Impact Of Diet And Nutrition On The Health Of Rural And Urban Adolescent Girls With Reference To Their Haemoglobin Level

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Abstract

Adolescent anemia continues to be one of the most prevalent public health issues that continue to pose significant challenges for low and middle-income countries like India. Adolescent girls require increased micronutrients due to their fast growth processes, menstrual cycles, and physiological needs. Despite national initiatives, such as the Anemia Mukt Bharat initiative, the prevalence is still quite high. The latest meta-analysis indicates that the estimated prevalence rate of anemia in adolescent girls in India stands at about 65 percent, while areas such as rural settings may report prevalence above 70 to 80 percent. This literature review will explore the connections between dietary habits, nutrition, and hemoglobin status of adolescents. Furthermore, this research will analyze key determinants of anemia in socio-cultural and economic environments and examine the role of structured interventions (diet modification, nutrition education, and social work and media interventions) in improving the hemoglobin level.

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1. Introduction

1.1 Adolescence and Nutritional Vulnerability

The age group between 10 and 19 years referred to as the adolescent period by the World Health Organization (WHO) represents a period of intense physiological developments after which nothing else happens in terms of nutrient needs other than the time immediately after birth (infancy). During this phase, physical development takes place alongside hormonal changes and brain development. The amount of lean body mass and bone mineral increases immensely in the early part of the adolescent phase. Menstruation in the case of girls causes the need for iron intake owing to losses of blood every month. Insufficient intake of essential nutrients such as proteins, iron, folic acid, and vitamin B12 may have negative impacts on immunity, poor performance at schools and in cognitive functions as well as increasing susceptibility to infections.

The presence of iron in hemoglobin found in red blood cells makes hemoglobin an ideal indicator for anemia. Non-pregnant adolescents who have a concentration of hemoglobin less than 12 g/dl according to WHO criteria are considered as suffering from anemia. Anemia among adolescent individuals results in fatigue, difficulty concentrating, and reduced ability to perform both physically and intellectually. Long-term effects of anemia in adolescents include delayed puberty, obstetric complications.

1.2 Indian Context

Anemia among adolescents has remained a significant public health problem in India for many years. According to NFHS-5 data, the prevalence of anemia among girls aged 15-19 years in the country was estimated at around 67 percent. Studies conducted in specific regions and communities showed even higher prevalence rates (70-80%) and were attributed mainly to low dietary diversity, lack of access to iron-enriched foods, food insecurity, and minimal exposure to health and nutrition interventions.

There are a number of factors that affect the incidence of anemia in this country among adolescents; primarily, cultural practices and socio-economic conditions. Household economic conditions and mother's education level have been found to correlate with the type of food purchased by households, which in turn relates to the nutritional status of children and adolescents. There is also a correlation between early marriage and pregnancy among adolescents, particularly in certain rural areas of the country, which compounds the already complicated nutritional status of young mothers and their babies. Young mothers who enter pregnancy with low hemoglobin levels will typically have babies with low birth weight and an increased risk of maternal mortality during childbirth.

Recent efforts at the national level to reduce adolescent anemia have included programs such as Anemia Mukt Bharat, which encourages dietary improvement through iron and folic acid supplementation, deworming, and nutrition education; however, some barriers exist to reaching, adhering to, and sustaining behavioral change through these interventions. Therefore, it is important to understand the relationships between food consumption, social factors, and anemia rates in order to develop targeted interventions for adolescents in India.

2. Literature Review

2.1 Prevalence of Anemia Among Adolescent Girls

There is a problem with having low levels of hemoglobin (a condition called "anemia") for many girls between the ages of 10 to 19 years old in India. Studies conducted in several parts of India show around two out of every three girls in this population are anaemic; and in some rural areas as many as 80% of girls aged 10 to 19 years may have anaemia! Many of the studies also confirm that anemia is a significant health problem no matter how one views the data from a laboratory. Anemia impacts girls with fatigue and inability to concentrate in school, and even difficulty functioning in day-to-day life.

Numerous studies were conducted in Maharashtra, Nagpur, and other rural parts of India, show that there are high rates of anemia among disadvantaged girls who do not have access to iron dense foods. In big cities like Delhi and Chennai, anemia is still prevalent with rates for girls reflecting between 40% and 55%. These results also indicate that living in an urban area is not enough to ensure good nutrition due to a number of factors; including lifestyle choices, food choices, and awareness of the issues related to good health and nutrition.

2.2 Dietary and Nutritional Factors Influencing Hemoglobin

The quality of a girl's diet significantly impacts her chances of being anaemic. There is more reliance on cereals than intake of other food sources such as vegetables and fruits; likewise, these girls are not consuming enough protein-based foods (such as dairy products, eggs, and/or pulses) in their diets. Recent studies suggest that girls consuming sufficient amounts of iron-based foods as well as at least six different types of foods per day have improved levels of haemoglobin in their bloodstream.

