

Hemoglobin Level Profile in Adolescent Girls in Coastal Areas: A Study of Junior High School and Senior High School/Vocational High School Students in the Working Area of the Korbafo Community Health Center UPTD

Ratih Ariska Anindita Boga¹, Lewi Jutomo¹

¹Universitas Nusa Cendana, Indonesia

Email: ratihboga@gmail.com

Abstract. Adolescent girls are a vulnerable group to anemia because they experience menstruation, rapid growth, and often inadequate iron intake. Coastal areas have characteristics of food consumption patterns dominated by marine products and limited access to other sources of animal iron, so there is a risk of increasing the prevalence of anemia. This study aims to describe the profile of hemoglobin levels and the prevalence of anemia in adolescent girls in the coastal area of Rote Ndao Regency. A descriptive study with a cross-sectional approach was conducted on junior and senior high school students in the work area of UPTD Korbafo Health Center. A total of 96 students were selected using the purposive sampling technique. Hemoglobin levels were measured using a portable hemoglobinometer. Anemia is determined based on WHO criteria (Hb level <12 g/dL). The data was analyzed descriptively. The average hemoglobin level of female students was 11.2 g/dL (SD $\pm$ 1.3). The prevalence of anemia was found to be 47.9% (46 out of 96 students), with details of mild anemia (Hb 10–11.9 g/dL) for 31 students (32.3%) and moderate anemia (Hb 7–9.9 g/dL) for 15 students (15.6%). No cases of severe anemia were found. The average hemoglobin level of junior high school students was 11.3 g/dL and high school students 11.1 g/dL. Students who were menstruating at the time of measurement had lower Hb levels (10.8 g/dL) than non-menstruating students (11.4 g/dL). The prevalence of anemia among the participants is higher than the national rate in adolescents (32%); the factors underlying this difference were not examined in this study. The prevalence of anemia among the examined adolescent girls in the coastal area of Korbafo falls within the WHO category of a severe public health problem (prevalence $\geq$ 40%). Iron supplementation programs, balanced nutrition education based on local foods, and periodic screening are needed to reduce the anemia rate in this population.

Keywords: Anemia, Hemoglobin Levels, Adolescent Girls

Received: June 19, 2026

Received in Revised: August 18, 2026

Accepted: September 24, 2026

INTRODUCTION

Anemia is a global public health problem that remains a priority for management in various countries, particularly in areas with limited resources (Chaparro & Suchdev, 2019; Safiri et al., 2021; Kinyoki et al., 2021; Mildon et al., 2023). Anemia is defined as a decrease in hemoglobin levels, erythrocyte count, and hematocrit below normal values (Alfiah & Dainy, 2023). In adolescent girls, the WHO threshold for anemia is a hemoglobin level <12 g/dL.

According to 2023 WHO data, the global prevalence of anemia reached 30% in women aged 15–49 years (Doss, 2025). This figure indicates that nearly one-third of women worldwide suffer from anemia, with the highest burden occurring in developing countries, including Indonesia.

Adolescent girls are an age group that is highly susceptible to anemia due to several interrelated factors (Premalatha et al., 2012; Mengistu et al., 2019; Gonete et al., 2018; Tesfaye et al., 2015; Engidaw et al., 2018). Adolescence is characterized by accelerated physical growth that requires increased nutrient intake, including iron. Furthermore, adolescent girls experience monthly menstruation, which causes periodic blood loss (Handayani et al., 2024). This blood loss increases iron requirements, while inadequate iron intake can lead to iron deficiency, leading to anemia (Pasricha et al., 2021; Lopez et al., 2016; Camaschella et al., 2015; Kumar et al., 2022). The impact of anemia on adolescent girls is far-reaching, not only limited to physical disorders such as fatigue and decreased immunity, but also impacts learning concentration, academic achievement, and productivity. Furthermore, anemia in adolescence can persist into adulthood and pregnancy, increasing the risk of giving birth to a low birth weight (LBW) baby and other pregnancy-complications.

In Indonesia, the problem of anemia in adolescents shows a worrying trend. Based on data from the 2018 Basic Health Research (Riskesdas), the prevalence of anemia in the 15–24 age group reached 32% (Hartati & Nurhidayati, 2021). This figure has increased significantly compared to the 2013 Riskesdas, which recorded an anemia prevalence of 18.4% in the same age group. In other words, there has been a nearly twofold increase in five years. The prevalence of anemia in women in Indonesia is recorded at 27.2%, higher than in men, which is only 20.3%. Some provinces have much higher rates. For example, Lampung Province recorded an anemia prevalence of 63% among the 15–24 age group (Evayanti et al., 2026; Fatihah et al., 2026; Zuraida et al., 2020). This figure is far above the national average and indicates a gap that requires serious attention.

