

Effectiveness of Provision of Iron Tablet (Fe), Vitamin C and Psidium Guajava Juice on Improvement of Hemoglobin Level of Young Women

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Abstract— Young Women are at higher risk of anemia, due to the loss of iron during menstruation so the concentration of iron in the blood decreases and which will result in a decrease of hemoglobin Content. The research aimed to find out the effectiveness of iron tablet (Fe) provision, vitamin C, and Psidium guava juice on the improvement of young women's hemoglobin content. This was an experimental design of the pretest-posttest with the control group. The research samples were the female students of senior high school with a Hemoglobin content of <12gr/dL as many as 45 students were divided into three groups. They were the female students obtaining the supplementation of Fe tablet + Psidium guava juice (group I), those obtaining the supplementation of Fe tablet + vitamin C (group II), and those obtaining the supplementation of Fe tablet (control). The intervention provision was conducted for 8 weeks. And the examination of Hb content was carried out every two weeks. The data analysis used the paired t-test and ANOVA test. The research result indicates that after 8-week intervention, the average highest Hb content improvement is in the group of Fe tablet and Psidium guava juice is 1.7gr/dL; the group is Fe tablet and vitamin C is 1.5 gr/dL, and the group of Fe tablet is 0.8 gr/dL. Based on the Anova test, after two-week intervention is $p=0.010$, after four-week intervention is $p=0.316$, after six-week intervention is $p=0.323$, after eight-week intervention is $p=0.203$ with $\alpha=0,05$. It can be concluded, that there are significant differences in mean Hb in groups I, II, and control two weeks after the intervention, while after interventions 4, 6, and 8 weeks the mean Hb levels showed no significant difference however between the groups I, II, and control.

Index Terms— Hemoglobin, Fe, guava juice, vitamin C, Young Women

I. INTRODUCTION (HEADING 1)

The incidence rate of anemia in young women in developing countries according to WHO is about 53.7% of all young women. Anemia often affects young women due to stress, menstruation, or late meals [1]. The prevalence of anemia according to Indonesia's basic health research has increased from 2013 to 2018, from 37.1% to 48.9% with the proportion of anemia aged 15-24 years, which is 84.6% [2]. Women have a higher risk of developing anemia than men because every month women have menstruation. A woman who has had a lot of menstruation for more than five days is worried that she will lose iron, so she needs more replacement iron than a woman whose menstruation is only three days or less [3]. One of the government's efforts in tackling anemia in women of childbearing age and pregnant women is the Fe tablets program. Each Fe tablet contains 200 mg of *ferrous sulfate* and 0.25 mg of folic acid or equivalent to 60 mg of elemental iron and 0.25 mg of folic acid [4]. Iron absorption is greatly influenced by the availability of vitamin C. The role of vitamin C in the iron absorption process is to help reduce ferrous iron (Fe^{3+}) to ferrous (Fe^{2+}) in the small intestine so that it is easily absorbed, the reduction process will be greater if the pH in the stomach is more acidic. Vitamin C can increase acidity so that it can increase iron absorption by up to 30% [5]. The high content of vitamin C can be obtained through guava fruit or *Psidium guajava* in Latin. The content of vitamin C in guava fruits is higher compared to other fruits. The content of vitamin C in 100 grams of guava fruit is 103 mg. in addition to containing vitamin C, guava fruit also contains other nutrients such as vitamin A, and vitamin B₂ which also helps in the absorption of iron [6], [7]. Research of Sambou, Yamlean, & Lolo (2014), that is administration of red guava juice increases the blood Hb levels of male white rats. Yusnaini (2014), namely the administration of guava to anemic pregnant women who get Fe tablet supplementation increases Hb levels by about 1.6 gr/dL. The Research of [10], namely there is an effect of supplementation of Fe tablets and Vitamin C on the Hb levels of young women with a value of $p = 0.001$ ($p < 0.05$). This study aims to determine the effect of giving Fe tablets in combination with guava juice, Fe tablets in combination with vitamin C, and Fe tablets without combination.

