Prevalence of Anemia and Correlation with Knowledge, Nutritional Status, Dietary Habits among Adolescent Girls at Islamic Boarding School

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ABSTRACT

Background: Anemia is a globally public health problem, including in Indonesia (22.2%) and it has negative health impacts. Adolescent girls have high risk of anemia. Previous studies reported that adolescent girls at islamic boarding school had low food intake and poor knowledge about nutrition in preventing anemia.

Objectives: To assess the prevalence of anemia and to analyze association between knowledge, nutritional status, and dietary habits and anemia in adolescent girls.

Materials and Methods: A cross-sectional study was conducted in November 2020 among adolescent girls at islamic boarding school in Semarang. A total of 162 respondents were selected by cluster sampling. Anemia was determined by measuring the hemoglobin level in the blood by Cyanmethemoglobin method. Knowledge and dietary habits were collected through questionnaires. Nutritional status was assessed by measuring weight and height, then classified by body mass index for age using WHO Anthro. Bivariate and multivariate logistic analysis were used to test hypothesis and it was significant if p<0.05.

Results: The prevalence of anemia was found to be 17.3%. In the bivariate analysis, overweight was more likely to have anemia (p=0.044). There was no association between father's education, mother's education, knowledge, frequency of staple food, breakfast habits, consumption of animal side dishes, consumption of vegetable side dishes, consumption of sweet tea and anemia. Mulitvariate model showed that overweight (OR=3.658; 95%CI=1.224-10.932; p=0.020) and good knowledge (OR=3.652; 95%CI=1.221-10.922; p=0.020) were significant associated with the anemia.

Conclusion: Nutritional status and knowledge were significantly associated with anemia among adolescent girls.

Keywords: anemia, adolescent girl, islamic boarding school, knowledge, nutritional status

BACKGROUND

Anemia is one of the global health problems which happened in the low, middle, and high income countries.[1,2] The group which has high risk of anemia is adolescent girls.[3] According to The Ministry of Health Indonesia, adolescents are individuals in 10-18 years age group.[4] Adolescent girls have high risk of anemia because of some conditions such as increased need of iron intake, blood loss during menstruation, lack of iron intake, worm infections, early marriage, and teenage pregnancy.[3,5] Adolescent girls can suffer from anemia if their blood hemoglobin level is less than 12 g/dl.[5]

Anemia is caused of many factors. The main factor is 50% iron intake deficiency.[2,3] Some studies have reported high iron diet consumption, nutritional status, and knowledge are related to anemia among adolescent girls.[6–8] Anemia can caused various adverse impacts on adolescent girls, such as decreasing immunity, easily exposed infections, decreasing physical fitness and thinking agility due to muscle cells and brain cells lack of oxygen, decreasing learning achievement and performance productivity.[5] A study in India have reported anemic adolescent girls had low scores on numeracy test and visual memory than non-anemic adolescent girls.[9] Anemic adolescent girls will have a high risk of anemia during pregnancy. It has negative impacts on the fetus' growth and development. Moreover, anemia in pregnancy have risks to pregnancy and delivery complications such as low birth weight, stunting, and child and maternal mortality.[5,10]

The prevalence of anemia among adolescent girls in the world is approximately 29%.[2] Some studies reported that anemia prevalence in Indonesia is estimated at 30%.[3] There are less study about anemia among Indonesian adolescent girls. The prevalence of anemia as a public health problem is categorized as follows: <5%, no public health problem; 5–19.9%, mild public health problem; 20–39.9%, moderate public health problem; and ≥40%, severe public health problem.[2]

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A study in Indonesia reported that anemia prevalence among adolescent girls at islamic boarding school was 52.25%.[11] Central Java, the third largest province in Indonesia, has 57.1% adolescent girls aged 10-18 years old who suffer from anemia.[12] Semarang is the capital city of Central Java. There has been no official report from *Dinas Kesehatan Kota Semarang* regarding the prevalence of anemia in adolescent girls. There is only a few study about anemia among adolescent girls in Semarang such as a study by Annisa reported 21.9% adolescent girls in Senior High School 11 Semarang had anemia.[13]

