Eksakta : Berkala Ilmiah Bidang MIPA
VOLUME 27 NO 05 2026, pp 850-858
ISSN : Print 1411-3724 — Online 2549-7464
DOI : https://doi.org/10.24036/eksakta/vol27-iss05/762

Eksakta
Berkala Ilmiah Bidang MIPA
http://www.eksakta.ppj.unp.ac.id/index.php/eksakta

Article

Synergistic Effect of Date Pudding and Moringa Leaf Extract on Hemoglobin Levels in Adolescent Girls

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Article Info

Article history :
Received September 08, 2026
Revised September 18, 2026
Accepted September 28, 2026
Published October 30, 2026

Keywords :
Anemia, dates,
hemoglobin,
moringa,
adolescent girls

Abstract. Anemia among adolescent girls can negatively affect learning concentration, productivity, and quality of life. The administration of iron (Fe) tablets, dates (Phoenix dactylifera L), and moringa leaves (Moringa oleifera Lam) has the potential to increase hemoglobin levels because they contain iron and other essential nutrients that support erythrocyte formation. Objective: to determine the effectiveness of consuming date and moringa leaf extract pudding combined with Fe tablets in hemoglobin levels among female adolescent girls at Sukabumi. Methodology: This study employed a quasi-experimental design using a two-group prepost test. The sample of 40 respondents, divided into an intervention (n=20) and a control (n=20), selected using purposive sampling. The intervention group received combination pudding and moringa leaf extract along with one Fe tablet daily for 14 days, while the control group received only one Fe tablet daily. The Independent Samples t-test got a p value of 0.00 in both groups, and the Dependent Samples t-test got a p value of 0.62 before the treatment and 0.00 after the treatmentConclusion: Consumption of date pudding containing moringa leaf extract combined with Fe tablets was more effective in increasing hemoglobin levels than Fe tablet supplementation alone among adolescent girls.

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1. Introduction

Iron deficiency anemia remains a global health problem that directly impairs growth, learning concentration, and productivity among adolescent girls. According to the WHO (2025), 30.7% of women aged 15–49 years worldwide were reported to have anemia in 2023 [1]. Sony et al. (2025) stated that anemia remains one of the most significant health challenges worldwide, particularly among women of reproductive age and adolescents [2]. Adolescent girls are a particularly vulnerable age group due to rapid physical growth, increased nutritional requirements, and regular menstrual blood loss [3]. During adolescence, iron requirements increase substantially to support increases in blood volume, muscle mass, and overall growth [4]. If dietary intake is inadequate, iron deficiency anemia can commonly occur [5].

Adolescents are individuals aged 10 to 19 years [6]. Adolescence is characterized by changes in physical appearance and physiological functions, particularly those related to the sexual glands. Psychologically, adolescence is a period during which individuals experience changes in cognitive, emotional, social, and moral aspects as they transition from childhood to adulthood [7]. Iron deficiency is considered the most common cause of anemia globally; however, other nutritional deficiencies, including folate, vitamin B12, and vitamin A, as well as acute and chronic inflammation and parasitic infections, can also cause anemia [8].

Various promotive and preventive measures have been implemented by the Indonesian government to control anemia among adolescent girls. One such program is the Iron and Folic Acid Supplementation Program, commonly known as the Weekly Iron-Folic Acid Supplementation (WIFAS) or iron (Fe) tablet program, which provides iron tablets to adolescent girls to reduce the incidence of anemia associated with menstruation. During menstruation, many adolescent girls experience fatigue, weakness, pain, and decreased concentration while studying [9].

The iron supplementation program is intended to fulfill iron requirements while preventing anemia among adolescent girls [10]. Dinengsih et al. emphasized that innovations based on non-pharmacological approaches are highly useful in supporting government programs. Therefore, it is important to understand how practical nutritional interventions can be packaged in an appealing manner for adolescents without reducing the biological efficiency of iron absorption in the body [11].

Various programs have been implemented; however, the prevalence of anemia among adolescent girls remains high. One of the contributing factors is poor adherence to regular Fe tablet consumption due to complaints of nausea, boredom, and inadequate understanding of the benefits of iron supplementation [12]. This highlights the need for intervention options that are innovative, practical, and acceptable to adolescents. The utilization of iron-rich local foods prepared in forms that are appealing to adolescents may serve as one potential approach. Ajwa dates (Phoenix dactylifera L) contain iron, vitamins, and energy that support hemoglobin formation [13]. Moringa leaves (Moringa oleifera Lam) are also rich in iron and antioxidants, making them potentially beneficial in increasing hemoglobin levels [14].

