



Nutritional Strategies for Maintaining Optimal Hemoglobin Levels in Soccer Players: A Review of Health Implications

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Abstract: This study uses a literature review-based qualitative descriptive research model to explore nutritional strategies in maintaining optimal hemoglobin levels in football players. The research process begins with the collection of literature from reliable sources, by accessing scientific databases such as Scopus, Science Direct, and Google Scholar using keywords such as "Nutrition Strategies," "Hemoglobin Levels," and "Soccer Players." After gathering the relevant literature, the authors reviewed important terms related to hemoglobin and their application to football players. Furthermore, data from the relevant literature is collected and analyzed. The data includes the author's name, year of publication, research design, research objectives, samples, instruments, and a summary of the findings. Articles that met the criteria were then filtered for further analysis. The documentation method is used to collect data by searching and extracting information from related literature. The collected data is then compiled into a comprehensive document to answer the research questions. Content analysis was conducted to evaluate the relevance and contribution of the study to nutritional strategies in maintaining hemoglobin levels. The conclusions of this analysis provide evidence-based recommendations regarding effective nutrition strategies to maintain optimal hemoglobin levels in soccer players.

Keywords: Hemoglobin, Soccer Players, Nutrition Strategies

Introduction

In the world of soccer, hemoglobin plays a crucial role in supporting optimal physical performance (Insani et al., 2024; Likardo et al., 2023; Nusri et al., 2024; Rambe et al., 2024). Hemoglobin, a protein in red blood cells, is responsible for transporting oxygen from the lungs to the rest of the body and carrying carbon dioxide back to be expelled (Schwellnus & Derman, 2010). This function is especially important during intensive physical activity, such as soccer matches, where oxygen needs increase significantly (Gawrecki et al., 2019). Adequate hemoglobin levels ensure that all body cells, including muscle cells that work hard during the game, receive the oxygen necessary for energy metabolism and recovery (Meo et al., 2021). Conversely, low hemoglobin levels

can result in decreased endurance, fatigue, and decreased athlete performance. Therefore, maintaining optimal hemoglobin levels is essential for soccer players to ensure maximum performance on the field.

Several factors affect hemoglobin levels in the body, including diet, general health conditions, and exercise intensity (Mannaa et al., 2023). Nutrient requirements are the main factors that play a role in hemoglobin synthesis. Iron, vitamin B12, and folic acid are important components in hemoglobin production. A deficiency in any of these nutrients can result in decreased hemoglobin production and potential anemia. Iron, as a major component of hemoglobin, is essential for preventing iron deficiency anemia. Vitamin B12 and folic acid are also necessary for the production of healthy red blood cells (Scantlebury et al., 2024). Vitamin B12

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deficiency can lead to megaloblastic anemia, while folic acid deficiency can result in macrocytic anemia. An unbalanced diet can lead to micronutrient deficiencies, which can affect hemoglobin levels. Additionally, certain medical conditions, such as indigestion or infections, can affect the absorption of essential nutrients (Toro-Román et al., 2023).

Intensive exercise without adequate recovery can also affect hemoglobin levels. Excessive physical activity can lead to damage to red blood cells, leading to a decrease in hemoglobin levels (Jastrzębska et al., 2023). Therefore, it is important to maintain a balance between training and recovery. To ensure hemoglobin levels remain optimal, soccer players need to implement several nutritional strategies (Shaw et al., 2022). One is to ensure adequate iron intake from heme sources, such as red meat, chicken, and fish, as well as non-heme sources from plant-based foods such as legumes and green vegetables. Vitamin C, which increases the absorption of non-heme iron, should also be considered (Andersen et al., 2021). Eating vitamin C-rich foods such as oranges, kiwis, and peppers along with iron-containing foods can increase the efficiency of iron absorption. In addition, meeting the needs of vitamin B12 and folic acid from the right food sources is very important. Vitamin B12 can be obtained from animal products, while folic acid is found in green vegetables, nuts, and seeds. Good hydration also plays an important role in maintaining hemoglobin levels; Dehydration can decrease blood volume and affect hemoglobin concentrations. Ensuring adequate fluid intake, including water and electrolyte drinks, can help support optimal blood volume and hemoglobin function (Schwellnus & Derman, 2010).

