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Innovation Approaches in Health to Combat Anemia in Adolescent Girls

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Abstract

Anemia among adolescent girls represents a significant global health issue, especially in developing countries. This condition has serious consequences for both physical and cognitive growth, educational achievements, and future maternal health. This study investigates creative strategies to address anemia in adolescent girls, in line with Sustainable Development Goal 3 (Good Health and Well-being). A comprehensive strategy that includes dietary variety, biofortification, micronutrient supplementation, and behavioral change initiatives is proposed. The focus is on utilizing local resources and fostering community involvement. Furthermore, policy initiatives and collaborations between the public and private sectors are examined to guarantee the sustainable execution of these interventions. Examples of successful models from different regions demonstrate the effectiveness of integrated strategies in decreasing anemia rates. This research emphasizes the necessity for a comprehensive, cooperative approach that not only tackles immediate nutritional shortages but also fosters long-term health and well-being in adolescent girls, thereby contributing to the wider goals of sustainable development.

Keywords: *Anemia, Adolescent Girls, Health Innovation, Nutritional Intervention, Public Health Strategies, SDG3.*

1. INTRODUCTION

It mostly affects children, adolescents, and women of reproductive age, making them susceptible to various health problems in the short and long term(Gallagher PG.2022).In India, adolescents constitute about 25% of the population(Kumar A., et al., 2018). Their current nutritional status will decide the well-being of the present and future generations. As the adolescent age is the formative years for development, anemia at this stage of life has some long-term consequences, such as stunted

growth, poor school performance, reduced immunity, menstrual irregularities, and later on poor pregnancy outcomes such as intrauterine growth restriction, low birth weight, and increased perinatal morbidity and mortality **(Melwani V, et al., 2018)**.Patients range from 80 to 90 percent of adolescent girls, pregnant women, and preschool children. More than ⅕ of the world population suffers from anemia, and 5 million are in well-developed countries. Anemia is also caused by insufficient consumption of nutritious food and affects the development and growth of well-being worldwide. As opined by **(Singh et al., 2019)**. Anemia is associated with factors such as low socioeconomic status, lack of education, limited access to drinking water, precarious living conditions, and other factors such as the environment, i.e., exposure to natural disasters and altitude above sea level**(Al-JermmyAS,etal., 2022)**. Adolescents, particularly girls, are vulnerable to iron deficiency. The World Health Report2 (2002) identified iron deficiency among the 10 most serious risks in countries with high infant mortality coupled with high adult mortality and reported that measures to address iron deficiency anemia are among the most cost-effective public 2 health interventions **(WHO, 2002)**. Adolescent girls are at risk of iron deficiency and anemia due to various factors, including high requirements for iron, poor dietary intake of iron, high rates of infection and worm infestation, as well as pregnancy**(WHO 2011)**.

2. PREVALENCE AND IMPACT OF ANEMIA IN ADOLESCENT GIRLS

The prevalence of anemia in adolescent girls significantly impacts their educational and socio-economic outcomes, creating a cycle of disadvantage. Anemia, affecting approximately 43.6% of teenage girls in Africa and 42.75% in rural India, is linked to poor nutritional status and socio-economic factors **(Tiruneh&Ejigu, 2024; Gore et al., 2024)**. This condition not only hampers physical health but also diminishes cognitive abilities and educational attainment, leading to lower wages and limited life opportunities **("Undernourished and Overlooked: A Global Nutrition Crisis in Adolescent Girls and Women", 2023)**. The prevalence rate increased to 80 to 90 percent when the World Health Organization's cut-off of 120 g/l was applied. Worldwide, iron deficiency anemia is the most prevailing nutritional problem. Anaemia is foremost concerned not only with human health but also with social and economic development. Anaemia is considered the second leading cause of disability, which accounts for about 1 million deaths per year. In terms of lost years of healthy life **(Kaur T et al., 2015)**. The overall prevalence of anemia among school-going adolescent girls in rural Bangladesh is 37.7%, with mild anemia at 33.8% and moderate anemia at 3.9%. This data highlights the extent of the public health issue in this specific population **(Rahman Md. J., et al., 2024)**

3. FACTORS CONTRIBUTING TO ANEMIA

People from low socioeconomic backgrounds are more likely to be anemic, as they do not have access to foods with sufficient nutrition or healthcare, and the combination of unsanitary living conditions and undernutrition increases the likelihood of anemia for those living under the poverty line **(Hardings et al., 2018)**. Anemia rates are even higher among children in rural areas, with these children being more likely to be anemic than those living in urban areas **(Kupolusi&Osiobe, 2024)**. Maternal education, for instance, is hugely significant because children born to literate mothers are less likely to be anemic, because literate mothers have a better knowledge of nutrition and health practices **(Raut& Reddy, 2024)**. Education can provide health literacy, which may result in better food choices and healthcare-seeking behaviour, which can prevent anemia **(Raghav& SM, 2024)**. Socioeconomic background matters when attempting to understand anemia, but it is important to focus outcomes on determinants of health, and seek a variety of each determinant (e.g., genetic determinants, environmental determinants, etc.). No single intervention will triumph in changing the state of anemia; rather, amelioration of education and economic experiences and places is important, but combining medical interventions **(Kaviya&Dhanushya, 2024)**.

