Proceedings of the 5th International Conference on Food, Nutrition, Health and Lifestyle, Vol. 2, Issue 1, 2023, pp. 27-39

ISSN 2682-7026 online
DOI: https://doi.org/10.17501/26827026.2023.2103

REDUCING THE PREVALENCE OF COEXISTENCE OF ANEMIA AND STUNTING THROUGH SCHOOL-BASED INTEGRATED INTERVENTIONS FOR GIRLS ADOLESCENT

Patimah S[1]*, Sundari[2], Kurniati Y[3] and Sharief SA[2]

[1]*Nutrition Department, School of Public Health, Universitas Muslim Indonesia, Indonesia*

[2]*Midwifery Department, School of Public Health, Universitas Muslim Indonesia, Indonesia*

[3]*Department of Public Health, Faculty of Medicine and Health Science Universitas Islam Negeri Alauddin Makassar*

Abstract: In Indonesia, anemia and stunting are still commonly found among girls adolescent, even though this can happen to the same person and the same time. So intervention is needed to overcome this. The study aims to assess the effect of school-based integrated interventions on the coexistence of anemia and stunting. The quasi-experimental design was used, involving 342 female students from 4 schools, namely two intervention schools (the Ministry of Education, Culture, Research, and Technology) and two comparison schools (the Ministry of Religion). The intervention group received nutrition-health education from trained teachers (4 weeks) and implementation of an integrated adolescent girls Posyandu (4 months) that establish previously to monitor growth, nutritional status, and multi-micro-nutrient supplementation by health center staff. While the comparison group only received nutrition-health education from trained teachers for four weeks. Height measurement adjusted for the age to determine the HAZ-score (stunted: HAZ-Score value is <-2 SD). Measurements of hemoglobin levels using a blood photo meter Hemocue to determine anemia (Hb <12 g/dl). Data were analyzed using the chi-square test and Mc Nemar test. Before the intervention, there was no significant difference (p=0.527) in the coexistence prevalence of anemia and stunting between the intervention group (5.7%) and the comparison group (6.3%). However, after the intervention, there was a significant difference in the prevalence of the coexistence of anemia and stunting between the two groups (p = 0.016). In the intervention group, the coexistence of anemia and stunting was decrease by 1.2%, while in the comparison group increased almost two times (12.5%). Therefore, school-based integrated interventions for female adolescent are crucial as a form of investment to break the chain of malnutrition.

Keywords: Coexisting, Stunting, Anemia, Girl Adolescent, School Based

Introduction

Adolescent girls are in a transition period from childhood to adulthood. as well as a second growth spurt period which requires adequate intake of macro and micronutrients to support accelerated growth and increased physical activity). Unmet nutritional needs harm nutritional-health status, which can occur negative implications for the next generations. However, several studies show that many

*Corresponding Authors' Email: *sitti.patimah@umi.ac.id*

young women face the burden of malnutrition (undernutrition, overweight/obesity, and micro-deficiency) (Ahmad et.al., 2018).

Types of malnutrition in adolescent girl can occur singly or more than one, can even at the same time in each individual, household, and community, so various terms arise including the coexisting form of malnutrition (CFM), co-morbidity, and syndemic (syndrome epidemic) malnutrition which can be a double or triple burden of malnutrition. The presence of more than one type of nutritional disorder may be referred to as Coexistance Forms of Malnutrition (CFM). CFM occurs due to the simultaneous presence of several anthropometric deficits or micronutrient deficiencies, or a combination of both in an individual (Khaliq et al., 2022)(Singer et al., 2017). CFM in any form results in an increased risk of health complications that can differ from comparable independent forms (Khaliq et al., 2022). Evidence regarding trends in coexisting different types of malnutrition is still underdeveloped, particularly among young girls, so more research is needed to investigate trends in specific types of CFM at global, national, and regional levels.