Islamic boarding school is one of choice to study for adolescent girls beside studying in public school. At islamic boarding school, students have food intake from their school. A study in 2019 showed that 72% of female students in islamic boarding school had bad dietary habits.[14] Islamic boarding school serves almost the same food menu every day. Therefore, adolescent girls at islamic boarding school have low food intake because they are bored of the food.[15] Low food intake quality and low iron bioavailability are the main factors of iron deficiency.[16] A previous study has reported that 54% adolescent girls had poor knowledges.[17] Studies about anemia among adolescent girls in Semarang especially at islamic boarding school is still limited. Measurement of hemoglobin (Hb) level to determine anemia status in previous studies used a portable hemoglobinometer. It is used for screening of anemia. Cyanmethemoglobin method is a method to measure Hb level recommended by International Committee for Standarization in Hematology (ICSH). In this study, the researchers used Cyanmethemoglobin to determine the Hb level. This study aimed to assess prevalence of anemia and to analyze association between knowledge, nutritional status, and dietary habits with anemia among adolescent girls at islamic boarding school in Semarang. This result of this study can be useful for supporting anemia prevention program among adolescent girls.

MATERIALS AND METHODS

An observational analytic study with cross-sectional design was conducted in November-December 2020 among adolescent girls aged 14 to 18 years at islamic boarding school in Semarang. This study was an initial study from a study entitled "The Effectiveness of Iron-Folic Acid Tablet Supplementation and Anemia Education as Prevention Anemia Among Adolescent Girls in Semarang City". The inclusion criteria of the subjects are female students aged 14 to 18 years old living at islamic boarding school, capable to communicate well, and willing to be respondent in this study. Respondents taking iron-folic acid tablet for the last 3 months, having disease or getting treatment in one last month such as tuberculosis, intestinal worms, menstrual bleeding, and HIV/AIDS were excluded from the study. A total of 162 adolescent girls from 3 islamic boarding schools were selected as subjects for this study by *cluster sampling* (40, 40, 82 students from school A, B, C, respectively). This number has fulfilled the minimum sample size 94 which calculated by Lemeshow formula, which d=10%, P=0.58, Z^2 1-μ/2=1.96.[18]

Ethical clearance was obtained from the Ethical Review Board of Faculty of Medicine, Diponegoro University No. 265/EC/KEPK/FK-UNDIP/XII/2020. The informed consent was given to respondent's parents through the islamic boarding school`s trustee. To collect the data during the COVID-19 pandemic, the researcher and respondents always obey the health protocol in prevention COVID-19 such as wearing masks, maintaining distances, and washing hands with soap before entering and leaving the islamic boarding school.

Dependent variable was anemia status. Anemia was measured by taking the blood by laboratory analysis to assess Hb level by Cyanmethemoglobin method. Cyanmethemoglobin method is a method to measure Hb level recommended by International Committee for Standarization in Hematology (ICSH). Respondents were categorized anemia if Hb level <12 gr/dl and normal if Hb level $\geq$12 gr/dl. Anemia was classified as mild anemia if Hb level 11.0-11.9 gr/dl, moderate anemia if Hb level 8.0-10.9 gr/dl, and severe anemic if Hb level <8.0 gr/dl.

Independent variables were nutritional status, knowledge, and dietary habit. Demographic data such as age, parent's education was also observed as additional data. The researcher measured respondents' weight by digital scale and the height by microtoise staturmeter to assess body mass index (BMI). The digital scale and microtoise had been calibrated by the researcher. BMI for age was calculated by using WHO calculator with help of z scores tables. Nutritional status was determined by BMI results. Knowledge was tested through questionnaire which consist of 30 true or false questions. The questionnaires were about description, sign and symptom, risk factor, impact, and nutrition prevention of anemia. Knowledge level was classified into 'poor knowledge' if the correct answer was <75% and 'good knowledge' if the correct answer was $\geq$ 75%. Dietary habits were staple food frequency, breakfast habit, snack habit, animal and vegetable side dishes consumption, vegetable and fruit consumption, sweet tea and street food consumption. The dietary habit was collected by questionnaire.

