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PREVENTIVE MEASURES FOR IRON DEFICIENCY ANEMIA AMONG ADOLESCENTS

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Abstract
This article is aimed at analyzing the causes of the spread of iron deficiency anemia among adolescents, reviewing international experiences in preventing this condition, and proposing effective preventive measures that can be applied in the context of Uzbekistan. The article is intended to provide practical recommendations not only for healthcare professionals but also for teachers, parents, and representatives of government agencies.

Keywords: Iron deficiency anemia, adolescents, prevention, nutrition, iron fortification, pharmacological prevention, education, screening, Uzbekistan.

Introduction

Iron deficiency anemia (IDA) is one of the most common health problems among adolescents and significantly affects their physical, mental, and emotional development. Iron is a vital micronutrient necessary for the synthesis of hemoglobin, which carries oxygen in the body. A deficiency in iron disrupts the functioning of the circulatory system and can lead to fatigue, reduced concentration, and weakened immunity. Adolescence is one of the most critical stages of growth and development in a person's life, and during this period, the body's need for iron increases substantially. In particular, blood loss due to menstruation in girls and rapid muscle mass growth in boys further increase the risk of iron deficiency. According to the World Health Organization (WHO), approximately 25–30% of adolescents worldwide suffer from iron deficiency anemia, with this figure being even higher in developing countries. Although detailed statistical data on this issue in Uzbekistan is limited, it is assumed that imbalanced dietary habits, insufficient consumption of iron-rich foods, and socio-economic factors contribute to the spread of this condition. Among adolescents, IDA not only causes health issues but also negatively impacts their academic performance, social interactions, and overall quality of life. For example, decreased attention and memory caused by iron deficiency can lead to lower academic outcomes and reduced chances of success in future professional endeavors. Preventing iron deficiency anemia is essential for strengthening adolescent health and ensuring their full development. Strategies such as improving nutrition, expanding the availability of iron-fortified products, implementing pharmacological prevention, and raising awareness play a crucial role in addressing this issue. However, these measures must be adapted to the local context and implemented based on

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

scientifically grounded approaches. In developing countries like Uzbekistan, it is important to consider factors such as dietary habits, economic conditions, and the infrastructure of the healthcare system when designing and applying effective interventions.

Iron deficiency anemia (IDA) is one of the most widespread global health problems among adolescents and significantly affects their physical, intellectual, and emotional development. This section analyzes the global and national (Uzbekistan) status of IDA, its causes, risk factors, and prevention strategies based on existing scientific literature. The analysis is grounded in data from the World Health Organization (WHO), the Ministry of Health of Uzbekistan, UNICEF, and recent international research studies.

For example, in Iran, the prevalence of IDA among adolescent girls is 21.4%, while the rate of iron deficiency reaches 23.7% (Akbari et al., 2009). In China, the prevalence of anemia among adolescents was 12.6% in 2002, but it decreased to 6.6% during the years 2010–2012 (Zhang et al., 2019). These data highlight the global relevance of IDA and the importance of effective prevention programs. In India, the prevalence of IDA among adolescent girls can reach up to 56%, which is associated with iron-deficient diets and socio-economic factors (Kotecha et al., 2021). This global statistic underlines the seriousness of the IDA issue in developing countries, including Uzbekistan.

