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EFFECT OF FE-FORTIFIED TEMPE ON HEMATOLOGIC STATUS IN PREGNANT MOTHERS WITH ANEMIA

Anggraini Wulandhari*, Supriyana, Bahiyatun, Soeharyo Hadisaputro, Imam Djamaluddin Mashoedi

Magister Applied Midwifery, Poltekkes Kemenkes Semarang, Indonesia

*Correspondence:
Anggraini Wulandhari
Magister Applied Midwifery, Poltekkes Kemenkes Semarang, Indonesia
Jl. Tirto Agung, Pedalangan, Banyumanik, Kota Semarang, Jawa Tengah, Indonesia (50268)
E-mail: wulanwoewulan@gmail.com

ABSTRACT
Background: The prevalence of anemia among pregnant mothers is still high in Indonesia. Fe-fortified tempe is a traditional soy product originating from Indonesia considered able to increase hematologic status.
Objective: This study aims to determine the effect of Fe-fortified tempe on hemoglobin, hematocrit, and erythrocyte levels in pregnant women with anemia.
Methods: This was a true-experimental study with randomized pretest and posttest control group design, conducted on November - December 2016 in Bandarharjo Health Center, Semarang. Sixty eight respondents were selected using simple random sampling, with 34 respondents were randomly assigned to each group. Blood examination was performed in each respondent. Mean, percentage, and frequency distribution of respondents were described. Paired t Test and independent t test with $\alpha = 0.05$ were performed to analyze the data.
Result: Findings showed that hemoglobin, hematocrit, and erythrocyte levels before and after intervention in the treatment group showed p-value 0.000 (< 0.05), which means there was a significant effect of Fe-fortified on the increase of hemoglobin, hematocrit, and erythrocyte levels.
Conclusion: There was an increase in hemoglobin, hematocrit, and erythrocyte levels after given Fe-fortified tempe for 10 consecutive days. It is suggested that pregnant women can consume Fe-fortified tempe.

Key words: Fe-fortified tempe, hemoglobin, hematocrit, erythrocyte, anemia

INTRODUCTION

During pregnancy, anemia is defined as a hemoglobin concentration (Hb) <110 g/L (< 11 g/dL), affects more than 56 million women globally, two thirds of them being from Asia.[1] The prevalence of anemia in pregnant women in Indonesia is approximately 37.1%, while in Central Java Province is 57.7%; and 18.36% in Semarang. The Community Health Center of Bandarharjo reported 26.78% of the prevalence of anemia.

Iron deficiency is a leading cause of anemia in many parts of the world.[2] Iron is an essential element in the production of hemoglobin for the transport of oxygen to tissues and in the sythesis of enzymes that are required to use oxygen for the production of cellular energy.[3] Iron deficiency anemia detected in early pregnancy is associated with a lower energy and iron intake, resulting in an inadequate gestational weight gain over the whole pregnancy, and a greater than two-fold increase in the risk of preterm delivery.[1,4]

In Indonesia, the management of iron-deficiency anemia cases is pharmacologically performed by the administration of 90 Fe tablets during pregnancy to raise the level of hemoglobin 1 gr/dL per month.[5] The program has been well executed, as evidenced by the relatively high Fe coverage. However, the incidence of anemia is still high, which may be caused by the obedience of pregnant women in consuming the Fe tablets. Besides, Fe tablets can cause side effects such as discomfort in the pit of the stomach, nausea, vomiting, diarrhea, colic, dizziness, and constipation, but not harmful.[6] In other words, side effects actually make them feel uncomfortable. Therefore, alternative treatment might be needed.

The aim of the study was to provide alternative food, namely Fe-fortified tempe, to increase maternal hematologic status in pregnancy. Fe-fortified tempe is a traditional soy product originating from Indonesia that made by a natural culturing and controlled *Rhizopus* sp. fermentation of soybean into a cake form, and added by Fe micronutrients. Tempe is very popular food in Indonesia. However, limited studies have been found in the literatures to see the effect of Fe-fortified tempe for anemia.

Sudargo revealed that tempe fortification can significantly increase hemoglobin levels in Wistar rats.[7] The higher the amount of fortified tempe given, the greater the hemoglobin level in the blood of the Wistar rat. Followed by Salmiah who modified tempe fortification into a form of cake and proved to increase hemoglobin levels in children with iron deficiency anemia.[8]

METHODS

Design

A true experiment with randomized pretest and posttest control group design.

Setting

The study was conducted on November - December 2016 in Bandarharjo Health Center, Semarang.

Research Subjects

Sixty eight respondents were selected using simple random sampling, which 34 respondents were randomly assigned to each group. Pregnant mothers in trimester III were included to be respondents in this study. The exclusion criteria were: a) pregnant women with complications such as pre-eclampsi / eclampsi, placenta previa, solutio placenta, and others, b) pregnant women who had hemoglobin formation disorders (e.g thalesemic, hereditary hemolytic, and sickle cell anemia), c) pregnant women aged <20 years and > 35 years old, d) pregnancy spaced <2 years, e) parity > 5, and f) mid-upper arm circumference <23.5 cm.

Intervention

Blood tests were performed before the intervention (pretest), then the respondents were given the Fe-fortified tempe in the treatment group, and the Fe

tablet in the control group for 10 consecutive days. After that a second blood test was performed again after the treatment (posttest). Fe-fortified tempe in this study was given in the form of Sari tempe, which had been steamed, blended until smooth, and filtered to obtain the filtrate, then heated again to improve the taste. Sari tempe was given as much as 200 ml per day for 10 consecutive days, with the reason that the basic process of hemoglobin synthesis takes about 7-10 days until it becomes mature and ready to be circulated to the whole body with red blood cells. Provision of sari tempe was done by researchers and assisted by 5 enumerators.