Coastal areas have unique characteristics that can impact the health status of their communities, including the incidence of anemia (Effendy et al., 2025). Coastal communities generally have a dietary pattern dominated by seafood such as fish, shellfish, and seaweed. Fish provides heme iron, which is well absorbed, and also enhances the absorption of non-heme iron eaten in the same meal; however, many commonly consumed fish species contain less total iron than red meat or liver, so diets in which fish is the main animal-source food may still supply limited iron when portions are small (Hurrell & Egli, 2010). In addition, a low intake of absorption enhancers such as vitamin C may limit the absorption of non-heme iron from plant foods.

This reflects the absence of an enhancer rather than active inhibition, which is caused by dietary compounds such as phytates, polyphenols, and calcium. Another contributing factor is limited access to nutritious food sources due to transportation constraints and the geographical conditions of the archipelago. In the East Nusa Tenggara (NTT) region, including Rote Ndao Regency, malnutrition remains quite high. Based on data from several studies, the prevalence of anemia in coastal areas of NTT has reached quite significant levels, although specific data for Rote Ndao is still limited (Orysa & Safitri, 2025).

Research in the coastal area of Sitiarjo, Malang Regency, shows a relationship between instant food consumption patterns and anemia status in adolescent girls. Adolescent girls who frequently consume instant foods have a higher risk of anemia because instant foods are generally low in iron and vitamin C, which are needed for iron absorption (Yanti et al., 2024; Sari et al., 2022; Anggraini et al., 2024; Anas et al., 2023). Meanwhile, research in other coastal areas identified that the lack of hemoglobin (Hb) screening in adolescent girls is one of the obstacles in early detection of anemia cases. In fact, Hb screening is effective in identifying anemia cases in adolescent girls so that intervention can be carried out immediately (Orysa & Safitri, 2025).

Other factors contributing to the incidence of anemia in adolescent girls include knowledge about anemia, adherence to iron supplementation (IBP), and consumption patterns of iron-rich foods (Rahman et al., 2024; Subba & Araveti, 2025; Emiliana et al., 2025; Saju &

Mohammed, 2025; Nurzinah & Al, 2025; Fitria et al., 2026). Research shows that the majority of adolescent girls lack knowledge about anemia and its prevention. For example, a study at South Rawajitu 1 State Senior High School found that although adolescent girls' knowledge about anemia was relatively good, adherence to iron supplementation was still very low, with 89.1% non-adherence. This low adherence is one of the causes of the high prevalence of anemia despite the implementation of an iron supplementation program. Another study in neighborhood 3, Sipolu-polu Village, showed that 45% of adolescent girls lacked knowledge about iron supplementation during menstruation. In addition to knowledge and adherence to iron supplementation, menstrual duration is also known to be associated with the incidence of anemia (Astikasari et al., 2025; Nugraheni et al., 2023; Dubik et al., 2019). Research at SMP N 2 Tambusai, Rokan Hulu Regency, showed a significant association between menstrual duration and the incidence of anemia in adolescent girls (p -value = 0.001). The longer the menstrual duration, the greater the volume of blood lost and the higher the need for iron. Research at SMA N 2 Semendawai Barat, East OKU Regency, also confirmed the association between knowledge, menstrual duration, and nutritional status with the incidence of anemia (p -values of 0.001, 0.033, and 0.003, respectively). These findings indicate that anemia in adolescent girls is a multifactorial problem that requires a comprehensive approach.

Rote Ndao Regency, as an archipelago in East Nusa Tenggara, has specific geographic and socioeconomic characteristics. This region consists of several islands with limited inter-island transportation access. Korbafo Community Health Center, one of the community health centers in Rote Ndao Regency, serves an area encompassing several villages/sub-districts with coastal communities. No study has ever been conducted specifically examining the hemoglobin level profile and prevalence of anemia in adolescent girls in the Korbafo Community Health Center's coverage area. However, baseline data in the form of hemoglobin level profiles is essential for designing targeted interventions. Based on the description above, the researcher is interested in conducting a descriptive study entitled "Hemoglobin Level Profile in Adolescent Girls in Coastal Areas: A Study of Junior High School and Senior High School/Vocational High School Students in the Working Area of the Korbafo Community Health Center UPTD". This study is important to obtain an initial picture (baseline) of the anemia status in adolescent girls in the area which can later be used as a basis for planning intervention programs.

METHODS

This study used a descriptive study design with a cross-sectional approach [24]. This design was chosen because it aimed to describe the profile of hemoglobin levels and the prevalence of anemia in adolescent girls in a region at a specific point in time without intervention or follow-up. Cross-sectional studies are suitable for descriptive research to determine the distribution of a health condition in a specific population.

