



Effect of Moringa Leaf Iced Tea Consumption on Increasing Hemoglobin Levels in Adolescent Girls

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Abstract

Anemia remains a significant public health issue among adolescent girls in Indonesia, primarily due to iron deficiency exacerbated by poor dietary habits and menstruation. Nutritional interventions utilizing local food sources such as *Moringa oleifera* offer a promising solution. Moringa leaves are rich in iron and essential micronutrients that may support hemoglobin synthesis. This study aims to examine the effect of Moringa leaf iced tea consumption on hemoglobin levels among adolescent girls. A quantitative pre-experimental design with a one-group pretest-posttest approach was employed. Ninety female students from a health sciences college in Cirebon participated. Hemoglobin levels were measured before and after the consumption of Moringa leaf iced tea. Data were analyzed using paired sample t-tests with a significance level of $p < 0.05$. The mean hemoglobin level increased significantly from 10.656 g/dL to 11.338 g/dL post-intervention, with a mean difference of 0.6822 g/dL ($p < 0.001$). This result suggests a positive hematinic effect of Moringa iced tea, likely due to its high iron and vitamin C content. Moringa leaf iced tea is a practical and culturally acceptable dietary intervention that effectively improves hemoglobin levels in adolescent girls. It holds potential for integration into school and community-based nutrition programs aimed at preventing anemia.

Keywords: Adolescent girls, anemia prevention, hemoglobin level, moringa leaf, nutritional intervention.

1. Introduction

Adolescence is a critical period marked by rapid physical and psychological growth and development (Iannucci & Nierenberg, 2022; Žukauskienė, 2014). During this stage, adequate nutritional intake plays a vital role in supporting biological and psychosocial processes (Sparrow et al., 2021; Tadzong Mamokem, Kana Sop, Takougoum Marbou, & Telefo, 2022). However, numerous studies have shown that iron deficiency significantly impedes optimal development in adolescents (Aksu & Unal, 2023; Helmyati, Syarifa, Rizana, Sitorus, & Pratiwi, 2024; Trisasmita et al., 2025). This condition is particularly prevalent among adolescent girls, who are more susceptible to iron loss due to regular menstrual cycles, thereby increasing their risk of developing anemia (Sigit et al., 2024).

Anemia remains a major public health challenge in many developing countries, including Indonesia (Susanah et al., 2025). According to the World Health Organization (WHO), the prevalence of anemia among adolescent girls in developing countries is approximately 27% (P. Sari, Judistiani, Herawati, Dhamayanti, & Hilmanto, 2022). In Indonesia, the prevalence among females aged 15–25 years stands at 18.14%. Furthermore, the 2013 National Basic Health Research (Risikesdas) reported a national anemia prevalence rate of 21.7%, with a higher incidence among females at 23.9% (Enggardany, Hendrati, & Hairi, 2021). These figures surpass the 20% threshold defined by WHO, categorizing anemia as a significant public health issue.

The consequences of anemia in adolescents are far-reaching and include impaired reproductive health (Misroh, 2021) and cognitive processes (Samliani & Handayani, 2023), delayed motor development (Christian, Afful-Dadzie, & Marquis, 2023), and the inability to achieve optimal height (Eli-Cophie, Apprey, & Annan, 2024). Nutritional habits and dietary patterns in adolescence have a direct impact on nutrient intake. Adolescent girls often engage in poor eating behaviors, such as frequent consumption of low-nutrient snacks and fast food (Cohen et al., 2012; Setiawan, Budiarto, & Indriyanti, 2023), which, if continued, can lead to iron-deficiency anemia (Soans et al., 2025). Efforts to address nutritional anemia in Indonesia are still hindered by various challenges, notably the limited reach and effectiveness of Communication, Information, and Education (IEC) initiatives.

