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ORIGINAL ARTICLE

The effect of giving combination boiled chicken egg and red dragon fruit (*Hylocereus polyrhizus*) to increase hemoglobin levels in women during menstruation

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ABSTRACT

Background: Menstruation women are susceptible to anemia, due to loss of blood during this period. One alternative to prevent the occurrence of iron deficiency anemia is to consume food that contains iron and vitamin C such as egg chicken and red dragón fruit. **Aims:** To investigate the effect of the combined consumption of boiled chicken egg and dragon fruits to increase hemoglobin levels in women during their menstruation. **Subjects and Methods:** Thirty-two women (18 – 22 years) were randomized into two groups: 16 received boiled chicken eggs, 36 g/day, red dragón fruits, 365 g/day, and 16 were considered as controls. Hemoglobin level data were obtained at baseline (T0), 3 days (T1), and 5 days (T2) after the start of the treatment. **Results:** Results report a change in hemoglobin levels in the intervention group compared to the control. An increase ($p < 0.05$) in level hemoglobin was recorded at T2. Meanwhile a decrease in hemoglobin levels in the control ($p < 0.05$) who does not have any treatment. **Conclusions:** The intervention of boiled chicken eggs and red dragons fruit increase hemoglobin levels in women and may lead to decreased iron deficiency anemia during menstruation.

Keywords: chicken egg, red dragon fruit, iron, vitamin C, menstruation, hemoglobin level.

ARTICLE INFORMATION

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1 Introduction

Menstruation is a natural process of women during their productive age. It is cyclical bleeding, caused by endometrial shedding at regular intervals when ovum fertilization does not take place [1]. The normal cycle of menstruation is considered to occur every 24 to 38 days, with bleeding that last 4 to 8 days. In that period women will lose 5 to 80 mL of blood per cycle and the average amount of menstrual blood is 30 mL [2,3].

In 2019, the World Health Organization (WHO) estimated 29.9 % women aged 15 – 49 years suffered from anemia [4]. Factor associated with anemia have been reported as regular blood loss (due to menstrual bleeding) depletion of iron stores and therefore [5]. The most common type of anemia is nutritional anemia that mainly due to iron deficiency [6]. Menstruation is the major cause of anemia and iron deficiency [7]. Menstrual iron losses average about 0.5 mg/day. When this is added to basal losses of 0.8 mg/day, total iron losses are 1.3 mg/day. The reason why excessive menstrual bleeding, exceeding 80 mL/cycle is considered irregular and can lead to a risk of developing iron deficiency and to anemia [8 - 10].

Anemia has a significant negative impact on women of reproductive age, including decreased productivity due to decreased work capacity, cognitive impairment, higher susceptibility to infections due to its impact on immunity, stillbirth/miscarriage and maternal mortality [11, 12].

To prevent the risk of anemia, adequate intake of iron should be encouraged [13]. Food consumption is the principal determinant for adequate intake of iron. Dietary iron can be found in two forms; heme iron (HI and non-heme iron (NHI) where heme iron is efficiently absorbed from the intestine. [13, 14]. Heme iron is from animal products such as meat, poultry, and fish, whereas nonheme iron is obtained from cereals, pulses, legumes, fruits, and vegetables [15, 16].

A few intervention studies have been performed, eggs show tremendous potetial for improving maternal and child nutrition. [17] Kobayashi et al. [18] found out that egg white protein was useful for recovery from iron deficiency anemia, and one of the efficacious components was ovalbumin. Eggs contain both heme and nonheme iron same as the meat [19]. Heme iron can contribute 40 % or more to the total iron absorbed by the body, meanwhile, nonheme iron is less efficiently absorbed [14].

To absorb significant quantities of nonheme iron, it is imperative to combine iron with vitamin C. Research showed that iron absorption increased in a dose-response manner when vitamin C was ingested with a meal [20]. To maximize non-iron absorption, Schlueter and Johnston recommended a dose of 50 mg of vitamin C per meal. Natural or synthetic sources of ascorbic acid both can perform this function [21].