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4. CURRENT STRATEGIES TO COMBAT ANEMIA

Anemia remains a critical global health concern, and current strategies for its management include dietary interventions, pharmaceutical treatments, public health campaigns, and novel therapies. Dietary therapy, particularly increasing iron intake through iron-rich foods and vitamin C for enhanced absorption, remains a primary approach **(Ramírez, L. et al., 2024)**. Among adolescents, addressing anemia requires a multifaceted approach, including better nutritional education, improved dietary intake, and addressing socio-economic disparities **(Melani et al., 2024)**. Research also highlights a link between Helicobacter pylori infections and anemia, emphasizing the need for screening and targeted treatment in persistent cases **(Motupalli, S.K., &Oroszi, T.L., 2024)**. Chronic kidney disease-related anemia has been traditionally managed with erythropoiesis-stimulating agents and iron supplements, but new hypoxia-inducible factor (HIF) inhibitors show promise in improving iron absorption and erythropoiesis **(Kuragano, T., 2024)**.

5. INNOVATIVE APPROACHES IN HEALTH AND NUTRITION

Digital tools will improve diabetes management and obesity treatment through personalized nutrition therapy **(Almutairi et al., 2024)**. Other innovative materials, such as educational videos, pop-up books, and interactive materials, have been shown to create awareness and enhance community knowledge and engagement in healthy practices. Community members who actively participate in collaborative work, such as focus groups and collaborative meal planning, report positive nutrition-based behaviours. Empowering and preparing local health workers and educators to assist community members in sustainable health practices will evolve **(Saci et al., 2024)**. Innovative food policies and practices are evolving to prepare for the rational use of available resources and food safety in Turkey **(Yegenoglu et al., 2021)**. Combining plant and animal ingredients or components in food products enhances nutritional value, costs can be lowered, and healthier options will be available **(Tretyakova et al., 2021)**.

6. ROLE OF EDUCATION AND AWARENESS

Knowledge of iron and folic acid supplementation in pubertal girls causes the building of the iron stores in them, and when directed towards those who will soon be entering married life and motherhood, may be just the right answer to the problem of anemia in pregnant women, which can be tried forming a bedrock platform in the idea of continuum of care. Based on iron and folic acid supplementation, it becomes essential to understand where the scope of this micronutrient-deficient disease lies, firstly by exploring the knowledge, attitude, and practice of this micronutrient (iron), and secondly, communicating its importance in the establishment of adequate iron stores **(Chaluvaraj T.S. et al., 2018)**. The animated educational video can be used as educational media to increase female adolescents' knowledge of anemia prevention during the COVID-19 pandemic. Educational programmes using video animation can be made more appealing and interesting to promote good health among female adolescents **(Aisah, S. et al., 2022)**. Lectures contained accurate, updated, acceptable, and simple information about the definition of IDA, manifestations, risk factors, consequences, epidemiological description, the association between dietary habits and IDA, the benefits of performing good alternative habits and being free from IDA, and sources of food that are related to IDA. The control group did not undergo the educational program **(Abu-Baker et al., 2021)**. Education and awareness are foundational components in the fight against anemia, particularly among vulnerable populations such as children and adolescent girls from low socioeconomic backgrounds. A strong link exists between literacy, especially maternal literacy, and anemia prevalence. Children of literate mothers are significantly less likely to be anemic, largely because educated mothers possess better knowledge of nutrition, hygiene, and healthcare practices **(Raut& Reddy, 2024)**. This reinforces the broader role of education in promoting health literacy, which empowers individuals and families to make

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informed decisions about food, sanitation, and medical care **(Raghav& SM, 2024)**. Health education can lead to improved dietary practices, such as increased consumption of iron-rich foods and better understanding of balanced nutrition, even within economic limitations. It also enhances healthcare-seeking behavior, encouraging timely treatment and compliance with interventions such as iron and folic acid supplementation. Moreover, educational programs tailored to rural communities can address specific knowledge gaps and cultural barriers that contribute to the higher anemia rates observed in these areas **(Kupolusi&Osiobe, 2024)**. Awareness campaigns at the community level, delivered through schools, public health centers, and local organizations, can play a critical role in dispelling myths, promoting menstrual hygiene, and encouraging regular health check-ups. These efforts are especially impactful when combined with interventions that address other social determinants of health, such as poverty, food insecurity, and poor sanitation **(Hardings et al., 2018)**. Thus, while socioeconomic status is a deeply ingrained contributor to anemia, awareness and education are potent means of decreasing its occurrence through the provision of information and incentives to choose healthier lifestyles. Education intervention was administered via teachers and consisted of seven sessions with lectures, role-playing, and practical demonstrations. Teachers were selected as educators by the co-development team to facilitate the sustainability of the intervention, and students in grades six and seven were selected, taking into account the greater attrition among older students.

The topics discussed during the sessions were:

- balanced diet
- anemia and its significance
- anemia during pregnancy
- diet and anemia – foods rich in iron
- IFA supplementation
- myths and facts regarding IFA, dos/don'ts of taking IFA
- good habits to be developed
- summary and mantras for adolescent health **(Salam, S.S., et al., 2023)**.