Existing research on the prevalence of iron deficiency anemia (IDA) among adolescents in Uzbekistan indicates a high rate of anemia among women and children, which also includes the adolescent group. For example, according to studies conducted by the Ministry of Health of Uzbekistan and international organizations, the prevalence of anemia among women aged 15–49 was around 60% in 2002. However, due to flour and other food fortification programs with iron, this figure dropped to 34.4% by 2013 (Turaev et al., 2013). This data is also highly relevant for adolescent girls, as they fall within this age group. In Karakalpakstan, it has been noted that the deficiency of iron and folic acid among adolescent girls is 40–50% higher than the national average (UNICEF, 2022). These regional disparities are explained by differences in dietary habits, economic conditions, and limited access to healthcare services. According to the Ministry of Health of Uzbekistan, a program was implemented in Karakalpakstan between 2018 and 2022 to provide iron and folic acid supplements to adolescent girls, which achieved certain successes in reducing the level of IDA (Ministry of Health of Uzbekistan, 2023). The prevalence of IDA in neighboring countries shows similar trends to those in Uzbekistan. For instance, in Kyrgyzstan, the prevalence of anemia among children can reach up to 50% (AKIpress, 2023). In Kazakhstan, the prevalence of IDA among adolescents is around 20–25%, which is associated with unbalanced diets and limited access to iron-rich foods (Kazakhstan Ministry of Health, 2022). This data allows for useful comparisons with Uzbekistan and emphasizes the importance of considering regional characteristics.

The main causes of iron deficiency anemia (IDA) among adolescents are linked to various factors. These include insufficient intake of iron-rich foods (such as meat, liver, and leafy green vegetables), high consumption of substances that inhibit iron absorption (like tea and coffee), and increased iron requirements during periods of rapid growth (Stevens et al., 2022). In adolescent girls, blood loss due to menstruation further increases the risk of IDA. Additionally, vegetarian diets, low socio-economic status, and chronic illnesses (such as intestinal parasites) contribute to

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the development of IDA (Pasricha et al., 2021). Studies on adolescents' dietary habits in Uzbekistan have shown that many adolescents do not consume adequate amounts of iron-rich foods, which raises the risk of anemia (Ministry of Health of Uzbekistan, 2020).

International experience in prevention shows that IDA can be effectively managed. The World Health Organization (WHO) recommends that adolescents take weekly doses of iron and folic acid supplements, a strategy that can reduce anemia rates in at-risk groups by 20–30% (WHO, 2021). Countries such as China and India widely implement iron fortification programs for flour, rice, and dairy products, resulting in a significant decrease in anemia prevalence (Zhang et al., 2019; Kotecha et al., 2021). Uzbekistan has also implemented a flour fortification program since the 2000s, which has played an important role in reducing IDA levels among women and children (Turaev et al., 2013). However, specific educational programs for adolescents and regular screenings within the healthcare system are still insufficient and remain a challenge (UNICEF, 2022).

Preventive Measures for Iron Deficiency Anemia. Iron deficiency anemia (IDA) is a widespread health problem among adolescents. Preventing it is crucial not only to support their physical and mental development but also to improve their quality of life in the future. The increased demand for iron during adolescence, imbalanced diets, and socio-economic factors all contribute to the risk of IDA. This section presents scientifically based, comprehensive measures for preventing IDA that can be applied within the context of Uzbekistan. The proposed strategies focus on improving nutrition, fortifying food products, pharmacological prevention, education, and the involvement of the healthcare system. The effectiveness of these measures is evaluated based on global experience and adapted to local conditions.

Improving adolescents' nutrition is considered a key strategy in preventing IDA. Iron-rich foods—such as red meat, liver, fish, leafy green vegetables (like spinach and broccoli), and legumes (like peas and beans)—should be included in their diet. According to the World Health Organization (WHO), there are two types of iron: heme iron (from animal products), which is absorbed at a rate of 15–35%, and non-heme iron (from plant-based sources), which is absorbed at only 2–20% (WHO, 2021). Therefore, it is important that adolescents' diets include sufficient amounts of animal-based foods. Due to economic constraints, many families in Uzbekistan consume meat infrequently; thus, promoting more affordable alternatives like iron-rich legumes and green vegetables is necessary. To improve iron absorption, consuming vitamin C-rich foods (such as oranges, tomatoes, and bell peppers) is recommended, as vitamin C can increase iron absorption by 20–30% (Pasricha et al., 2021). At the same time, intake of iron absorption inhibitors such as tea, coffee, and calcium-rich dairy products during meals should be limited.