There are several factors associated with the way that foods are combined that affect iron absorption from the digestive system. For example, foods containing vitamin C assist with iron absorption, while drinks such as tea taken with meals inhibit iron absorption. Studies using interventions show that by combining iron-rich supplements with education on proper nutritional practices both the level of haemoglobin in the bloodstream improves and the adoption of a long-term healthy eating pattern is encouraged.

2.3 Socio-Economic and Cultural Deterrents to Anaemia

Anaemia is also influenced by social and cultural norms and values. Household income, level of parent education and community traditions and/or customs are all factors that influence eating patterns and nutritional outcomes. In rural areas of developing countries, adolescent marriage and pregnancy often occur early on and these two events put additional strain on the adolescent girls' ability to obtain proper nutrition thereby increasing their chances of being anaemic. Specific research studies have demonstrated that adolescent girls who come from households with less financial resources and/or have parents with limited education and/or limited nutritional knowledge have a greater risk of examining positive hematological outcomes.

Anaemia continues to exist in urban areas where food is more abundant even when considering the potential for improved anaemia status because of poor food choices made by adolescents; furthermore, insufficient knowledge of the basic principles of nutrition; and competing roles of being a spouse and parent. These observations provide evidence for the need to develop and implement programs that not only include nutrition education but also have a broad social context associated with them.

2.4 Implications for Interventions

The issue of Anemia in developmental age (young females) is not just a simple issue. It requires more than just nutritional supplements. It is influenced by daily food intake, family behaviours, social acceptability and general awareness of health. Understanding these patterns will provide researchers and policy makers with the tools they need to develop practical and culturally sensitive interventions to enhance girls' growth and health, and the well-being of their futures.

3. Theoretical Framework

3.1 Health Belief Model (HBM)

Perceived susceptibility to anemia, perceived benefits of diet adjustment and barriers to such adjustment (availability of food, social factors) are among the factors considered by the HBM in terms of the adolescents' health. Factors include perceived susceptibility, benefits, barriers, cues to action, self-efficacy and so forth.

3.2 Social Cognitive Theory (SCT)

The SCT assumes that behavioral change results from an interaction between cognitive processes within the individual and social environment and behavior observation.

Objectives

1. To determine the prevalence and intensity of anemia in rural and urban areas using Hb concentration in adolescent girls.
2. To analyze eating habits and nutrition and their correlation with Hb concentration.
3. To investigate the effectiveness of the organized dietary and educational intervention in the Hb improvement.
4. To evaluate the contribution of the social work and media campaigns in the changing eating behavior and nutritional knowledge.

5. Methodology

5.1 Study Design

A quasi-experimental pre-post assessment integrating surveys, dietary assessments, biochemical measurements, education sessions, and community engagement.

5.2 Participants

Adolescent girls aged 10–19 years across purposively selected rural and urban sites. Sample size was determined to detect at least a **1.0 g/dL** change in mean hemoglobin with 80% power.

5.3 Measures

1. **Food intake:** The information was obtained using two different methods -- a 24-hour food recall and a Food Frequency Questionnaire (FFQ) that has been validated for use in adolescents.
2. **Anthropometry:** Height, weight and BMI measurements were conducted in accordance with World Health Organization (WHO) guidelines.
3. **Biochemical:** Hemoglobin will be measured using the cyanmethemoglobin method. Serum ferritin and vitamin B12 will be assessed when feasible within sub-sample groups.
4. **Socioeconomic status:** Family income, parental education and indicators of food security were collected from each family.

5.4 Intervention components:

1. **Nutrition education:** Group sessions highlighting sources of iron, folate and B12 along with factors that can help (e.g., vitamin C) or hinder (e.g., tea) their absorption.
2. **Low-cost food demonstrations:** Practical demonstrations with foods that are either locally grown or widely available (e.g., millets, legumes, greens, and citrus).

3. **Social work activities:** Peer support groups, school clubs, family counseling, community mobilization around nutrition.
4. **Media campaigns:** Distribution of promotional material in local languages through leaflets, posters, community radio spots, and social media.

5.5 Data Analysis
SPSS software was used. Paired t-tests evaluated pre-post changes in Hb, dietary intake frequency, and nutrition knowledge. Logistic regression explored predictors of change.