In this context, identifying locally available, nutrient-rich food sources as alternative interventions is of urgent importance. Moringa (*Moringa oleifera*) leaves have been identified as a promising candidate due to their rich content of essential micronutrients, including 28.2 mg of iron, β -carotene, protein, and vitamins A, C, D, E, K, and the B-complex group (thiamine, riboflavin, niacin, pantothenic acid, biotin, vitamin B6, vitamin B12, and folate) (D. I. Sari, Yulianti, & Wahyuni, 2020). In addition to these nutrients, moringa leaves contain bioactive compounds with antioxidant properties and are easily digestible and absorbable by the human body (Peñalver, Martínez-Zamora, Lorenzo, Ros, & Nieto, 2022). Thus, processing moringa leaves into consumable products such as iced moringa leaf tea could offer an innovative nutritional strategy to combat iron-deficiency anemia in adolescent girls (Arviyani, Afifah, Noer, Rahfiludin, & Mahati, 2022; Hapsari, Parameswari, & Novianingrum, 2025).

This study aims to examine the effect of iced moringa leaf tea consumption on the increase in hemoglobin levels among adolescent girls. Beyond its scientific contribution regarding the utilization of local food sources in nutritional interventions, this research is expected to serve as a reference for public health policy formulation, particularly in preventive and promotive nutrition programs targeting adolescent populations. Accordingly, this study holds substantial relevance not only

from a public health perspective but also in relation to the sustainable development of human resources.

2. Method

This study employed a quantitative research design using a pre-experimental approach, specifically the "one-group pretest-posttest" design. In this design, a single group of participants is observed at two time points: before (pretest) and after (posttest) the intervention, without the inclusion of a comparison or control group. The intervention administered was the consumption of Moringa leaf iced tea.

The study population consisted of 90 female students from the Cirebon Health Science College. The selection of this site was purposive, based on the assumption that students in a health sciences institution are generally more health-conscious, share relatively homogeneous characteristics, and were enrolled in the same academic semester, thereby minimizing potential confounding variables.

Data were collected on participants' hemoglobin levels before and after the intervention. Statistical analysis was performed using a paired sample t-test to determine the significance of differences in hemoglobin levels pre- and post-intervention, with a significance level set at $p < 0.05$.

3. Results and Discussion

3.1 Univariate Analysis

3.1.1 Distribution of respondents based on Study Program

Table 1. Frequency Distribution of Adolescent Girls

No	Study Program	Frequency	%
1	D3 Midwifery	23	25,6
2	D3 Nursing	32	35,6
3	S1 Nursing	35	38,8
	Total	90	100

Based on the Table 1 above, the researchers involved 90 female students as respondents (late adolescents) consisting of three study programs in the STIKes Cirebon environment, namely D3 midwifery study program as many as 23 people, D3 nursing as many as 32 people and S1 Nursing study program as many as 35 people.

3.1.2 Frequency Distribution of Hb Levels In Adolescent Girls Before and After Being Given Moringa Iced Tea

Table 2. Frequency Distribution of Hb level in adolescent girls before and after being given morinaga leaf iced tea

Hb levels	
Before	After

Mean	10.656	11.338
Minimum	9.0	10.0
Maximum	12.3	12.5



Figure 1. Giving Moringa Leaf Iced Tea to Adolescent Girls

Table 2 presents the frequency distribution of hemoglobin (Hb) levels among adolescent girls before and after the administration of Moringa leaf iced tea. Prior to the intervention, the mean Hb level was 10.656 g/dL, with values ranging from a minimum of 9.0 g/dL to a maximum of 12.3 g/dL. Following the consumption of Moringa iced tea, the mean Hb level increased to 11.338 g/dL, with the lowest recorded level being 10.0 g/dL and the highest 12.5 g/dL. These findings indicate an overall improvement in hemoglobin levels after the intervention, suggesting a potential positive effect of Moringa leaf iced tea on the hematological status of the participants.

3.2 Bivariate Analysis

Table 3. T-test of the Effects of Moringa Leaf Iced Tea Consumption on Increased Haemoglobin (Hb) Levels in Adolescent Girl

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Dev	Std. Error Mean	95% CI Lower	95% CI Upper			
Before-After	-.6822	.5939	.0626	-.8066	-.5578	-10.898	89	.000

As shown in the Table 3, the mean difference in hemoglobin levels before and after the intervention was -0.6822 g/dL, with a standard deviation of 0.5939 and a standard error of 0.0626 . The 95% confidence interval for the mean difference ranged from -0.8066 to -0.5578 , indicating that the true mean difference is unlikely to be zero. The t-value obtained was -10.898 with 89 degrees of freedom, and the p-value was 0.000 ($p < 0.05$). These results indicate a statistically significant increase in hemoglobin levels following the consumption of Moringa leaf iced tea, thus supporting the effectiveness of the intervention.

