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Original Research

The Effect of Beet Juice Intake on Increasing Hemoglobin Levels in Adolescent Girls with Anemia: A Literature Review

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ABSTRACT

Background: *Anemia in adolescent girls is a health problem that is still commonly found and has an impact on decreased learning concentration, productivity, and reproductive health. One non-pharmacological alternative that can help increase hemoglobin levels is the consumption of beet juice, which contains iron, folate, and vitamin C. This study aims to determine the effectiveness of beetroot juice in increasing hemoglobin levels in adolescent girls with anemia.*

Methods: *This study used a literature review design by searching articles from the Google Scholar and PubMed databases. The search strategy was conducted using the keywords "beetroot effect," "blood hemoglobin," "beetroot benefit," and "anemia." The articles analyzed were selected based on inclusion and exclusion criteria relevant to the topic, resulting in 10 eligible journals. The data were analyzed descriptively by examining the study design, sample size, intervention, and results of hemoglobin level improvement.*

Results: *The review showed that all ten journals reported a significant increase in hemoglobin levels after regular consumption of beetroot juice in adolescent girls with anemia. The nutrients in beetroot play a role in red blood cell formation and increasing blood oxygen capacity.*

Conclusion: *Beet juice is effective in increasing hemoglobin levels in adolescent girls with anemia. Nutrition education programs for adolescents should recommend beet juice consumption as a natural alternative to increase hemoglobin levels.*

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INTRODUCTION

Anemia is a global health problem that remains a major challenge, especially among adolescent girls. This condition occurs when hemoglobin levels in the blood fall below normal, reducing the blood's ability to carry oxygen. According to WHO data (2017), the prevalence of anemia worldwide ranges from 40–88%, and in developing countries, it reaches more than 50% among adolescent girls . In Indonesia, the Riskesdas results show

that around 84.6% of adolescent girls suffer from iron deficiency anemia (Indonesian Ministry of Health, 2018). This figure indicates that anemia is still a public health problem that needs serious attention and treatment.

Adolescent girls are a group that is vulnerable to anemia due to increased iron requirements during growth and menstruation (Basith, 2017). Lack of iron intake, an unbalanced diet, and high activity levels without adequate nutritional support can exacerbate this condition. The effects of anemia on adolescents include decreased concentration, reduced physical endurance, and impaired physical development (Jaelani & Yuliani, 2017). Anemia that is not treated early also increases the risk of complications in adulthood, such as anemia during pregnancy and the risk of postpartum hemorrhage (Budiarti & Astutik, 2020). Therefore, early intervention in adolescents is an important step to prevent long-term effects.

The government has made various efforts to combat anemia, such as a program to provide iron tablets through educational institutions and health facilities. However, compliance with taking these tablets remains low due to side effects and taste fatigue (Nursela & Suryani, 2021). This calls for alternative non-pharmacological approaches that are safe, natural, and easily accepted by adolescents. One food ingredient with potential to support increased hemoglobin levels is beetroot (Beta vulgaris), which is rich in iron, folic acid, and vitamin C (Rokhana & Kartikasari, 2018).

Beetroot has long been known to have benefits in helping the formation of red blood cells. Its betacyanin and antioxidant content play a role in improving blood circulation and increasing hemoglobin levels (Khadem & El-Hadi, 2018). Research conducted by Ginting and Simanullang (2020) shows that consuming beetroot juice can significantly increase hemoglobin levels in individuals with anemia. Similar results were also found by Kartika and Hidayat (2021), who reported that adolescent girls who consumed beet juice experienced an increase in hemoglobin levels after several weeks of regular consumption. These findings reinforce the potential of beetroot as an effective and easily applied complementary therapy.

This study has novelty in its approach, namely conducting a literature review to examine the latest research results on the effectiveness of beet juice in increasing hemoglobin levels in adolescent girls with anemia. This approach not only assesses the benefits but also compares the dosage, duration of administration, and characteristics of respondents from various studies. Based on this, this study aims to determine the effect of beet juice administration on increasing hemoglobin levels in adolescent girls with anemia through a systematic and comprehensive literature review.

MATERIALS AND METHODS

This study used a *literature review* design with a descriptive analytical approach. This design was chosen because it was suitable for identifying, evaluating, and synthesizing the results of previous studies on the effect of beet juice administration on increasing hemoglobin levels in adolescent girls with anemia. The literature review was conducted by examining various scientific works, including articles, national and international journals, and other scientific publications relevant to the topic (Utami, , 2019). This design was chosen based on the objective of obtaining a comprehensive overview of the scientific effectiveness of beet juice without conducting direct experiments.

