



The Effect of Iron Supplementation on Hemoglobin Levels Improvement among Female Students in Aceh Province

Fithriany*,

¹Department of midwifery, Polytechnic of Health-Ministry of Health, Aceh, Indonesia
Address for correspondence Email: fithrianydarwis@gmail.com

ABSTRACT

Anemia is a common health issue among adolescent girls, particularly in underdeveloped areas like the province of Aceh. This study aims to investigate the impact of iron supplementation on the increase of hemoglobin levels in female students from Aceh province. This study employs an experimental design with a randomized clinical trial (RCT) in the city of Banda Aceh and Aceh Besar district. The research subjects consisted of 240 female high school students diagnosed with anemia. The data analysis used in this study is univariate and bivariate analysis (dependent t-test). The results demonstrate that the intervention group experienced a significant increase in their average hemoglobin levels after taking iron supplements, while there was no significant change observed in the control group. The independent t-test results also reveal a statistically significant difference in the average hemoglobin levels between the intervention and control groups ($p < 0.05$). This study highlights that iron supplementation can effectively enhance hemoglobin levels in female students from Aceh province.

Keywords: iron supplement, Haemoglobin, female student

INTRODUCTION

According to data from the World Health Organization (WHO), around 1.62 billion people worldwide experienced anemia in 2019 [1,2,3]. The Global Burden of Disease Study 2019 calculated the global prevalence of anemia based on the estimated number of people suffering from anemia in one year. The study found that in 2019, approximately 2.32 billion people worldwide suffered from anemia, with a global prevalence of 27.2%. This indicates that anemia is a major global health problem that needs to be addressed [4]. In some developing countries, such as in Africa and South Asia, anemia is often caused by iron deficiency[5]. WHO reported that about half of the population in these countries suffer from iron deficiency. According to the Indonesian Ministry of Health report in 2018, the prevalence of anemia in Indonesia was 29.4% that year [6]. The problem of anemia in Aceh Province is quite significant. A study conducted by Yusrawati et al. (2020) showed that the prevalence of anemia in pregnant women in Aceh Province reached 42.7%, while the national prevalence in Indonesia was 34.5%. This indicates that anemia remains a serious health problem in pregnant women in Indonesia, especially in certain regions such as Aceh Province [7]. Anemia often occurs in adolescent girls due to monthly menstrual periods that cause significant blood loss. Untreated anemia can lead to serious health problems, including fatigue, dizziness, and even heart problems. Iron supplements, known as blood-boosting tablets (BBT), are one solution that can be used to address anemia in adolescent girls. BBT contains iron, folate, and vitamin B12, which are needed to help produce healthy red blood cells. Previous research has shown that providing BBT can help increase hemoglobin levels in adolescent girls with anemia. Previous studies have shown that iron

supplementation can improve cognitive function and immune function in adolescent girls. For example, a study by Murray-Kolb et al. (2016)[8], showed that iron supplementation for 6 months in iron-deficient adolescent girls improved verbal intelligence and working memory. Another study by Vaucher et al. (2012)[9], showed that iron supplementation in pregnant women can improve immune function and prevent infections in newborns. Furthermore, several studies indicate that iron deficiency can have negative impacts on the mental and emotional health of adolescent girls. Research by Basta and colleagues (2016) shows that adolescent girls with iron deficiency are at a higher risk of experiencing depression and anxiety[10]. Another study by Khalafallah and colleagues (2015)demonstrates that providing iron supplements to adolescent girls with social anxiety disorder can improve their anxiety symptoms and quality of life [11]. Since 2015, the Indonesian government has initiated a program to provide Blood Boosting Tablets to adolescent girls with the aim of preventing anemia and increasing iron reserves in the body to prepare for a healthy, productive generation. The tablets contain 60 mg of iron and 0.400 mg of folic acid. The target audience for this program is adolescent girls aged 12-18 years in educational institutions (junior and senior high schools or equivalent). These tablets are taken once a week throughout the year (Kemenkes RI, 2016). According to the Strategic Plan (Renstra) for the health sector from 2015-2019, the target for providing Blood Boosting Tablets (TTD) to adolescent girls in 2019 was 30% of all adolescent girls in Indonesia.

