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The Effect of Nutrition Education on Knowledge, Attitudes, and Iron Intake in Adolescent Girls

Sitti Zakiah[1]*, Aminah Toaha[2], Nur Abri[1], Endah Wahyutri[1]
[1] Department of Nutrition, Health Polytechnic, Ministry of Health East Kalimantan, Indonesia
*Corresponding author, contact: sittizakiahzakiah@gmail.com

Abstract

Anemia in adolescent girls is still a health emergency in developing countries, including Indonesia. This is still a priority scale for health management in various countries because it will harm the generation to be born. The education movement is considered very effective and efficient in preventing problems early. This study aimed to determine the influence of education on the knowledge, attitudes, and iron intake of adolescent girls at Public high schools 1 Tanjung Redeb. The research method is an experimental Quasy with a design of two groups Pre-test and Post-test conducted in May-June 2023. 50 research samples were selected in total sampling. Nutritional status is measured using anthropometric tools, and knowledge, attitudes, and food recalls are obtained using questionnaires that have been validated by tests. Independent sample T-test and Paired T-test and Wilcoxson test. The results showed that there was an effect of nutrition education in the intervention group on increasing knowledge (p 0.000) while the control group did not (p 0.100), while attitude did not affect the intervention and control groups respectively (p 0.876) and (p 0.410). Nutrient intake in the intervention and control groups (p 0.709) and (0.143) respectively. There were differences in knowledge after education in the control and intervention groups (p 0.013). Meanwhile, attitudes and iron intake were no different (p 0.722) and (p 0.100) after intervention and control education.

Keywords: Anemia, Nutrition Education, Knowledge, Attitudes, Iron Intake

Key Messages:

- Nutrition education is an effective and efficient way to prevent anemia in adolescent girls. In this study, nutrition education was found to increase knowledge about anemia in the intervention group. However, there was no effect on attitudes or iron intake.
- These findings suggest that nutrition education is a valuable tool for preventing anemia in adolescent girls, and that further research is needed to determine the most effective ways to deliver this education

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1. Introduction

Anemia is a condition of hemoglobin and hematocrit at low levels that cause the body to experience hypoxia as a result of decreased ability to transport oxygen from the blood (1) Adolescent girls are one of the

groups prone to anemia(2)At that time, growth and development occurred very quickly physically, psychologically, and cognitively, as eggs maturation in the reproductive system(2). Adolescent girls have a higher risk of anemia than boys because, every month adolescent girls face menstruation and also severely limit their food intake (3)

Anemia is one of the biggest public health problems in the world, especially in developing countries. According to WHO, the prevalence of anemia in adolescents in the world in 2016 within the Global Health Observatory (GHO) was estimated at 32.8%. Globally, the problem of anemia in adolescents affects around 2 billion people in the world, which has a major impact on the health and socioeconomic development of people, especially in developing countries, including English (2). Nationally, it is reported that the prevalence of anemia in Indonesia is 26.8% of children aged 5-14 years suffering from anemia and 32% at the age of 15-24 years. That means 3 out of 10 adolescent girls suffer from anemia(4).

Globally it is believed that the main causes of anemia are iron deficiency, malaria, chronic infections, lack of vitamin A, folate, vitamin B12, and vitamin C(5). Iron deficiency is one of the most common nutritional disorders with several adverse consequences for health such as decreased physical capacity and work performance, disorders cognitive performance, behavior, and growth (6) Other factors that influence anemia in adolescent girls include knowledge and awareness of meeting the needs and adequacy of nutrients. One of the efforts to encourage positive attitude changes related to food and nutrition is education. Education is a broad-dimensional process to change behavior so that a person can apply good eating habits in daily life that display informational messages that want to be conveyed through several media and methods(2).

