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Implementation of iron supplementation program increases hemoglobin levels among adolescent girls: A study in Somba Opu, Gowa

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ABSTRACT

Previous studies have highlighted a persistent high prevalence of anemia among adolescent girls in rural areas, often attributed to inadequate nutritional intake and limited access to health interventions, yet few have rigorously evaluated targeted supplementation programs in this context. This study aims to assess the effectiveness of the iron supplementation program (Tablet Tambah Darah/TTD) in increasing hemoglobin levels and reducing anemia prevalence among adolescent girls in the Somba Opu health center area, Gowa. A quasi-experimental design with a one-group pre-posttest approach was employed, involving adolescent girls aged 12–18 years. The intervention consisted of routine iron supplementation and education on healthy dietary and lifestyle practices. The results demonstrated a substantial decrease in anemia prevalence: among junior high school students, anemia rates declined from 48.10% in 2023 to 26.50% in 2024, and among senior high school students, from 41.60% to 26.10% over the same period. These findings indicate that the TTD program significantly contributed to improved hemoglobin levels and reduced anemia rates in the target population. The implications underscore the importance of structured supplementation and health education programs for adolescent girls in rural settings to address nutritional deficiencies and promote overall well-being.

ABSTRAK

Penelitian sebelumnya telah menyoroti tingginya prevalensi anemia pada remaja putri di daerah pedesaan, yang sering dikaitkan dengan asupan gizi yang tidak memadai dan terbatasnya akses terhadap intervensi kesehatan, namun hanya sedikit yang mengevaluasi secara ketat program suplementasi yang ditargetkan dalam konteks ini. Penelitian ini bertujuan untuk menilai efektivitas program suplementasi zat besi (Tablet Tambah Darah/TTD) dalam meningkatkan kadar hemoglobin dan menurunkan prevalensi anemia pada remaja putri di wilayah kerja Puskesmas Somba Opu, Kabupaten Gowa. Penelitian ini menggunakan desain kuasi-eksperimental dengan pendekatan one-group pretest-posttest yang melibatkan remaja putri berusia 12-18 tahun. Intervensi terdiri dari suplementasi zat besi secara rutin dan edukasi mengenai pola makan dan gaya hidup sehat. Hasilnya menunjukkan penurunan prevalensi anemia yang substansial: di antara siswa sekolah menengah pertama, tingkat anemia menurun dari 48,10% pada tahun 2023 menjadi 26,50% pada tahun 2024, dan di antara siswa sekolah menengah atas, dari 41,60% menjadi 26,10% pada periode yang sama. Temuan ini menunjukkan bahwa program TTD secara signifikan berkontribusi terhadap peningkatan kadar hemoglobin dan penurunan angka anemia pada populasi sasaran. Implikasi ini menggarisbawahi pentingnya suplementasi terstruktur dan program pendidikan kesehatan bagi remaja perempuan di daerah pedesaan untuk mengatasi kekurangan gizi dan meningkatkan kesehatan secara keseluruhan.

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INTRODUCTION

The Health development in Indonesia increasingly emphasizes promotive and preventive efforts, as these strategies yield broader and more economically efficient impacts. Nutritional improvement initiatives are focused on the first 1,000 days of life (HPK) and adolescence, which are critical periods for sustainable health development and essential investments in building a competitive and high-quality human resource base. Nutritional and health problems during adolescence significantly influence quality of life and productivity in adulthood. Despite these efforts, Indonesia continues to face a double burden of malnutrition, including high rates of stunting, wasting, and obesity, as well as micronutrient deficiencies—especially anemia, which remains a serious concern (Yunita Amraeni et al., 2023).

