

ANEMIA RISK INDICATORS AND LEARNING FOCUS AMONG SCHOOL-BASED ADOLESCENT GIRLS

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ABSTRACT

Anemia among adolescent girls remains an important public health problem because it may affect fitness, learning concentration, productivity, and reproductive health readiness during the preconception period. This study aimed to describe anemia risk indicators and learning focus among adolescent girls and to analyze menstrual factors, dietary patterns, iron supplementation tablet consumption, tea/coffee intake, vitamin C-rich fruit consumption, and screen time as school-based prevention indicators. An observational analytic study with a cross-sectional approach was conducted among 140 female senior high school students. Data were collected using a structured questionnaire and analyzed descriptively and bivariately. The mean age was 15.55 years and the mean age at menarche was 11.72 years. Previous anemia was reported by 35.7% of respondents. Most respondents had menstrual cycles <28 days (67.9%), menstrual duration of 5-10 days (69.3%), and moderate-to-severe menstrual complaints (51.4%). Weekly iron supplementation tablet consumption was reported by 70.0%, but 30.7% still often forgot to take the tablets. The mean learning focus score was 24.41 out of 40, and 51.4% had good learning focus. Menstrual duration, menstrual complaints, and breakfast frequency were significantly associated with learning focus. School-based anemia prevention should integrate nutrition education, iron supplementation monitoring, breakfast habituation, menstrual health support, and balanced screen time education.

Keywords: Anemia; Adolescent Girls; Menstruation; Iron Supplementation Tablets; Learning Focus

INTRODUCTION

Adolescence is a critical period for biological growth, psychosocial transition, and preparation for future reproductive health. The contemporary understanding of adolescence emphasizes not only age boundaries but also continuing biological, cognitive, and social development; therefore, school-based health promotion during this period has long-term implications for human capital and intergenerational health (Sawyer et al., 2018). Among adolescent girls, anemia is especially relevant because iron requirements increase during growth and because menstrual blood loss may reduce iron stores when dietary intake and supplementation are inadequate (APRININGSIH et al., 2020).

Globally, anemia remains a major public health concern among women of reproductive age. The World Health Organization reported that 30.7% of women aged 15-49 years had anemia in 2023, and anemia contributes to fatigue, reduced productivity, and adverse intergenerational consequences (WHO, 2025). In Indonesia, anemia prevention among adolescent girls has been strengthened through school-based nutrition education and iron supplementation tablets, locally known as Tablet Tambah Darah (TTD). The Indonesian Ministry of Health reported that anemia prevalence reached 26.8% among children aged 5-14 years and 32.0% among those aged 15-24 years based on Riskesdas 2018, while TTD

adherence remained a challenge despite school-based distribution (Kementerian Kesehatan Republik Indonesia, 2022).

The school-based weekly iron-folic acid supplementation strategy has been recommended and implemented in several settings as a feasible approach for anemia prevention among adolescent girls. Evidence from Indonesia has shown that multisectoral collaboration through schools is necessary for delivery, monitoring, and behavioral reinforcement (Roche et al., 2018). Studies on weekly iron-folic acid supplementation also indicate that education and adherence support are important because supplementation alone may not be sufficient when compliance is inconsistent (Utami et al., 2022).

Anemia risk among adolescent girls is not determined solely by iron supplementation. Menstrual patterns, menstrual duration, menstrual complaints, dietary intake, consumption of iron inhibitors such as tea or coffee close to meals or supplementation, and intake of enhancers such as vitamin C-rich fruits may interact with iron status and perceived daily functioning. Hemoglobin and iron status have also been linked with cognitive test performance among school-aged populations, supporting the relevance of connecting anemia prevention with educational outcomes (Mantey et al., 2021).

Learning focus is a practical school-based outcome because it reflects students' perceived ability to pay attention, complete tasks, avoid distractions, remember learning material, and maintain enthusiasm during the school day. Breakfast habits may contribute to learning focus because breakfast skipping has been associated with poorer academic performance among adolescents in school-based studies (Feye et al., 2023). At the same time, screen time has become an important lifestyle factor. A systematic review found that specific forms of screen media use, particularly television viewing and video gaming, were negatively associated with academic performance among children and adolescents (Adelantado-Renau et al., 2019), although recent research also suggests that phone restriction policies alone may not automatically improve adolescent wellbeing or educational outcomes (Goodyear et al., 2025).

Despite the existence of school-based anemia programs, there is still a need to describe how menstrual indicators, dietary behaviors, TTD consumption, tea/coffee habits, vitamin C intake, screen time, and learning focus appear together in adolescent girls. This study hypothesized that menstrual duration, menstrual complaints, breakfast frequency, TTD adherence indicators, tea/coffee consumption, vitamin C-rich fruit intake, and screen time are associated with learning focus among adolescent girls. The objective of this study was to describe anemia risk indicators and learning focus among school-based adolescent girls and to analyze relevant factors for strengthening school-based anemia prevention programs (Kementerian Kesehatan Republik Indonesia, 2021).

