# NUTRITION-BASED EDUCATION TO PREVENT ANEMIA: THE EFFECT OF PSIDIUM GUAJAVA L. AND PHOENIX DACTYLIFERA PUDDING ON HEMOGLOBIN LEVELS AMONG ADOLESCENT

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**ABSTRACT**
Iron-deficiency anemia remains a critical public health issue among adolescent girls, particularly in rural areas with limited access to nutrition education and supplementation. Red guava (Psidium guajava L.) and dates (Phoenix dactylifera) are known to contain vitamin C and iron, respectively, which are essential for hemoglobin synthesis. This study aims to evaluate the effect of consuming pudding made from red guava and dates on hemoglobin (Hb) levels in female adolescents with anemia in Lebakadi Village, Lamongan Regency. A quasi-experimental non-equivalent control group design was used involving 60 adolescent girls aged 14–17 years. Participants were divided into an intervention group (n=30) receiving 100g/day of guava-date pudding for 14 days and a comparison group (n=30) receiving placebo pudding. Hb levels were measured pre- and post-intervention using a digital hemoglobinometer. Data were analyzed with paired and independent sample t-tests ($p<0.05$). The treatment group showed a significant increase in mean Hb levels from 10.43±0.31 g/dL to 12.00±0.55 g/dL ($p=0.000$), while the comparison group showed no significant change (11.45±0.25 g/dL to 11.47±0.27 g/dL, $p=0.229$). No adverse effects were reported. Guava-date pudding significantly improves Hb levels in anemic adolescent girls. This intervention is culturally appropriate, well-accepted, and effective as a non-pharmacological strategy. The findings support the implementation of food-based anemia prevention programs in schools and rural health posts. Future research should involve a larger, more diverse sample and include additional biomarkers such as ferritin and TIBC.

**Keywords:** Adolescent health, Anemia, Dietary intervention, Hemoglobin, Psidium guajava L.

## INTRODUCTION

Adolescence is a critical period marked by significant biological, psychological, and social changes. These developmental transformations are accompanied by a heightened demand for nutrients, particularly iron, to support rapid growth, increased blood volume, and muscle development (Aprianningsing, 2023). Nutritional imbalances during this stage, especially iron deficiency, may lead to anemia, a condition characterized by hemoglobin levels below normal thresholds—defined as less than 12 g/dL in adolescent girls. Anemia reduces the blood's oxygen-carrying capacity, resulting in fatigue, impaired cognitive function, and diminished academic and physical performance (Hadi, 2023). Globally, anemia remains a persistent public health challenge. According to the World Health Organization (2024), the prevalence of anemia among adolescent girls in developing countries is approximately 53.7%. In Indonesia, data from the 2023 Indonesian Health Survey revealed a national prevalence of 15.5% among adolescents aged 15–24 years, with higher rates in females (18%) compared to males (14.4%). Though there has been a slight reduction in prevalence compared to five years prior, the numbers remain significantly above the WHO's threshold for a severe public health problem (Ministry of Health, 2023). In East Java, the prevalence is particularly concerning, with the East Java Provincial Health Office (2020) reporting that 42% of adolescent girls are affected. Specifically, in Lamongan Regency, the Indonesian Nutrition Survey (SSGI, 2022) recorded an anemia rate of 10.9% among adolescents. A preliminary assessment conducted in May 2025 in Lebakadi Village, Lamongan, revealed a lack of awareness about anemia among adolescent girls, with only 15 out of 30 students reporting any knowledge of the condition. This suggests that inadequate health education and nutritional literacy may be contributing to the persistence of anemia in this population.

