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ORIGINAL ARTICLE

Association Between Postprandial Tea Consumption and Anemia Among Male Adolescents: A Cross-Sectional Study

Syoifa Rahmawati[1], Tegar Kurniawan[2], Dimas Saputra Aminullah[3], Badros Soleh[4], Muhammad Itfal Maulana[5], Muhammad Hasyim[6]

[1-6] Universitas Nurul Jadid, Indonesia

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Corresponding Author:

Syoifa Rahmawati
Universitas Nurul Jadid
Email:
syoifarahma@unuja.ac.id

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ABSTRACT

Background: Anemia among male adolescents is often overlooked despite its potential effects on concentration, physical performance, and growth. Tea consumed during or immediately after meals may inhibit iron absorption because of its tannin and polyphenol content.

Objectives: This study aimed to examine the association between postprandial tea consumption and anemia among male adolescents.

Methods: A quantitative analytical observational study with a cross-sectional design was conducted among 35 male students at SMK PP Nurul Jadid, Probolinggo, Indonesia. All eligible students were included using total sampling. Tea consumption habits were assessed using a Food Frequency Questionnaire, while hemoglobin levels were measured through capillary blood testing. The association between tea consumption timing and anemia status was analyzed using the Chi-square test, with statistical significance set at $p < 0.05$.

Results: Of the 35 participants, 28 (80.0%) consumed tea with a two-hour interval after meals, 5 (14.3%) consumed tea immediately after meals, and 2 (5.7%) did not consume tea. Five participants (14.3%) were classified as anemic. All participants who consumed tea immediately after meals were anemic, whereas no anemia was identified among those who consumed tea after a two-hour interval or did not consume tea. A significant association was found between postprandial tea consumption habits and anemia status ($p = 0.001$).

Conclusions: Postprandial tea consumption was significantly associated with anemia among male adolescents. Avoiding tea immediately after meals and allowing an interval before tea consumption may support anemia prevention strategies in this population.

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Introduction

Anemia remains a major public health and nutritional concern worldwide, with dietary iron deficiency contributing substantially to its global burden across age and sex groups (WHO, 2025; Lee et al., 2025). Adolescence represents a particularly important period because rapid growth, increased blood volume, and changing nutritional requirements increase the demand for iron and other micronutrients (Cohen & Powers, 2024; Zhou et al., 2025). Although adolescent girls receive greater attention because of menstrual iron losses, anemia and iron deficiency also occur among boys and may adversely affect physical capacity, concentration, and educational performance (Samson et al., 2022). Therefore, anemia prevention during adolescence should address both sexes and consider modifiable dietary behaviors that may influence iron intake and bioavailability.

In Indonesia, anemia remains relevant among school-age children and adolescents despite improvements in national nutritional indicators. The 2023 Indonesian Health Survey reported anemia in 16.3% of individuals aged 5–14 years and 15.5% of those aged 15–24 years, while anemia was also identified among males in the broader population (Ministry of Health Republic of Indonesia, 2023). Indonesian evidence involving adolescent boys and girls has shown that anemia occurs in both sexes and that dietary patterns, particularly the consumption of micronutrient-rich foods, are associated with anemia risk (Knijff et al., 2021). More recent longitudinal evidence from Yogyakarta also demonstrated that anemia remains common among Indonesian adolescents and is influenced by multiple biological, nutritional, and psychosocial factors (Asrullah et al., 2025).

The etiology of adolescent anemia is multifactorial and includes inadequate iron intake, low dietary diversity, impaired iron absorption, infection, socioeconomic conditions, and other individual and environmental factors (Wiafe et al., 2023; Martins et al., 2026). Iron deficiency is particularly sensitive to dietary practices because the amount of iron absorbed from food depends not only on total intake but also on the type of iron and the presence of enhancers or inhibitors within the meal (Domellöf & Sjöberg, 2024). Non-heme iron, which constitutes a substantial proportion of dietary iron in many populations, has lower and more variable bioavailability than heme iron and is strongly influenced by other dietary components (Cohen & Powers, 2024). Consequently, beverage consumption around mealtimes may be clinically relevant, particularly when the diet already provides limited bioavailable iron.

