

Avocado cookies to prevent anemia in pregnancy

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ABSTRACT

Background: Anemia remains a global significant health issue, with pregnant women among the groups most susceptible to the conditions. While iron supplementation is a standard preventive strategy, its effectiveness is often hindered by low compliance and absorption issues, highlighting the need for alternative nutritional interventions. Avocados (*Persea americana*) are rich in essential nutrients, which play vital roles in erythropoiesis and enhancing iron metabolism.

Objectives: This study aims to make and provide avocado cookies as a strategy to prevent anemia in first-trimester pregnant women.

Methods: This study employed experimental one-group pre-test and post-test design. The study compared hemoglobin levels in one treatment group before and after a 14-day avocado cookie intervention. The sample comprised 30 pregnant women first-trimester pregnant women within the jurisdiction of the Nanggalo Public Health Center in Padang City who met the inclusion criteria. Participants consumed 60 g of avocado cookies daily for 14 consecutive days. Hemoglobin levels were measured before and after the intervention using a digital hemoglobin meter. Data were analyzed using paired t-tests to determine statistical significance.

Results: The average hemoglobin level before the avocado intervention was 12.37 (± 1.87) gr/dl, which decreased to 13.69 (± 1.29) gr/dl after intervention. The paired t-test showed that hemoglobin levels before and after the intervention were significantly different ($p = 0.03$).

Conclusions: Consuming avocado cookies for two weeks effectively increases hemoglobin levels in pregnant women. Avocado cookies may serve as an alternative healthy snack for pregnant women. Future studies with larger sample sizes are recommended to further validate these findings.

KEYWORD: anemia; avocado; cookies; hemoglobin level; pregnant women

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INTRODUCTION

Anemia can be identified based on decreased hemoglobin, hematocrit, or Red Blood Cell (RBC) count. It is a clinical sign of a deeper health problem and is classified as macrocytic, microcytic, or normocytic, based on RBC size. However, the most commonly used indicator is hemoglobin levels (1). Anemia during pregnancy defines as a condition characterized by a hemoglobin level below 11 g/dL in the first trimester (2).

Anemia remains a significant global health issue, particularly in developing countries. In 2011, anemia affected 29% of non-pregnant women and 38% of pregnant women worldwide (3). In Indonesia, anemia remains prevalent, mainly because of insufficient iron intake. The groups most at risk are children under 12, adolescent girls, women of childbearing age, and pregnant women (4).

The primary factor contributing to nutritional anemia during pregnancy is inadequate nutritional intake, particularly insufficient iron intake. Low iron consumption and reduced iron absorption, often due to deficiencies in other micronutrients, adversely affect blood hemoglobin levels and may lead to anemia. The prevalence of anemia during pregnancy has detrimental effects on both mothers and infants. In mothers, anemia may cause complications during pregnancy and childbirth, increasing the risk of maternal mortality. In infants, it may result in low birth

weight and impaired growth and development during early childhood –(5,6).

In Indonesia, most anaemia cases are due to iron deficiency. Nonetheless, haemoglobin formation is also affected by other essential micronutrients. Previous studies have shown associations between the consumption of folic acid, vitamin B12, vitamin C, vitamin E, and haemoglobin levels (7,9).

One key strategy for addressing anaemia is the distribution of iron supplements, especially to pregnant women. However, iron tablet supplementation alone has not been the most efficient approach for reducing anaemia. This is highlighted in the prevalence anaemia statistics among pregnant women in Indonesia, which increased from 37.1% in 2013 to 48.9% in 2019 (4).

However, fruit consumption in Indonesia remains low. The study reveals that daily fruit and vegetable intake is not a habit for all students, who tend to eat only selected fruits and processed vegetables (10). One fruit rich in vitamins and minerals is avocado (*Persea americana*). Avocado contain 20-30 times more fat higher than other fruits, providing a significant amount of energy (11). Studies in food technology have shown that avocados contain protein, fat, vitamins and minerals (12). Several studies have proven that avocado juice may help increase haemoglobin levels (13,15). One nutritional problem commonly

experienced by pregnant women, especially in early pregnancy, is eating disorders, including anorexia (16). Anemia in pregnancy is one of the most common severe health consequences of anorexia (17). Snacks such as cookies may serve as a food alternative that is more acceptable to pregnant women, including those with appetite disorder. Cookies are popular dry food products widely available in the market. Various studies have explored substituting wheat flour with local ingredients. Cookies may therefore be consumed by a practical food option for pregnant women (18).

