

Original Article

**Nutritional Needs and Dietary Modifications in Woman- Iron Deficiency**

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**ABSTRACT**

*In developing and underdeveloped countries, anemia exists in terms of food insecurity, where meeting overall energy needs and dietary diversity continues to be the major challenge. In India, women of reproductive age are undernourished which results in the premature birth of child, miscarriages, and even later in life changes of increasing risk of diabetes, hypertension, and obesity. Iron deficiency among the males also imparts a socio-economic burden of the country. Millions in India depends on rice and wheat to fill their stomachs, but those staple foods lack important vitamins and minerals. India is the latest country to enter the realm of biofortification. Therefore, there has been a need to explore the strategies to ensure the biofortification management to finally prove a boon for the food security. The study was carried out to provide some of the information needed for an effective & sustainable program to control anemia in women.*

**Keywords:** Anemia, Iron deficiency, malnutrition, socio-economic, biofortification, ferritin, folate

**1. INTRODUCTION:**

In South Asian countries especially in India, iron deficiency is the major public health concern. [1], despite many supplementations program run through the Government of India by the name of the National Nutritional Anemia Prophylaxis Programme introduced in 1970 and National Rural Mission contribution to POSHAN Abhiyaan in 2018. The various program was started under NNAP specifically for adolescence (10-19) & young children and the data which received on the global occurrence of anemia during 1986 were disappointing [2]. Even though few modifications of NNAP have been done to make the program more efficient and effective, but the issue remains the same. The reason may be because supplementation may be too late during pregnancy. In India, the maximum women population is suffering from anemia to the extent when they enter into pregnancy [3,4,5,6]. Therefore, its necessary to start iron supplementation before pregnancy or in adolescent age. In the adolescent (10-19) which is the developmental phase of life when physical and psychological changes take place [7,8,9]. This is considered to

be an unprotected period in the life cycle for the development of nutritional anemia, which has been constantly neglected by health programmers. In India, adolescent girls are mostly the victim due to limited resources being female in the family or either been neglected, deprived to get nutrients rich food and good education and utilized them as a working hand for the household work in addition to the menstrual blood loss. Thus, during adolescence, it is important to improve iron intake in the diet before conceiving [10,11,13]. Deficiency of iron in growing female is a cause of impaired physical and mental development [14], delayed menarche [15], hookworm infestation [16,17,18] and future poor reproductive outcomes [19,20,21]. In addition to these, ignorance, deficiency, and village residence that also affect anemia [22,23,24,25]. Lots of micro-level studies have been supervising on the prevalence of anemia and its main causes among Indian adolescent girls [26,27,28]. According to data collected from urban and rural areas by the Reproductive and Child Health Project provides an opportunity to examine the seriousness and administration of anemia among adolescent girls between the age of 10-19 years at the national level [29,30]. The challenge is to draw up some protocol for the awareness, execution, and funding of effective supplementation programs for adolescents and women [31,32,33].

Worldwide, there are 42% of pregnant women are anemic [34,35]. Maternal anemia is associated with many health

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problems with increased risk of mother and infant mortality [36,37,38]. In rural areas where women are mostly contributors to household food production, malnutrition, or iron deficiency, carry a major economic cost [39,40,41]. Modeling studies on iron absorption and loss by Lynch (2000) suggest that adolescent revert to their pre-supplementation levels of iron five months after stopping a weekly 60 mg supplementation [42].

In Indian states, during the survey data shows, Assam is the worst affected with 72% of married women being anemic, followed by Haryana with 69% and Jharkhand with 68.4%. Generally, due to malaria in states like Assam was one of the chief reasons for anemia was identified. [43]. In educated families and higher-income groups, moderate and severe anemia is seen [44,45]. The Hb less than 8 g/dl constitute a high-risk group in pregnant women. Investigation was done in other states like Himachal Pradesh and Haryana in the North Tamil Nadu and south Kerala, Assam, and Orissa in the East and Madhya Pradesh in central India. And it was found that a total of 84% of pregnant women and 92% lactating women were under the severe anemia categories [46,47]. In the same districts, ICMR data also reported 90.1% of adolescent girls with anemia out of which 7.3% having severe anemia [48,49]. In India, the studies conducted on micronutrient deficiency confirm the high prevalence estimated from blood level (Table-1) and of anemia among adolescent Females and males represented in given Table no.- 2.