Dragon fruits are fruits that contain essential nutrients, including precursors required for erythropoiesis, such as iron (Fe), vitamins C, E, B12, thiamine, and riboflavin [22]. A study conducted by Rahmawati et al. [23] showed that the high content of vitamin C in the dragon fruit is responsible for its anti-anemia activity, as it facilitates the absorption of iron required in the production of blood and non-heme iron. We hypothesize that the intervention group should have better hemoglobin levels than the control group. The purpose of the study was to investigate the effect of the combined consumption of boiled chicken egg and dragon fruits to increase hemoglobin levels in women during their menstruation.

2 Subjects and Methods

2.1 Study design

This study was a quasi-experimental investigation with non-equivalent control group design on 32 respondents from October 2021 to February 2022 in Samarinda, East Kalimantan Province, Indonesia. The determination of respondents was performed using the purposive sampling method. Respondents were enrolled from an online announcement for those who meet the inclusion criteria and are willing to participate by filling out the online form. The respondents who meet the criteria were divided into intervention and control groups.

All the steps of the study were explained to the respondents and a consent was obtained and signed. The experimental protocol was approved by the Health Research Ethics Committee of the Faculty of Pharmacy, Mulawarman University according to seven WHO 2011 (No. 95/KEPK-FFUNMUL/EC/EXE/12/2021).

2.2 Population and subjects

Recruited participants with inclusion criteria were 20 – 30-year-old who work as private employer and students; not consuming iron supplements; anemia showed by hemoglobin levels <12 g/dL; and not a vegan. Forty (40) respondents agreed to participate to the study. Eight women were excluded for various reasons, such as less than 4 days of follow up and not completing the questionnaire. Finally, a total of thirty-two respondents were included (Figure 1). Participating women signed consent forms prior data collection.

Respondents were divided into two main groups (the control and the intervention groups) and were randomly assigned using the random number function (RAND) in Microsoft Excel. The nutritional content per 100 grams of boiled chicken eggs and dragon fruits are displayed in Table 1. Respondents in the intervention group (n=16), received boiled chicken eggs ± 36 g per day (Fe: ± 1.72 mg, protein: ± 3.15 g) and red dragon fruits 365 g per day (Fe: ± 2.00 mg, protein: ± 4.01 g) for 4 days during their menstruation period. While the control group (n=16) consisted of respondents who did not receive any treatment.

2.3 Data collection

Respondents who participated to the study protocol were screened when menstruation occurred every month. During the menstruation period of the intervention group, the investigator distributed the red dragon fruit (365 g per day) and boiled chicken eggs (± 36 g per day) at a distance of 15 minutes in dinner for 5 consecutive days. The level of compliance with boiled chicken eggs and dragon fruit consumption in the intervention group was observed by the research team through home visits, which were performed during five days. The purpose of home visits was to distribute the treatment and ensure the respondent consumed it entirely, to assess complaints, to note side effects after consuming it, and also to measure the hemoglobin level of the respondents.

Table 1. Nutrient content per 100 - gram boiled chicken eggs and dragon fruits

Food	Energy (kCal)	Carbohydrate (gr)	Protein (gr)	Fat (gr)	Fe (mg)
Boiled chicken eggs	154	12.53	1.012	10.57	1.2
Dragon fruits	60	12.9	1.2	0	0.7