In addition to focusing on specific nutrients, it is important to implement a balanced and varied diet to meet overall nutritional needs. A diet consisting of different types of foods from major food groups—carbohydrates, proteins, healthy fats, and fruits and vegetables—can provide micronutrients and macronutrients necessary for blood health and athlete performance. Avoiding monotonous diets and ensuring intake from a variety of food sources can help prevent nutrient deficiencies that can affect hemoglobin levels. Regular monitoring of hemoglobin levels is also important to ensure that soccer players are in optimal condition. Regular blood tests can help detect changes in hemoglobin levels and identify potential health problems early. Based on the results of these tests, nutritional strategies can be tailored to meet the specific needs of each individual.

Maintaining optimal hemoglobin levels is key to supporting the peak performance of soccer players. Adequate hemoglobin ensures that the body receives enough oxygen for intense physical activity and

supports an effective recovery process. By paying attention to their nutritional intake, including iron, vitamin B12, folic acid, and vitamin C, as well as maintaining hydration and a balanced diet, soccer players can maximize their performance on the pitch and ensure optimal health. The right nutritional approach not only helps prevent anemia but also improves aerobic capacity, reduces fatigue, and supports the achievement of the best results in sports competitions. Based on this background, researchers need to conduct a comprehensive literature review on nutritional strategies for maintaining optimal hemoglobin levels in soccer players.

Method

This study employs a qualitative descriptive research model based on literature reviews to examine nutritional strategies for maintaining optimal hemoglobin levels in soccer players. The process begins with the collection of literature from reliable sources by accessing scientific databases such as Scopus, Science Direct, and Google Scholar using keywords like "Nutritional Strategies," "Hemoglobin Levels," and "Soccer Players." After gathering the literature, important terms related to hemoglobin and their application to soccer players are reviewed.

Subsequently, data from the relevant literature is compiled and analyzed. This data includes information such as the author's name, year of publication, study design, research objectives, samples, instruments, and a summary of findings. Articles that meet the criteria are then filtered for further analysis. The documentation method is used to collect data by searching for and extracting information from related literature. The collected data is compiled into one comprehensive document to address the research questions. Content analysis is used to evaluate the relevance and contribution of the studies to nutritional strategies for maintaining hemoglobin levels. The conclusions drawn from this analysis provide evidence-based recommendations regarding effective nutritional strategies for maintaining optimal hemoglobin levels in soccer players. This methodology aims to offer in-depth insights into hemoglobin management within the context of soccer.

Result and Discussion

Managing optimal hemoglobin levels involves employing dietary strategies, monitoring iron and vitamin intake, and adhering to a nutrition plan tailored for soccer players. Players should balance their nutritional needs with their training regimen and make

necessary adjustments to avoid deficiencies, ensuring both performance and overall health are maintained effectively. There are 10 articles that will be further

analyzed in this literature review. Detailed information can be found in Table 1.