The results of the preliminary study with hemoglobin examination on 48 female students of Public high school 1 Tanjung Redeb class X and XI, obtained the results of 7 female students (14.58%) with moderate anemia levels, and 37 female students (77.0%) with severe anemia levels and 4 female students (8.3%) with mild anemia levels. From interviews conducted with 10 female students about nutritional knowledge related to anemia, 60% of respondents with low knowledge scores were obtained, and 40% of respondents with high scores. Phenomenally, anemia is still one of the health emergencies today. Increasing knowledge, attitudes, and iron intake through education is considered very important to overcome the current anemia problem.

The education movement is considered very effective and efficient in preventing problems early. Nutrition education plays a vital role in preventing and treating anemia. It can help people understand the importance of eating a healthy diet, which includes foods rich in iron, vitamin A, and folate. These nutrients are essential for the production of red blood cells, which carry oxygen throughout the body. By teaching people how to choose and prepare nutrient-rich foods, nutrition education can help people prevent anemia and improve their overall health. This study aimed to determine the influence of education on the knowledge, attitudes, and iron intake of adolescent girls.

2. Methods

This research is an experimental quasi with a two-group Pre-test and Post-test design conducted at Public High School 1 Tanjung Redeb, Berau Regency in May-June 2023. The sample in this study was class X adolescent girls aged 14-15 years and had anemia with a total of 50 adolescent girls. The sampling method uses total sampling which is limited to inclusion and exclusion criteria. Young women who are willing to become respondents after reading and filling out informed consent, aged 14-15 years, and students of Public High School 1 Tanjung Redeb are eligible for samples. Those who are not willing to be respondents and are under the age of 14 years or over 15 years are not eligible to be sampled. Validity and reliability tests are conducted before questionnaires are used.

The characteristics of adolescents seen are nutritional status, upper arm circumference, and menstrual cycle. The classification of nutritional status, the risk of chronic energy deficiency if the upper arm circumference measurement results < 23.5 cm while there is no risk of chronic energy deficiency if ≥ 23.5 cm. The menstrual

cycle is said to be abnormal if > 7 days, and normal if 3-7 days. The nutrition education variable was assessed using the speech method and Teams Games Tournament (TGT) in the intervention group while in the control group only the speech method. The variable knowledge and attitudes were obtained using a structured questionnaire that has been tested for validation and rehabilitation of iron intake (Fe) obtained using 24-hour food recall. To determine the adequacy of iron consumption for adolescent girls, the Nutrisurvey 2007 application was used and the results were adjusted to the 2019 Daily Value for Health.

Test the effect of nutrition education on knowledge, attitudes, and iron intake using the Independent sample T-test and Paired T-test because the data are normally distributed, and the Wilcoxson test because the data are not normally distributed with a confidence level of 95%. The difference between knowledge scores, attitudes, and iron intake using the Mann-Whitney test on knowledge because the data is not normally distributed, whereas attitudes and intake iron use the Independent T-test because the data is normally distributed.

3. Results

Table 1 shows that nutritional status in adolescent girls is dominated by normal nutritional status, namely 11 adolescent girls in the control group (44%), and 16 adolescent girls in the intervention group (64%). The measurement of upper arm circumference found that the majority of adolescent girls were not at risk of chronic energy deficiency, in the control group of 16 adolescent girls (64%) and the intervention group of 15 adolescent girls (60%). The menstrual cycle of adolescent girls was obtained on average normal, namely in the control group 25 (92%) and intervention 22 (88%).

Table 1 The characteristics of respondents

Characteristics of Adolescent Girls	Group			
	Control (n 25)		Intervention (n 25)	
	n	%	n	%
Nutritional Status				
Severe Malnutrition	3	12	2	8
Malnutrition	4	16	5	20
Usual	11	44	16	64
Overweight	1	4	1	4
Obesity	6	24	1	4
Upper Arm Circumference				
Chronic Energy Deficiency Risk	9	36	10	40
No Chronic Energy Deficiency Risk	16	64	15	60
Duration of Menstruation				
Abnormal	2	8	3	12
Usual	23	92	22	88
Total	**25**	**100**	**25**	**100**