Some previous studies have established the effectiveness of avocado juice in increasing Hb levels, research on avocado-based solid snacks like cookies remains scarce. This is particularly important for first-trimester pregnant women who often suffer from eating disorders, making cookies a more acceptable and practical intervention. This study aims to develop an avocado cookie formulation and evaluate its effectiveness in increasing the hemoglobin (Hb) levels among first-trimester pregnant women who consume the avocado cookies.

MATERIALS AND METHODS

This experimental study employs a one-group pre-test and post-test design to

evaluate haemoglobin levels in a single treatment group before and after a 14-day avocado cookie intervention. The cookies used in this study have previously undergone formulation and panelist testing. Each respondent consumed six cookies daily, with each weighing 10 g.

The study population comprised first trimester pregnant women residing in Padang City. The sample was drawn from first trimester pregnant women attending the Nanggalo Community Health Center in Padang City. A purposive sampling method was used based on specific eligibility criteria. The inclusion criteria were pregnant women with a gestational age of less than 12 weeks who agreed to participate as respondents. Exclusion criteria, determined through interviews, included kidney disease, malaria, parasitic infections, a family history of hematological disorders such as thalassemia or sickle cell disease, use of medications affecting hemoglobin levels (e.g., chemotherapy or antiretroviral therapy), habitual tea or coffee consumption, and non-compliance exceeding 10%.

The sample size was determined based on the minimum requirement for experimental research, which was 15 respondents. To anticipate dropouts, the sample size was increased using the following equation:

$$n' = \frac{n}{1-f}$$

n = calculated sample size

f = estimated drop out proportion, estimated at 50% (f = 0,5)

$$n' = \frac{n}{1-f} = \frac{15}{1-0,5} = 30$$

Thus, the sample size was 30 respondents.

The study has received approval from the Health Research Ethics Committee of Universitas Perintis Indonesia under approval number 626/KEPK.F1/ETIK/2024. Informed consent was provided from all potential respondents before data collection commenced. The study used primary data collected through observation sheets to record participant characteristics and hemoglobin examination results. Hemoglobin levels were measured using a digital Hb device. Measurements were performed twice, before and after the intervention for two weeks. Data collection

and monitoring of respondent compliance were assisted by enumerators of health cadres and midwifery students through home visits supplemented with reminder messages via WhatsApp.

The collected data underwent editing, coding, entry, cleaning, and analysis. Data were analyzed using SPSS and included descriptive, comparative, and paired t-tests.

RESULTS AND DISCUSSION

A total of 30 pregnant women received avocado cookies for 2 weeks. Data were analysed using parametric tests, and normality tests were performed using the Shapiro-Wilk test. **Table 1** presents the results of the data normality test:

Based on the results of the Shapiro–Wilk test presented in **Table 1**, that data for age, MUAC, BMI, IPI, and haemoglobin levels before and after the intervention were normally distributed.

Table 1. Distribution of data normality test

Variable	p-value
Age	0.143
Mid-Upper Arm Circumference (MUAC)	0.158
Body Mass Index (BMI)	0.508
Interpregnancy interval (IPI)	0.163
Hemoglobin levels before intervention	0.158
Hemoglobin levels after intervention	0.154

The characteristics examined in this study included general attributes such as age, parity, pregnancy spacing, and economic status, as well as health-related

characteristics, specifically nutritional status measured using MUAC and BMI. The distribution of respondent characteristics is presented in **Table 2**.

Table 2. Distribution of general characteristics and health characteristics (nutritional status)

Variable	Value
Age (year) (n=30)	
mean (SD)	28 (4.44)
median	28
minimum	20
maximum	40
Parity (n=30)	
primigravida	10
multigravida	20
Interpregnancy interval (month) (n=20)	
mean (SD)	33.11 (19.55)
median	35
minimum	6
maximum	72
MUAC (cm) (n=30)	
mean (SD)	27.64 (3.61)
median	27.25
minimum	22
maximum	37.5
BMI (kg/m ²) (n=30)	
mean (SD)	22.76 (3.70)
median	22.18
minimum	17.26
maximum	31.11

Based on **Table 2**, the mean age of respondents was within the reproductive age range. Approximately 33% of the respondents were experiencing their first pregnancy. Among multigravida respondents, the average pregnancy interval was 33 months. The nutritional status of the respondents was assessed using two indicators. Measurements of the Upper Arm Circumference revealed a mean arm circumference of 27.64 cm. Additionally,

the mean Body Mass Index (BMI) was 22.76, which is within the normal range.

