ORIGINAL RESEARCH

Jackfruit seeds milk administration increased hemoglobin levels in third trimester pregnant women at Bangetayu Health Center, Semarang, Indonesia

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ABSTRACT

Objective: This study aimed to investigate the impact of administering jackfruit seeds milk on hemoglobin levels in third trimester pregnant women at Bangetayu Health Center in Semarang, Indonesia.

Materials and Methods: This study utilized a quasi-experimental approach with pre- and post-test control groups. The study included a sample of 35 out of 107 third trimester pregnant women from the Bangetayu Health Center in Semarang, Indonesia. The study was conducted between January and February 2022. The research sample comprised 35 respondents, divided into 17 control groups and 18 intervention groups. Purposive sampling was utilized as the sampling technique. Data analysis involved both univariate and bivariate analysis techniques. The statistical analyses used were chi-square test and independent t-test. This study utilized the SPSS software version 23 for data analysis.

Results: The intervention group had an average hemoglobin level of 10.2 g/dL before treatment and 10.7 g/dL after treatment. The average hemoglobin level in the control group increased from 12.1 g/dL before to 12.4 g/dL after. The results revealed p=0.000 and a Relative Risk (RR) of 1.2.

Conclusion: The consumption of jackfruit seed milk increased hemoglobin levels of third-trimester pregnant women at the health center in Bangetayu, Semarang, Indonesia. Failure to consume jackfruit seed milk resulted in 1.2 times decrease in the likelihood of boosting hemoglobin levels.

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Highlights:

1. Pregnant women are prone to suffer from anemia.
2. Jackfruit seeds milk can be consumed as a non-pharmacological treatment to prevent and overcome anemia in pregnant women.

INTRODUCTION

Anemia is a medical disorder characterized by a deficiency in the number of red blood cells or a decrease in the amount of hemoglobin present in the blood, both of which fall below the typical range.[1] Pregnant women are considered non-anemic if their hemoglobin level is 11 g/dL. Mild anemia is defined as a hemoglobin level between 9-10.9 g/dL, moderate anemia is between 7-8.9 g/dL, and severe anemia is when the hemoglobin level falls below 7 g/dL.[2] Anemia is a common occurrence among pregnant women worldwide, regardless of whether they live in developed or underdeveloped countries. The World Health Organization (WHO) approximates that anemia affects 35-75% of pregnant women in developing countries and 18% of pregnant women in developed countries.[3] According to data from the 2013 Basic Health Research in Indonesia, 37.1% of the Indonesian population suffered from anemia.[4] The year 2018 experienced a surge of 48.9%.[5] According to the Health Profile of Central Java Province in 2018, the prevalence of anemia among pregnant women was 27.6%.[6] In 2018, the prevalence of anemia in Semarang, Indonesia, was 16.58%.[7]

Currently, the standard approach to managing anemia in pregnant women involves the use of blood-booster tablets (Fe tablets) and the consumption of iron-rich meals or beverages. Iron is an essential micronutrient required by the organism. Fe pills consist of 250 grams of folic acid and 60 milligrams of elemental iron. The recommended daily dosage of iron tablets is 60 mg/day, and during pregnancy, it is advised to take a minimum of 90 tablets.[8] Aside from pharmacological intervention through the administration of iron tablets, anemia can be mitigated by modifying one's dietary intake, specifically by consuming food and beverages rich in iron and vitamin C. Iron can be obtained from both plant and animal sources of diet. Nuts and vegetables are plant-based sources of iron, whereas meat, eggs, and fish are animal-based sources of iron.[9] In addition to iron-rich meals consumption, one can address anemia by incorporating foods that are high in vitamin C into their diet. Vitamin C aids in the absorption of iron. Vitamin C can enhance the assimilation of non-heme iron by up to fourfold. The combination of iron and vitamin C results in the formation of a soluble and easily absorbable iron ascorbic acid complex. Iron is utilized in the synthesis of hemoglobin.[10]

