

THE EFFECT OF A COMBINATION OF MORINGA LEAF PUDDING AND HONEY ON HEMOGLOBIN LEVELS IN FEMALE ADOLESCENTS AT SMK IBRAHIMY 1 SUKOREJO

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ABSTRAK

Background: Iron-deficiency anemia is one of the health issues commonly experienced by adolescent girls, which can affect academic concentration, physical endurance, and quality of life. Natural ingredients such as moringa leaves and honey contain iron and other supportive nutrients that have the potential to be used as non-pharmacological alternatives to increase hemoglobin levels.

Objective: This study aims to investigate the impact of administering a combination of moringa leaf pudding and honey on the hemoglobin levels of adolescent girls.

Methods: This research used a quantitative method with a quasi-experimental design and a non-equivalent control group strategy. A total of 60 female students in grade eleven participated, split into an intervention group and a control group. The intervention group was given moringa leaf and honey pudding once per day over a period of seven days. Hemoglobin levels were assessed before and after the intervention using a digital hemoglobin meter. The data were evaluated using the Wilcoxon and Mann-Whitney statistical tests.

Results: The average hemoglobin level in the intervention group rose from 10.19 g/dL to 13.57 g/dL, which was statistically significant ($p < 0.05$). In contrast, the control group showed no significant change, with levels remaining virtually the same at 11.68 g/dL to 11.67 g/dL ($p > 0.05$). The Mann-Whitney test indicated a significant difference between the two groups ($p = 0.000$).

Conclusion: The combination of moringa leaf pudding and honey significantly increased hemoglobin levels in adolescent girls. This intervention has the potential to become an alternative strategy for preventing anemia among adolescents.

BACKGROUND

Adolescence is a transitional period from childhood to adulthood, occurring between the ages of 10 and 19. During this phase, significant changes occur in physical, social, and emotional



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aspects (Istiqamah & Kas, 2022). One of the common health problems faced by adolescents, especially adolescent girls, is iron deficiency anemia. Anemia can significantly reduce the overall quality of life for adolescents, affecting their physical health, academic performance, and social and emotional development. Anemia is also a global health issue with high prevalence, particularly in developing countries (Budiman & Handayani, 2022). This issue was also found at SMK Ibrahimy 1 Sukorejo, Situbondo, where a preliminary study showed that all respondents had anemia, with 10% classified as mild, 50% moderate, and 40% severe. If left untreated, anemia can reduce academic concentration, weaken the immune system, and disrupt adolescents' overall development. **Iron deficiency anemia can cause paleness, fatigue, decreased concentration, and stunted growth. In adolescence, this can impact academic performance and daily activities.**

According to data from the World Health Organization (WHO) data from 2018, anemia affects between 40% and 88% of the global population. In developing countries, the prevalence rate is approximately 27%, while in developed countries, it is about 6% (Fitriyani et al., 2023). The Indonesian Ministry of Health reported in 2018 As many as 37.1% of adolescent girls were found to be anemic, which later increased to 48.9% (Sihotang & Tarigan, 2024). In East Java Province, the Health Office recorded a prevalence of 42% in 2020 (Laili et al., 2023). Furthermore, the Situbondo District Health Office revealed in 2019 that 43.5% of 7,000 adolescent girls in the region were anemic. A study conducted by Hamidiyah (2020) at the Salafiyah Syafi'iyah Islamic Boarding School in Sukorejo found that 70.7% of the female students were affected by anemia. In a preliminary study at SMK Ibrahimy 1 Sukorejo, hemoglobin levels were measured in 10 female students of grade XI. The results showed that all participants had anemia, with 10% experiencing mild anemia, 50% moderate anemia, and 40% severe anemia.

Anemia in adolescent girls is generally caused by iron deficiency due to low micronutrient intake. Menstruation is one of the main causes because of the monthly blood loss, which, if not balanced with sufficient iron intake, can lead to deficiency (Yulianti et al., 2024). Unhealthy lifestyles, such as irregular eating patterns and consumption of nutrient-poor fast food, further exacerbate this condition (Rosida & Dwihesti, 2020). Additionally, psychological factors like the desire to maintain body shape through extreme dieting, as well as rapid growth during adolescence, further increase the need for iron (Subratha & Ariyanti, 2020).

