Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Widaryanti et al. | Amerta Nutrition Vol. 8 Issue 4 (December 2024). 665-674

LITERATURE REVIEW
English Version

OPEN ACCESS

Essential Health Intervention Package for Adolescent Girls as a Step to Break the Stunting Cycle: A Literature Review

Paket Intervensi Kesehatan Esensial pada Remaja Putri Sebagai Langkah Memutus Siklus Stunting: Sebuah Tinjauan Literatur

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ARTICLE INFO

Received: *12-12-2023*
Accepted: *23-10-2024*
Published online: *22-11-2024*

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DOI:
10.20473/amnt.v8i4.2024.665-674

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Health interventions, Adolescent girls, Stunting

ABSTRACT

Background: In Indonesia, approximately 32% of Indonesian adolescents experience anemia, if it not addressed effectively, adolescents suffering anemia pose a risk of resulting in stunted growth in their future offspring. Addressing nutritional issues including anemia in adolescence is a crucial step in efforts to break the cycle of stunting.
Objectives: This study aimed to review and analyze various essential health interventions for adolescent girls as a strategy to break the cycle of stunting through a comprehensive article review.
Methods: Literature was collected from four English-language databases: Scopus, PubMed, Springer Link, and EBSCOhost published from January 2013 to November 2023. The authors conducted article searching using the keywords "Adolescent girl" OR "teenage girl" OR "young woman" AND Intervention AND stunting. Inclusion criteria for this study encompassed community- or population-based research utilizing cross-sectional, cohort, and experimental methods. Exclusion criteria included systematic literature reviews and studies that did not report relevant findings. Ultimately, 10 articles were reviewed from a total of 4,596 articles identified, following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)2020 checklist.
Discussions: The health intervention package designed for adolescent girls to prevent stunting includes health education delivered through various methods such as PowerPoint presentations, videos, booklets, and comics, along with the implementation of youth integrated post (*posyandu*) and community or school-based health intervention. Health promotion materials cover diet, personal hygiene, and supplementation of micronutrients and macronutrients.
Conclusions: Implementing the appropriate package of essential health interventions constitutes an effective and efficient approach to break the cycle of stunting.

INTRODUCTION

Three burdens of malnutrition represent critical nutritional issues that lead to morbidity and mortality in infants, extending into adolescence and adulthood[1]. This condition is not limited to low-income countries but has emerged as a global challenge. The nutritional issues include malnutrition, essential micronutrient deficiencies, and overweight or obesity[2]. If left unaddressed, these problems can create a vicious cycle of intergenerational malnutrition[3]. Historically, nutritional intervention programs have focused on the first 1,000 days of life; however, the subsequent 7,000 days can lead to serious health consequences if not adequately managed[4]. Adolescence is a vulnerable period for nutritional deficiencies due to rapid physical growth, which increases nutritional requirements. Globally, adolescents show a high prevalence of both macro- and micronutrient deficiencies, which manifest clinically as iron deficiency anemia, underweight, stunting, and obesity, contributing to various chronic diseases[5]. Therefore, integrated nutritional interventions are essential, utilizing both school-based and community-based platforms[6].

Research indicates that 32% of adolescents in Indonesia suffer from anemia or iron deficiency. This condition is primarily caused by inadequate nutrient intake and suboptimal physical activity[7]. To address malnutrition among adolescents, several interventions are recommended, including iron supplementation, education on dietary diversity, and personal hygiene. The implementation of iron supplementation among adolescents requires substantial support, as only 35.9% of adolescent girls in Yogyakarta have received iron tablets. The findings reveal that not all iron tablets

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provided to adolescents are consumed; reasons for non-consumption include an aversion to the taste (44%) and forgetfulness (16.6%)[8]. Nutritional issues in adolescents often arise from poor dietary patterns, a tendency to consume fast food and ultra-processed foods, and body image concerns[9]. Common dietary habits include high-energy food consumption, frequent snacking, skipping breakfast, irregular meal patterns, and low intake of fruits and vegetables[10].