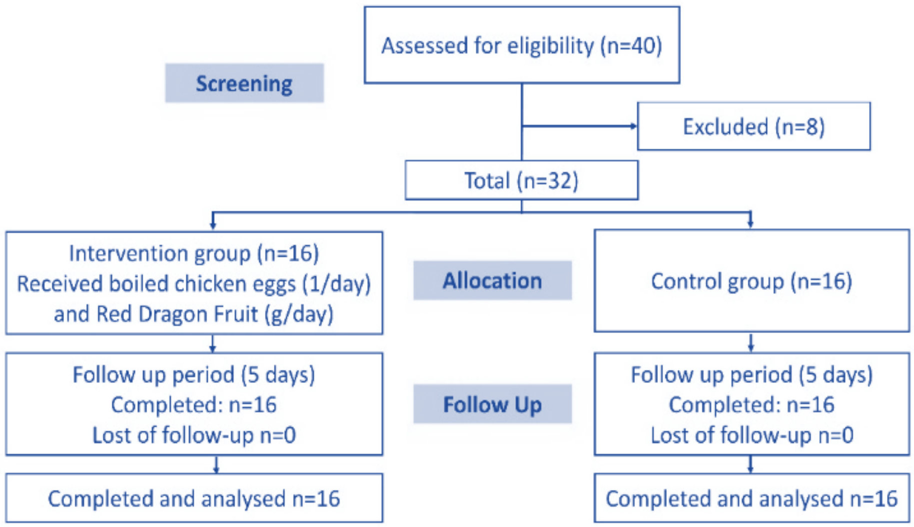

Figure 1. Flowchart of subject respondents throughout the study

At each visit, the investigator also monitored so that the respondent did not take iron supplements and medicine that can affect iron absorption. Respondents were also confirmed not to perform strenuous physical activity because it could worsen iron deficiency anemia during menstruation. Hemoglobin levels of respondents were recorded on the baseline 1st day (T0), 3rd day (T1), and 5th day (T2). Hemoglobin level data were obtained by measuring hemoglobin levels using the Easy Touch GCHb tool.

2.4 Data analysis

Data analysis was performed using descriptive statistical analysis and a repeated measure ANOVA design was used to detect differences in hemoglobin levels of treatment-control groups. The repeated measures ANOVA used the data from the pretest (1st day), middle (3rd day) and the posttest (5th day) to determine hemoglobin levels over time. Statistical test using IBM SPSS statistic 22.0 software at a 95 % confidence level.

3 Results

A total of thirty-two women participated in the study during their period. The age range of respondents was 20 – 21 years, and most of them were aged 21 years, as shows in Figure 2. Most participant indicated that their period length was 6 – 7 days, as shows in Figure 3. There were no significant differences in age and period length between the two groups ($p > 0.05$).

The between-subject variable was treatment/control while the within-subject variables were the hemoglobin level of the pretest (T0), the middle intervention (T1), and the posttest (T2).

The analysis showed that there were significant differences in hemoglobin levels between respondents in intervention and control groups ($F (1.30) = 15.793$, $p = 0.000$ ($p < 0.05$). Table 2 shows the result of repeated measures ANOVA. Figure 4 shows a bar chart of the hemoglobin levels means for each of pretest, middle and posttest. There was a growing trend of the hemoglobin levels for intervention group and decreased trend of hemoglobin levels for control groups.

Table 2. Repeated measures analysis of hemoglobin levels in control and treatment groups

Source	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1	10967.513	3923.596	.000*	.992
Intervention Control	1	44.146.	15.793	.000*	.345
Error	30	2.795			

Pre-test: Day 1 before treatment; Middle-test: Day 3 during treatment Post-test: Day 5 after treatment; Intervention group: Respondent with boiled chicken eggs and red dragon fruits treatment, Control group: Respondent without any treatment. Data were analyzed using repeated measures analysis and were compared between intervention and control groups (*) ($p < 0.05$)