Instrument

Blood examination was performed in Clinical Pathology Laboratory of Muhammadiyah University of Semarang using BC-2600 Auto Hematology Analyzer to measure the levels of hemoglobin, Hematocrit, and erythrocytes.

Ethical consideration

Ethical consideration was obtained from the Ethics Committee of Poltekkes Kemenkes Semarang with number 269 / KEPK / Poltekkes-SMG / EC / 2016. Researchers confirmed that all respondents have obtained an appropriate informed consent.

Data analysis

Mean, percentage, and frequency distribution of respondents were described. Paired t-test and independent t-test with $\alpha = 0.05$ were performed to analyze the data.

RESULTS

Table 1 shows the frequency distribution of respondents based on maternal age, parity, gestational age, education level, employment status, and nutritional status. The result of equality test shows that all variables had p-value > 0.05, which means that all variables did not influence the relationship between treatment to the levels of hemoglobin, hematocrit, and erythrocytes in the respondents, both in the treatment and control group.

Table 1. Frequency distribution of the characteristics of respondents

Respondents Characteristics	Group		P-value
	Treatment	Control	
Maternal Age (year)			
Mean ± SD	27.88±4.611	26.82±4.635	0.856
Parity			
Primipara	26.5%	41.2%	0.305
Multipara	73.5%	58.8%	
Gestational age (week)			
Mean ± SD	32.76±2.686	32.56±2,596	0.988
Educational level			
High	17.6%	11.8%	0.418
Middle	26.5%	41.2%	
Low	73.5%	47.1%	
Employment Status			
Employed	26.5%	35.3%	0.600
Unemployed	73.5%	64.7%	
Nutritional status			
According to diet	58.8%	67.6%	0.615
Not according to diet	41.2%	32.4%	

Table 2. Levels of hemoglobin, hematocrit, and erythrocytes in pregnant women with anemia before and after intervention in the treatment and control group

Variable	Mean±SD	Group		p-value
		Treatment (n=34)	Control (n=34)	
Hemoglobin (g/dL)	*Pretest*	10.21±0.52	10.36±0.40	0.184 [b]
	Posttest	10.73±0.49	10.84±0.46	0.402 [b]
	Mean difference	0.52±0.33	0.47±0.28	
	p value	0.000[a]	0.000 [a]	
Hematocrit (%)	*Pretest*	31.08±1.93	30.52±1.52	0.191 [b]
	Posttest	32.97±1.72	32.30±1.60	0.102 [b]
	Mean difference	1.89±0.83	1.78±0.88	
	p value	0.000[a]	0.000 [a]	
Erythrocytes **(x 10^6/uL)**	*Pretest*	3.84±0.32	3.83±0.31	0.942 [b]
	Posttest	4.13±0.35	4.04±0.32	0.258 [b]
	Mean difference	0.29±0.09	0.20±0.06	
	p value	0.000[a]	0.000 [a]	

[a]*Paired t test,* [b]*Independent t-test*

Based on the result of paired t-test, hemoglobin, hematocrit, and erythrocyte levels before and after intervention in the treatment and control group showed p-value 0.000 (< 0.05), which means there was a significant effect of Fe-fortified on the increase of hemoglobin, hematocrit, and erythrocyte levels. However, Independent t-test showed p-value >0.05, which indicated that there was no difference of hemoglobin, hematocrit, and erythrocyte count between the treatment and control group after given intervention.

DISCUSSION

Measuring hemoglobin and hematocrit is common during pregnancy.[9] Hemoglobin (Hb) is the protein contained in red blood cells or erythrocytes that is responsible for delivery of oxygen to the tissues.[10] To ensure adequate tissue oxygenation, a sufficient hemoglobin level must be maintained. When the hemoglobin level is low, the patient has anemia.[10] Pregnant women with hemoglobin levels less than 11.0 g/dl in the first and third trimesters and less than 10.5 g/dl in the second trimester are considered anemic.[11] While normal values of hematocrit have been determined from 28 to 48 percent for pregnant women in the third semester.[12]

The results of this study revealed that there was a significant increase in hemoglobin (0.52 gr/dL), hematocrit (1.89%), and erythrocytes (0.29x 10^6/uL) after given Fe-fortified tempe for 10 consecutive days. The results of this study was in line with earlier findings of Salmiah who modified tempe fortification into a form of cake and proved to increase hemoglobin levels in children with iron deficiency anemia.[8] Similar with the study of Martorell, et al[13] who suggested that iron fortified foods may decrease the prevalence of anemia and increase hemoglobin levels in women and children.

Iron in Fe-fortified tempe is an essential micro mineral in the formation of hemoglobin level. Hemoglobin is composed of four polypeptide chains of globins that each of which contains heme molecules.[14] There are various proteins with important roles in cellular physiology that require iron to operate their functions.[14]

However, although there was no difference between the effect of Fe-fortified tempe and Iron supplement tablet, the result of this study indicated that tempe alone could improve the levels of hemoglobin, hematocrit, and erythrocytes.

Fe-fortified tempe remains comparable with iron supplementation although it almost universally recommended during pregnancy to prevent iron deficiency.[15,16] However, the absorption depends on the form of iron ingested and the composition of the diet (tea nad phytates inhibit absorption).[17] Heme iron is more efficiently absorbed than nonheme iron, but it is available only from animal foods that generally are relatively expensive and therefore less likely to be consumed by poor women in developing countries,[15] including Indonesia. Thus, The findings of this study provide an alternative treatment for those who do not tolerate with oral iron suplement tablet.

CONCLUSION

There was an increase in hemoglobin, hematocrit, and erythrocyte levels after given Fe-fortified tempe for 10 consecutive days. It is suggested that pregnant women can consume Fe-fortified tempe.

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