Study Setting and Population

The study was conducted in the working area of the UPTD Korbafo Community Health Center, Rote Ndao Regency, East Nusa Tenggara Province, an area inhabited mainly by coastal communities. The study sites were the junior high schools and senior high schools/vocational high schools located in this working area. These schools were selected because they are located within the working area of the Korbafo Community Health Center and serve adolescents from the surrounding coastal villages, so that the results can be used directly by the health center to plan anemia prevention programs. The target population was all female students of junior high schools and senior high schools/vocational high schools in the working area of the UPTD Korbafo Community Health Center. The accessible population was the female students of the participating schools who were present at school during the data collection period.

Eligibility Criteria

The inclusion criteria were: (1) female students aged 12–18 years who were registered as active students at the participating schools; (2) residing in the working area of the UPTD

Korbafo Community Health Center; (3) having experienced menarche; and (4) willing to participate, as indicated by signed informed consent from the student and her parent or guardian. The exclusion criteria were: (1) pregnancy; (2) a known history of hematological disorders, such as thalassemia or other hemoglobinopathies; (3) acute illness on the day of examination; (4) bleeding other than menstruation, or a blood transfusion, within the previous three months; and (5) currently receiving treatment for anemia.

Sample Size and Sampling Technique

The sample size was calculated using the Lemeshow formula for estimating a single proportion: $n = Z^2 \times p(1 - p) / d^2$, where $Z = 1.96$ for a 95% confidence level, p is the assumed prevalence of anemia, and d is the absolute precision (margin of error). An assumed prevalence of $p = 0.5$ was used because no previous estimate of anemia prevalence among adolescent girls in Rote Ndao Regency was available, and this value produces the largest required sample size. With $d = 0.10$, the calculation yielded $n = (1.96^2 \times 0.5 \times 0.5) / 0.10^2 = 96.04$, which was rounded to 96 participants. No additional allowance for non-response was added, and all 96 selected students completed the hemoglobin examination. The formula for an unknown population size was used because the number of students who met all eligibility criteria (for example, menarche status, pregnancy, or acute illness on the day of examination) could not be determined from school enrollment records before screening. This approach is also conservative, because omitting the finite population correction gives a sample size equal to or larger than that obtained with a finite-population formula. Participants were selected using purposive sampling, namely female students who met the eligibility criteria and were present at school on the day of data collection, until the required sample size was reached. The final sample consisted of 96 female students: 52 junior high school students and 44 senior high school/vocational high school students. Because purposive sampling is a non-probability technique, not all eligible students had an equal probability of being selected. Therefore, the prevalence reported in this study applies to the examined participants and cannot be confidently generalized to all adolescent girls in the Korbafo coastal area.

Hemoglobin Measurement and Data Analysis

Hemoglobin levels were measured using a portable hemoglobinometer according to the manufacturer's instructions. Menstrual status on the day of measurement (menstruating or not menstruating) was recorded based on the participants' self-report. Anemia was defined as a hemoglobin level <12 g/dL according to WHO criteria [25], and anemia severity was categorized as mild (10.0–11.9 g/dL), moderate (7.0–9.9 g/dL), or severe (<7.0 g/dL). Data were analyzed descriptively. Hemoglobin levels were presented as the mean, standard deviation, median, minimum, and maximum, while anemia status and severity were presented as frequencies and percentages, both overall and by educational level and menstrual status. No inferential statistical tests were performed; therefore, differences between groups are reported descriptively

RESULT AND DISCUSSION

The results of hemoglobin level measurements in 96 female students showed the following distribution:

Table 1. Descriptive Statistics of Hemoglobin Levels

Parameter	Value
Mean	11.2 g/dL
Standard Deviation	± 1.3
Minimum Value	8.1 g/dL
Maximum Value	13.8 g/dL
Median	11.3 g/dL

The table above shows that the average hemoglobin level for all respondents was 11.2 g/dL (SD $\pm$ 1.3). This value is below the WHO normal threshold for adolescent girls, which is 12.0 g/dL. The range of respondents' Hb values was quite wide, from 8.1 g/dL to 13.8 g/dL.

Table 2. Average Hemoglobin Levels by Education Level

Educational Level	Mean Hemoglobin Level (g/dL)	Standard Deviation
Junior High School (n = 52)	11.3	$\pm$ 1.2
Senior High School (n = 44)	11.1	$\pm$ 1.4

Junior high school students had slightly higher average hemoglobin levels (11.3 g/dL) than high school students (11.1 g/dL); this small difference (0.2 g/dL) was not tested statistically.