The primary problem identified is the high prevalence of anemia among female adolescents in rural areas, attributed to poor nutritional intake and lack of knowledge regarding iron-rich foods and anemia prevention. Anemia in adolescents often results from iron deficiency due to insufficient consumption of iron-rich foods, poor absorption of nutrients, and physiological losses due to menstruation (Aulya et al., 2022). The general solution for addressing adolescent anemia includes both pharmacological and non-pharmacological strategies. Pharmacological treatment involves iron supplementation, typically with 60 mg of elemental iron weekly (Alami Wulandari et al., 2022). However, adherence to supplementation programs is often low due to gastrointestinal side effects or poor health-seeking behaviors. Therefore, a complementary non-pharmacological approach using dietary interventions has gained prominence.

Recent scientific literature supports the use of food-based interventions as a sustainable and culturally acceptable method to address anemia. One such approach involves the consumption of iron-rich and vitamin C-rich fruits to enhance iron absorption. Saudia and Putri (2021) demonstrated that iron absorption is significantly improved when consumed alongside natural vitamin C sources rather than synthetic supplements. Red guava (Psidium guajava L.) has emerged as a potent natural remedy due to its high vitamin C content and iron-supportive nutrients such as phosphorus, calcium, and amino acids (Mei Winarni et al., 2020). Similarly, dates (Phoenix dactylifera) contain iron, calcium, potassium, and vitamin C—nutrients that collectively promote the production of red blood cells and enhance hemoglobin synthesis (Mufidah et al., 2024). These fruits can be easily incorporated into the adolescent diet in various forms, including juice, extract, or pudding, offering a palatable and accessible solution to iron deficiency.

Several studies have explored the individual effects of red guava and dates on hemoglobin levels. Anggeriani and Yatiliu (2020) reported that daily consumption of a mixture of red guava juice and dates increased hemoglobin levels by 0.9 gr/dL among adolescents with mild to moderate anemia. Similarly, Alami et al. (2022) observed a rise in average hemoglobin levels from 11.376 g/dL to 14.129 g/dL after red guava juice intervention. Rohaninda et al. (2021) also documented significant improvements in hemoglobin levels following seven days of date juice consumption. While these findings highlight the efficacy of red guava and date juice independently, there is a lack of research on the synergistic effect of combining these fruits into a food form that is both appealing and easy to consume for adolescents. Furthermore, no published studies have specifically investigated the effect of Psidium guajava L. and Phoenix dactylifera combined in pudding form on hemoglobin levels among female adolescents in rural Indonesia, particularly in the Lamongan Regency. This gap in the literature signifies a crucial opportunity for research to evaluate a culturally appropriate, natural dietary intervention tailored to adolescent girls.

The main objective of this study is to examine the effect of consuming a pudding made from Psidium guajava L. (red guava) and Phoenix dactylifera (dates) on changes in hemoglobin levels among female adolescents diagnosed with anemia in Lebakadi Village, Lamongan Regency. The novelty of this study lies in the formulation and evaluation of a non-pharmacological intervention that combines the known hematological benefits of red guava and dates into a single, adolescent-friendly food product—pudding. Unlike prior studies that used juice or extract forms, this study tests the practicality and effectiveness of a pudding, which may be more acceptable and sustainable as a dietary supplement among adolescents. The working hypothesis is: “There is a significant increase in hemoglobin levels in female adolescents with anemia after consuming pudding made from Psidium guajava L. and Phoenix dactylifera.” This hypothesis is supported by biochemical mechanisms identified in the literature. Vitamin C in red guava enhances non-heme iron absorption by reducing it to the more bioavailable ferrous form ($Fe^{2+}$), while the iron content in dates directly contributes to hemoglobin synthesis (Saudia & Putri, 2021; Mufidah et al., 2024). The synergy between these fruits may amplify their individual hematological benefits. This study is limited to female adolescents aged 15–18 years diagnosed with anemia (Hb <12 g/dL) residing in Lebakadi Village, Lamongan Regency. The intervention consists of daily consumption of the formulated pudding for a defined period, followed by a post-test hemoglobin measurement. The study does not account for genetic factors, other underlying diseases, or external iron supplementation. The research is designed to contribute empirical evidence supporting food-based anemia management strategies in resource-limited settings, with a specific focus on adolescent nutrition.

