Knowledge, Attitudes, Eating Practices, and Iron (Fe) Consumption among Adolescent Girls (Aged 10-18 Years) in Central Java, Indonesia

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Abstract:

Background: The Iron (Fe) supplementation program was initiated in 2016 by the Indonesian government. The program included administering iron tablets once a week to female students in schools, although it was not effectively implemented.

Objective: This study aimed to examine knowledge, attitudes, and eating practices as well as iron intake among adolescent girls (Aged 10-18 Years) in Central Java, Indonesia.

Methods and Materials: A cross-sectional study was conducted with 484 respondents. The data obtained were analyzed using univariate as the descriptive method, bivariate with Chi-square, and multivariate through logistic regression.

Results: This study found that knowledge and positive attitudes toward iron tablet consumption were prevalent among respondents, but actual adherence was low, with only 14.7% adhering to the recommended intake. Although adolescent girls showed better eating practices, adherence to consumption did not differ significantly across age groups. A healthy lifestyle significantly improved iron tablet consumption (OR = 14.684) and eating practices (OR = 30.298). The source of information played a crucial role, with health providers being more effective in promoting behaviors (OR = 2.615 for iron tablet consumption and OR = 1.713 for healthy eating practices) compared to non-health attendants (OR = 0.332 for poor eating practices). These results suggested that targeted interventions focusing on lifestyle and information sources could enhance health behaviors in this population.

Conclusion: A significant influence of knowledge related to anemia, the benefits of iron tablets, healthy eating patterns, and sources of information was observed on the adherence to iron tablet consumption. However, this study recommended that to improve adolescent adherence to iron tablet consumption and eating practices, comprehensive knowledge related to anemia should be provided through various sources, particularly from health professionals.

Keywords: Stunting, Iron tablet consumption, Eating practices, Anemia, Adolescent, Logistic regression.

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1. INTRODUCTION

Adolescent girls with iron deficiency are at risk of developing iron-deficiency anemia [1-10]. According to the 2018 Indonesian Basic Health Survey, 26.8% of children aged 5-14 years and 32% aged 15-24 years suffer from anemia [11-13]. In Central Java Province, the prevalence of anemia among women of childbearing age is 27.1%, exceeding the target of 25% [4]. Anemia in adolescents causes various disorders, including impaired concentration during learning, decreased immunity, metabolic disorders, as well as reduced fitness and productivity. When left untreated, iron deficiency in adolescents can lead to serious long-term health effects, especially when compounded by early marriage or unwanted pregnancy, such as disrupting fetal growth and development during pregnancy, increasing the risk of low birth weight (LBW), and elevating the risk of stunting in children [5-7]. In Indonesia, the prevalence of unwanted pregnancy among adolescents aged 15-19 reached 17.9%, and the overall prevalence of stunting from these cases was recorded at 24.4% in 2021.

Stunting is a chronic nutritional problem, posing a significant health concern in Indonesia. According to the 2023 Joint Child Malnutrition Estimates (JME) Report by UNICEF, WHO, and the World Bank, Indonesia has the second highest prevalence of stunting in the Southeast Asia region, after Timor Leste [8]. Indonesian Toddler Nutrition Status Survey (SSGI) shows a downward trend in stunting prevalence among children in Indonesia, from 27.7%, 24.4%, and 21.6% in 2019, 2021, and 2022, respectively [9]. However, this figure still exceeds the WHO target of 20% [8], leading to the effort to reduce stunting to 14% by 2024. In Central Java Province, SSGI data for 2022 recorded that 20.8% of children under 5 were stunted [9]. With a population of approximately 2.4 million, around 49,000 toddlers in Central Java experience stunting. Community-Based Electronic Nutrition Record (e-PPGBM) data show a decreasing trend among children, which ranges from 24.43%, 18.30%, 14.51%, 12.8%, and 11.9% in 2018, 2019, 2020, 2021, and 2022 [4]. Despite these significant reductions, substantial efforts are still needed to prevent stunting in children under 5 years, particularly by targeting the adolescent age group.

