Peer Tutoring on Fish and Vegetables-Based Diets Education to Prevent Anemia and Hypoalbuminemia in Adolescents

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ABSTRACT

Early detection of nutritional problems is a vital skill for individuals as it enables timely prevention before any symptoms arise. This skill can be fostered through enhancing knowledge, practicing skills via educational activities and mentoring, and seeking support from peers who share similar challenges. This study aims to investigate the impact of peer tutoring on the development of a balanced menu and healthy snack consumption based on fish and vegetables among 11th-grade female students at a state high school in Singosari, Malang Regency. This study examined the effect of these interventions on the intake of energy, protein, and iron among the participants. Data were gathered by collecting food consumption data using the 24-hour food recall method and measurement of weight, height, Hb, and Albumin levels. The study employed a purposive sampling technique by conducting pretest, intervention, and post-test. The results showed significant improvements in the health indicators of the participants, including knowledge, intake, Hb, and Albumin levels (p=0.000; α=0.005). These findings demonstrate the potential of education and mentoring through peer tutoring in promoting healthy eating habits and preventing nutrition-related problems among female adolescents.

Keywords: diet, peer tutoring, anemia, hypoalbuminemia, adolescent

INTRODUCTION

Adolescent girls aged 10 to 19 years old are going through a period of rapid physical growth and changes. Besides being highly active and engaged in various activities, including school, adolescent girls are also starting to experience monthly menstrual cycles and are preparing for reproductive health as future mothers. This critical period requires careful consideration of their nutrient intake. Middle and high school adolescents begin to become interested in idols and tend to copy their idols’ physical appearance or body image. This emulation sometimes leads to the reduction of food intake as a means of achieving a desired

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appearance (Permaesih & Susilowati, 2015; Pou et al., 2015). However, inadequate nutrient intake in adolescent girls can negatively affect health, such as an increased risk of giving birth to low birth weight babies (BAPPENAS, 2006). This situation requires attention from parents or trusted individuals close to these adolescent girls, especially in preparation for their future as mothers (Kemenkes, 2014).

Inadequate nutrient intake often leads to the development of chronic energy malnutrition (CEM) in adolescent girls, characterized by hypoalbuminemia, thinness, and anemia. Compared to older age groups, this age group has a higher prevalence of CEM. The transitional period from childhood to adulthood brings about rapid physical, cognitive, and psychosocial changes in adolescents (Apriyanti, 2019). Insufficient consumption of energy, protein, and micronutrients during this phase can significantly contribute to nutritional issues, including CEM (Damayanti, 2017). According to the 2018 Basic Health Research, the national prevalence of CEM risk in non-pregnant women of childbearing age is 14.5%. Among female students, as many as 54%-55% experience CEM, while the incidence of anemia among adolescent girls in the 15-24 age group is 48.9% (Sulistyoningsih, 2011; Kemenkes, 2016).

Chronic Energy Deficiency (CED) can be identified through observable and measurable signs and symptoms. One such indicator is an Upper Arm Circumference (UAC) measuring less than 23.5 cm, which reflects nutrient availability in muscles and adipose tissues. CED occurs when a lack of nutrient intake, influenced by environmental and individual factors, leads to the depletion of the body’s nutrient stores as they are utilized to meet physiological demands. The prolonged persistence of this condition results in tissue deterioration (Supariasa et al., 2012). Various factors influence the occurrence of CED, as highlighted by Permaesih (Permaesih, 2005). These factors encompass food intake, activity levels, infectious diseases, nutritional knowledge, and family income.

Meeting the nutritional needs of adolescents is of utmost importance due to its direct influences on their growth and development. Nutrients play a vital role in cellular growth, making it essential to ensure an adequate intake. Furthermore, eating patterns significantly impacts the growth and development of adolescents. Those with poor eating patterns face a 1.2 times higher risk of developing anemia compared to their counterparts who follow regular and healthy eating patterns. Inadequate nutrient intake and unhealthy eating patterns contribute to low hemoglobin levels, adversely affecting overall health. Insufficient energy intake from macronutrients and micronutrients due to poor eating patterns can lead to the breakdown of proteins as a continuous energy source (Choudhary et al., 2015).