Tea is an important dietary consideration because it contains polyphenolic compounds, including tannins, that can bind dietary iron and reduce its absorption from the gastrointestinal tract. Stable-isotope studies have demonstrated that tea consumed with an iron-containing meal can markedly decrease iron bioavailability, including among individuals with iron deficiency anemia (Lazrak et al., 2021). A systematic review and meta-analysis of randomized trials also confirmed that dietary polyphenols can influence circulating iron indices, supporting the biological plausibility of an interaction between polyphenol exposure and iron metabolism (Xu et al., 2021), while experimental work has similarly shown that polyphenol-containing products can reduce fractional iron absorption when consumed with meals (Buerkli et al., 2022). Importantly, a controlled trial demonstrated that separating tea consumption from an iron-containing meal by approximately one hour attenuated its inhibitory effect on non-heme iron absorption, suggesting that the timing of tea intake may be as important as tea consumption itself (Ahmad Fuzi et al., 2017).

However, epidemiological evidence regarding habitual tea consumption and anemia is not entirely consistent. A large prospective cohort combined with Mendelian randomization found no evidence that habitual tea intake itself increased anemia risk, indicating that the relationship may depend on the amount consumed, dietary context, baseline iron status, and timing relative to meals (Zhang et al., 2024). Research on coffee and green tea has similarly suggested that beverage consumption may influence some markers of iron metabolism without necessarily producing a direct association with hemoglobin concentration or iron-deficiency anemia in all populations (Lee, 2023). Awareness studies continue to emphasize

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concern regarding the potential interaction between black tea and iron deficiency, while contemporary nutrition guidance recommends avoiding iron-absorption inhibitors around iron-rich meals in individuals at risk of deficiency (Alorainy et al., 2025; Ren et al., 2025). These mixed findings indicate that research should distinguish general tea consumption from specific behaviors such as consuming tea immediately after meals.

Despite growing evidence on iron deficiency and dietary determinants among adolescents, studies examining the timing of tea consumption specifically among male adolescents remain limited. Much of the existing adolescent anemia literature has focused on girls because of menstruation-related iron loss, while studies involving both sexes have demonstrated that male adolescents are not free from anemia risk (Knijff et al., 2021; Wiafe et al., 2023). Evaluating postprandial tea consumption among boys is therefore relevant because delaying tea after meals represents a simple and potentially modifiable dietary practice that could be incorporated into school-based nutrition education without requiring complete avoidance of tea. Accordingly, this study aimed to examine the association between postprandial tea consumption habits and anemia among male adolescents at SMK PP Nurul Jadid, Probolinggo, Indonesia.

Methods

This study employed a quantitative analytical observational design with a cross-sectional approach to examine the association between postprandial tea consumption habits and anemia among male adolescents. The study was conducted at SMK PP Nurul Jadid, Probolinggo, Indonesia. The study population consisted of 35 male students from class XI B, all of whom were included using a total sampling technique. Students were eligible if they were enrolled in class XI B and agreed to participate in the study, while students from other classes and those who declined participation were excluded.

The independent variable was tea consumption after meals, which was assessed using a Food Frequency Questionnaire (FFQ). Tea consumption was categorized as no tea consumption, tea consumption with a two-hour interval after meals, and tea consumption immediately after meals. The questionnaire also recorded the amount of tea consumed using household measures and gram units. The dependent variable was anemia status, determined by measuring hemoglobin levels through capillary blood sampling using a hemoglobin testing device. Hemoglobin levels below 12 g/dL were classified as anemia, whereas levels of 12 g/dL or higher were classified as non-anemia. An observational checklist was also used to document current symptoms among participants whose hemoglobin levels indicated anemia.

