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EFFECTIVENESS OF CONSUMING BLOOD SUPPLEMENTATION TABLETS ON HEMOGLOBIN LEVELS: A PRE-EXPERIMENTAL STUDY AT SMAN 1 PEMALANG

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ABSTRAK

Anemia masih menjadi masalah kesehatan yang sering terjadi pada remaja putri. Salah satu upaya pemerintah dalam pencegahan anemia pada kelompok tersebut adalah melalui program pemberian Tablet Tambah Darah (TTD). Berdasarkan Survei Kesehatan Indonesia (SKI) tahun 2023, cakupan konsumsi TTD pada remaja putri usia 10-19 tahun masih tergolong rendah, yaitu sebesar 73,5%. Hal ini menunjukkan perlunya konsumsi suplemen zat besi secara rutin untuk meningkatkan cadangan zat besi dalam tubuh, yang berperan dalam pembentukan sel darah merah dan hemoglobin. Penelitian ini bertujuan untuk menganalisis perbedaan kadar hemoglobin sebelum dan sesudah mengikuti program pemberian TTD pada siswi SMAN 1 Pemalang. Penelitian ini merupakan penelitian pra-eksperimental dengan desain *one-group pretest-posttest* menggunakan data kadar hemoglobin sebelum dan sesudah mengikuti program pemberian TTD . Subjek adalah 90 siswi yang dipilih menggunakan teknik purposive sampling. Data dikumpulkan menggunakan hemoglobinometer *EasyTouch GCHb* . Data sebelum konsumsi TTD menggunakan data rekam medis. Hasil uji paired t-test menunjukkan terdapat perbedaan yang signifikan antara kadar hemoglobin sebelum dan sesudah mengikuti program pemberian TTD pada siswi SMAN 1 Pemalang (p-value 0,019 dan mean difference 0,42).

ABSTRACT

Effectiveness of Consuming Blood Supplementation Tablets on Hemoglobin Levels: A Pre-Experimental Study at SMAN 1 Pemalang. . Anemia remains a common health problem among adolescent girls. One of the government's efforts to prevent anemia in this population is through the Iron Supplementation Program (Blood Addition Tablets/TTD). According to the 2023 Indonesian Health Survey (SKI), the coverage of iron supplementation among adolescent girls aged 10–19 years remains relatively low at 73.5%. This condition indicates the need for regular iron supplementation to increase iron stores, which are important for red blood cell and hemoglobin production. This study aimed to analyze the differences in hemoglobin levels before and after participation in the Iron Supplementation Program among female students at SMAN 1 Pemalang. This analytical study employed a pre-post design using hemoglobin data collected before and after participation in the Iron Supplementation Program. The study subjects consisted of 90 female students selected through purposive sampling. Hemoglobin data were collected using an EasyTouch GCHb hemoglobinometer, while baseline hemoglobin data were obtained from medical records. The results of the paired t-test showed a significant difference in hemoglobin levels before and after participation in the Iron Supplementation Program among female students at SMAN 1 Pemalang (p-value = 0.019; mean difference = 0.42).

INTRODUCTION

Globally, anemia remains a significant public health issue, particularly among women of reproductive age and adolescent girls. This condition occurs when hemoglobin levels in the blood fall below normal limits, reducing the blood's ability to carry oxygen to body tissues. The WHO reported that in 2019, approximately 30% of non-pregnant women experienced anemia. The most common form of anemia is iron deficiency anemia, which accounts for approximately 50% of cases worldwide. Adolescent girls with anemia can experience various symptoms, including fatigue, decreased concentration, impaired productivity, and impacts on future reproductive health.[1]

According to the 2018 Basic Health Research (Riskesdas), the prevalence of anemia among adolescent girls in Indonesia was 48.9%, indicating that approximately 3–4 out of every 10 adolescent girls suffer from anemia. This indicates that the incidence of anemia in Indonesia is high, especially among adolescent girls. Furthermore, anemia rates were observed in other groups, including postpartum mothers (45.1%), adolescent girls aged 10–14 (57.1%), and women of childbearing age (WUS) aged 17–45 (39.5%).[2]