To prevent nutritional problems such as anemia, hypoalbuminemia, and protein-energy malnutrition (PEM), maintaining a healthy diet is crucial. Consuming high-energy foods rich in protein and micronutrients like iron and vitamin C is essential. Several studies have demonstrated a direct correlation between energy, protein, and iron consumption and changes in hemoglobin levels. Therefore, it is crucial to educate adolescent girls about the importance of a balanced diet that includes adequate protein and iron sources such as fish and vegetable-based foods. Providing nutrition education to adolescents is vital, as it can increase their nutrition knowledge by 54.3% and equip them with the necessary skills and awareness to prevent nutritional problems (Choudhary et al., 2015).
Although Indonesia is a maritime country with abundant food sources, the consumption of fish in Indonesian society remains relatively low. One notable animal-based protein source is the Snakehead fish, scientifically known as Channa striata, which is frequently used in research due to its high protein and albumin content. The Snakehead fish belongs to the Channa genus and is commonly found in rivers and freshwater environments. Compared to plant-based protein sources, animal-based proteins offer a more complete profile of essential amino acids. Many studies have utilized Snakehead fish as a dietary component to enhance hemoglobin levels and improve overall nutritional status (Fajri et al., 2020).

A study conducted by Choudhary et al. (Choudhary et al., 2015) examined 39 malnourished adolescent girls randomly selected from a group of 273 girls across seven villages. The results revealed a significant relationship between protein intake and nutritional status. Similar findings were reported in a study conducted by Tri (Pujiatun, 2014) on adolescent girls, showing strong correlations between energy and protein consumption levels and the incidence of CED. Therefore, it is crucial to consider meeting nutritional needs during adolescence due to the increased demand for supporting physical and psychological growth and development, which undergo rapid changes during this period.

The adequacy of protein intake can be assessed by measuring the level of albumin, as a storage protein in the body, which is related to changes in nutritional status. In protein-energy malnutrition cases, the levels of total protein and albumin in serum significantly decrease. Currently, the measurement of albumin levels is considered the gold standard in evaluating nutritional status conditions, and its indicative value increases when combined with prealbumin, transferrin, or cholinesterase. The synthesis of albumin and its level in plasma is very sensitive to protein intake. It can decrease drastically during periods of food shortage and increase when the deficiency is corrected (Oy et al., 2019).

Studies have demonstrated that the consumption of snakehead fish can elevate albumin levels and enhance immune function. Snakehead fish contains a superior profile of essential and non-essential amino acids compared to egg albumin. With its albumin content of 62.24 g/kg, consuming 2 grams of snakehead fish every day can increase albumin levels in the blood by 0.6 to 0.8 g/dl for 7-10 days.

Based on the above discussion regarding anemic adolescent girls, this study aimed to investigate how nutritional education about fish and vegetable-based innovative food products through peer tutoring can help increase their nutritional knowledge, dietary intake, Hb, and Albumin level. The study also evaluated the effectiveness of providing education and mentoring on implementing a balanced menu and fish and vegetable-based snacks in raising awareness of nutrition problems in adolescents.

**RESEARCH METHOD**

**Data Source**

This research was conducted at Singosari State High School, located in Malang Regency, Indonesia. The study was carried out between May and October 2022.

**Research Participants**

The study focused on female students who exhibited undernutrition, defined as having Hb levels below 12 g/dL, and/or BMI of 18.5 kg/m2 or less, and/or MUAC of 23.5 cm or less. Out of the 475 students screened, 47 students met the inclusion criteria and were selected as research participants. Inclusion criteria
included a willingness to participate from start to finish, an age range of 16 to 18 years, and no history of underlying diseases or illnesses with specific prohibitions. Exclusion criteria were applied to exclude respondents who were absent at the research location more than three times during data collection and intervention, or who experienced illness during the study, as confirmed by a medical certificate.

**Instrument**

The primary objective of the training was to strengthen the capabilities of the cadres of “Prestasi,” the health affairs student body at Singosari High School, as peer tutors and agents of change in the field of adolescent health. The training covered crucial topics such as adolescent characteristics, balanced menus, healthy snacks, proper nutrition, common nutrition issues, and personal hygiene. Additionally, participants received reinforced training to improve their skills in conducting health screenings and anthropometric measurements, with a focus on height, weight, and upper arm circumference.

**Data Collection**

During the training, participants were taught how to measure adolescent nutrition and health knowledge, conduct a 24-hour dietary recall, and distribute healthy snacks to their peers. Each health cadre was responsible for accompanying 2-3 peers who faced nutrition-related problems. The accompaniment took place twice a week for a period of 2 months. The intervention involved education through accompaniment by the health cadres, who were selected and formed prior to the study, as well as by the research team. The aim was to familiarize adolescents with consuming healthy meal menus and providing healthy snacks based on snakehead fish and vegetables.

**Data Analysis**

Pre- and post-intervention assessments included measurements of adolescent nutrition and health knowledge, a 24-hour dietary recall, and anthropometric measurements (height, weight). Data collection involved various methods, including a questionnaire form to identify anemic adolescent girls, an informed consent form to obtain participants’ willingness to participate, and a 24-hour food recall form. Food consumption data were collected using the 2x24-hour food recall method, which utilized the use of food images and household measurement units converted to weight (grams). Anthropometric data, such as height and weight, were collected through measurement and weighing.