Vitamin C contained in Moringa leaves may also help enhance iron absorption in the body [15]. Date pudding with Moringa leaf extract was selected because its taste is more acceptable to adolescent girls, it is practical to consume, and it serves as a healthy supplementary food to help prevent anemia. The combination of these two ingredients is expected to support iron absorption, thereby promoting an optimal increase in hemoglobin levels

West Java is among the provinces with a high prevalence of anemia among adolescent girls. The 2023 West Java Provincial Health Profile reported a prevalence of 34%, which was higher than the prevalence in 2020, which was 28%. This finding highlights the need for health promotion and anemia prevention measures among adolescent girls [16]. Sukabumi Regency also faces the issue of anemia among adolescent girls, with a prevalence of 36% among adolescents [17].

This study aimed to examine the effectiveness of a combination of date pudding and Moringa leaf extract administered together with iron (Fe) tablets among adolescent girls. In Sukabumi. This

approach was implemented using a quasi-experimental method with a two-group pretest-posttest design. The study represents an applicable preventive strategy that can be implemented in school settings. Through this study, the researchers demonstrate that local food ingredients can be developed into modern food products as an approach to addressing anemia among adolescent girls.

2. Experimental Section

2.1. Materials

The main material investigated in this study was date pudding combined with Moringa leaf (Moringa oleifera Lam) extract. The dates used were the Ajwa variety (Phoenix dactylifera L.) originating from Medina, obtained from a local distributor in Sukabumi, West Java. The dates met the following physical criteria: fully ripe (tamr), dark brown to blackish in color, soft in texture, and clean. Fresh Moringa leaves were obtained from a family medicinal plant garden in the Cicurug area, Sukabumi (Figure 1).



Figure 1. Ajwa Dates, Moringa Leaves, Research Location

The leaves were harvested in the morning to maintain the stability of their antioxidant content, with dark green leaves selected The standard comparator material used was the Iron and Folic Acid Supplementation, tablet manufactured by PT Kimia Farma, containing fumarate equivalent to 60 mg of elemental iron and 400 mcg of folic acid per tablet. The formulation for producing 100 grams of pudding consisted of a combination of 30 grams of mashed Ajwa date flesh (puree), 250 mg of dried Moringa leaf extract powder, 2 grams of unflavored agar-agar powder (halal-certified), 10 mL of pure cow's milk (UHT), and 58 mL of water. This formulation was designed to provide a soft gel texture and a predominantly natural sweet taste to mask the strong herbal (earthy/grassy) flavor of the Moringa extract, thereby improving sensory acceptability (palatability) among adolescent girls. The equipment used to measure hemoglobin levels included one portable digital hemoglobinometer (Easy Touch Hb), which had undergone internal calibration; specialized hemoglobin test strips (Easy Touch Hb strips); sterile disposable lancets; and 70% alcohol swabs.

2.2. Methods

The experimental design implemented in this study was a quasi-experimental design using a two-group pretest-posttest design. The study was conducted at Sukabumi Regency, West Java Province, with a structured clinical intervention period of 14 consecutive days in 2026. The methodological procedures were systematically implemented through four main procedural phases, as illustrated in the Flowchart (Figure 2).