**Table 1:** Categorizing of anemia estimated from blood level of hemoglobin in population

S.No	Category of anemia	Prevalence of anemia (%)
1	Severe	Higher or 40
2	Moderate	20 -39.9
3	Mild	5.0 – 19.9
4	Normal	Lower or 4.9

**Table 2:** Deficiency of Iron in Non-Pregnant Females and Adolescent Males

Gender/Age[yrs]	Iron Deficiency	Iron Deficiency Anemia
<b>Females</b>		
12-15	9%	2%
16-19	11%	3%
<b>Males</b>		
12-15	1%	<1%
16-19	<1%	<1%

## 2. STAGES OF ANEMIA

Iron deficiency develops in many stages. In stage first, total store body iron decreases but RBC synthesis and Hb remain unaffected. Later iron deficiency affects RBC synthesis and responsible for anemia. In stage 3, hemoglobin levels start reducing but red blood cell appearance remains normal [51,52]. Changes in the appearance of red blood cells are the indications of stage 4; first microcytosis and then hypochromia develop. In stage 5, iron deficiency starts affecting tissues, manifesting as symptoms and signs. When there is no anemia but only an iron deficiency, the condition is known as latent iron deficiency which is the final stage of iron deficiency anemia; then the condition reaches to low ferritin levels called as iron-transport deficiency [53,54], the TSAT is below 15% and finally the IDA with low ferritin levels, TSAT < 15% and anemia. (Table 3)

**Table 3.** Classification of different stages of iron deficiency

	Hb	Ferritin ng/ml	Soluble transferrin receptor ng/L	Transferrin mg/dl	Transferrin saturated %
Latent iron Deficiency	Normal	< 20	< 5	360	>15
Iron Transport deficiency	Normal	< 12	> 5	>380	< 15
Iron-deficiency Anemia	Decreasing	< 12	> 5	>380	<15%

**Source:** Guzman et.al<sup>55</sup>

### 2.1 TYPES OF ANEMIA:

This most common type of anemia is caused by a shortage of iron in women body & are linked to various diseases and conditions are listed in Table- 4

bearing age, people with a poor iron dietary intake for several years, and adults in rapid growth phases [59,60]. The clinical feature of iron deficiency anemia depends on the various factors including multiple disorders, age group, illness consistency, stages of severity of anemia as shown below Table-5.

Table:4 Types of Anemia		
<b>sickle cell anemia</b>	anemia of chronic disease	hemolytic anemia
<b>secondary aplastic</b>	anemia of B12 deficiency	Due to glucose phosphate dehydrogenase deficiency, hemolytic anemia
<b>iron-deficiency anemia</b>	Folate deficiency anemia	idiopathic aplastic anemia
<b>Drug-induced immune hemolytic anemia</b>	immune hemolytic anemia	idiopathic autoimmune hemolytic anemia

### 2.2 REASON BEHIND ANEMIA

The causes of iron deficiency are many. Nutritional Anemia develops slowly as the normal stores of iron starts depleting in the body and the bone marrow. As compared to men, women have smaller stores of iron in addition to the burden of increased blood loss through menstruation, placing them at higher risk for nutritional anemia [56,57,58]. In children due to lead poisoning, parasite infestations, gastrointestinal blood loss with ulcers, men and postmenopausal women, and nonsteroidal anti-inflammatory medication. High-risk groups include children, infants, lactating women, women of child-