Table 3. Average Hemoglobin Levels Based on Menstrual Status

Menstrual Status	Mean Hemoglobin Level (g/dL)	Standard Deviation
Currently Menstruating (n = 28)	10.8	$\pm$ 1.1
Not Menstruating (n = 68)	11.4	$\pm$ 1.3

Respondents who were menstruating at the time of measurement had a lower average hemoglobin level (10.8 g/dL) compared to those who were not menstruating (11.4 g/dL). This 0.6 g/dL difference is a descriptive observation. Because menstrual history was not assessed and no inferential analysis was performed, it cannot be attributed to menstrual blood loss.

Distribution of Anemia Status

Based on WHO criteria (hemoglobin level <12 g/dL), the prevalence of anemia among the participating female students in the Korbafo Community Health Center area is as follows:

Table 4. Distribution of Anemia Status

Anemia Status	Frequency (n)	Percentage (%)
Anemia (Hemoglobin < 12 g/dL)	46	47.9
Non-Anemia (Hb $\geq$ 12 g/dL)	50	52.1
Total	96	100

The study results showed that 47.9%, or nearly half, of the female students examined, suffered from anemia. Among the examined participants, this proportion falls within the WHO category of a severe public health problem (prevalence $\geq$ 40%); because participants were selected purposively, it should not be generalized to all adolescent girls in the region. Of the 46 female students identified as anemic, the distribution by severity is as follows:

Table 5. Distribution of Anemia Severity

Severity Level	Hemoglobin Level (g/dL)	Frequency (n)	Percentage (%)
Mild Anemia	10.0 – 11.9	31	67.4
Moderate Anemia	7.0 – 9.9	15	32.6
Severe Anemia	< 7.0	0	0.0
Total		46	100

*Percentages calculated from the total number of anemic female students (n=46).

Most of the female students with anemia were classified as mildly anemic (67.4%), and the remaining 15 students (32.6%) were moderately anemic. No cases of severe anemia (Hb <7.0 g/dL) were found; the lowest hemoglobin level, 8.1 g/dL, fell within the moderate category.

Table 6. Prevalence of Anemia by Education Level

Educational Level	Anemia (n)	Non-Anemia (n)	Total (n)	Anemia Prevalence (%)
Junior High School	23	29	52	44.2
Senior High School	23	21	44	52.3

The prevalence of anemia is higher among high school students (52.3%) than among junior high school students (44.2%). Previous studies have suggested that menstrual characteristics and dietary habits may differ among older adolescents [5]; however, these variables were not measured in the present study, and the difference between educational levels was not tested statistically.

Table 7. Prevalence of Anemia by Menstrual Status

Menstrual Status	Anemia (n)	Non-Anemia (n)	Total (n)	Anemia Prevalence (%)
Currently Menstruating	19	9	28	67.9
Not Menstruating	27	41	68	39.7

The prevalence of anemia was higher among menstruating female students (67.9%) compared to non-menstruating female students (39.7%). Thus, in this sample, being in menses at the time of measurement was descriptively associated with lower hemoglobin values and a higher proportion of anemia. This observation does not establish menstruation as a major risk factor: menstrual duration, blood-loss volume, cycle regularity, age at menarche, and history of heavy menstrual bleeding were not measured; no inferential analysis or adjustment for potential confounders was performed; and the cross-sectional design cannot establish temporal direction.

Interpretation of Research Results

This study found that the average hemoglobin level in adolescent girls in the Korbafo Community Health Center (Puskesmas) area was 11.2 g/dL, below the normal threshold set by the WHO for adolescent girls, which is 12 g/dL. This finding indicates that the hematological status of the participating students was generally low; because participants were selected purposively, it may not represent all adolescent girls in the coastal areas of Rote Ndao Regency.

Compared to research in Kupang Regency, NTT, a study by Lada et al. (2023) on female students at SMP N 2 Nekamese showed that of the 36 adolescents examined, 5 (13.9%) had Hb levels below normal, with the normal value used being 10-15 g/dL. The difference in the threshold used (10 g/dL vs. 12 g/dL) resulted in a lower prevalence rate in that study. However, using the same WHO standard (12 g/dL), the prevalence in Nekamese is likely higher.

Research in other coastal areas, such as SMPN 3 Batang Kapas, Pesisir Selatan Regency, found an anemia prevalence of 27.5%, with an average Hb level that was not specifically reported. This figure is lower than our findings (47.9%), suggesting that the Rote Ndao region may face greater challenges related to anemia (Sukmayenti & Pasalina, 2025).

The present data cannot determine why hemoglobin levels were low in this sample, because dietary intake, food access, sanitation, helminth infection, and other potential determinants were not measured. The following explanations are therefore hypotheses drawn from previous literature rather than findings of this study. First, the diets of coastal communities are often dominated by fish and other seafood. Fish provides heme iron, which is well absorbed, and also enhances the absorption of non-heme iron eaten in the same meal; however, many commonly consumed fish species contain less total iron than red meat or liver, so total iron intake may be limited when portions are small or other iron-rich foods are rarely eaten (Hurrell & Egli, 2010). Second, access to a varied and nutritious diet may be limited by transportation constraints and the geography of the islands. Third, inadequate sanitation in some coastal settings may increase the risk of helminth infection, which can cause chronic blood loss. Future analytical studies that measure these variables directly are needed to test these hypotheses in the Korbafo area.

