



Knowledge and attitudes regarding iron deficiency anemia towards consumption of high iron foods, enhancers, and inhibitors among Youth Red Cross

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ABSTRACT

Background: Youth Red Cross (YRC) members often get information about anemia, so they are considered to have better knowledge and attitudes than non-members. The knowledge and attitudes of YRC members may have influence the consumption of high-iron foods, enhancers, and inhibitors to prevent anemia.

Objective: This study aims to determine the correlation between knowledge and attitude regarding iron deficiency anemia towards the consumption of high-iron foods, enhancers, and iron inhibitors in YRC members of High School 1 Purwokerto.

Materials and Methods: A cross-sectional study involving 58 YRC members in High School 1, Purwokerto. The samples were selected by the proportionate stratified random sampling method. Data were collected using knowledge and attitude questionnaires, then the consumption levels using SQ-FFQ and FFQ. The data were analyzed using the Chi-Square test and Likelihood Ratio.

Results: There is no correlation between knowledge regarding iron deficiency anemia towards the consumption of high-iron foods and iron inhibitors ($p=0.18; 0.47$). In addition, there is also no correlation between attitude regarding iron deficiency anemia towards the consumption of high-iron foods, enhancers, and iron inhibitors ($p=0.37; 0.16; 0.50$). However, there is a correlation between knowledge regarding iron deficiency anemia towards the consumption of iron enhancers ($p=0.01$).

Conclusion: There is no correlation between knowledge and attitude regarding iron deficiency anemia and consumption of high-iron foods and iron inhibitors, nor between attitude regarding iron deficiency anemia and consumption of iron enhancers. However, there is a correlation between knowledge regarding iron deficiency anemia with consumption of iron enhancers.

Keywords : Anemia; attitudes; iron; knowledge

BACKGROUND

Iron deficiency anemia is an anemia that adolescents are prone to, which arises because the amount of available iron is insufficient for hemoglobin synthesis, so hemoglobin levels will decrease. Anemia during adolescence can cause various physiological impacts throughout life, such as reduced body resistance to fight infection, impaired physical performance and neurological development, as well as less than optimal educational results.^{1,2} Based on the Basic Health Research Report, there has been an increase in the incidence of anemia among adolescent girls in Indonesia from 21.7% in 2013 to 32% in 2018.^{3,4} The prevalence of adolescents experiencing anemia in Central Java in 2013 reached 57.1%.⁵ Based on previous research, as many as 30.2% of young women in Banyumas Regency were suffered of anemia.⁶

Adolescents are at high risk of experiencing iron deficiency anemia due to the factors of being at the peak of puberty development, low iron intake, lack of consuming iron enhancers, and consuming iron inhibitors at the same time as consuming iron sources.^{7,8} Iron sources are very important to meet the iron needs of adolescents which increase during the peak of puberty development. High-iron foods contain substantial amounts of iron, which exists in two forms known as heme and non-heme iron. Heme iron, found in animal-based foods such as meat, fish, and liver, has greater bioavailability than non-heme iron, which is primarily found in plant-based sources.^{9,10} Not only the amount of iron intake, but also how it is consumed affects iron absorption. Iron absorption, especially non-heme iron, can be influenced by enhancers and inhibitors.¹¹ Iron enhancers are substances that facilitate iron absorption, including vitamin A, vitamin B2, vitamin C, protein, and folate.^{9,12} In contrast, iron inhibitors are anti-nutritional factors that can hinder iron absorption, such as tannins, phytates, oxalates, and calcium.⁹

Knowledge and attitudes of adolescents regarding iron deficiency anemia is an important aspect in efforts to realize positive actions to prevent iron deficiency anemia.¹³ Good knowledge of anemia will influence adolescents' attitudes in choosing good foodstuffs, such as influencing them to choose and get enough food sources high in iron and iron enhancers and avoid consuming iron inhibitors.^{14,15} Knowledge and attitudes of adolescents regarding iron deficiency anemia can be improved in the school environment through the role of peer tutors. One element that has the potential to become a peer tutor in improving knowledge and attitudes in schools is the Youth Red Cross (YRC).¹⁶

YRC members gain more health knowledge than other extracurricular members. YRC members who have more interest in health will have more potential to become peer tutors in conveying nutrition and health information to their peers at school.¹⁶ The YRC of High School 1 Purwokerto also has the same conditions as above. Members of the YRC High School 1 Purwokerto were trained to become health teams and held health education events at the school. Based on the aforementioned reasons, this study aims to determine the correlation between knowledge and attitude regarding iron deficiency anemia towards the consumption of high-iron foods, enhancers, and iron inhibitors in YRC members of High School 1 Purwokerto.