The research was conducted from July to October 2021. The data used was secondary data obtained from previous studies. Data sources were collected from two

main databases, namely Google Scholar and PubMed, as both provide scientific journals with high credibility. The search strategy was carried out using a combination of keywords and *Boolean operators* (AND, OR) to make the search results more specific and relevant to the topic. The keywords used included "beetroot effect," "blood hemoglobin," "beetroot benefit," and "anemia." To focus the literature review, this study used the **PICO** (*Population, Intervention, Comparison, Outcome)* framework as listed in the following table:

Table 1. PICO Framework

Component	Description
Population (P)	Adolescent girls with anemia
Intervention (I)	Administration of beet juice
Comparison (C)	No comparison
Outcome (O)	Increase in blood hemoglobin levels

The population in this study included all articles discussing the effect of beet juice on hemoglobin levels. The sampling technique used *total sampling*, in which all articles that met the inclusion criteria were included in the analysis. The research sample consisted of 10 articles that met the criteria, both national and international. The inclusion criteria included *original research* articles in Indonesian or English, available in *full text,* and published between 2015 and 2021. The exclusion criteria were articles that were irrelevant to the topic, did not explain the results of hemoglobin level measurements, or were only abstracts without full text (Notoatmodjo, 2018).

The variables in this study consisted of an independent variable, namely the administration of beetroot juice (*Beta vulgaris*), and a dependent variable, namely an increase in hemoglobin levels in adolescents with anemia. The research instrument was an article review sheet compiled based on the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)* guidelines (Polit & Beck, 2018). Data validity was maintained through the article selection process according to the criteria, while reliability was achieved by assessing the consistency of results between articles. Each article that met the criteria was analyzed systematically to ensure its suitability for the research objectives.

The data collection procedure was carried out in stages, starting from literature search, article selection, data extraction, to analysis of results. The first stage was to identify titles and abstracts to ensure relevance to the research theme. The second stage was to read the full text of the selected articles. The third stage was to summarize the results of each article based on the research design, sample size, intervention, and main results. Data analysis was performed descriptively by presenting the findings in the form of a narrative synthesis that compared the similarities and differences between studies (Made & Nugraha, 2021).

The article selection process is visualized in the following flowchart based on the **PRISMA 2009** guidelines:

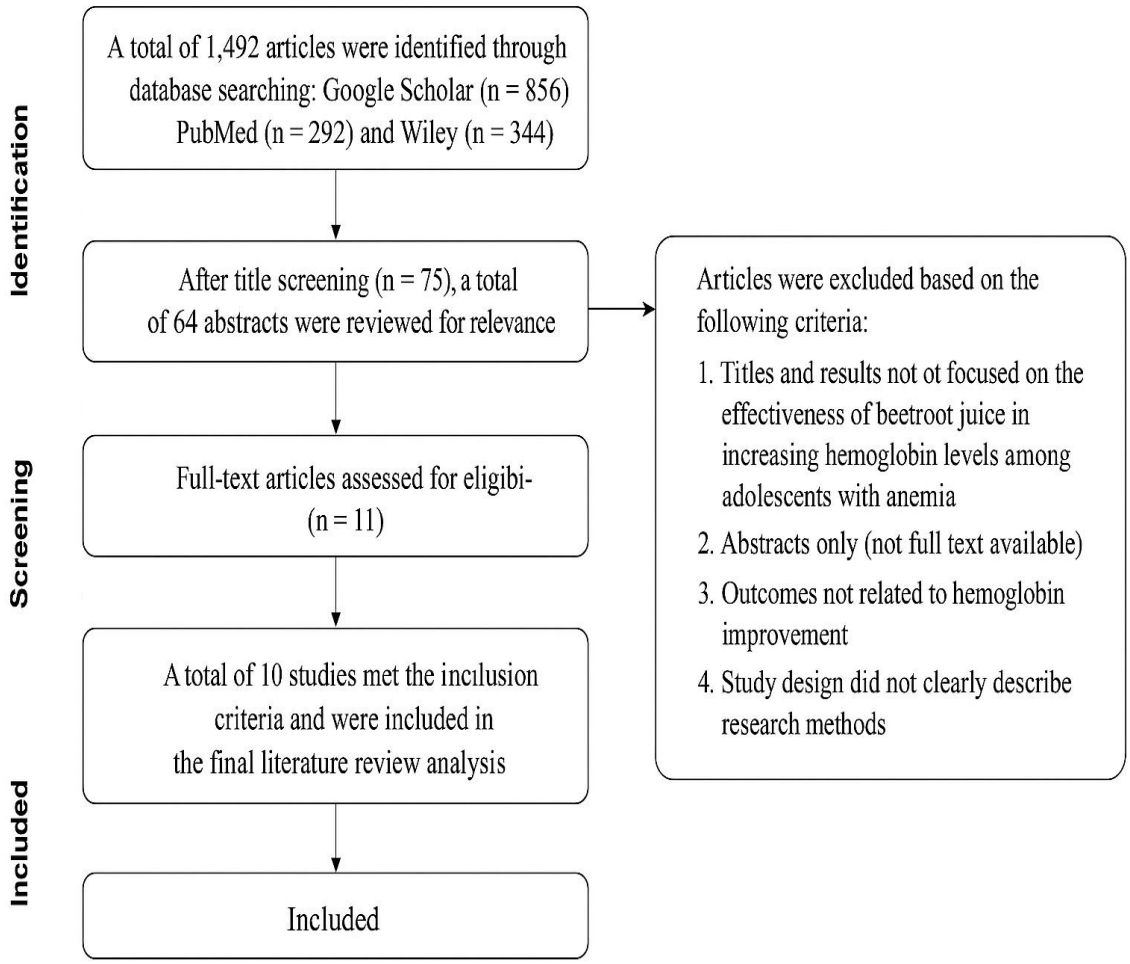

Figure 1. PRISMA Literature Review Reporting

RESULTS

Articles were searched through three databases, namely PubMed, Wiley, and Google Scholar, using the keywords beetroot effect, blood hemoglobin, beetroot benefit, and anemia. After screening based on inclusion and exclusion criteria, ten articles were obtained that were eligible for further analysis.

Table 2 presents a summary of the ten articles discussing the effect of beetroot juice on hemoglobin levels in adolescent girls with anemia. The information presented includes the author's name, year of publication, research title, methods (including variables, samples, instruments, design, and analysis), frequency and dosage of beetroot juice administration, and the main results of the study. In general, all studies used a quasi-experimental design with a pre-test post-test approach to measure the effectiveness of beet juice in increasing hemoglobin levels. The number of respondents in each study varied between 9 and 60 people, with adolescents aged 13–19 years.

Table 2. Search Results and Summary of Reviewed Articles

No	Author (Year)	Research Title	Methods (Design, Sample, Instruments, Analysis)	Dose & Frequency of Administration	Summary of Research Results
1	Rudolf Boyke Purba et al. (2021)	Beetroot Juice and Red Spinach Juice to Increase Hemoglobin Levels in Anemic Adolescent Girls	Quasi-experiment; 25 anemic adolescent girls; observation sheets; paired t-test	150 ml of beetroot juice every morning for 2 weeks	There was an increase in Hb levels from 11.47 g/dl to 12.02 g/dl after the intervention.
2	Damini B. Patel et al. (2020)	Study to Assess the Effectiveness of Beetroot Juice with Jaggery on Hemoglobin Level among Adolescent Girls in Gujarat	Quasi-experimental pre-post test; 60 adolescent girls; haemometer; t-test	150 ml of beetroot juice every morning for 15 days	Significant increase in Hb levels in the experimental group ($p < 0.05$).
3	Kartika Pibriyanti (2021)	The Effectiveness of Giving Beetroot Juice on Increasing Hemoglobin (Hb) Level of Adolescent Women in Islamic Boarding School	Pre-experimental one group pre-post test; 30 adolescent women; observation sheet; t-test	200 ml of beetroot juice per day for 7 days	The average Hb level increased from 12.03 g/dl to 13.60 g/dl ($p=0.001$).
4	Rani Zuhraini et al. (2021)	The Effect of Beet Juice Administration on Hb Levels in Adolescent Girls	Quasi-experimental one-group pre-post test; 17 adolescent girls; observation sheets; dependent t-test	250 ml of beet juice per day for 7 days	The average Hb level increased from 10.68 g/dl to 11.09 g/dl ($p=0.001$).
5	Rapael Ginting et al. (2020)	The Intake of Beta Vulgaris and Amaranthus Tricolor L. Juice on Increasing the Hemoglobin Level	Quasi-experimental pre-post test; 30 respondents; Shapiro-Wilk test	180 ml of beet juice/day for 14 days	Increase in Hb levels of 1.03–1.34 g/dl after intervention.
6	Mamata Swain et al. (2020)	Effectiveness of Beetroot Juice on the Prevention and Management of Anemia	Quasi-experimental pre-post test; 46 students; hemoglobin meter; t-test	100 ml of beetroot juice daily for 1 month	Hemoglobin levels increased from 10.04 g/dl to 12.67 g/dl ($p=0.001$).