If left untreated, anemia can lead to serious consequences, including chronic fatigue, concentration difficulties, impaired memory, hindered physical growth and development, and weakened immunity, making adolescents more susceptible to infections (Budiman & Handayani, 2022). The government's efforts to address adolescent anemia include the distribution of Iron-Folic Acid Tablets (IFAT), which are taken once a week (Sari & Nasuha, 2021). However, the use of TTD often causes side effects such as nausea, vomiting, constipation, and changes in stool color to black, which makes some adolescents reluctant to consume them (Nurfiana et al., 2024).

As a natural alternative, consuming iron-rich foods such as vegetables can help increase hemoglobin levels without harmful side effects (Maulina et al., 2022). Moringa leaves (*Moringa oleifera*) are one of the vegetables with high iron content, and they also contain vitamins A, C, K, B6, thiamine, riboflavin, and protein, which play a crucial role in hemoglobin synthesis (Hastuti & Sari, 2022). A study by Indriani et al. (2019) Consuming moringa-based capsule supplements resulted in a 1.76 ± 0.80 g/dL increase in hemoglobin concentration. **Pharmacological**

Treatment



- Iron supplementation (ferrous sulfate or ferrous gluconate) – standard dose 100–200 mg of elemental iron per day, divided 2–3 times, for 3–6 months and non-Pharmacological Treatment

- Diet: Increase consumption of foods rich in heme iron (red meat, liver, fish) and non-heme iron (nuts, spinach, tofu), as well as sources of vitamin C to aid absorption.

Apart from moringa leaves, honey is also known to contribute to increased hemoglobin levels, as it contains iron, vitamin C, various B-complex vitamins, and folic acid (Pramestiyani & Wahyuni, 2022). Research conducted by Harjuna (in Idris & Fatmawaty Mal, 2019) It was reported that consuming 45 ml of honey resulted in an increase in hemoglobin levels by 1.2 g/dL.

A gap found in the literature is the lack of innovation in food products that combine iron-rich ingredients in an appealing and easy-to-consume form for adolescents. Therefore, researchers developed a pudding product combining moringa leaves and honey, as pudding is a food favored by adolescents due to its soft texture, sweet taste, and ease of preparation and consumption.

The motivation for this study is to provide a natural alternative solution that is appealing to adolescents in order to overcome anemia, while also increasing adolescents' awareness of the importance of iron intake. The combination of moringa leaves and honey as a sugar substitute is expected to not only increase hemoglobin levels but also add nutritional value to adolescents' diets.

In this context, the aim of this research is to evaluate the impact of providing moringa leaf pudding mixed with honey on the hemoglobin levels of adolescent girls. This research seeks to contribute to the prevention and management of anemia through an innovative, natural, and community-based nutritional approach that aligns with the preferences and habits of the target population. **The object of research in this study is female adolescents at the Salafiyah Syafiyah Islamic boarding school in Situbondo.**

Method

This study employs a quantitative method utilizing a quasi-experimental design a Non-Equivalent Control Group Model. The design included two separate groups: the intervention group, which received a mixture of moringa pudding and honey, and the control group, which received no treatment. Hemoglobin levels were measured in both groups before and after the intervention.

The sample population consisted of all 473 eleventh-grade female students at SMK Ibrahimy 1 Sukorejo Situbondo. The selection of participants followed purposive sampling, guided by particular inclusion and exclusion standards. A total of 60 female students participated in the study, with 30 placed in the intervention group and 30 assigned to the control group.

Data were collected through hemoglobin level measurements using the EasyTouch GCHb digital device, which has a high accuracy level with an error tolerance of ± 0.1 g/dL. Additionally, a pudding consumption observation sheet was used to record respondents' compliance in consuming the intervention for seven consecutive days.