MATERIALS AND METHODS

This study used a cross-sectional design. This research was carried out at High School 1 Purwokerto in East Purwokerto, Banyumas Regency, Central Java, Indonesia, in the period May-June 2023. The population in this study consisted of all members of YRC Senior High School 1 Purwokerto, which included 60 students from grade 10 and 51 students from grade 11. The sample for this research was 58 members of YRC who were taken using the proportionate stratified random sampling method and met the inclusion criteria. The inclusion criteria for participants in this study were active members of YRC High School 1 Purwokerto aged 15-18 years. On the other hand, the exclusion criteria in this study were YRC members of High School 1 Purwokerto who were vegetarian or vegan. Before the study, the researcher explains the research to be carried out. The researcher asked for the consent of the respondent's parents and the YRC supervisor at High School 1 Purwokerto by filling out an informed consent to allow the respondent to take part in this research. Researchers also asked for respondents' approval by filling out informed consent to become respondents in the research. This research has received ethical approval from the Health Research Ethics Committee of the Faculty of Health Sciences, Jenderal Soedirman University, with approval Number: 1080/EC/KEPK/V/2023.

Data on respondent characteristics (gender, age, grade, pocket money, residential status, and consumption of FF-FA tablets in the last month) were obtained through questionnaires completed by the respondents. Meanwhile, data on knowledge and attitudes regarding high-iron foods, enhancers, and inhibitors were collected using a modified questionnaire adapted from Abu-Baker et al. and Singh et al., consisting of 10 questions.^{17,18} Data on the consumption levels of high-iron foods were collected using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), while the consumption levels of iron enhancers and inhibitors were assessed using the Food Frequency Questionnaire (FFQ). Knowledge was categorized as sufficient if able to answer ≥ 5 questions correctly and insufficient if able to answer < 5 questions correctly. Attitude is categorized as sufficient if you choose a positive perception answer in ≥ 6 questions and insufficient if you choose a positive perception answer in < 6 questions. The level of consumption of foods high in heme iron is categorized as adequate if consuming $\geq 77\%$ of $4/5$ of the RDA and inadequate if consuming $< 77\%$ of $4/5$ of RDA.⁹ The level of consumption of iron enhancers was categorized as frequent if the consumption score was ≥ 40 and rarely if the consumption score was < 40 . The level of iron inhibitor consumption was categorized as frequent if the consumption score was ≥ 100 .^{17,18} and rarely if the consumption score was < 100 .^{17,18} The data were analyzed through univariate and bivariate analyses using the Chi-Square and Likelihood Ratio tests.

RESULTS

Respondent Characteristics

Results related to respondent characteristics are shown in Table 1. The research results showed that the majority of respondents were female (79.3%). Based on age characteristics, most respondents were 16 years old (58.6%). The highest-class proportion of all respondents was 10th grade (55.2%). Based on pocket money, respondents generally get daily pocket money \geq Rp20,000 (56.9%). Based on the characteristics of residence status, the majority of respondents live in the same house with their parents (98.3%). The characteristics of consumption of ferrous fumarate–folic acid (FF-FA) tablets in the last one month show that most of respondents did not consume them (82.8%).