The seeds of jackfruit (*Artocarpus heterophyllus*) are a type of food that is rich in both iron and vitamin C. Jackfruit seeds can be utilized to produce jackfruit seed milk. Jackfruit seed milk contains higher levels of phosphorus and calcium compared to soy milk, while having a lower fat content.[11] One hundred grams of jackfruit seeds include 1 mg of iron and 10 mg of vitamin C.[12] The beneficial potential of jackfruit seeds has not been fully understood. The utilization of jackfruit seeds in food industry is limited to approximately 10% primarily because of the insufficient public demand for jackfruit seeds process. Jackfruit seeds possess numerous advantages, among which is their utilization as a primary ingredient for producing jackfruit seed milk.[13] The process of producing jackfruit seed milk involves ensuring that it contains an adequate amount of starch, which allows it to function as a soluble carbohydrate. Laboratory tests indicate that the phosphorus and calcium levels in jackfruit seed milk are higher compared to soy milk, while its fat content is comparatively lower.[11] The objective of this study was to investigate the impact of administering jackfruit seed milk on the hemoglobin levels of pregnant women in their third trimester at a health center in Bangetayu, Semarang, Indonesia; and to establish empirical support for the use of jackfruit seed milk as a non-pharmacological intervention for the prevention and management of anemia in pregnant women.

MATERIALS AND METHODS

This study employed a quasi-experimental design using a pre- and post-test approach with a control group. The research was carried out between August 2021 and February 2022. The participants in this study were pregnant women in their third trimester living in the working area of the Public Health Center in Bangetayu, Semarang, Central Java, Indonesia. The research sample comprised 35 respondents, who were allocated into 17 control groups and 18 intervention groups. This research employed a purposive sampling technique.

The study included pregnant women in their third trimester who were in good physical and mental health, without a history of chronic blood disorders (such as leukemia, sickle cell anemia, aplastic anemia, poly-cythemia, thalassemia, and others). Additionally, they had no allergies to the ingredients in jackfruit seed milk, were willing to participate as respondents, and were not receiving any other interventions to increase hemo-globin levels, except for iron tablets. The exclusion criteria comprised pregnant women who did not adhere to the research's procedures, as well as those who delivered their babies prior to the completion of the study.

The study included observation sheets and a Hb meter (EasyTouch Brand) as the measuring devices. The methodology employed in this study was as follows: Prior to starting the study, laboratory tests were performed to analyze the nutritional composition. The

researcher received assistance from a single enumerator belonging to the health center's staff, who had received prior education regarding this study. Following the identification of control and intervention groups within the participants, the hemoglobin levels were assessed prior to the intervention using a Hb meter (EasyTouch Brand). Subsequently, the researcher administered jackfruit seeds milk to the intervention group. The control group received either iron tablets or blood-booster tablets only. The intervention group received 250 mL of jackfruit seeds milk, which was packed in a plastic bottle. During a period of two weeks, 18 pregnant women in their third trimester consumed jackfruit seed milk once daily. Following a 2-week intervention, the hemoglobin levels of both the intervention group and the control group were assessed to determine the impact of administering jackfruit seeds milk on the hemoglobin levels of pregnant women in their third trimester.

Data collection method employed an observation sheet that included the respondent's identity, pre- and post-intervention hemoglobin levels, and a checklist for tracking the consumption of jackfruit seed milk. Data processing was conducted using the SPSS version 23 software, and data analysis was performed using univariate and bivariate analysis techniques. The bivariate analysis was conducted utilizing the chi-square test and independent t-test. The research obtained ethical permission from the bioethics commission of the Sultan Agung Islamic University Faculty of Medicine, Semarang, Indonesia, under Ethical Clearance number 383/XI/2021/Bioethics Commission.