Anemia Prevalence in National and Global Contexts

The 47.9% anemia prevalence found in this study is considerably higher than the national figures. According to the 2018 Basic Health Research (Riskesdas), the prevalence of anemia among adolescent girls in Indonesia was 32%, and data from 2025 showed a prevalence of 26.4%

among girls aged 5-14 and 18.4% among girls aged 15-24. The 47.9% figure means that nearly 1 in 2 of the examined students had anemia, while nationally only around 3-4 in 10 adolescent girls experience this condition.

Compared with other regions in Indonesia, the prevalence we found is considered high (Noviyani et al., 2021; Herningtyas & Ng, 2019; Titaley et al., 2019). A study at the Kalideres Community Health Center in Jakarta reported a prevalence of anemia of 49.62% among 7th-grade female students and 60.56% among 10th-grade female students. These figures are higher than our findings, possibly due to differences in population characteristics and measurement methods. A study at the Tamiang Layang Community Health Center in Central Kalimantan reported the highest prevalence of anemia, reaching 61.46%.

Globally, the prevalence of anemia among adolescent girls in developing countries generally ranges from 30-60%. Our prevalence of 47.9% falls in the middle of this range and is consistent with anemia remaining an important public health problem among adolescent girls, although a single study with purposive sampling cannot confirm the situation across coastal areas of Indonesia.

Anemia Severity

The findings indicate that most anemia cases were mild (67.4%), and the remainder were moderate (32.6%), with no cases of severe anemia. This pattern is similar to a study at the Kalideres Community Health Center, which reported a proportion of mild anemia of 20.81-30.37%, moderate anemia of 28.61-29.69%, and severe anemia of 0.21-0.50%.

The predominance of mild anemia indicates that most anemia cases are in the early stages and still have significant potential for improvement with appropriate intervention. However, the proportion of moderate anemia (32.6% of anemia cases) remains concerning because it can significantly impact quality of life, academic achievement, and long-term reproductive health [16]. The student with the lowest hemoglobin level (8.1 g/dL) also requires special attention and follow-up, because anemia at this level can cause clinical symptoms such as severe fatigue, dizziness, shortness of breath, and impaired concentration. If left untreated, anemia can progress to a severe level that impairs tissue perfusion and vital organ function.

Study Limitations

This study has several limitations. First, the cross-sectional design measured hemoglobin at a single point in time and cannot establish temporal relationships between hemoglobin levels and participant characteristics. Second, participants were selected by purposive sampling, so eligible students did not have an equal probability of selection; the reported prevalence therefore applies to the examined participants and cannot be confidently generalized to all adolescent girls in the Korbafo coastal area. Third, the analysis was descriptive: differences between groups were not tested statistically or adjusted for potential confounders such as dietary intake, nutritional status, iron supplementation, and infection. Fourth, menstrual status was recorded only as whether a participant was menstruating on the day of measurement; menstrual duration, blood-loss volume, cycle regularity, age at menarche, and history of heavy menstrual bleeding were not assessed. Fifth, the factors discussed above as possible explanations, including diet, food access, sanitation, and helminth infection, were not measured. Sixth, hemoglobin was measured with a portable hemoglobinometer, which may be less precise than laboratory-based methods. Future studies should use probability sampling and measure these variables so that the determinants of anemia in this population can be analyzed inferentially.

CONCLUSION

This discussion shows that the prevalence of anemia among the participating adolescent girls in the Korbafo Community Health Center area (47.9%) is categorized as a serious public health problem and is much higher than the national average. The low average hemoglobin level (11.2 g/dL) indicates generally low hematological status among the examined students.

Descriptively, anemia was more common among students who were menstruating at the time of measurement (67.9%) and among senior high school students (52.3%). These patterns are consistent with previous studies in Indonesia and other developing countries, but they were not tested statistically and should not be interpreted as established risk factors. Study limitations such as the cross-sectional design, purposive sampling technique, and limited measured variables require consideration when interpreting the results. Nevertheless, these findings provide important evidence of the magnitude of the anemia problem among the examined adolescent girls in the coastal area of Rote Ndao and provide a basis for planning more effective interventions.

SUGGESTION

A multisectoral approach involving health offices, community health centers, schools, families, and adolescents themselves is needed to address this anemia problem. An integrated program of iron supplementation, nutrition education, sanitation improvement, and empowerment of adolescent girls needs to be implemented immediately to prevent the long-term impact of anemia on reproductive health and the quality of human resources in the future.