METHOD

Participant characteristics and research design

This study used an observational analytic design with a cross-sectional approach. The participants were 140 female senior high school students. The study focused on adolescent girls because this group is biologically vulnerable to anemia related to growth, menstruation, and inadequate iron intake, and because schools are strategic settings for anemia prevention and health education.

Eligibility and exclusion criteria

The eligible participants were female students who were present during data collection and were willing to complete the structured questionnaire. Students who did not provide complete responses for the main variables were not included in the analysis. The analysis used complete data from 140 respondents.

Sampling procedures

Data were collected in a school setting using a structured self-administered questionnaire. The sampling procedure was based on accessible eligible female students during the data collection period. The questionnaire included demographic characteristics, menstrual history, previous anemia history, dietary patterns, TTD consumption behavior, tea/coffee habits, vitamin C-rich fruit intake, screen time, and learning focus indicators.

Sample size, power, and precision

The actual sample size was 140 adolescent girls. The sample size was considered sufficient for descriptive profiling and initial bivariate exploration of anemia risk indicators and learning focus. No interim analysis or stopping rule was applied because this was a cross-sectional questionnaire-based study.

Measures and covariates

The primary outcome was learning focus. Learning focus was measured using eight indicators: ability to focus when the teacher explains, not being easily distracted by mobile phones, completing tasks on time, staying focused when the class is noisy, remembering learning materials, quickly regaining focus after break time, not easily feeling sleepy in the morning, and being enthusiastic during learning. Each item was scored on a 1-5 scale, resulting in a total score range of 8-40. A score of 25 or higher was categorized as good learning focus.

The independent variables included age, age at menarche, menstrual cycle, menstrual duration, menstrual complaints, previous anemia history, consumption of animal and plant protein, milk or sweetened condensed milk consumption, breakfast frequency, complaints after consuming TTD, TTD consumption behavior, tea/coffee consumption before main meals, tea/coffee consumption close to the TTD schedule, vitamin C-rich fruit consumption when eating iron-source foods, and screen time on school days and holidays. For the main bivariate analysis, several variables were grouped to maintain interpretability, including menstrual complaints as none/mild and moderate/severe, TTD consumption according to weekly schedule as yes/no, and screen time as ≤ 60 minutes or > 60 minutes.

Data analysis

Data were analyzed descriptively using frequency, percentage, mean, and standard deviation. Bivariate analysis was conducted using the Pearson chi-square test to examine associations between selected independent variables and learning focus category. A p-value < 0.05 was considered statistically significant. Because this study used a cross-sectional design and self-reported questionnaire data, findings were interpreted as associations rather than causal effects.

RESULTS AND DISCUSSION

Results

A total of 140 female students were included in the analysis. The mean age was 15.55 years (SD = 0.54), and the mean age at menarche was 11.72 years (SD = 1.13). Most respondents were aged 16 years (57.1%), followed by 15 years (40.7%) and 14 years (2.1%). Previous anemia history was reported by 35.7% of respondents. Menstrual indicators showed that 67.9% had menstrual cycles shorter than 28 days, 69.3% had menstrual duration of 5-10 days, and 51.4% reported moderate-to-severe menstrual complaints.

Table 1
Characteristics and Menstrual Indicators of Respondents (n = 140)

Variable	Category/statistic	n or Mean	% or SD
Age (years)	Mean (SD)	15.55	0.54
Age at menarche (years)	Mean (SD)	11.72	1.13

Variable	Category/statistic	n or Mean	% or SD
Age	14 years	3	2.1
	15 years	57	40.7
	16 years	80	57.1
Previous anemia history	Yes	50	35.7
	No	90	64.3
Menstrual cycle	<28 days	95	67.9
	28-35 days	36	25.7
	>35 days	9	6.4
Menstrual duration	<5 days	41	29.3
	5-10 days	97	69.3
	>10 days	2	1.4
Menstrual complaints	None	6	4.3
	Mild	62	44.3
	Moderate	64	45.7
	Severe	8	5.7

Notes. SD = standard deviation.

Table 2 presents dietary, TTD, tea/coffee, vitamin C, screen time, and learning focus indicators. Breakfast fewer than three times per week was reported by 24.3% of respondents. Although 70.0% reported taking TTD according to the weekly schedule, 30.7% still often forgot to take TTD. Most respondents did not consume tea/coffee close to the TTD schedule (95.7%) and reported consuming vitamin C-rich fruit when eating iron-source foods (88.6%). Screen time exceeding 60 minutes was reported by 20.0% on school days and 38.6% on holidays. The mean learning focus score was 24.41 (SD = 5.77) out of a maximum score of 40, and 51.4% of respondents were categorized as having good learning focus.