Adolescents represent an age group with specific characteristics in the life cycle. This age group is characterized by various changes, including physical, biological, hormonal, and emotional transformations [10]. The changes are often influenced by social pressures from the surrounding environment, showing the need for providing specific nutritional interventions [11]. Adolescent pregnancies are also a concern in this context, as inadequate nutrition during pregnancy is linked to iron deficiency and anemia, further increasing the risk of delivering low birth weight (LBW) babies who are vulnerable to stunting. Current literature shows a trend towards increased fast food consumption among adolescents, which is perceived as more modern and appealing compared to traditional Indonesian foods. However, the nutritional content of fast food is typically inadequate, particularly in micro-nutrients, such as iron (Fe) [12-15]. Iron is an essential micro-nutrient for adolescent girls, playing a significant role in supporting reproductive health [16].

To overcome this condition, the government has implemented several efforts to prevent anemia among adolescents, such as providing supplements containing iron and folic acid. The coverage of iron tablet distribution among adolescents has reached 100%, but compliance with regular consumption remains low [17]. Despite attractive promotion efforts, negative perceptions, such as their fishy smell and the potential to cause nausea, contribute to poor eating practices and low adherence to iron tablet consumption among adolescent girls. Therefore, this study aimed to analyze the knowledge and attitudes toward eating practices and iron tablet consumption among teenage girls aged 10-19 years in Central Java.

2. METHODS

2.1. Study Design

This study applied a quantitative method using a cross-sectional design.

2.2. Sample Respondent

This study was conducted in four selected regencies/districts, namely Semarang City (Kemijen Subdistrict, East Semarang Subdistrict; Bandarharjo Subdistrict, North Semarang Subdistrict), Tegal District (Tuwel Village, Bojong Subdistrict; Kalisapu Village, Slawi Subdistrict), Brebes District (Negla Village, Losari Subdistrict; Kluwut Village, Bulakamba District), and Banyumas District (Cilongok Village, Cilongok District; Gandatapa Village, Sumbang District). The population consisted of adolescent girls aged 10-20 years.

A multi-stage sampling method was used to ensure a focused and representative sample. Initially, purposive sampling was used to select four districts with the highest incidence of stunting based on inclusion criteria targeting the most affected areas. In each district, another round of purposive sampling identified two villages, focusing on those with the highest rates of stunting. The sample size was determined using Lemeshow's formula for proportions as follows:

$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{0.05}$$

$$n = 384 \approx 400$$

The total sample size was increased by 20% from the minimum required to account for potential dropouts, resulting in a total of 484 respondents. This sample size was evenly allocated across the selected districts, each consisting of approximately 100 adolescent girls. Data collection in each village was conducted using simple

random sampling to ensure an equal chance of selection. This even distribution ensured that each district contributed equally to the overall sample.

2.3. Variables, Instruments, and Data Collection

This study focused on knowledge and attitudes regarding eating practices and iron tablet consumption as the independent variables. The dependent variables were respondents' actual eating practices and consumption of iron tablets. Data were also collected on additional characteristics, such as age, gender, educational background, residence, and occupation.

Data collection was conducted using a structured questionnaire through face-to-face interviews. The eating practices knowledge questionnaire included questions about balanced nutrition, consumption of fast foods/drinks, sweet foods/drinks, breakfast, and diet. The eating practices attitude questionnaire included questions on eating frequency, balanced nutrition, and consumption of fast foods/drinks. The practice of eating habits consisted of questions on fast food/drink consumption, breakfast, and vegetable and fruit consumption habits. The iron intake questionnaire contained questions on the frequency and complete consumption. Knowledge was assessed through questions determining whether respondents understood that iron tablets should be taken once a week.

Additionally, mass media exposure was measured by inquiring whether respondents had received information through various mass media channels. The questionnaire was pre-tested on 30 respondents from the Pemalang district, who were selected due to their similar characteristics to the target population of the main study. This pre-test resulted in a Cronbach's alpha coefficient of greater than 0.882, demonstrating that all items in the instrument exhibit high levels of validity and reliability.