II. METHOD AND MATERIAL

Location and Research Design

This research was conducted on March 23-May 23, 2016. Location at Darul Aman Gombara Islamic Boarding School in Makassar. This study used an *experimental design with a pretest-posttest with control group design*, in this study will use treatment group I (Fe + guava juice tablets), Treatment group II (Fe + vitamin C tablets) and control group (Fe tablets).

Population and Sample

The population in this study is all Islamic High School student class IV-VI, which is 104 with *accidental sampling* techniques that meet the criteria for inclusion and exclusion.

Data Collection Methods

Measurement of hemoglobin levels using a hemoglobin meter (*Hemocue*), carried out as much as 5 times, before and after the intervention of 2 weeks, 4 weeks, 6 weeks and 8 weeks.

Data Analysis

To test normal/no distributed data using *the kolmogorov-smirnov* statistical test. Significant level ($\alpha=0.05$). If $\alpha > 0.05$, then H_0 is received, which is normally distributed data. If the data is normally distributed, the analysis test uses *a simple anova* test and *paired t-test* if the data is not normally distributed using *the wallis scale test*.

III. RESULT AND DISCUSSION**Table 1. Changes in Hemoglobin (Hb) Levels After 2 Weeks of Intervention**

No	Group	Pretest	Posttest 1		% Increased	P
		Mean	Mean	Different		
1	Fe+ guava juice	10,447	11,467	1,02	8,89	0,000
2	Fe & vitamin C	10,000	10,307	0,307	2,98	0,433
3	Fe	10,560	10,807	0,247	2,28	0,208

Table 1 shows an increase in average Hb levels after 2 weeks of intervention. the increase in average Hb levels was highest in the Fe+ group of guava juice, namely with an increase of 8.89%, then in the Fe+ vitamin C group the average increase was 2.98%, and the lowest in the Fe group with an average increase of about 2.28%. Based on *the paired t-test* of the Fe + guava juice tablet group ($p=0.000<0.05$), there were significant differences in Hb levels before and after the 2-week intervention, the Fe+ vitamin C tablet group ($p=0.433<0.05$) and the Fe tablet group ($p=0.208<0.05$) that is, the results are not significant, meaning that there are differences in Hb levels before and after 2 weeks of intervention

Table 2. Changes in Hemoglobin (Hb) Levels After 4 Weeks of Intervention

No	Group	Pretest	Posttest 2		% Increased	P
		Mean	Mean	Different		
1	Fe & Guava juice	10,447	11,587	1,14	9,84	0,000
2	Fe & Vitamin C	10,000	11,180	1,18	10,55	0,011
3	Fe	10,560	11,053	0,493	4,46	0,007

Table 2 shows an increase in average Hb levels after 4 weeks of intervention. The average increase in Hb levels was highest in the Fe + vitamin C group, namely with an increase of 10.55%, then in the Fe + guava juice group the average increase was 9.84%, and the lowest in the Fe group with an average increase of about 4.46%. *The paired t-test* showed that the Fe+ group of guava juice, Fe+Vitamin C, and Fe tablets obtained p values of 0.000, 0.011 and 0.007 ($p>0.05$), respectively, meaning that there were differences in Hb levels before the intervention and after the intervention in each group for 4 weeks.

Table 3. Changes in Hemoglobin (Hb) Levels After 6 Weeks of Intervention

No	Group	Pretest	Posttest 3		% Increased	P
		Mean	Mean	Different		
1	Fe & Guava juice	10,447	11,427	0,98	8,58	0,000
2	Fe & Vitamin C	10,000	11,153	1,153	10,34	0,012
3	Fe	10,560	10,913	0,353	3,23	0,222

Table 3 shows an increase in the average Hb levels after 6 weeks of intervention. The average increase in Hb levels was highest in the Fe+Vitamin C group, namely with an increase of 10.34%, then in the Fe+guava juice group the average increase was 8.58%, and the lowest in the Fe group with an average increase of about 3.23%. *The Uji paired t-test* showed that the Fe+ group of guava juice and Fe+Vitamin C, respectively obtained p values of 0.000 and 0.012 ($P<0.05$) meaning that there were differences in Hb levels before and after the 6-week intervention. Meanwhile, the Fe tablet group p value of 0.222 ($p>0.05$) means that there is no difference in Hb levels before and after the 6-week intervention.