3.3 Discussion

Based on the results of this study, the respondents were female students enrolled in three academic programs: 23 from the Diploma in Midwifery, 32 from the Diploma in Nursing, and 35 from the Bachelor of Science in Nursing, all of whom were classified within the late adolescence stage. Because as literature noted that adolescence is categorized into three phases: early adolescence (ages 11–14), middle adolescence (ages 15–17), and late adolescence (ages 18–21) (Felgueras, López-Díaz, & Garrote, 2024; Hafshoh & Saleh, 2021; Sejati & Olimpia, 2023).

The findings indicated a notable difference in hemoglobin (Hb) levels before and after the intervention. Anemia is defined based on hemoglobin thresholds, with non-pregnant adult females considered anemic at Hb levels below 12 g/dL, adult males below 13 g/dL, children aged 6–14 years below 12 g/dL, children aged 6 months to 6 years below 11 g/dL, and pregnant women below 11 g/dL. Anemia severity is classified as mild when Hb levels are between 9–10 g/dL, moderate between 7–8 g/dL, and severe when below 7 g/dL (Domenica Cappellini & Motta, 2015; Yilmaz & Shaikh, 2023).

As noted by Almatsier, Soetardjo, & Soekatri (2011), the high prevalence of anemia among adolescent girls in Indonesia is largely attributed to dietary patterns dominated by plant-based foods that are low in bioavailable iron, as well as the common practice of restricting food intake for aesthetic reasons. Additionally, iron loss occurs daily through excretion (approximately 0.6 mg/day) and menstruation (approximately 1.3 mg/day), further increasing iron requirements in adolescent females compared to males (Irianti, 2019).

Moringa leaves are rich in both macro- and micronutrients, as well as bioactive compounds with antioxidant properties (Xie et al., 2025). They are a source of essential nutrients including iron (28.2 mg), β -carotene, protein, and a wide spectrum of vitamins such as A, C, D, E, K, and B-complex (thiamine, riboflavin, niacin, pantothenic acid, biotin, vitamin B6, vitamin B12, and folate) (D. I. Sari et al., 2020). Due to these properties, Moringa has been extensively used in the formulation of medicinal products for both preventive and therapeutic purposes.

Anemia in adolescents has serious implications, including impaired reproductive health, delayed motor and cognitive development, decreased academic performance and concentration, and suboptimal physical growth (Chaparro & Suchdev, 2019; Vaira, Merlin Karinda, & Mufliah, 2022). Therefore, prevention and management of anemia in adolescent girls are crucial.

In this study, Moringa leaf iced tea was introduced to participants as a convenient, modern beverage packaged in pouches. This drink, enriched with iron and vitamin C, not only serves as a refreshing beverage but also supports the improvement of hemoglobin levels and enhances iron absorption. Regular consumption of this functional drink has the potential to support the healthy growth and development of adolescent girls and prepare them to become future mothers, thereby contributing to the prevention of stunting in the next generation.

4. Conclusion

The findings of this study demonstrate that the consumption of Moringa leaf iced tea significantly increases hemoglobin levels in late-adolescent girls. The mean hemoglobin level rose from 10.656 g/dL before the intervention to 11.338 g/dL after the intervention, with a statistically significant mean difference of 0.6822 g/dL ($p < 0.001$). This increase indicates the potential hematonic effect of Moringa leaves, attributed to their high iron and vitamin C content, which enhances iron absorption. Given the high prevalence of anemia among adolescent females in Indonesia, this intervention offers a promising, accessible, and culturally acceptable nutritional strategy for addressing iron deficiency in this vulnerable population.

Based on these results, it is recommended that Moringa leaf iced tea be considered as a practical dietary supplement in school- and community-based anemia prevention programs targeting adolescent girls. Future studies should include a randomized controlled trial design with a control group, larger and more diverse samples, and longer follow-up periods to validate and generalize the efficacy of Moringa-based interventions. Integrating such functional beverages into adolescent nutrition policies may contribute significantly to improving reproductive health outcomes and reducing the intergenerational cycle of malnutrition, particularly in settings with high anemia prevalence and limited access to iron-rich animal-based foods.

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