**Table 5:** The various reasons behind Anemia in women and children

S.No.	Women	Children
1	Insufficient quantity of iron-rich foods or foods containing only non-heme iron	Too early introduction of inappropriate food
2	Excessive quantity of iron inhibitors such as tea, coffee, calcium-rich food in daily diet.	Early introduction of non-fortified substitutes in infant instead of milk
3	Repeated pregnancies and Teenage pregnancy with less than 2 years' interval	Low iron stores at birth due to anemia in mother
4	During pregnancy increased iron requirements due to tissue, energy, blood requirements or in some areas due to heavy workloads	During infancy and childhood increased iron requirements due to heavy physical workloads or rapid growth and development.
5	Iron loss during menstruation	Iron loss due to intestinal worms load
6	Poor iron stores from infancy and childhood deficiencies	Poor surrounding sanitation, insufficient personal hygiene and unsafe drinking water
7	Iron loss from post-partum hemorrhage	Decreased in appetite

### 2.3 SYMPTOMS AND COMPLICATION OF ANEMIA

Iron deficiency is categorized into two types 1) absolute iron deficiency develops due to the body total iron stores are low and, 2) functional iron deficiency in which total body iron stores are increased, with the inadequate iron supply to the bone marrow [61,62]. Functional iron deficiency is present in

many acute inflammatory states [63,64]. Various symptoms associated with anemia are given below in Table 5 & several risk factors were found to be associated with anemia showed in Table 6 and Table 7.

**Table-6: Symptoms related with IDA**

Fatigue	Glossitis
Dizziness	Pica
Lethargy	Pale Conjunctivae
Taste disturbance	Pallor
Shortness of breath	Blue sclera
Restless leg syndrome	Cracks at mouth corners
Headaches	Brittle, Flattened nails
Ringling in ears	

Sources: Beard et.al<sup>65</sup>

**Table 7:** Risk Factors for Iron Deficiency

Inadequate iron absorption	Increased iron losses/ requirements
<b>Meal Skipping</b>	
<b>Low intake of foods rich in ascorbic acids</b>	Heavy menstrual periods
<b>Vegetarian eating styles, especially vegan diets</b>	Participation in endurance sports
<b>Chronic weight loss</b>	Chronic use of nonsteroidal anti-inflammatory drugs
<b>Frequent dieting or restricted eating</b>	Pregnancy current or recent
<b>Low intakes of meat, poultry, fish</b>	Inflammatory bowel disease
<b>History of iron deficiency anemia</b>	Intensive physical training
<b>Recent immigrant from developing country</b>	Special health care needs especially blood donations

Sources: Frewin et.al <sup>66</sup>; Wharton et.al <sup>67</sup>

#### 2.4 NUTRITIONAL ANEMIA A PRIORITY

Ninety percent of women, children live in developing countries (mostly found in South Asia), have the highest prevalence of anemia. Recent anemia survey shows that up to 90 percent of young children including infants and 75 percent of pregnant women may be suffering from anemia in Indian states, Nepal and Bangladesh [68,69,70]. The frequency of Nutritional Anemia in South Asia showed in given below Table-8.

**Table 8:** The Prevalence of Nutritional Anemia in South Asia

Countries	Women (%)	Pregnant (%)	Children %
<b>Bangladesh</b>	70.0	77.0	73.0
<b>Bhutan</b>	-	59	-
<b>India</b>	51.8	49.7	74.3
<b>Maldives</b>	62.4	68.0	81.5
<b>Nepal</b>	67.7	74.6	78.0
<b>Pakistan</b>	29	33	62.9
<b>Sri Lanka</b>	45.0	39.0	45.0

Pathological disorders associated with iron deficiency in Table-9. They include the following:

**Table 9:** Pathological disorder associated with IDA

S.No.	In infants and children (6-9)	In adults of both sexes (10, 11)	In pregnant women(12-15)
<b>1</b>	impaired motor development and coordination	decreased physical work and earning capacity	increased maternal morbidity and mortality
<b>2</b>	Impaired language development	decreased resistance to fatigue	Increased morbidity and mortality in fetal
<b>3</b>	Behavioral effects and psychological effects		low birth weight risk increases
<b>4</b>	decreased physical activity. Iron deficiency anemia		

## 2.4 CONTROL OF NUTRITIONAL ANEMIA AND ITS PREVENTION: A SOUTH ASIA PRIORITY

There are four approaches to the prevention of iron deficiency anemia. These are education & awareness to increase dietary iron intake, supplementation, the control of infection, and fortification of food [71,72].