Data was edited, entry and analyzed by univariate, bivariate, and multivariate using SPSS 20 software. The univariate analysis used descriptive test. Bivariate logistic regression was used to analyze factors associated with anemia. Variable observed in the bivariate logistic regression analysis with a p-value <0.025 were included in the multivariate binary logistic regression. Results with p-value <0.05 were considered statistically significant.

RESULTS
Prevalence of anemia

From a total of 164 students participated in this study, 162 (98.7%) responded for the enquiry. Twenty eight (17.3%) respondents had anemia and classified into mild anemia 13.6% and moderate anemia 3.7%. None of respondents was classified as severe anemia (figure 1).
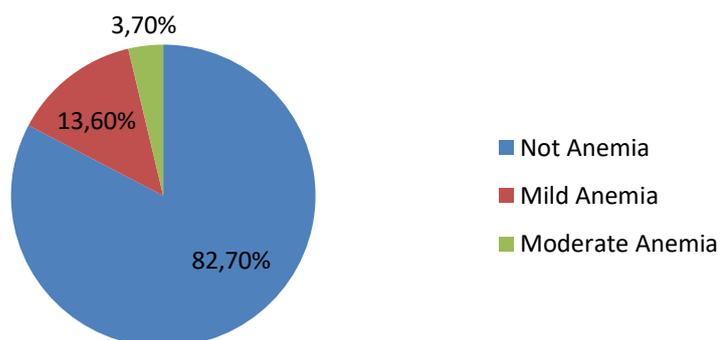
Figure 1. The prevalence of anemia among adolescent girls at Islamic boarding school in Semarang, 2020

Respondent characteristics

The respondents were in the age range of 14-18 years old and in high school. High school graduated was the most parent's education. More than half (59.3%) respondents had normal nutritional status and good knowledge (66%) (table 1).

Table 1. Respondents characteristic, nutritional status and knowledge among adolescent girls at islamic boarding school in Semarang, 2020

Variable	Frequency n(%)	Mean (±SD)	Median (Min-Max)
Age		16.48(±1.059)	17(14-18)
Father education			
Primary school	43 (26.5%)		
Secondary school	42 (25.9%)		
Senior high school	62 (38.3%)		
Bachelor Degree	15 (9.3%)		
Mother education			
Primary school	41 (25.3%)		
Secondary school	50 (30.9%)		
Senior high school	58 (35.8%)		
Bachelor Degree	12 (7.4%)		
Nutritional status			
Underweight	15 (9.3%)		
Normal	96 (59.3%)		
Overweight	21 (13%)		
Obese	30 (18.5%)		
Knowledge			
Poor	55 (34%)		
Good	107 (66%)		

Dietary habit

The majority (57.4%) of respondents had staple food 3 times a day, and 77.2% had snacks sometimes. The examples of snacks consumed by respondents were cakes, chips, bread and snacks sold in the school canteen. Most of the respondents (80.2%) answered that they sometimes consume animal side dishes in a day such as eggs, chicken, and fish. The majority (74.7%) of respondents admitted consuming vegetable side dishes every day, such as tempeh and tofu. There were 63.6% of respondents that eat vegetables every day such as soup, mustard greens, spinach, kale, and long beans. It was different from the habit of consuming fruit which most of respondents (74.1%) consumed fruit occasionally. The fruits were consumed by respondents were orange, watermelon, apple and papaya. Most of the respondents rarely consumed sweet tea (90.7%) and often consumed street food (93.2%) (table 2). The snacks were chips, fried foods, chocolate, and other snacks in the canteen.

Table 2. Description of dietary habit for adolescent girls at islamic boarding school in Semarang

Variable	Frequency (%)
Staple Food Frequency	
<3x /day	69 (42.6%)
3x /day	93 (57.4%)
Breakfast Habit	
Rarely	7 (4.3%)
Sometimes	94 (58%)
Always	61 (37.7%)
Snack Habit	
Rarely	18 (11.1%)
Sometimes	125 (77.2%)
Always	19 (11.7%)
Animal Side Dishes Consumption	
Rarely	28 (17.3%)
Sometimes	130 (80.2%)
Always	4 (2.5%)
Vegetable Side Dishes Consumption	
Rarely	2 (1.2%)
Sometimes	39 (24.1%)
Always	121 (74.7%)
Vegetable Consumption	
Rarely	12 (7.4%)
Sometimes	47 (29%)
Always	103 (63.6%)
Fruit Consumption	
Rarely	37 (22.8%)
Sometimes	120 (74.1%)
Always	5 (3.1%)
Sweet Tea Consumption	
Rarely	147 (90.7%)
Often	15 (9.3%)
Street Food Consumption	
Rarely	11 (6.8%)
Often	151 (93.2%)