## METHOD

### Research Design

This study utilized a quasi-experimental research design with a non-equivalent control group structure. Such a design is appropriate when random assignment of participants is not feasible. Instead, it compares two groups—an intervention group and a comparison group—both observed before and after the application of a treatment. In this study, the intervention group received a pudding made from *Psidium guajava L.* (red guava) and *Phoenix dactylifera* (dates), while the comparison group was provided with a placebo pudding. This method enables the measurement of treatment effectiveness under naturally occurring conditions (Rukminingsih, Sari, & Hadi, 2020).

### Research Setting and Duration

The research was conducted in Lebakadi Village, Sugio District, Lamongan Regency, East Java, Indonesia. This area was selected due to its high prevalence of adolescent anemia and limited access to nutritional interventions. The research was carried out over a span of 26 days, from May 12 to June 6, 2025. Activities during this period included participant selection, pretest measurements, intervention implementation, and posttest evaluations.

### Population and Sampling

The population targeted in this study consisted of female adolescents aged 14 to 17 years who attended the integrated health post (Posyandu) in the research area. Using purposive sampling, 60 respondents were selected based on specific inclusion and exclusion criteria. The sample was then divided into two equal groups: the intervention group (n = 30), which received the guava and date pudding, and the comparison group (n = 30), which received the placebo pudding. Inclusion criteria included adolescent females with hemoglobin (Hb) levels ranging from 9.8 to 11.9 g/dL, willingness to participate, and no ongoing iron supplementation. Exclusion criteria included allergic reactions to guava or dates and any underlying chronic or gastrointestinal conditions.

### Variables

The independent variable in this study was the daily consumption of 100 grams of *Psidium guajava L.* and *Phoenix dactylifera* pudding over 14 days. The dependent variable was the change in hemoglobin levels measured before and after the intervention. Additional control variables, such as age and knowledge level of anemia, were considered to ensure homogeneity between groups.

### Research Procedures

The research process began with a preparation phase in which the research team developed educational materials on anemia and created standardized recipes for the guava and date pudding. Hb levels of the respondents were measured on the first day (Day 0) using a digital hemoglobinometer to determine eligibility and establish a baseline. During the intervention phase, the treatment group consumed 100 grams of pudding made from equal portions of mashed red guava and date extract daily for 14 consecutive days. No additional vitamins or supplements were provided to isolate the effect of the pudding. Meanwhile, the comparison group received a placebo pudding that resembled the treatment in appearance and texture but lacked active ingredients. On Day 15, a follow-up Hb measurement was conducted for both groups. Data collection employed a combination of checklist forms and observation sheets. Checklist forms captured demographic and anemia-related knowledge, while observation sheets monitored adherence to the intervention and any reported side effects. These instruments allowed for systematic tracking of the intervention and its outcomes.