The moringa leaves (*Moringa oleifera*) utilized in this research were freshly harvested from areas surrounding the vicinity of the Islamic boarding school located in Sukorejo (Salafiyah Syafi'iyah). Meanwhile, the pure honey was sourced directly from natural forest origins and delivered from the researcher's own home. The preparation of the pudding was carried out by the researcher using personal cooking equipment at the Ibrahimy University campus. The



intervention was given to participants in the intervention group in the form of pudding, with a daily dosage of 100 ml administered for a continuous period of seven days.

Data analysis in this study was conducted descriptively and inferentially. The data obtained were analyzed to determine the effect of the combination of moringa leaf pudding and honey on hemoglobin levels. As the data did not exhibit a normal distribution based on the results of the normality test, non-parametric statistical analysis was employed. The Wilcoxon Signed Rank Test was applied to assess the differences in hemoglobin levels within groups pre- and post-intervention. Additionally, the Mann-Whitney U Test was used to compare hemoglobin levels between groups. Statistical analyses were performed with the latest version of the SPSS software.

Results

1. Normality Test of Hemoglobin Levels in the Intervention and Control Groups

A hypothesis test was conducted to determine the difference between hemoglobin levels before and after the intervention. However, before conducting the hypothesis test, a normality test was first performed on the data generated during the study.

Table 1 Distribution of normality test results for hemoglobin levels in the intervention and control groups at SMK Ibrahimy 1 Sukorejo Situbondo (n=60 individuals)

group	Category	N	Kolmogorov-Smirnov	P-value	Notes
Pretest	Intervention	30	0,145	0,108	Normal
posttest	Intervention	30	0,257	0,000	Not Normal
Pretest	control	30	0,136	0,165	Normal
posttes	control	30	0,186	0,010	Not Normal

Table 1 shows that the results of the displays the results indicating that the posttest data in both groups did not follow a normal distribution based on the normality test. Therefore, the statistical test used in this study is a non-parametric test.

2. Differences in Hemoglobin Levels Before and After Administration of the Combination of Moringa Leaf Pudding and Honey in the Intervention Group and Control

Table 2 Distribution of differences in hemoglobin levels before and after administration of the combination of moringa leaf pudding and honey in the intervention group and control group (n=60 people)

Group	Mean Before	Mean After	Difference (Δ Hb)	P value
Intervention	10,19 g/dl	13,57 g/dl	+3,38 g/dl	0,000
control	11,68 g/dl	11,67 g/dl	-0,01 g/dl	0,658

Table 2 presents the findings of the Wilcoxon Signed Ranks Test for the intervention group, showing a p-value of 0.000 ($p < 0.05$), which signifies a statistically significant change in hemoglobin levels before and after the intervention. In contrast, the control group recorded a p-value of 0.658 ($p > 0.05$), indicating no significant difference in hemoglobin levels pre- and post-treatment

Thus, these results prove that consuming moringa leaf pudding and honey for 7 days (once a day) has a significant effect on increasing hemoglobin levels in adolescent girls with anemia.

3. Post-Treatment Differences Between the Intervention Group and the Control Group in Terms of Hemoglobin Level Increases

Table 3 Distribution of post-treatment differences between the intervention group and the control group in terms of hemoglobin level increase (n=60 individuals)

No	Group	N	Mean	P Value
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1.	Treatment Group	30	40,98	0,000
2.	Control Group	30	20,02	

According to Table 3, the Mann–Whitney analysis revealed a p-value of 0.000 ($p < 0.05$), signifying a meaningful distinction in posttest hemoglobin levels between the intervention and control groups. This suggests that administering pudding made from moringa leaves and honey was considerably more successful in raising hemoglobin levels than in participants who did not receive the intervention.

Discussion

1. Before and After the Administration of a Combination of Moringa Leaf Pudding and Honey on Hemoglobin Levels dan

Hemoglobin plays a crucial role in red blood cells, functioning to transport oxygen throughout the body's tissues. Hemoglobin production is greatly influenced by the adequacy of iron, vitamin C, and protein. Moringa leaves (*Moringa oleifera*) are recognized for their high nutritional content, particularly iron (28.2 mg), vitamin C (220 mg), and protein (27.1 grams) per 100 grams, as well as essential amino acids (Sulistriany et al., 2023). Iron is a key component of hemoglobin and is crucial in the process of red blood cell formation. Nevertheless, the body's ability to absorb it is limited without support from additional compounds like vitamin C, which improves the uptake of non-heme iron in the digestive system, and protein, which plays a crucial role in facilitating hemoglobin production within the bone marrow.

