

## Multilevel Analysis on the Ecological Effect of School on the Risk of Anemia among Female High School Students in Klaten Central Java

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### ABSTRACT

**Background:** Anemia is a major nutritional problem worldwide. In 2018, at least 1.62 billion people were affected by anemia, and 33% were school children. Anemia in female adolescents contributes to high rates of maternal and infant mortality. This study aims to analyze the determinants of anemia among female adolescent at the individual level and at the school level.

**Subjects and Method:** This study used a cross sectional research design. The study was conducted in Klaten Regency in February 2020. Sampling used was probability sampling with a total of 200 female adolescents aged 15 to 19 years old. The independent variables include knowledge, family economy, menstrual pattern, consumption of blood supplement tablets, and nutritional status. The dependent variable is anemia. Data were collected by using the Easy Touch brand hemoglobinometer, weighing scale, microtoice and questionnaire. Data were analyzed using multilevel multiple logistic regression with a stata of 13.

**Results:** The results of this study indicated that good knowledge ( $b=-2.29$ ; 95% CI= -4.23 to -0.32;  $p= 0.022$ ), family economy  $\geq$ Rp 1,947,821 ( $b= -2.73$ ; 95% CI= -4.58 to -0.75;  $p=$

0.006), regular menstrual patterns ( $b= -2.29$ ; 95% CI= -4.58 to -0.75;  $p= 0.001$ ), blood supplement consumption ( $b= -3.22$ ; 95% CI= -8.96 to -2.17;  $p= 0.001$ ), normal nutritional status ( $b= -3.36$ ; 95% CI= -6.65 to -1.74;  $p= 0.001$ ) reduce the incidence of anemia in adolescents. Variations at the school level indicate a contextual influence on the incidence of anemia in adolescents (ICC= 59.36%).

**Conclusion:** There was a statistically significant influence of knowledge, family economy, menstrual patterns, blood supplement consumption and nutritional status on the incidence of anemia in adolescents. Variations at the level of school indicated that there was a contextual influence on the incidence of anemia in adolescents.

**Keywords:** Multilevel, Anemia, Adolescents, School

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### Cite this as:

Dewayanti N, Sulaeman ES, Murti B (2021). Multilevel Analysis on the Ecological Effect of School on the Risk of Anemia among Female High School Students in Klaten Central Java. J Matern Child Health. 06(01): 1-14. <https://doi.org/10.26911/thejmch.2021.06.01.01>.



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### BACKGROUND

Anemia is a major nutritional problem worldwide. Anemia in Indonesia is also a major nutritional problem. This makes anemia a serious public health problem around the world. Anemia can be caused by infec-

tious diseases, insufficient nutritional intake, blood loss (menstruation) and knowledge. Anemia can have a big impact on the health and well-being of women, because it can increase the risk of being bad

for pregnant women and newborns (Suryani et al., 2015).

As a developing country, the incidence of anemia in Indonesia is still quite high (National Institute of Health Research and Development, 2013). In 2018, at least 1.62 billion people were affected by anemia, of which 33% were school children. The prevalence of anemia in the world according to WHO is still around 40% to 88%. About 370 million women in various developing countries suffer from iron deficiency anemia, 41% of which are non-pregnant women. The prevalence of anemia in Indonesia is still quite high (Fakhidah et al., 2016). Based on Basic Health Research (2018), there was an increase in the prevalence of anemia in pregnant women from 2013, which was 37.1% to 48.9% in 2018 with the proportion of anemia in the age group 15 to 24 years and 25 to 34 years. The incidence of anemia in Central Java in 2013 reached 57.1%. The prevalence of anemia in women is relatively higher (23.90%) than men (18.40%).

Anemia is more common in girls than boys. This is because young women lose iron (Fe) during menstruation, so they need more iron intake. Anemia in young women contributes to high rates of maternal and infant mortality.

Adolescence is a period of growth and development, both physically, mentally, and in activities, so that the need for food containing nutrients becomes quite large. Many young women experience lack of nutrients in their daily food consumption. In adolescence, changes occur in a person's physical, biological, and psychological and occur continuously during adolescence. An imbalance between intake and nutritional needs results in nutritional problems, both under nutrition and over nutrition (Briawan, 2013).