ACKNOWLEDGMENT

Thank you to the lecturers who helped guide the journal creation.

REFERENCES

- Alfiah, S., & Dainy, N. C. (2023). Asupan zat besi, vitamin C dan konsumsi tablet tambah darah berhubungan dengan kejadian anemia remaja putri SMPIT Majmaul Bahrain Bogor: Iron intake, vitamin C and iron supplement tablets consumption associated with the incidence of anemia in adolescent girls SMPIT Majmaul Bahrain Bogor. <https://doi.org/10.25182/jigd.2023.2.2.103-108>
- Anas, H., Hidayanty, H., Nontji, W., Hadju, V., & As'ad, S. (2023). The Effect Of Health Education On Hb Levels And Intake Of Iron, Protein And Vitamin C Among Adolescent Girls. *JKM (Jurnal Kebidanan Malahayati)*, 9(3), 491-500.
- Anggraini, V. R., Maulida, N. R., & Aini, R. N. (2024). The Relationship Between Protein, Iron, Folic Acid, Vitamin C Intake and Breakfast Habits With The Incidence of Anemia in Female Students of SMPN 152 Jakarta. *Journal of Global Nutrition*, 4(2), 351-357. <https://doi.org/10.53823/jgn.v4i2.93>
- Astikasari, N. D., Wahyuni, C., Ripursari, T., & Mandasari, D. (2025). Factor Analysis of Menstrual Duration, Level of Knowledge, and Compliance with the Consumption of Blood Supplement Tablets on the Prevalence of Anemia in Adolescents with Prostate. *Journal Of Nursing Practice*, 8(3), 601-614. <https://doi.org/10.30994/jnp.v8i3.837>
- Camaschella, C. (2015). Iron deficiency: new insights into diagnosis and treatment. *Hematology 2014, the American Society of Hematology Education Program Book*, 2015(1), 8-13. <https://doi.org/10.1182/asheducation-2015.1.8>
- Chaparro, C. M., & Suchdev, P. S. (2019). Anemia epidemiology, pathophysiology, and etiology in low-and middle-income countries. *Annals of the new York Academy of Sciences*, 1450(1), 15-31. <https://doi.org/10.1111/nyas.14092>
- Doss, D. (2025). Almtsier, S. (2010). Prinsip Dasar Ilmu Gizi. Jakarta; PT Gramedia. *Gizi Kerja dan Produktivitas*, 232.
- Dubik, S. D., Amegah, K. E., Alhassan, A., Mornah, L. N., & Fiagbe, L. (2019). Compliance with weekly iron and folic acid supplementation and its associated factors among adolescent girls in Tamale Metropolis of Ghana. *Journal of nutrition and metabolism*, 2019(1), 8242896. <https://doi.org/10.1155/2019/8242896>
- Effendy, D. S., Sawitri, P. A., & Herawati, S. (2025). Risk Factors of Anemia in Coastal Communities in Indonesia: A Review. *Journal of Epidemiology and Health Science*, 2(1), 155-161.