### Instrumentation

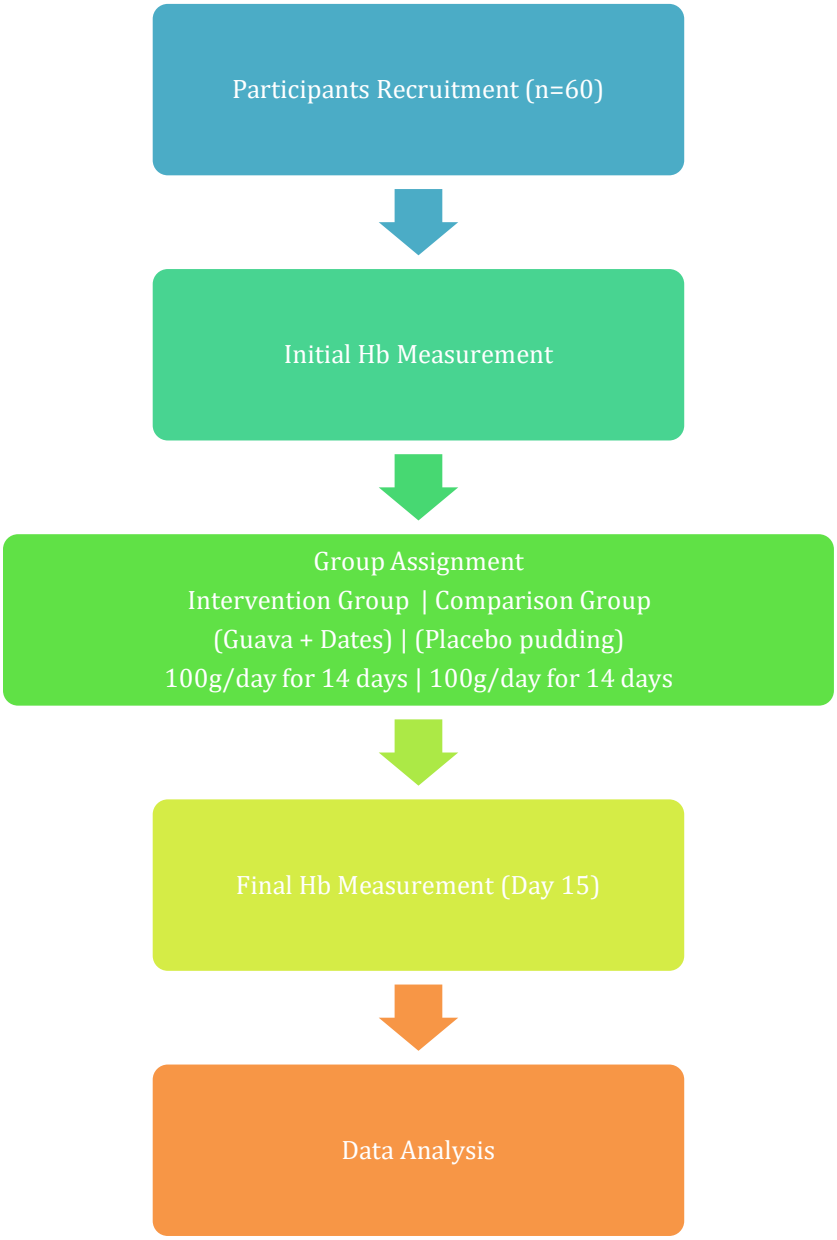
The primary tool used to measure hemoglobin levels was a digital hemoglobinometer, which offered reliable and quick analysis of blood samples. Additionally, the researchers used validated checklist questionnaires to gather information about participants' age, knowledge of anemia, and dietary habits.

Observation logs were used daily to document pudding consumption and ensure compliance. All instruments underwent a pilot test to assess validity and reliability before the full study commenced.

**Data Analysis**

The data collected were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize the demographic characteristics and hemoglobin levels of the respondents. To evaluate the effectiveness of the intervention, paired sample t-tests were conducted to compare hemoglobin levels before and after the intervention within each group. Independent sample t-tests were also employed to compare changes in hemoglobin levels between the treatment and control groups. A significance level of $p < 0.05$ was adopted to determine statistical significance. To visualize the research flow, a schematic representation of the methodology is presented below:

**Figure 1. Research Flowchart**



In addition to the visual flow of the research, the variables used in this study and their operational definitions are summarized in the following table:

**Table 1. Research Variables and Operational Definitions**

| Variable | Type | Definition | Measurement Tool |
|---|---|---|---|
| Hemoglobin Level | Dependent | Grams of hemoglobin per deciliter of blood (g/dL) | Digital hemoglobinometer |
| Pudding Intervention | Independent | 100g/day pudding made of red guava and dates | Standardized recipe & logs |
| Age | Control | Age of participant in years | Demographic questionnaire |
| Knowledge Level | Control | Awareness of anemia and nutritional knowledge | Pre- and posttest forms |

**Ethical Considerations**

This research received ethical clearance from the Ethics Committee of the Institute of Technology, Science and Health of Dr. Soepraoen Hospital. All participants and, where necessary, their legal guardians were informed about the purpose, procedures, benefits, and risks of the study. Written informed consent was obtained before participation. The research adhered to standard ethical guidelines in medical and health-related research, including voluntary participation, the right to withdraw at any time, and strict confidentiality of personal data. Participant identities were anonymized in all reports and data analyses, and biological specimens used in the Hb tests were not stored beyond immediate analysis.