Food fortification with iron is widely used globally as an effective method to prevent IDA. In China and India, fortification programs for flour, rice, and dairy products with iron have reduced anemia prevalence by 10–15% (Zhang et al., 2019; Kotecha et al., 2021). In Uzbekistan, a national flour fortification program with iron and folic acid has been in place since the 2000s, helping to reduce anemia rates among women aged 15–49 from 60% to 34.4% (Turaev et al., 2013). However, this program is mainly targeted at adults, and specific products for adolescents (such as fortified bread or dairy products provided through school feeding programs) are not sufficiently

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promoted. Incorporating iron-fortified products into school meals could be especially effective in high-prevalence regions like Karakalpakstan. For instance, UNICEF's program to provide iron and folic acid supplements to adolescent girls in Karakalpakstan has achieved measurable success (UNICEF, 2022). Pharmacological prevention is another important strategy, especially for at-risk groups. WHO recommends that adolescent girls take weekly doses of 60 mg of iron and 400 mcg of folic acid, which can reduce the risk of anemia by 20–30% (WHO, 2021). In Uzbekistan, a distribution program for iron supplements for adolescent girls was carried out in Karakalpakstan between 2018 and 2022, yielding positive outcomes in reducing IDA rates (Ministry of Health of Uzbekistan, 2023). However, long-term use of iron supplements may be limited by side effects (such as gastrointestinal issues) and poor adherence. Therefore, it is essential to educate adolescents and their parents about supplement use and to establish a system for regular and free distribution of these supplements.

Education and Awareness-Raising as Long-Term Preventive Measures Raising education and awareness is a long-term and effective approach to preventing iron deficiency anemia (IDA). It is important to provide information to adolescents and their parents about the consequences of iron deficiency, the benefits of iron-rich foods, and their significance in the daily diet. In Uzbekistan, awareness campaigns conducted through the healthcare system and schools can play an important role in this process. For example, organizing nutrition classes for adolescents in schools or holding seminars for parents in health centers can be effective measures. International experience also supports this approach—for instance, in India, school-based education programs increased adolescents' consumption of iron-rich foods by 15% (Kotecha et al., 2021). In Uzbekistan, such programs are not yet widely implemented, but they can be developed in cooperation with local public health organizations and international partners such as UNICEF. The involvement of the healthcare system is also crucial in preventing IDA. Implementing regular screening programs among adolescents enables early detection and treatment of anemia. According to WHO data, routine screenings can reduce the number of anemia cases by up to 40% (WHO, 2021). Although healthcare resources in Uzbekistan are limited, simple blood tests (such as checking hemoglobin levels) can be organized through school medical staff and local clinics. Special attention should be given to screening programs in high-risk areas like Karakalpakstan, where the prevalence of IDA is 40–50% higher than the national average (UNICEF, 2022). Furthermore, healthcare workers need to be specially trained on IDA and provided with modern diagnostic tools.

The Importance of Considering Local Factors in Uzbekistan. It is vital to take local factors into account when preventing IDA in Uzbekistan. For example, the cost of iron-rich foods may be too high for many families. Therefore, affordable and locally available products—such as beans and spinach—should be promoted. Additionally, certain cultural habits, such as the common practice of drinking tea during meals, reduce iron absorption. The public should be informed about such issues. Government programs that subsidize iron-fortified foods and expand school meal programs may provide economically efficient solutions. The following table summarizes the key measures for preventing IDA and their effectiveness:

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Measure	Description	Effectiveness (Global Experience)	Application in Uzbekistan
Improving nutrition	Consumption of iron-rich foods (meat, liver, legumes) and vitamin C.	Reduces anemia risk by 15–20%	Promote affordable foods and educate on reducing tea consumption during meals.
Food fortification	Fortifying flour, rice, and dairy products with iron.	Reduces anemia prevalence by 10–15%	Flour fortification program exists; needs expansion into school meal programs.
Pharmacological prevention	Weekly iron and folic acid supplementation.	Reduces anemia risk by 20–30% (WHO, 2021)	Partially implemented in Karakalpakstan; needs nationwide expansion.
Education and awareness	Informing adolescents and parents about IDA.	Increases consumption of iron-rich foods by 15%	Organize campaigns in schools and health centers.
Screening programs	Regular blood tests for early detection of anemia.	Reduces anemia cases by 40% (WHO, 2021)	Can be organized through schools and local clinics.