Anemia, defined as a reduction in hemoglobin concentration in erythrocytes below physiological requirements, is a common condition among adolescent girls. According to the World Health Organization (WHO), normal hemoglobin levels for females above 15 years old are >12.0 g/dL (>7.5 mmol/L). Clinical symptoms of anemia arise from organ hypoxia and compensatory physiological mechanisms, often manifesting as weakness, fatigue, lethargy, headaches, dizziness, and visual disturbances (Novita Sari, 2020). The etiology of anemia in adolescents includes direct causes such as iron deficiency and infections, indirect factors such as low family support, high activity levels, and poor dietary patterns, and fundamental factors including low education, socioeconomic status, and challenging geographic conditions. The consequences of iron deficiency anemia in adolescents are profound, leading to impaired growth and development, increased susceptibility to infections, diminished physical capacity, and decreased academic performance (Wahyuni & Widyaningsih, 2021).

The high prevalence of anemia among adolescent girls—affected by inadequate dietary intake and insufficient physical activity—represents a significant public health challenge in Indonesia and other low- and middle-income countries (Riskesdas, 2018). Effective interventions, such as the routine administration of iron supplementation tablets (Tablet Tambah Darah) combined with educational strategies to promote healthy dietary and lifestyle behaviors, have been identified as essential measures to address and prevent anemia in this vulnerable population (Pedoman Penanggulangan dan Pencegahan Anemia, 2018).

The implementation of iron supplementation programs has proven effective in various international and national contexts. For instance, the WHO reports that adolescent anemia prevalence remains high across South and Southeast Asia, with countries such as Bangladesh (98%), Nepal (68.8%), and southern India (67.9%) experiencing particularly acute challenges (WHO, 2021). Studies indicate that weekly iron supplementation, combined with health education on balanced nutrition and active lifestyles, can significantly improve hemoglobin levels and reduce anemia prevalence among adolescent girls (Pratiwi et al., 2022). Furthermore, school-based interventions, which include regular distribution of iron tablets and structured educational sessions, have demonstrated notable reductions in anemia rates and improvements in overall health outcomes in adolescent populations (Kementerian Kesehatan RI, 2018).

In the Indonesian context, the Ministry of Health's guidelines advocate for a comprehensive approach to anemia prevention among adolescent girls, emphasizing both regular iron supplementation and the integration of nutrition and health education. Evidence from recent studies shows that such programs not only increase hemoglobin levels but also foster healthier dietary behaviors and enhance awareness regarding anemia prevention (Risky Amalia et al., 2023). Despite these documented benefits, challenges remain in ensuring program adherence and reaching target coverage, particularly in rural settings where access and resources may be limited.

While several studies have documented the effectiveness of iron supplementation and education interventions, most existing research has focused on urban populations or lacked rigorous evaluation of program coverage and outcomes in rural areas. There is a notable research gap in the assessment of targeted health interventions for adolescent girls in rural Indonesian contexts, where the burden of anemia often remains underreported and inadequately addressed (Yunita Amraeni et al.,

2023). Moreover, few studies have examined the impact of integrating routine supplementation with tailored education on both hemoglobin levels and anemia prevalence in these settings.

The present study seeks to address this gap by evaluating the effectiveness of the Tablet Tambah Darah (TTD) program, implemented alongside nutrition and lifestyle education, in improving hemoglobin levels and reducing anemia rates among adolescent girls in the Somba Opu Health Center area, Gowa. The novelty of this research lies in its focus on a rural adolescent population and the comprehensive assessment of both program coverage and clinical outcomes, thereby providing valuable insights for the development of effective, scalable health interventions in similar contexts.

METHODS

This study employed a quasi-experimental design using a one group pre-posttest approach, wherein the intervention was administered to a single cohort without a comparison group. The research was conducted in the Somba Opu Health Center area, targeting all female adolescents aged 12–18 years enrolled in junior and senior high schools (SMP and SMA) within the health center's operational region.

The study was conducted from January 2023 to January 2024. The population comprised all adolescent girls in the designated age group at schools collaborating with the health center. The sample was determined through purposive sampling, selecting participants who met the inclusion criteria: female students aged 12–18 years, attending SMP or SMA in the area, willing to participate, and having received informed consent from their parents or guardians. Exclusion criteria included known hematologic disorders unrelated to iron deficiency and refusal to participate.