No	Author (Year)	Research Title	Methods (Design, Sample, Instruments, Analysis)	Dose & Frequency of Administration	Summary of Research Results
7	Pushpaanjali G. et al. (2020)	Effect of Beetroot Juice on Anemic Patients – An Analytical Study	Quasi-experimental study with one group pre-post test; 9 participants; observation; hematological parameters	200 ml of beetroot juice twice daily for 3 weeks	Hemoglobin levels increased by an average of 1.05 g/dl.
8	Maryam L. et al. (2018)	The Effects of Consuming 6 Weeks of Beetroot Juice on Hematological Parameters in Female Soccer Players	Semi-experimental; 20 female athletes; questionnaire and observation; SPSS	200 ml of beetroot juice three times a week for 6 weeks	Significant increase in Hb, Hct, RBC, and ferritin levels ($p < 0.05$).
9	Kartika Ikawati et al. (2018)	The Effect of Beetroot (Beta Vulgaris) on Erythrocyte Index in Adolescent Girls with Anemia	One group pre-post test; 30 female students; observation; SPSS	250 ml of beet juice per day for 7 days	Increase in Hb levels from 11.27 g/dl to 12.67 g/dl ($p < 0.05$).
10	Senthil Kavitha et al. (2019)	An Experimental Study to Determine the Effectiveness of Beetroot Juice on Hemoglobin among Girls of Selected Hostel Girls, Bidar, Karnataka	One group pre-post test; 30 adolescents; observation; descriptive & inferential analysis	100 ml of beetroot juice every morning for 20 days	Significant increase in Hb, Hct, RBC, and ferritin levels ($p < 0.05$).

DISCUSSION

The Effect of Beetroot Juice Administration on Hemoglobin Levels in Adolescents with Anemia

All journals indicate a significant effect on the effectiveness of beet juice administration on increasing hemoglobin levels in adolescent girls. This is in line with the fact that beetroot contains vitamins and minerals such as iron, sodium, zinc, calcium, potassium, magnesium, phosphorus, vitamin C, and folic acid, which function to grow and replace damaged cells (USDA, 2014).

The most common type of anemia is iron deficiency anemia. Anemia is most prevalent in women of childbearing age. In developing countries, approximately 370 million women are diagnosed with iron deficiency anemia (Fitri, 2016). One solution that can be applied to meet the body's iron needs is to consume fruits that contain iron. One source of iron that plays a role in the formation of hemoglobin in the blood is found in beets (Kavitha, 2020).

This is in line with research conducted by Kartika Pibriyanti in 2020 entitled "The Effectiveness of Giving Beetroot Juice on Increasing Hemoglobin (Hb) Levels in Adolescent Women in Islamic Boarding Schools." This type of research is pre-experimental, using a one-group pretest design. The sample in this study consisted of female adolescents aged 15-19 years who had already experienced menstruation in Islamic boarding schools. The intervention group was given 60 grams of beetroot in the form of 200 ml of juice per day for 7 days. The results of this study showed an increase in hemoglobin levels in adolescent girls from 12.03g/dl to an average of 13.60g/dl. The hemoglobin levels before and after the intervention obtained p=0.001, which means that there was a significant difference between the hemoglobin levels before and after the intervention of giving beet juice to adolescents.

Beet juice contains iron, minerals, and vitamins. It is very useful for people suffering from anemia. Beet juice is an excellent source of iron and vitamin C for anemia. Beets help repair and reactivate red blood cells in the body, which in turn increases the oxygen supply to all parts of the body. One of the best ways to consume beets for anemia is in the form of juice (Journal & Pharmaceutical, 2020). In the 10 articles studied, all articles used a quasi-experimental design in conducting their research. The respondents used in the study were females aged 13-19 years who were experiencing anemia.

