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The Effect of Vitamin C Consumption on Increasing Hemoglobin and Ferrithin Levels of Pregnant Anemia Who Receive Blood Supplements

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ABSTRACT

Anemia in pregnancy is a problem that frequently occurs in pregnant women. It is a national health problem that will affect human resources in the future. Supplements in the government program to overcome the problem of anemia are by giving blood-added tablets and should be combined with vitamin C. The objective of this study was to determine the effect of vitamin C consumption on increasing hemoglobin and ferritin levels in pregnant women with anemia who received blood supplement tablets. This is a quasi-experimental design that uses a pretest and posttest approach with a control group. The research was conducted at the Pauh Public Health Center and the Health Laboratory Center. Data collection was carried out on January 02 – March 03 on 34 pregnant women with TM III who had anemia who were divided into two groups. Ferritin levels were checked by using ECLIA method and hemoglobin levels by a hematology analyzer. Normality test was done by using Shapiro Wilk and continued with T-test T-Independent and Dependent Test. The results showed that the average hemoglobin level before vitamin C consumption in the intervention group was 10.32 g/dL and the control group was 10.15 g/dL. Ferritin levels before the intervention group was 13.23 g/mL and the control group was 13.06 g/mL. Hemoglobin level after intervention was 11.75 g/dL and control 11.36 g/dL. Ferritin levels after intervention were 57.37 g/mL and control 50.91 g/mL. The results of the statistical test showed no difference in the increase in hemoglobin levels with a p value of 0.194 and a ferritin level with a p value of = 0.367 between the intervention and control groups. The conclusion in this study is that there was no difference in the increase in hemoglobin and ferritin levels of anemic pregnant women after consuming vitamin C between the intervention and control groups.

1. Introduction

Hemoglobin level is one of the hematological parameters that changes during pregnancy (Cakmak et al., 2018). During pregnancy, plasma volume will increase by approximately 40-45% which begins progressively at 6-8 weeks of gestation and reaches a peak at 32-34 weeks. Simultaneously, kidney erythropoietin will also increase the number of red blood cells, which is of 20-30%. However, the increase in the number of red blood cells is not proportional to the increase in plasma volume, resulting in hemodilution and a decrease in hemoglobin levels (Prawirohardjo, 2013).

The decrease in hemoglobin levels occurs gradually from the first trimester, then reaches its minimum limit at the end of the second trimester and tends to increase in the third trimester (Cakmak et al., 2018). Hemoglobin levels in the first trimester ranged from 11.6-13.9 g/dl, in the second trimester ranged from 9.7-14.8 g/dl and in the third trimester ranged from 9.5-15.0 g/dl (Cunningham et al., 2018). One of the efforts that can be done to prevent anemia in pregnant women is by giving Fe tablets to pregnant women. Fe tablets are essential micro elements for the body that are indispensable in the formation of blood, namely in the formation of hemoglobin (Proverawati, 2013). In addition, to achieve health goals in reducing the incidence of anemia in pregnant women, it is recommended to take Vitamin C as a combination in giving Fe tablets. Vitamin C plays a role in helping accelerate the process of iron absorption. The role of vitamin C in the iron absorption process is to help reduce ferric iron (Fe^{3+}) to ferrous (Fe^{2+}) in the small intestine so that it is easy to absorb; the reduction process will be even greater when the pH in the stomach becomes more acidic. Vitamin C can increase acidity so that it can increase iron absorption by up to 30% (Mehta and Hoffbrand, 2006). The need for vitamin C of a pregnant woman is 85 mg per day (Cunningham, 2015). This study aimed to determine the effect of vitamin C consumption on the increase in hemoglobin and ferritin levels in pregnant women with anemia who receive blood supplement tablets.

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2. Method

This is a quantitative research with a quasi-experimental design that uses a pretest and posttest approach with a control group. The research was conducted at the Pauh Public Health Center and the Health Laboratory Center. Data collection was carried out on January 02 – March 03 on 34 pregnant women with TM III who had anemia who were divided into two groups, namely 17 intervention groups and 17 control groups. The treatment was given for 30 days. Normality test was done by using Shapiro Wilk and continued with paired T-test using T-Independent test and Dependent Test.

In this study, ferritin levels were checked by using ECLIA method and hemoglobin levels by a hematology analyzer. The research material was venous blood serum in TM III pregnant women who had anemia and the Human Ferritin ECLIA Kit reagent. The tools used are one pair of gloves, micropipette, serum cup, centrifuge, 3 ml syringe, tourniquet, 3 ml vacutainer.