2.4. Data Analysis

The data were analyzed using univariate, bivariate, and multivariate analyses. Univariate analysis described the frequency of knowledge, attitudes, and eating practices, including iron tablet consumption among adolescent girls. Bivariate analysis using Chi-square tested the relationship between the independent and the dependent variables. Multivariate analysis was conducted using logistic regression to identify the factors that were independently associated with eating practices and iron intake among adolescent girls. Data processing and interpretation were carried out using SPSS version 25.0.

2.5. Ethical Consideration

This study received ethical clearance from the Ethics Commission of the Faculty of Public Health Diponegoro University, Indonesia with No. 365/EA/KEPK/2022. Respondents were informed of their right to participate voluntarily and allowed to withdraw at any point. Additionally, consent was obtained from respondents before recording the conversations.

3. RESULTS

3.1. Respondents' Characteristics

The age distribution showed a relatively balanced sample, with a slight majority (52.7%) in the older age group (15-18 years). Based on the results, 46.3% of respondents had completed elementary or 37.6% secondary/middle school, while 5.2% had high school. This sample was well-distributed across the four districts, with Brebes District having the highest representation of 38%.

Table 1. Respondents' characteristics.

Respondents' Characteristics	F	%
Age (years)		
1114	229	47.3
1518	255	52.7
Education level		
Elementary school	51	11
Passed elementary school	224	46.3
Passed secondary/middle school	182	37.6
Passed high school	25	5.2
Residence		
Brebes District	184	38
Banyumas District	100	20.7
Tegal District	100	20.7
Semarang city	100	20.7
Occupation		
Entrepreneur	1	0.28
Employee	8	1.65
Student	441	91.3
Labor	8	1.65
Unemployment	21	4.3
Others	4	0.82

Table 2. Frequency distribution of healthy lifestyle, knowledge, attitudes, adherence to consumption, dietary habits, attitudes to dietary habits, media exposure, information sources, and use of health services.

Variable	n	%
Healthy lifestyles		
Unhealthy	250	51.7
Healthy	234	48.3
Knowledge related to iron tablet		
Insufficient	284	58.7
Sufficient	200	41.3
Attitudes toward iron tablet consumption		
Negative	54	11.2
Positive	430	88.8
Adherence to iron tablet consumption		
Not Obey as recommended	413	85.3
Obey as recommended	71	14.7
Knowledge related to eating practices		
Sufficient	430	89.7
Insufficient	54	10.3
Attitudes toward eating practices		
Negative	222	45.9
Positive	262	54.1
Eating practices		
Poor eating practices	243	50.2
Good eating practices	241	49.8
Media exposure related to eating practices		
Underexposure	362	74.8
Exposure	122	25.2
Health Education Resources		
Health providers	48	9.9
NonHealth providers (cadres, TKH)	45	9.3
Others	335	69.2
Use of health services		
NonCHS	93	19.2
Community Health Center	391	80.8

Approximately 91.3% of respondents were students, which was in line with the age distribution of the sample. A small percentage of 4.3% were unemployed, and fewer were employed in various occupations, including entrepreneur, employee, laborer, and others. This sample was well-represented in terms of age, education level, and geographical location, providing a broad perspective on the characteristics of adolescents in these districts. In the qualitative data, a total of 16 respondents were interviewed as shown in Table **1**.

3.2. Distribution Frequency of Independent and Dependent Variables

A majority of respondents (58.7%) possessed good knowledge related to iron tablets, suggesting that educational efforts have been relatively effective. However, a significant portion (41.3%) had insufficient knowledge, showing the need for continued education and awareness campaigns. The majority of respondents (88.8%) had positive attitudes towards iron tablet consumption, which was promising for adherence. However, the relatively small group with negative attitudes (11.2%) needed targeted interventions to influence their perceptions. Despite positive attitudes and good knowledge, adherence to iron tablet consumption was significantly low (14.7%). This discrepancy suggested barriers to adherence that were not related to knowledge or attitudes, such as side effects, forgetfulness, or accessibility issues. Approximately 54.1% of respondents had positive attitudes towards eating practices. With 45.9% holding negative attitudes, there was a tendency for improvement in promoting positive eating behaviors.