Addressing malnutrition in adolescents is an effective and efficient health investment[6]. Healthy adolescents with adequate nutritional status are more likely to produce quality generations, thereby breaking the cycle of stunting[11]. Chronic malnutrition in adolescent girls that persists into adulthood can adversely affect reproductive health, impacting fetal health during pregnancy. Maternal malnutrition is a significant determinant of stunting. Some literature indicated that adolescents who have good nutritional status are positively associated with study outcomes[12], and in the future can access more decent jobs[13]. However, health programs targeting adolescents to break the cycle of stunting have not yet become a primary focus. Therefore, further studies are needed to investigate the impact of health interventions on adolescent girls as a strategy to break the cycle of stunting. The aim of this literature review is to evaluate and analyze various essential health interventions for adolescent girls to break the cycle of stunting through a systematic review of the literature.

METHODS

This study employs a literature review methodology, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist[14]. Literature was collected using four English-language databases: Scopus, PubMed, Springer Link, and EBSCOhost, covering publications from January 2013 to November 2023. The researchers conducted article searching using the keywords "Adolescent girl" OR "teenage girl" OR "young woman" AND Intervention AND stunting. Inclusion criteria for this study encompassed community- or population-based research utilizing cross-sectional, cohort, and experimental methodologies published in English. Exclusion criteria included systematic literature reviews and studies that did not report relevant findings. A total of 4,596 articles were identified based on the specified keywords, and 10 articles meeting the inclusion criteria were reviewed by three reviewers. The following is a flowchart of the selection process based on the PRISMA 2020 checklist.

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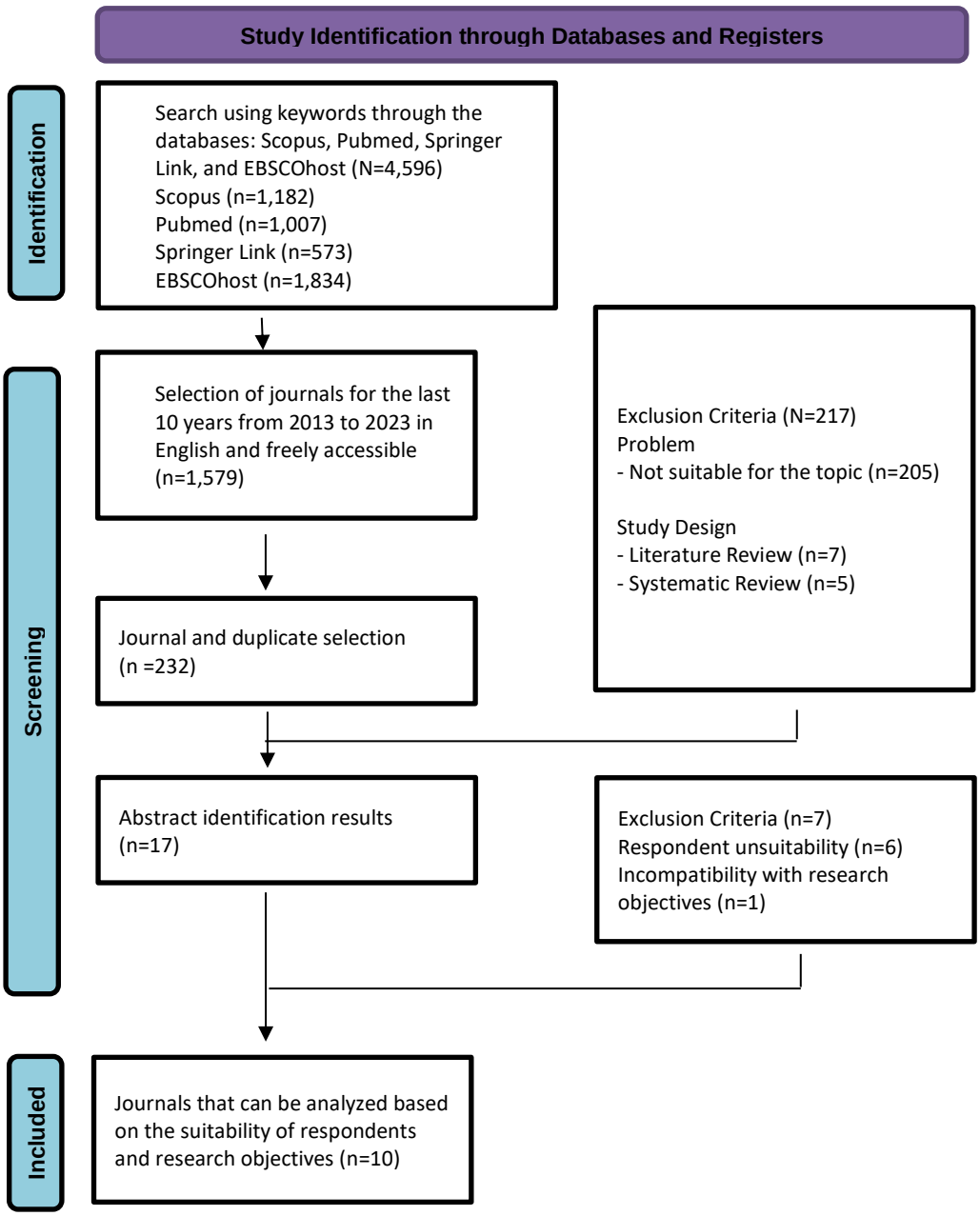