Associated factors of anemia among adolescent girls

There was a significant association between nutritional status 'overweight' (p=0.044;OR=2.860;95%CI=1.026-7.969) with anemia. There was no relationship between father's education level, mother's education, staple food frequency, breakfast habit, consumption of animal side dishes, consumption of vegetable side dishes, sweet tea consumption, knowledge and anemia status (table 3). Multivariate logistic regression analysis showed that the variables associated with anemia were overweight

(p=0.020;OR=3.658;95%CI=1.224-10.932) and good knowledge (p=0.020;OR=3.652; 95%CI=1.221-10.922) (table 4).

Table 3. Bivariate analysis of associated factors of anemia among adolescent girls in Semarang, 2020

Variable	Anemia Status				p value	OR (95% CI)
	Anemic		Normal			
Father education						
Primary school	6	14%	37	86%	0.109	0.324 (0.082-1.285)
Secondary school	7	17%	35	83%	0.182	0.400 (0.104-1.536)
Senior high school	10	16%	52	84%	0.140	0.385 (0.108-1.368)
Bachelor Degree	5	33%	10	67%	1	
Mother education						
Primary school	5	12%	37	88%	0.666	0.676 (0.114-4.016)
Secondary school	7	14%	43	86%	0.814	0.814 (0.146-4.525)
Senior high school	14	24%	44	76%	0.577	1.591 (0.311-8.144)
Bachelor Degree	12	55%	10	45%	1	
Nutritional status						
Underweight	1	7%	14	93%	0.302	0.332 (0.041-2.698)
Overweight	8	38%	13	62%	0.044*	2.860 (1.026-7.969)
Obese	2	7%	28	93%	0.157	0.332 (0.072-1.529)
Normal	17	18%	79	82%	1	
Knowledge						
Poor	5	9%	50	91%	1	
Good	23	21%	84	79%	0.055	2.738 (0.979-7.658)
Staple Food Frequency						
Less than 3 times/day	10	14%	59	86%	1	
3 times/day	18	19%	75	81%	0.420	1.416 (0.608-3.296)
Breakfast Habit						
Rarely	1	14%	6	86%	0.852	1.231 (0.139-10.934)
Sometimes	16	17%	78	83%	0.806	1.320 (0.144-12.097)
Always	11	18%	50	82%	1	
Animal Side Dishes Consumption						
Rarely	6	21%	22	79%	1	
Sometimes	21	16%	109	84%	0.503	0.706 (0.256-1.952)
Always	1	25%	3	75%	0.872	1.222 (0.107-13.974)
Vegetable Side Dishes Consumption						
Rarely/Sometimes	4	10%	37	90%	0.149	0.437 (0.142-1.345)
Always	24	20%	97	80%	1	
Sweet Tea Consumption						
Rarely	24	16%	123	84%	1	
Often	4	27%	11	73%	0.319	1.864 (0.547-6.345)

*significant if p value<0,05

Table 4. Multivariate logistic regression analysis of associated factors of anemia among adolescent girls in Semarang, 2020

	B	p value	OR	95%CI	
				Lower	Upper
Nutritional status		0.015			
Underweight	-1.129	0.295	0.323	0.039	2.671
Overweight	1.297	**0.020***	3.658	1.224	10.932
Obese	-1.194	0.128	0.303	0.065	1.412
Good knowledge	1.295	**0.020***	3.652	1.221	10.922

*statistically significant at p <0.05

DISCUSSION

In this study, we found that the prevalence of anemia among adolescent girls at islamic boarding school was 17.3%. High prevalence of anemia at islamic boarding school was also founded in other studies in Kediri City, Indonesia of 29,93% adolescent girl.[19] This result was similar to study in Jakarta that showed anemia was founded in 19.6% of adolescent girls aged 12-15 years.[20] Those study was conducted in adolescent girls who live with their parents. It showed there was no difference about prevalence of anemia between adolescent girls at islamic boarding school with who living with their parents.