Hemoglobin level examination was carried out by taking 3 ml median venous blood with a syringe. A portion of blood of 20 µl was used to check hemoglobin levels with a Hematology Analyzer and then read with an analyzer. The rest was put by the researcher into a centrifuge tube (vaccutainer) for ferritin examination. After all the serum was met, then the ferritin level was checked by using the human ferritin ECLIA Kit.

3. Results, Analysis and Discussion

The results showed that the average hemoglobin level before vitamin C consumption in the intervention group was 10.32 g/dL with a standard deviation of 0.501. Meanwhile, the average hemoglobin level before vitamin C consumption in the control group was 10.15 g/dL with a standard deviation of 0.407 and the ferritin level before vitamin C consumption in the intervention group was 13.23 g/mL with a standard deviation of 5.775. Meanwhile, the average ferritin level before vitamin C consumption in the control group was 13.06 g/mL with a standard deviation of 5.887. The average hemoglobin level after taking vitamin C in the intervention group was 11.75 g/dL with a standard deviation of 0.518. Meanwhile, the average hemoglobin level after taking vitamin C in the control group was 11.36 g/dL with a standard deviation of 0.551 and the average ferritin level after consuming vitamin C in the intervention group was 57.37 g/mL with a standard deviation of 25.500. Meanwhile, the average ferritin level after consuming vitamin C in the control group was 50.91 g/mL with a standard deviation of 23.945. The conclusion in this study is that there was no difference in hemoglobin levels and ferritin levels after consuming vitamin C in anemic pregnant women who received blood supplements in the intervention and control groups.

3.1 Table

Table 1

Effect of Vitamin C Consumption on the Increase of Hemoglobin Levels and Ferritin Levels of Pregnant Women Who Receive Blood Supplement Tablet

Group	Categort	n	Mean	Deviation Standard	P Value
Interventionhemoglobin level	Before	17	10,32	0,501	
	After	17	11,75	0,518	0,000
Control hemoglobin level	Before	17	10,15	0,407	
	After	17	11,36	0,551	0,000
Intervention ferritin level	Before	17	13,23	5,775	
	After	17	57,37	25,00	0,000
Control ferritin level	Before	17	13,06	5,887	
	After	17	50,91	23,945	0,000

Table 2

The Difference of the Increase of Hemoglobin Levels between Intervention and Control Group

Category	n	Mean (Difference)	Deviation Standard	P Value
Intervention	17	1,429	0,423	

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Control	17	1,205	0,550	0,194

Table3
The Difference of the Increase of Ferritin Levels between Intervention and Control Group

Category	N	Mean (Difference)	Deviation Standard	P Value
Intervention	17	44,13	20,821	
Control	17	37,85	19,191	0,162

3.2 Discussion

The results showed that there was no difference in the increase in hemoglobin levels in the intervention and control groups after consuming vitamin C in anemic pregnant women who received blood supplements and there was no difference in the increase in ferritin levels between the intervention and control groups after consuming vitamin C in anemic pregnant women who received blood supplements.

The research conducted by Siallagan et al. (2016) stated that vitamin C intake was correlated with the incidence of anemia. This happens because vitamin C is an essential element that is needed by the body for the formation of hemoglobin, especially in conditions where the body lacks iron intake. The presence of vitamin C in the food consumed will increase the acidity of the stomach so that it can facilitate the reaction of reducing ferric iron to ferrous which is more easily absorbed by the small intestine. In addition, the absorption of iron in the form of non-heme increases four times faster when vitamin C is available. In addition to increasing iron absorption, vitamin C also plays a role in inhibiting the formation of hemosiderin which is difficult to mobilize to liberate iron when needed. Furthermore, vitamin C plays a role in transferring iron from transferrin in plasma to ferritin (Siallagam, 2016).

Iron in food, especially non-heme iron in the form of ferric iron, that is absorbed in ferrous form requires vitamin C to reduce it. After being absorbed through the mucosal cells, apoferritin will bind to ferritin (Fe + apoferritin) and in serum, the bond will be released and ferrous iron will be transported in the form of transferrin (Fe bonds with proteins containing 3-4 mg Fe), then stored in liver, spleen and spinal cord. Some of the iron is used for hemoglobin synthesis (20-25 mg/day), the iron is 60-70% of the hemoglobin component (Hoffbrand & Moss, 2013).