Table 1. Summary of data description

Author	Topic	Results
(Younesi et al., 2021)	Relationships Between Aerobic Performance, Hemoglobin Levels, and Training Load During Small-Sided Games: A Study in Professional Soccer Players	Research indicates that maximum speed (V IFT) and training load affect hemoglobin levels in soccer players. Low hemoglobin is associated with fatigue due to internal load. Nutritional strategies to maintain hemoglobin levels include consuming iron and vitamin C, ensuring adequate hydration, and having a balanced diet.
(Polimeni et al., 2022)	The impact of UEFA Euro 2020 football championship on Takotsubo Syndrome: Results of a multicenter national registry.	Research highlights that UEFA Euro matches are linked to Takotsubo syndrome (TTS) due to positive emotions, though no significant change in acute coronary syndrome (ACS) was found. For soccer players, maintaining heart health involves proper nutrition, iron-rich foods for optimal hemoglobin, and good hydration and electrolyte balance to manage stress and performance.
(Wołyńiec et al., 2022)	Impact of hydration with beverages containing free sugars or xylitol on metabolic and acute kidney injury markers after physical exercise	The study reveals that proper hydration and carbohydrate intake are crucial for soccer players' performance. Many semi-professional players fail to meet dietary recommendations, impacting hydration and energy levels. Key nutritional strategies include consuming iron-rich foods, maintaining hydration, and following a balanced diet for optimal hemoglobin and performance.
(Li & Li, 2022)	Football Player's Training for Improving Physical Function and Health	The study shows that soccer players' fitness index correlates with aerobic capacity, highlighting the need for soccer-specific training. Effective testing methods are crucial. For optimal hemoglobin levels, players need proper nutrition, including iron to support aerobic capacity, and recovery through balanced intake of proteins and carbohydrates.
(Özen et al., 2020)	The effect of pre-season football training on hematological parameters of well-trained young male football players	The study reveals that pre-season soccer training significantly improves hemoglobin levels and endurance, but also affects blood pressure and heart rate. To maintain optimal hemoglobin, players should focus on iron-rich foods, proper hydration, and balanced intake of carbohydrates and proteins, with possible iron supplementation if needed.
(Wang et al., 2021)	NCAA Division I American football players with sickle cell trait have altered hematological responses and hydration status	The study found that NCAA Division I soccer players with sickle cell trait (SCT) had higher HbS levels and RDW, with better hydration but higher uric acid levels compared to controls. For optimal hemoglobin, SCT players need targeted nutrition, increased fluid and electrolyte intake, and monitoring of uric acid levels.
(Fortin & Billaut, 2019)	Blood-flow restricted warm-up alters muscle hemodynamics and oxygenation during repeated sprints in american football players	The study found that warm-up with blood flow restriction (WFR) enhances local blood volume and muscle oxygen saturation, benefiting performance in prolonged activities. To maintain optimal hemoglobin levels, combining effective warm-up techniques with good nutrition, such as iron and vitamin B12 intake, supports better oxygenation and athletic performance.
(Fornaziero et al., 2023)	Acute Responses of Youth Elite Players to a Football Match in Terms of Blood Markers	The study shows that elite young soccer players experience acute increases in immune markers, muscle damage, and metabolic indicators post-match, with no significant changes in electrolytes. For optimal hemoglobin, post-match nutrition should include carbs

Author	Topic	Results
(My et al., 2022)	Biological, Psychological, and Physical Performance Variations in Football Players during the COVID-19 Lockdown: A Prospective Cohort Study	and protein for muscle recovery, iron-rich foods, and proper hydration. The study reveals that during COVID-19 lockdowns, players showed increased body fat and decreased hematocrit, hemoglobin, and ferritin. To maintain optimal hemoglobin, players should focus on iron-rich foods, vitamin D supplementation, and good hydration to support blood health and physical performance.
(Nicotra et al., 2023)	Iron Deficiency and Anemia in Male and Female Adolescent Athletes Who Engage in Ball Games	The study reveals significant iron deficiency (ID) and iron deficiency anemia (IDA) among adolescent athletes, with higher rates in females. To maintain optimal hemoglobin, athletes should focus on iron-rich foods and supplementation, especially females. Regular blood tests are recommended to monitor and address iron levels to prevent performance issues.

Results from literature investigations reveal that nutrition strategies have an important role in maintaining optimal hemoglobin levels for football players. Research by Younesi et al. (2021) shows that exercise intensity affects hemoglobin levels, with low hemoglobin levels often associated with fatigue due to internal loads. Therefore, players are advised to eat foods rich in iron and vitamin C, maintain adequate hydration, and adopt a balanced diet. Polimeni et al. (2022) emphasized the importance of a diet that supports heart health and hemoglobin levels, especially during periods of intense competitions such as the UEFA Euro. A diet that includes iron-rich foods as well as good hydration and electrolyte balance becomes essential for managing stress and performance. In addition, research by Wołynec et al. (2022) highlights that proper hydration and carbohydrate intake play a crucial role in a football player's performance. Good hydration, combined with iron-rich foods, contributes to optimal hemoglobin levels and maximum performance. Li & Li (2022) correlates a player's fitness index to aerobic capacity, emphasizing that proper nutrition, including iron, as well as good recovery through protein and carbohydrate intake, is essential to support optimal performance. Research by Özen et al. (2020) shows that intense pre-season training can improve hemoglobin levels and endurance, but it also affects blood pressure and heart rate. Therefore, players should focus on iron-rich foods, proper hydration, and a balanced intake of carbohydrates and proteins. Meanwhile, Wang et al. (2021) identified that players with sickle cell traits require tailored nutrition, increased fluid and electrolyte intake, and monitoring uric acid levels to maintain hemoglobin levels. Fortin & Billaut (2019) showed that warming with blood flow restriction can increase local blood volume and muscle oxygen saturation, which is beneficial for performance in long-term activity. Fornaziero et al. (2023) noted that young elite soccer