Based on table 2 illustrates the average knowledge level score of the intervention group before and after nutrition education increased by 1.96, while in the control group before and after education increased to 0.88. This shows that there is an influence of nutrition education using speech and TGT methods on increasing the knowledge of adolescent girls with a p-value of 0.000. Furthermore, the average attitude score in the intervention group increased before and after nutrition education by 0.16 while in the control group before and after education increased by 1.04. The results showed that there was no effect of nutrition education in the intervention group and control group with *p-values* of 0.876 and *p* 0.410 respectively. As for iron intake, it illustrates an increase in the average score of variable values of iron intake in the intervention group before and after nutrition education

of 0.31 while Iron intake in the control group before and after nutrition education increased by 1.01. The results showed that there was no effect of nutrition education on iron intake in the intervention and control groups with *p* 0.709 and *p* 0.143 respectively.

Table 2 Influence between variables

Variable	Intervention Group		*p*	Control Group		*p*
	Mean Before	Mean After		Mean Before	Mean After	
Knowledge	11,76	13,72	0,000 *	11,92	12,80	0,100*
Attitude	50,16	50,32	0,876**	49,28	50,32	0,410**
Iron (Fe) Intake	6,97	7,28	0,709**	6,64	7,65	0,143**

Remarks: * Wilcoxon Test; ** Paired T-test; ** Paired T-test

Based on Table 3, the average score of the intervention group after nutrition education was 30.48 while the control group after nutrition education had a mean average of 20.52. The results of the Mann-Whitney test showed a *p-value* of 0.013 which means that there was a difference between the intervention group when compared to the control group of 9.96 scores. As for attitude, the average mean value of the intervention group after nutrition education was 50.32, while the control group had a mean value after nutrition education of 50.32. The result of the Independent T-test with a *p-value* of 1,000 which means Ha rejected Ho accepted. There was no difference in attitude between the intervention group and the control group. Furthermore, iron intake showed a mean value after nutrition education in the intervention group of 7.28 mg while the mean value of iron intake after nutrition education in the control group of 7.65 mg. The result of the Independent T-test shows a *p-value* of 0.722 which means Ha rejected Ho is accepted. From these results, it can be concluded that there was no difference in iron intake after nutrition education between the intervention group and the control group in adolescent girls at Public High School 1 Tanjung Redeb.

Table 3 Value differences between variables

Variable	Mean Post-Test Intervention Group	Mean Post-Test Control Group	*p*
Knowledge	30,48	20,52	0,013*
Attitude	50,32	50,32	1,000**
Iron (Fe) Intake	7,28	7,65	0,722**

4. Discussion

Nutrition education on Adolescent Girls 's knowledge

Knowledge is the result of knowing, knowledge occurs after a person senses something through the five human senses, namely the senses of sight, hearing, smell, taste, and touch(7). The knowledge of Adolescent Girls in this study includes understanding anemia, its characteristics, causes, prevention of anemia, and food sources of iron. Notoatmodjo said that the information an individual has obtained can provide a cognitive foundation. Knowledge is one of the predisposing factors that can influence a person's behavior(3). The results showed a *p-value* of 0.000 in the intervention group which means that there was an influence of nutrition education on increasing the knowledge of adolescent girls at Public High School 1 Tanjung Redeb with an average increase in the mean value of 1.96 before and after nutrition education was given. Most respondents do not know anemia, the characteristics of anemia, and food sources of iron. This can occur due to various factors, such as lack of education/counseling, differences in the distribution time of iron supplements to each school, and program implementation methods in schools that are not optimal (8). However, after speech and TGT, there was an addition of new insights so that adolescents already knew about anemia.