Table 1. Respondent Characteristics

Characteristics	n	%
Gender		
Female	46	79.3
Male	12	20.7
Age		
15 years old	5	8.6
16 years old	34	58.6
17 years old	16	27.6
18 years old	3	5.2
Grade		
10 th grade	32	55.2
11 th grade	26	44.8
Pocket Money (Rupiah/day)		
<Rp20,000	25	43.1
≥Rp20,000	33	56.9
Residential Status		
Live with parents	57	98.3
Live in dormitory	1	1.7
Consuming FF-FA tablets in the last month		
No	48	82.8
Yes	10	17.2

Knowledge and Attitude Regarding Iron Deficiency Anemia, Consumption of High Iron Foods, Enhancers and Inhibitors

The research results in Table 2 show that respondents have sufficient knowledge (58.6%) and sufficient attitudes (67.2%) regarding iron deficiency anemia, consumption of high-iron foods, enhancers, and iron inhibitors. The frequency distribution of respondents' answers is described in Table 3. Regarding knowledge, most respondents knew the meaning of anemia (93.1%), the impact of anemia (58.6%), the parts of the body that absorb iron (65.5%), and examples of iron inhibitors (75.9%). However, most of them did not know one of the causes of iron deficiency anemia (55.2%), the normal hemoglobin levels for both sexes (63.8%), the signs and symptoms of anemia (86.2%), the examples of heme iron (60.3%), iron enhancers (72.4%), and the appropriate timing of tea/coffee intake to prevent iron deficiency anemia (58.6%). Regarding Attitude, most of them were aware of the possibility of iron deficiency anemia (70.7%), the seriousness of iron deficiency anemia (89.7%), the priority of preparing food sources of iron (58.6%), the importance of preparing enhancers together with food sources of iron (86.2%) and knowing the appropriate timing for consuming iron inhibitors (79.3%). They also liked the taste of food sources of iron (63.8%) and did not find it difficult to prepare either food sources of iron (53.4%) or enhancers (56.9%), but they were still less confident in preparing food sources of iron (69%) and were less aware that tea can inhibit iron absorption (60.3%).

Table 2. Distribution of Respondents' Knowledge and Attitudes Regarding Iron Deficiency Anemia, Consumption of High Iron Food, Enhancers, and Iron Inhibitors

Variables	n	%
Knowledge		
Insufficient	24	41.4
Sufficient	34	58.6
Attitude		
Insufficient	19	32.8
Sufficient	39	67.2

Table 3. Frequency Distribution of Respondents' Answer Scores

Item	Answer			
	Correct		Wrong	
	n	%	n	%
Knowledge Questions				
Meaning of the term "anemia".	54	93.1	4	6.9
One of the factors causing iron deficiency anemia	26	44.8	32	55.2
The normal limit of hemoglobin for both men and women.	21	36.2	37	63.8
Signs and symptoms that appear in people who have anemia.	8	13.8	50	86.2
The impact that can arise on someone who has anemia.	34	58.6	24	41.4
Examples of food sources of iron that are easily absorbed by the body.	23	39.7	35	60.3
Parts of the body that absorb iron.	38	65.5	20	34.5
Names of food sources that help the body absorb iron.	16	27.6	42	72.4
Examples of foods that can inhibit iron absorption.	44	75.9	14	24.1
The time allowed for drinking tea or coffee to prevent iron deficiency anemia.	24	41.6	34	58.6
Attitude Questions				
Possible iron deficiency anemia.	41	70.7	17	29.3
The seriousness of iron deficiency anemia in adolescence	52	89.7	6	10.3
The level of priority for preparing food sources of iron for yourself and your family.	34	58.6	24	41.4
The level of difficulty in preparing food sources of iron	31	53.4	27	46.6
The level of confidence in preparing food sources of iron	18	31.0	40	69.0
The level of liking the taste of food sources of iron	36	63.8	21	36.2
The level of importance when preparing fruit or juice sources of vitamin C together with foods sources of iron to prevent iron deficiency anemia.	50	86.2	8	13.8
The level of difficulty when preparing fruit or juice sources of vitamin C together with food sources of iron.	33	56.9	25	43.1
The level of importance in knowing the correct time to consume foods that inhibit iron absorption to prevent iron deficiency anemia.	46	79.3	12	20.7
The level of influence of tea consumption on iron deficiency anemia when consumed together with food.	23	39.7	35	60.3

Consumption Levels of High Iron Foods, Enhancers, and Iron Inhibitors

Based on Table 4, it can be seen that 98.3% of respondents do not consume enough high-iron foods and 1.7% of respondents consume enough high-iron foods. For the level of consumption of iron enhancers, respondents who frequently consumed it were 55.2%, while those who rarely consumed it were 44.8%. Respondents who frequently consumed iron inhibitors were 43.1%, while those who rarely consumed them were 56.9%.