- Emiliana, A., Noveyani, A. E., & Rachmawati, S. N. (2025). Association between knowledge, attitude, and behavior on nutritional anemia among female undergraduate students: a cross-sectional study. *AcTion: Aceh Nutrition Journal*, 10(3), 572-583. <http://dx.doi.org/10.30867/action.v10i3.2373>
- Engidaw, M. T., Wassie, M. M., & Teferra, A. S. (2018). Anemia and associated factors among adolescent girls living in Aw-Barre refugee camp, Somali regional state, Southeast Ethiopia. *PloS one*, 13(10), e0205381. <https://doi.org/10.1371/journal.pone.0205381>
- Evayanti, Y., Suwanto, S., Setyowati, R., & Mulyani, S. (2026, May). Empowering Adolescent Girls in Anemia Prevention through Monitoring Book Media: A Qualitative Health Promotion Study. In *Proceedings of the 4th International Conference on Multidisciplinary Studies 2025 (ICOMSI 2025)* (p. 13). Springer Nature.
- Fatihah, A. K., Febriani, C. A., Aryastuti, N., & Muhani, N. (2026). Factors Related to Anemia Prevention in Adolescent Females at Baitul Jannah Islamic High School in Bandar Lampung in 2025. *PROMOTOR*, 9(1), 62-67. <https://doi.org/10.32832/pro.v9i1.1820>
- Fitria Rahmiati, B., Khomsan, A., Riyadi, H., & Meti Dwiriani, C. (2026). The effect of socio-ecological model intervention on nutritional status among adolescent girls in West Nusa Tenggara. In *BIO Web of Conferences* (Vol. 243, p. 04003). EDP Sciences. <https://doi.org/10.1051/bioconf/202624304003>
- Gonete, K. A., Tariku, A., Wami, S. D., & Derso, T. (2018). Prevalence and associated factors of anemia among adolescent girls attending high schools in Dembia District, Northwest Ethiopia, 2017. *Archives of Public Health*, 76(1), 79. <https://doi.org/10.1186/s13690-018-0324-y>
- Handayani, E. Y., Sari, E. Y., Nurkhasanah, S., Wulandari, S., & Ismail, M. A. (2024). Hubungan Lama Menstruasi Remaja dengan Kejadian Anemia pada Remaja Putri di SMP N 2 Tambusai Kabupaten Rokan Hulu. *Jannatul Makwa Health: Jurnal Ilmiah Kesehatan*, 2(2), 55-62. <https://doi.org/10.69886/jmh.v2i2.30>
- Hartati, S., & Nurhidayati, T. (2021). Pemberian Tablet Fe dan Pendidikan Kesehatan untuk Pencegahan Anemia pada Remaja Putri. *Jurnal Kebidanan dan Keperawatan*, 7(2), 112-120
- Herningtyas, E. H., & Ng, T. S. (2019). Prevalence and distribution of metabolic syndrome and its components among provinces and ethnic groups in Indonesia. *BMC public health*, 19(1), 377. <https://doi.org/10.1186/s12889-019-6711-7>
- Hurrell, R., & Egli, I. (2010). Iron bioavailability and dietary reference values. *The American journal of clinical nutrition*, 91(5), 1461S-1467S. <https://doi.org/10.3945/ajcn.2010.28674F>
- Kapil, R. (2017). Bioavailability & absorption of iron and anemia. *Indian Journal of Community Health*, 29(4), 453-457. <https://doi.org/10.47203/IJCH.2017.v29i04.020>
- Kinyoki, D., Osgood-Zimmerman, A. E., Bhattacharjee, N. V., Kassebaum, N. J., & Hay, S. I. (2021). Anemia prevalence in women of reproductive age in low-and middle-income countries between 2000 and 2018. *Nature medicine*, 27(10), 1761-1782. <https://doi.org/10.1038/s41591-021-01498-0>
- Kolarš, B., Mijatović Jovin, V., Živanović, N., Minaković, I., Gvozdenović, N., Dickov Kokeza, I., & Lesjak, M. (2025). Iron deficiency and iron deficiency anemia: a comprehensive overview of established and emerging concepts. *Pharmaceuticals*, 18(8), 1104. <https://doi.org/10.3390/ph18081104>
- Kumar, S. B., Arnipalli, S. R., Mehta, P., Carrau, S., & Ziouzenkova, O. (2022). Iron deficiency anemia: efficacy and limitations of nutritional and comprehensive mitigation strategies. *Nutrients*, 14(14), 2976. <https://doi.org/10.3390/nu14142976>