## RESULTS AND DISCUSSION

**Respondent Characteristics**

This study involved a total of 60 adolescent girls from Lebakadi Village, Sugio District, Lamongan Regency, who were divided equally into an intervention group and a comparison group. The age distribution of respondents is presented in Table 1.

**Table 2. Frequency Distribution of Respondents Based on Age**

| Age | n (Treatment) | % (Treatment) | n (Comparison) | % (Comparison) |
|---|---|---|---|---|
| 14 years | 0 | 0% | 0 | 0% |
| 15 years | 15 | 50% | 15 | 50% |
| 16 years | 13 | 40% | 12 | 40% |
| 17 years | 2 | 6.6% | 2 | 6.6% |
| **Total** | **30** | **100%** | **30** | **100%** |

The data indicates that the majority of the participants in both groups were 15 years old, which aligns with the period of middle adolescence—a developmental stage associated with increased nutritional requirements due to growth spurts and menstruation (Patton et al., 2016).

**Hemoglobin Levels Before and After Intervention**

Hemoglobin (Hb) levels were measured before and after the intervention to evaluate the effect of guava and date pudding. The results are shown in Tables 2 and 3.

**Table 3. Hemoglobin Frequency Distribution Before and After Intervention**

| Hemoglobin Levels | Min | Max | Mean | Std. Deviation |
|---|---|---|---|---|
| Prior Treatment | 9.8 | 10.9 | 10.43 | 0.31 |
| After Treatment | 10.3 | 12.6 | 12.00 | 0.55 |
| Prior Comparison | 11.0 | 11.9 | 11.45 | 0.25 |
| After Comparison | 11.0 | 11.9 | 11.47 | 0.27 |

**Table 4. Average Increase in Hemoglobin Levels Before and After Administration**

| Group | Initial Mean ± SD | Final Mean ± SD | p-value |
|---|---|---|---|
| Treatment | 10.43 ± 0.31 | 12.00 ± 0.55 | 0.000 |
| Comparison | 11.45 ± 0.25 | 11.47 ± 0.27 | 0.229 |

As presented in Table 3, the treatment group experienced a statistically significant increase in Hb levels ($p < 0.05$), with an average increase of 1.57 g/dL. Meanwhile, the comparison group had a negligible and statistically insignificant change of only 0.02 g/dL ($p > 0.05$).

**Comparative Findings with the Literature**

This study's findings are consistent with prior research on food-based interventions for anemia. For instance, Apriyanti et al. (2022) demonstrated that consuming 100 grams of dates daily for seven days could increase hemoglobin levels by 1.3 g/dL in adolescent girls. Similarly, Aisah et al. (2022) found an increase of 1.4 g/dL over 14 days with date consumption. These results support the role of *Phoenix dactylifera* in improving hematological parameters. Red guava (*Psidium guajava L.*), known for its high vitamin C content, enhances the bioavailability of non-heme iron, thereby aiding iron absorption. Handayani (2021) reported a 0.6 g/dL increase in Hb levels after the administration of guava juice, consistent with our findings of a higher increase when combined with dates. Vitamin C's role as a potent enhancer of iron absorption is well-documented, with studies indicating it can improve iron uptake by up to 67% in iron-deficient subjects (Teucher et al., 2004; Hallberg et al., 1989).