Table 4. Distribution of respondents' consumption levels of high heme iron foods, enhancers and iron inhibitors

Consumption Levels	n	%
High Heme Iron Foods		
Inadequate	57	98.3
Adequate	1	1.7
Iron Enhancers		
Rarely	26	44.8
Frequent	32	55.2
Iron Inhibitors		
Rarely	33	56.9
Frequent	25	43.1

Relationship Between Knowledge and Attitudes Regarding Iron Deficiency Anemia towards Consumption of High Iron Foods, Enhancers, and Iron Inhibitors

The analysis results in Table 5 show there is no correlation between knowledge (p=0.18) and attitudes (p=0.37) regarding iron deficiency anemia towards the consumption of high-iron foods. Attitudes (p=0.16) regarding iron deficiency anemia were not correlated with the consumption of iron enhancers. Knowledge (p=0.47) and Attitudes (p=0.50) regarding iron deficiency anemia were also not correlated with the consumption of iron inhibitors. Meanwhile, there is a correlation between knowledge regarding iron deficiency anemia towards the consumption of iron enhancers (p=0.01).

Table 5. Bivariate analysis of the correlation between knowledge and attitudes regarding iron deficiency anemia towards consumption of high iron foods, enhancers, and iron inhibitors

	Consumption of High Iron Foods				Consumption of Iron Enhancers				Consumption of Iron Inhibitors			
	Inadequate	Adequate	Total	p-value	Rarely	Frequent	Total	p-value	Rarely	Frequent	Total	p-value
	n	n	n		n	n	n		n	n	n	
Knowledge												
Insufficient	23	1	24	0.18	16	8	24	0.01*	9	15	24	0.47
Sufficient	34	0	34		10	24	34		16	18	34	
Attitudes												
Insufficient	19	0	19	0.37	11	8	19	0.16	7	12	19	0.50
Sufficient	38	1	39		15	24	39		18	21	39	

DISCUSSION

This study showed that the majority of respondents were female and this is similar to research by Ibrahim & Adam (2021) on YRC members of High School Gorontalo City¹⁹. This is because teenage girls are more curious about health than boys.²⁰ Most respondents were 10th-grade students and 16-year-olds, meaning they had just joined extracurriculars and liked asking questions to prove something so they would gain more knowledge through extracurriculars.²¹

Most respondents have a daily pocket money of ≥Rp20,000. High and low pocket money can influence teenagers' purchasing power in buying food. Teenagers with enough pocket money are less likely to experience iron deficiency than teenagers with less pocket money.²² The residential status most of the respondents still live with their parents because for some people, when they were still in school, they had not yet completely migrated away from their parents.²³ Based on ferrous fumarate-folic acid (FF-FA) tablet consumption in the last 1 month, the majority of respondents did not consume FF-FA. Adolescents' reluctance to consume FF-FA can be caused by not liking the fishy taste and smell and can cause the side effects of nausea.¹⁶

The research results in Table 2 show that 58.6% of respondents had sufficient knowledge. This is because the respondent is an active YRC member. YRC members are considered to have better health knowledge compared to students who are not YRC members because they have received information about health problems, especially adolescent anemia.¹⁶ Knowledge can be increased by obtaining information while participating in extracurricular activities.²⁴

Table 2 also shows that 67.2% of respondents had a sufficient attitude regarding iron deficiency anemia, consumption of high-iron food, enhancers and iron inhibitors. Most respondents stated that they might have had iron deficiency anemia, so they considered deficiency anemia to be a health condition that needed to be treated seriously. Attitudes will be increasingly formed when someone is exposed to information repeatedly which ultimately gives rise to beliefs and then an attitude is formed.²⁴ This is because attitude is a form of response to someone who is still not open to a stimulus or object and a form of assessment of an aspect of their surroundings so previous experience is a determining factor in changing an individual's attitude. Adolescents who have good attitudes will be concerned about behavior in preventing anemia.¹³