According to WHO, the anemia prevalence rate of 17.3% is categorized into a mild public health problem if prevalence <20%.[2] The respondents of this study were adolescent girls had no consume iron folic tablet for the last 3 months. It showed that the Indonesian government policy through the iron folic supplementation program for adolescent girls aged 12-18 years in school are not optimally implemented. Even though previous studies have shown that iron supplementation interventions can reduce the prevalence of anemia from 20.9% to 15.7%.[21]

This study found that 13% of adolescent girls had overweight BMI and 18.5% was obese. BMI can describe individual nutritional status at the time. One of the risk factors of anemia was nutritional status.[22–25] It was found that overweight was significantly related to the anemia in this study. The overweight girls tended to be at risk of anemia compared to normal weight girls. It was similar to previous study in children aged 2-19 years showed prevalence of anemia increased along the increasing of BMI from normal to overweight.[26] The lack of nutrients in thin woman affected to anemia case, but there was an increasing of hepcidine concentration in overweight women, especially extreme obesity which can interfere with iron absorption, so that iron deficiency anemia occurred.[27]

Nutritional status can be influenced by food intake.[28] An assessment of nutritional intake can be seen from dietary habits such as staple food frequency, breakfast habits, consumption of animal or vegetable side dishes, vegetable and fruit consumption and consumption of sweet tea after meals. The eating habits, frequency of meals, quantity of food and types of food such as animal and vegetable side dishes that were eaten by respondents at islamic boarding school tended to be the same. The variety of food menu provided by islamic boarding school was almost the same; therefore, all students consumed almost the same food every day.[29] It may be related to this study that dietary habits were not significantly associated with anemia among adolescent girls. It was in line with a study in Ethiopia explained that the tea consumption and side dishes consumption were not risk factors of anemia. The study in Canada also showed that the consumption of animal side dishes was not associated with anemia.[30,31]

In this study, good knowledge about anemia and nutrition for anemia prevention had a significant relationship with the anemia prevalence (p=0.029). Adolescent girls with a good knowledge had a risk of anemia compared to adolescents with poor knowledge in this study. Good knowledge might not affect to behave well. Food intake consumed was provided by head of islamic boarding school. So, they could not choose the food. Beside that, adolescent girls had less attention to the food nutrition value. This result was in contrast with previous study which stated that adolescent girls with a poor knowledge were more risk to have anemia than good knowledge.[22,32] We found that there were more than one third of subjects (34%) had poor knowledge about anemia prevention in this study. So, it is necessary to provide information and counseling about anemia and nutrition to prevent anemia for adolescent girls.

The father and mother`s educations are not related to anemia in this study as in several previous studies.[20,24] A higher education level will lead a better individual knowledge level. Parents with good knowledge about anemia nutrition will provide food that is suitable for the nutritional needs for adolescents. In this study, the adolescents did not live with their parents so that their food intake was not determined by the parents.

The limitations of this study are the precision to measure the sample size (10%), the food intake measurement by qualitative method has the weakness, namely there was bias about the differences between each respondent regarding the frequency and quality of meals. For further research, it is expected to use smaller precision samples and food intake quantitative assesment with the SQ-FFQ (Semi Quantitative Food Frequency Questionnaire).

CONCLUSIONS

Anemia among adolescent girls at islamic boarding school in Semarang still becomes a public health problem where the prevalence is 17.3%. There was a significant association between nutritional status, knowledge about nutrition and anemia status among adolescent girls. It is necessary to provide a regular nutrition education and

monitoring from public health center to *Pos Kesehatan Pesantren* of islamic boarding schools (adolescent girls and head of islamic boarding school) about the importance of nutrition in adolescents to improve the knowledge about nutrition and change the behaviour of food intake. Head of islamic boarding school must provide the good nutritions for students, so students can keep the normal weight and it can decrease and prevent anemia among adolescent girls.

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