Data collection was conducted after participants received information regarding the study objectives, procedures, voluntary participation, and confidentiality. The collected data were processed through editing, scoring, coding, tabulation, and data cleaning. Descriptive statistics were used to summarize participant characteristics, tea consumption patterns, and hemoglobin status. The association between postprandial tea consumption and anemia was analyzed using the Chi-square test, with statistical significance set at $p < 0.05$.

The study adhered to ethical research principles, including informed consent, respect for participant autonomy, anonymity, confidentiality, justice, and consideration of potential benefits and risks. Participation was voluntary, and participants were informed of their right to withdraw from the study at any time. No personally identifying information was included in the research report, and all collected data were used exclusively for research purposes.

Results

A total of 35 male adolescents were included in the study. Most participants were 17 years old (48.6%), followed by those aged 16 years (45.7%) and 15 years (5.7%). All participants were senior high school students.

Table 1. Characteristics of Participants

Characteristics		n	%
Age	15 years	2	5.7
	16 years	16	45.7
	17 years	17	48.6
Educational level	Senior high school	35	100.0

A total of 35 employees were included in this study. Based on the respondents characteristics, the majority of the 35 male

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students were 17 years old (17 respondents; 48.6%), followed by those aged 16 years (16 respondents; 45.7%). Meanwhile, only 2 respondents (5.7%) were 15 years old. Regarding educational level, all respondents (100%) were senior high school students.

Table 2. Distribution Frequency Distribution of Tea Consumption Habits After Meals and Hemoglobin Levels Among Male Students

Variable	Category	n	%
Tea Consumption	No tea	2	5.7
	2 hour interval	28	80.0
	After meals	5	14.3
Hemoglobin level	Anemia	5	14.3
	Unanemia	30	85.7

The frequency distribution of tea consumption habits among the 35 male students showed that the majority of respondents consumed tea with a time interval after meals (28 respondents; 80.0%). Meanwhile, 5 respondents (14.3%) consumed tea immediately after meals, while 2 respondents (5.7%) did not consume tea. These findings indicate that most students practiced allowing a time interval between meals and tea consumption. The majority of respondents were non-anemic (30 respondents; 85.7%), while 5 respondents (14.3%) were anemic. These findings indicate that most male students at SMK PP Nurul Jadid had hemoglobin levels within the non-anemic range, although some students were still identified as anemic.

Table 3. The Association Between Tea Consumption Habits After Meals and The Incidence of Anemia among Male Students

Tea consumption habits	Anemic		Unanemic		Total		p-value
	n	%	n	%	n	%	
No Tea	0	0.0	2	5.7	2	5.7	0.001
2 hour interval	0	0.0	28	80.0	28	80.0	
After meals	5	14.3	0	0.0	5	100.0	

The Chi-square test showed a significant association between tea consumption after meals and the incidence of anemia among male students, with a p-value of 0.001 ($p < 0.05$). This indicates that tea consumption immediately after meals is significantly associated with the occurrence of anemia among male students. Students who consumed tea immediately after meals were more likely to experience anemia than those who consumed tea 2 hours after meals or did not consume tea.

Discussion

Based on the research findings, there was a significant association between tea consumption habits after meals and the incidence of anemia among male students at SMK PP Nurul Jadid. The results showed that all students who consumed tea immediately after meals experienced anemia. In contrast, students who consumed tea after allowing a time interval following meals, as well as those who did not consume tea, did not experience anemia. According to the researchers' interpretation, this association may be related to the tannin and polyphenol content in tea, which can inhibit iron absorption in the body. Consuming tea immediately after meals allows polyphenolic compounds to bind to non-heme iron from food, forming complexes that are difficult for the intestines to absorb. This condition may reduce the availability of iron required for hemoglobin synthesis. If this occurs continuously and is not balanced with adequate iron intake, it may increase the risk of developing anemia (Cohen & Powers, 2024; Zhou et al., 2025).

