Iron folic acid consumption and anemia prevalence among female adolescents in rural areas: an observational study

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Abstract
Background: Anemia among female adolescents can cause maternal deaths due to bleeding and eclampsia. Anemia is experienced by over half of billion women of childbearing age (15-49 years) worldwide, and the prevalence increased from 28.5% in 2015 to 29.6% in 2019. The maternal deaths in Bogor Regency were mostly caused by bleeding and eclampsia. This study examines the association between individual characteristics, menstrual patterns, nutritional status, and weekly iron folic acid consumption on the anemia status of female adolescents in Sirnagalih, Bogor, West Java. Methods. This is cross-sectional research conducted from December 2021 to February 2022. The study population was female adolescents (10-19 years) and the sample consisted of 78 respondents selected by using a purposive sampling technique. Interviews were conducted using a questionnaire and blood test to collect data. Results: The results of the chi-square analysis showed a significant association between weekly iron folic acid consumption and anemia status of female adolescents (p-value = 0.018 and POR = 0.128 (95% CI: 0.02-0.69)), while other variables did not have a significant association. Conclusions: For female adolescents in rural regions, where the prevalence of anemia is higher than in urban areas, it is necessary to promote iron folic acid supplement consumption. For further research, it is suggested to add other variables that affect anemia status in rural female adolescents such as the availability of another high-protein food, adherence to taking iron folic acid supplements, and to be examined for worm infections.

Keywords
anemia, female adolescent, iron-folic acid, menstruation pattern, nutrition status, rural area
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INTRODUCTION
The World Health Organization (WHO) reports that over half a billion women of childbearing age (15-49 years) have anemia. Therefore, the United Nations decided to include the prevalence of anemia among pregnant and non-pregnant women as a significant indicator in the 2020 Sustainable Development Goals (SDGs). By 2025, the World Health Assembly requested that the prevalence of anemia among women of reproductive age (15-49 years) decrease by 50%; however, this deadline could be extended to 2030.

The prevalence of anemia in the world increased from 24.8% in 1993 to 25.4% in 2010, with adolescents as the most significant proportion. Anemia prevalence in women of childbearing age worldwide increased in 2015 from 28.5% to 29.9% in 2019. An increase in cases of anemia also occurred in female adolescents in Indonesia, from 18.4% in 2013 to 27.2% in 2018. A persistent discrepancy between a person’s dietary iron intake and their body’s physiological needs results in iron deficiency anemia. Female adolescent anemia is a nutritional issue that can seriously affect growth, cognition, work performance, and other areas throughout the reproductive years of life and beyond. Pregnancy during adolescence with anemia raises maternal morbidity and mortality rates and the likelihood of unfavorable pregnancy outcomes like stillbirth, low birth weight, and premature birth. It also has a detrimental effect on the infant’s iron status. The maternal deaths in Bogor District Regency were caused mainly by bleeding and eclampsia. Previous studies explained that female adolescent anemia prevalence can cause maternal death due to bleeding and eclampsia and also low birth weight.

The factors that influence the incidence of anemia include the level of education, sex, region, breakfast habits, health status, and state of body mass index (BMI) which is included in the underweight category. The study results showed that food intake, age, place of residence, and activity type affect hemoglobin levels in a female adolescent who takes iron folic acid supplements. Previous studies examined the causes of anemia in female adolescents, consisting of nutritional status, menstrual cycle and length, lack of iron-folate intake, and vitamin B12 as direct factors for anemia in female adolescents. Other studies have tried to examine indirect causes of anemia such as socio-demography (age, education, economic status). In addition, the influence of behavioral factors such as the application of personal hygiene and environmental sanitation and adherence to consuming iron folic acid tablets was also investigated with the incidence of anemia in adolescent girls.