The speech method is the most commonly used method for counseling. This method only relies on the sense of hearing for the learning process. The technicality of the speech method is describing to the audience and then on some occasions, the audience is given time to ask questions. Some studies say the speech method affects increasing knowledge. The advantage of the speech method is that it is effective and efficient in terms of time as well as cost. The speech method allows someone to provide more material so that hopefully a lot of information can be received. In addition, in the speech method, the audience does not need preparation and can immediately receive material(9). While TGT is a learning method that is easy to apply and can involve many people. According to Slavin, TGT-type cooperative learning consists of five stages, namely the class presentation stage, teams, games, tournaments, and team recognition. However, in the control group, nutrition education with the speech method did not have a significant effect with a *p-value* of 0.100.

This combination education method is an educational method that attracts and motivates respondents to be more active and teamwork in receiving and extracting information, in a real atmosphere and Fun, open discussions with friends that spark enthusiasm and understanding. The TGT and Speech methods occur in two-way communication which is carried out face-to-face so that extension workers can directly know the response of students who are given nutrition education, Also, there is interaction between teachers and students. TGT is effective in increasing knowledge because it creates a more active, relaxed atmosphere, and fosters cooperation and communication between team members(10) Interventions around nutrition education show a positive impact on knowledge, attitudes, and practices among adolescents attending school in Chidambaram India (11).

Analysis of the difference test after nutrition education between the intervention group with the speech method and TGT used the Mann-Whitney statistical test obtained a *p*-value of 0.013 which means there is a significant difference in knowledge after nutrition education between the intervention group with the speech method and TGT was compared with the control group with the speech method of 9.96. Previous research states that education has a positive effect on increasing knowledge in adolescents(12). This study is in line with research by Foresters et al (2023) in Java, Indonesia which found a change in knowledge of anemic adolescents after conducting nutrition education(13). Educational interventions effectively improve knowledge, attitudes, and practices regarding health, nutrition, and hygiene in junior and senior high school students (13)(14) Each learning method has advantages and disadvantages. Therefore, educators must be able to understand the right methods to be used in learning.

By providing knowledge about nutrient-rich foods, portion control, and the consequences of poor dietary choices, nutrition education equips adolescent girls with the tools they need to maintain good health throughout their lives. Furthermore, nutrition education is quite effective because it goes beyond theoretical knowledge; it often includes practical components that allow adolescent girls to apply what they have learned in their daily lives. Hands-on activities such as cooking demonstrations, meal planning, and grocery shopping guidance make the educational process more engaging and relatable. These practical experiences not only reinforce the theoretical knowledge but also instill valuable life skills that can help adolescent girls make healthier food choices independently. Additionally, nutrition education often addresses cultural and societal factors that may influence dietary decisions, promoting a more holistic understanding of nutrition. It encourages open dialogue and critical thinking, enabling adolescent girls to challenge misconceptions and make informed choices that positively impact their health. Overall, nutrition education provides a comprehensive and interactive approach to enhancing the knowledge of adolescent girls, making it a highly effective tool for promoting healthier lifestyles and long-term well-being.

Nutrition education on Adolescent Girls 's attitudes

Attitudes are influenced by knowledge, if adolescent knowledge increases then adolescent attitudes will also increase, this is following the theory put forward by Notoatmodjo (2007) that good knowledge will encourage

someone to display attitudes that are by the knowledge they have gained(15). Based on the existing theory that knowledge can influence the attitude of a person with good knowledge, good intentions will be realized, and vice versa. The results showed a p-value of 0.876 which means that there was no effect of nutrition education on the intervention group with speech and TGT methods before and after nutrition education on changes in the attitude of Adolescent Girls at Public High School 1 Tanjung Redeb.

Attitude change cannot happen quickly, especially in Adolescent Girls who have a critical nature and have unique habits and lifestyles. Including attitude towards the selection of food and drinks consumed. In this study, the frequency of nutrition education was only carried out once, no intervention was carried out in the form of health and nutritious food selection practices. Likewise, in the control group using the speech method, a p-value of 0.410 was obtained, which means Ha was rejected and Ho was accepted. Healthy school snacks and according to nutritional needs are not yet available, parenting and food habits are wrong related to food and nutrition so after being educated a positive attitude does not spontaneously change into a good one. This research is in line with research conducted by Witri Priawanti Putri et al. (2019) on school children that there is no influence of nutrition education media on changes in attitudes(16).