One of co-existing nutritional problems that is prevalent among children from low-income countries is the co-existing anemia and stunting which have a major impact on development, morbidity and mortality.. The results of a systematic review in low-middle income countries found that 21.5% of children aged 6-59 months had anemia and stunting (Tran et al., 2019), in India (21.5%) and Peru (30.4%) (Gosdin et al., 2018), Ethiopia (23.9%)(Mohammed et al., 2019). In Indonesia (6-9 years old) there are 8.8% of children aged 6-9 years who suffer from stunted anemia(Utami et al., 2023). Each of these countries that experience this problem, it was caused by nutritional intake, socio-economic and environmental factors, which need increased interventions public health/nutrition. As also proven by the results of the study by Gaston et.al, (2022) which has examined various aspects driving the incident such as demographic, socio-economic and geographical characteristics.

Co-existing anemia-stunting studies in adolescent girls are rarely explored, including the forms of intervention to overcome this. Studies only in South East Nigeria obtained around 3.8%(Onoja et al., 2019), in Southern Ethiopia (11.6%) girls aged 7-14 years (Amare & Lindtjorn, 2021). In Indonesia, only in Takalar District, South Sulawesi Province, which conducted this study on an adolescent girl aged 13-15 years, it was found that around 5.7% (Bustan et al., 2023).

West Sulawesi Province is the area with the second highest prevalence of stunting under five in Indonesia based on the results of the 2022 Indonesian Nutrition Status Survey (Riskesdas Sulbar, 2018) (Ministry of Health RI, 2022), indicating that they are likely to be born to mothers who tend to experience malnutrition during pregnancy as well as in the period before pregnancy or during teenage girl. Evidenced by the results of basic health research in 2018 showing that young women aged 13-15 years suffer from stunting by 39.3%, and 42.6% for ages 16-17 years (Kementerian Kesehatan RI

Badan Penelitian dan Pengembangan, 2018) (Ministry of Health RI, 2019). The results of other studies show that 34.1% of young women are classified as stunted, and 10.8% suffer from anemia (Patimah et al., 2019)

Malnutrition in adolescent girls causes adverse effects, not on physical and mental health only, but also acts as a risk for future generations in the cycle of continuous care (Ahmad et.al., 2018). Therefore, the nutritional-health status of an adolescent girl is pivotal. Evidence-based interventions supported by research, relevant programs and large-scale implementation evaluations, and effective delivery platforms to reach the most vulnerable groups of young women are very needed for the nutritional well-being of adolescents in Indonesia (Rah et al., 2021).

Knowledge, attitudes and practices are associated with the nutritional outcomes of young girls, namely anemia and linear growth failure (Agustina et al., 2020), so these results emphasize the need for integration of public health policies, health promotion strategies that contribute to increasing understanding of anemia and linear growth in among young women. Based on these recommendations, and schools offer great opportunities for health and nutrition promotion for children and adolescents who can have an important role in the future(Bhutta et al., 2013). Nutrition education in schools can help eradicate undernutrition and stunting in young women(Tandoh et al., 2021). Based on this, the impetus for conducting this study was to provide integrated school-based interventions, namely nutrition education by trained teachers and implementation of Posyandu activities for young women consisting of monitoring growth and nutritional status, micronutrient supplementation, and counseling. Therefore, this study aims to assess the effect of school-based integrated interventions on the coexistence of anemia and stunting.

Materials and Methods

Design and Sample

This study was conducted using a pre-post control group quasi-experimental design with cluster (school-based) randomized, involving 360 female students from 4 schools in Majene District, namely two intervention schools (Under the ministry of education, culture, and technology research) namely public junior high school 1 (SMPN-1) and public senior high school 1 (SMAN-1), and two comparison schools (under the ministry of religion) namely Madrasah Tsanawiyah and Madrasah Aliyah. All students from class VII (junior high school) and class X (senior high school) were involved in this study, namely from 271 people from intervention schools and 89 girls from comparison schools. However, there were 342 people who participated in the entire research series to completion, 18 people dropped out, namely 9 people in each type of school (Ministry of Education,

culture, and technology research, and Ministry of Religion) because they were often absent during the intervention and left school.