5.6 Ethical Considerations
The research focused on the rights and well-being of teenage girls as of utmost importance. Prior to conducting the research, the research received ethical committee approval so that the research would be done in a safe and respectful manner. For female participants who were under 18 years of age, consent was obtained from the parent/legal guardian as well as the participant themselves to participate in the study. Female participants that were 18-19 years of age provided their own consent to participate in the study.
We let the participants know that they could voluntarily participate in the study, and that they could withdraw from the study at any time without penalty. Private information that the girls provided was confidential, and the data were securely stored and only accessible by the research team.
Blood sampling for hemoglobin testing was performed by trained health professionals utilizing standard safety protocols to minimize the discomfort and risk of discomfort to the participants. The research was designed to avoid embarrassment and stress when discussing dietary habits, menstrual health, and family food consumption patterns.
We involved the parents, teachers, and community leaders at the site to assist in the planning and implementing the study; so the parents, teachers, and community leaders would feel comfortable and informed. After the study was completed, counselling and assistance regarding anemia, nutrition, and healthy eating habits was provided to each of the participants and their families.

6. Results
6.1 Anemia Prevalence from Key Studies

Table 1: Anemia Prevalence among Adolescent Girls in India

Region / Study	Population	Anemia Prevalence	Notes
National Meta-analysis	14,053 girls	65%	Mild & moderate most common
Rural Maharashtra	600 girls	80%	Rural, socioeconomically disadvantaged
Urban Delhi & Chennai	~1,200 girls	44–55%	Urban adolescents

6.2 Dietary Patterns and Behavioral Outcomes

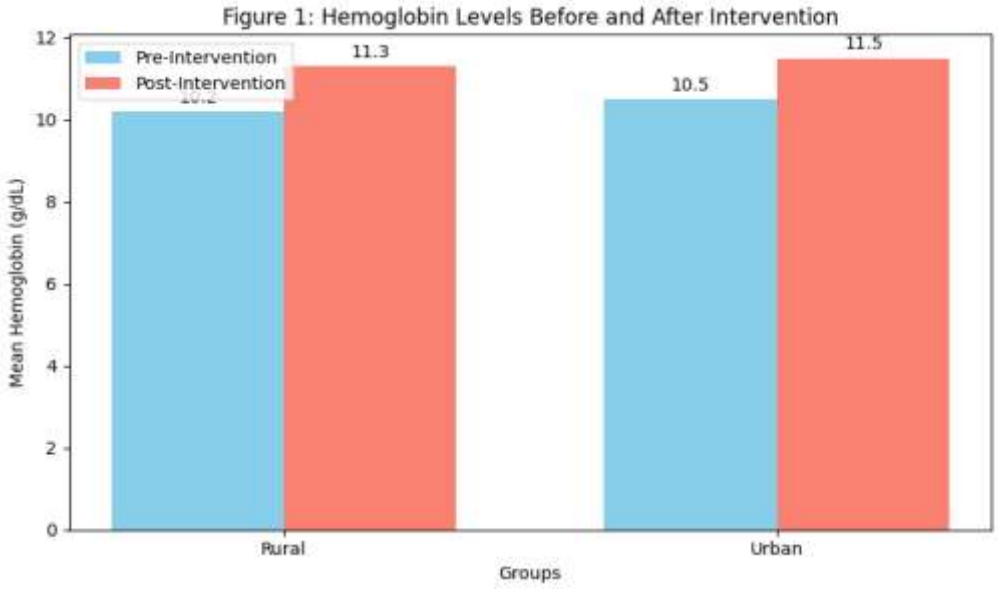
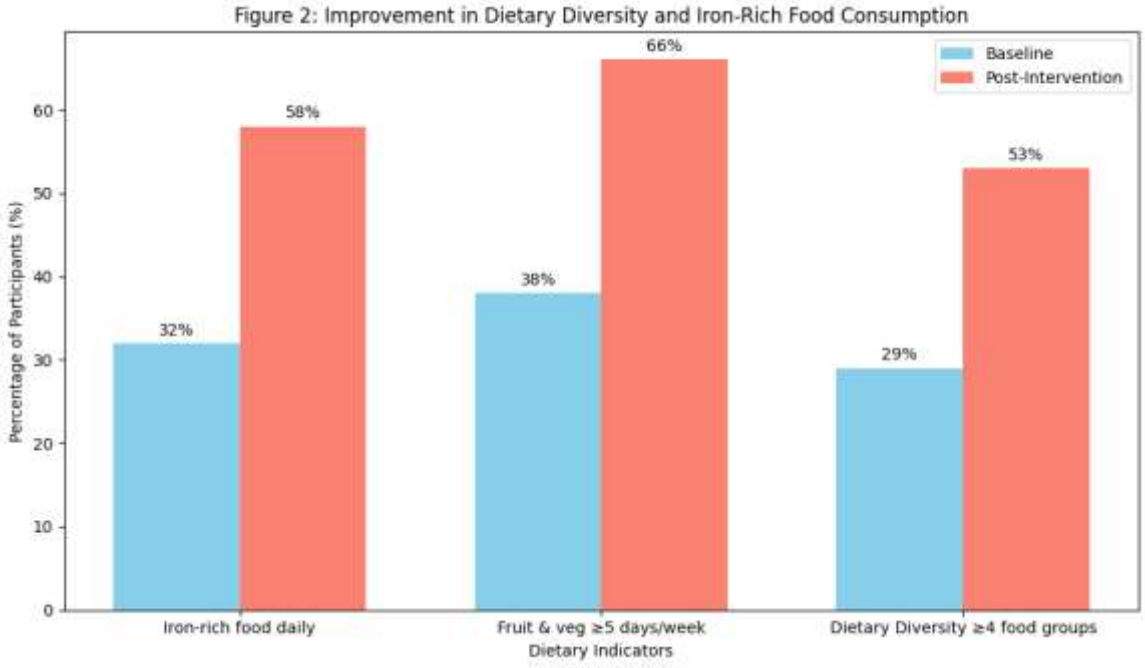