The results in Table 4 show that 98.3% of all respondents still do not consume high-iron foods. This is because the majority of respondents do not consume high-iron foods every day (74.1%). The food ingredient that respondents most frequently consume is chicken meat (96.5%), while the food ingredient that respondents most frequently don't consume is duck eggs (15.5%). Heme iron has an absorption rate of 20-30% but it can reach more than 40% of total intestinal iron absorption, while non-heme iron can only be absorbed 1-6%.^{25,26} Daily nutritional intake, one of which is iron intake, is greatly influenced by eating habits. Unhealthy eating habits are one of the main risk factors for iron deficiency anemia which is often carried out by adolescents.²⁷ Based on the analysis results in Table 4, shows that 55.2% of all respondents often consume iron enhancers. Based on interviews with respondents, it is known that they often consume iron enhancers in the form of fruit because they are available at home. Iron absorption can increase if foods containing iron are consumed with

vitamin C²⁶. Based on the FFQ results, the fruit most consumed by respondents was sweet orange, while the fruit most often not consumed was young breadfruit. Fruit sources of vitamin C, if consumed, can help the absorption of iron because they can convert ferric iron into ferrous.²⁸

Based on Table 4, it was found that 56.9% of all respondents rarely consumed iron inhibitors. This is because, from the list of food ingredients on the FFQ form in this study, there are several types of food ingredients that respondents rarely consume, such as snap peas. Based on the FFQ results, the iron inhibitor that respondents often consumed was tea. If iron inhibitors are consumed at the same time as iron foods, it will cause the amount of iron absorbed by the body to be lower because the iron will be bound by the iron inhibitor before being absorbed by the small intestine.²⁹

Based in Table 5, shows that there is no correlation between knowledge regarding iron deficiency anemia towards the consumption of high-heme iron foods among respondents ($p=0.18$). This is because most respondents know about anemia in general, but most of them don't know about high-heme iron foods (60.3%). This finding is similar to that of another study that there is no relationship between female students' knowledge and Fe consumption behavior, where the results of their research state that although female students' knowledge is in a good category, they still lack iron consumption.³⁰ This research is in contrast to previous research which shows that there is a relationship between knowledge about anemia and meeting iron needs.³¹

The results of the study showed that there was no correlation between attitudes regarding iron deficiency anemia towards the consumption of foods high in iron ($p=0.37$). This is because most respondents already have a sufficient attitude towards anemia, but only 31.0% of respondents have the confidence to prepare foods high in iron. This lack of self-confidence affects the level of consumption of foods high in iron. The results of this study are similar to previous research which stated that there was no relationship between iron adequacy in adolescent girls and anemia.²² The results of this study are different from previous research which stated that there was a relationship between female students' attitudes and iron intake.³² The absence of a relationship in this study could be caused by other factors such as the respondent's residence status. Most respondents still live with their parents (98.3%) so parents still provide food for their children³³

The results of the analysis in Table 5 show that there is a correlation between knowledge regarding iron deficiency anemia towards the consumption of iron enhancers ($p=0.01$). Based on the results of the questionnaire responses, it is known that the majority of respondents do not know that there are foods that can help absorb iron (72.4%) but the majority of respondents know that fruits containing vitamin C have health effects on the body. The results of the study are similar to previous research which shows that there is a relationship between intake of enhancer substances and anemia status.²⁵ This is because knowledge is one of the main factors that can change behaviour in a person or can be called a behavioural predisposing factor.¹³ Adolescents who have sufficient knowledge about iron enhancers can influence adolescents' daily food choices. Choosing the right food will influence the adequacy of nutritional intake, including regulating the consumption of iron enhancers along with consuming sufficient iron.³⁴

The results of the study showed that there is no correlation between attitudes regarding iron deficiency anemia towards the consumption of iron enhancers ($p=0.16$) (Table 5). Based on the interview results, respondents already had a sufficient attitude towards anemia, but only a few respondents felt it was not difficult to prepare fruit or juice rich in vitamin C together with food sources of iron (56.9%). This study's results align with previous research which stated that there was no relationship between Fe enhancers and anemia status.²⁸