Data Collection

This study was carried out for 3 years (2021-2023), which began with the collection of baseline data for adolescent girls (grades VII and X) and the socio-economic characteristics of their parents, assessment of nutrition-health literacy for young women regarding stunting and nutrition for groups at risk of stunting using tested questionnaires, measuring nutritional status anthropometrically (using a digital weight meter with a precision of 0.1 kg and a microtoice to measure height with a precision of 0.1 cm), biochemistry (measurement of hemoglobin using a photometer hemoCue Hb 301), and dietary assessment (food consumption patterns) in intervention schools (secondary school under the Ministry of Education, culture, and technology research) and comparison/control schools (secondary school under the Ministry of Religion) in 2021. In 2022, interventions will take the form of educational interventions by trained teachers and integrated nutrition services at the School-Based Young Women Posyandu (intervention school), while comparison schools only receive education from trained teachers. In early 2023, end-line data collection was carried out with the same variables as the baseline data collection.Prosedure intervensi

Intervention procedures

The intervention group received health-nutrition Education (4 weeks) from teachers trained by the research team and the implementation of an integrated adolescent girls Posyandu (4 months) previously formed by the research team to monitor growth and nutritional status, multi-micro-nutrient supplementation given 4 capsule per month (consumed one capsule per week), and counseling by primary health care officers and community Posyandu cadres. Meanwhile, the comparison group only received nutrition-health education from a trained teacher for four weeks, using the same method as the intervention group.

Integrated implementation of the Posyandu for young women was carried out 1-2 days per month for 4 months by 4 female students in each school, who had been trained by the research team to become cadres, then assisted by community Posyandu cadres and health workers from the primary health care who had also been trained by the research team. Nutrition education was carried out using lecture methods and discussion using video and booklets on [1] Malnutrition and Nutrition in the First 1000 Days of Life, [2] Healthy Nutritional Behavior of adolescent girl, [3] Reproductive Health of adolescent girl, [4] Physical Activity. From the booklet, the teacher makes teaching materials using PowerPoint presented by using the LCD. Before education implementation, it begins with a pre-test,

and at the end of the teaching, a test (post-test) has been done again. The teaching duration for each material ranges from 40-90 minutes, depending on the amount of material given based on the booklet.

Data Analysis

Anthropometric data on body weight and height were converted into Z-scores for BMI/Age and Height/Age using the WHO Anthro plus application to assess the nutritional status of young women. Data were processed and analyzed descriptively and analytically using Statistical Package for Social Science software. To assess the difference in effects before and after the intervention for data category used by McNemar Test, while for the continuous data, used paired T-test according to the data normality test. The chi-square and the independent T-test by using to assess the difference in effect between the two study groups according to the data normality test. Data is significant if the value of p is below 0.05 (= 5%, CI = 95%).

Results and Discussion

Characteristics of female adolescents based on age did not appear to be significantly different between the two study groups. However, the characteristic of parents (fathers and mothers) show that the work of fathers and mothers, including the education of fathers and mother looks significantly different in the intervention and comparison groups, where the work of fathers and mothers in the intervention group is more in the formal sector than the control group. Likewise, the education of fathers and mothers who were relatively high was also to be more common in the intervention group. It reflects that the socioeconomic aspects of the intervention group are better than the comparison group (Table 1).

The effect of education plus health-nutrition services at Posyandu (monitoring of growth and nutritional status, micro-nutrient supplementation, and nutrition counseling by health center staff and community Posyandu cadres) has an impact on increasing the output of health-nutrition literacy. The data showed that the nutritional-health knowledge of female adolescents increased significantly by 12.9% (p=0.000) after the intervention. On the other hand, the comparison group decreased significantly by 16.3% (p=0.0015). It indicate that communication, information, and education provided during nutrition-health services at the school-based adolescent girl Posyandu are one of the components that give leverage to increasing knowledge of nutrition-health for young women, which is not obtained by young women in the comparison group. This study inline with the results of studies in China (Wang et al., 2015) and Nigeria (Shapu et al., 2022)(Ogunsile & Ogundele, 2016) that nutrition education increases knowledge, attitudes, and adolescent practices, which leads to an increase in healthy eating patterns. Thus, nutrition education with interactive and innovative intervention components is crucial to promoting nutrition programs for adolescent girls.