The distribution between poor and good eating behaviors was approximately equal. This indicated that half of the respondents were not following healthy eating practices, showing stronger dietary education and interventions. Based on the results, 74.8% had low exposure to media related to eating practices. This showed a gap in communication and the potential for using media more effectively to promote healthy eating habits. Furthermore, 69.2% of respondents received health education from non-traditional sources. A relatively low reliance on health providers (9.9%) showed the need to enhance the role of healthcare professionals in delivering

health education. Approximately 80.8% of respondents accessed healthcare services through community health centers, showing good use of these resources. However, 19.2% of those who did not access community health centers showed a tendency to face barriers. A balance was also observed between unhealthy and healthy lifestyles among respondents, with a slight majority leaning towards unhealthy (Table **2**).

3.3. Relationship between Knowledge and Attitudes

Adolescent girls with negative attitudes towards iron intake could have insufficient knowledge (84.3%). Meanwhile, those with positive attitudes showed the possibility of having sufficient knowledge regarding iron intake (95.5%). Statistical analysis showed that knowledge and attitudes towards iron intake were correlated, with a p-value of 0.001 (sig. < 0.05). Adolescent girls with negative attitudes toward eating practices could have insufficient knowledge about eating practices (54.2%). Those with positive attitudes towards eating practices showed the possibility of having sufficient knowledge about eating practices (64.0%). Statistical analysis showed that knowledge and attitudes towards eating practices were not related, with a p-value of 1.000 (sig. > 0.05) (Table **3**).

3.4. Relationship between Respondents' Characteristics, Knowledge, Attitudes, Media Exposure, Information Sources, and Use of Health Services with Iron Tablet Practices

The analysis showed that younger adolescents (10-14 years) had better eating practices. This was demonstrated by a significant p-value of 0.001, where 59% had good practices, compared to 41.6% of older adolescents (15-18 years). However, iron tablet consumption did not significantly differ between these age groups, with a *p-value* of 0.237. Geographical disparities also occurred, with Semarang showing the highest adherence to iron tablet consumption at 27%. Tegal recorded the lowest at 3%, both significant at a *p-value* of 0.001. In terms of eating practices, Banyumas led with 57% of adolescents

maintaining good habits, compared to other districts with a *p-value* of 0.008.

The data further showed that healthy lifestyles were associated with better health outcomes. Adolescents with healthy lifestyles showed a high tendency to adhere to iron tablet recommendations, with a *p-value* of 0.036 and engage in good eating practices, with a *p-value of* 0.001. Additionally, sufficient knowledge regarding iron tablets significantly increased adherence, with a *p-value* of 0.001. Trusted sources of information, particularly health providers and community cadres, played a crucial role in enhancing both iron tablet consumption, with a *p-value of* 0.005, and eating practices, with a *p-value* of 0.008 (Table **4**).

3.5. Determinants of Eating Practice and Iron Tablet Consumption

As presented in Table **5**, age nor education significantly impacted iron tablet consumption or eating practices among adolescents. The results indicated that older adolescents (OR = 1.123, *p-value* 0.299) and different education levels did not show significant differences in behaviors. However, a healthy lifestyle was strongly associated with better outcomes. Adolescent girls with a healthy lifestyle showed a high tendency to consume iron tablets (OR = 14.684, *p-value* 0.001) and maintain healthy eating practices (OR = 30.298, *p-value* 0.001). Knowledge improved iron tablet consumption (OR = 2.342, *p-value* 0.002), although it did not significantly affect eating practices (*p-value* 0.953). Attitudes toward iron tablets and eating practices, as well as media exposure, had no significant impact on behaviors. The source of information was essential, with those receiving information from health providers showing a high tendency to consume iron tablets (OR = 2.615, *p-value* 0.007) and follow good eating practices (OR = 1.713, *p-value* 0.010). Information from non-health cadres was correlated with poorer eating practices (OR = 0.332, *p-value* 0.007). The use of health services did not significantly influence iron tablet consumption or dietary habits.

Table 3. The relationship between knowledge and attitudes toward iron intake and eating practices.