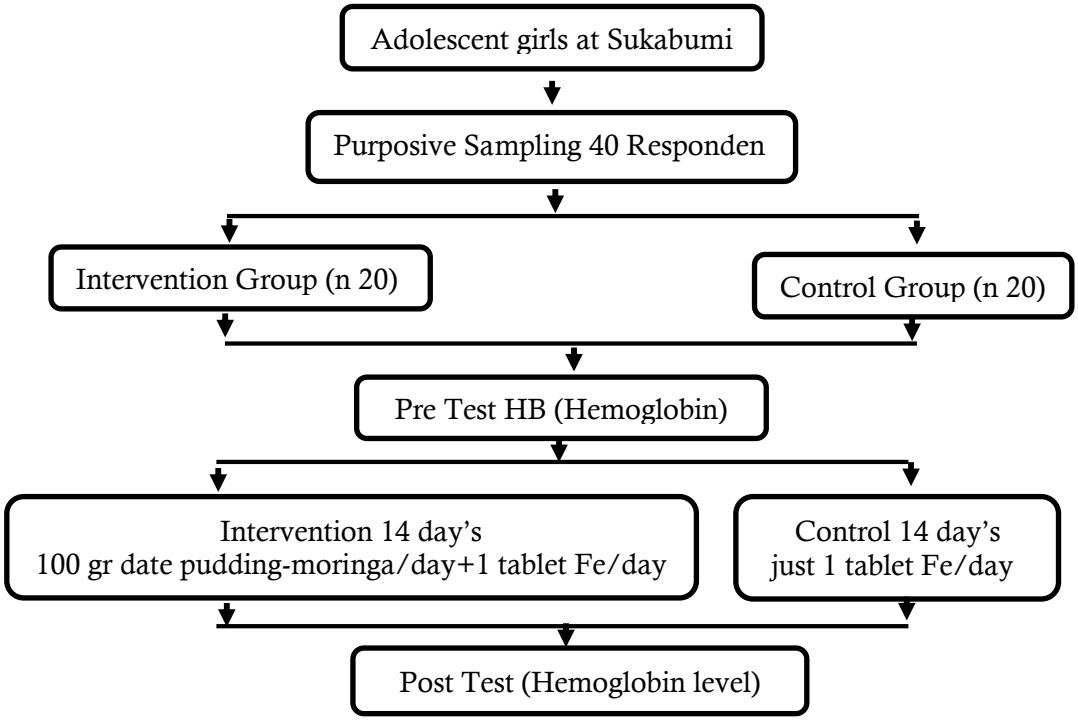


Figure 2. Research Flowchart

The first phase was the preparation phase, which included obtaining a research permit and ethical approval from the Health Research Ethics Committee. The study passed the ethical review and received an ethics certificate with Number 092/e-KEPK/FIKES/VIII/2026. This phase was followed by population screening using purposive sampling to recruit 40 adolescent girls aged 15–17 years who met the inclusion criteria: having mild to moderate anemia with an initial hemoglobin level of 8.0–11.9 g/dL, having a regular menstrual cycle, and being willing to provide written informed consent. The selected subjects were allocated homogeneously and equally divided into two groups: an intervention group (n=20) and a control group (n=20).

The second phase was the initial measurement (pretest), in which peripheral capillary blood samples were collected from the fingertip of each respondent in both groups under the supervision of school medical personnel. Hemoglobin levels were measured using a digital Easy Touch Hb device.

The third phase was the 14-day clinical intervention. The intervention was conducted for 14 days to avoid extending beyond the menstrual cycle. As the menstrual cycle was considered to last 28 days, the researchers administered the intervention for half of the cycle, namely 14 days. The intervention group was required to consume 100 grams of date pudding containing Moringa leaf extract daily after school and take one Fe tablet, whereas the control group was instructed to independently take one Fe tablet daily at the same frequency. Consumption in the intervention group was directly supervised (direct observation) by the researchers in the school health unit to ensure 100% adherence.

The fourth phase was the final measurement (posttest), in which blood samples were collected again on the 15th day. All quantitative ratio-scale data obtained were tested for normality using the Shapiro-Wilk test. After the data were confirmed to be normally distributed, parametric inferential analyses were performed using the Paired Samples t-test to assess changes in mean hemoglobin levels within each group and the Independent Samples t-test to analyze differences in effectiveness between the groups, with a significance level of $\alpha=0.05$.

3. Results and Discussion

Based on Table 1, the majority of respondents in both groups were 16 years old, accounting for 60% of the intervention group and 55% of the control group. All respondents (100%) had menstrual cycles within the normal range of 21–35 days. Regarding age at menarche, most of the female students experienced their first menstruation between 12 and 14 years of age (77.5%). In terms of menstrual duration, 90% of respondents in the intervention group and 85% in the control group had menstrual periods within the normal range of 3–7 days.

