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Original Research Paper

The Relationship Between Fruit and Vegetable Consumption with The Incidence of Anemia Among Adolescent Girls in Three High Schools In Central Maluku

Damara Herlis Mailera[1], Elpira Asmin[2*], Mutmainnah Abbas[3], Ritha Tahitu[2], Christiana R. Titaley[2], Theresia Seimahuira[2]

[1]Undergraduate Medical Study Program, Faculty of Medicine, Universitas Pattimura
[2]Department of Public Health Sciences, Faculty of Medicine, Universitas Pattimura University
[3]Department of Biomedical Sciences, Faculty of Medicine, Universitas Pattimura

Email Corresponding:
elpiraasmin@gmail.com

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ABSTRACT

Background: Anemia is a global health problem common in both developed and developing countries, often caused by nutritional deficiencies, including low intake of fruits and vegetables. Adolescent girls are particularly at risk due to monthly menstrual blood loss. **Objective**: This study aimed to analyze the relationship between fruit and vegetable consumption and the incidence of anemia among adolescent girls in three high schools in Central Maluku in 2024. **Methods**: This was a quantitative analytical study using a cross-sectional design. The population consisted of students from SMA Negeri 15, SMA Negeri 44, and SMA Negeri 48 Central Maluku. A total of 102 respondents were selected using a total sampling technique. Anemia status was measured using the Hemocue device, and data on fruit and vegetable consumption were collected using the Commcare application. Data analysis was performed using the Spearman test. **Results**: The prevalence of anemia among respondents was 36.3%. Meanwhile, 63.7% reported regularly consuming fruits and 55.9% regularly consumed vegetables. **Conclusion**: There was no statistically significant relationship between fruit ($p = 0.504$) and vegetable ($p = 0.587$) consumption and the incidence of anemia in adolescent girls in the selected Central Maluku high schools in 2024.

Introduction

Anemia is a public health problem that still occurs frequently in adolescents, both in developed and developing countries[1]. According to the World Health Organization (WHO), when the number of red blood cells or hemoglobin concentration is less than the normal value, it can be said as anemia[2]. This condition can cause symptoms such as fatigue, weakness, dizziness, headache, and shortness of breath[3]. The hemoglobin concentration required to meet physiological needs may vary depending on factors such as age, gender and physiological status[2].

The global prevalence of anemia according to WHO in 2021 in women aged 15-49 years reached 29.9%[4]. The incidence of anemia in Maluku Province in 2023 reached 9.04%, while in Central Maluku District it was 1.54%. Not all districts have implemented anemia screening, because the anemia screening program was only implemented at the end of 2023. The district with the highest prevalence of anemia in Maluku Province is Buru District with a prevalence of 39.24%[5].

Iron absorption is strongly tied to the consumption of certain nutrients, such as vitamin A which can affect erythropoiesis, as well as vitamin C which functions in the formation of hemoglobin in the blood circulation, these vitamins will support the absorption of iron and nutrients, allowing them

to be processed into red blood cells[6,7]. Foods rich in vitamin C and vitamin A include fruits and vegetables. Apart from vitamins, fruits and vegetables also contain fiber, folic acid, and various minerals that are good for the body[8].

Anemia in adolescents can result in impaired growth and development, fatigue, increased risk of infection due to a decreased immune system, decreased body function and endurance, increased susceptibility to poisoning, and impaired cognitive function[9]. The impact of anemia can also carry over until she becomes an anemic pregnant woman, which can result in the risk of stunted fetal growth, prematurity, low birth weight and stunting[10,11,12].

Based on the explanation above and no research has been conducted related to anemia in Central Maluku, especially in three Central Maluku High Schools, namely SMA Negeri 15, SMA Negeri 44 and SMA Negeri 48 Central Maluku. In addition, Central Maluku is one of the loci of stunting in Maluku Province. One of the areas with a high incidence of stunting is in Sepa Village. The three schools that became the research locations were located close to Sepa Village, so the author was interested in examining the incidence of anemia in adolescent girls attending the three high schools and analyzing the relationship between fruit and vegetable consumption and the incidence of anemia.

Deficiency of iron and other macronutrients is a major cause of anemia. Vitamin A and vitamin C found in vegetables and fruits are beneficial in improving iron absorption and increasing hemoglobin, thus preventing anemia. Currently, adolescents' food choices tend to be loaded with sugar, fat, and protein, and low in vitamins and minerals, which may adversely affect their future health[13]. This triggers an important question to be answered, namely "Is Fruit and Vegetable Consumption Associated with the Incidence of Anemia in Adolescent Girls in three Central Maluku High Schools in 2024?".

Materials and Methods

Research Design

The study employed an observational analytic method with a cross-sectional approach, conducted at SMA Negeri 15, SMA Negeri 44, and SMA Negeri 48 in Central Maluku.

Sample

The sampling technique used was total sampling with specific inclusion and exclusion criteria. The inclusion criteria were adolescent girls enrolled in the selected schools who were willing to participate in the research. Exclusion criteria included adolescent girls who had not yet menstruated, were menstruating during data collection, or were suffering from infectious diseases such as intestinal worms or tuberculosis. From a total of 134 respondents, only 102 met the criteria and were included in the analysis, while 32 were excluded based on the criteria and absentees during data collection.

