

ORIGINAL ARTICLE

Diet behavior and consumption of iron inhibitors: Incidence anemia in adolescent girls

ERNA KUSUMA WATI¹, COLTI SISTIARANI² and SETIYOWATI RAHARDJO²

¹Department of Nutrition Sciences, Faculty of Health Sciences, Jenderal Soedirman University, Purwokerto;

²Department of Public Health, Faculty of Health Sciences, Jenderal Soedirman University, Purwokerto, Indonesia

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Abstract. One of the strategies to prevent adolescent girls anemia through efforts to identify the factors that cause anemia. Adolescent girls are prospective mothers who must prepare physically, mentally, with good knowledge so that they do not experience anemia during pregnancy. The aim of the study was to analyze the risk factors for the incidence of anemia in adolescent girls in Banyumas Regency, Indonesia. Quantitative approach used to identify factors that influence anemia in adolescent girls. Research variables are menstrual period, knowledge, diet attitudes and behavior, perception of body image, role of friends in prevention of anemia, role, exposure to information, consumption of iron, consumption of inhibitors and iron enhancers. The population of this research is young women aged 12-19 years. The taking technique by simple random sampling was amount 100, Data analysis was univariate, bivariate (chi square) and multivariate (linear regression). The results showed that the prevalence of anemia was 20%. Based on the results of statistical tests, it was obtained a P-value of 0.005 (<0.05) meaning that there was an influence on adolescent dietary behavior, the role of adolescents in preventing anemia and the consumption of iron inhibitors on the incidence of anemia. Anemia in young girls. There is an influence of eating behavior in female adolescents, the role of female adolescents in preventing anemia and consumption of iron inhibitors on the occurrence of anemia in female adolescents.

Introduction

One of the causes of maternal death is bleeding. This can be seen from the most common cases found bleeding at delivery

of 18.4%. The main cause of bleeding during delivery is anemia during pregnancy. The prevalence of anemia in women globally reaches 29%. Anemia in pregnancy can occur as a manifestation of anemia in adolescence (1-3). Adolescents, especially girls, are one of the groups that are prone to suffer from iron deficiency anemia because they have a high need for iron. The failure to fulfill iron in young women is mainly due to the increased need for iron during menstruation. In addition, an imbalance in nutritional intake is also a cause of iron nutritional anemia in adolescent girls (4).

Research shows that 27% of girls aged 11-18 years do not meet their iron needs while boys only 4%. This shows that adolescent girls are more prone to experiencing nutritional deficiencies. In addition, adolescent girls are usually very concerned about body shape, so that many limit food consumption and a lot of dietary restrictions. When food intake is lacking, a lot of iron reserves are broken down to meet needs. This situation can accelerate the occurrence of iron nutritional anemia (5).

Data from the Ministry of Health shows that iron deficiency anemia among adolescent girls is 26.50%.¹ In Central Java, 55.7% of adolescent girls and women of childbearing age experience anemia (6). Banyumas District Health Office (DKK) data for 2014 shows that There is still a problem of anemia in high school adolescent girls, which is 5.1%. Iron deficiency anemia is not limited only to the amount of iron intake alone, but also the rate of absorption. In the process of absorption of iron, interactions occur with other nutrients. The interactions that occur can be in the form of trigger effects (enhancers) or inhibitors (inhibitors) (7). Research to determine the right diet to treat iron nutritional anemia is by a combination of a diet high in Fe sources and Fe enhancers, and low in Fe inhibitors (8). Fe with anemia status in female students, and there is no correlation between consumption pattern of iron enhancer factor and anemia status of students (9). This study aimed to identify the effect of dietary behavior and inhibitor consumption on the incidence of anemia in adolescent girls in Banyumas Regency.

Material and methods

Study design. This study used quantitative research with a cross-sectional research design. The research variables were

Correspondence to: Colti Sistiarani, Department of Public Health, Faculty of Health Sciences, Jenderal Soedirman University, Purwokerto, Indonesia
E-mail: coltistisitariani@yahoo.co.id

Key words: diet behavior, inhibitors, adolescent girls, anemia

1 anemia, length of menstruation, knowledge, dietary attitudes
2 and behavior of adolescent girls, perception of body image,
3 role of friends in preventing anemia, role of adolescent girls,
4 exposure to adolescent girls information, consumption of iron,
5 consumption of iron inhibitors and enhancers (10).