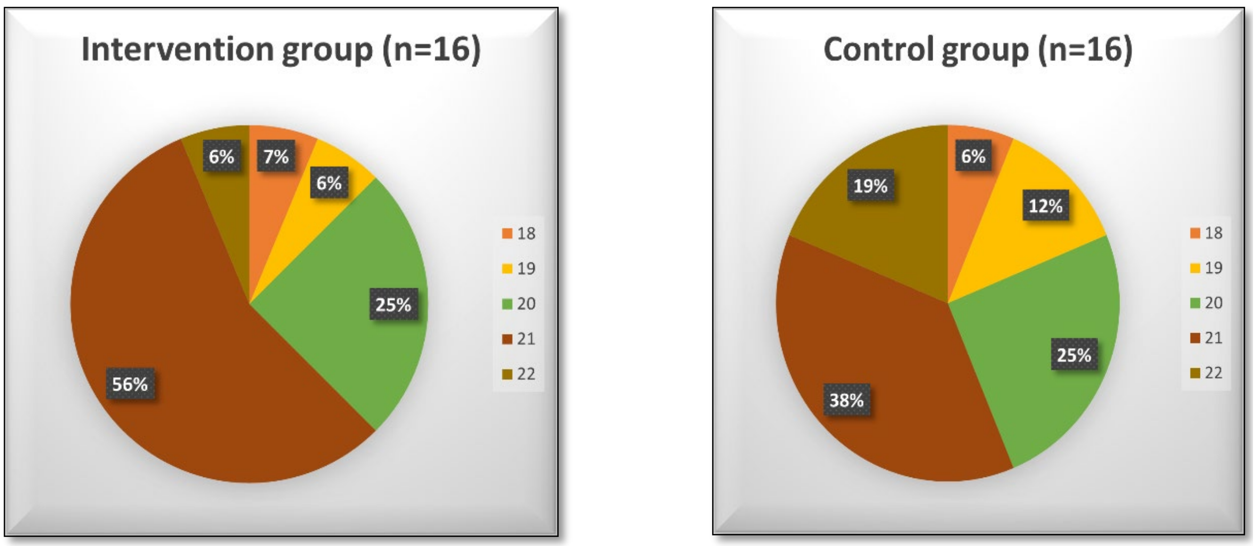

Figure 2. Distribution percentage of respondent age (years)

On the 1st day (pretest), 3rd day (middle test) and the 5th day (post-test) of measurement in the control group, hemoglobin levels decreased in almost all respondents with an average decrease of 1.4 g/dL, from 10.72 g/dL to 9.28 g/dl. Meanwhile in the intervention group, there was an increase in all respondents after receiving boiled chicken eggs and red dragon fruits intervention, with an average increase in hemoglobin level of 4.4 g/dL, from 9,12 g/dL to 13.51 g/dL.

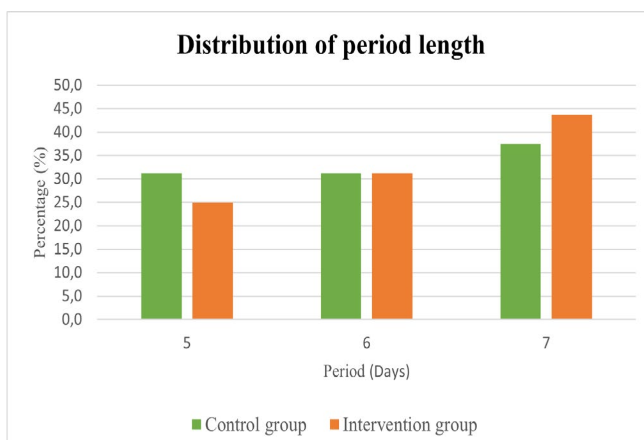

Figure 3. Distribution of period length (days)

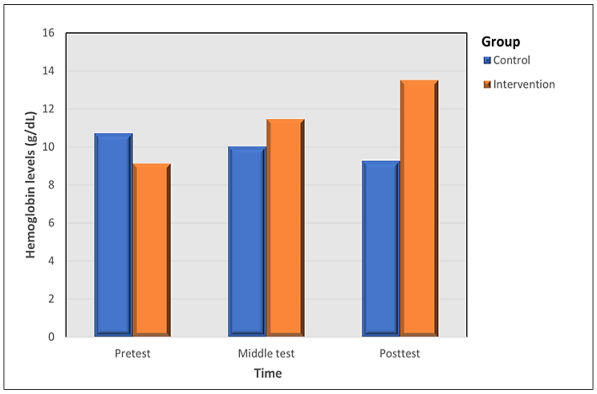

Figure 4. Bar chart presenting average of hemoglobin levels change for respondent in the intervention and control groups on each three tests: pretest, middle test, and posttest

4 Discussion

Women in reproductive age are physiologically more prone to anemia [24]. The most common cause of anemia worldwide is iron deficiency. Particularly women are likely to develop this type of anemia with two most frequent causes: 1) frequent blood loss through the menstrual period and, women's menstrual blood loss causes a negative iron load, that increases the risk of developing iron deficiency anemia [25]; 2) limited intake of iron-rich foods. Iron is known to be an essential micronutrient required for numerous biological functions, including oxygen transport, gene regulation, cell growth, and differentiation [26].

