Original Article

The Effectiveness of Spirulina Compared with Iron Supplement on Anemia among Pregnant Women in Indonesia

Dini Marlina
Midwifery Program, Sekolah Tinggi IlmuKesehatan Jenderal Achmad Yani, Cimahi, West Java, Indonesia

Fitri Nurhayati
Midwifery Program, Sekolah Tinggi IlmuKesehatan Jenderal Achmad Yani, Cimahi, West Java, Indonesia

Correspondence: Fitri Nurhayati, Faculty of Midwifery, Sekolah Tinggi Ilmu Kesehatan Jenderal Achmad Yani, Jalan Terusan Jenderal Sudirman, Cimahi, West Java Indonesia Email: fitribidan2019@gmail.com

Abstract

Anemia is a common problem in women during pregnancy and has a significant impact on pregnancy outcomes. This study aimed to determine the effect of spirulina could increase hemoglobin (Hb) level compared usual supplement in pregnant women. A queasy experiment with the pre-post-test design was conducted for eight weeks to 30 women in the intervention group (spirulina) and 30 women in conventional iron supplement at the maternity clinic in Bandung, West Java, Indonesia from January to April 2019. Women with a gestational age more than 20 weeks and Hb concentration range 8 to 11 gr/dl were included in this study. Of 60 pregnant women included in this study. A student t test and chi square were used to evaluate the results with significant level was set up as 5% using SPSS version 22 for windows. The mean of Hb before the intervention was 10.16 and increased significantly 13.35 after took spirulina for eight weeks (p=0.001). In contrast, pregnant women who took iron supplement did not show significant improvement in the Hb concentration (p=0.142). Spirulina may ameliorate anemia among women in the second trimester of pregnancy. Future studies with rigor design and larger sample size are needed to provide more robust results.

Keywords: Anemia, iron, pregnancy, spirulina, supplement

Introduction

Anemia during pregnancy is a common problem with serious impact on maternal and child health (Bencaiova G, 2012). Previous evidence reported that anemia during pregnancy has a significant effect on prematurity, low birth weight, and adverse pregnancy outcomes (Tunkyi, 2017). The prevalence of anemia during pregnancy was very high, about 80% in developing countries, and 40% in Indonesia (Bora, 2014; Hadi, 2012).The prevalence of anemia increased from 20% in the first trimester to 70% in second to the third trimester of pregnancy (Cunningham, 2001). Anemia defined as hemoglobin (Hb) concentration less than 110 g/L in the first trimester and less than 105 g/L in the second and third trimesters (Pavord S, 2012). Decline in the Hb concentration during pregnancy seen as a regular physiological change. In the first trimester of pregnancy, an iron supplement is less needed due to no menstruation and fetal growth still slow. In the second to third trimester, the volume of blood in a woman will increase to 35% to 50%; this is equivalent to 450 mg of iron to produce red blood cells (Blackburn S, 2013; Cunningham, 2001).

An iron supplement is recommended for consumption during pregnancy. Indonesia government provided a free iron supplement containing 60 mg iron and 0.25 mg folic acid (Indonesian Ministry of Health, 2010). Previous studies conducted in Indonesia reported took an iron supplement for eight weeks during pregnancy was significantly increased Hb concentration (Widarsa, 2012; Wirawan, 2015). However, oral consumption of iron supplement reported having several adverse effects such as epigastric pain, nausea, vomiting, and diarrhea, or even constipation (Almatsler, 2009). These side effect could be a burden to iron supplement consumption adherence. Spirulina is commonly used as a dietary supplement containing high iron concentration of about 28.5 to 100 mg (Astawan, 2008). Moreover,

spirulina also contains 60-70% of protein, 15-25% carbohydrate, 6-8% lipid, 7-13% mineral, 8-10% fiber, and 3% of water (Kabinawa, 2006). Spirulina contains mucopolysaccharides and does not have cellulose on the cell wall. Thus, its absorption can reach 85% to 95% better than powdered milk that contains lactic acid (Astawan, 2008). Therefore, consumption of 100-gram spirulina can fulfill 158% of the iron requirement for every day. However, evidence of the effectiveness of spirulina on anemia during pregnancy is limited. The aimed of this study was to evaluate the efficacy of spirulina compared with an iron supplement on anemia among pregnant women in Indonesia.