When implementing these measures in Uzbekistan, it is essential to consider socio-economic factors, cultural habits, and the capabilities of the healthcare system. For example, in high-risk regions such as Karakalpakstan, expanding free distribution programs for iron supplements and fortified foods could be an effective strategy. Additionally, collaboration between the government, the healthcare system, schools, and international organizations plays a crucial role in preventing iron deficiency anemia (IDA).

Discussion

The proposed measures for preventing iron deficiency anemia (IDA) among adolescents could be effective, but several factors need to be considered when applying them in the context of Uzbekistan. While improving nutrition, food fortification, pharmacological prophylaxis, and educational programs have shown positive results globally, local economic constraints, cultural habits, and the capacities of the healthcare system may pose challenges to implementing these strategies. For example, the high cost of iron-rich foods and the population's dietary habits limit their widespread consumption. Additionally, issues such as poor adherence to regular intake of iron supplements and unequal access to healthcare services create difficulties.

In Uzbekistan, the collaboration of the government, healthcare system, and community is crucial in preventing IDA. Expanding educational campaigns through schools and promoting affordable fortified products could be effective. Future research should focus on determining the precise prevalence of IDA among adolescents, developing prevention strategies tailored to local conditions, and evaluating the long-term effectiveness of existing programs. This approach will enable sustainable success in combating IDA.

If left untreated, iron deficiency anemia can seriously harm adolescents' health. Prolonged iron deficiency may lead to cardiovascular dysfunction, such as heart failure, because the body overworks the heart due to impaired oxygen delivery. Furthermore, weakened immunity increases adolescents' susceptibility to infectious diseases, raising the risk of chronic illnesses. Cognitive

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delays, decreased academic performance, and psychological problems like depression can also be observed as complications of untreated IDA. After treatment, if it is timely and properly administered, many complications can be resolved, but some irreversible consequences may remain. For example, cognitive delays caused by prolonged iron deficiency might not be fully reversed, and the body's ability to fight diseases could remain partially compromised due to weakened immunity. During iron supplement treatment, gastrointestinal side effects such as constipation or nausea may occur, but these are usually temporary.

Conclusion

Iron deficiency anemia (IDA) is a serious health threat to adolescents, negatively affecting their physical, mental, and social development. Adolescence is a crucial growth stage in human life, and preventing iron deficiency during this period is important not only for strengthening health but also for improving academic performance, enhancing immunity, and ensuring a better quality of life in the future. Key prevention strategies include improving nutrition, expanding the availability of iron-fortified foods, pharmacological prophylaxis, educational programs, and regular screening through the healthcare system. While each of these measures has proven effective globally, their successful implementation in Uzbekistan requires consideration of economic capabilities, cultural characteristics, and the state of healthcare infrastructure. For example, promoting affordable iron-rich foods and fortified products, as well as expanding school nutrition programs, could benefit wide segments of the population. At the same time, collaboration among the government, healthcare organizations, schools, and international agencies plays an important role in combating IDA.

Future efforts to prevent IDA in Uzbekistan should focus on determining the precise prevalence of anemia among adolescents, developing locally adapted strategies, and evaluating the long-term impact of existing programs. Through this approach, not only adolescents' health can be improved, but also their active participation in society and the welfare of future generations can be ensured. Every step in fighting IDA paves the way for a healthy and successful future for adolescents.

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