RESULTS AND DISCUSSION

Parity

Table 1 indicates that the majority of respondents in both the intervention group and the control group had given birth several times (multipara). In the intervention group, there were 11 multiparous respondents, accounting for 61.1% of the total. In the control group, there were 10 multiparous respondents, making up 58.8% of the total. The p-value was 0.890 (p >0.05), indicating that there was no significant association between parity and the occurrence of anemia. This study corroborated the findings of Tanziha (2016) that parity does not exhibit a statistically significant correlation with the occurrence of anemia (p >0.05).[13]. This study confirmed Andita's (2018) research findings, which indicated the absence of a correlation between parity and anemia.[14] The incidence of anemia is not influenced by parity, as both primiparas and multiparas have an equal likelihood of experiencing anemia. Anemia can arise from multiple variables, rather than being attributed to a single cause. For instance, it might be triggered by factors such as dietary intake, ingestion of iron supplements, and other similar causes.[15]

Pregnancy intervals

The majority of pregnancies in both the intervention and control groups had a distance of 2 years. In the intervention group, there were 10 patients (55.6%) and in the control group, there were 11 patients (64.7%) with this pregnancy interval. Statistical analysis (p=0.581; p >0.05) indicated no significant association between the distance of pregnancies and the occurrence of anemia. This study's findings aligned with Tanziha's (2016) research, which indicated no correlation between gestational distance and the prevalence of anemia (p >0.05).[13] This study corroborated Fitriany's research (2018) which found no significant correlation between pregnancy interval and anemia (p=1.000).[16]

Table 1. Characteristics of respondents

Groups / Variables	Intervention		Control		p-values*
	n	%	n	%	
Parity					
Primipara	7	38.9 %	7	41.2%	0.890
Multipara	11	61.1 %	10	58.8%	
Pregnancy interval					
< 2 years	8	44.4%	6	35.3%	0.581
≥ 2 years	10	55.6%	11	64.7%	
Income					
< Minimum wage	10	55.6%	9	52.9%	0.877
≥ Minimum wage	8	44.4%	8	47.1%	

*Chi-square test

The incidence of anemia is not influenced by the distance between pregnancies, as both intervals of less than 2 years and 2 years carry a similar risk of developing anemia. Pregnancies with an interval beyond 2 years can diminish the advantages derived from prior pregnancies, such as uterine enlargement and enhanced uterine blood flow, and vice versa. A brief pregnancy interval is one of the factors that can accelerate the onset of anemia in pregnant women.[17]

Income

The majority of the participants' income in both the intervention group and the control group was below the regional minimum wage. In the intervention group there were 10 respondents, accounting for 55.6% of the group, while in the control group there were 9 respondents, making up 52.9% of the group. The p-value of 0.877 (p >0.05) suggests that there was no significant correlation between income and the occurrence of anemia. This study confirmed Ramadhani's (2018) research findings, which indicated that there was no significant correlation between income and the occurrence of anemia (p=0.31; p >0.05).[18]

The occurrence of anemia is not influenced by income, as high-income mothers or families that can afford costly food may not always prioritize the nutritious value of the food they purchase. Several inexpensive food options, such as green vegetables, are rich in iron.[19] Furthermore, individuals with limited financial resources but having sufficient knowledge are more likely to effectively prevent anemia. Their knowledge enables them to make informed choices about the sorts of food they consume, ensuring that their nutritional requirements are met within the constraints of their purchasing power.[20]

Hemoglobin levels

According to Table 2, the average hemoglobin level in the intervention group was 10.2 g/dL before treatment and increased to 10.7 g/dL after receiving therapy. This means that pregnant women in the intervention group had an average hemoglobin increase of 0.5 g/dL. In the control group, the average hemoglobin level before was 12.1 g/dL and the hemoglobin level after was 12.4 g/dL. This indicates that pregnant women in the control group had an average increase in hemoglobin levels of 0.3 g/dL. The intervention group experienced a higher increase in hemoglobin levels due to their consumption of jackfruit seed milk, which is rich in minerals, iron, and vitamin C. The hemoglobin level in the control group was lower than in the intervention group because they consumed iron tablets only.