Physiologically, iron is an essential mineral that plays an important role in hemoglobin synthesis. Hemoglobin functions to bind and transport oxygen from the lungs to all body tissues. Iron deficiency can interfere with hemoglobin production, thereby reducing the blood's capacity to transport oxygen effectively. Therefore, adequate dietary iron intake is an important factor in maintaining normal hemoglobin levels (Alorainy et al., 2025). A study by (Lee, 2023) demonstrated that consuming tea together with meals can inhibit iron absorption. The study also explained that allowing a time interval between meals and tea consumption can reduce the inhibitory effect on iron absorption. This finding indicates that the timing of tea consumption is an important aspect to consider in maintaining adequate iron levels in the body.

The findings of this study are also supported by research conducted by (Buerkli

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et al., 2022), which examined the association between tea consumption habits and anemia among adolescents. The study indicated that the timing of tea consumption was associated with the incidence of anemia, particularly when tea was consumed together with meals. This further supports the assumption that consuming tea during mealtimes may affect the absorption of dietary iron. However, anemia is not solely influenced by tea consumption habits. Other contributing factors include inadequate iron intake, low consumption of protein-rich foods, insufficient vitamin C intake, nutritional status, infections, and certain underlying health conditions. Vitamin C helps enhance the absorption of non-heme iron, while protein plays a role in the process of hemoglobin formation. Therefore, daily dietary patterns should also be considered in anemia prevention (Xu et al., 2021).

Among male students, anemia can still occur despite the absence of menstrual blood loss, which is a contributing factor in adolescent females. This condition may be associated with inadequate iron intake, impaired nutrient absorption, blood loss due to certain conditions, or underlying diseases. Therefore, adequate iron intake remains essential for male adolescents to support their growth and development and maintain overall health (Xu et al., 2021). The researchers suggest that consuming tea immediately after meals should receive attention as a dietary habit that may inhibit iron absorption. Preventive measures can be implemented through education regarding appropriate tea consumption timing, particularly by allowing an interval of approximately one to two hours after meals. Furthermore, students should be encouraged to consume iron-rich foods, such as meat, fish, eggs, and green leafy vegetables, and combine them with vitamin C-rich foods to enhance iron absorption (Alorainy et al., 2025). In conclusion, tea consumption habits after meals are an important dietary aspect to consider in relation to the incidence of anemia among male students. Education regarding appropriate tea consumption habits and balanced nutritional intake is expected to serve as a promotive and preventive measure to reduce the risk of anemia among adolescents.

Implication and limitation

The findings of this study have implications for health promotion and anemia prevention among male adolescents, particularly regarding appropriate tea consumption habits after meals. Health education should emphasize the importance of avoiding tea consumption immediately after meals and allowing a time interval of approximately one to two hours to minimize its potential inhibitory effect on iron absorption. Schools and healthcare professionals, particularly nurses, can play an important role in providing balanced nutrition education, encouraging the consumption of iron-rich and vitamin C-rich foods, and promoting early anemia screening among male adolescents. However, this study has several limitations. The cross-sectional design limits the ability to establish a causal relationship between tea consumption habits and the incidence of anemia. Other factors that may influence anemia, such as daily iron intake, vitamin C consumption, nutritional status, dietary patterns, and underlying health conditions, were not comprehensively examined. Therefore, future research is recommended to involve larger populations and additional nutritional variables to provide a more comprehensive understanding of the factors associated with anemia among male adolescents.

Relevance for Practice

The findings of this study can serve as a basis for nurses and healthcare professionals to develop health promotion and anemia prevention strategies among male adolescents. Nurses can provide education on appropriate tea consumption habits, particularly the importance of allowing a time interval after meals to minimize the inhibition of iron absorption. Furthermore, education on balanced nutrition, the consumption of iron-rich and vitamin C rich foods, and regular hemoglobin screening should be enhanced. Schools can also collaborate with healthcare professionals to implement anemia screening programs and nutrition education as part of early detection and anemia prevention efforts among adolescents.