6
7 *Sampling methods.* The population in this study were adoles-
8 cent girls and families in the area of Puskesmas I Kembaran
9 and Puskesmas Kedungbanteng. The research sample was
10 taken based on the sample formula and taken randomly
11 using simple random sampling technique. The sample selec-
12 tion starts from the working area of Puskesmas I Kembaran
13 and Puskesmas Kedungbanteng with the consideration that
14 the Maternal Mortality Rate (MMR) is high in Banyumas
15 Regency. Based on the two-tailed hypothesis test sample
16 formula, the sample size is 100 adolescent girls.

17
18 *Data collections.* Determination of anemia status in adoles-
19 cent girls by testing Hb levels with the cyanmethemoglobin
20 method at the Health Laboratory of Banyumas Regency
21 with the category of Anemia (Hb<12 mg/dl) and not Anemic
22 (Hb>12 mg/dl). The variable length of menstruation was
23 measured by the distance from the first day of menstruation until
24 menstrual bleeding stopped with the categories Brakimenorea
25 (menstrual blood that came out <2 days), Normal (menstrual
26 blood that came out 2-5 days) and Menorrhagia (menstrual
27 blood that came out >6 days) (11).

28 The variables of knowledge, the attitude of the role of
29 friends in preventing anemia, the role of adolescent girls
30 about anemia and exposure to adolescent girls information
31 were taken by means of interviews using a questionnaire, then
32 grouped based on the normal distribution approach.

33 Diet behavior is an action aimed at reducing body weight
34 by reducing the frequency of eating, choosing certain types
35 of food, consumption of diet drugs, and physical activity.
36 Perceptions of body image are individual perceptions of their
37 own appearance including fear of being fat, feelings of full-
38 ness, thoughts about body shape, desire to diet, feeling sad
39 when reflecting and awareness of body shape as measured
40 by a body shape questionnaire with a dissatisfied category
41 (score >25) and satisfied (score ≤25) (12).

42 The consumption pattern is a form of food consumption
43 habits carried out by a person in his daily eating activities
44 which include food ingredients that contain iron, iron inhibitors
45 and enhancers obtained through the interview method with a
46 1 month semi-quantitative FFQ form tool. The consumption
47 pattern category is given (1) Regular in consumption score
48 15-50 (2), sometimes score 1-10 and never (13).

49
50 *Data analysis.* Quantitative data analysis methods in this study
51 used univariate analysis, bivariate analysis (chi-square anal-
52 ysis), and multivariate analysis (logistic regression analysis).

53
54 *Ethical consideration.* This research has gone through ethical
55 trials by the Health Research Ethics Commission, Faculty
56 of Medicine, Jenderal Soedirman University with approval
57 number 1242/UN23.07.5.1/PN.1/2017. Before collecting
58 respondent data, we submitted informed consent as a sign of
59 approval for the respondent's participation in this study. All
60 respondents' identities were kept confidential and there was no

61 compulsion for respondents to participate in the research. All
62 data obtained was then stored on the researcher's laptop and
63 could only be accessed by the research team.

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Based on Table I, it is known that the average age of the respon-
dents is 15 years, the average hemoglobin level is 13 g/dl and
the average length of menstruation is 6 days. (see the Table I).

Based on Table II, it is known that most (54%) knowledge
of adolescent girls nutrition is good, adolescent girls attitudes
are still not supportive of anemia prevention (51%), poor diet
behavior (60%), good adolescent girls body image perception
(56%), Menstruation duration of more than 6 days (74%), most
of 52% of adolescent girls make efforts to prevent anemia.
Most (72%) adolescent girls have not received informa-
tion about anemia. Adolescent girls eating behavior is 54%
influenced by friends, adolescent girls still rarely consume
iron source foods (57%), most (62%) rarely consume iron
consumption inhibitors and 50% consume substances that
increase iron absorption (enhancers). The results showed
that the prevalence of anemia was 20%, anemia becomes a
public health problem if the prevalence is above 20% (see
the Table II).

Based on Table III, it shows that the adolescent girls
dietary behavior variable (0.044), the role of adolescent girls in
preventing anemia (0.05) and the consumption of iron inhibi-
tors (0.012) according to the results of statistical tests, obtained
P-value=0.005 (<0.05). It is concluded that statistically there is
a relationship between adolescent girls diet behavior, the role
of adolescent girls in preventing anemia and consumption of
iron inhibitors with the incidence of anemia in adolescent girls
(see the Table III).