- Lada, N., Kaseh, J., & Astuti, A. (2023). Remaja Sehat Bebas Anemia dengan identifikasi Kadar Hemoglobin Pada Siswi SMP N 2 Nekamese Kabupaten Kupang Nusa Tenggara Timur. *Jurnal Nusantara Berbakti*, 1(4), 122-126. <https://doi.org/10.59024/jnb.v1i4.251>
- Lopez, A., Cacoub, P., Macdougall, I. C., & Peyrin-Biroulet, L. (2016). Iron deficiency anaemia. *The lancet*, 387(10021), 907-916.
- Mengistu, G., Azage, M., & Gutema, H. (2019). Iron deficiency anemia among in-school adolescent girls in rural area of Bahir Dar City Administration, North West Ethiopia. *Anemia*, 2019(1), 1097547. <https://doi.org/10.1155/2019/1097547>
- Mildon, A., Lopez de Romaña, D., Jefferds, M. E. D., Rogers, L. M., Golan, J. M., & Arabi, M. (2023). Integrating and coordinating programs for the management of anemia across the life course. *Annals of the New York Academy of Sciences*, 1525(1), 160-172. <https://doi.org/10.1111/nyas.15002>
- Noviyani, A., Nopsopon, T., & Pongpirul, K. (2021). Variation of tuberculosis prevalence across diagnostic approaches and geographical areas of Indonesia. *PLoS One*, 16(10), e0258809. <https://doi.org/10.1371/journal.pone.0258809>
- Nugraheni, A. N., Latifah, E., & Wijayatri, R. (2023). Influence of Knowledge Level about Anemia and Menstrual Patterns on Adherence to Consumption Iron Supplement in Adolescents at A Public Senior High School in Magelang. *Pharmacon: Jurnal Farmasi Indonesia*, 20(1), 68-77. <https://doi.org/10.23917/pharmacon.v20i1.21904>
- Nurzinah, R., & Al Rahmad, A. H. (2025). The Effect of Whatsapp-Based Nutrition Education on Anemia Knowledge and Attitudes Among Female Adolescents In Pidie District. *JAND: Journal of Applied Nutrition and Dietetic*, 5(2), 8-15. <https://doi.org/10.30867/jand.v5i2.952>
- Orysa, D., & Safitri, R. (2025). Pengaruh Pola Konsumsi Makanan Instan Terhadap Status Anemia Pada Remaja Putri Di Wilayah Pesisir Sitiarjo, Kabupaten Malang. *Assyifa: Jurnal Ilmu Kesehatan*, 3(3), 307-313. <https://doi.org/10.62085/ajk.v3i3.188>
- Pasricha, S. R., Tye-Din, J., Muckenthaler, M. U., & Swinkels, D. W. (2021). Iron deficiency. *The Lancet*, 397(10270), 233-248.
- Premalatha, T., Valarmathi, S., Srijayanth, P., Sundar, J. S., & Kalpana, S. (2012). Prevalence of anemia and its associated factors among adolescent school girls in Chennai, Tamil Nadu, India. *Epidemiology*, 2(118), 1165-2161.
- Qadir, A. M., Omer, R. A., & Ahmed, S. S. (2026). Iron Metabolism and Ferritin in Health and Disease: Molecular Regulation, Clinical Applications, and Nutritional Perspectives. *SN Comprehensive Clinical Medicine*, 8(1), 388. <https://doi.org/10.1007/s42399-026-02645-9>
- Rahman, M. J., Rahman, M. M., Sarker, M. H. R., Kakehashi, M., Tsunematsu, M., Ali, M., ... & Shimpuku, Y. (2024). Prevalence and influencing factors with knowledge, attitude, and practice toward anemia among school-going adolescent girls in rural Bangladesh. *PLoS one*, 19(11), e0313071. <https://doi.org/10.1371/journal.pone.0313071>
- Safiri, S., Kolahi, A. A., Noori, M., Nejadghaderi, S. A., Karamzad, N., Bragazzi, N. L., ... & Grieger, J. A. (2021). Burden of anemia and its underlying causes in 204 countries and territories, 1990–2019: results from the Global Burden of Disease Study 2019. *Journal of hematology & oncology*, 14(1), 185. <https://doi.org/10.1186/s13045-021-01202-2>
- Saju, M., & Mohammed, M. (2025). Enhancing health: effective interventions addressing iron-deficiency anaemia among adolescent girls and reproductive-aged women in India: a comprehensive systematic review. *J Integrated Health*, 4(1), 332-350.

- Sari, P., Judistiani, R. T. D., Herawati, D. M. D., Dhamayanti, M., & Hilmanto, D. (2022). Iron deficiency anemia and associated factors among adolescent girls and women in a rural area of Jatinangor, Indonesia. *International journal of women's health*, 1137-1147. <https://doi.org/10.2147/IJWH.S376023>
- Subba, S. S., & Araveti, S. (2025). Knowledge, attitudes, and practices related to iron deficiency anemia and probiotics among adolescent girls in Anantapur, India: A QIDAP-guided cross-sectional study. *Food and Humanity*, 4, 100551. <https://doi.org/10.1016/j.foohum.2025.100551>
- Sukmayenti, S., & Pasalina, P. E. (2025). Pemeriksaan Status Gizi Dan Kadar Haemoglobin Remaja Putri Smpn 3 Batang Kapas Pesisir Selatan. *Jurnal Abdimas Saintika*, 7(2), 1-8. <http://dx.doi.org/10.30633/jas.v7i2.30684>
- Tesfaye, M., Yemane, T., Adisu, W., Asres, Y., & Gedefaw, L. (2015). Anemia and iron deficiency among school adolescents: burden, severity, and determinant factors in southwest Ethiopia. *Adolescent health, medicine and therapeutics*, 189-196. <https://doi.org/10.2147/AHMT.S94865>
- Titaley, C. R., Ariawan, I., Hapsari, D., Muasyaroh, A., & Dibley, M. J. (2019). Determinants of the stunting of children under two years old in Indonesia: A multilevel analysis of the 2013 Indonesia basic health survey. *Nutrients*, 11(5), 1106. <https://doi.org/10.3390/nu11051106>
- Yanti, S., Sari, Y. A. P., & Meilina, A. (2024). Diet, protein, iron and vitamin C intake on anemia status of adolescent girls. *Journal of Applied Nursing and Health*, 6(1), 177-183.
- Zuraida, R., Lipoeto, N. I., Masrul, M., & Februhartanty, J. (2020). The effect of anemia free club interventions to improve adolescent dietary intakes in Bandar Lampung city, Indonesia. *Open Access Macedonian Journal of Medical Sciences*, 8(B), 145-149.