Table 4. Changes in Hemoglobin (Hb) Levels After 8 Weeks of Intervention

No	Group	Pretest	Posttest 4		% Increased	P
		Mean	Mean	Different		
1	Fe+Guava juice	10,447	12,113	1,666	13,75	0,000
2	Fe+Vitamin C	10,000	11,553	1,553	13,44	0,001
3	Fe	10,560	11,407	0,847	7,42	0,008

Table 4 shows an increase in average Hb levels after 8 weeks of intervention. The average increase in Hb levels was highest in the Fe + guava juice group, namely with an increase of 13.75%, then in the Fe + Vitamin C group the average increase was 13.44%, and the lowest in the Fe group with an average increase of about 7.42%. *The paired t-test* of the Fe+ guava juice, Fe+Vitamin C, and Fe tablets obtained p values of 0.000; 0.001 and 0.008 ($P>0.05$) respectively, meaning that there were differences in Hb levels before and after the 8-week intervention in each group.

Table 5. Comparison of Average Hemoglobin (Hb) Levels Between Intervention Groups

Hb Level	Intervention group	Average	p
Pre	Fe + guava juice	10,447	0,265
	Fe + Vitamin C	10,000	
	Fe	10,560	

Post 1	Fe + guava juice	11,467	0,010
	Fe + Vitamin C	10,307	
	Fe	10,807	
Post 2	Fe + guava juice	11,587	0,316
	Fe + Vitamin C	11,180	
	Fe	11,053	
Post 3	Fe + guava juice	11,427	0,323
	Fe + Vitamin C	11,153	
	Fe	10,913	
Post 4	Fe + guava juice	12,113	0,203
	Fe + Vitamin C	11,553	
	Fe	11,407	

Table 5 shows the comparison of Hb levels of the Fe+ guava juice tablet group, the Fe + Vitamin C group, and the Fe group. Based on the *simple anova test*, the average Hb levels of the Fe + guava juice tablet group, the Fe + Vitamin C group, and the Fe group after the 2-week intervention ($p = 0.010 < 0.05$) were significant results meaning that there was a significant difference in Hb levels between the three groups. Meanwhile, after the intervention of 4 weeks, 6 weeks and 8 weeks, the average Hb levels of the Fe + guava juice tablet group, the Fe + Vitamin C group, and the Fe group ($p < 0.05$) were insignificant results, meaning that there were differences in Hb levels but were not meaningful between the three groups.

From the results of the study, it was found that the Fe tablet + guava juice group increased Hb levels faster than the Fe + Vitamin C group and Fe tablet group, after 2 weeks of intervention, an increase in Hb levels to the normal stage was obtained by 3 respondents while in the Fe + Vitamin C group group and the Fe group each did not get an increase in Hb levels until the normal stage. Giving iron supplementation combined with vitamin elements that can increase the *bioavailability* of iron is more effective in increasing hemoglobin levels, compared to only iron supplementation [11].