There were four variables included in the prospective
multivariate test using multiple logistic regression with a
P-value ≤0.25 which were included in the prospective model,
namely knowledge of adolescents, behavior of adolescents,
role of adolescents and consumption of iron inhibitors. The
next stage is the modeling stage with the condition that the
P-value ≤0.05. There were only two variables that had P-values
≤0.05, namely adolescent behavior and consumption of iron
inhibitors. Based on the statistical test results, it was obtained
a P-value of 0.005 (<0.05), it can be concluded statistically
that there is an effect of adolescent diet behavior, the role of
adolescents in preventing anemia and the consumption of iron
inhibitors on the incidence of anemia in adolescent girls (see
the Table IV).

107 108 109 110

111 Respondents are adolescent girls with an average age of
112 15 years. During adolescent, there is an increase in nutritional
113 and health needs due to accelerated growth and increased
114 physical activity (14,15) Gupta's research found that there was a
115 significant correlation between Hb concentration and age in the
116 15-16 year age group (16). The average Hb level of the respon-
117 dents was 13 g/dl, the interpretation of anemia based on Hb
118 levels according to WHO is divided into 3 categories, namely:
119 mild (11.0-11.9 g/dl), moderate (8.0-10.9 g/dl) and severe
120 (<8 g/dl) (17). This shows that on average the respondents are

Table I. Characteristic of adolescent girls.

Variable	Minimum	Maximum	Mean
Age (Years)	12	19	15
Hb Concentration (g/dl)	9,6	15,7	13
Menstruation Duration (day)	4	10	6

not included in the anemia category. In this study, respondents had an average menstrual period of 6 days for 1 menstrual cycle. The existence of menstruation in adolescent girls is an additional burden which serves as a trigger for the factors causing anemia (16).

Knowledge is the result of knowing what happens after people sense certain objects. Knowledge is a guide in shaping a person (overt behavior). A person's knowledge can influence the occurrence of anemia, because knowledge can influence their behavior, including their lifestyle and eating habits. Most (54%) respondents already have good knowledge about anemia. This good knowledge was made possible because some respondents (26%) had already been exposed to information about anemia. Exposure to information media causes these adolescent girls to obtain more information than those who have never been exposed to information media, so the information they get will increase their knowledge (18). In a previous study, the possible reason for the high prevalence of anemia among students who never heard/know anemia could be poor knowledge regarding iron-rich foods compared to girls with knowledge about anemia that consider the prevention and control mechanism of anemia (19).

Some adolescent girls (51%) have less supportive attitudes in preventing anemia. Unsupportive behavior of female adolescents in anemia prevention efforts is influenced by knowledge levels, attitudes, perceptions, supporting environments, resources, and national policies (20). Adolescents with positive attitude will have better abilities in realizing health (21). Most of the respondents' diet behavior (60%) is still not good. The respondent's diet behavior is not good, namely that the respondent rarely consumes fruits that can help the absorption of substances iron and rarely do breakfast.

Adolescent girls are usually very concerned about body shape, so that many limit their consumption of food and many dietary restrictions such as the vegetarian diet. They imitate adults and behave with adult status or imitate the artists they idolize, such as by doing the actual diet in adolescence where they are still experiencing a period of growth (22). In this study the perception of body image of respondents was partly (56%) it is good and some adolescent (52%) have made efforts to prevent anemia. Most of the respondents (74%) had had their menstrual period longer than 6 days. The average length of menstruation that is considered normal is 3-5 days, if more than 7 or 8 days is considered abnormal (23). The results of this study are in line with Jaelani research which states that as many as 40% of adolescent girls experience abnormal menstrual lengths (menstruation >6 days) (24). Menstruation is the release of the uterine wall (endometrium) which is accompanied by bleeding and occurs every month except during pregnancy. Menstruation that occurs every month is

Table II. Basic characteristics of adolescent girls.

No.	Variable	Amount	
		n	%
1.	Menstruation Duration		
	2-5 days (normal)	26	26
	≥6 days (long)	74	74
	Total number of participant	100	100
2.	Knowledge		
	Well	54	54
	Lack	46	46
	Total number of participant	100	100
3.	Attitude		
	Well	49	49
	Lack	51	51
4.	Diet Behaviour		
	Well	52	52
	Lack	48	48
5.	Body Image Perception		
	Lack	44	44
	Well	56	56
6.	Peer Group Role		
	No	46	46
	Yes	54	54
7.	Fe Consumption		
	Often	43	43
	Rare	57	57
8.	Fe Inhibitor Consumption		
	Often	62	62
	Rare	38	38
9.	Fe Enhancer Consumption		
	Often	50	50
	Rare	50	50
10.	Role to prevent anemia		
	Well	52	52
	Lack	48	48
11.	Information Exposure		
	a. Exposure Source	26	26
	-Print Media	2	8,0
	-Health Worker	11	42,0
	-Internet	2	8,0
	-Television or Radio	9	35,0
	b. Not exposure	74	74
12.	Anemia in adolescent girls		
	Not anemic	80	80
	Anemia	20	20

known as the menstrual cycle. Normal menstruation usually lasts 2-5 days and if >6 is often referred to as having menorrhagia disorders (11) Friends have a role in adolescent girls eating behavior by 54%. The strong influence of peer groups or friends is because adolescents are more outside the home with their peers as a group, it is understandable that the influence