players experienced increased markers of immunity and muscle damage after the game, and recommended the consumption of carbohydrates, protein, as well as foods rich in iron and good hydration post-match. My et al. (2022) reported a decrease in hemoglobin and ferritin levels during the COVID-19 lockdown, demonstrating the importance of iron-rich foods, vitamin D supplementation, and good hydration to support blood health and physical performance. Finally, Nicotra et al. (2023) found significant levels of iron deficiency and anemia among adolescent athletes, especially women, with an emphasis on the importance of iron-rich foods and regular monitoring of iron levels to prevent performance problems.

This research is in line with previous literature that shows that hemoglobin levels are directly related to athletic performance, especially in sports that require high endurance such as soccer. Previous studies have long emphasized the importance of iron and vitamins in the formation of hemoglobin and their effect on athlete performance. For example, research by (Barbosa et al., 2021) highlighted that hemoglobin plays a key role in oxygen transport during intense physical activity, and that deficiency can degrade athletes' performance. Physical activity is very important because it plays a big role in improving the efficiency of the cardiovascular system and overall health (Haris et al., 2024; Khani et al., 2024; Pitnawati et al., 2023). Regular exercise helps to strengthen the heart and blood vessels, allowing the body to distribute oxygen more effectively during intense activity (Amin et al., 2023; Chinta et al., 2024; Hambali et al., 2024). Hemoglobin, which is responsible for transporting oxygen in the blood, works better thanks to the increased cardiovascular capacity resulting from physical activity. Additionally, exercise improves muscle health and flexibility, which are essential for physical performance and injury prevention (Al Zaki et al., 2023; Oktadinata et al., 2024). Physical activity also

has mental benefits, reduces stress, and improves mood and cognitive function. All of this contributes to improved athlete performance and long-term health, making physical activity an integral part of a healthy lifestyle.

These findings are consistent with the results of studies in this review that suggest that iron and vitamin deficiencies can negatively impact hemoglobin levels and performance. While this study provides important insights into nutritional strategies for maintaining optimal hemoglobin levels, some limitations should be noted. First, most of the studies reviewed did not distinguish between nutritional needs for professional and amateur soccer players, who may have different needs. Second, many studies have focused solely on nutritional aspects without considering other factors such as genetics or individual health conditions that can affect hemoglobin levels. Third, there are variations in the methodology used in the study that can affect the reported results. For future studies, it is recommended that further studies explore the differences in nutritional needs between professional and amateur soccer players, as well as conduct more controlled and structured studies to assess the effects of interactions between nutrition, exercise, and genetic factors on hemoglobin levels. In addition, a more holistic approach that considers aspects of individual health and other variables that may affect hemoglobin levels will provide a more comprehensive picture of hemoglobin management in the context of exercise.

Conclusion

The conclusion of this literature review shows that maintaining optimal hemoglobin levels is a crucial aspect to support the performance of soccer athletes. Adequate hemoglobin is essential for the efficient transport of oxygen to the body's tissues, including muscles, and plays a vital role in the recovery process as well as the improvement of physical endurance. Proper nutrition, especially iron intake, vitamin B12, and folic acid, plays a major role in hemoglobin production and overall blood health. A deficiency of any of these nutrients can result in anemia, which negatively affects the performance of athletes. In addition, adequate hydration and electrolyte balance are essential in maintaining hemoglobin levels and supporting optimal physical performance. The study also confirms that intensive exercise that is not balanced with adequate recovery can reduce hemoglobin levels, highlighting the need for a balance between exercise and recovery and the implementation of supportive nutrition strategies. Therefore, maintaining a balanced diet with the consumption of foods rich in iron and vitamin C, as well

as ensuring optimal hydration, is an important strategy to maximize performance on the soccer field.

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Author Contributions

This article was written by two contributors, Indra Adi Budiman contributed to the writing of the introduction, methodology, literature review, results, and conclusions. Yovhandra Ockta contributed to the process of conceptualization, methodology, review, and finalization of articles and improvement of the content of the article.

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Conflict of Interest

The content of this article does not create a conflict of interest.

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