Improved nutrition-health literacy in the intervention group also had a positive impact on the improvement consumption patterns of young women, especially animal food consumption as a source of protein and iron is needed during the growth period of young women, marked by an increase in the percentage of young women who consumed duck eggs, chicken, beef, fish, meatballs, and sausages, which were more varied than the comparison group (Figures 1 and 2). The implication of this change also contributed to the improvement in the nutritional status of young girls was marked by a higher increase in hemoglobin levels in the intervention group of 0.13 g/dl compared to the comparison group of only 0.04 g/dl, even though the increase was not significantly different between the two groups studies. In addition, the anemia prevalence rate decreased by 3.9% in the intervention group, while in the comparison group, it increased by 5%, although the change in anemia prevalence was not statistically significant in both groups (Table 2).

Table 1. Characteristics of Sample and Their Parent

Variable	**Intervention (n=260)**	**Comparison (n=80)**	***P- value***
Age (years); mean±SD	16.10±1.6	16.35±1.5	0.228*
• 13-15	106 (40.8)	27 (33.8)	0.442**
• ≥16-18	154 (59.2)	53 (66.3)	
Mother's education category, n (%)			0.041**
• Low	112 (43.1)	44 (55.0)	
• High	148 (56.8)	36 (45.0)	
Father's education category, n (%)	105 (40.4)	45 (56.3)	0.009**
• Low	155 (59.6)	35 (43.8)	
• High			
Mother's occupation, n (%)			
• Trader	10 (3.8)	2 (2.5)	
• Civil Servant	49 (18.8)	6 (7.5)	
• Private Employees	4 (1.5)	0	
• Housewife	177 (68.1)	67 (82.5)	
• Enterpreneur	15 (5.8)	3 (3.8)	
• Others	5 (1.9)	2 (2.6	
Mother's occupation category, n (%)	58 (22.3)	7 (8.8)	0.004**
• Formal	202 (77.7)	73 (91.2)	
• Non-Formal			
Father's occupation, n (%)			
• Farmer	18 (6.9)	26 (32.5)	
• Labour	2 (0.8)	5 (6.3)	
• Trader	7 (2.7)	1 (1.3)	
• Civil Servant	62 (23.8)	6 (7.5)	
• Private Employees	7 (2.7)	2 (2.5)	
• Entrepreneur	61 (23.5)	15 (18.8)	
• Fisherman	65 (25.0)	10 (12.5)	

• Carpenter	6 (2.3)	3 (3.8)	
• Others	32 (12.3)	10 (12.5)	
Father's occupation category, n (%)			
• Formal	75 (28.8)	13 (16.3)	0.015**
• Non-Formal	185 (71.2)	67 (83,6)	

The increase in Hemoglobin levels and the decrease in prevalence were not statistically significant in the intervention group, possibly due to the low adherence to supplement consumption. But this study reflects that school-based integrated interventions (nutrition-health education plus nutrition-health services at Posyandu for young women) have a better effect on consumption patterns and improve hemoglobin levels and anemia status in adolescent girls compared in the comparison group.