A systematic review observed that adolescents with better knowledge had better attitudes, but improved attitudes did not necessarily result in better practices(17). Analysis of attitude differences test after nutrition education between the intervention group with speech method and TGT compared to speech method in the control group obtained *p* result 0.100. It was concluded that there was no difference in attitudes of adolescent girls after nutrition education between the intervention group and the control group. Many other external and internal factors can affect a person's attitude. Attitude itself is not yet an action or activity but is a predisposition to the action of a behavior. However, this study is not in line with the research of Panchali Moitra et al. (2021) in India that there is an influence of education on attitudes and practices of eating habits in adolescents in India (18).

The observation that nutrition education has no significant effect on the attitudes of adolescent girls raises important questions about the underlying factors at play. Several reasons may contribute to this phenomenon. Firstly, it's essential to consider that attitudes are shaped by a complex interplay of various influences, including cultural, social, and familial factors. Nutrition education programs often focus primarily on imparting knowledge and fail to address the broader socio-cultural context in which food choices are made. Additionally, attitudes are not easily changed through information alone; they are deeply ingrained over time and influenced by personal beliefs and past experiences. Therefore, nutrition education programs may need to incorporate more comprehensive strategies, such as behavioral interventions and psychological support, to address the emotional and social aspects that underpin attitudes towards food and nutrition. Moreover, the impact of nutrition education may be influenced by the duration and intensity of the program, with longer and more immersive interventions potentially having a more profound effect on attitudes. Overall, while nutrition education can effectively enhance knowledge, a more nuanced and holistic approach may be necessary to achieve significant changes in the attitudes of adolescent girls towards nutrition

Nutrition education on Fe intake of **adolescent girls**

Arisman (2010) states that one of the causes of nutritional problems is to lack of nutrition knowledge which can then cause errors in choosing food. Poor adolescent eating habits begin with family eating habits that are also not good and have been ingrained since childhood and will continue to occur in adolescence. They eat sober without knowing the need for various nutrients and the impact of not meeting these nutritional needs on their health. Eating habits in adolescence will have an impact on health in the later phases of life(19). The results showed no significant effect between nutrition education in the intervention group and the control group after nutrition education on iron intake of adolescent girls at Public High School 1 Tanjung Redeb with *p* 0.709 and p 0.143 respectively. We found that the difficulty of realization of the intervention that has been carried out is

corroborated by the wrong pattern of eating habits shown from the 2 x 24-hour recall showing a less varied average selection of foodstuffs with amounts that are not as needed, canteen snacks are high in carbohydrates, Lack of vegetables and animal side dishes, not bringing provisions from home and the tendency of respondents to like certain types of food only, which causes lack of nutritional intake, as a trigger for health problems including anemia.

Knowledge of the source of iron and the benefits of iron has been obtained, but this is considered multifactor caused by the problems mentioned above. Test the difference in average iron intake after nutrition education in the intervention group was 7.28 mg while the mean value of average iron intake after nutrition education in the control group A total of 7.65 mg obtained a p-value of 0.722. From these results, it can be concluded that there was no difference in iron intake after nutrition education between the intervention group with the speech method and TGT with the control group with the speech method to Adolescent Girls at Public High School 1 Tanjung Redeb. The Sama et al (2023) study in Cameroon found insufficient meat consumption in a week, plantains (which are rich in iron) and fruits, (which facilitate iron absorption) were reported as risk factors for anemia, and Iron deficiency has been established as the leading cause of anemia(20). A previous study in Brazil suggested that consumption of dairy products, meat, and dietary diversity was associated with a low prevalence of anemia in adolescent girls(21). This is corroborated by the high prevalence of severe anemia in preliminary studies at the study site but in treatment, both interventions were considered to have no effect. Future strategies to address identified nutritional gaps among these population groups could include continued promotion of healthy food choices (including education around 'healthy' lifestyles and restrictions on food marketing), increased food supply through reformulation (fat, sugar, salt, diet), fiber, food fortification for micronutrients of concern and nutritional supplement recommendations(22).