Figure 1. Literature search flow

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Table 1. Summary of literature found

No.	Authors, Title	Intervention	Research Method	Research Findings	Conclusion
1	Patimah, S., Idrus, H. H., & Noviasty, R. (2023). Effect of School-Integrated Interventions on Improvement of Nutrition-Health Knowledge and Nutritional Status among Adolescent Girls: A Quasi-Experimental Study[15].	Health nutrition education by trained teachers and integrated health nutrition services for adolescent girls (*posyandu*).	A quasi-experimental on 342 adolescent girls.	The average scores increased across all aspects of nutrition and health knowledge, with a more significant improvement observed in the intervention group. Malnutrition biomarkers significantly decreased in the intervention schools, where the prevalence of anemia was 3.4%, Chronic Energy Deficiency (CED) was 24.1%, severe stunting was 0.8%, and wasting was 1.6%. However, overweight prevalence increased by 1.2%. Only CED decreased significantly by 26.2%, while anemia, severe stunting, wasting, and overweight showed a significant increase.	Integrated interventions with schools are more effective than nutrition education alone in enhancing nutrition knowledge and improving the nutritional status of adolescent girls.
2	Khan, M. F., Banerjee, S., Bandyopadhyay, K., Kalaiselvi, S., Akkilgunata, S., Tripathy, J., & Deshmukh, P. (2022). Role of dietary habits and personal hygiene on nutritional status of school-going adolescents: A cross-sectional study in selected schools located in slum areas of Nagpur City, Maharashtra[16].	Dietary habits, personal hygiene.	Cross-sectional study, on 814 students.	This study found the prevalence of underweight, stunting, and overweight/obesity to be 40%, 20%, and 4.2%, respectively. Male students were found to be more underweight (61.1% vs. 38.8%) and stunted (55.6% vs. 44.4%) compared to female students. Less than a quarter (13.7%) of students reported consuming fewer than five servings of fruits and vegetables per day. In the multivariable analysis, male students, children of housewives, those who skipped breakfast every day of the week, those consuming fast food ≥3 times per week, those consuming highly sweetened ready-to-eat meals, and those who rarely washed their hands after using the toilet were identified as predictors of thinness.	Dietary habits and personal hygiene were found to be significant factors in malnutrition. Promoting health behaviors through school health policies that involve teachers, students, and parents is strongly recommended to mitigate malnutrition issues among adolescents.
3	El-Abbassy, A. A., Ahmed, H., Diab, S. S. E. M., & El-Nagar, S. A. (2022). Nutrition Intervention Based on Health Belief Model for Promoting	Nutrition intervention based on the health belief model to promote dietary calcium intake among adolescent female students.	Quasi-experiment with controls.	1. There was a significant increase in awareness among adolescent girls, as well as in practices related to dietary calcium intake in the study group compared to the control group.	Nutrition interventions based on the Health Belief Model (HBM) have a positive effect on promoting awareness among adolescent girls and enhancing practices related to dietary calcium intake, as well as promoting daily calcium consumption.