The results of the study in the Fe + guava juice tablet group showed an average increase in Hb levels after 2 weeks of intervention 1.02 gr / dL (8.89%), after 4 weeks of intervention 1.14 gr / dL (9.84%), after 6 weeks of intervention 0.98 gr / dL (8.58%) and after 8 weeks of intervention 1.7 gr / dL (13.75%). Based on Almatsier (2009), Vitamin C has a function in Fe metabolism, especially to accelerate the process of fe absorption in the intestine by keeping Fe reduced in ferrous form and the process of its transfer into the blood. Guava is a high source of vitamin C. In 100 grams of guava fruit contains several vitamins that help in the formation of Hb and help the absorption of iron in the formation of Hb namely vitamin A (4.00 RE), B₂ (0.04 mg) C (87 mg) And protein (0.90 grams) [12]. The mechanism of linkage between vitamin A and anemia occurs through several possibilities, namely the regulation of erythropoiesis, mobilization of iron from reserves to transferrin circulation, increasing the body's resistance from infections, and increasing the absorption of iron in the intestine, while vitamin B₂ deficiency (*Riboflavinin*) causes anemia due to impaired absorption and mobilization of iron [13]. This is in line with research conducted by Yusnaini (2014), in pregnant women who get Fe supplementation that there is an increase in levels after consuming guava with an increase in Hb levels on average 1.6 gr / dl.

The results of the study in the Fe + Vitamin C tablet group showed an average increase in Hb levels after 2 weeks of intervention 0.3 gr / dL (2.98%), after 4 weeks of intervention 1.18 gr / dL (10.55%), after 6 weeks of intervention 1.15 gr / dL (10.34%) and after 8 weeks of intervention 1.5 gr/dL (13.44%). Vitamin C plays a role in iron absorption by reducing ferries to ferrous in the small intestine so that it is easily absorbed. Vitamin C also improves the absorption of iron from plant-based (non-heme) foods. Consumption of 25-75 mg of vitamin C can increase the absorption of four times that of non-heme iron [13]. This Hal is in line with the study conducted by Almasyuri, the administration of iron capsules (60 mg) added with vitamin C (100 mg) will increase the average absorption of iron by about 10% [14]. The research of Jessica *et. al* shows that there is an effect of Fe tablet supplementation and Vitamin C on the Hb levels of young women with a value of $p = 0.001$ ($p < 0.05$) [15].

The results of the study in the Fe tablet group showed an average increase in Hb levels after 2 weeks of intervention 0.2 gr / dL (2.28%), after 4 weeks of intervention 0.5 gr / dL (4.46%), after 6 weeks of intervention 0.3 gr / dL (3.23%) and after 8 weeks of intervention 0.8 gr/dL (7.42%). The importance of giving this iron to someone who is affected by iron deficiency anemia and there is no absorption disorder, so in 7-10 days the level of Hb increase can occur by consuming blood-added tablets of 1.4 mg / day [16]. The results of statistical tests with the Anova test found that the difference in average Hb levels between the three intervention groups showed significant results in the first posttest or intervention after 2 weeks with a p value = 0.010. And in the second posttest to the fourth posttest although there was an increase in Hb levels in each group, but between the three groups did not show a significant difference in average Hb levels (p 0.316; 0.323; 0.203). it was discovered in postest 1 or after 2 weeks of intervention that there was a difference in average Hb levels between the supplementation group of Fe+ guava juice tablets and the supplementation of Fe+ vitamin C tablets with an average difference value of 1.160 and a value of $p=0.003$ ($p < 0.05$). This is because guava juice not only has a high content of vitamin C but also has a content of vitamins and other nutrients such as energy (49.00 Cal), protein (0.90 grams), fat (0.30 grams), Carbohydrates (12.20 grams), Calcium (14.00 grams), Phosphorus (28.00 grams), fiber (5.60 grams), iron (1.10 mg), vitamin A (4.00 RE), vitamin B₁ (0.05 mg), vitamin B₂ (0.04 mg), vitamin C 87.00 mg, and vitamin B₃ (1.10 grams). This caused an increase in hemoglobin levels in the Fe tablet supplementation + guava juice group higher than the Fe + vitamin C tablet supplementation group and Fe tablet supplementation group.

IV. CONCLUSIONS

There was an effect of supplementation in all three groups on increased Hb levels in young women. However, the Fe tablet and guava juice group had a higher increase in Hb levels and increased Hb levels faster than other groups. It is necessary to take Fe tablets taken with guava juice in adolescents with anemia to accelerate the increase in hemoglobin levels to a normal stage.

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