Anemia during pregnancy is closely linked to the physiological changes that take place throughout pregnancy, the gestational age of the fetus, and the health status of the pregnant mother in prior pregnancies. During pregnancy, the body undergoes physiological changes, including a 20-30% increase in blood volume. Consequently, there is an elevated demand for iron and vitamins to support hemoglobin production. During pregnancy, the body undergoes an increase in blood production to supply the growing fetus. The body requires an additional 30% volume of blood during pregnancy compared to its pre-pregnancy state.[21]

Effect of jackfruit seeds milk administration on hemoglobin levels in trimester III pregnant women

The independent t-test yielded a p-value of 0.000 (p <0.05), showing a significant effect of administering jackfruit seed milk on the increase of hemoglobin levels in pregnant women during the third trimester. The Relative Risk (RR) value obtained was 1.2 (CI 95% 1.021 - 4.452). This indicates that individuals who did not consume jackfruit seed milk were 1.2 times more likely not to have an increase in hemoglobin levels compared to those who did consume jackfruit seed milk.

Table 2. Hemoglobin levels

No.	Variables	Group	
		Intervention (n=18)	Control (n=17)
1.	Hemoglobin levels before		
	Mean (SD)	10.194 (0.6881)	12.124 (0.7742)
	Min	9.0	11.2
	Max	11.0	13.9
2.	Hemoglobin levels after		
	Mean (SD)	10.695 (0.6913)	12.406 (0.7611)
	Min	9.5	11.5
	Max	11.5	14.1

Table 3. Effect of jackfruit seeds milk on hemoglobin levels of trimester III pregnant women

Groups / Variables	Hemoglobin levels				RR (CI95%)	p-value*
	Before		After			
	n	%	n	%		
Intervention	18	100	18	100	1.2	0.000
Control	17	100	17	100	(1.021-4.452)	

*Independent t-test

The study utilized jackfruit seed milk that had undergone laboratory analysis by Chem-Mix Pratama Yogyakarta, Indonesia. The milk was found to contain the following components per 100 grams: calcium (39.2461 mg), phosphorus (38.9844 mg), iron (3.0124 mg), vitamin C (13.8274 mg), carbohydrates (8.0848 mg), and protein (0.6088 mg). Jackfruit seed milk is rich in iron, phosphorus, carbohydrates, protein, calcium, phosphorus, and vitamin C. Iron has multiple physiological roles in the body, including the crucial function of avoiding anemia, particularly in pregnant women who have an increased requirement for iron consumption for the production of hemoglobin in the organism. Vitamin C facilitates the absorption of iron. Phosphorus also has various health benefits, including regulating energy transfer, absorption of nutrients and maintaining the acidity of fluids in the body. Carbohydrates and protein also have benefits for the body, carbohydrates serve as the main source of energy and protein as body building substances and repair damaged cells.[22]

The milk derived from jackfruit seeds is rich in minerals such as iron and vitamin C, which have the potential to enhance hemoglobin levels in pregnant women. Iron is essential for pregnant women due to the heightened demand for iron during pregnancy. Iron plays a crucial role in the production of hemoglobin, which helps counteract hemodilution that occurs during pregnancy. Vitamin C facilitates the absorption of iron. Iron and vitamin C, when combined, create a compound known as complex ascorbic acid, which is both soluble and readily assimilated by the body. Both the intervention and control groups had elevated hemoglobin levels in this study. The rise in the control group was attributed to the ingestion of iron pills and meal consumption.[23] The administration of iron tablets was monitored using an observation sheet. Nevertheless, as the limitation of the study, the researchers were unable to regulate the dietary intake of the pregnant women within a 24-hour period. Additionally, the control group just received iron tablets without any other interventions.

CONCLUSION

The administration of jackfruit seed milk resulted in increased hemoglobin levels among pregnant women in their third trimester at the health center in Bangetayu, Semarang, Indonesia. Pregnant women who did not consume jackfruit seeds milk had a 1.2 times higher likelihood of not having an increase in hemoglobin levels compared to those who consumed jackfruit seeds milk. Jackfruit seed milk is evidently advantageous for pregnant women in the prevention and treatment of anemia.

DISCLOSURE

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Conflict of interest

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Author contributions

All authors have contributed to all processes in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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