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No.	Authors, Title	Intervention	Research Method	Research Findings	Conclusion
	Dietary Calcium Intake among Adolescent Girl students[17].			2. A significant increase was observed in the total average daily calcium intake (mg) in the study group (1231.04 ± 221.01) compared to 904.47 ± 183.38 in the control group. 3. The average score of the Health Belief Model (HBM) significantly increased, including perceived benefits of consuming calcium-rich foods, vulnerability to disease, risks associated with inadequate calcium intake, and self-efficacy, while there was a significant decrease in barriers to obtaining sufficient calcium in the study group compared to the control group.	
4	Draper, C. E., Macclesfield, L. K., Kahn, K., Tollman, S. M., Pettifor, J. M., Dunger, D. B., & Ntshembo Consortium. (2014). Application of Intervention Mapping to develop a community-based health promotion pre-pregnancy intervention for adolescent girls in rural South Africa: Project Ntshembo (Hope)[18].	A healthy and balanced diet, increasing physical activity, reducing sedentary behavior, and improving reproductive health.	Research and development (R&D) using the PRECEDE-PROCEED model theory.	The Ntshembo intervention is a novel approach both in South Africa and globally, characterized by: (1) a strong evidence base, extensive formative work, and best practices from evaluated interventions; (2) the integration of theory with evidence to inform intervention components; (3) the inclusion of multiple domains of influence (from community to individual); (4) a focus on at-risk target groups; and (5) alignment with existing and planned healthcare priorities in South Africa.	The Intervention Mapping (IM) approach has proven useful in ensuring that both local and international evidence and theory inform the development of the Ntshembo intervention. This approach has highlighted the importance of considering personal and environmental determinants of behavior. The evidence presented clearly indicates the need to address non-communicable disease (NCD) risks and optimize health among adolescent girls in South Africa, particularly in the pre-pregnancy phase, to sequentially reduce the intergenerational transmission of disease risk. The Ntshembo intervention has demonstrated scalability and sustainability due to its alignment with priority health services in South Africa.
5	Shinde, S., Madzorera, I., & Fawzi, W. (2021). Association of Iron Supplementation and Dietary Diversity With Nutritional Status and Learning Outcomes Among Adolescents: Results From a Longitudinal Study in India[12].	Iron supplementation, dietary diversification and deworming.	Longitudinal study of 12,035 adolescents.	1. Administration of iron and folic acid interventions is significantly associated with hemoglobin levels in adolescent girls [adjusted mean difference (aMD)=0.41; (95% CI=0.00-0.82)]. 2. Receipt of iron and folic acid tablets is positively correlated with reading proficiency [(Adjusted Odds Ratio	Integrated nutrition and health interventions that strengthen existing nutrition supplementation programs are essential for meeting the nutritional needs of adolescents and improving educational outcomes.