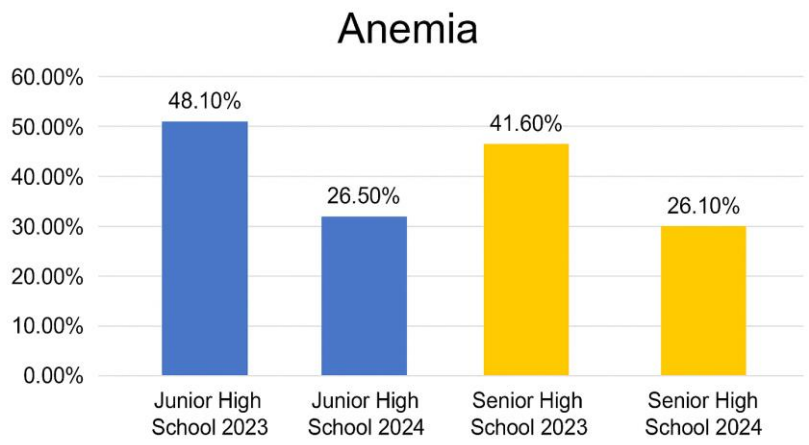
The intervention program consisted of several components: educational sessions about anemia and its prevention, routine distribution of iron supplementation tablets (Tablet Tambah Darah, TTD), and communal activities such as shared meals and supervised group tablet intake sessions. The TTD was administered at a dosage of one tablet per week throughout the study period, in accordance with the guidelines from the Ministry of Health. Health education aimed to improve knowledge and attitudes towards anemia prevention and to encourage active participation and consistent tablet consumption among participants.

Data collection involved measuring hemoglobin levels before and after the intervention using standard laboratory methods. Anemia prevalence rates were recorded for both junior and senior high school participants at baseline and post-intervention (See Figure 1). Data analysis included descriptive statistics and paired statistical tests to assess changes in hemoglobin levels and anemia prevalence before and after the intervention. The results were presented in tabular and narrative form to illustrate trends and evaluate program effectiveness.

All participants and their legal guardians provided informed consent prior to inclusion in the study. The research protocol adhered to ethical principles and received approval from the relevant institutional review board.

Figure 1
Activity Process of Blood Addition Tablet Distribution (TTD)

Figure 2
Distribution of Anemia Rates among Junior and Senior High School Students from 2023 to 2024



RESULTS AND DISCUSSION

Based on Figure 2, there was a marked reduction in the prevalence of anemia among junior and senior high school female students in the Somba Opu area between 2023 and 2024. Among junior high school students, the anemia rate declined from 48.10% in 2023 to 26.50% in 2024. A similar trend was observed among senior high school students, with a decrease from 41.60% to 26.10% over the same period. These results were achieved alongside the implementation of the iron supplementation program (Tablet Tambah Darah, TTD), which targeted a coverage rate of 25%. The program involved direct administration of iron tablets to female students at educational institutions and included regular group dosing sessions as mandated by the Ministry of Health (Fitria et al., 2021).

These findings are consistent with previous research indicating that iron supplementation programs, when administered consistently and supported by educational interventions, can significantly improve hemoglobin levels and reduce anemia prevalence among adolescent girls. Yuanti et al. (2020) reported a significant increase in hemoglobin levels following the administration of iron tablets to female adolescents. The effectiveness of such interventions is further enhanced when coupled with activities promoting iron absorption and healthy dietary practices. The present study distinguishes itself by demonstrating not only a reduction in anemia prevalence but also a successful integration of routine supplementation, health education, and communal activities (such as group dosing and shared meals), which have proven to enhance program participation and adherence—an advantage over interventions that rely solely on supplementation.

