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Differences in hemoglobin levels before and after administration of iron supplements and eggs to female students

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Abstract

Anemia is a condition characterized by a decrease in the number of red blood cells or hemoglobin concentration, which impairs the blood's capacity to transport oxygen to body tissues. The high prevalence of anemia is influenced by several factors, including inadequate intake of iron and other essential nutrients such as vitamins A, C, folate, riboflavin, and vitamin B12. Iron requirements can be fulfilled through the consumption of animal-based foods, which provide highly bioavailable iron, or plant-based foods, which contain iron with lower absorption rates. This study aimed to determine the differences in hemoglobin levels before and after the administration of iron tablets and eggs among female students at SMA N 1 Segedong, located in the working area of the Segedong Community Health Center, Mempawah Regency. A quasi-experimental design with a non-randomized one-group pretest–posttest approach was employed. The sample was selected using purposive sampling. Data were analyzed using univariate and bivariate analyses with the Chi-square test. The results showed a significant difference in hemoglobin levels before and after iron tablet administration (p = 0.001) and before and after egg consumption (p = 0.000). In conclusion, there were significant differences in hemoglobin levels following the administration of iron tablets and eggs among female students at SMA N 1 Segedong.

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INTRODUCTION

Anemia is a condition characterized by a reduction in the number of red blood cells (erythrocytes) or hemoglobin concentration, resulting in an impaired ability of the blood to transport oxygen to body tissues (Permatasari, 2016). Among adolescent girls, anemia is influenced not only by inadequate iron intake but also by poor dietary patterns and multiple micronutrient deficiencies. Adriani (2012) emphasizes that adequate nutrition during adolescence is essential to support optimal growth and prevent micronutrient-related disorders. In line with this, Dieny (2014) explains that adolescent girls are particularly vulnerable to anemia due to increased physiological demands and menstrual blood loss. Iron deficiency anemia remains the most prevalent type of anemia globally (Ani, 2013) and is closely associated with poor reproductive health and inappropriate dietary practices (Badriah, 2014).

Previous studies indicate that insufficient consumption of iron-rich foods significantly contributes to reduced hemoglobin levels among adolescents (Maslikhah, 2014). Additionally, several environmental and occupational factors have been reported to influence hemoglobin concentration, as described by Fahma (2017) and Amalia (2017). Basith et al. (2017) further highlight that nutritional status, menstrual patterns, and dietary habits are key determinants of anemia among adolescent girls. The high prevalence of anemia is also associated with low intake of other essential nutrients, including vitamins A, C, folate, riboflavin, and vitamin B12. To meet daily iron requirements, individuals may consume animal-based foods, which provide highly bioavailable iron, or plant-based foods, which are rich in iron but have lower absorption rates (Briawan, 2014).

In response to the widespread problem of anemia, the Indonesian Ministry of Health issued Regulation No. 88 of 2014, which recommends iron tablet supplementation for women of reproductive age (Kementerian Kesehatan Republik Indonesia, 2014). This policy aims to improve the nutritional status of adolescent girls, break the cycle of stunting, prevent anemia, and enhance the quality and productivity of future generations (Ministry of Health, 2014). Globally, anemia remains a major public health issue. Adolescents are particularly at risk due to rapid growth and menstrual blood loss.

In Indonesia, adolescents aged 10–19 years constitute 26.2% of the population, with 49.1% being female (Indonesian Ministry of Health, 2013). National data show that anemia continues to be a significant health problem. The 2013 Basic Health Research (Riskesdas) reported an anemia prevalence of 21.7%, with 26.4% among individuals aged 5–14 years and 18.4% among those aged 15–24 years (Indonesian Ministry of Health, 2014). Furthermore, the 2012 Household Health Survey (SKRT) documented a prevalence of 57.1% among adolescent girls aged 10–18 years, indicating that females, particularly adolescents, are the group most vulnerable to anemia (Kementerian Kesehatan Republik Indonesia, 2013).

Anemia during adolescence has serious short- and long-term consequences, including reduced productivity, decreased learning ability, weakened immune function, impaired reproductive health, and symptoms such as dizziness, fainting, and pallor. The main causes of anemia in women are menstrual blood loss and inadequate intake of nutrients required for erythropoiesis, such as iron, protein, folic acid, and vitamin B12. Persistent anemia in adolescent girls increases the risk of physical and mental health disorders and may lead to adverse pregnancy outcomes later in life, including premature birth and low birth weight infants (Sediaotama, 2010; Uzunov, 2022). Although iron tablet supplementation programs have been widely implemented, most studies focus on supplementation alone and provide limited evidence on the combined use of iron tablets and locally available animal-based foods, such as eggs, to improve hemoglobin levels. This indicates a research gap regarding integrated, food-based interventions that complement supplementation strategies. Therefore, the novelty of this study lies in examining the

combined effect of iron tablet administration and egg consumption on hemoglobin levels among adolescent girls. The objective of this study is to determine the difference in hemoglobin levels before and after the administration of iron tablets and eggs among female students at SMA N 1 Segedong in the working area of the Segedong Community Health Center, Mempawah Regency.