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No.	Authors, Title	Intervention	Research Method	Research Findings	Conclusion
				aOR=1.47; (95% CI=1.07-2.01; p-value=0.02)], mathematical proficiency [((aOR)=1.51; 95% CI=1.16-1.98; p-value<0.001)], and reduced risk of school dropout [(aOR=0.72; (95% CI=0.54-0.96; p-value=0.03)]. 3. A diverse diet is positively associated with hemoglobin levels, height-for-age z-scores, mathematical proficiency, and reduced risk of school dropout among adolescents. 4. Administration of deworming medication was not associated with nutritional status or academic performance.	
6	Mardiana, M., & Yulianto, Y. (2022). The effect of nutrition education on balanced nutrition knowledge and macronutrient intake among adolescents[19].	Education using comics and booklets on nutrition and macronutrient intake in adolescents.	Quasi-experiment with controls on 150 junior high school students.	1. In the group of adolescents given comic-based interventions, a significant increase in knowledge about balanced nutrition was observed (median pre-post min=6±10, max=17±25; p-value=0.0001). 2. The booklet intervention also demonstrated a significant increase in balanced nutrition knowledge (pre-post median min=7±11, max=19±24; p=0.000). 3. Educational interventions using comics and booklets significantly improved average scores of knowledges about balanced nutrition among adolescents (p-value<0.01).	There were differences in knowledge regarding balanced nutrition and macronutrient intake between the comic intervention group and the booklet intervention and control groups (no intervention). Comics and booklets influenced knowledge and macronutrient intake among adolescents.
7	Fitria, M., Santosa, H., Lubis, Z., & Lubis, R. (2021). The Effect of Peer Education on Knowledge and Attitudes about Anemia and Chronic Energy Deficiency of Adolescent Girls at Percut Village, Indonesia[20] .	Peer education on anemia and chronic energy deficiency.	Quasi-experiment with controls on 150 adolescent girls aged 12-16 years old.	There was a significant difference in average knowledge and attitudes about anemia in the treatment group (p-value=0.0001), while no significant difference was found in the control group (p-value>0.05).	Peer education on anemia and chronic energy deficiency.

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No.	Authors, Title	Intervention	Research Method	Research Findings	Conclusion
8	El-Ammari, A., El Kazdouh, H., Bouftini, S., El Fakir, S., & El Achhab, Y. (2020). Suggestions and Preferences for Interventions to promote Adolescents' Health: Insights from Focus Groups[21].	Focus groups on physical activity, eating habits, substance use.	Focus group discussions with 100 adolescents, parents, and teachers.	Four themes emerged regarding social-ecological recommendations (i.e., social, physical, distal, and individual environmental levels) on how to enhance health behaviors, dietary practices, and substance use among adolescents. Three themes focused on participant preferences concerning the mode of delivery, content, and facilitators of school-based interventions.	A comprehensive approach is considered effective in improving adolescent health behaviors. Participant preferences in school-based programs are valuable for developing such initiatives.
9	Neherta, M., & Nurdin, Y. (2021). Primary Prevention of Neglect in Children through Health Education for Adolescent Girls in West Sumatra, Indonesia[22].	Health education intervention on anemia prevention.	Quasi pretest and posttest experiment on 370 adolescent girls.	Health education interventions aimed at preventing anemia can significantly enhance the knowledge and attitudes of adolescent girls, with a p-value of 0.00.	The primary prevention model for stunting can improve knowledge and attitudes among adolescent girls.
10	Jolly et al (2023) Water, sanitation and hygiene (WASH) practices and deworming improve nutritional status and anemia of unmarried adolescent girls in rural Bangladesh[23].	Water, sanitation and hygiene (WASH) Practices and deworming.	Cross-sectional and comparative study of 1620 unmarried adolescent girls aged 10-19 years.	1. The prevalence of stunting (22.9% vs. 22.5%), underweight (12% vs. 14%), and anemia (34.5% vs. 37.3%) showed similarities between intervention and comparison areas. Stunting and thinness were predictors of one another in this population group. 2. The study indicates that adolescent girls who do not wash their hands with soap after defecation are more likely to experience stunting [aOR=1.51 (95% CI =1.12-2.04)], and those who do not use latrines have an increased likelihood of being underweight [aOR=2.38 (95% CI=1.11-5.08)]. 3. Conversely, those who do not watch television [aOR=1.69 (95%CI=1.12-2.56)] and do not have deworming tablets [aOR=1.33 (95%CI=1.07-1.64)] in the six months leading up to the interview have a 69% and 33% higher likelihood of experiencing anemia, respectively.	For ongoing improvements in malnutrition and anemia among adolescent girls, the integration of WASH (Water, Sanitation, and Hygiene), consistent deworming tablet distribution, and the broadcasting of awareness programs through television are urgently needed to enhance nutrition intervention programs in similar settings like Bangladesh.