Iron in foods can be broadly divided into heme and non-heme iron. Heme iron comes from hemoglobin and myoglobin in animal sources, while non-heme iron is obtained from food plants like cereals, pulses, fruits and vegetables. Non-heme iron is usually much less well absorbed than heme iron [14].

Consumption of boiled chicken eggs and dragon fruit can help increase hemoglobin levels. The current study showed significant differences in hemoglobin levels between intervention and control groups. It can be concluded that the boiled chicken egg and dragon fruit intervention during the woman's menstrual period significantly influences the changes in hemoglobin levels higher than the control group. Hemoglobin decrease in the control group could be a result of blood loss throughout the menstruation cycle [27].

The differences in hemoglobin levels may be explained by differential intake of dietary iron during the menstrual period. Identical results were found in a study conducted by Susanti *et al.* [28] that there was an effect of providing boiled chicken eggs and papaya to increase hemoglobin levels in female students. An earlier study reported that egg white protein was useful for recovery from iron deficiency anemia [18].

The egg is a source of both heme and non-heme iron, meanwhile, the dragon fruit is a source of non-heme iron. Eggs are useful source of iron, with 1.2 mg per medium egg. This amount contributes about 6.6 % of women's adult daily iron. Whether the iron content in eggs has limited bioavailability [29]. The results of the present investigation agree with those obtained by Yun *et al.* [30] where the amount of iron absorbed from consumed eggs may significantly increase by consuming food or drink containing vitamin C (ascorbic acid) at the same meal. Ascorbic acid accelerates absorption in the process of hemoglobin formation [31]. Ascorbic acid may reduce ferric iron to ferrous iron and bind it in soluble complexes which are available for absorption [14].

The red dragon fruit possesses the potential as a source of iron, antioxidants, and other essential nutrients, such as vitamins C, E, B12, thiamine and riboflavin [22, 32, 33]. In 100 grams of dragon fruit 0.7 g Fe and vitamin C 2.5 mg are available. Red dragon fruit significantly helps the process of absorption of iron. The high content of vitamin C in dragon fruit can help the induction of iron in the body. Furthermore, it can increase the acidity of the stomach which can help increase iron absorption by 30 % [34]. Previously, some studies found that there was a significant effect of red dragon fruit on hemoglobin levels, hematocrit and erythrocytes in investigated patents [23, 35]. The amount of non-heme iron in the diet is several times elevated than that of heme-iron in most meals [36]. Despite its lower bioavailability, non-heme iron generally contributes more to iron nutrition than heme-iron [14].

Research hypothesizes that combination of dietary sources of this heme and non-heme iron can accelerate the process of red blood cell formation in the body, such that the increase in hemoglobin levels of respondents who received the intervention is higher than that of the respondents who did not receive. It appears that the use of boiled chicken eggs and dragon fruit as a dietary-based intervention was the appropriate method to improve iron status in young women and may provide an alternative to conventional treatment [37].

5 Conclusion

In conclusion, daily consumption of boiled chicken egg combined with red dragon fruits in women during their menstruation increased hemoglobin levels, which may contribute to the prevention of the risk of iron deficiency anemia. Nutritionists can play a vital role in educating women about their periods to increase intake of animal protein sources supported by an intake of vitamin C sources to reduce the risk of iron deficiency anemia. The result of this study provides a basis for future research evaluating dietary records and the long-term effects of combined foods to reduce the risk of anemia, especially in adolescent girls. This study presents some inherent limitations; the dietary factors affecting hemoglobin or iron absorption could not be controlled in this study such as gastric acidity, iron metabolism, nutritional intake, and other iron absorption issues. Further analysis is necessary by controlling factors that can affect hemoglobin levels and generalizing the results to a large sample size and diversity among participants.

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Conflicts of Interest: The authors declare that they have no conflict of interest.

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