One indicator of anemia is a low hemoglobin (Hb) level in the blood. Hemoglobin is a protein found in red blood cells that functions to transport oxygen from the lungs to the body's tissues and carry some carbon dioxide back. to the lungs. Hemoglobin is composed of a globin portion consisting of four polypeptide chains and four heme groups containing iron atoms. These iron atoms play a role in binding oxygen, so hemoglobin can transport it from the lungs to all body tissues and carry some carbon dioxide back to the lungs. Therefore, low hemoglobin levels can reduce the oxygen supply to body tissues.[3] Normal hemoglobin levels in adult women are around 12-15 g/dL, while in adult men around 13-17 g/dL. Thus, hemoglobin levels are closely related to anemia, as a person is considered to have anemia if their hemoglobin level is <12 g/dL.[4]

Adolescent girls are at higher risk of anemia due to monthly menstruation, which can reduce red blood cells/hemoglobin in the body. Furthermore, adolescent girls' iron needs also increase during growth. This lack of iron-rich foods can inhibit hemoglobin formation and increase the risk of anemia. To prevent anemia and maintain normal hemoglobin levels, adolescent girls need adequate iron intake.[5]

Efforts to meet iron needs and increase hemoglobin production are implemented by providing Iron Supplement Tablets (TTD), which contain iron and folic acid. This program is one of several government strategies to prevent anemia among adolescent girls.[5]

Coverage of iron tablet use in Indonesia still needs improvement: 26.5% of adolescent girls have not used them, according to the 2023 National Health Policy Report (SKI) from the National Health Policy Agency. This condition is influenced by various factors, such as not obtaining iron tablets from health workers (23.5%), lack of availability (1.25%), the perception that iron tablets are unnecessary or have no benefits (12.4%), dislike of the taste or smell (2.5%), side effects (0.9%), the perception that iron tablets are a medicine (2%), limited costs (0.2%), and lack of knowledge (51.4%). On the other hand, among adolescent girls aged 10–19 years, 73.5% have consumed iron tablets for ≤ 12 months. The main distribution comes from schools (89.6%), followed by health care facilities (10.1%), and personal initiative (3.2%). These findings confirm that the understanding, access, and availability of iron tablets still need to be strengthened to increase coverage of iron tablet consumption among adolescent girls.[6]

Thus, adherence to iron supplementation is a determinant of hemoglobin levels in adolescent girls. The aim of this study was to determine the effectiveness of iron supplementation on hemoglobin levels among female students at SMAN 1 Pemalang.

METHOD

This study is a pre-experimental, one-group, pretest-posttest design. The subjects were female students in grades X and XII of SMAN 1 Pemalang with initial Hb levels <12 g/dL, selected according to inclusion and exclusion criteria. Female grade XI students were not included in the study because there was no data on initial hemoglobin levels required for a comparative analysis before and after participation in the Iron Supplement Tablet (TTD) program. The number of respondents was 90, selected using purposive sampling. The purpose of this study was to analyze differences in hemoglobin levels before and after participation in the TTD program among female students at SMAN 1 Pemalang.

The inclusion criteria in this study were female students who were still active at SMAN 1 Pemalang, received iron supplements, had initial Hb levels <12 g/dL, and signed an *informed consent form*. The exclusion criteria in this study were female students who were absent from the hemoglobin examination and had serious illnesses other than anemia. The independent variable was iron supplement consumption, and the dependent variable was the hemoglobin levels of female students at SMAN 1 Pemalang.

The study was conducted in November 2025 and January 2026. Iron tablet administration was carried out from September 23, 2023, to January 22, 2026. The school implemented the iron tablet administration program in accordance with the government program, with one tablet per week. The iron tablet administration program is an intervention implemented in schools in accordance with the government program. The researchers did not provide direct intervention, but evaluated changes in hemoglobin levels before and after the program implementation.