The important thing in controlling anemia in pregnant women is to ensure that iron needs in adolescents are fulfilled. There are several factors that can cause anemia, including nutritional status, menstruation, and socioeconomic conditions. Simamora et al. (2018) added the level of education is one of the fundamental causes that can lead to anemia. This is because the level of education affects the level of knowledge on nutritional intake that must be fulfilled every day. A good understanding of adequate nutritional intake will have an impact on a good diet so that it can prevent anemia in the community, especially in female adolescent who are prone to anemia.

School contextual factors can affect adolescent anemia such as sanitation of the school environment. There are several factors related to environmental health and sanitation, one of which is worm infection. Worm infection greatly affects the incidence of anemia in school age children.

Anemia treatment is needed in policy makers to invest as a means of promoting development, economic growth, health, wealth and welfare of a country. Researchers are interested in conducting study related to the effect of school context on the incidence of anemia in adolescents aged 15 to 19 years old in Klaten Regency. This study is expected to describe the benefits, so that efforts to prevent anemia can be carried out.

## SUBJECTS AND METHOD

### 1. Study Design

This study used a cross sectional study conducted at 25 schools in Klaten, Central Java, in February 2020.

### 2. Population and Sample

In this study, the population studied was all female adolescents aged 15 to 19 years old in the Klaten area in February 2020. Sampling used was probability sampling tech-

niques to select female adolescents and schools in the Klaten area. The subjects used were 200 subjects from 8 subjects in each level 2 unit (school).

### 3. Study Variable

The dependent variable is the incidence of anemia in adolescents. Independent variables include: knowledge, family economy, menstrual patterns, consumption of blood supplement, and nutritional status and level 2 is school.

### 4. Operational Definition of Variables

**Anemia** is a state of Hb in the blood of <12 g/dL based on blood tests.

**Knowledge** is students' knowledge about the definition, symptoms, causes, effects, and ways to prevent anemia.

**Family economy** is the average amount of fixed and side income from the head of the household, mother and other members each month which is stated in Rupiah.

**Menstrual pattern** is the level of menstrual frequency measured based on the frequency of menstrual length and the number of times changing the pads in a day.

**Blood supplement consumption** is an effort to use blood supplement to fulfill the needs of young women during menstruation.

**Nutritional status** is the nutritional state of each respondent. The measurement scale in the independent variable uses a continuous scale, because for the needs of data analysis it is converted into a dichotomous scale.

### 5. Study Instrument

The data collection techniques was with primary data and secondary data. Primary data were obtained using a questionnaire filled out by study subjects. Secondary data were obtained from the Karanganyar District Health Office in the form of post-partum data in Karanganyar Regency. The instruments used were the Easy Touch

brand hemoglobinometer, body scale, microtoice and questionnaire.

### 6. Data Analysis

The univariate analysis was to see the frequency distribution and characteristics of the study subjects, while the bivariate analysis used the chi-square test and the calculation of the odds ratio (OR) with a 95% confidence level (CI) to study the relationship between the incidence of anemia in adolescents with the independent variable. Multivariate analysis was done using logistic regression through a multilevel approach indicated by the Intra Class Correlation (ICC) value.

### 7. Study Ethic

Study ethics include informed consent, anonymity, confidentiality and ethical clearance. Ethical clearance in this study was carried out at Dr. Moewardi Hospital Surakarta and was declared ethical based on decree number 576/XII/HREC/2020.

## RESULTS

### 1. Univariate Analysis

The subjects in this study were 200 adolescents. Univariate analysis included anemia, knowledge of adolescents, family income, menstrual patterns, iron consumption, adolescents' nutritional status, age, and class.

Table 1 showed the results of descriptive statistical tests on the variables that include the number of study subjects, the mean, standard deviation, minimum and maximum values for measuring the dependent variable and the independent variable on a continuous scale. The mean describes the mean value and the standard deviation (SD) describes the variation in the data. If the standard deviation (SD) value is smaller than the mean value, it indicates that the data is representative and can be used as a representation of the entire data.