Furthermore, the process of creating snacks based on the Snakehead Fish (Channa striata) was carried out at the Center of Excellence Laboratory of the Health Polytechnic of the Ministry of Health in Malang. Acceptance tests were conducted in March 2022 for three snack products based on Snakehead Fish, resulting in changes in weight and quantity for each product. Siomay was adjusted to 5 pieces weighing 25 g each, while nuggets remained at 3 pieces.

### RESULT

A total of 47 female students were assessed for student knowledge, hemoglobin (Hb) level, and albumin level.

#### Knowledge

Student knowledge data, collected through a questionnaire, revealed a normal distribution (p-value=0.200). Prior to the treatment, the baseline level of knowledge was 56.23±9.48. Following the treatment, which consisted of educational support and snacks for 16 sessions, a significant increase in the mean score was observed (p=0.000), resulting in a final score of 68.68±8.53.
**Hemoglobin**

The hemoglobin level data from the 47 female students showed a normal distribution (p=0.09). The mean hemoglobin level prior to the treatment was 11.73±1.69. Following the treatment, a significant increase in the mean hemoglobin level was observed (p=0.000), with a mean value of 13.37±1.58.

**Albumin**

The albumin level data measured from 33 female students exhibited a non-normal distribution (p=0.000). Prior to the treatment, the mean albumin level was 4.20 (ranging from 3.40 to 5.31). After the treatment, a significant increase in the mean albumin level was observed (p=0.000), with a mean value of 4.62 (ranging from 4.29 to 5.92).

Table 1 shows that after treatment, Knowledge, Hemoglobin and Albumin levels increased. Prior to the treatment, 34 female students had Hb levels below 12.00g/dL, but by the end of the study, only 9 students had Hb levels below the normal range. Although all female students had albumin levels within the normal category, the mean score increased from 4.20 to 4.62 mg/L. The statistical analysis using the Paired T-Test at a 95% confidence level revealed a significant difference (p=0.000) in all variables studied, including Knowledge, and Hb levels. Additionally, the increase in albumin levels was found to be significant (p=0.000) using the Wilcoxon Signed Rank Test.

<table>
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<td>Hb</td>
<td>Normal</td>
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<td>47</td>
<td>0.000*</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>13.37±1.58</td>
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<td></td>
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<tr>
<td>3</td>
<td>Albumin</td>
<td>Abnormal</td>
<td>4.20 (3.40-5.31)</td>
<td>33</td>
<td>0.000†</td>
</tr>
<tr>
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<td>4.62 (4.29-5.92)</td>
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</table>

Note: * Paired t-test; †Wilcoxon signed Rank Test α 0.05

**Table 1. Changes in Knowledge Indicator, Hemoglobin Level, and Albumin Level of the Female Adolescents**

**DISCUSSION**

The positive impact of education on health is reflected in the significant improvement in the scores of various health indicators. Research by Asmarudin (Pakhri et al., 2018) supports the relationship between education and knowledge enhancement. In their study, nutrition education using healthy food materials was provided to teenagers, resulting in a significant increase in their average nutritional status. This improvement can be attributed to the increased awareness and understanding of nutrition among the respondents, as well as the support from their close relatives.

The energy content derived from carbohydrates, protein, and fat is an essential component of the diet. The study results showed that the average energy intake of female students before the intervention was 1174 calories, which significantly increased to 1371 calories (p = 0.008 < 0.05) after the intervention.

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Insufficient energy intake can lead to weight loss and chronic energy deficiency, as pointed out by Suarjana (Suarjana, 2020). Moreover, the average protein intake of female students also showed a substantial increase, rising from 44.6 grams to 53.7 grams ($p = 0.001 < 0.05$). Protein plays a vital role in various bodily functions, including cell repair and tissue synthesis, hormone production, and regulation of the acid-base balance. However, thin teenagers tend to consume inadequate amounts of protein, as revealed by the recall data. To address this, adolescents are advised to incorporate a variety of high-protein foods into their diet, encompassing both animal and plant sources. Animal-based protein options include beef, lamb, poultry, eggs, fish, milk, and other processed products. Meanwhile, the plant-based protein group includes legumes such as nuts, tofu, tempeh, green beans, red beans, and lentils, among others (Apriyanti, 2019). These foods are recommended as part of a balanced diet according to the dietary guidelines provided by the Ministry of Health in Indonesia (Kemenkes, 2014).