METHOD

This study employed a quantitative research methodology emphasizing objective measurement and statistical analysis (Sugiyono, 2012). A quasi-experimental design with a non-randomized control group pretest–posttest approach was applied to evaluate changes in hemoglobin (Hb) levels before and after the intervention. The research procedures followed the framework proposed by Arikunto (2013), including sample selection, intervention implementation, and data collection. Scientific documentation and reporting were conducted in accordance with established academic writing standards (Hidayat, 2014). A pretest was administered to determine baseline hemoglobin levels prior to treatment, followed by a posttest after the intervention to assess changes attributable to iron tablet and egg consumption. Statistical analysis procedures were conducted based on the guidelines suggested by Sunyoto (2012).

The study population consisted of all female students enrolled at SMA N 1 Segedong, Mempawah District, totaling 374 students from seven tenth-grade classes and six eleventh-grade classes (Willie, 2024). From this population, a sample of 20 female students was selected based on predetermined inclusion criteria to ensure representativeness and feasibility of hemoglobin assessment. The study was conducted at SMA N 1 Segedong, Mempawah Regency, over a one-week period from May 22 to May 28, 2019.

Primary data were collected directly from the research subjects through hemoglobin level measurements (Sunyoto, 2012). Baseline Hb levels were measured using an Easy Touch digital hemoglobin meter and recorded on standardized examination result sheets. Following the initial assessment, participants were assigned to two intervention groups: one group received 10 iron tablets, while the other group received iron tablets combined with egg consumption over a seven-day period. After completion of the intervention, hemoglobin levels were re-measured to evaluate differences before and after treatment.

Data analysis was conducted in two stages. Univariate analysis was used to describe the distribution of hemoglobin levels among participants, while bivariate analysis was performed to examine differences in hemoglobin levels before and after the intervention (Notoatmodjo, 2012). The paired t-test, a parametric statistical test for normally distributed data, was applied to determine whether there were significant differences in mean hemoglobin levels following the intervention.

RESULTS

This study was conducted at SMA N 1 Segedong, located at Jl. Sy. Abubakar No. 01 Peniti Dalam I, Segedong District. SMA N 1 Segedong consists of 19 classes with a total of 630 students, including 256 male and 374 female students distributed across seven tenth-grade classes, six eleventh-grade classes, and six twelfth-grade classes. A total of 20 female students participated in this study. Hemoglobin levels were measured at baseline, after which 10 respondents received iron tablets once daily, while the remaining 10 respondents consumed one egg once daily for seven days. Hemoglobin levels were then re-measured following the intervention.

Table 1. Comparison of Mean Hemoglobin Level Changes After Iron Tablet and Egg Administration Among Female Students at SMA N 1 Segedong.

Intervention Group	n	Mean Hb Increase (g/dL)	Mean Difference (g/dL)	p-value
Iron tablet	10	0.78	0.62	0.020
Egg consumption	10	1.40		

Table 1 shows that the univariate analysis demonstrated that hemoglobin levels increased in both intervention groups after treatment. The mean increase in hemoglobin levels in the iron tablet group was 0.78 g/dL, whereas the egg consumption group showed a higher mean increase of 1.40 g/dL. Bivariate analysis revealed a statistically significant difference in mean hemoglobin level changes between the two groups, with a p-value of 0.020 ($p \leq 0.05$). This finding indicates that the increase in hemoglobin levels in the egg consumption group was significantly greater than that observed in the iron tablet group.

Based on these results, it can be concluded that egg consumption was more effective than iron tablet supplementation in increasing hemoglobin levels among female students at SMA N 1 Segedong, with a mean difference of 0.62 g/dL. These findings suggest that eggs, as an affordable and locally available animal-based food source, may serve as an effective alternative or complementary strategy to iron tablet supplementation in anemia prevention programs for adolescent girls.