**Table 1. Univariate analysis (continuous data) knowledge of adolescents, family income, nutritional status of adolescents, age, and class on anemia among adolescents**

Characteristics	N	Mean	SD	Min.	Max.
Age (years old)	200	17.13	0.78	16	18
Class (10-12)	200	11.13	0.78	10	12
Hemoglobin (g/dL)	200	12.10	0.96	10	14
Knowledge	200	66.96	14.18	20	95
Family Income (Rupiah)	200	2,090,500	559,306	1,000,000	5,500,000
BMI	200	21.45	2.08	16	26

Table 1 shows the measurement of anemia variable in adolescents has a mean= 12.10 and SD= 0.96, the lowest anemia variable value was 10 and the highest was 14. The knowledge variable of adolescents has a mean= 66.96 and SD= 14.18 with the lowest knowledge value, which was 20 and the highest was 95. Family income variable has a mean= Rp 2,090,500 and SD= Rp 559,306,59 with the lowest family income

was Rp. 1,000,000 and the highest was Rp. 5,500,000. The nutritional status variable of adolescents has a mean= 21.45 and SD= 2.08 with the lowest value of 16 and the highest was 26. Adolescents have a mean= 17.13 and SD= 0.78, with the lowest age was 16 years old and the highest was 18 years old. Classes/grades (10 to 12) have a mean= 11.13 and SD= 0.78, with the lowest grade of 10 and the highest grade was 12.

**Table 2. Univariate analysis (dichotomy data) of adolescents' knowledge, family income, menstrual patterns, iron consumption, adolescents' nutritional status, age, and class on anemia among adolescents**

Variable	N	%
<b>Anemia</b>		
Normal	175	87.5
Anemia	25	12.5
<b>Knowledge</b>		
Poor	28	14.0
Good	172	86.0
<b>Family Income</b>		
<MW (Rp 1,947,821)	28	14.0
≥MW (Rp 1,947,821)	172	86.0
<b>Menstrual Pattern</b>		
Normal	161	80.5
Abnormal	39	19.5
<b>Iron tablet consumption</b>		
No	14	7
Yes	186	93.0
<b>Nutritional Status</b>		
Normal	177	88.5
Abnormal	23	11.5
<b>Students' Age</b>		
15-16 years old	50	25
17-18 years old	150	75
<b>Grade</b>		
Low (10)	50	25
High (11, 12)	150	75

Table 2 showed that most of the study subjects who were not anemia were 175 subjects (87.5%), 172 subjects had good knowledge (86.0%), family income  $\geq$ Rp 1,947,821 were 172 (86.0%), normal menstrual were 161 (80.5%), consumed iron tablet were 186 (93.0%), and normal nutritional status were 177 (88.5%). Most of the subjects were 17 to 18 years old, who were 150 students (75%). And most of the

students come from high grade (grade 11 and 12) by 150 students (75%) and 50 students (25%) come from grade 10.

**2. Bivariate Analysis**

The statistical analysis used to see the effect of a dependent variable (anemia) on the independent variable (adolescents' knowledge, family income, menstrual patterns, consumption of blood supplements, and nutritional status) in table 3.

**Table 3. Bivariate analysis of the effect of adolescents' knowledge, family income, menstrual patterns, blood supplement consumption, and adolescents' nutritional status on anemia among adolescents**

Independent Variable	Anemia				OR	p
	Yes		No			
	n	%	N	%		
<b>Knowledge</b>						
Poor	10	35.71	18	64.29	5.81	<0.001
Good	15	8.72	157	91.28		
<b>Family Income</b>						
<MW (Rp 1,947,821)	10	35.71	18	64.29	5.81	<0.001
$\geq$ MW (Rp 1,947,821)	15	8.72	157	91.28		
<b>Menstrual Pattern</b>						
Abnormal	12	30.76	27	69.24	5.06	<0.001
Normal	13	8.07	148	91.93		
<b>Iron tablet consumption</b>						
No	7	50.00	7	50.00	9.33	<0.001
Yes	18	9.67	168	90.33		
<b>Nutritional Status</b>						
Abnormal	9	39.13	14	60.87	6.46	<0.001
Normal	16	9.03	161	90.97		

Table 3 shows the results of the chi-square test the effect of adolescent knowledge, family income, menstrual patterns, iron consumption, and adolescent nutritional status on anemia in adolescents as follows:

**a. The effect of adolescent knowledge on anemia in adolescents**

Good knowledge reduced the likelihood of anemia in adolescents. Adolescents with good knowledge decreased the likelihood of anemia by 5.81 times than adolescents with poor knowledge (OR= 5.81,  $p < 0.001$ ).

**b. The effect of family income on anemia in adolescents**

Family income  $>$ Rp 1,947,821 reduce the likelihood of anemia in adolescents. Ado-

lescents with a family income  $>$ Rp 1,947,821 reduce the likelihood of anemia by 5.81 times than adolescents with family income  $<$ Rp 1,947,821 (OR=5.81,  $p < 0.001$ ).

