool in delivering education to adolescents has been proven to increase adolescent knowledge. Starting from creative media such as snakes and ladders games, posters, "*cakram gizi",* leaflets, pocket books to audiovisuals, all have shown positive results. The more senses used in using media, the faster the knowledge, attitudes and behavior of adolescents change.(24)

Educational media that can be given to adolescents is the Monopoly Anemia game educational media for adolescent girls. This media can increase adolescent knowledge about anemia to prevent stunting early on. The existence of a monopoly game simulation

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makes adolescents more interested and practices healthy food consumption to prevent anemia.(17) Education can be provided using the game method for elementary school adolescents. The game method using interesting creative media can increase memory faster for the information conveyed. Educational media such as puzzle games, snakes and ladders, spinning wheels. The game contains information about stunting using the four pillars of balanced nutrition principles to prevent stunting, starting from consuming varied foods, a healthy lifestyle, maintaining ideal body weight, and regular exercise.(25) The Snakes and Ladders game has proven effective in educating health to prevent stunting. Providing education through games is effective because it will encourage teenagers as participants to actively participate in the game. Each box on the giant snakes and ladders contains messages to prevent stunting. When the teenage participants advance to a certain box, the teenagers read information about concrete steps in preventing stunting and its causative factors. Teenagers are encouraged to apply these steps in their daily lives.(26)(18)

Educational media that can be used for teenagers is technology-based long-distance media using the WhatsApp application. From the WhatsApp application, knowledge can be provided through e-posters, digital booklets, e-books, e-leaflets. Research states that anemia education for teenage girls through WhatsApp messenger-based e-leaflets is effective in increasing adolescent knowledge to prevent anemia to prevent stunting.(27)(28) The use of the Android-based E-smart Care application can increase adolescent knowledge from an early age about stunting and improve adolescent skills in using the application. The use of this application is carried out through the *Sekolah Siaga Kependudukan* (SSK), namely schools that integrate population and family planning education into several subjects.(29)

Providing early stunting education through adolescent Posyandu can be done through online game application media. Online games as an educational media can increase brain intelligence and English language recognition in adolescents. The results of the study showed that the online game ESTU JADI DIPUJA is effective in increasing adolescent knowledge about stunting. However, in using this application, adolescents need to be equipped with how to use it.(30)

Providing education through internet-based digital can indeed increase adolescent knowledge, but the problem is that not all adolescents have quotas or Android cellphones, especially adolescents in rural areas and adolescents with lower middle-class family economic conditions. The results of the study showed no effect of nutrition education to prevent stunting using WhatsApp group media on improving adolescent attitudes. It turns out that digital educational media also needs to be combined so that changes in attitudes can occur because adolescents only read less effectively in changing attitudes quickly. (15) Similar research also stated that there was a difference in knowledge of adolescents given stunting track booklets and adolescents without booklet media. However, there was no difference between attitudes and practices between the two groups. This shows that print media only increases knowledge.(31) Educational media should be followed by interesting methods because adolescents still need teaching aids that are easily accepted by adolescents. *Sempoating* media is a media that can be used with a game method so that adolescents can receive information more quickly on how to detect stunted children. *Sempoating* media can also influence adolescent attitudes and practices because adolescents have also simulated games using the tool for 3 months.

The present findings have several practical and policy implications. First, educational programs targeting adolescents should consider incorporating kinesthetic and participatory media to enhance learning retention and behavioral engagement. Second, the *Sempoating* media can be integrated into existing national platforms such as the Youth Information and Counseling Center (*PIK R*), adolescent-friendly health services, or school-

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based health education programs (*UKS* and *Sekolah Siaga Kependudukan*). This integration would support the government's goal of reducing stunting prevalence to 14% by 2024 through community-driven strategies. From a theoretical perspective, this study contributes to the growing body of evidence supporting experiential learning theory in adolescent health education. It underscores the value of engaging learners not only cognitively but also physically and socially to produce meaningful and lasting change. Despite these promising findings, further research is needed to evaluate the long-term behavioral impact of *Sempoating* media and its adaptability in diverse sociocultural settings. Future studies may also explore integration of this media with digital platforms for wider reach without compromising its interactive core.

CONCLUSION

The study demonstrated that the use of *Sempoating* media significantly improved adolescents' knowledge and activity related to stunting prevention compared to conventional module-based education. Adolescents who received both the module and the interactive *Sempoating* media showed greater engagement and understanding of early stunting detection and prevention practices.

These findings underscore the potential of integrating creative, game-based educational media into adolescent health promotion efforts, particularly in low-resource rural settings. The use of *Sempoating* media can empower adolescents as proactive agents in community-based stunting prevention strategies. Future programs should consider scaling up the use of *Sempoating* media through schools, youth health posts, and the national adolescent health movement (PIK-R). Further research is recommended to assess the long-term behavioral impact and effectiveness of this media across diverse demographic and geographic settings.

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AUTHOR CREDIT STATEMENT

NIW; MA: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Visualization, Supervision, Validation.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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