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Conclusion

This study found a significant association between tea consumption habits after meals and the incidence of anemia among male students at SMK PP Nurul Jadid. Students who consumed tea immediately after meals experienced anemia, whereas those who consumed tea after allowing a time interval or did not consume tea did not experience anemia. These findings highlight the importance of appropriate tea consumption habits in maintaining iron absorption and preventing anemia among male adolescents. Health education regarding balanced nutrition, iron-rich food consumption, and appropriate tea consumption timing should be strengthened through collaboration between nurses, healthcare professionals, and schools. Further research is recommended to investigate other factors associated with anemia among male adolescents.

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Author Contribution

Syoifa Rahmawati contributed to the conceptualization, study design, literature review, manuscript drafting, and preparation of the original manuscript. Muhammad Itfal Maulana Ridho, Badros Soleh, and Tegar Kurniawan contributed to data collection, data organization, data analysis, and interpretation of the study findings. Dimas Saputra Aminullah and Muhammad Hasyim assisted with hemoglobin screening during the study. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Declaration of Conflicting Interest

The authors declare no conflict of interest.

Declaration of Use of AI in Scientific Writing

The authors declare that generative AI and AI-assisted technologies were used to support language editing and grammatical refinement of the manuscript.

References

Ahmad Fuzi, S. F., Koller, D., Bruggraber, S., Pereira, D. I. A., Dainty, J. R., & Mushtaq, S. (2017). A 1-h time interval between a meal containing iron and consumption of tea attenuates the inhibitory effects on iron absorption: A controlled trial in a cohort of healthy UK women using a stable iron isotope. The American Journal of Clinical Nutrition, 106(6), 1413–1421. https://doi.org/10.3945/ajcn.117.161364

Alorainy, M., Aldhahi, R., Alharbi, M., Alshahrani, A., Alanzy, K., Alqarni, M., & Aloriney, A. (2025). Community awareness of association between black tea consumption and iron deficiency anemia. Journal of Family Medicine and Primary Care, 14(9), 3969–3975. https://doi.org/10.4103/jfmpc.jfmpc_766_25

Asrullah, M., Maula, A. W., Frans, S. O., Dewi, S. L., L'Hoir, M., Feskens, E. J. M., & Melse-Boonstra, A. (2025). Sleep quality, depression, and the risk of anaemia in adolescents aged 10–19 years during one year of the COVID-19 pandemic in Indonesia. Stress and Health, 41(3), e70046. https://doi.org/10.1002/smi.70046

Buerkli, S., Salvioni, L., Koller, N., Zeder, C., Teles, M. J., Porto, G., Habermann, J. H., Dubach, I. L., Vallelian, F., Frey, B. M., Moretti, D., Baumgartner, J., & Zimmermann, M. B. (2022). The effect of a natural polyphenol supplement on iron absorption in adults with hereditary hemochromatosis. European Journal of Nutrition, 61(6), 2967–2977. https://doi.org/10.1007/s00394-022-02829-8

Cohen, C. T., & Powers, J. M. (2024). Nutritional strategies for managing iron deficiency in adolescents: Approaches to a challenging but common problem. Advances in Nutrition, 15(5), 100215. https://doi.org/10.1016/j.advnut.2024.100215

Domellöf, M., & Sjöberg, A. (2024). Iron—A background article for the Nordic Nutrition Recommendations 2023. Food & Nutrition Research, 68. https://doi.org/10.29219/fnr.v68.10451

Knijff, M., Roshita, A., Suryantan, J., Izwardy, D., & Rah, J. H. (2021). Frequent consumption of micronutrient-rich foods is associated with reduced risk of anemia among adolescent girls and boys in Indonesia: A cross-sectional study. Food and Nutrition Bulletin, 42(1_suppl), S59–S71. https://doi.org/10.1177/0379572120977455