Table 2: Key Indicators Before and After Intervention

Indicator	Baseline (%)	Post-Intervention (%)	Change
Mean Hb (g/dL)	10.4	11.5*	+1.1 g/dL
Iron-rich food daily	32	58	+26 pp
Fruit & veg ≥5 days/week	38	66	+28 pp
Dietary Diversity ≥4 food groups	29	53	+24 pp
Nutrition Knowledge (high)	15	67	+52 pp

*Change statistically significant ($p < 0.001$)



6.3 Association of Diet & Hemoglobin Status

- Weekly consumption of iron-rich foods correlated with higher hemoglobin ($r = 0.42$, $p < 0.001$).
- Girls with higher dietary diversity scores were significantly less likely to be anemic after adjusting for SES and BMI (Adjusted OR = 0.54).

7. Discussion

7.1 Prevalence Insights

The consistent incidence of anemia in adolescents in different parts of India highlights existing nutritional problems. The prevalence in rural areas is relatively higher due to increased food insecurity and lack of nutrient-rich foods in their diet. Urban prevalence is relatively lower compared to rural but still high, indicating that financial resources cannot guarantee nutritional adequacy.

7.2 Diet and Behavior

Dietary diversity, frequent drinking of tea along with meals, and a low intake of animal products coincide with the patterns observed for anemia in the nutrition of adolescents. Increased availability of foods rich in iron (green leafy vegetables, millet, legumes, and fortified foods), and overcoming inhibiting eating behaviors are possible interventions.

7.3 Impact of the Intervention

The impact on nutrition literacy, dietary diversity, and hemoglobin level was significant, following a structured education program and demonstration of healthy food practices. Changes in Hb level by ~1.1 g/dL correlate well with intervention studies reported in literature.

7.4 Contribution of Social Work and Media Interventions

Social work through peers and parents' counseling and local language radio campaign interventions were helpful. These interventions based on HBM and SCT have helped increase awareness and perception, benefit recognition, and self-efficacy.

7.5 Programmatic Implications

Supplementation is necessary, yet it should be combined with interventions that improve nutrition through food, increase family participation, and ensure communication that resonates with the community's culture.

8. Conclusion

Adolescent anemia in India remains a public health issue due to a combination of dietary deficiencies, poverty, cultural practices, and behaviors. Although anemia programs involving iron-folic acid supplements, in addition to various educational initiatives, have been implemented over several decades throughout India, their success has remained limited because of the multi-faceted nature of this condition. Thus, in order to fight anemia successfully, an integrated and comprehensive approach is required.

The findings from this and many other recent studies suggest that interventions involving dietary changes, nutritional education, social work and public awareness activities through the media can improve hemoglobin levels and also promote sustainable changes in behaviour. Interventions can be implemented by promoting various types of food in the diet and the use of diversified and nutrient-rich foods, as well as involving the family and the community in solving adolescent anaemia.

In addition, developing good nutrition in adolescents will lead to additional future benefits such as better cognitive development, a higher level of academic performance, greater size and growth, and a stronger immune system. By increasing the levels of hemoglobin in girls, they will be less likely to experience risks related to pregnancy later in life. This will help break the perpetuation of poor nutrition through generations.

In conclusion, interventions for addressing anaemia in adolescent girls in India must take a holistic and culturally appropriate approach. The multiple sectors relevant to addressing anaemia (biomedical, nutrition, behavioural change and social approaches) need to be incorporated within the program. The relevant stakeholders (policymakers, public health professionals, educators, and community members) need to work together to provide access to healthy diets, increase health education, provide resources to utilize the media and social media to rise awareness of anaemia.

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