Table 2
Dietary, Iron Supplementation, Screen Time, and Learning Focus Indicators (n = 140)

Variable	Category/statistic	n or Mean	% or SD
Breakfast frequency	<3 times/week	34	24.3
	4-5 times/week	54	38.6
	>6 times/week	52	37.1
Complaints after TTD	No	72	51.4
	Sometimes	61	43.6
	Often	7	5.0
TTD weekly schedule	Yes	98	70.0
Often forgot TTD	Yes	43	30.7
Delayed TTD because busy	Yes	14	10.0
Consumed TTD with water	Yes	65	46.4
Consumed TTD during menstruation	Yes	39	27.9
Tea/coffee near TTD schedule	No	134	95.7
	Always	6	4.3
Vitamin C-rich fruit with iron-source meal	Always	124	88.6
	No	16	11.4
School-day screen time	<=60 minutes	112	80.0
	>60 minutes	28	20.0
Holiday screen time	<=60 minutes	86	61.4
	>60 minutes	54	38.6

Variable	Category/statistic	n or Mean	% or SD
Learning focus score	Mean (SD)	24.41	5.77
Learning focus category	Good	72	51.4
	Poor	68	48.6

Notes. TTD = Tablet Tambah Darah; SD = standard deviation.

Bivariate analysis showed that menstrual duration, menstrual complaints, and breakfast frequency were significantly associated with learning focus category. Respondents with menstrual duration of 5-10 days had a higher proportion of good learning focus than those with duration <5 days. Moderate-to-severe menstrual complaints were more frequent among respondents with poor learning focus. Breakfast frequency was also associated with learning focus, with the highest proportion of good focus observed among respondents who had breakfast more than six times per week. Previous anemia history, menstrual cycle, weekly TTD schedule, forgetting TTD, tea/coffee consumption close to TTD schedule, vitamin C-rich fruit consumption, and screen time categories were not significantly associated with learning focus in the main bivariate analysis.

Table 3
Bivariate Analysis of Selected Factors and Learning Focus Category

Variable	Category	Poor focus n (%)	Good focus n (%)	p-value
Previous anemia history	No	44 (48.9)	46 (51.1)	0.920
	Yes	24 (48.0)	26 (52.0)	
Menstrual cycle	<28 days	50 (52.6)	45 (47.4)	0.219
	28-35 days	13 (36.1)	23 (63.9)	
	>35 days	5 (55.6)	4 (44.4)	
Menstrual duration	<5 days	26 (63.4)	15 (36.6)	0.020
	5-10 days	40 (41.2)	57 (58.8)	
	>10 days	2 (100.0)	0 (0.0)	
Menstrual complaints	None/mild	27 (39.7)	41 (60.3)	0.041
	Moderate/severe	41 (56.9)	31 (43.1)	
Breakfast frequency	<3 times/week	22 (64.7)	12 (35.3)	0.004
	4-5 times/week	30 (55.6)	24 (44.4)	
	>6 times/week	16 (30.8)	36 (69.2)	
Weekly TTD schedule	No	21 (50.0)	21 (50.0)	0.825
	Yes	47 (48.0)	51 (52.0)	
Often forgot TTD	No	50 (51.5)	47 (48.5)	0.290
	Yes	18 (41.9)	25 (58.1)	
Tea/coffee near TTD schedule	No	64 (47.8)	70 (52.2)	0.365
	Always	4 (66.7)	2 (33.3)	
Vitamin C-rich fruit with iron-source meal	No	10 (62.5)	6 (37.5)	0.236
	Always	58 (46.8)	66 (53.2)	
School-day screen time	<=60 minutes	54 (48.2)	58 (51.8)	0.866
	>60 minutes	14 (50.0)	14 (50.0)	
Holiday screen time	<=60 minutes	37 (43.0)	49 (57.0)	0.097
	>60 minutes	31 (57.4)	23 (42.6)	

Notes. Pearson chi-square test; TTD = Tablet Tambah Darah. Some cells had small expected counts; therefore, the results should be interpreted as exploratory.

Discussion

This study found that adolescent girls had several anemia risk indicators that are relevant for school-based prevention. More than one-third of respondents reported previous anemia, and a high proportion reported short menstrual cycles, menstrual duration of 5-10 days, and moderate-to-severe menstrual complaints. These findings support the importance of integrating menstrual health screening into anemia prevention because menstrual characteristics may reflect iron loss, discomfort, and perceived limitations during school activities.