The statistical analysis conducted showed no significant increase in iron intake among female students at Singosari State High School ($0.09 > 0.05$). This suggests that education on iron consumption among students did not have a significant difference. Iron is an essential component in hemoglobin formation, and inadequate nutritional intake can lead to a deficiency in the body, particularly in nutrients such as iron. Insufficient iron intake can lead to a decrease in the production of red blood cells, leading to anemia. This finding is supported by Pakhri’s study (Pakhri et al., 2018), indicating nutrition education did not significantly affect iron consumption, possibly, due to limited food diversity and inadequate nutritional intake, including iron.

However, before consuming snakehead fish snacks, the average hemoglobin level of female students was 11.7 g/dL, while after consuming snakehead fish snacks, it significantly increased to 13.3 g/dL ($p = 0.000 < 0.05$). The research results demonstrate that snakehead fish meat has a very good chemical composition and can be consumed as a healthy snack (Karnila et al., 2017). This significant increase in hemoglobin levels before and after the intervention indicates the positive impact of snakehead fish consumption. Hemoglobin is responsible for transporting oxygen and carbon dioxide in the body, and changes in hemoglobin levels can be influenced by factors such as nutrition, knowledge of nutrition and health, eating patterns, and iron supplements. Increased iron needs occur mainly during menstruation or chronic illness (Oy et al., 2019). Protein plays a crucial role in hemoglobin formation, as it assists in the absorption of iron. Protein is an essential building block throughout the human life cycle. Food that enhances iron absorption, especially non-heme iron, is vitamin C and other animal protein sources such as fish and chicken. Protein from meat sources, such as fish and chicken, can increase the absorption of non-heme iron derived from cereals and plants. Iron is essential for hemoglobin production, and the majority of iron is recycled from broken-down red blood cells. However, when there is a deficiency, it must be replenished through dietary intake. Anemia can occur when there is insufficient iron absorption in the intestines, which may be caused by intestinal disorders or surgical procedures (Adriani & Wirjatmadi, 2012).

Study results found a correlation between protein intake and hemoglobin levels in females (Kristin et al., 2022). Protein plays a crucial role in the storage, transport, and absorption of iron. Insufficient protein intake can disrupt the
transportation of iron, leading to iron deficiency and low hemoglobin levels. The measurement of albumin levels showed that 31 respondents experienced a significant increase in albumin levels ($p = 0.000 < 0.05$) between the results of blood albumin tests before and after the intervention. Albumin levels are an indicator of a person’s nutritional status and usually occur over a prolonged period. Changes in albumin levels can cause platelet function disorders. Albumin level tests are usually performed to determine low energy and protein intake, and they are considered more accurate than anthropometry measurements. Albumin is the most abundant protein in blood plasma, and its value can be used as an indicator of health status and a long-term disturbance in nutrient intake, particularly protein (Aulia, 2019).

Peer tutors have been found to have a significant impact on adolescents, making them an ideal choice for delivering messages. Adolescents are highly influenced by their peers, whether in terms of eating habits, fashion choices, or lifestyle preferences. A study conducted by Lidiawati et al. (2020) specifically highlights the significant influence of peers of the same age on the eating behavior of adolescents. This influence can be harnessed to create positive impacts among adolescents. Furthermore, research conducted by Nuryani and Paramata (2018) emphasizes the effectiveness of peer tutoring and education provided by peers in improving knowledge, attitudes, and behaviors related to balanced nutrition in adolescents. Therefore, utilizing peer tutors as messengers can be a powerful strategy to promote healthy behaviors and empower adolescents in making informed choices.

**CONCLUSION**

The study findings indicate that utilizing peer tutors as an intervention is an effective method for transferring knowledge and encouraging healthy eating and lifestyle habits. Providing female students who suffer from malnutrition or low hemoglobin levels with 16 educational sessions, each lasting 10-15 minutes, significantly improve their understanding of nutrition and health. Moreover, offering healthy snacks weighing between 60-100 grams during these sessions further improves their overall health status. Interventions, such as providing healthy snacks based on snakehead fish and vegetables, can be a viable alternative in preventing anemia and hypoalbuminemia in adolescents.

The present study recommends utilizing the Achievement Cadres of Singosari State High School to assist the School Health Unit in monitoring the health development of students at school, facilitating early detection of health issues. To sustainably maintain and improve student health, periodically refresh and train the school Cadres are crucial. Incorporating nutrition and health topics into learning activities and promoting best practices related to nutrition and health can significantly enhance student awareness for early prevention of anemia and hypoalbuminemia.

**REFERENCES**


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IKAN GABUS CHANNA STRIATA UNTUK MENINGKATKAN KADAR HEMOGLOBIN PADA IBU NIFAS ANEMIA DI RSUD HJANNA LASMANAH BANJARNEGARA


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