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DISCUSSIONS

Stunting is a serious nutritional issue, as it not only impacts individuals currently but also extends into adulthood. Preventive measures against stunting should begin during adolescence, particularly because adolescent girls are future mothers. If a teenager experiences prolonged energy deficiency, the risk of giving birth to a low-birth-weight baby increases[24] which in turn raises the likelihood of that baby becoming stunted[25]. Therefore, efforts are needed to prepare future mothers with adequate nutrition to break the cycle of stunting. A literature review of 10 analyzed journals identified several risk factors for stunting during adolescence, including knowledge, dietary habits, micronutrient intake (such as iron and folic acid), deworming, personal hygiene, and sanitation.

Health education is a crucial step in changing behaviors at both individual and community levels. It enhances knowledge and fosters positive perceptions, thereby promoting better behaviors[26]. The nutritional knowledge possessed by adolescents influences their attitudes and behaviors in making food choices at home and at school. To optimally meet the nutritional needs of adolescents, adequate knowledge about balanced nutrition is essential[22]. Various methods exist for providing health education to adolescents. For instance, research conducted by Mardiana (2022) found that the use of booklets can significantly increase knowledge about balanced nutrition among adolescents (median pre-test and post-test min=7±11, max=19±24; p-value=0.000). Additionally, adolescents educated with comic media also showed increased knowledge about balanced nutrition (median pre-post min=6±10, max=17±25; p-value=0.0001)[19]. Typically, health education is delivered by more experienced, usually older individuals; however, peer education can also be effective. Most adolescents feel more comfortable communicating with peers than with adults, including their parents, highlighting the need for peer-led educational programs. Research by Fitria et al. (2021) showed a significant difference in knowledge among adolescents who received education about anemia and chronic energy deficiency (CED) compared to a control group[20].

Promoting healthy behaviors to encourage healthy lifestyles should start early, especially in young adulthood, as many of them may become complacent and indifferent to healthy lifestyles, making it difficult for them to change their behavior. Health promotion efforts to change behavior using the Health Belief Model (HBM) are among the most effective and efficient methods. A study by El-Abbassy et al. (2022) indicated that post-intervention average knowledge scores using the HBM were significantly higher in the intervention group compared to the control group (11.8±2.6 vs. 3.6±1.5; p-value<0.0001)[17]. Another approach utilized for health promotion is the PRECEDE-PROCEED model. This approach was employed by Draper et al. (2014) in health promotion efforts concerning healthy and balanced diets, increasing physical activity, reducing sedentary behavior, and enhancing reproductive health in South Africa. This approach has proven valuable in ensuring that both local and international evidence informs the development of the Ntshembo intervention, emphasizing the importance of considering personal and environmental determinants of behavior. The evidence clearly indicates the need to address non-communicable disease (NCD) risks and optimize health among adolescent girls in South Africa, particularly in the pre-pregnancy phase, to sequentially reduce the intergenerational transmission of disease risk. The Ntshembo intervention has demonstrated scalability and sustainability due to its alignment with priority health services in South Africa[18].