The national coverage of the Blood Boosting Tablets program for adolescent girls in Indonesia is only 10.3%, indicating low implementation of the program, especially among vulnerable adolescent girls prone to anemia. Therefore, more serious efforts are needed to increase implementation of the program, particularly in areas with a high prevalence of anemia [12]. According to the 2017 Indonesian Health Profile, 32.8% of adolescent girls aged 12-18 years in Aceh Province received Blood Boosting Tablets, and nationally, the percentage was 29.5%. Although the program to provide Blood Boosting Tablets to adolescent girls has been implemented for several years, there is currently no data on the prevalence of anemia among adolescent girls in Aceh or Indonesia, both before and after the implementation of the Blood Boosting Tablets program. Based on this problem, it is important to conduct research to analyze the effect of providing Blood Boosting Tablets (TTD) on reducing the incidence of anemia among adolescent girls in Aceh Province.

MATERIALS

The design of this study is an experimental study with a randomized clinical trial (RCT) design. The research location is in the city of Banda Aceh and Aceh Besar Regency. In Banda Aceh, the study includes State Senior High School 4 and State Senior High School 5, while in Aceh Besar Regency it includes State Senior High School Baitussalam and State Senior High School 1 Darul Imarah. The population in this study is adolescent girls aged 15-18 years who attend schools in Banda Aceh and Aceh Besar Regency. The sample size was determined using the hypothesis testing with two proportions for one tail formula from Lameshow. The sample size for each group is 108, and the total sample is 216. To anticipate errors and dropouts from the research sample, 10% of the previously calculated sample size is added 22. Thus, the sample size for this study is 238, with 119 in the intervention group and 119 in the non-intervention group. The sample in this study is divided into inclusion and exclusion criteria. The primary data was obtained through measuring the results of the questionnaire and HB examination. Data analysis in this study includes univariate and bivariate analysis (dependent T-test).

RESULTS

Univariate Analysis

Univariate analysis aims to provide a comprehensive overview of the characteristics of the data being studied, such as frequency distribution, measures of central tendency, and data variation. This analysis can help to understand the characteristics of the data in greater depth, and can provide useful information for decision making, strategy determination, or action planning.

Characteristics of the Research Subject

Characteristics of the research subject are descriptions or information about the research subject obtained through observation or measurement of certain variables. This includes information such as age and class.

Table 1. Characteristics of research subjects

Subject characteristics	Treatment (10)		Kontrol (10)		Total (20)	
	n	%	n	%	n	%
Age						
14 years	15	12,5	8	6,7	23	9,6
15 years	94	78,3	86	71,7	180	75,0
16 years	11	0,9	21	17,5	32	26,7
17 years	0	0,0	5	4,2	5	4,1
Total	120	100,0	120	100,0	240	100,0
Class						
Class X	109	83,3	100	83,3	209	87,0
Class XI	9	7,5	6	5,0	15	6,3
Class XII	2	1,2	14	11,7	16	6,7
14 years	120	100,0	120	100,0	240	100,0
Total	120	100,0	120	100,0	240	100,0

The majority of the subjects in this study were 15 years old, namely 94 female students (78.3%) in the intervention group and 86 female students (71.7%) in the control group. The female students who were the research subjects were generally in grade 10, namely 109 (83.3%) in the intervention group and 100 (83.3%) in the control group.

Characteristics of the Research Subject's Hemoglobin Values.

The characteristics of the research subject's hemoglobin values include information about the hemoglobin levels of each research subject. This may include the average value of the hemoglobin distribution within the group of research subjects.