Dosage and Frequency of Beet Juice Administration for Adolescent Girls with Anemia

In the study by Kartika Ikawati et al. (2018), the researchers provided 200 grams of beetroot, consumed in the form of juice with a volume of 250 ml/day for 7 days. In the study by Rapael Ginting et al. (2020), the researchers provided 180 ml/day of beetroot juice for 14 days. The researchers also instructed the respondents not to consume foods or beverages containing tannins, such as tea and coffee. In the study by Mamata Swain et al. (2020), the researchers gave 100 ml of fruit juice every day for 1 month, which was consumed at breakfast.

In the next article, Pushpaanjali G et al (2020), entitled "Effect of Beetroot Juice on Anaemic Patients -an Analytical Study," administered 200 ml of beet juice mixed with 10 g of sugar twice a day, at noon and at night, for 3 weeks. In the next study conducted by Maryam L et al (2018), it was mentioned that beetroot juice was given to adolescents with anemia at a dose of 250 ml/day for 7 days.

In a study by Rudolf Boyke Purba et al. (2021) entitled "Beetroot Juice and Red Spinach Juice to Increase Hemoglobin Levels in Anemic Adolescent Girls," the researchers gave 150 ml of beetroot juice for 2 weeks to the respondents. In a study by Senthil Kavita (2019) entitled "An Experimental Study to Determine the Effectiveness of Beetroot Juice on Hemoglobin Among Girls of Selected Hostel Girls, Bidar, Karnataka," the researchers stated that beetroot juice was given at a dose of 100 ml for 20 days in the morning once on an empty stomach.

The next study was by Rani Zuhraini et al. (2021) entitled "The Effect of Beetroot Juice on Increasing Hb in Adolescent Girls," in which researchers gave 250 ml of beetroot juice once a day for 7 days. Researcher Kartika Pibriyanti (2021), in a study titled "The Effectiveness of Giving Beetroot Juice on Increasing Hemoglobin (Hb) Level of Adolescent Women in Islamic Boarding School," administered 200 ml of beetroot juice for 1 week to the respondents. In a study conducted by Damini B Patel et al (2020) entitled "Study to Assess the Effectiveness of Beetroot Juice with Jaggery on Hemoglobin Levels Among Adolescent Girls in Selected Schools in Anand District, Gujarat," the researchers gave 150 ml of beetroot juice once a day every morning for 15 days.

In a study by Ikawati et al. (2018) entitled "The Effect of Beetroot (Beta Vulgaris) on the Erythrocyte Index in Adolescent Girls with Anemia," the researchers gave 250 ml of beetroot juice per day for 7 days. Of the 10 articles reviewed, all articles showed the effectiveness of beet juice in increasing blood hemoglobin levels in adolescent girls with anemia. The best dose for treating anemia in adolescents is 100 ml to 200 ml of beet juice once a day for at least 1 week.

The results of this literature review have positive implications for efforts to prevent anemia in adolescent girls, especially in developing countries. The administration of beet juice can be used as an alternative non-pharmacological therapy that is easy to implement in schools and families. In addition to being relatively inexpensive, beet juice is safe for regular consumption and can be a nutritional intervention that supports adolescent health improvement programs (Purba et al., 2021; Maryam et al., 2018).

This literature review has several limitations that need to be considered. Most studies used quasi-experimental designs with relatively small sample sizes and without strong control groups. In addition, the duration of the intervention varied between studies, limiting the generalizability of the results. Other factors such as diet, physical activity, and the nutritional status of the respondents were also not fully controlled, which could affect changes in hemoglobin levels (Swain et al., 2020; Ikawati et al., 2018).

Given these results and limitations, future research is recommended to use a randomized controlled trial (RCT) design with a larger sample size and a uniform intervention duration. Researchers also need to assess the long-term effects of beet juice consumption on iron status and other hematological parameters. In health practice , medical personnel and health educators can encourage beet juice consumption as a food-based anemia prevention strategy that is easily accepted by adolescents (Pibriyanti, 2021; Kavitha et al., 2019).

CONCLUSION

The results of analysis and synthesis from various reviewed studies conclude that beet juice is effective in increasing hemoglobin levels in adolescent girls with anemia. The iron, folic acid, and antioxidant content in beetroot plays an important role in the process of red blood cell formation, thereby helping to improve anemia naturally. Giving beetroot juice at a dose of 100–250 ml per day showed consistent results in increasing

hemoglobin levels. These findings reinforce the evidence that natural-based interventions can be an easy, affordable, and safe alternative in the prevention and treatment of anemia in adolescents. The recommendation from the results of this study is that health workers, especially midwives, should educate adolescent girls about the benefits of consuming beet juice as a non-pharmacological measure to maintain hemoglobin levels.

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