**c. The effect of menstrual pattern on anemia in adolescents**

Regular menstrual patterns reduce the likelihood of anemia in adolescents. Adolescents with regular menstrual patterns had a 5.06 times lower chance of anemia than adolescents with irregular menstrual patterns (OR=5.06,  $p < 0.001$ ).

**d. The effect of iron tablet consumption on anemia in adolescents**

Adolescents who consume iron tablet reduce the likelihood of anemia. Adoles-

cents who consumed iron tablet decreased the risk of anemia by 9.33 times than adolescents who did not consume blood supplement (OR=9.33, p<0.001).

**e. The effect of nutritional status on anemia in adolescents**

Good nutritional status reduced the likelihood of anemia in adolescents. Adolescents with good nutritional status reduce the likelihood of anemia by 6.46 times than

those with poor nutritional status (OR= 6.46, p<0.001).

**3. Multivariate Analysis with a Multilevel Analysis Approach**

Multilevel multiple logistic regression analysis explained the effect of more than one independent variable and variable at level 2, namely school. The results of the analysis can be seen in Table 4.

**Table 4. Multilevel multiple logistic regression analysis results of the influence of adolescent knowledge, family income, menstrual patterns, blood supplement consumption, and nutritional status of adolescents on anemia in adolescents**

Independent Variables	(b)	95% CI		p
		Lower Limit	Upper Limit	
<b>Fixed Effect</b>				
Knowledge (good)	-2.29	-4.23	-0.32	0.022
Family income (≥MW (Rp. 1,947,821)	-2.73	-4.58	-0.75	0.006
Menstrual pattern (regular)	-3.07	-5.84	-1.28	0.002
Blood supplement consumption (yes)	-3.22	-8.96	-2.17	0.001
Nutritional status (normal)	-3.36	-6.65	-1.74	0.001
<b>Random effect</b>				
<b>School Variable</b>	4.80			
N observation= 200				
N group= 25				
Average group= 8, min=8, max=8				
Log likelihood= -41.38				
p= 0.008				
p LR test vs logistic regression= 0.002				
ICC= 59.36%				

Table 4 showed that knowledge, family economy, menstrual patterns, consumption of blood-supplemented tablets, and nutritional status have a statistically significant effect on the incidence of anemia in adolescents. The results of the logistic regression analysis can be described as follows:

**a. The effect of adolescent knowledge on anemia in adolescents**

There is a positive influence between adolescent knowledge on anemia in adolescents. Adolescents who have poor knowledge have the risk (logodd) of experiencing anemia by 2.29 units higher compared to

adolescents who have good knowledge (b= 2.29; 95% CI= 0.32 to 4.23; p= 0.022).

**b. The effect of family income on anemia in adolescents**

There is a positive influence between family income on anemia in adolescents. Adolescents who have an economy <Rp 1,947,821 have a risk (logodd) of experiencing anemia by 2.73 units higher compared to adolescents who have a family income ≥Rp 1,947,821 (b= 2.73; 95% CI= 0.75 to 4.58; p= 0.006).

**c. The effect of menstrual pattern on anemia in adolescents**

There is a positive influence between menstrual patterns on anemia in adolescents.

Adolescents who have abnormal menstrual patterns have a logoddd risk of experiencing anemia by 2.29 units higher compared with adolescents who have normal menstrual patterns ( $b= 2.29$ ; 95% CI= 0.75 to 4.58;  $p= 0.001$ ).

#### **d. The effect of blood supplement consumption on anemia in adolescents**

There is a positive influence between blood supplement consumption on anemia in adolescents. Adolescents who did not consume blood supplement had a risk (logoddd) of anemia by 3.22 units higher compared to adolescents who consume iron tablet ( $b= 3.22$ ; 95% CI= 2.17 to 8.96;  $p= 0.001$ ).

#### **e. The effect of nutritional status on anemia in adolescents**

There is a positive influence between nutritional status on anemia in adolescents. Adolescents who have abnormal nutritional status have a logoddd risk of experiencing anemia by 3.36 units higher compared to adolescents who have normal nutritional status ( $b= 3.36$ ; 95% CI= 1.74 TO 6.65;  $p= 0.001$ ).