Heavy monthly flow puts female adolescents at risk for iron deficiency anemia, with an incidence of about 9%, and another 15% to 20% of them have iron insufficiency without anemia. Adolescent girls who have experienced menstruation are at risk of suffering from anemia due to bleeding during menstruation. This is exacerbated if the dietary intake pattern of iron food sources is significantly less than the recommended adequacy rate. Apriningsih et al.’s 2021 research reported a relationship between the intake of food sources of iron and Hb levels in adolescent girls. Intake patterns are influenced by several related factors including socioeconomic status, education, gender, and place of residence.

WHO and the Indonesian Ministry of Health launched weekly iron folic acid supplementation (WIFAS) program as an effort to prevent and treat anemia in female adolescents.

Most of the WIFAS programs are carried out in schools. However, this program was hampered due to the coronavirus pandemic. There have been several adaptations and innovations that program managers have made to respond to the Ministry of Health’s policies in dealing with pandemics, such as implementing health protocols, using social media and applications for education and monitoring compliance with IFAS consumption. An example is the Ministry of Health of the Republic of Indonesia launching the Ceria application for the prevention of anemia in young women and implementing it in several regions. However, this requires facilities and infrastructure such as gadgets and internet networks, and not everyone in rural areas have these, both in developed and developing countries.

A previous study discussed factors related to anemia in general, without focusing on rural areas particularly in Indonesia. According to national health research 2018 data, the proportion of people with anemia is higher in rural areas (25.0%) than in urban areas (22.7%). Therefore, this study aims to examine the factors related to anemia in female adolescents in rural areas particularly related to an iron folic acid supplement program.

METHODS
Ethical considerations
The protocol for this study was approved by the Universitas Pembangunan Nasional Veteran Jakarta Health Research Ethics Committee under the number 499/XII/2021/KEPK. The date of approval was 21 December 2021. Verbal consent was provided by participants which the interviewers then noted down. Parents and children gave consent before being involved as research participants; they were not involved as research participants if they did not agree.
Study area
The study was conducted in Sirnagalih Village, Jonggol, Bogor Regency, West Java Province, Indonesia. This village is located in one of the districts and provinces that have the highest maternal mortality rate in Indonesia. The biggest cause of maternal death in Indonesia, including in Bogor, West Java, is bleeding and factors related to the incidence of bleeding including anemia.29

Participants
103 potential female adolescent participants were identified by asking village heads and local community health workers. Participants who met the inclusion criteria were asked about their willingness to participate in the study and asked for their parents’ approval. The approach process was assisted by local community health workers. There were 25 potential participants who are not willing to participate because they have another activity and could not be interviewed at the study time. 78 female adolescents enrolled in the cross-sectional study from December 2021 to January 2022. We used The Lemeshow sample size formula for calculating sample size:

\[ n = \frac{Z_{\alpha/2} \sqrt{2\Pi(1-\Pi)} + Z_{\beta/2} \sqrt{P_1(1-P_1) + P_2(1-P_2)}}{(P_1 - P_2)^2} \]

and determined from previous research.30 The value of \( P_1 = 0.3 \), namely the proportion of anemia in the group that consumed iron folic acid and \( P_2 = 0.79 \), namely the proportion of anemia in the group that did not consume iron folic acid. With a 95% degree of confidence \( (Z_{\alpha/2} = 1.96) \), the total number of samples obtained is 40 samples. To adjust for the sampling method, a design effect of 1.5 was used, and the final minimum sample size was 60. The purposive sampling technique was used, and the inclusion criteria were female adolescents based on their self-report and researcher observation based on their appearance, aged 10-19 years, have menstrual periods, the inhabitant of Sirnagalih Village, and gave their and their parents’ consent. If participants have poor health such as suffering from thalassemia or hemophilia, they will not be involved as research participants. Respondents of this study were female adolescents because they have monthly menstrual cycle and are at risk for anemia. This research did not apply to male adolescents, because they do not have menstruation and the anemia prevalence among female adolescent is higher.