Data Collection Techniques

Two instruments were used in this study: a HemoCue device and a questionnaire. The HemoCue was utilized to measure hemoglobin levels, while the questionnaire—sourced from Commcare was administered through interviews to assess fruit and vegetable consumption. A location survey was conducted on May 30 and 31, 2024, followed by a training session on June 5, 2024, in Classroom 3 of the Faculty of Medicine, Pattimura University. The training involved six team members, consisting of two height, weight, and MUAC examiners, two hemoglobin examiners, and four interviewers. The actual data collection was carried out on June 7 and 8, 2024.

Data Analysis Techniques

The data obtained were analyzed using SPSS version 23. Univariate and bivariate analyses were applied. The bivariate analysis included a correlation test, preceded by a normality test using the Kolmogorov-Smirnov method. Since the data were not normally distributed, the Spearman correlation test was used. The results were presented in tables, as well as frequency and percentage distributions.

Ethical Consideration

Although the study does not mention formal ethical approval, the research ensured ethical feasibility by obtaining informed consent from all respondents, maintaining confidentiality, and ensuring voluntary participation without coercion. All procedures were conducted in accordance with ethical research principles for studies involving human participants.

Resutls

The characteristics of respondents reviewed in this study include fruit consumption, vegetable consumption, and anemia (Table 1). Based on Table 1, it is known that out of 102 female students, the majority regularly consume fruit with 65 people (63.7%) and regularly consume vegetables as many as 57 people (55.9%). In this study, it was also found that the majority of respondents did not experience anemia with 65 people (63.7%). Indicators of routine or non-routine fruit and vegetable consumption were assessed using a questionnaire on Commcare conducted by interviewing respondents based on WHO fruit and vegetable consumption recommendations. Routine if fruit consumption in 1 day > 150 g and not routine if fruit consumption in 1 day < 150 g, while routine vegetable consumption if in 1 day > 250 g and not routine if vegetable consumption in 1 day < 250 g[14]. This study categorizes anemia based on WHO recommendations using HemoCue to measure Hb levels in respondents. Respondents were said to be anemic if the Hb level was < 12 g/dL and not anemic if the Hb level was < 12 g/dL[15].

Table 1. Respondent Characteristics

Characteristics	n	%
Fruit Consumption		
Routine	65	63,7
Not Routine	37	36,3
Vegetable Consumption		
Routine	57	55,9
Not Routine	45	44,1
Anemia		
Yes	37	36,3
Not	65	63,7

Source: Primary Data

In the bivariate analysis, Table 2 shows that the incidence of anemia can be found most in respondents with non-routine fruit consumption levels as many as 15 people (40.5%), while anemia in respondents with routine fruit consumption is 33.8%. In this study, it was also found that the most respondents who experienced anemia were respondents with routine vegetable consumption levels as many as 22 people (38.6%) and respondents who experienced anemia at the level of non-routine vegetable consumption were 15 people (33.3%). The results of the Spearman test conducted showed no relationship between fruit consumption and anemia with a value of $p = 0.504$ ($p > 0.05$). In addition, the results of the analysis also showed that vegetable consumption was not associated with the incidence of anemia, with a p value = 0.462 ($p > 0.05$), indicating that vegetable intake did not significantly affect the anemia status of the study subjects. These findings suggest that other dietary components or external factors, such as iron intake, vitamin C adequacy, absorption inhibitors, or underlying health conditions, may have a more dominant influence on anemia incidence and should be considered in further research.

Table 2: Relationship between Fruit and Vegetable Consumption and Anemia

Variables	Anemia				Total		p
	Yes		Not				
	n	%	n	%	n	%	
Fruit Consumption							
Routine	22	33,8	43	61,4	65	100	0,504*
Not Routine	15	50,5	22	59,5	37	100	
Vegetable Consumption							
Routine	22	38,6	35	61,4	57	100	0,587*
Not Routine	15	33,3	30	66,7	45	100	

Notes= *: Significant (p > 0.05)

Discussion

Relationship between Fruit Consumption and Anemia Incidence

This study shows that there is no relationship between fruit consumption and the incidence of anemia in adolescent girls, with a p value = 0.504. The results of this study also found that respondents who do not routinely consume more anemia than respondents who routinely consume fruit. The results of this study are in line with research conducted by Liyana et al[16] (2020), in Karanganyar Regency stated that there was no relationship between fruit consumption and hemoglobin levels in adolescent girls. The study showed that fruit consumption did not correlate with hemoglobin levels with a p value = 0.740. There was no correlation between fruit consumption and hemoglobin levels in these respondents because most of them had low fruit consumption.