#### **f. The effect of school on anemia in adolescents**

The school level shows that there is a contextual effect on anemia in adolescents (ICC= 59.36%), this shows that the variation of postpartum depression is 59.36% determined by variables at the school level. The ICC value in this study is greater than the 8-10% rule of thumb, so the contextual influence, namely school, is very important.

## **DISCUSSION**

### **1. The effect of adolescent knowledge on anemia in adolescents**

Knowledge has a great influence on the occurrence of anemia in adolescents. Knowledge influences a person to take an action as well as to prevent or overcome anemia. Research by Kabir et al. (2010) showed that

73.8% of the participants did not know about iron-rich food sources due to the lack of knowledge that adolescents have. So that teenagers are wrong in choosing food consumption.

In line with Chalise et al. (2018) who concluded that the level of education is one of the fundamental causes that can lead to anemia. This is because the level of education affects the level of knowledge on nutritional intake that must be fulfilled every day. A good understanding of adequate nutritional intake will have an impact on a good diet so that it can prevent anemia in the community, especially in adolescent girls who are prone to anemia. The majority of adolescents do not know about the symptoms of anemia, vitamins involved in iron, few teenagers know about iron-rich food sources, adolescents do not know about anemia prevention (Kamat and Sangupta, 2019).

A study by Pareek and Hafiz (2015) concluded that most of the subjects had wrong food habits, 60% of subjects ate out once a week and 23% of the subjects ate out twice a week. Most of them prefer to eat fast food and soft drinks. Only 25% of the subjects have good knowledge about anemia. A person's knowledge can influence the occurrence of anemia, because knowledge can affect their behavior, including their lifestyle and eating habits. Lack of knowledge about anemia, its signs, effects, and prevention results in adolescents consuming foods that contain little iron so that the iron intake they need is not fulfilled.

### **2. The effect of family income on anemia in adolescents**

There was a positive influence between family income on anemia in adolescents. Adolescents who have an economy <Rp 1,947,821 have a risk (logoddd) of experiencing anemia by 2.73 units higher compared to adolescents who have a family

income  $\geq$  Rp 1,947,821 ( $b = -2.73$ ; 95% CI = -4.58 to -0.75;  $p = 0.006$ ).

Female adolescents who have parents with high incomes are easier to get all their needs, both primary and secondary needs, and with high incomes, parents can provide a variety of nutritious foods like their children, in contrast to adolescents who have low income parents, they must accept the food given by their parents because they cannot ask for more due to the limited income of their parents. The higher the income of the parents, the easier it is to get the facilities and infrastructure needed by the child, while the parents with a low economic background, it is more difficult for them to get the facilities and infrastructure needed by the child and the less time they can give to their children because of the parents prioritizing to fulfill daily needs (Kim et al., 2014; Jawarkar et al., 2015).

A study by Mangistu et al. (2019) concluded that the prevalence of anemia was found to be 11.1% with low economic status which can directly affect changes in family food consumption. Increased income means increasing opportunities to buy food of better quality and quantity. Conversely, a decrease in income will cause a decrease in the quality and quantity of food purchased, which can result in the body's need for nutrients not being fulfilled, one of which is not fulfilling the body's need for iron, which can lead to anemia.

Economic status can cause a person to have balanced eating habits, especially iron-rich food groups. The low economic level (income) of the family will affect the pattern and type of family food, in which most of the families who have a low economic level (income) prefer carbohydrate-oriented foods to protein, vitamins and minerals. This is because foods containing carbohydrates are cheaper than others. Low

economies tend to suffer from malnutrition. This will affect the ability to consume food and nutrients so that this situation leads to anemia in adolescents (Gonete *et al.*, 2018; PAHO, 2010).

### **3. The effect of menstrual pattern on anemia in adolescents**

The results of this study indicated that there was a positive influence between menstrual patterns on anemia in adolescents. Adolescents who had a normal menstrual pattern had a logod risk of anemia by 2.29 units lower than adolescents with abnormal menstrual patterns ( $b = -2.29$ ; 95% CI = -4.58 to -0.75;  $p = 0.001$ ).

The need for iron in female adolescent is higher than male adolescent, because it is needed to replace the iron lost during menstruation. One of the causes of nutritional anemia is chronic blood loss. In women, there is blood loss every month which happened naturally. If there is a lot of blood that comes out during menstruation, iron deficiency anemia will occur. Irregular menstruation for  $\geq 5$  days were 2.4 times more likely to be anemic than adolescent girls with menstrual flow  $< 5$  days per each cycle (Mangistu et al., 2019; Ahmed et al., 2018).