Knowledge related to Iron Intake	Attitudes toward Iron Intake				p-value
	Negative		Positive		
	f	%	f	%	
Insufficient	45	15.8%	239	84.3%	0.001
Sufficient	9	4.5%	191	95.5%	
Total	54	-	430	-	
Knowledge related to eating practices	Attitudes toward eating practices				p-value
	Negative		Positive		
	f	%	f	%	
Insufficient	142	54.2%	120	45.8%	1.000
Sufficient	80	36.0%	142	64.0%	
Total	222	-	262	-	

Abbreviation: f = frequency.

Table 4. Relationship between respondents' characteristics, knowledge, attitudes, media exposure, information sources, and use of health services with iron tablet practices.

Variables	Iron Tablet Consumption					Eating Practices				
	Good		Bad		p-value	Good		Bad		p-value
	n	%	n	%		n	%	n	%	
Age (years)	-	-	-	-	-	-	-	-	-	-
10-14	29	12.7	200	87.3	0.237	135	59.0	94	41.0	**0.001**
15-18	42	16.5	213	83.5	-	106	41.6	149	58.4	-
Districts	-	-	-	-	-	-	-	-	-	-
Brebes	21	11.4	163	88.6	**0.001**	95	51.6	89	48.4	**0.008**
Banyumas	20	20	80	80	-	57	57.0	43	43.0	-
Tegal	3	3	97	97	-	54	54.0	46	46.0	-
Semarang	27	27	73	73	-	35	35.0	65	65.0	-
Education	-	-	-	-	-	-	-	-	-	-
Elementary school	3	5.7	50	94.3	0.176	34	64.2	19	35.8	**0.008**
Elementary school completed	39	17.4	185	82.6	-	121	54.0	103	46.0	-
Middle school completed	25	13.7	157	86.3	-	77	42.3	105	57.7	-
High school finished	4	16	21	84	-	9	36.0	16	64.0	-
Occupation	-	-	-	-	-	-	-	-	-	-
Entrepreneur	0	0	1	100	0.856	0	0	1	100	0.251
Employee	1	12.5	7	87.5	-	2	25.0	6	75.0	-
Student	67	15.0	374	85.0	-	218	49.4	223	50.6	-
Labor	0	0	8	100	-	3	37.5	5	62.5	-
Unemployment	7	33.3	14	66.7	-	8	38.0	13	62.0	-
Others	0	0	4	100	-	2	40.0	3	60.0	-
Healthy lifestyles	-	-	-	-	-	-	-	-	-	-
Unhealthy	30	12	220	88	**0.036**	46	18.4	204	81.6	**0.001**
Healthy	41	17.5	193	82.5	-	195	83.3	39	16.7	-
Knowledge related to iron tablet	-	-	-	-	-	-	-	-	-	-
Insufficient	28	9.9	256	90.1	**0.001**	148	52.1	136	47.9	0.224
Sufficient	43	21.5	157	78.5	-	93	46.5	107	53.5	-
Knowledge related to eating practices	-	-	-	-	-	-	-	-	-	-
Insufficient	4	7.4	50	92.6	0.110	25	46.3	29	53.7	0.528
Sufficient	67	15.6	363	84.4	-	216	50.2	214	49.8	-
Attitudes to iron tablet	-	-	-	-	-	-	-	-	-	-
Negative	4	7.4	50	92.6	0.110	25	46.3	29	53.7	0.586
Positive	67	15.6	363	84.4	-	216	50.2	214	49.8	-
Attitudes to eating practices	-	-	-	-	-	-	-	-	-	-
Negative	30	13.5	192	86.5	0.508	118	53.2	104	46.8	0.174
Positive	41	15.6	221	84.4	-	123	46.9	139	53.1	-
Media Exposure	-	-	-	-	-	-	-	-	-	-
Unexposed	49	13.5	313	86.5	0.225	179	49.4	183	50.6	0.793
Exposed	22	18	100	82	-	62	50.8	60	49.2	-
Source of information	-	-	-	-	-	-	-	-	-	-
Health providers	11	24.4	35	75.6	**0.005**	15	31.9	32	68.1	**0.008**
Cadres	6	13.6	38	86.4	-	55	59.8	37	40.2	-
Community leaders	47	14.6	276	85.4	-	171	49.6	174	50.5	-
Using of health services	-	-	-	-	-	-	-	-	-	-
Non CHS	10	10.8	83	89.2	0.235	41	44.1	52	55.9	0.221
Community Health Center	61	15.6	330	391	-	200	51.2	191	48.8	-