Anemia can be caused by lack of nutrients, worm investment, and bleeding. Nutritional anemia is caused by lack of iron, folic acid, vitamin C, protein, vitamin B6, vitamin B12. Generally, in the community, iron deficiency is the most common nutritional anemia, so it is referred to as Iron Nutritional Anemia (AGB). However, iron deficiency is not the sole cause of iron nutritional anemia but is also influenced by absorption enhancers such as vitamin C and iron absorption inhibitory factors such as tannins, phytates, oxalate and calcium. However, if the absorption of iron is perfect, not only iron is needed to make hemoglobin, but also protein, especially the amino acids glycine and succinyl Co A to make protoporpirin and finally become heme after interacting with iron with the help of the ferrocelatase enzyme. While for the synthesis of globin, amino acids, biotin, folic acid, vitamin B6 and vitamin B12 are needed. The interaction between heme and globin will produce hemoglobin so that the presence of iron is needed in the synthesis of heme (Cunningham, 2013).

Factors inhibiting iron absorption include tannins, phytates, oxalates and calcium which will bind iron before it is absorbed by the intestinal mucosa into insoluble substances, thereby reducing its absorption. With reduced absorption of iron, due to these inhibitory factors, the amount of ferritin will also decrease which has an impact on decreasing the amount of iron that will be used for hemoglobin synthesis and replacing damaged hemoglobin. This is one of the factors that causes low levels of hemoglobin in the blood (Hoffbrand & Moss, 2013).

One of the factors that triggers iron blockers is calcium. Calcium phosphate will reduce the absorption of non-heme iron by 50% for non-semi-synthetic foods. Calcium salts will reduce iron absorption by 55% for breakfast foods containing low iron, high bioavailability and low calcium. The addition of 165 mg of calcium in the form of Calcium Chloride (CaCl2), milk, or cheese will reduce the absorption of non-heme iron by 50-60%, as well as will decrease the absorption of heme iron. The effect of inhibitors for calcium will be seen if consuming doses of more than 300 mg of calcium per day. About 30-50% of iron will be absorbed from dishes containing 1.4 mg of heme iron and 11.9 mg of non-heme iron if the lunch or dinner does not consume milk or cheese. Ten days later,

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only 0.4 mg of iron is absorbed per day after consuming a meal with milk or cheese, which contains 937 mg of calcium per day, at lunch and dinner (Harberg, 2011).

This is what the Swedes did. In contrast to calcium citrate and calcium carbonate, about 300 mg or 600 mg did not provide an iron-lowering effect on iron-sulfate supplementation containing 37 mg or 18 mg of iron if given without food. However, if given with food (such as hamburgers), the three calcium compounds will have an iron-blocking effect. Administration of 1000 mg calcium/day in the form of calcium carbonate in premenopausal women for 12 weeks with food does not have effect on serum ferritin levels in the short term. The impact of calcium on iron absorption will be seen if these calcium salts are used routinely in food preparation as happened in Mexico and Central and South American countries.

There was no significant difference in the present study because in the intervention group, there were respondents who consumed the intervention, namely the consumption of Fe and vitamin C tablets after eating so that the food consumed by the mother could affect the absorption of iron in the body even though they had received additional vitamin C to help boost the absorption of iron absorption in the body. In this study, the researchers could not clearly evaluate the food consumed by respondents at the time of the study. Even though the intervention group received additional vitamin C supplements that play a role in iron absorption, respondents also consumed the inhibiting factor of iron absorption which was also obtained from food consumed daily; one of which was consuming milk containing calcium where calcium phosphate will reduce absorption of iron by forming complex bonds (Riswanda, 2017).

In this study, there was no significant difference in hemoglobin and ferritin levels between the intervention group and the control group, also because after a survey was conducted at the time of the study, it was found that the control group respondents continued to consume vitamin C in their daily diet so that their intake of vitamin C met the nutritional adequacy according to the RDA of 85 mg. This can trigger an increase in hemoglobin levels that are comparable between the intervention and control groups. After conducting a dietary survey, it was found that one of the intakes of vitamin C in the control group was obtained from vegetable and food consumed. The presence of vitamin C intake obtained in the control group can affect the increase in hemoglobin levels that are comparable between the two groups.

4. Conclusion

a. There is an effect of vitamin C consumption on the increase in hemoglobin and ferritin levels of anemic pregnant women who receive blood supplement tablets.
b. There is no difference in hemoglobin levels after consuming vitamin C in anemic pregnant women who receive blood supplements in the intervention and control groups.
c. There is no difference in ferritin levels after consuming vitamin C in anemic pregnant women who receive blood supplements in the intervention and control groups.

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