Women will experience menstruation every month and will experience blood loss every month. Adolescents who have abnormal menstrual periods will experience more blood loss during menstruation than respondents who have normal menstrual periods. The length of the menstrual process will affect the number of red blood cells in the body, the longer the menstruation process, the more blood that comes out, which can cause anemia problems in women. In addition, menstrual patterns are also influenced by the personal hygiene of a teenager (PAHO, 2010; ACOG, 2015; Kunaryanti et al., 2019).

Heavy regular and irregular cycles are important factors contributing to adolescent anemia. Heavy bleeding during menstruation in women has a negative impact. It can decrease iron levels and hemoglobin counts and cause anemia in women if not treated. Fatigue is a sign that women experience anemia due to bleeding during menstruation (Kocaoz et al., 2019; Toheed et al., 2017).

The impact of anemia on female adolescent is that during their growth period, they are prone to infection, decreased body fitness, decreased enthusiasm for learning and achievement, so that at times they will become prospective mothers with high risk conditions. If menstrual irregularities in adolescents last in a long time, they should immediately check with their doctor for therapy. Adolescents with a history of untreated anovulatory cycles for 2 years to 3 years should be evaluated with an endometrial biopsy, because there is an increased risk of endometrial carcinoma in these patients (Elmaogullari and Aycan, 2018).

#### **4. The effect of blood supplement consumption on anemia in adolescents**

The results of this study indicate that there is a positive influence between consumption of blood supplement on anemia in adolescents. Adolescents who consume blood supplement had a risk (logod) of anemia by 3.22 units lower than adolescents who did not consume blood supplements ( $b = -3.22$ ; 95% CI = -8.96 to -2.17;  $p = 0.001$ ).

The use of blood supplements affects the incidence of anemia in adolescents. Fe deficiency anemia is prevented by maintaining a balance between Fe intake and Fe intake and loss. The amount of iron required to maintain this balance varies from woman to woman, depending on reproductive history and the amount of

blood loss during menstruation. Increasing consumption of Fe to fulfill Fe needs is done through increasing consumption of foods containing heme iron and minimizing consumption of foods containing inhibiting factors for Fe absorption (Ramzi et al., 2011; Aprianti et al., 2018).

If the need for iron is not fulfilled from the diet, iron supplements can be added, especially for pregnant women and childbirth and adolescents who are in the process of growth. Fe supplementation is one of the strategies to increase Fe intake which is successful only if the individual adheres to the consumption rules. Another form of strategy used to increase compliance with Fe consumption is through education about the importance of Fe supplementation and the side effects of consuming Fe. Iron deficiency anemia occurs because the dietary pattern of Indonesian people is still dominated by vegetables as a source of iron that is difficult to absorb, while meats are good sources of iron for consumption in insufficient amounts (Mulugeta et al., 2015; Mahmudiono et al., 2019).

The low consumption of iron is also caused by the low ability of the family to provide a source of iron, especially animal protein in their daily diet, in addition, because the respondents' food consumption is still monotonous, the habit of consuming tea after eating also has an impact on low iron absorption in the respondent's body. For this reason, the role of local health workers is very important in socializing iron supplementation for young women, especially during menstruation, because iron is an essential microelement for the body, as the main factor in forming haemoglobin (Chalise et al., 2018).

### **5. The effect of nutritional status on anemia in adolescents**

The results of this study indicate that there was a positive influence between nutritional status on anemia in adolescents. Adolescents who have good nutritional status have a risk (logodds) for experiencing anemia by 3.36 units lower than adolescents who have abnormal nutritional status ( $b = -3.36$ ; 95% CI = -6.65 to -1.74;  $p = 0.001$ ).

Gonete et al. (2018) who concluded that anemia is a public health problem that can occur in adolescent women. In adolescence, changes occur in a person's physical, biological, and psychological and occur continuously during adolescence. An imbalance between intake and nutritional needs results in nutritional problems, both under nutrition and over nutrition. Anemia is significantly associated with a low BMI for age. Female adolescents who have a low BMI for ages are 3.2 times more likely to be anemic than those who have a BMI for ages (Mangistu et al., 2019).