However, it is possible that daily consumption of fresh fruits may help in the absorption of iron.[16] The results of this study are inversely proportional to the results of previous research conducted by Ghose and Yaya [17] (2018) in Ghana, which found a significant relationship between fruit consumption and anemia with chi-square test p value = <0.01. The results of crosstabs in Ghose's study showed that respondents who consumed less fruit suffered from severe anemia as much as 72.1%, moderate anemia as much as 88.1% and mild anemia as much as 96.6%, while respondents who consumed enough fruit suffered from severe anemia as much as 27.9%, moderate anemia as much as 11.9% and mild anemia as much as 3.4%.[17]

The similarity between the results of this study and the research of Liyana et al[16] (2020) may be due to the fact that the respondents in this study mostly consumed fruits that were low in vitamin C or contained less iron that could help in increasing hemoglobin so that there was no relationship between fruit consumption and the incidence of anemia in respondents. Although fruit consumption is important for overall health, including supporting the immune system and increasing the absorption of iron from other foods, not all fruits can function in preventing anemia.

The iron found in fruits is non-heme iron, which has a lower bioavailability compared to heme iron found in animal sources, such as red meat and fish. Non-heme iron from plants tends to be more difficult to absorb by the body, mainly due to inhibiting factors such as phytates present in plant foods, so absorption rates may vary depending on individual conditions and the type of food consumed together. Although fruits contain vitamin C which is known as an iron absorption enhancer, helping to increase the bioavailability of non-heme iron, the iron content itself in fruits is usually very low. Therefore, relying on fruits as

the sole source of iron to prevent anemia is not effective enough[18].

Relationship between Vegetable Consumption and Anemia Incidence

This study shows that the relationship between anemia in adolescent girls is not significant, with a p value = 0.587. The results of this study also found that the incidence of anemia was mostly found in respondents with routine vegetable consumption levels compared to respondents who did not routinely consume vegetables. The results of this study are in line with previous research conducted by Gita Restiana et al[19] (2022), at MA Darussa'adah Jakarta which shows that there is no relationship between vegetable consumption and the incidence of anemia with the results of the pearson correlation test p = 0.333. In the study, it was said that the relationship between vegetable consumption and anemia showed a very weak but positive relationship, which means that the higher the consumption of vegetables and fruits, the higher the hemoglobin level of female students[19]. The results of this study are inversely proportional to the results of previous research conducted by Liyana et al[16] in 2020. The research shows that vegetable consumption has a positive correlation with hemoglobin levels with a p value <0.001. It can be concluded from this study that vegetable consumption can be related to hemoglobin levels in adolescent girls[16].

Vegetables generally contain non-heme iron, which is less efficiently absorbed by the body than heme iron found in animal products. Vegetables also contain other important nutrients, but some molecular components such as calcium, polyphenols and phytates, which are abundant in green leafy vegetables, may interfere with iron absorption. Since most plants contain non-heme iron even in high amounts, iron absorption is low due to plant-derived iron-molecule interactions[20,21].

Limitations in this study include the relatively small number of respondents, which may affect the generalizability of the research results. This is due to the timing of the study, which was conducted after the school graduation exams, so that many grade XII students could not participate because they had entered the vacation period or other activities outside of school. This limitation caused the researcher to not be able to reach the entire planned target population, which in turn may affect the overall representation of the sample. In addition, this study also did not take an in-depth look at other variables that could potentially be risk factors for anemia in respondents, such as nutritional history, dietary habits, physical activity levels, socioeconomic status, and exposure to chronic infections or other health conditions that could affect hemoglobin levels. Therefore, in the future, further research with wider coverage and control of more variables is needed to obtain more comprehensive and representative results regarding the prevalence of anemia and the risk factors that affect it. In addition, a more appropriate timing of the study is also needed so that the entire population can be optimally involved in this study.

Conclusion

Adolescent girls who were not anemic were found to be more numerous than those who were anemic in this study. Interestingly, although the majority of those who were not anemic consumed fruits and vegetables more regularly than those who were less regular, there was no significant association between fruit or vegetable consumption and the incidence of anemia. This result was obtained from a study conducted in three senior high schools in Central Maluku in 2024. This indicates that while fruit and vegetable intake is important for overall health, their consumption may not be sufficient to directly prevent anemia. The causes of anemia can be more

complex, including various other factors such as deficiencies in iron, vitamin B12, folic acid, as well as other health issues, which cannot be fully addressed by simply increasing fruit and vegetable consumption. Therefore, more comprehensive interventions, such as increased intake of foods rich in heme iron and other micronutrients, may be needed to reduce the risk of anemia in this population. Future researchers are expected to consider the results and limitations of this study as a basis for improvement in future studies. By conducting a more comprehensive analysis of other variables that may affect hemoglobin levels in adolescent girls, such as daily nutrient intake, hydration status, genetic factors, and family health history, future research can obtain a more holistic picture of the causes of anemia. In addition, it is important for future studies to expand the sample size and choose a more appropriate time to ensure optimal respondent participation. Not only that, socioeconomic variables, exercise habits, and exposure to infections also need to be taken into account because they can have a significant impact on the condition of anemia. Thus, it is hoped that future studies can produce more accurate and useful findings for effective anemia prevention and treatment programs among adolescent girls.

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