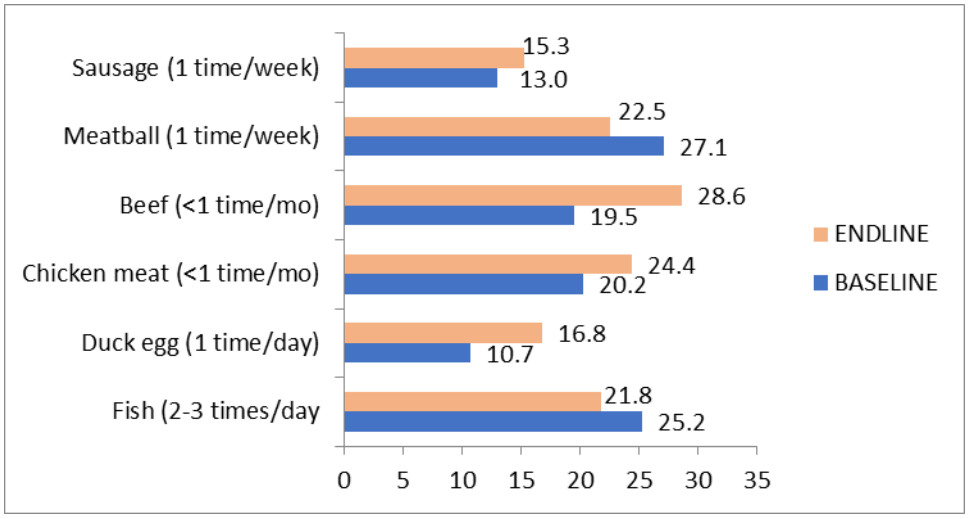

Fig. 1. Food pattern of consumption of sources of animal protein in intervention group

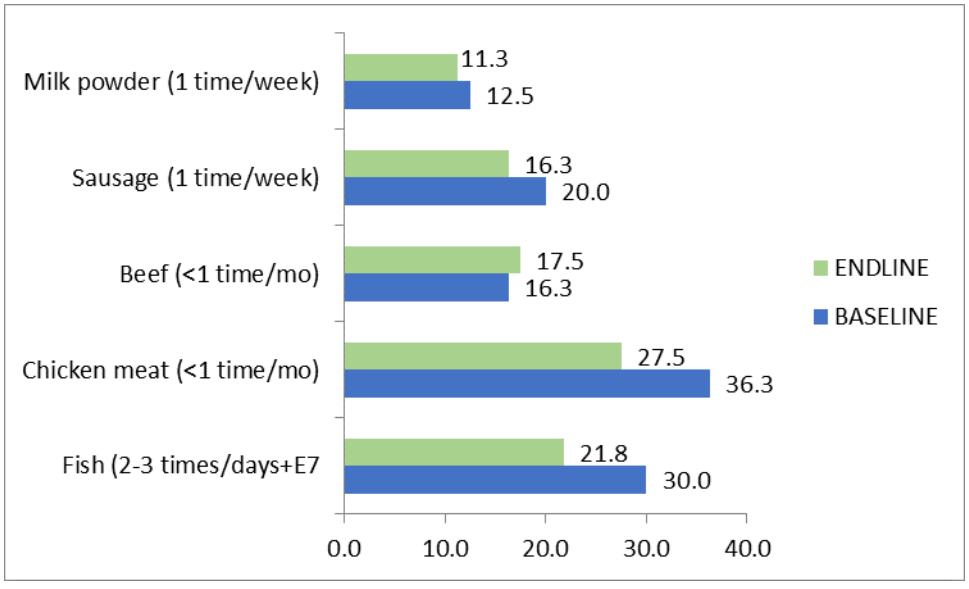

Fig. 2. Food pattern of consumption of sources of animal protein in comparison group

The study is in-line with the findings of Knijff et.al (2021) that frequently consuming foods rich in animal iron (meat, poultry, and fish) is associated with a significantly lower risk of anemia (prevalence ratio [PR]: 0.59; 95% CI: 0.36-0.97), and is associated with a 35% reduction in the prevalence of anemia in female adolescents (Knijff et al., 2021). Studies in Southern Ethiopia also show that a nutritionally sensitive intervention by giving poultry to children for six months can increase hemoglobin concentrations and reduce the prevalence of anemia in children under two years(Omer & Hailu, 2023).Other study reveal that nutritional education and counseling interventions for adolescents in rural Ghana positively affect the intake of foods rich in iron and vitamin C and reducing the prevalence of anemia and serum ferritin(Wiafe et al., 2023). High literacy is a factor associated with improving the nutritional status of adolescent girls (Mostafa et al., 2021)