The association between menstrual duration and learning focus suggests that menstrual experiences may be linked with classroom functioning. Although this study did not measure hemoglobin, ferritin, or menstrual blood volume, menstrual duration and complaints can be used as practical screening indicators in schools. Menstrual complaints were significantly associated with poorer learning focus, indicating that discomfort, pain, fatigue, or other menstrual symptoms may interfere with students' ability to concentrate and maintain motivation during learning activities. This finding is consistent with the broader rationale that adolescent health problems can reduce school functioning and productivity.

Breakfast frequency was significantly associated with learning focus. Students who reported more frequent breakfast had a higher proportion of good learning focus. This finding aligns with evidence that breakfast skipping among adolescents is associated with poorer academic performance and school functioning (Feye et al., 2023). In the context of anemia prevention, breakfast can also serve as a strategic moment for improving dietary quality, increasing iron-source food intake, and delivering nutrition messages that are easier to apply in daily routines.

TTD consumption indicators showed a mixed pattern. While 70.0% of respondents reported taking TTD according to the weekly schedule, nearly one-third still often forgot to take the tablets. In the bivariate analysis, weekly TTD schedule and forgetting TTD were not significantly associated with learning focus. This does not mean that TTD is unimportant. Rather, learning focus is a functional outcome that may be influenced by many factors beyond supplementation, including sleep, breakfast, menstrual symptoms, classroom environment, phone distraction, and psychosocial factors. Previous studies in Indonesia have emphasized that education and adherence support are needed to strengthen the effectiveness of WIFAS/TTD programs (Roche et al., 2018; Utami et al., 2022).

Tea/coffee consumption close to the TTD schedule was reported by a small proportion of respondents, while most respondents reported consuming vitamin C-rich fruit when eating iron-source foods. These patterns are encouraging for anemia prevention because school-based messages commonly emphasize avoiding inhibitors of iron absorption and strengthening enhancers of iron absorption. However, because these variables were self-reported and highly imbalanced, their association with learning focus may be difficult to detect statistically in this sample.

Screen time was higher during holidays than school days. Although screen time was not significantly associated with learning focus in the main bivariate analysis, the higher proportion of >60 minutes screen time during holidays suggests that digital lifestyle management remains relevant. Existing evidence indicates that screen media should be examined according to activity type and context rather than total duration alone (Adelantado-Renau et al., 2019). Therefore, schools should not only restrict devices but also educate students about purposeful use, rest, sleep hygiene, and attention management, consistent with recent findings that phone restriction policies alone may not be sufficient to improve adolescent wellbeing (Goodyear et al., 2025).

Overall, the findings indicate that anemia prevention among adolescent girls should not be limited to tablet distribution. A more comprehensive school-based model should include menstrual health monitoring, reinforcement of TTD adherence, breakfast habituation, dietary

education on iron sources and vitamin C, and balanced screen time education. This integrated approach is aligned with Indonesian adolescent nutrition initiatives that combine nutrition education, supplementation, and school-based behavior change ((Kementerian Kesehatan Republik Indonesia, 2022).

LIMITATION OF THE STUDY

This study has several limitations. First, the cross-sectional design does not allow causal inference between anemia risk indicators and learning focus. Second, the data were collected using self-reported questionnaires, which may be affected by recall bias and social desirability bias. Third, the study did not measure hemoglobin, ferritin, or other biomarkers; therefore, the term anemia risk indicators was used instead of confirmed anemia status. Fourth, some categories had small frequencies, particularly menstrual duration >10 days and tea/coffee consumption close to the TTD schedule, so the bivariate results should be interpreted as exploratory. Fifth, screen time was measured by duration only and did not distinguish between educational use, social media, entertainment, or gaming. Future studies should include objective hematological assessment, validated learning concentration instruments, and multivariable analysis with larger samples.

CONCLUSIONS AND SUGGESTIONS

This study concludes that school-based adolescent girls presented multiple anemia risk indicators related to previous anemia history, menstrual patterns, menstrual complaints, TTD consumption consistency, and dietary habits. Learning focus was moderate overall, with slightly more than half of respondents categorized as having good learning focus. Menstrual duration, menstrual complaints, and breakfast frequency were significantly associated with learning focus, indicating that menstrual health and daily nutrition practices are important entry points for strengthening school-based anemia prevention and learning support.

Further research is suggested to include hemoglobin, ferritin, dietary intake assessment, sleep duration, and validated cognitive or learning concentration measures. Schools and health program managers are encouraged to strengthen anemia prevention through integrated activities, including menstrual health screening, routine TTD monitoring, breakfast promotion, counseling on iron-source foods and vitamin C intake, avoidance of tea/coffee close to iron consumption, and balanced screen time education.

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ETHICAL CONSIDERATIONS

Ethical Approval and Informed Consent

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Conflict of Interest Statement

The authors declare that they have no known conflict of interest related to this manuscript. This statement should be confirmed by all authors before submission.

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