This is in line with Ahwal (2016) which concluded that a higher prevalence of anemia is among female adolescent. Iron intake and absorption which causes anemia in female adolescent. Basically, anemia is directly influenced by the daily consumption of foods that contain less iron, in addition to infection as the trigger. In general, food consumption is closely related to nutritional status. If the food consumed has a good nutritional value, the nutritional status is also good, on the other hand, if the food consumed is of less nutritional value, it will cause malnutrition and can cause anemia (Hapzah and Yulita, 2012).

Adolescents with high nutritional status can reduce the incidence of anemia. If the nutritional status is deficient, the incidence of anemia is high. Good nutrition will be achieved by providing balanced food for the body according to the needs and lack

of nutrition illustrates the imbalance of the food eaten with the needs of the human body. The nutritional status of adolescents greatly affects the incidence of anemia. In adolescents the diet is not certain, especially in female adolescent who mostly have unhealthy diets in order to maintain an ideal body weight. In fact, an unhealthy diet can cause problems in nutritional status which greatly affect the incidence of anemia in adolescents. Health education about nutritional status is very influential on food consumption patterns in adolescents (Tesfaye et al., 2015; Ocak et al., 2017; Said et al., 2020).

### **6. The effect of school on anemia in adolescents**

The results showed that there was a contextual influence at the school level indicating that there was a contextual effect on anemia in adolescents with scores (ICC = 59.36%). The variation of anemia among adolescents was 59.36% influenced by school. The ICC value in this study is greater than the 8-10% rule of thumb, so the contextual influence in this study is that school is very important.

School is an institution for students teaching students under the supervision of the teacher. Most countries have formal education systems that are generally compulsory. In this system, students progress through a series of teaching and learning activities in schools. The names for these schools vary by country (discussed in the Regions section below), but generally include primary schools for young children and secondary schools for adolescents who have completed primary education.

Senior High School, is a form of formal education unit that provides general education at the secondary education level as a continuation of JHS, MTs, or other forms of equivalent or continuation of learning outcomes that are equal/ equivalent

lent to JHS or MTs. Madrasah Aliyah, which abbreviated as MA, is a form of formal education unit under the guidance of the Minister of Religion which provides general education with the uniqueness of the Islamic religion at the secondary education level as a continuation of JHS, MTs, or other forms of equivalent or advanced learning outcomes that are recognized as the same or equivalent to JHS or MTs. Vocational High School, which abbreviated as VHS, is a form of formal education unit that provides vocational education at the secondary education level as a continuation of JHS, MTs, or other forms of equivalent or advanced learning outcomes that are recognized as equal or equivalent to JHS or MTs (Republic of Indonesia Government Regulation Number 66 of 2010).

Schools are one of the facilities that can help prevent anemia in adolescents by cooperating with health workers and schools. One of the ways that can be done is by conducting counseling and health education regarding anemia which includes danger signs and types of foods that contain iron. In addition, it is also possible to provide iron supplements to adolescents in school. Various studies have shown school-based iron and folic acid supplementation as a feasible and effective intervention to prevent hemoglobin reduction and reduce the prevalence of iron deficiency anemia in female adolescents (Mulugeta et al., 2015; Dharmalingam et al., 2017).

School programs by providing health education, health counseling, and providing iron supplements can be carried out since they are at the Junior High School/Madrasah Tsanawiyah/equivalent level to detect or prevent anemia in adolescents. So that teenagers from an early age already have knowledge about anemia. Whether it's about the signs of anemia, the impact of anemia, and some foods that contain iron

(Mahmudiono et al., 2019; Regasa and Haidar 2019).

Based on the results of the study, it can be concluded that there is a significant influence between knowledge, family economy, menstrual patterns, consumption of blood supplements, and nutritional status with anemia in adolescents. Variations at the school level indicate a contextual influence on the incidence of anemia in adolescents.

#### **AUTHOR CONTRIBUTION**

Nurmala Dewayanti as the main has the role in coordinating the study, conducting all stages of the study, and completing the study paper. Bhisma Murti has the role in compiling the study framework, processing study data, presenting the results of study analysis, and preparing study papers. Endang Sutisna Sulaeman has a role in developing ideas, study designs, and study hypotheses.

#### **CONFLICT OF INTEREST**

There was no conflict of interest in this study.

#### **FUNDING AND SPONSORSHIP**

The funding for this study used personal cost of the main researcher.

#### **ACKNOWLEDGEMENT**

Our gratitude goes to all school principals and high school teachers in Klaten Regency who has helped the study and students who have been willing to become study subjects.

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