The data used include both primary and secondary sources. Primary data were obtained by researchers through hemoglobin level checks after consuming iron supplements, using an EasyTouch GCHb hemoglobinometer. Prior to data collection, the device was calibrated in accordance with standard operating procedures to ensure measurement accuracy. Meanwhile, initial hemoglobin level data were secondary data obtained from the medical records of study subjects who underwent Hb level checks on September 23, 2023, at the Kebondalem Community Health Center, Pemalang Regency. All data were then analyzed using *a Paired A T-test* to determine the difference in hemoglobin levels before and after the iron supplementation program. Ethical review and research permit were obtained for this study under license number 642/KEPK/FK UNTAR/X/2025.

RESULTS

The average age of the research subjects was 16.34 ± 1.083 years with a median age of 17.0 years and an age range of 15-19 years. Based on class level, most respondents came from class XII as many as 54 female students (60.0%), while respondents from class X were 36 female students (40.0%).

Based on initial Hb measurements, all respondents were classified as anemic, namely 90 female students (100%). This condition aligns with the criteria for selected research subjects based on hemoglobin levels <12 g/dL. Meanwhile, the percentage of anemic female students decreased after iron supplementation: 61 (67.8%) were still anemic, and 29 (32.2%) were not.

Table 1. Characteristics of Research Subjects

Variables	Frequency (n,%)	Mean (± SD)
Age		16.34 (1.083)
Class		
X	36 (40.0%)	
XII	54 (60.0%)	
Anemia Status Beginning		
Anemia*	90 (100%)	
No Anemia	0 (0%)	
End		
Anemia*	61 (67.8%)	
No Anemia	29 (32.2%)	

*Anemia = Hb <12 g/dL

As obtained from the Dependent T-test, the average hemoglobin level before consuming TTD was 10.70 ± 1.13 g/dL, and after consuming iron tablets, it increased to 11.13 ± 1.52 g/dL. There was an average increase in hemoglobin levels of 0.43 g/dL with a 95% CI of 0.07-0.78. The analysis results showed p = 0.019 (p < 0.05), indicating a significant difference in Hb levels before and after consuming TTD.

Table 2. The Effectiveness of Consuming Iron Supplements on Hemoglobin Levels of Female Students at Pemalang 1 High School

Variables	Mean (±SD)	Median (Min, Max)	P-Value	Mean (95%CI)	Difference
Initial Hb Level	10.70 (1.13)	11.1 (7.1, 11.9)	0.019	0.42	(0.07-0.78)
Final Hb Level	11.13 (1.52)	11.15 (7.4, 14.2)			

DISCUSSION

As per these findings, the average age of respondents was 16.34 ± 1.083 years, with an age range of 15-19 years. The majority of respondents were grade XII students, with 54 female students (60.0%). Hemoglobin levels can decrease in adolescent girls due to low iron intake and poor diet. This condition is exacerbated by increased iron requirements during growth and blood loss during menstruation, resulting in anemia in this group. According to Fitriany et al.[7] iron deficiency anemia in adolescent girls is influenced by low iron intake and blood loss during menstruation. Therefore, the Indonesian Ministry of Health recommends regular consumption of iron-enriched tablets as a preventive measure for anemia in adolescent girls.[5]

After consuming iron supplements, the majority of female students, 61 (67.8%), still experienced anemia. Although most respondents still experienced anemia, this condition may be influenced by various factors, including students' adherence to iron tablet intake, which may be suboptimal. Rianti et al.[8] stated that adherence to iron supplement tablet consumption is a factor that can influence the success of increasing hemoglobin levels and preventing anemia among adolescent girls. However, in this study, compliance with iron tablets was not consistently observed, so the effect of iron tablets on changes in hemoglobin levels could not be directly analyzed. Research by Pangesti et al.[9] showed that before iron tablet administration, anemia among adolescent girls

was often due to low iron intake, an imbalanced diet, blood loss during menstruation, a habit of consuming nutrient-poor foods, and a lack of knowledge about the importance of iron. Simatupang and Widiyarti explained that hemoglobin levels in adolescent girls are also influenced by factors such as age, gender, diet, health conditions, and heredity. During adolescence, especially during puberty, growth and physiological changes increase iron requirements, particularly in adolescent girls, so meeting these requirements is crucial for maintaining adequate iron status. Iron is obtained from many food sources, including meat, fish, liver, and chicken, and its absorption can be increased by consuming foods that contain vitamin C.[10]