7. POLICY IMPLICATIONS AND GOVERNMENT INITIATIVES

S. No	Initiative / Program	Innovative Approach	Target Group	Objective	Policy Implications
1.	Weekly Iron and Folic Acid Supplementation (WIFS)**(MoHFW 2013)**	School and community-based distributions of iron folic acid (IFA)	Adolescent girls (10–19 years)	Prevent and manage iron deficiency anemia	Incorporate preventive care into school health programs.
2.	Anemia Mukt Bharat (AMB) **(MoHFW 2018)**	Strategy—targeting 6 beneficiaries, 6 interventions, and 6 institutional mechanisms	Teenagers and females	Decrease anemia prevalence to <32% by 2022	Multi-sectoral convergence of health, education, and ICDS departments
3.	PoshanAbhiyaan **(NITI Aayog 2020)**	ICT-supported real-time monitoring and behaviour change campaigns	Teenage girls and women	For better nutritional outcomes through digital technology and convergence.	Digital innovation blended with service delivery and evidence-based policy design.
4.		Health education	School-	Encourage	Incorporates health

	School Health &Wellness Programme **(MoHFW 2019)**	is provided by trained educators (Health Ambassadors).	going teenagers	nutrition awareness and healthy practices	literacy into formal curricula and education policies.
5.	Fortification of Mid-Day Meals **(FSSAI 2016)**	Production of fortified rice/wheat/flour and micronutrients in mid-day meals	Children, secondary school children, and adolescents	Tackle hidden hunger and enhance micro-nutrient intake.	Endorses mandatory food fortification in the policy that noting it as a nutritional security issue.
6.	Mobile Medical Units (MMUs) **(MoHFW 2021)**	Screening and supplements for anemia that could be provided through a mobile outreach approach	Rural and deployed youth populations	Enhance access to anemia care	The rural and tribal areas need to be aggressively catered to for health outreach.
7.	Jan Andolan (Community Mobilization under Poshan) **(MWCD 2019)**	Awareness generation among Panchayats, SHGs, and youth groups.	Community and adolescents	More public engagement for confronting malnutrition	Promotes social responsibility in public health measures
8.	NIN's Digital Apps (e.g., NutriAp **(NIN 2020)**	Mobile nutrition tracking and anemia support	Healthcare workers and teenagers	Enable users to self-assess the risk of anemia	Promotes decentralised decision-making based on digital health innovation

8. CHALLENGES AND FUTURE PERSPECTIVES

The nutritional needs of lower socioeconomic hydro-iron students, which, in turn, fulfill the educational prerequisites, pose great difficulty, particularly if one considers anemia, a prevalent issue today. One of the greatest problems is the chronic imbalance of spatial inequity within a particular socio-economic range of nutritious food, adequate medical care, and wholesome living conditions. The impoverished underclass is often a victim of several interacting components, including under nutrition, inadequate hygiene, and scant medical care, which heighten the risk of anemia. **(Balarajan, Y., et al., 2011)**.Even more alarming problems remain in the countryside. Children with anemia, for instance, tend to be much worse off **(Kupolusi and Osiobe 2024)**, point out. But there are no less severe issues—a lack of education, for one. The most notable gap in schooling is maternal health literacy. We know the effect harsher maternal literacy has on child health is positive, so in this context, anemia levels are likely lower with educated mothers due to appropriate health and nutrition practices **(Raut& Reddy, 2024)**. Unfortunately, a lack of health education resources makes combating this anemia-enabling illiteracy impossible. Educational literacy is a way to help individuals gain these resources **(Raghav& SM, 2024)**. In the long term, some changes will be necessary. Targeted healthcare, like providing iron supplements, deworming, and distributing fortified food, needs to be accompanied by

sustained economic growth and access to education **(Kaviya&Dhanushya, 2024)**. A focus on social health determinants, including environment, genetics, and culture, enables sustainable solution development.

9. CONCLUSION

The condition of anemia in adolescent girls is still a major public health issue, especially in low and middle-income regions, where these regions face a lack of resources. Poor nutrition, inadequate menstrual care, and a lack of health concern combined to create these problems. Advances in health, such as digital health technologies and mHealth interventions, fortified foods, as well as school-based screening programs, have shown promise in having a sustainable approach towards solving these issues. These methods provide empowerment through teaching adolescent girls about their health alongside enabling community participation, engaged behavior change, and providing self-care. For all these innovations to succeed, they need to be flexible, integrate into existing systems, be culturally respectful, and be adaptable healthcare systems.

10. RECOMMENDATION

- Schools provide an ideal environment to receive health interventions like regular anemia screenings, iron and folic acid supplementation, and nutrition education.
- These tools can also help to bridge the communication gap between HCPs and adolescent girls, particularly in remote or deprived regions.
- Nutrition interventions can be implemented through iron-fortified foods as part of existing government programs like the Mid-Day Meal Program and ICDS.
- School (as well as community level) provision of menstrual product access plus education on its use and hygiene.

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