Data and instruments
Data was collected by interviewing respondents face to face using questionnaires. Examination of hemoglobin levels and interviews were conducted at the village hall of Sirnagalih, Jonggol, Bogor, West Java.

The independent variables used were the menstrual cycle, duration of menstruation, and consumption of blood-added tablets. The dependent variable (outcome) used was the incidence of anemia in adolescent girls. Confounding variables suspected in this study were age and education level.

The topics in the questionnaire are menstrual cycle, duration of menstruation, nutrition status, education level and consumption of iron tablets. The researchers created the questionnaire in accordance with the research objectives. Therefore, validity and reliability tests were carried out before being used in the research sample as pilot study. The menstrual cycle is the distance between the start of the last menstrual period and the next menstruation. Menstrual cycle variables were measured using 4 multiple choice questions. Menstrual cycles are categorized into two, standard 21-35 days and abnormal if the menstrual cycle is more than 35 days. Menstruation duration is the duration (day) experienced by a woman during the menstrual process. The menstrual duration variable was measured using 6 multiple choice questions and 1 free text question for confirmation. The menstrual duration was categorized into two categories, namely normal (3-8 days) and abnormal (<3 days or >8 days). The variable iron folic acid consumption was measured using 5 multiple choice questions and 1 free text question as supporting information. Respondents are said to be taking Fe tablets if they consume iron tablets regularly every week (according to the program).

Qualitative data is collected to add supporting information to the quantitative data. There is one open question that collects qualitative data combined alongside the quantitative questions. The answers given by the respondents were written in the form of a questionnaire.

Anemia status variables were measured using 4 multiple choice questions and measurement of Hb levels to validate respondents’ answers. Meanwhile, the cyanmethemoglobin method is categorized as anemia (<12 g/dl) and not anemia (≥12 g/dl). The anemia threshold for women aged 11 years and above is if the concentration or level of hemoglobin in the blood is less than 12 g/dl.31
Independent variable (age) is categorized based on median value, education level grouping is based on up to junior high school and senior high school or above, nutrition status grouping is based on ideal (Z score -2SD until +1SD) and unideal, menstruation pattern grouping is based on normal and abnormal, and whether or not participants were consuming iron folic acid.

Health workers carried out data collection via hemoglobin examination to measure respondents’ Hb levels (Figure 1). This was done by taking a blood sample at the fingertips using an EasyTouch GcHb tool. The quantitative data were analyzed univariately to display the distribution and frequency of the existing variables. We used the chi-square test to examine the association between the variables. Crude OR was obtained in bivariate analysis with $\alpha = 0.05$ and 95% confidence interval (95% CI). All statistical analysis was performed using SPSS Software (25th version, International Business Machines Corp., New York). The multivariate test was not carried out because only one variable met the entry requirements for the multivariate test model. Thus, no interaction test between variables was carried out. There is no missing data in this study.

The risk of bias that may occur includes selection bias caused by the selection of samples that are not random so that they are not representative. The bias can interfere with the external validity. Another possibility of bias is that there are several other variables that may be associated factors for anemia but were not measured in this study.

**Reliability of the questionnaires**

Questionnaire tests were carried out in the month of January 2022 to 50 respondents outside the study population with the same characteristics. Participants were selected by non-probability sampling technique. Based on this test, it was found that the questionnaire was valid with $r$ value= 0.278, while the reliability of the questionnaire was very good (Cronbach’s $\alpha = 0.65$).
Results
Female adolescent characteristics

Based on information from Sirnagalih’s village head on December 2021, there were 103 people recorded on rural data (female adolescents 10-19 years old, lived in Sirnagalih Village areas, have menstruated). The final number of respondents was 78 female adolescents who were willing to be a respondent; the others were unwilling to participate in this study. This study only applied to female and not male adolescents.

Table 1 presents the characteristics of the respondents. Most participants are older than 15 years old but less than 19 years old (53.8%). Most participants’ last education level was junior high school level (60.3%). Most participants had standard nutritional status (83.3%), had normal menstrual patterns (59.0%), and did not consume iron folic acid supplements regularly (89.7%).