Based on the dependent t-test, there was a significant difference in hemoglobin levels before and after iron supplementation among female students at SMAN 1 Pemalang ($p = 0.019$; $p < 0.05$). Before the intervention, the average hemoglobin level was 10.70 ± 1.13 g/dL; after the intervention, it increased to 11.13 ± 1.52 g/dL. This finding confirms that iron supplementation through iron supplementation can increase hemoglobin levels and help meet iron needs in adolescent girls. Physiologically, hemoglobin is formed with iron as one of its main components. After being absorbed in the small intestine, iron is transported by transferrin to the bone marrow for use in heme synthesis during erythropoiesis. Globin binds to heme to form hemoglobin, a molecule that primarily transports oxygen to body tissues. Therefore, iron supplementation can help meet increased iron requirements, thereby aiding hemoglobin formation and increasing hemoglobin levels in adolescent girls.[11]

The changes observed in this study indicate that administering iron supplements can increase hemoglobin levels and reduce the incidence of anemia in adolescent girls. The findings of Susanti et al.[12]support these findings by showing a significant increase in hemoglobin levels after the intervention ($p < 0.05$). This increase is thought to be influenced by several factors, including education on anemia, respondents' compliance with iron tablets, and support from the school during program implementation. This finding is also consistent with the study by Syahrina et al.[13] which confirmed that education through the "Edu-Anemia" program significantly increased adolescents' knowledge and compliance with iron tablet use ($p = 0.00$). The study by Nabila et al. [14] showed that anemia education significantly improved adolescent girls' knowledge of anemia and its prevention.

In general, the number of female students experiencing anemia decreased after iron supplementation. These findings suggest that iron supplementation can increase hemoglobin production. This is particularly important for adolescent girls because they are at higher risk of iron deficiency due to blood loss during menstruation. These results align with an experimental study that reported that regular iron supplementation through the Nutritional Action Program significantly increased hemoglobin levels in anemic adolescent girls.[15] Furthermore, a systematic review by Silitonga et al.[16] also found that iron supplementation is associated with improved hemoglobin levels and reduced anemia incidence in adolescent girls.

Statistical analysis showed a difference in hemoglobin levels before and after iron supplementation. This confirms that the iron supplementation program was successful, as evidenced by both data processing and fieldwork findings. However, not all respondents experienced an optimal increase in hemoglobin levels. Some respondents showed minimal changes or even decreased hemoglobin levels after the intervention. This condition is likely influenced by factors such as compliance with iron supplementation, nutritional status, health conditions, and the presence of infections or inflammation, which can hinder iron absorption. The dominant factors related to iron supplementation are attitude and knowledge.[17] The success of iron supplementation in adolescent girls, as evidenced by a systematic review, is influenced by nutritional status before the intervention and the presence of infections that can hinder iron absorption, resulting in

suboptimal hemoglobin levels.[16] The compliance with iron supplementation is influenced by various factors, including behavioral, psychological, social, family, health and medical conditions, demographics, and the school environment. Non-compliance among adolescent girls in taking iron-containing tablets can also occur due to internal factors, including forgetfulness, side effects, organoleptic characteristics, or the perception that the body is healthy and therefore does not need iron-containing tablets.[18] In addition, Aprilia et al.[19] revealed that motivation is the most dominant determinant in influencing iron-containing tablet consumption, followed by social support. The study by Putri et al. [20] showed that knowledge of anemia and the benefits of iron supplement tablets also play a role in improving adherence to iron supplement tablet consumption among adolescent girls.

A limitation of this study is the lack of regular monitoring of respondents' adherence to iron supplementation. Therefore, the effect of adherence on changes in hemoglobin levels cannot be definitively determined and requires further investigation in future studies.

CONCLUSION

Iron tablet consumption among female students at SMAN 1 Pemalang decreased the incidence of anemia and increased hemoglobin levels after the intervention. The results of the Paired T-Test statistical analysis showed a significant difference in hemoglobin levels before and after the intervention (p=0.019), indicating that iron tablet supplementation affected hemoglobin levels. However, the intervention's effectiveness can still be influenced by factors such as compliance with consumption guidelines, health conditions, and respondents' nutritional status.

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