School-based health education is an effective and efficient program, as the number of health facilities is limited compared to the number of schools. Health promotion through schools can reach a broader segment of the population across various economic strata[27]. Adolescents also spend significantly more time in school than in the community, making school-based health education a more targeted approach[28]. Research by Patimah et al. (2023) on the implementation of integrated interventions in schools showed improvements in nutritional knowledge and status among adolescent girls in Indonesia, revealing a decrease in biomarkers of malnutrition such as anemia (down by 3.4%), chronic energy deficiency (CED) (down by 24.1%), stunting (down by 0.8%), and wasting (down by 1.6%), although overweight prevalence increased by 1.2%. This demonstrates that integrated school interventions are more effective than providing nutritional education alone in enhancing nutrition and health status among adolescent girls[15].

Eating habits established during adolescence will affect future health status. Therefore, promoting healthy behaviors in adolescence is key to breaking the cycle of stunting. Research by Khan et al. (2022) highlighted that adolescents with concerning nutritional deficiencies exhibited poor dietary habits and personal hygiene practices, as well as a tendency to skip breakfast and prefer ultra-processed foods, alongside inadequate fruit and vegetable intake[16].

Nutritional supplementation of both macro and micronutrients aims to meet the nutritional needs of adolescents, promoting healthier individuals who can subsequently give rise to healthy generations. Supplementation for adolescent girls includes iron and folic acid tablets to prevent iron deficiency anemia[29]. A study by Shinde et al. (2021) found that providing iron and folic acid interventions was significantly associated with hemoglobin levels in adolescent girls (AMD=0.41; 95%CI=0.00, 0.82). Adolescents receiving iron and folic acid tablets also had positive correlations with reading proficiency (AOR=1.47; 95%CI=1.07, 2.01; p-value=0.02), mathematical proficiency (AOR=1.51; 95%CI=1.16, 1.98; p-value<0.001), and reduced risk of school dropout (AOR=0.72; 95%CI=0.54, 0.96; p-value=0.03). A diverse diet was positively associated with hemoglobin levels, height-for-age z-scores, mathematical proficiency, and reduced risk of school dropout among adolescents[12].

Personal hygiene is closely related to stunting occurrences[30]. Poor access to clean water increases the risk of infections, raising the prevalence of stunting. Moreover, enhancing personal hygiene practices is necessary to prevent infections. A study by Jolly et al. (2023) found that adolescent girls are at increased risk of

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stunting if they do not wash their hands with soap after defecation (AOR=1.51; 95%CI=1.12-2.04), and those who do not use latrines are more likely to be underweight (AOR=2.38; 95%CI=1.11-5.08)[23]. The findings of this literature review can inform intervention packages for adolescents implemented in several countries, including Indonesia. Integrated intervention packages have proven to be more effective than providing health education alone[15].

The results of this study should be interpreted with caution due to several limitations. There is heterogeneity among the included interventions due to varying intervention durations and measurement instruments that may affect the findings. Additionally, this research is limited to a specific time frame (publications from the past ten years). A significant limitation of this study is the language barrier, as the authors restricted articles to English, potentially overlooking valuable articles in local languages.

CONCLUSIONS

The health intervention packages provided to adolescent girls as a preventive measure against stunting include health education or education through various methods, along with school- and community-based health interventions. Health promotion materials encompass dietary practices, personal hygiene, and supplementation of micronutrients and macronutrients. A well-designed essential health intervention package is an effective and efficient step to break the cycle of stunting.

ACKNOWLEDGEMENT

The authors express appreciation to various parties that have provided support and contributions in the preparation of this manuscript for publication.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All of the authors declare no conflict of interest, and that this research was funded by personal funds.

AUTHOR CONTRIBUTIONS

RW: conceptualization, methodology, resources, writing–review and editing; YAD: methodology, writing–original draft, formal analysis; DI: conceptualization, resources, writing–original draft; SAN: supervision, methodology, validation, writing-review & editing.

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