Materials and Methods

Study design: A queasy experimental design with pre-posttest was used to evaluate the effectiveness of spirulina compared to iron supplement on anemia — each participant assigned to the intervention group (spirulina) and the control group (iron supplement). This study was conducted at the maternity clinic in Bandung, West Java, Indonesia from January to April 2019. In the intervention group, each participant was given 56 capsules contain 300 mg of spirulina, once a day for eight weeks. Participants in the control groups provided with 56 tables contain 60 mg of iron, once a day for eight weeks. Spirulina used in the intervention group has been approved by the Food and Drug Supervisory Agency (BPOM, No. Reg. TR 123 366 601) and has a Halal license from the Indonesian Muslim Council (MUI, No. 00130056471010).An ethical permission has obtained from the ethical committee at STIKes Ahmad YaniCimahi, Indonesia (102/KEPK/STIKES/AHMAD/YANI/III/2018).

Participants:

Participant in this study was recruited from the maternity clinic in Bandung, West Java, Indonesia. The inclusion criteria were pregnant women in the second trimester, gestational age more than 20 weeks, hemoglobin (Hb) concentration ranges 8 to 11 gr%. Pregnant women diagnosed with the infection, hemorrhoid, or other disease caused bleeding were excluded from this study. A total of 60 pregnant women with anemia have joined this study, 30 participants in the intervention group and 30 participants in the control group. The sample size was calculated using G-Power Software Version 3.1.6 using the F test with the assumption $\alpha = 0.05$, effect size= 0.30), power level=0.80, 2 numbers of groups. The estimation for minimum sample will be resulted is 45 and assuming attrition rate of 30 %, so the total minimal sample recruited was 60. A written inform consent was obtained prior data collection and participant have free to withdraw from this study anytime with any reason.

Measures: The study of women's demographic information will be collected on enrolment: this information including maternal age, level of education, insurance coverage, employment, and gestational age. Hb concertation was measured directly before and after intervention in 8 weeks using portable Hb analysis, low-cost hemoglobin meters that are user-friendly and reliable can be a great aid to change the global anemia scenario. Blood collected was immediately processed to estimate the hemoglobin concentration using HemoCue®,
which needs only a small sample of capillary / veno us blood, blood collected were immedialyanalyzed to estimate hemoglobin concentration.HemoCue ® is made up of disposable microcuvettes containing dry form reagent and a single-use photometer built.

Data analysis: Descriptive and inferential analysis statistic was used to explain demographic data and significant variables. Differences in characteristics between intervention and control groups will be tested using independent t-tests and Chi-Square tests. The difference of outcome between two groups after the intervention, we will use an independent t-test. A significance level of 5% used for between-group comparisons. Data were analyzed using SPSS version 22 for windows.

Results

The mean age of the two groups was 23.45(SD=2.76) and 24.01 (SD=1.347), respectively. Around 30% of the subjects were graduated from junior and senior high school, and more than half of the respondent was unemployed with over 66% covered by the national health insurance. The mean of gestational age between the two groups was 21.15 (SD=1.65) and 21.34 (SD=10.7). There were no significant differences between intervention and control group in term of a demographic characteristic (Table 1).

Among respondent in the intervention group, the mean of Hb before the intervention was 10.16 and increased significantly 13.60 after took spirulina for eight weeks (p=0.001).In contrast, pregnant women who took iron supplement did not show significant improvement in the Hb concentration (p=0.142) (Table 2).