Tabel 1. Characteristics Responden

Responden Charactetistic	Intervention Group *f* (%)	Control Group *f* (%)	Total *f* (%)
Age (years)			
15	4 (20%)	5 (25%)	9 (22.5%)
16	12 (60%)	11 (55%)	23 (57.5%)
17	4 (20%)	4 (20%)	8 (20.0%)
Cycle Menstrual			
Regular (21-15 hari)	20 (100%)	20 (100%)	40 (100%)
Irregular	0 (0%)	0 (0%)	0 (0%)
Menarche Age			
<12 years	3 (15%)	2 (10%)	5 (12.5%)
12-14 years	15 (75%)	16 (80%)	31 (77.5%)
> 14 years	2 (10%)	2 (10%)	4 (10.0%)
Long Period (Days)			
Normal (3-7 days)	18 (90%)	17 (85%)	35 (87.5%)
Too Long (> 7 days)	2 (10%)	3 (15%)	5 (12.5%)

Middle adolescence is a crucial phase in the female life cycle, characterized by a second wave of accelerated physical growth (growth spurt) and maturation of the reproductive organs, which require an increased supply of micronutrients [15],[18]. International adolescent health literature states that during this age range, blood volume undergoes substantial expansion in parallel with increases in muscle tissue mass, resulting in a marked increase in iron (Fe) requirements for the formation of new hemoglobin molecules, exceeding those of adolescent boys [13],[19]. This is consistent with the findings of Dinengsih et al., who stated that school age is a crucial period for nutritional interventions [11].

All respondents (100%) had regular menstrual cycles within the physiological range of 21–35 days. The regularity of these menstrual cycles indicates relatively stable gonadotropic hormonal function among the female students [20]. Although regular menstrual cycles may minimize the risk of excessive bleeding, consistent monthly blood loss remains a major contributor to daily iron loss among women of reproductive age [21].

Regarding age at menarche (first menstruation), the majority of respondents experienced menarche within the normal age range of 12–14 years (77.5%). Adolescents who experience menarche at a normal age are generally considered to have more favorable physiological development compared with those who experience early menarche (<11 years). Regarding menstrual duration, a small proportion of respondents experienced menstruation lasting longer than 7 days. Epidemiological publications from the World Health Organization (WHO) emphasize that abnormal menstrual duration is an important risk factor for iron deficiency anemia among adolescent girls in developing countries. Excessive blood loss requires adequate compensation through dietary iron intake. The presence of female students with prolonged menstrual duration in this study further highlights the

importance of providing blood-enhancing foods, such as a composite pudding made from Ajwa dates and Moringa leaves, as a potential nutritional intervention to help prevent anemia among adolescent girls [22].

Table 2. Changes (Pre-Test to Post-Test) in Hb Levels in the Intervention and Control Groups

Group	Measurement	Average Value Mean± SD (gr/dl)	Min-Max	Calculated t-value	p-value
Intervention	Pre test	10.25 ± 0.61	9.10 – 11.7	29.481	0.00
	Post Test	12.83 ± 0.68	11.4 – 14.3		
Control	Pre test	10.35 ± 0.60	9.20 – 11.8	18.724	0.00
	Post Test	11.56± 0.61	10.4 – 13.1		

Table 2, the intervention group showed a p-value of 0.00 and a calculated t-value of 29.481. This finding was supported by an increase in the minimum hemoglobin level from 9.1 g/dL to 11.4 g/dL after the intervention. This improvement was greater than that observed in the control group, which had a calculated t-value of 18.724, with the mean hemoglobin level increasing from 10.35 ± 0.60 g/dL to 11.56 ± 0.61 g/dL. The increase in hemoglobin levels in the intervention group was associated with the consumption of Ajwa dates (Phoenix dactylifera L) and Moringa (Moringa oleifera Lam.) concentrate. Adolescent girls are more vulnerable to anemia because iron requirements increase during growth, while menstruation causes the loss of this mineral [23].

The increase in hemoglobin levels in the intervention group may be attributed to dates (Phoenix dactylifera L), which provide iron, various vitamins and minerals, as well as bioactive compounds that support hemoglobin synthesis. This nutritional composition provides a basis for the use of dates as a functional food to help prevent anemia [24]. Ridwan et al. (2018), the iron in dates supports the formation of red blood cells, so giving them can boost hemoglobin in teenage girls [25]. Another study reported an increase in hemoglobin after teenage girls with anemia consumed date syrup who reported an increase in hemoglobin levels among adolescent girls with anemia after consuming date extract [26]. Their study demonstrated that hemoglobin levels changed following the intervention involving date extract consumption.