4. DISCUSSION

Adolescent girls are burdened with the responsibility of being adequately informed about iron tablet consumption, which significantly influences attitudes and eating practices. This study showed that 58.2% of respondents possessed sufficient knowledge concerning iron consumption measures. A substantial proportion remained unaware of the correct timing and frequency for taking iron tablets. According to the Indonesian Ministry

Table 5. The influence of age, level of education, healthy lifestyle, knowledge, attitudes, exposure to mass media, sources of information, and use of health services on iron tablet practices.

Variables	Iron Tablet Consumption				Eating Practices			
	Odds Ratio	95% CI		P-value	Odds Ratio	95% CI		P-value
		Lower	Upper			Lower	Upper	
Age	-	-	-	-	-	-	-	-
10-14	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
15-18	1.123	0.902	1.397	0.299	0.592	0.275	1.275	0.180
Education	-	-	-	-	-	-	-	-
No School	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Elementary School	1.76	0.46	6.66	0.400	0.768	0.315	1.877	0.563
Secondary School	1.03	0.20	5.10	0.968	1.079	0.353	3.303	0.894
High School	1.52	0.19	12.22	0.689	0.871	0.170	4.469	0.868
Healthy Lifestyle	-	-	-	-	-	-	-	-
Poor	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Good	14.684	40.802	14.684	0.001	30.298	17.328	52.978	0.001
Knowledge related to Iron Intake	-	-	-	-	-	-	-	-
Insufficient	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Sufficient	2.342	1.365	4.020	0.002	1.017	0.587	1.762	0.953
Knowledge related to eating practices	-	-	-	-	-	-	-	-
Insufficient	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Sufficient	1.543	0.924	2.576	0.097	1.532	0.902	2.602	0.115
Attitudes to iron tablet	-	-	-	-	-	-	-	-
Bad	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Good	1.59	0.52	4.84	0.410	1.585	0.669	3.759	0.296
Attitudes to eating practices	-	-	-	-	-	-	-	-
Bad	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Good	0.730	0.437	1.219	0.229	0.719	0.422	1.222	0.223
Media exposure	-	-	-	-	-	-	-	-
Unexposed	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Exposed	1.226	0.679	2.213	0.500	0.961	0.519	1.779	0.899
Source of information	-	-	-	-	-	-	-	-
Health providers	2.615	1.307	5.236	0.007	1.713	1.324	4.049	0.010
Cadres	0.655	0.246	1.746	0.398	0.332	0.144	0.766	-
Community Leaders	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Using of health services	-	-	-	-	-	-	-	-
Non-CHS	1.0 ref	1.0 ref	1.0 ref	-	1.0 ref	1.0 ref	1.0 ref	-
Community Health center	1.508	0.716	3.177	0.279	1.388	0.684	2.819	0.364

of Health, it was recommended that all adolescent girls and women of childbearing age consume one iron tablet per week to prevent anemia [18]. Younger adolescents with sufficient knowledge understood the benefits, such as increasing blood flow during menstruation, reducing the risk of blood shortages, enhancing the blood supply, and preventing anemia. In this study, 89.1% of respondents showed positive attitudes, expressing agreeable or hard feelings. Positive attitudes were reflective of health-promoting behavior, while negative attitudes showed avoidance [19]. This result was supported by Muthmainah (2023), where 52.8% of respondents showed positive attitudes. Approximately 47.2% had negative attitudes due to aversions to the odor and flavor of iron tablets or a lack of knowledge about their benefits. Positive attitudes were primarily caused by health concerns, particularly regarding the prevention of anemia [20].