Table 1. Demographic characteristics of pregnant women in Bandung, West Java (N=60)

Variables	Intervention (n=30)		Control (n=30)		*p* value
	n	%	n	%	
Maternal age (year) (Mean±SD)	23.45±2.76		24.01±1.34		0.127
Education:					
Not finished	1	3.3	2	6.7	0.851
Elementary school	6	20.0	7	23.3	
Junior high school	10	33.4	9	30.0	
Senior high school	12	40.0	10	33.4	
Diploma III/Bachelor	1	3.3	2	6.7	
Employment:					
Unemployment	20	66.7	18	60.0	0.278
Employment	10	33.3	12	40.0	
Health coverage :					
National health insurance	22	73.3	20	66.7	0.856
Non-insurance	8	26.7	10	33.3	
Gestational age (week) (Mean±SD)	21.15±1.65		21.34±1.07		0.111

Table 2. The Effectiveness of spirulina compared with an iron supplement on Hb concertation in pregnancy women (n=60)

	Before		After		Mean different	*p*-value
	Mean	SD	Mean	SD		
Hb Concentration						
Intervention	10.16	2.12	13.60	1.79	3	0.001
Control	10.03	2.35	10.30	1.34	0.27	0.142

Discussion

The data obtained from our study suggested that the average of Hb was low in 21 weeks of pregnancy before intervention between the two groups. Based on Riskesdas 2018, in Indonesia, the prevalent of anaemia inpregnant women was 37.1% (Ministry of Health, 2018). The Centers for Disease Control and Prevention (1998) defined that hemoglobin and hematocrit levels are below the fifth percentile of a normal reference population to describe anemia. These are 11% and 33% in the first quarter, 10.5% and 32% in the second quarter, and 11% and 33% in the third quarter.Anemia during pregnancy is responsible for prematurity birth, low birth weight, and adverse pregnancy outcomes (Tunkyi, 2017). The mother's negative health effects include fatigue, poor working ability, decreased immune function, increased risk of heart disease, and mortality (WHO, 2001; CDC, 1998; Mbule, 2013). During pregnancy, plasma volume increases approximately about 50% that followed by an increase in the demands of iron to produce red blood cell (Cunningham dan Garry , 2001; Blackburn, 2013). Although anemia is common during pregnancy, many women may not be aware or recognize it due to clinical signs and symptoms of anemia are not specific (Indonesian Ministry of Health, 2015). Accurate identification of anemia and its management are essential to improve the pregnancy outcomes. Our study suggested that spirulina could prove beneficial to increased Hb concentration and reducing the risk of anemia during pregnancy. Previous studies reported that consuming spirulina

for six weeks had a significant effect of lowering anemia by rising 60% of Hb concentration (Dewi, 2014; Selmi, 2010). Spirulina, a blue green algae, has a variety of nutrients including protein, fat, carbohydrates, vitamins and minerals. It was deemed by the 1974 United Nations World Food Conference as ' the best food for tomorrow (Sengupta, 2004). In West Bengal, the role of spirulina supplementation in vitamin A deficiency was studied and a definite role in improving vitamin A deficiency was found(Sengupta, 2004). In addition, spirulina contains high iron, about 28.5 mg /100 gr, of which 58 times more than in spinach, and 18 times higher than that found in meat (Astawan, 2008). Consumption of 100 gr of spirulina can fulfill 158% of iron needed in a day (Astawan, 2008). From this study, it is evident that in cases of pregnancy anaemia, when Spirulina is added with traditional iron supplementation, it can give more striking improvements. However, our study did not identify other potential confounding such as additional food contains iron consumed during this study. Therefore, future studies using a rigor design are needed to explore the mechanism of spirulina counteract anemia. In this study, the iron supplement no significantly improved the Hb level. In the current national program, every pregnant woman provides a 90 iron tablet during pregnancy contained FeSO4 320 mg (iron 60 mg) and folic acid 0.25 mg to prevent anemia during pregnancy(Indonesian Ministry of Health, 2015). The previous study found that 35.28% of pregnant women suffered from anemia (Hb <11 g%) and after took iron tablets for eight weeks, the prevalence of anemia reduced about 26.05% became 9.23% (Fatimah &Hadju, 2015). Another study found a significant difference in hemoglobin levels before and after administration of Fe tablets with an increase in hemoglobin level of 0.91 gr%, and the number of anemia decreased (Linda, 2007). The possible reason for non-significant in the current study might due to a small sample size that could be less sensitive to detect a significant level.

An essential limitation of this study was no randomly assignment or randomization of the sample; therefore, the selection bias is not taken into account. This study may also cannot be generalize to all pregnant women due to the eating behaviour may varies and other factors that could affect anaemia are not considered in this study. However, this study probably the first in Indonesia to evaluate the effectiveness of Spirulina on anaemia among pregnant women.