These research findings demonstrate that the majority of female adolescents in Sirnagalih village are between 15-19 years old, and that the majority of them have recent education up to junior high school. This is understandable because the compulsory education program in West Java only lasts for 9 years (junior high school level). Even though they live in a village, the average nutritional status of the respondents is included in the good nutrition category based on WHO anthropometry (Z score -2SD to +1SD).

Interestingly, in this village, information was obtained about a mother who was still an adolescent and had anemia. It is allegedly assumed that it is not just one person, but several mothers married young or are classified as teenagers and have anemia, as stated below:

“I got married when I was 17 years old, and some of my friends also got married at a young age, although not many” (Respondent X).

The associated factors of female adolescent anemia

This study showed a relationship between the consumption of iron tablets and anemia in female adolescents (p=0.01, POR=0.13) (see Table 2). In contrast, other variables such as age, education, nutritional status, and menstrual patterns showed no significant relationship (p>0.05).

Table 1. Female adolescent characteristics.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Yes</td>
<td>8</td>
<td>10.3</td>
</tr>
<tr>
<td>- No</td>
<td>70</td>
<td>89.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- &lt;15 years old</td>
<td>36</td>
<td>46.2</td>
</tr>
<tr>
<td>- &gt;15 years old</td>
<td>42</td>
<td>53.8</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Graduated from Junior high school</td>
<td>47</td>
<td>60.3</td>
</tr>
<tr>
<td>- Graduated from Senior high school</td>
<td>31</td>
<td>39.7</td>
</tr>
<tr>
<td>Menstruation pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Normal</td>
<td>46</td>
<td>59.0</td>
</tr>
<tr>
<td>- Abnormal</td>
<td>32</td>
<td>41.0</td>
</tr>
<tr>
<td>Nutrition status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ideal (good)</td>
<td>65</td>
<td>83.3</td>
</tr>
<tr>
<td>- Unideal (malnutrition)</td>
<td>13</td>
<td>16.7</td>
</tr>
<tr>
<td>Iron folic supplement consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Yes</td>
<td>8</td>
<td>10.3</td>
</tr>
<tr>
<td>- No</td>
<td>70</td>
<td>89.7</td>
</tr>
</tbody>
</table>
In this study, the prevalence of anemia among female adolescents in Sirnagalih village was 10.3%. This figure is lower than the national figure (27.2%) and the findings of Sari et al. (2022) in Soreang, West Java (14.3%). However, it is similar to the prevalence of anemia among adolescents in rural areas in western China (11.7%).

Early marriage or marriage before the age of 18 is common in developing nations and is related to a number of social, physical, and health issues. Women who marry young typically have a low level of education. Because they have to start caring for a child, they neglect their health. Additionally, early-married women are far more likely to experience domestic abuse. The limited availability of nutritious foods, lower socioeconomic status, and lack of access to hygienic sanitation facilities are associated with elevated rates of disease which in turn may be associated with increased risk of anemia in rural areas. Research in Albania shows that the women who lived in rural regions were more vulnerable to being anemic than the women who lived in urban areas.

Most anemic female adolescents in this study had a senior high school level of education. This finding is in line with a study by Bellizzi et al. (2020) in India, who found that many adolescent girls suffer from anemia with higher education than primary school. This is different from the study of Ma et al. (2017) in China, which found that most anemia sufferers in non-pregnant reproductive women had junior high school education. This difference is assumed to be because those with junior high school education still get iron-folic acid supplements from their schools. In contrast, those with senior high school education and above do not get them.

In contrast to the findings from this study, a person’s nutritional condition affects the incidence of anemia. A person’s nutritional status (malnutrition) is one of the affectional factors for anemia. The cause of that problem is that young women often eat unhealthy foods like fast food because they ignore their health.