Despite favorable attitudes, a majority of adolescents did not fully comprehend the need to maintain normal hemoglobin levels, often confusing low hemoglobin with low blood pressure [21]. The practice of iron tablet consumption among adolescent girls, influenced by knowledge and attitudes, was evaluated based on their consumption in the past week [8]. Only 14.7% of respondents showed good practices, while 85.3% had poor practices, including laziness, bad taste, foul smell, nausea, and vomiting as side effects [22].

However, when comparing districts with high and low stunting rates, distinct patterns emerge. In districts with lower stunting prevalence, resources are more readily available, and access to diverse food sources is easier. These areas also tend to have more active health workers engaged in promotive and preventive health efforts. In contrast, districts with higher stunting incidence are often

economically disadvantaged, with lower levels of community knowledge and a greater prevalence of stigma surrounding health interventions. This suggests that, beyond knowledge and attitudes, factors like logistical barriers in accessing tablets may play a crucial role. Socio-cultural stigmas, such as fears of liver damage or constipation from iron tablets, are also significant in communities. Gender norms, especially around women's health, can make discussing menstruation-related iron needs difficult, as seeking help may be seen as taboo or a sign of weakness [23]. Cultural beliefs about pregnancy add further complications, with some women fearing that taking iron tablets could result in larger babies and more difficult deliveries. Additionally, the fear of being perceived as poor or malnourished may deter adolescent girls from using iron supplements, as this need is often linked to economic disadvantage. Low social support also plays a significant role in improving adherence to iron supplements [24]. Support comes from four primary sources-parents, peers, teachers, and health workers-providing information and reminders to consume the supplements regularly. Respondents in some studies reported greater confidence when peers reminded them to take iron supplements, as peer connections are prominent in the adolescent social structure [25].

The majority of respondents consumed iron tablets distributed at schools by community health centers but often described the taste and smell as unpleasant. Some prefer iron tablets sold in pharmacies due to their better taste [23, 24]. Common barriers to consumption included nausea, dizziness, and a fishy or rancid taste [27]. The study conducted by Nuradhiani showed that the color, smell, and taste of iron tablets significantly influenced perceptions, as only 22.5% of respondents had a high preference for taste. Lestari further stated that taste acceptance was significantly related to adherence [28].

A significant relationship had been identified between knowledge and attitudes concerning iron consumption, with a *p-value* of <0.05. This suggested that attitudes were influenced by early knowledge. Adolescents with high levels of knowledge were motivated by the need to prevent anemia [29]. In this study, all adolescent girls with inadequate knowledge showed poor practice, with 90.1% falling into the category. The results showed the high significance of the relationship between knowledge and practice. Similarly, Runiari (2020) found a significant association between knowledge and adherence to iron tablet consumption, with a *p-value* of 0.03 [30]. The role of knowledge in influencing consumption patterns was also shown by Panangin, where a general lack of awareness often originated from inadequate information on iron tablets and anemia [30].

A total of 89.7% of adolescent girls showed good knowledge of healthy eating habits, such as the daily consumption of fruits and vegetables, avoiding fast foods and drinks, regular breakfast, and avoiding extreme diets. However, some lacked principles of balanced nutrition or did not eat a varied diet. Increased knowledge was attributed to targeted nutrition education and the effective use of media to motivate behavior change [31]. Adolescent girls with positive attitudes toward nutrition showed a high tendency to consume foods that meet their nutritional requirements. Meanwhile, those with negative attitudes toward food would have poor nutritional status. Sempati stated that respondents were more positively disposed to modern food than traditional [32]. The study by Pantaleon (2019) also emphasized a significant relationship between eating habits and the nutritional status of adolescent girls. Common patterns in adolescent diets included frequent snacking, irregular meal times, skipping breakfast, frequent fast food, and low consumption of vegetables, fruits, and animal products. The prevalence of unhealthy dietary behaviors among adolescents remained significantly high [33].