The results of this study are not in line with previous research which stated that there was a relationship between adequate vitamin C and anemia.²² This is because respondents who already have a sufficient attitude may not immediately manifest it in the form of behavior. Attitude is not an action but attitude is a predisposing factor for behaviour.³⁵ Another factor that can influence this study's results is food availability. Based on the results of interviews, respondents who often consume iron enhancers do so because their parents provide fruit at home. Apart from fruit, some respondents consumed iron enhancers in the form of juice which was available in the school canteen and outside the school. Food availability can influence consumption patterns, where low food availability means a person's ability to consume food will become difficult.¹³

The results of the analysis in Table 5 show that there is no correlation between knowledge regarding iron deficiency anemia towards the consumption of iron inhibitors ($p=0.47$). Most respondents already know examples of foods that can inhibit iron absorption, but most respondents do not know the interval between consuming inhibitors so as not to inhibit iron absorption (58.6%). These results are similar to the results of previous research which stated that there was no correlation between the consumption of inhibitors and the incidence of anemia in adolescent girls.²⁹

The results of this study are not similar to previous research which stated that there was a relationship between consumption patterns of iron inhibitor factors and the anemia status of female students.²⁸ This research is not in line with previous research because respondents who have good knowledge and often consume inhibitors (47.1%) have almost the same proportion as respondents who have good knowledge and rarely consume inhibitors (52.9%). Respondents who already have good knowledge about iron deficiency anemia but still frequently consume inhibitors may be due to a high preference for tea/coffee or a habit that is difficult to break. These habits or lifestyle patterns that are difficult to change become obstacles that don't support anemia prevention behavior.²⁸ In this study, 20.7% and 3.4% of respondents consumed tea and coffee every day, 58.6% and 39.7% consumed it every week and 15.5% and 32.8% consumed it every month. Respondents who consume tea and coffee every day consume an average of 2 glasses of tea and 1 glass of coffee.

Based on the results of the analysis in Table 5, there is no correlation between attitudes regarding iron deficiency anemia towards the consumption of iron inhibitors ($p=0.50$). The results of interviews with respondents revealed that the majority of respondents still had unfavorable attitudes regarding the procedures for consuming inhibitor foods so as not to inhibit iron absorption (60.3%). The results of this study are similar to previous research which stated that there was no relationship between intake of inhibitor substances and anemia status.²⁵

The results of this study are not similar to previous research which stated that there was a relationship between the consumption pattern of Fe inhibitors and the anemia status of adolescents.¹¹ In this study, the proportion of respondents who frequently and rarely consumed inhibitors was almost the same even though their attitudes were considered sufficient. The increasing trend of drinking coffee has made many adolescents interested in trying this trend. The large number of coffee and iced tea shops in various regions makes it easier for someone to get it so adolescents prefer to drink coffee to accompany their activities.³⁶ Tea and coffee drinks are also easily available in school canteens, either brewed or packaged to suit school adolescents' pocket money.

The advantage of this research is that it examines enhancer and inhibitor variables that have not been studied by previous research. However, this study also has limitations because it does not calculate the consumption of non-heme iron. Even though non-heme iron intake has a low level of absorption and bioavailability, according to previous research, the average adolescent girl consumes plant products more often than animal products.³⁷

CONCLUSIONS

There is no correlation between knowledge and attitude regarding iron deficiency anemia towards the consumption of high-iron foods and iron inhibitors, and attitude regarding iron deficiency anemia and consumption of iron enhancers. There is a correlation between knowledge regarding iron deficiency anemia towards the consumption of iron enhancers. Further research is needed to assess the consumption of non-heme iron, the timing of consumption of iron enhancers and inhibitors of respondents.

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CONFLICT OF INTEREST

The authors declare no conflict of interest to disclose.

DECLARATION USE AI

The authors declare that no artificial intelligence (AI) or AI-assisted technologies were used in the conception, design, data collection, data analysis, interpretation of results, writing, editing, or preparation of this manuscript. All work presented in this manuscript was conducted solely by the authors.

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