Research also showed an increase in hemoglobin in teenage girls who were given dates at MTs Negeri 5 Sragen. Research also showed an increase in hemoglobin in teenage girls who were given dates at MTs Negeri 5 Sragen [27]. Another study reported that date extract can improve hemoglobin in teenagers [28]. Moringa leaf supplementation was also effective in increasing hemoglobin levels among adolescent girls. Its iron content and various micronutrients support hemoglobin synthesis. Therefore, the combination of dates and Moringa leaves in pudding consumed together with Fe tablets has a scientific basis as a potential nutritional intervention to improve hemoglobin levels [29]. The increase in hemoglobin levels in the control group indicates a positive response to Fe supplementation. The iron provided by the tablets is utilized in heme synthesis within erythrocytes. When iron availability is adequate, red blood cell production can proceed more effectively, resulting in a gradual increase in hemoglobin levels [30].

Table 3. Comparison of HB Levels in the Intervention Group and the Control Group

Variabel	Group	Mean ± SD (gr/dl)	Median	T	p-value
Pre-Test	Intevention	10.25 ± 0.61	10.25	-0.532	0.62
	Control	10.35 ± 0.60	10.35		
Post-Test	Intevention	12.83 ± 0.68	12.85	6.218	0.00
	Control	11.56 ± 0.61	11.55		

Table 3 shows that the significance value before the intervention was p=0.622 (p>0.05). This finding indicates that there was no statistically significant difference between the two groups at baseline, confirming that the sample conditions were comparable and suitable for comparison. In contrast, the results after the intervention showed a highly significant difference, with p=0.000 (p<0.05). The difference in the post-intervention mean hemoglobin levels (12.83 ± 0.68 g/dL in the intervention group and 11.56 ± 0.61 g/dL in the control group) provides empirical evidence supporting the research hypothesis, indicating that the combination of date pudding and Moringa leaf extract was significantly more effective in increasing hemoglobin levels among adolescent girls than iron supplementation alone.

The intervention group demonstrated a calculated t-value of 29.481, compared with 18.724 in the control group. This finding was further supported by the range of hemoglobin values (minimum–maximum) in the intervention group, which increased from 9.1 g/dL to 11.4 g/dL after the intervention.

Based on Table 3, the Independent Samples t-test analysis showed a significance value of p=0.622 before the intervention. However, after the 14-day intervention, a calculated t-value of 6.218 was obtained, with a p-value of 0.000. These statistical results provide empirical evidence that the addition of Ajwa date (Phoenix dactylifera L) pudding and Moringa (Moringa oleifera Lam.) concentrate increased hemoglobin levels compared with the control group, which relied solely on Iron and Folic Acid Supplementation (IFA) tablets.

Adolescent girls are a high-risk group for anemia because iron requirements increase during rapid growth, while menstruation contributes to blood loss. If these requirements are not adequately met, hemoglobin levels may decrease, resulting in anemia. Regular consumption of Moringa leaf extract capsules has been reported to significantly increase hemoglobin levels among adolescent girls [31]. The relationship between nutritional adequacy and the occurrence of anemia indicates that sufficient nutrient intake, including iron, is necessary to maintain adequate hemoglobin levels [32]. The administration of date extract together with Fe tablets has also been reported to be effective in increasing hemoglobin levels among adolescent girls with anemia. Iron, vitamin C, and other micronutrients contained in date extract may support iron absorption, thereby facilitating more optimal hemoglobin synthesis [33].

4. Conclusion

The innovation of consuming functional food in the form of date pudding containing Moringa leaf extract combined with Iron and Folic Acid Supplementation (IFA) tablets was shown to be significantly more effective in increasing hemoglobin levels among adolescent girls at Cicurug, Sukabumi. The intervention resulted in a substantial mean increase in hemoglobin of 2.58 g/dL, from 10.25 g/dL to 12.83 g/dL (p=0.000), compared with standard iron supplementation alone. The potential synergistic effects of the high vitamin C content in Moringa leaves as a biochemical absorption enhancer and the readily available energy provided by Ajwa dates may support iron absorption in the small intestine.

In addition, the soft and sweet pudding formulation may improve acceptability and potentially reduce complaints such as nausea and metallic taste, which may contribute to poor adherence among

adolescents. Therefore, as an applicable and innovative strategy, school health programs (Usaha Kesehatan Sekolah/UKS), in collaboration with local community health center (Puskesmas) cadres, may consider adopting this local composite pudding formulation as a complementary intervention during national IFA tablet distribution activities. This approach may contribute to the development of an independent, acceptable, and adolescent-friendly anemia prevention program.

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