To enhance the effectiveness of nutrition education in influencing the eating habits of adolescent girls, several suggestions and recommendations can be considered. Firstly, incorporating a diverse range of food sources rich in essential nutrients, such as iron, into nutrition education programs can be highly beneficial. Adolescent girls often have specific dietary needs, and introducing a variety of foods that provide iron from both animal and plant sources can help address potential deficiencies. Emphasizing foods like lean meats, poultry, fish, legumes, leafy greens, and fortified cereals can provide a well-rounded approach to iron intake and encourage dietary diversity. Furthermore, addressing specific eating behavior problems is crucial. Adolescence is a time when certain eating behaviors, such as skipping meals, emotional eating, or restrictive diets, can emerge. Nutrition education should include guidance on recognizing and managing these behaviors, promoting regular meal patterns, and fostering a healthy relationship with food. This could involve sessions on mindful eating, stress management techniques, or seeking professional support when necessary. Additionally, involving parents, guardians, and school communities in nutrition education initiatives can create a supportive environment that reinforces positive eating habits. Moreover, utilizing interactive and engaging teaching methods, such as cooking classes, taste tests, and meal planning activities, can make nutrition education more appealing and effective for adolescent girls. These hands-on experiences can help bridge the gap between knowledge and practical application, encouraging them to experiment with nutritious foods and develop a greater appreciation for healthy eating.

Research Limitations

This research was conducted only once so that education was carried out only once so that it could not produce positive results on the attitudes of Adolescent Girls. A person's attitude will change if the intervention is done repeatedly. In addition, it is difficult for Adolescent Girls to remember the food they have consumed over the past 24 hours. We assure that the researchers' accuracy in probing adolescent girls' food consumption is maximum.

5. Conclusion

The results of this study indicate that nutrition education had a significant and positive impact on the knowledge of adolescent girls in the intervention group. However, there was no discernible effect of nutrition education on the attitudes or iron intake of either the intervention or control group. It is noteworthy that knowledge levels improved significantly among those who received the intervention when compared to the control group.

The increase in knowledge resulting from nutrition education carries important practical implications for the health and well-being of these adolescent girls. Enhanced nutritional knowledge equips them with the information needed to make informed dietary choices, potentially leading to healthier eating habits. Over the long term, this improved knowledge could contribute to better nutritional practices, reduced risk of nutritional deficiencies, and overall improved health outcomes among adolescent girls. It is essential to emphasize that knowledge gained during adolescence can have a lasting impact on lifelong dietary patterns, making it a valuable investment in their future well-being.

Based on the findings of this study, several recommendations for future research and interventions can be made. Firstly, exploring ways to enhance the effectiveness of nutrition education in influencing attitudes and iron intake among adolescent girls is crucial. This could involve developing more tailored approaches that address the specific challenges and barriers faced by this demographic group. Additionally, considering the socio-cultural factors that may influence attitudes towards nutrition and iron intake could provide valuable insights for future interventions. Furthermore, it is essential to assess the long-term effects of improved knowledge resulting from nutrition education. Longitudinal studies could track the dietary habits and health outcomes of adolescent girls over an extended period to better understand the lasting impact of nutrition education. Moreover, evaluating the role of family, school, and community support in reinforcing the knowledge acquired during these interventions is an avenue worth exploring.

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Conflicts of Interest: The authors declare no conflict of interest

Ethical Clearance

Health Polytechnic Research Ethics Commission, Ministry of Health, East Kalimantan with number: DP.04.03/7.1/7821/2023

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