Honey is another natural substance that can aid in hemoglobin formation. Honey also contains 0.42 mg of iron per 100 grams, various B-complex vitamins such as B1, B2, and B6, as well as folic acid, and antioxidants such as flavonoids and polyphenols (Pramestiyani & Wahyuni, 2022). The natural sugars in honey, such as glucose and fructose, provide the energy needed for red blood cell formation. In addition, honey's antioxidants assist in defending red blood cells from the damage induced by free radicals. After understanding the nutritional content of moringa leaves and honey, it is important to examine how the combination of both affects hemoglobin levels in adolescent girls. This study was conducted by providing a moringa leaf and honey pudding to the intervention group for seven days. The hemoglobin level measurements showed a significant change.

According to Table 2, the average hemoglobin levels of the intervention group before the intervention were 10.19 g/dL. After being given the moringa leaf and honey pudding combination for seven days, hemoglobin levels increased to 13.57 g/dL. This represents an increase of 3.38 g/dL in a short period of time. Meanwhile, in the control group, hemoglobin levels decreased from 11.68 g/dL to 11.67 g/dL. The Wilcoxon test results showed a significance value of $p < 0.05$, indicating a significant difference before and after the intervention.

The findings of this study demonstrate that administering a combination of moringa leaf pudding and honey effectively increases hemoglobin levels. Therefore, these results support the use of this combination as an alternative approach to improving hemoglobin status in adolescent girls. This research is consistent with the study by Indriani et al. (2019), which found a hemoglobin increase of 1.76 g/dL after providing moringa leaf capsules. Similarly, Harjuna's study (cited in Idris & Fatmawaty, 2019) reported that consuming honey for 14 days led to a 1.2 g/dL rise in hemoglobin levels. Furthermore, Maulina and Puspita (2020) noted that foods derived from moringa can enhance hemoglobin concentrations in pregnant women. Adolescent girls are considered a suitable target population due to their



susceptibility to anemia caused by menstruation and rapid growth (Rosida & Dwihesti, 2020).

The combination of moringa leaves and honey in the form of pudding can serve as an effective, practical, and easily accepted nutritional intervention strategy. This intervention has added value as it utilizes locally available, inexpensive, and easily producible ingredients. Implementation in schools or boarding schools is feasible through the UKS program or healthy canteen activities. If widely replicated, this strategy could become a national solution for addressing adolescent anemia. Additionally, this effort can increase adolescents' awareness of the importance of consuming healthy foods from an early age, improve eating patterns, and establish sustainable nutritional habits. Such innovations also encourage the involvement of families, teachers, and healthcare workers in collaborative and systematic anemia prevention. This intervention can also strengthen school-based health promotion strategies and become an integral part of adolescent health policies at both the regional and national levels.

2. Differences Between the Intervention Group and the Control Group in Terms of Hemoglobin Level Improvement

Moringa leaves and honey contain complementary nutrients in the process of increasing hemoglobin levels. Moringa leaves contain iron, vitamins A and C, protein, and flavonoids that aid in erythrocyte synthesis and regeneration (Angelina et al., 2021). Honey adds benefits with its copper and manganese content, which play a role in iron metabolism (Yuliarti, 2015). These two minerals function as important cofactors in enzyme activity that helps the absorption and transport of iron into the body. Moreover, copper and manganese contribute to the synthesis of hemoglobin and the maintenance of healthy red blood cells, which supports efficient production of red blood cells and aids in anemia prevention.

The administration of a combination of moringa leaf pudding and honey in increasing hemoglobin levels can be seen from the results of the Mann-Whitney statistical test in Table 3, which shows a highly significant difference between the intervention and control groups with $p = 0.000$. The intervention group showed an increase in Hb from 10.19 g/dL to 13.57 g/dL, whereas the control group's levels remained relatively stable between 11.67 and 11.68 g/dL. This finding confirms that the administration of moringa leaf pudding and honey effectively raises hemoglobin levels compared to the group without this treatment.