The synergistic effect observed in this study can be attributed to the complementary nutritional profiles of the two fruits. Dates are rich in iron (1.2 mg/100g), calcium (52 mg/100g), and potassium (500 mg/100g), while guava offers a remarkable concentration of vitamin C (228 mg/100g) and small but effective amounts of iron and selenium (Fandy et al., 2023; Mufidah et al., 2024). International research by Houghton et al. (2016) emphasized the potential of combining vitamin C-rich and iron-rich foods to combat adolescent anemia. Additionally, a randomized controlled trial by Sharma et al. (2020) found that girls consuming iron-rich snacks along with citrus fruits had a significantly better improvement in Hb levels than those receiving iron supplements alone.

**Interpretation and Significance of Findings**

Anemia in adolescent girls poses long-term risks, including impaired cognitive development, decreased academic performance, and increased risk during future pregnancies (WHO, 2021; Black et al., 2013). The significant increase in Hb levels in the intervention group suggests that red guava and date pudding could serve as an accessible, culturally appropriate dietary intervention, especially in rural or low-resource settings where iron supplements are underutilized due to side effects or lack of awareness. This food-based intervention aligns with WHO recommendations for using locally available and acceptable foods to address micronutrient deficiencies (WHO, 2020). The pudding format may also enhance compliance due to its palatability, making it an ideal medium for school-based health education and nutrition programs.

Pharmacological approaches, such as iron supplementation, though effective, often suffer from low adherence and gastrointestinal side effects (Petry et al., 2016). This study reinforces the growing body of evidence that food-based strategies can offer safer and more sustainable alternatives or complements to pharmacological interventions, especially among adolescents with mild to moderate anemia. A meta-analysis by Low et al. (2013) comparing food fortification with iron supplements found comparable efficacy in improving Hb levels but reported higher acceptability and fewer side effects in dietary interventions. Our study's findings support this trend by demonstrating a significant improvement without reported adverse effects.

**Biochemical Justification for Efficacy**

From a biochemical perspective, vitamin C in guava acts as a reducing agent, converting ferric ($Fe^{3+}$) to the more soluble ferrous ($Fe^{2+}$) form, thus enhancing intestinal absorption of iron (Fairweather-Tait et al., 2014). Concurrently, dates not only supply elemental iron but also provide other hematopoietic cofactors

such as vitamin B6 and folate (Al-Farsi et al., 2005). This complementary action likely contributed to the statistically significant increase in hemoglobin levels observed in the treatment group. Furthermore, according to Hurrell & Egli (2010), the combination of vitamin C and iron-rich foods is a globally accepted strategy for reducing anemia prevalence. The findings of this study offer empirical support for applying such a strategy at the community level through simple, cost-effective dietary measures.

**Study Limitations and Recommendations for Future Research**

While the results are promising, this study had several limitations. The sample size was limited to 60 respondents in a single geographic location, which may restrict the generalizability of the findings. Future studies should expand to include diverse populations across different regions, and ideally, incorporate male adolescents and different socioeconomic backgrounds. Moreover, this study focused solely on hemoglobin levels. For a more comprehensive assessment of anemia status and iron metabolism, future research should include ferritin, transferrin saturation, and total iron-binding capacity (TIBC) measurements. Finally, qualitative research exploring adolescents' perceptions of food-based anemia prevention could yield deeper insights into behavioral adherence and cultural acceptability.

## CONCLUSION

This study aimed to evaluate the effect of consuming Psidium guajava L. and Phoenix dactylifera pudding on changes in hemoglobin levels among female adolescents with anemia in Lebakadi Village, Lamongan Regency. The results demonstrated a statistically significant increase in hemoglobin levels in the treatment group, with an average rise of 1.57 g/dL after 14 days of daily pudding consumption, while no significant change was observed in the comparison group. These findings highlight the efficacy of integrating iron-rich and vitamin C-rich fruits into a culturally appropriate and adolescent-friendly food format, offering a sustainable non-pharmacological strategy for addressing iron deficiency anemia. This research contributes to the body of knowledge by validating a low-cost, locally sourced intervention that supports WHO recommendations on dietary-based anemia prevention, and provides a model for school or community-based health education programs targeting nutritional deficiencies in rural populations.

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