Lazrak, M., El Kari, K., Stoffel, N. U., Elammari, L., Al-Jawaldeh, A., Loechl, C. U., Yahyane, A., Barkat, A., Zimmermann, M. B., & Aguenaou, H. (2021). Tea consumption reduces iron bioavailability from NaFeEDTA in nonanemic women and women with iron deficiency anemia: Stable iron isotope studies in Morocco. The Journal of Nutrition, 151(9), 2714–2720. https://doi.org/10.1093/jn/nxab159

Lee, J. (2023). Association between coffee and green tea consumption and iron deficiency anemia in Korea. Korean Journal of Family Medicine, 44(2), 69–70. https://doi.org/10.4082/kjfm.44.2E

Lee, S., Son, Y., Hwang, J., Kim, M. S., GBD 2021 Dietary Iron Deficiency Collaborators, Shin, J. I., Yon, D. K., & Kassebaum, N. J. (2025). Global, regional and national burden of dietary iron deficiency from 1990 to 2021: A Global Burden of Disease study. Nature Medicine, 31(6), 1809–1829. https://doi.org/10.1038/s41591-025-03624-8

Martins, S. H., Sello, M. G., Ndlovu, M., Moetlediwa, M. T., Madlala, S. S., Choshi, J., Dludla, P., Kengne, A. P., Mchiza, Z. J., & Mabhida, S. E. (2026). Prevalence and factors associated with anaemia among Sub-Saharan African adolescents: A systematic review and meta-analysis of nutritional, socio-demographic, environmental, and infectious factors. Nutrients, 18(15), 2404. https://doi.org/10.3390/nu18152404

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Ministry of Health Republic of Indonesia. (2023). Survei Kesehatan Indonesia 2023. Ministry of Health Republic of Indonesia.

Ren, T., Lu, Y., Dai, Z., Yang, J., Wu, Y., Chang, F., Wang, S., Wang, L., & Lu, Y. (2025). Effects of nutrition-specific interventions to prevent and control nutrition-related anemia in infants, children, and adolescents: A systematic review and network meta-analysis of randomized controlled trials. Journal of the Academy of Nutrition and Dietetics, 125(7), 964–983.e13. https://doi.org/10.1016/j.jand.2025.01.002

Samson, K. L. I., Fischer, J. A. J., & Roche, M. L. (2022). Iron status, anemia, and iron interventions and their associations with cognitive and academic performance in adolescents: A systematic review. Nutrients, 14(1), 224. https://doi.org/10.3390/nu14010224

Wiafe, M. A., Ayenu, J., & Eli-Cophie, D. (2023). A review of the risk factors for iron deficiency anaemia among adolescents in developing countries. Anemia, 2023, 6406286. https://doi.org/10.1155/2023/6406286

WHO. (2024). Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. World Health Organization.

WHO. (2025). Anaemia. World Health Organization.

Xu, T., Zhang, X., Liu, Y., Wang, H., Luo, J., Luo, Y., & An, P. (2021). Effects of dietary polyphenol supplementation on iron status and erythropoiesis: A systematic review and meta-analysis of randomized controlled trials. The American Journal of Clinical Nutrition, 114(2), 780–793. https://doi.org/10.1093/ajcn/nqab068

Zhang, R. H., Zhang, W. S., Jiang, C. Q., Zhu, F., Jin, Y. L., Au Yeung, S. L., Lam, T. H., Xu, L., & Wang, J. (2024). Does tea intake increase the risk of anemia? Evidence from a large prospective cohort and Mendelian randomization study. Food & Function, 15(18), 9552–9562. https://doi.org/10.1039/D4FO03324H

Zhou, J., Li, Y., & Cai, Y. (2025). Global burden of children and adolescents' nutritional deficiencies from 1990 to 2021. Frontiers in Pediatrics, 13, 1583167. https://doi.org/10.3389/fped.2025.1583167

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