DISCUSSION

Based on the statistical analysis, there was a significant difference in hemoglobin (Hb) levels before and after iron tablet administration ($p = 0.001$). This study involved 20 female students at SMA N 1 Segedong, Mempawah Regency, and examined changes in hemoglobin levels following the administration of iron tablets and eggs. The results showed a significant increase in hemoglobin levels both before and after iron tablet supplementation and before and after egg consumption ($p < 0.05$). These findings indicate that both interventions were effective in improving hemoglobin levels among adolescent girls.

The increase in hemoglobin levels following iron tablet supplementation is supported by clinical evidence demonstrating that iron plays a critical role in erythropoiesis and red blood cell production (Bakta, 2015). Inadequate iron intake can result in hematological disorders, including anemia (Haryanto et al., 2006). The findings of this study are consistent with previous research indicating that iron supplementation, particularly when accompanied by nutritional education, contributes to improved hemoglobin levels among adolescents (Ahmady, Hapzah, & Mariana, 2017). In the master table, the highest increase in hemoglobin levels was observed among respondents aged 15 years (1.6 g/dL) and 16 years (1.8 g/dL), while the lowest increases were 0.5 g/dL and 0.2 g/dL, respectively. Among respondents aged 17 years, the increase in hemoglobin levels was 0.1 g/dL, suggesting age-related variation in response to supplementation.

Similarly, the substantial increase in hemoglobin levels observed in the egg consumption group aligns with earlier studies reporting that boiled egg consumption significantly increases hemoglobin concentration due to its heme iron content and high-quality protein (Putri et al., 2017; Sugita, 2016; Subekti, 2024). Eggs also provide essential micronutrients that support hemoglobin synthesis. The procedures used to measure hemoglobin levels in this study followed standard methods and are consistent with the reliability and validity described by Suryani (2018).

This study is in agreement with the research conducted by Cahyaningtyas, D.K. (2016), which reported a statistically significant difference between pretest and posttest hemoglobin levels after iron tablet consumption using the paired t-test ($p = 0.002 < \alpha = 0.05$). These results further confirm that iron tablet supplementation has a meaningful impact on improving hemoglobin levels among adolescent girls. In addition, Hardiningsih (2025) states

that iron tablet consumption can effectively treat anemia in women and adolescent girls, improve learning ability, enhance nutritional status, and support overall adolescent health.

A comparison of the two interventions iron tablet supplementation and daily egg consumption revealed notable differences in their effects on hemoglobin levels. Although both interventions resulted in increased Hb levels, the magnitude of improvement differed significantly between groups. Statistical analysis showed a significant difference with a p-value of 0.020, indicating that the type of intervention influenced the degree of hemoglobin improvement. The mean increase in Hb levels in the iron tablet group was 0.78 g/dL, whereas the egg group experienced a higher mean increase of 1.4 g/dL, suggesting that egg consumption was more effective than iron tablet supplementation within the short intervention period.

Several factors may explain the greater increase in hemoglobin levels observed in the egg group. Eggs are a rich source of heme iron, which is more efficiently absorbed by the body than non-heme iron. They also contain high biological value protein, vitamin B12, folate, and riboflavin, all of which play essential roles in hemoglobin synthesis and red blood cell formation. The presence of these synergistic nutrients may enhance iron absorption and utilization. In contrast, iron tablets, although effective, may have variable absorption due to gastrointestinal side effects, timing of intake, or dietary inhibitors that reduce iron bioavailability.

Furthermore, compliance may have differed between the two intervention groups. Iron tablets are often associated with side effects such as nausea, constipation, and metallic taste, which can reduce adherence among adolescents. Eggs, by contrast, are familiar, palatable, and generally well tolerated, making them easier to incorporate into daily diets. Improved adherence in the egg group may therefore have contributed to the greater increase in hemoglobin levels observed.

Overall, the findings of this study indicate that while iron tablets remain a standard and recommended intervention for anemia prevention and treatment, nutrient-rich foods such as eggs can serve as an effective complementary strategy. The greater improvement in hemoglobin levels associated with egg consumption highlights the potential value of food-based interventions, particularly in adolescent populations where adherence to supplementation programs may be challenging. These results support the integration of dietary approaches with iron supplementation to achieve more optimal and sustainable outcomes in anemia management and prevention.

CONCLUSION

There was a difference in hemoglobin levels following the administration of iron tablets and eggs, indicating that both interventions were effective in increasing hemoglobin levels. Egg consumption demonstrated greater effectiveness in improving hemoglobin levels compared to iron tablet supplementation. For future research, it is recommended that researchers consider selecting respondents with similar age characteristics and use eggs of uniform weight to enhance the consistency and validity of the findings.

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