Conclusion: In conclusion, we note that Spirulina may be useful to reduce anemia during pregnancy. While our study has limitation including poorly feasible considering the small number of subjects and the number of potential confounding factors such as food recalls during the study, this study can be used as a pilot study. Future studies with rigor design, more extensive clinical studies and long term follow up is needed to evaluate the true effect of spirulina on anaemia among pregnant women. Prospective study is warranted to evaluate if Spirulina is added with the current iron-folic acid supplement, it may provide more significant improvements in nutritional anemia during pregnancy.

Acknowledgement: This study was funded by Ministry of Research, Technology & Higher Education Republic of Indonesia.

References

Almatsler, Soenita (2009). Basic Principles of Nutrition. Jakarta: PT. GramediaPustaka.

Astawan, M (2008). The Benefits of Colorful Color Foods. Jakarta: PT. GramediaPustaka.

Bencaiova G, Burkhardt T, Breymann C (2012). Anemia: prevalence and risk factors in pregnancy. Eur J Intern Med. 23:529–533.

Black R. E., Victora C. G., Walker S. P. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet, 382(9890): 427–451, 2013.

Blackburn S. Chapter 8: Hematologic and hemostatic systems in maternal, fetal, & neonatal physiology 4th ed. London, United Kingdom: Elsevier: 216–246; 2013.

Bora R, Sable C, Wolfson J, Boro K. & Rao R. (2014). Prevalence of anemia in pregnant women and its effect on neonatal outcomes in Northeast India. The Journal of Maternal-Fetal& Neonatal Medicine. 27:887–891

Cunningham dan Garry F (2001). Obstetrics Edisi 21 Vol 2. Jakarta: EGC.

Centers for Disease Control and Prevention. (1998). Recommendations to prevent and control iron deficiency in the United States. MMWR Recomm Rep, 47(RR-3):1–29.

Dewi, RS (2014). Spirulina Platenis Prevents Decrease in Peripheral Blood Components in Mice (Rattus Norvegius) Cyclophospamide. Denpasar: Program PascasarjanaIlmuBiomedikUniversitasUdayana.

Fatimah &Hadju (2015). Consumption Pattern and Hemoglobin Levels in Pregnant Women in Maros Regency, South Sulawesi. Makara Kesehatan, 15(1): 31-36 3

Hadi (2012). The content of DHA, EPA and AA in Microalgae from Spirulina, BotryococcusBraunii, ChrorellaAures and PorphyridiumCruetum Cultured Heterotrophically. Universitas Indonesia.

Indonesian Ministry of Health (2015). Safe Motherhood Project: A Partnership and Family

Approach). Jakarta: DirektoratJenderal Bina Kesehatan Masyarakat Depkes.

Irianto, K (2014). Balanced Nutrition in Reproductive Health. Bandung: PenerbitAlfabeta

Linda J Harvey, Jack R Dainty, Wendy J Hollands (2007). Effect of high-dose iron supplements on fractional zinc absorption and status in pregnant women. American Journal of Clinical Nutrition, 85 (1):131-136.

Kabinawa (2006). Spirulina: A variety of Disease-fighting Algae. Jakarta: PT. AgromediaPustaka.

Mbule M. A., Byaruhanga Y. B., Kabahenda M., and Lubowa A.. (2013). Determinants of anaemia among pregnant women in rural Uganda. Rural and Remote Health, 13(2): 2259, 2013.

Pavord S, Myers B, Robinson S (2012). UK guidelines on the management of iron deficiency in pregnancy. British Journal of Haematology, 156:588–600.

Sengupta P, Roy A, Manna P, Roy A, Dutta S, Biswas C. (2004). The effect of Spirulina on Vitamin A deficiency. J VIMS, 27:38–40.

Stevens G. A., Finucane M. M., De-Regil L. M. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data," The Lancet Global Health, 1(1):E16–E25.

World Health Organization (2001). Iron deficiency anaemia: assessment, prevention and control: a guide for programme managers.