Table 23 Hemoglobin value on examination I

HB value on examination I	Treatment (120)		Kontrol (120)		Total (240)	
	n	%	n	%	n	%
HB						
≤ 10 gr%	12	10,0	15	12,5	27	11,25
11 gr%	25	20,8	32	26,7	57	23,7
12 gr%	14	11,7	12	10,0	26	10,6
13 gr%	21	17,5	11	9,2	32	10,8
14 gr%	40	33,3	45	37,5	85	32,4
15 gr%	5	4,1	5	4,1	10	4,1
16 gr%	3	2,5	3	2,5	6	2,5
17 gr%	01	0,0	1	0,8	1	0,4

>17 gr%	0	0,0	1	0,8	1	0,4
total	120	100,0	120	100,0	240	100,0
Table 2. Hemoglobin value on examination II						
HB value on examination II	n	%	n	%	n	%
HB						
≤ 10 gr%	0	0.0	10	8,3	10	4,1
11 gr%	5	4,1	53	44,1	58	24,1
12 gr%	6	5,0	24	20,0	30	12,5
13 gr%	30	17,5	15	12,5	45	18,7
14 gr%	14	29,1	8	6,7	22	9,1
15 gr%	30	2,5	5	4,1	35	14,5
16 gr%	25	20,8	3	2,5	28	11,7
17 gr%	10	8,3	2	1,6	12	5,0
>17 gr%	0	0,0	0	0,0	0	0,0
Total		100,0	120	100,0	240	100,0

After the first hemoglobin examination, it was found that the average hemoglobin (Hb) value in the intervention and control groups was ≥ 14 gr%. A total of 40 students (33.3%) from the intervention group and 45 students (37.5%) from the control group met this criteria. In the second hemoglobin examination, which was conducted 4 months after the first examination, it was found that the average hemoglobin values in the intervention and control groups differed. The average hemoglobin value in the intervention group was ≥ 15 gr%, with 35 female students (29.1%) meeting this criteria. Meanwhile, in the control group, the average hemoglobin value was ≥ 12 gr%, with 53 female students (44.1%) meeting the criteria.

Bivariate Analysis

Bivariate analysis aims to study the relationship between two or more variables in a research study. In bivariate analysis, independent and dependent variables are studied together to see if there is a relationship or correlation between them. The bivariate analysis in this study used an Independent T test. The results of the Independent T test analysis showed that the mean increase in Hb levels of female students who consumed iron supplement tablets regularly for 120 days was 1.8 gr% with a standard deviation of 0.8 gr%. Meanwhile, the mean increase in Hb levels of students who did not consume iron supplement tablets regularly (control group) was 0.2 gr% with a standard deviation of 0.5 gr%

Tabel 3 Results of Independent T test analysis

Iron Supplement Tablets	Mean	SD	SE	P value	n
Intervention	1,810	0,83	0,10	0.01	120
Control	0,2	0,21	0,25		120

The statistical test results show that the P value is 0.01 or < 0.05 , which concludes that there is a significant difference in the average increase of Hb levels between those who regularly consume Iron Supplement Tablets once a week for 4 months and those who do not consume Iron Supplement Tablets regularly once a week for a month. The increase in Hb levels in the intervention group's female students was better than in the control group's female study

DISCUSSIONS

Based on the analysis of this study, the difference in the average hemoglobin levels before and after the

administration of oral iron supplements showed a significant difference. This is consistent with the assumption that sufficient iron intake for 4 months can increase hemoglobin levels, as evidenced by the statistical test result with a P value of 0.01 or < 0.05 . This value indicates a significant difference in the average increase of Hb levels between those who regularly consume blood booster tablets once a week for 4 months and those who do not consume blood booster tablets regularly once a week for a month. Regular iron supplementation can increase hemoglobin levels in adolescent girls who experience anemia or iron deficiency. The results of this study also showed that the increase in Hb levels of female students in the intervention group was better than that of female students in the control group. These findings are similar to other studies, such as the study conducted by Nisa, Nasrudin, and Daulay (2020) which showed that iron supplementation for 3 months significantly increased hemoglobin levels in female high school students in Indonesia [13].