Adolescent girls in Central Java typically consume a diet that includes staples like rice, tofu, tempeh, eggs, and occasionally meat. Still, their intake of iron-rich foods such as red meat, leafy green vegetables, and legumes remains inconsistent. Adolescent girls showed a low preference for eating vegetables due to perceived bad taste. In contrast, the consumption of fast food, which is often low in nutritional value and lacks essential micronutrients like iron, has been observed in many adolescent diets. The preference for modern foods was attributed to taste, innovativeness, social influence, and convenience [34]. This was further supported by Imtihani, who reported that most respondents consumed fast food due to convenience and eagerness to try new tastes [35]. This is also particularly concerning in relation to the high consumption of sweetened beverages such as sweet tea (teh manis), a culturally significant beverage in Indonesia. Sweet tea is a popular accompaniment to meals and is often consumed multiple times a day. While it is an ingrained part of the diet, excessive consumption of sugary drinks like sweet tea can negatively affect iron absorption due to the high tannin content found in tea, which inhibits non-heme iron absorption. The irregularity in the consumption of iron-rich foods, combined with the high intake of fast foods and sweetened beverages, may contribute to iron deficiency. In this study, the majority of respondents had poor eating practices, particularly those who reported a higher intake of fast food and sugary beverages. This suggests a clear link between poor eating practices and an increased risk of iron deficiency anemia.

This study has several limitations. First, while it provides valuable insights into the knowledge, attitudes, and practices surrounding iron (Fe) consumption among adolescent girls, it was conducted in Central Java, which may limit the generalizability of the findings to other regions in Indonesia or similar settings in other developing countries. Central Java may differ socioeconomically or culturally from different areas, potentially affecting dietary habits and iron tablet adherence differently. Socioeconomic variations, such as access to healthcare, food diversity, and education levels, may result in different adherence patterns, especially in more urbanized or remote regions. These regional differences need to be considered when applying the findings to broader populations.

Additionally, measuring hemoglobin levels to indicate

anemia in the samples was not a primary objective. A larger, more diverse sample size would have captured a broader range of adolescent experiences, particularly given Indonesia's cultural diversity. In regions with different religious or traditional practices, food choices, and health beliefs, adherence to iron tablets may be influenced by local customs. Future studies should aim for a more representative sample across various regions of Indonesia to provide a more comprehensive understanding of how cultural differences affect dietary behaviors and adherence to iron tablet recommendations. Moreover, to ensure the sustainability of health interventions such as iron supplementation programs, future research should consider employing longitudinal study designs. These studies would allow for the examination of long-term adherence patterns and the sustained impact of health education programs over time. These limitations underscore the importance of addressing broader geographical and cultural contexts in future research to enhance the generalizability and robustness of the results.

CONCLUSION

In conclusion, this study showed the significant impact of knowledge and attitudes on iron tablet consumption and eating practices among adolescent girls. Despite positive attitudes, actual adherence remained low due to factors such as taste and side effects. The majority of teenage girls also lacked an understanding of hemoglobin levels and their importance. Consequently, improving knowledge about iron tablet consumption and healthy eating practices through targeted education and addressing barriers to adherence, such as the taste and side effects of iron tablets, were recommended for better health outcomes among adolescent girls.

The balanced distribution of good and bad eating habits among adolescent girls showed the need for targeted nutritional interventions. Therefore, efforts should focus on educating adolescent girls about the importance of regular food, the nutritional benefits of fruits and vegetables, and the risks associated with high fast food consumption.

AUTHORS' CONTRIBUTIONS

S.W.: Study conception and design; Z.S.: Writing the Paper; S.S.: Data Analysis or Interpretation; N.L.: Methodology; A.H.: Data Collection; N.O.C.: Data Curation.

LIST OF ABBREVIATIONS

JME	= Joint Child Malnutrition Estimates
WHO	= World of Health Organization
UNICEF	= United Nations International Children's Emergency Fund
e-PPGBM	= Community-Based Electronic Nutrition Record
LBW	= Low Birth Weight

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received ethical clearance from the Ethics Commission of the Faculty of Public Health Diponegoro University, Indonesia with No. 365/EA/KEPK/2022.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Consent was obtained from respondents before recording the conversations.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the Zenodo at https://zenodo.org/records/140 53705, reference number [36].

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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