The observed reduction in anemia rates among both junior and senior high school female students underscores the critical role of comprehensive iron supplementation programs in improving adolescent health in rural settings. The combined approach of routine supplementation, targeted health education, and collective participation activities fostered greater awareness and sustained engagement among participants. These outcomes highlight the importance of multi-faceted intervention strategies in addressing micronutrient deficiencies and promoting long-term health improvements in adolescent populations. Furthermore, the program implemented in Somba Opu may serve as a model for similar interventions in other regions, demonstrating the potential for scalability and adaptability in various rural contexts to combat anemia and enhance youth productivity.

The success of anemia prevention programs is influenced by several critical factors, including educational outreach, community engagement, and the integration of health initiatives. Programs focusing on dietary improvements and iron supplementation have shown significant efficacy, particularly in high-risk groups such as adolescents and pregnant women Saxena et al., 2024; Al-Marzouqi et al., 2024). Educational programs targeting awareness and behavior change have been effective, with initiatives often incorporating culturally relevant materials to resonate with specific populations (Wisnuwardani et al., 2023; (Yanniarti et al., 2023; . For instance, health education has

been linked to increased knowledge and compliance regarding iron intake among adolescents (Wisnuwardani et al., 2023; Syswianti & Roslan, 2024).

However, barriers such as insufficient prioritization and logistical challenges persist in effectively implementing these programs (Safiri et al., 2021; (Wahdah et al., 2023). The Covid-19 pandemic has exacerbated these challenges, affecting adherence to supplementation programs (Wahdah et al., 2023). Moreover, multifactorial aspects, including personal behavior and sociocultural influences, complicate the implementation of anemia prevention strategies (Sinha et al., 2021). Ultimately, combining education, community involvement, and health system support is essential for achieving sustainable outcomes in anemia control (Yanniarti et al., 2023; Saxena et al., 2024; Al-Marzouqi et al., 2024).

The implications for public health policy and school health programs concerning anemia are multifaceted. Effective interventions require a comprehensive approach that includes education, dietary enhancements, and regular screening. Notably, the integration of nutritional education into school health policies can significantly improve awareness and promote healthy dietary habits among school-aged children. The Department of Health has recommended regular iron supplementation for school children, as this directly correlates with improved hematocrit levels and reduced anemia prevalence (Kaewpawong et al., 2022).

Furthermore, public health policies should prioritize antenatal care for pregnant women, emphasizing dietary modifications and iron supplementation, as these measures have been shown to substantially decrease anemia rates (Najam et al., 2022). Enhancing health literacy through targeted education programs is vital; evidence indicates that improved awareness leads women to adopt healthier lifestyle choices that prevent anemia (Mbowe et al., 2025). Additionally, past interventions by governments, such as those in Peru, underline the efficacy of structured screenings and personalized treatment plans in reducing childhood anemia (Berky et al., 2020). Establishing a collaborative framework that aligns school health initiatives with broader public health strategies will be instrumental in tackling anemia effectively across populations (DeLoughery, 2024).

CONCLUSION

This study demonstrates a significant reduction in anemia prevalence among junior and senior high school female students in the Somba Opu Health Center area from 2023 to 2024, directly associated with the successful implementation of the iron supplementation program (Tablet Tambah Darah, TTD). The comprehensive approach—including routine supplementation, health education, and collective participation in group dosing and meals—proved effective in increasing hemoglobin levels and promoting healthy behaviors among adolescent girls. These findings highlight the critical role of integrated health interventions in addressing micronutrient deficiencies in rural settings and underscore the potential of such programs to be scaled and adapted for broader application. While the absence of a control group and the reliance on self-reported adherence present certain limitations, the positive outcomes observed provide valuable evidence for the continued development and expansion of school-based anemia prevention initiatives. Future research should focus on comparative studies with control groups and explore long-term sustainability and adherence factors to further strengthen public health strategies aimed at improving adolescent nutrition and well-being.

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