The findings of this study confirm that the intervention yields measurable advantages. The notable rise in hemoglobin levels observed in the intervention group is attributable to the treatment itself, rather than natural variations or other external influences. Similarly, Wardana et al. (2019) found an increase in hemoglobin of 2.27 g/dL following the administration of moringa pudding. Usastiawaty et al. (2020) demonstrated the effectiveness of the combination of moringa and honey in pregnant women. Additionally, Yuniarti (2020) also found an increase in Hb levels of 2 g/dL in adolescent girls after one week of moringa-based dietary intervention. These results reinforce that moringa and honey, whether used alone or in combination, are equally beneficial in helping to address anemia, particularly in vulnerable groups such as adolescent girls and pregnant women.

The intervention using a combination of moringa leaf pudding and honey is not only beneficial for increasing hemoglobin levels but also has the potential to be developed on a larger scale. This product can be utilized as part of community empowerment activities, particularly in the field of locally-based healthy food. By utilizing easily obtainable raw materials and a simple production process, this pudding can serve as a small-scale business



opportunity at the household or school level. In addition to supporting nutritional improvement, this approach can also help foster community economic independence. For this program to be sustainable, collaboration is needed from various parties, such as health workers, teachers, education departments, and community leaders. This collaboration is important so that the intervention is not only successful in the short term but also becomes part of long-term efforts to prevent anemia among adolescents comprehensively.

3. Clinical and Theoretical Implications

Clinically, the increase in hemoglobin levels of ± 3.38 g/dL in the intervention group demonstrates significant efficacy in addressing mild to moderate anemia in adolescent girls. This intervention is non-pharmacological, safe, well-tolerated, and can be implemented independently in school or home settings.

Theoretically, these findings support the theory that the combination of nutrients such as iron, vitamin C, and protein has a synergistic effect in enhancing hemoglobin production. This also reinforces the concept of locally based functional foods as a sustainable nutritional strategy for anemia prevention.

4. Limitations of the Study

This study has limitations that may affect the research results, as follows:

1. The students at SMK Ibrahimy were not conducive and needed assistance from teachers and the Student Council of SMK 1 Ibrahimy.
2. The respondents were students with time constraints and often arrived late, especially at 1:00 PM when the intervention was conducted.
3. There was no strict control over other foods consumed by the respondents outside the intervention.

Conclusion

Based on the findings from the study on the effects of administering a combination of moringa leaf pudding and honey on hemoglobin levels in ninth-grade female students at SMK Ibrahimy 1 Sukorejo Situbondo, the following conclusions can be drawn:

1. Hemoglobin levels increased in the group that received the combination of moringa leaf pudding and honey over a 7-day intervention period. The levels improved from an anemic state to within the normal range, demonstrating a positive effect of the intervention on the hemoglobin status of adolescent girls.
2. There was a notable difference in hemoglobin levels between the intervention and control groups, with the intervention group showing a more substantial increase than the control group. This suggests that the administration of moringa leaf pudding combined with honey is more effective at boosting hemoglobin levels than receiving no treatment.

Drawing from the research findings and conclusions, the researchers propose the following recommendations:

1. For educational and health institutions: There is a need for educational programs and innovations in the use of local food ingredients, such as moringa leaves and honey, in forms that are appealing to adolescents, in order to reduce anemia rates.
2. For Adolescents and the Community: It is recommended to regularly consume iron-rich foods, such as moringa leaves and honey, and maintain a healthy diet to prevent anemia.
3. For Future Researchers: It is recommended to conduct further research with a longer intervention period and control for external factors such as diet and physical activity, to ensure more accurate and comprehensive results.

Ethical approval and consent to participate.



This study has obtained ethical approval and participation consent from various relevant parties. The following reference numbers were issued by the ethics committee: No: 116/03/kepkstikesbwi/i/ 2024-2025: 100/03/KEPK-STIKESBWI/I/2024-2025 .

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