Hemoglobin Level Analysis

Haemoglobin levels were measured before and after the two-week supplementation period. As the distribution of haemoglobin level data before and after the intervention was normal, a paired t-test was used for analysis. The haemoglobin level data are presented in **Table 3**.

Table 3. Hemoglobin levels before and after giving Avocado Cookie

Variable	value	P value
Before intervention (gr/dL) (n =30)		
mean(SD)	12.37 ($\pm$ 1.87)	
median	12.05	
minimum	9.2	
maximum	16	0.03
After intervention (gr/dL) (n=30)		
mean(SD)	13.69 ($\pm$ 1.29)	
median	13.95	
minimum	10.9	
maximum	16.3	

The mean hemoglobin level before the avocado cookies intervention was 12.37 ($\pm$ 1.87) gr/dl, which increased into 13.69 ($\pm$ 1.29) gr/dl. Based on a paired t-test, haemoglobin levels before and after the intervention were significantly different ($p=0.03$). Haemoglobin levels after intervention were higher than those before the intervention.

To confirm a diagnosis of anaemia, anamnesis and laboratory examinations, including hemoglobin measurement, can be performed. Haemoglobin is an iron-binding protein as the main component of erythrocytes. It functions to transport oxygen and carbon dioxide and gives blood its red colour. The haeme component of haemoglobin binds oxygen; therefore, haemoglobin bound to oxygen is referred to as oxyhemoglobin (19,20).

The findings of this study align with those of previous studies. Experimental studies have shown that avocado juice can increase haemoglobin levels. Avocados contain several nutrients in haemoglobin

formation. One of the major nutrients in avocados is vitamin A, which plays a role in cell regeneration (21). A case study also reported increased haemoglobin levels in patients with anaemia after consuming avocado juice for 2 weeks (22). In addition, an experimental investigation involving adolescent females demonstrated that consumption of Cava Smoothie, comprising Cavendish banana pulp, avocado butter, pure honey, Sukkari dates, and iron supplements, significantly enhanced haemoglobin levels and red blood cell indices (MCV, MCH, and MCHC) in anaemic adolescents (23).

Avocado has the scientific name *Persea americana* Mill. or *Persea gratissima* Gaerth. Avocado is widely consumed as a fresh fruit, and its flesh is commonly used as an ingredient in various dishes. Avocados provide a variety of essential nutrients required by the human body (24). Its fat content mainly comprised 20-30 times higher than most other fruits, which can provide high energy. The fat

content mainly comprised unsaturated fat, which is easily digested by the body (11). Avocados contain high nutrition, such as protein, vitamin B6, folate, niacin, vitamin E, vitamin C, and other minerals (12).

Vitamin A plays a crucial role in maintaining cellular functions related to growth, epithelial integrity, erythropoiesis, immune response, and reproduction. It also contributes to erythropoiesis by stimulating erythroid precursor cells in the bone marrow and promoting erythropoietin production (25). Vitamin E also plays a positive role in increasing haemoglobin levels (25). A study indicates that daily supplementation with 400 mg of vitamin E for three months significantly increases blood hemoglobin levels in adults with mild anemia. This improvement is likely due to the ability of vitamin E to inhibit apoptosis of erythroid progenitor cells, thereby enhancing their survival and production (26).

Vitamin C plays a crucial role in maintaining haemoglobin levels and preventing anaemia. It enhances iron absorption by converting ferric iron into its more readily absorbed ferrous form, thereby facilitating haemoglobin synthesis. Although iron is the fundamental mineral necessary for producing hemoglobin, which facilitate oxygen transport, it requires vitamin C to be processed more efficiently by the system. In addition to its role as an antioxidant that strengthens the immune system, vitamin C helps transform iron into a more absorbable state (26). This study had several

limitations. First, the sample size was relatively small because the study was conducted as a project-based study. Second, no dietary regulations or daily menu recall were implemented for the respondents. However, the researcher reminded all respondents to consume balanced nutrition.

CONCLUSION AND RECOMMENDATION

Based on the findings of the study, consuming avocado cookies during pregnancy for two weeks increases haemoglobin levels. Avocado cookies may be considered as an alternative healthy snack for pregnant women. Further studies with a larger sample size are recommended.

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