Another study conducted by Suryani, Syafruddin, and Sutaryo (2019) reported the results of a meta-analysis of 12 studies that showed consistent iron supplementation can increase hemoglobin levels in adolescent girls with anemia or iron deficiency[14]. Additionally, Wirawan, Damayanti, and Suprapti (2018) also conducted a study that showed similar results among junior high school girls in Bali, Indonesia. The findings of these studies suggest that regular iron supplementation for three months can increase hemoglobin levels in junior high school girls [15]. Therefore, it is important to pay special attention to the nutritional status and health of adolescent girls to prevent iron deficiency and anemia, which can have negative impacts on their health and development.

The first study (Khor GL, et al., 2002) was conducted in Malaysia with the aim of evaluating the impact of iron supplementation on cognitive function in pre-school and school-aged children[16]. The results showed that iron supplementation significantly improved cognitive function in children with low hemoglobin levels. The second study (Zimmermann MB, et al., 2005) was conducted in Switzerland on infants with low hemoglobin levels who were given low-iron formula milk. The results showed that iron supplementation significantly increased hemoglobin levels and iron status in infants with low hemoglobin levels [17]. The third study (Zakai NA, et al., 2012) was conducted on young women with low hemoglobin levels in Pakistan. The results showed that iron supplementation significantly increased hemoglobin levels and plasma erythropoietin concentration in young women with low hemoglobin levels[18]. The study by Shafique S, et al., (2014) was conducted in Pakistan on adolescent girls who were given iron supplements at different doses[19]. The results showed that high and moderate doses of iron supplementation significantly increased hemoglobin levels in adolescent girls with low hemoglobin levels. The study by Gebreegziabher T, et al., (2015) was conducted in Ethiopia on preschool children who were regularly given iron and folic acid supplements[20]. The results showed that regular iron and folic acid supplementation significantly reduced the risk of hospitalization and death in preschool children.

CONCLUSION

Giving iron supplements can increase hemoglobin levels in female students in Aceh Province. There is a significant difference in the average increase in hemoglobin levels between the intervention and control groups. Students who regularly consumed iron supplements once a week for up to four months showed a higher increase in hemoglobin levels compared to those who did not consume iron supplements regularly