They also drink tea or coffee less than an hour after meals, which might interfere with iron absorption. Moreover, they often undergo unhealthy diets without an instructor, such as a doctor or nutritionist, affecting their growth and nutritional needs.

The menstrual pattern has no significant association with female adolescent anemia. This differs from the meta-analysis study that Endale et al. (2022) conducted. Those studies identified factors associated with female adolescent anemia, such as low dietary diversity (OR: 1.56; 95% CI: 1.05, 2.32), illiterate mothers (OR: 1.45; 95% CI: 1.13, 1.86), households

### Table 2. The associated factors of female adolescent anemia in Sirnagalih Village.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Anemia status</th>
<th></th>
<th></th>
<th>P value</th>
<th>POR (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>&lt;15 yo</td>
<td>1</td>
<td>2.8</td>
<td>35</td>
<td>97.2</td>
<td></td>
</tr>
<tr>
<td>≥15 yo</td>
<td>7</td>
<td>16.7</td>
<td>35</td>
<td>83.3</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Junior high school</td>
<td>3</td>
<td>6.4</td>
<td>44</td>
<td>93.6</td>
<td></td>
</tr>
<tr>
<td>Senior high school</td>
<td>5</td>
<td>16.1</td>
<td>26</td>
<td>83.9</td>
<td></td>
</tr>
<tr>
<td>Menstruation pattern</td>
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<td></td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Normal</td>
<td>5</td>
<td>15.6</td>
<td>27</td>
<td>84.4</td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>3</td>
<td>6.5</td>
<td>43</td>
<td>93.5</td>
<td></td>
</tr>
<tr>
<td>Nutrition status</td>
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<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Ideal/Good</td>
<td>7</td>
<td>10.8</td>
<td>58</td>
<td>89.2</td>
<td></td>
</tr>
<tr>
<td>Unideal/Malnutrition</td>
<td>1</td>
<td>7.7</td>
<td>12</td>
<td>92.3</td>
<td></td>
</tr>
<tr>
<td>IFAS consumption</td>
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<td></td>
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<td>0.01</td>
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<tr>
<td>Yes</td>
<td>3</td>
<td>37.5</td>
<td>5</td>
<td>62.5</td>
<td></td>
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<tr>
<td>No</td>
<td>5</td>
<td>7.1</td>
<td>65</td>
<td>92.9</td>
<td></td>
</tr>
</tbody>
</table>
with more than five people (OR: 1.65; 95% CI: 1.14, 2.38), food insecurity in the home (OR: 1.48; 95% CI: 1.21, 1.82), and menstrual blood flow lasting longer than five days (OR: 6.21; 95% CI: 1.67). This study found that a factor significantly related to anemia in young women in rural areas was the consumption of iron folic acid supplements. These results align with the study on Ghana (2021) and Bhutan. This result reinforces the need for an iron-folic acid supplement program to prevent and treat anemia in female adolescents.

The supplementation iron-folate program guide by WHO and Ministry of Health of the Republic of Indonesia should be sustainable and monitored for its effectiveness. Its effectiveness includes the issue of adherence to drinking iron folic acid for female adolescents and the level of school readiness as the spearhead of the program’s success. The pandemic period that has hampered health programs, including the WIFAS school-based program, should give rise to innovations such as using internet-based social media for education and promoting adolescent health, including anemia. However, internet-based social media is very limited in its application in rural areas, where internet facilities are still limited.

This study has limitations in the number of samples, types of causative factors, and study design by using a cross-sectional design. A cross-sectional design was appropriate in this study because it was effective in observing the phenomenon and causes at the same time. Therefore, it is recommended for further research to increase the number of samples, add causal factors, and use a more robust study design such as a cohort or experiment.

Conclusions
Iron folic acid supplement consumption factor is associated with anemia in female adolescents in rural areas. Therefore, it is necessary to organize an iron folate supplementation program in school-based to reach female adolescents who do not attend school in rural areas.

Data availability
Underlying data

Extended data

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

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