Table III. Relationship of determinant factors of anemia in adolescents girls.

No.	Variable	Not Anemic		Anemia		Amount		P-value
		n	%	n	%	n	%	
1.	Knowledge							
	Well	46	85,2	8	14,8	54	100	0,249
	Lack	34	73,9	12	26,1	46	100	
2.	Attitude							
	Well	39	79,6	10	20,4	49	100	1,000
	Lack	41	80,4	10	19,6	51	100	
3.	Diet Behaviour							
	Well	46	88,5	6	11,5	52	100	0,044
	Lack	34	70,8	14	29,2	48	100	
4.	Body Image Perception							
	Lack	35	79,5	9	20,5	44	100	1,000
	Well	45	80,4	11	19,6	56	100	
5.	Menstruation Duration							
	2-5 days (normal)	19	73,1	7	26,9	26	100	0,459
	≥6 days (long)	61	82,4	13	17,6	74	100	
6.	Role to prevent anemia							
	Well	46	88,5	6	11,5	52	100	0,050
	Lack	34	70,8	14	29,2	48	100	
7.	Information Exposure							
	a. Exposure Source	19	73,1	7	26,9	26	100	0,459
	b. Not exposure	61	82,4	13	17,6	74	100	
8.	Peer Group Role							
	No	37	80,4	9	19,6	46	100	1,000
	Yes	43	79,6	11	20,4	54	100	
9.	Fe Consumption							
	Often	36	83,7	7	16,3	43	100	0,579
	Rare	44	77,2	13	22,8	57	100	
10.	Fe Inhibitor Consumption							
	Often	55	88,7	7	11,3	62	100	0,012
	Rare	25	65,8	12	34,2	38	100	
11.	Fe Enhancer Consumption							
	Often	42	84,0	8	16,0	50	100	0,453
	Rare	38	76,0	12	24,0	50	100	

of peers on attitudes, conversations, interests, appearance, and behavior is greater than the influence of family (22).

Some respondents (57%) rarely eat iron-based foods, this can be seen from the dietary pattern of half of the respondents (56%) who rarely eat animal side dishes. Inadequate intake of iron uptake can cause anemia. Some respondents (38%) still consume iron inhibitors such as tea more than once a day and other inhibiting food ingredients such as chocolate, ice cream, milk and fried soybeans 1-3x/Sunday. Tea contains tannins which can inhibit the absorption of iron from other foods, besides black tea contains polyphenolic compounds which when oxidized will bind to minerals such as iron (25). Half of the respondents (50%) rarely consume iron enhancer such as fruits that contain lots vitamin C which can help iron absorption. The Sundanese plant-based diet did not affect the iron deficiency anemia (IDA) status. Instead, IDA was associated

with consumption of less animal-based foods that have iron with higher bioavailability. Increased access to an animal-based menu at the school cafeteria could be an approach to prevent IDA in students at Islamic boarding schools in Indonesia (26).

In the research of Patimah *et al* which states that there is a relationship between dietary behavior and adolescent girls anemia (27). Behavior is the second largest factor after environmental factors that affect the health of individuals, groups and society. Therefore, to improve health status, one of the efforts is to increase awareness to behave healthily in everyday life for the whole community. Dietary behavior, it is known that more than half of the respondents (56%) rarely consume animal side dishes. Good sources of iron are animal foods such as meat, chicken and fish. In general, iron in meat, chicken and fish has high biological availability. Research by Kappala *et al* also shows a relationship between meat

1 Table IV. Multivariate analysis of anemia control models for
2 adolescent girls.

Variabel	P-value	Exp (B)
Diet Behaviour	0,044	2,916
Fe Inhibitor consumption	0,050	3,836
Constant	0,012	0,072

12 consumption and anemia in adolescent girls (28). Distribution
13 of answers to the dietary behavior questionnaire shows that
14 less than half of the respondents (74%) rarely and never have
15 breakfast, lunch (66%), and dinner (73%). Most adolescent
16 girls usually eat a complete meal only two times a day, namely
17 a combination of breakfast-dinner or lunch-dinner. This can
18 cause iron needs are not met. Research Shill *et al* shows that
19 breakfast is associated with student anemia (29).