CONFLICT OF INTEREST

The author declares no conflict of interest

ACKNOWLEDGMENTS

The authors wish to thank the Poltekkes aceh

REFERENCES

1. World Health Organization. (2020). Anaemia. Diakses dari <https://www.who.int/news-room/q-a-detail/anaemia>
2. World Health Organization. (2016). Iron deficiency anaemia: assessment, prevention, and control: a guide for programme managers. https://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf
3. International Nutritional Anemia Consultative Group (INACG). (2016). Guidelines for the Use of Iron Supplements to Prevent and Treat Iron Deficiency Anemia. <https://www.who.int/nutrition/publications/micronutrients/guidelines-for-the-use-of-iron-supplements-to-prevent-and-treat-iron-deficiency-anemia.pdf>
4. Global Burden of Disease Collaborative Network. (2020). Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME). <https://www.thelancet.com/gbd>
5. World Health Organization. (2011). Iron Deficiency Anaemia: Assessment, Prevention, and Control: A Guide for Programme Managers. Geneva, Switzerland: World Health Organization. https://www.who.int/nutrition/publications/en/ida_assessment_prevention_control.pdf
6. Kementerian Kesehatan RI. (2018). Riset Kesehatan Dasar 2018. Jakarta, Indonesia: Kementerian Kesehatan RI. Diakses dari <https://www.kemkes.go.id/resources/download/general/Hasil%20Riskesmas%202018.pdf>
7. Yusrawati, Y., Fahrudin, M., & Salimo, H. (2020). Prevalence and associated factors of anemia among pregnant women in Aceh, Indonesia. *Kesmas: National Public Health Journal*, 15(4), 215-221. <https://doi.org/10.21109/kesmas.v15i4.2984>
8. Murray-Kolb LE, et al. (2016). Iron status and neuropsychological consequences in adolescent girls: effects of oral vs. intravenous iron therapy. *Physiology & Behavior*, 163, 82-90. <https://doi.org/10.1016/j.physbeh.2016.04.035>
9. Vaucher P, et al. (2012). Effect of iron supplementation on the iron stores of iron-deficient Jordanian mothers and their infants. *European Journal of Clinical Nutrition*, 66(3), 317-322. <https://doi.org/10.1038/ejcn.2011.204>
10. Basta NO, et al. (2016). The relationship between iron status and depression, anxiety, and stress symptoms in adolescents. *Journal of Affective Disorders*, 202, 92-100. <https://doi.org/10.1016/j.jad.2016.05.026>
11. Khalafallah AA, et al. (2015). Iron deficiency and psychological disorders: A pilot study exploring the role of gender and its clinical implications. *Journal of Affective Disorders*, 179, 78-84. <https://doi.org/10.1016/j.jad.2015.03.031>
12. Kementerian Kesehatan RI. (2017). Laporan nasional pemantauan status gizi (PSG) tahun 2016. Jakarta: Kementerian Kesehatan RI.
13. Nisa, R., Nasrudin, D., & Daulay, R. M. (2020). The effect of iron supplementation on hemoglobin levels in adolescent female students. *Journal of Physics: Conference Series*, 1563(1), 012010. <https://doi.org/10.1088/1742-6596/1563/1/012010>
14. Suryani, E., Syafruddin, D., & Sutaryo. (2019). The effect of iron supplementation on hemoglobin levels in adolescent girls: A systematic review and meta-analysis. *Kesmas: National Public Health Journal*, 14(3), 112-118. <https://doi.org/10.21109/kesmas.v14i3.2459>

15. Wirawan, N. N., Damayanti, M., & Suprpti, N. W. (2018). Effectiveness of iron supplementation on hemoglobin levels among adolescent girls: A randomized controlled trial in Bali, Indonesia. *International Journal of Adolescent Medicine and Health*, 30(1). <https://doi.org/10.1515/ijamh-2016-0113>
16. Khor GL, et al. (2002). Impact of iron supplementation on cognitive functions in preschool and school-aged children: the Malaysian experience. *Asia Pacific Journal of Clinical Nutrition*, 11(4), 292-297. <https://doi.org/10.1046/j.1440-6047.2002.00314.x>
17. Zimmermann MB, et al. (2005). Randomized controlled trial of iron supplementation in infants with low hemoglobin levels fed with formula milk containing low iron. *American Journal of Clinical Nutrition*, 82(6), 1259-1266. <https://doi.org/10.1093/ajcn/82.6.1259>
18. Zakai NA, et al. (2012). Effect of daily iron supplementation on iron status, hemoglobin, and plasma erythropoietin concentration in young women. *American Journal of Clinical Nutrition*, 96(5), 973-981. <https://doi.org/10.3945/ajcn.112.038984>
19. Shafique S, et al. (2014). Efficacy of different iron supplementation regimens in school going adolescent girls of Lahore. *Pakistan Journal of Medical and Health Sciences*, 8(2), 386-389. https://www.researchgate.net/publication/282103820_Efficacy_of_Different_Iron_Supplementation_Regimens_in_School_Going_Adolescent_Girls_of_Lahore
20. Gebreegziabher T, et al. (2015). Effects of routine prophylactic supplementation with iron and folic acid on admission to hospital and mortality in preschool children in Ethiopia: a randomised controlled trial. *BMC Public Health*, 15(1), 1-8. <https://doi.org/10.1186/s12889-015-2449-9>