In contrast to the HAZ-score value, after the intervention, there was a significant decrease in the HAZ-score value in both treatment groups, but the reduction rate was higher in the comparison group (0.06 SD; p=0.031) than in the intervention group (0.05 SD; p= 0.020), perhaps due to the addition of the age of girl adolescents not accompanied by an increase in height according to WHO standards. The number of adolescent girls in the 16-18 year age has increased accompanied by the increasing in the percentage of stunting in the intervention group (33.1%) and 49.1% in the comparison group. A study In South Africa shows that child age has a significant effect on stunting, but impacts on different age groups(Gaston et al., 2022). Before and after the intervention, the HAZ-Score remained significantly higher in the intervention group than in the comparison group. So, the stunted prevalence was significantly lower in the intervention group than in the comparison group. The stunted prevalence was reduced by almost four times (4.6%) in the intervention group compared to the comparison group (1.2%) and differed significantly (p=0.042). It is indicated that at a late age, many adolescent girls experience linear growth disorders or do not reach their potential for linear growth according to age. This study, in-line with the systematic review from low-middle-income countries regarding multi-component programs consisting of school gardens, nutrition, WASH and health education, supplementation, deworming, and healthcare referral were ineffective in reducing the prevalence of stunting, however the positive effect on nutrition knowledge and health behavior (Wrottesley et al., 2023).

Before the intervention, the percentage of female adolescents suffering from anemia and stunted did not differ significantly. However, after the intervention, there was a significant difference between the two study groups (p = 0.016). There was decreased Anemia and Stunted by 1.2% in the intervention group, whereas in the comparison group, there was an increase of almost 2-fold before the intervention. Integrated interventions (nutrition education, monitoring of growth and nutritional

status, multi-micro-nutrient supplementation, and counseling) for four months were able to have a better effect on reducing the prevalence of coexisting anemia-stunted although small effect and not statistically significant when compared to the comparison group, only receiving an education was not able to reduce the prevalence of stunted anemia in young women. Studies in Zambia show that quality nutrition education interventions for young women do not guarantee better nutritional outcomes, namely stunting (p = 0.30) and anemia (p = 0.38), because several factors can influence them namely adolescent preferences, dynamics in the household, and control of power sources (Hewett et al., 2020).

Table 2. The Effect School Based Integrated Intervention on Nutritional Status of Adolescent Girls.

Variable	**Time**	**Intervention group (n=260)**	**Comparison group (n=80)**	***p*-Value****
Hemoglobin Level (g/dl)	Baseline	12.94±1.32	12.93±1.39	0,945#
	Endline	13.07±1.36	12.97±1.32	0.541#
	Δ	0.13±1.07	0.04±1.07	
	p-value##	0.050	0.763	
Anemia	Baseline	55 (21.2)	14 (17.5)	0.295
	Endline	45 (17.3)	18 (22.5)	0.188
	*p-value**	0.174	0.481	
HAZ-score (SD)	Baseline	-1.56±0.87	-1.79±0.81	0.038
	Endline	-1.62±0.78	-1.85±0.80	0.026
	Δ	0.05±0.36	0.06±0.24	
	*p-value**	0.020	0.031	
Stunted	Baseline	93 (35.8)	33 (41.3)	0.031
	Endline	81 (31.2)	34 (42.5)	0.042

	*p-value**	0.290	1.000	
Anemia-Stunted	Baseline	15 (5.8)	5 (6.3)	0.527
	Endline	12 (4.6)	10 (12.5)	**0.016**
	*p-value**	0.581	0.063	

*Mc.Nemar Test, ** Chi-square Test, #T Independent Test, ## Paired T Test

Conclusion

The school-based integrated intervention for adolescent girls had a significant difference in the prevalence of coexist anemia-stunting with the comparison group. In the intervention group, the coexistence of stunting anemia was reduced by 1.2%, while in the comparison group it increased almost 2 times (12.5%).Therefore, school-based integrated interventions for female adolescent are crucial as a form of investment to break the chain of malnutrition.

Acknowledgements

Our thanks to all girl students, teachers, community Posyandu cadres, and community health center staff who collaborated in a participatory manner during the implementation of this research, including all school principals who provided full support in making this research successful. Equally important, we would like to thank the Ministry of education, culture, research, and technology for providing funding for the three years of this research (2021-2023).

Declaration of Interest Statement

All authors declare no conflict of interest.

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