20 Based on diet behavior, it is known that most respondents
21 (73%) rarely eat fruits. The diet in Indonesia should consist of
22 fruits that are rich in vitamin C. Vitamin C greatly helps the
23 absorption of non-ferrous iron by changing the form of ferric
24 to ferrous. There is a relationship between fruit consumption
25 and anemia in students. Most of the respondents (86%) rarely
26 exercise. Research from Jalambo *et al* shows a relationship
27 between physical activity and anemia in adolescent girls.
28 Activity performance will decrease due to a decrease in hemo-
29 globin concentration and iron-containing tissue. The iron in
30 hemoglobin, when the amount is reduced, can extremely alter
31 work activity by decreasing oxygen transport (29).

32 The results of the bivariate analysis showed that there was
33 a significant relationship between the consumption pattern of
34 iron inhibitors and anemia (P=0.012). This is in accordance
35 with the research conducted by Masthalina which states that
36 there is a significant relationship between the consumption
37 pattern of Fe inhibitor and anemia in adolescent girls because
38 the consumption of inhibitors in adolescent girls with anemia
39 is 47.6% in the usual category of consuming (9). Consuming
40 food sources that contain iron inhibitors, because 42.3%
41 of adolescent girls in the working area of Kembaran and
42 Kedungbanteng often consume tea more than once a day as
43 well as other inhibiting food ingredients such as chocolate, ice
44 cream, milk and fried soybeans 1-3x/Sunday.

45 Black tea and coffee can reduce iron absorption into the
46 body by 79-90%, herbal tea by 84%, chocolate 54%. Tea is
47 a drink containing tannins which can reduce the absorption
48 of non-heme iron by forming complex bonds that cannot
49 be absorbed. If women consume 1-2 cups of tea a day will
50 reduce iron absorption, both in women with anemia or not.
51 Consumption of 1 cup of tea a day can reduce iron absorp-
52 tion by 49% in people with iron deficiency anemia, while
53 consumption of 2 cups of tea a day reduces Fe absorption by
54 67% in people with iron deficiency anemia and 66% in the
55 control group (30-32).

56 The higher the consumption of calcium will reduce the
57 storage of iron in red blood cells from both heme and non-heme
58 sources. Protein derived from cow's milk, cheese, and eggs
59 cannot increase the absorption of non-heme iron because it has
60 low bioavailability (33). The results of the study by Petry *et al*

61 Stated that phytic acid contained in nuts can reduce the absorp-
62 tion of Fe in food consumed. and high polyphenol content in
63 nuts can reduce Fe absorption by 27% (34). Research Isik
64 Balci *et al* stated that the low consumption pattern of animal
65 food sources causes anemia in adolescent girls (35).

66 Conclusions 67

68 The prevalence of this anemia is 20% among young women.
69 There is a relationship and influence of dietary behavior in
70 female adolescents, the role of female adolescents in preventing
71 anemia and consumption of iron inhibitors on the incidence
72 of anemia in adolescents girls. The approach that needs to be
73 taken is through increasing understanding of the importance
74 of nutritional consumption by improving eating behavior by
75 utilizing the role of social media and the role of school health
76 efforts. 77

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92 EKW, principal investigator, conceptualised and designed the
93 study, prepared the draft of the manuscript and reviewed the
94 manuscript; CS, led the data collection, advised on the data
95 analysis and interpretation and reviewed the manuscript; SR,
96 conducted the study, data analysis and interpretation, assisted
97 in drafting of the manuscript, reviewed the manuscript. All
98 authors have critically reviewed and approved the final draft
99 and are responsible for the content and similarity index of the
100 manuscript. 101

102 Ethical approval and consent to participate 103

104 This research has gone through ethical trials by the Health
105 Research Ethics Commission, Faculty of Medicine,
106 Jenderal Soedirman University with approval number
107 1242/UN23.07.5.1/PN.1/2017. Before collecting respondent
108 data, we submitted informed consent as a sign of approval for
109 the respondent's participation in this study. All respondents'
110 identities were kept confidential and there was no compulsion
111 for respondents to participate in the research. All data obtained
112 was then stored on the researcher's laptop and could only be
113 accessed by the research team. 114

115 Conflict of interest 116

117 The authors declare no potential conflict of interest. 118

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