## 2.5 EDUCATION & AWARENESS TO INCREASE DIETARY IRON INTAKE

The guidelines for food-based dietary development and technical assistance provided by FAO in the developing the dietary education programs and campaigns in public groups and schools [73,74,75] One of the important activities of FAO, aimed to promote Food and nutrition education for healthy diet intake. There is much evidence that shows that government programs are aimed for dietary modification which is most effective when combined with educational and promotional activities [76,77,78]. In schools promoting healthy eating and educating about nutrition enhance dietary patterns of children during young age and aimed to reach a clear message when they reach their parents to promote healthy food habits and consumption [79,80,81].

## 3. SUPPLEMENTATION

Iron status can be increased by supplementation and can be targeted to high-risk anemic groups such as infants, preschool children, and pregnant women because normal diet intake cannot be sufficient to provide the required amount of nutrients. Many programs have been introduced by the government to aimed at high-risk category groups and farmworkers who can receive their food supplements at work [82,83,84]. Even during lactation, iron supplements are needed to supply the required amount of nutrients in the mother and the growing fetus. Along with the iron supplements consumption of vitamin C or vitamin C rich foods can increase absorption and participate in the production of hemoglobin [85,86]

## 4. DIETARY THERAPY

In poor communities, dietary iron intake can be increased in two ways. Firstly, to ensure that people consume a large amount of staple food so that their energy needs can be fulfilled. And secondly, the bioavailability of the iron ingested to fill the gap for iron intake to approach in manipulating the dietary habits. Enhancing only iron-rich food consumption is not sufficient to treat iron deficiency and additional iron supplemental doses are essential shown in Table-10. However, consumption of iron and the maximum absorption can be increase by reducing the inhibitors during food consumption may be valuable for secondary prevention of iron deficiency (see in Table- 11) [87,88,89].

**Table 10.** Food Sources of Dietary Iron

Types of Iron & their chemical form	Source
iron Haem	Fish, poultry, and Meat products accounts for 10-15% of iron intake in industrialized, in developing countries, less than 10% of total iron intake found. High Bioavailability: absorption 20-30%
Non-haem food iron	Cereals, vegetables, pulses and tubers. In the food consumed, the presence of enhancing and inhibiting factors affect bioavailability
Contamination iron fortification iron	Iron pots, dust, water, and soil. If iron present in large quantities, it may possible its contribution to total iron intake is not sufficient bioavailability is low. For the potential iron bioavailability, different iron compounds are used

**Table 11:** - Factors affecting iron Absorption

	Enhance	Inhibit
1	Poultry	Tea
2	Seafood	Coffee
3	Meat	Phosphate
4	Fish	Calcium

5	Malic acid	High doses of minerals
6	Citric acid	Bran Fiber
7	Gastric acid	Colas
8	Ascorbic acid	Soy Protein

Source: Provan et.al<sup>90</sup>

## 5. ORAL IRON THERAPY

In adults, the dosage required is 120 mg/ day for three months for the treatment of anemia; in the case of children, the dosage is around 3 mg/ kg per day [91,92]. According to the Baker et al. study, after the treatment of deficiency, there is an increase in 1g/ dL of hemoglobin in one month showed a confirmed response in the treatment and the diagnosis of iron deficiency iron. The treatment should be for three months continuously for iron-deficient adults [93,94].

## 6. INTERVENTION

To enhance iron and vitamin C intakes in diet, iron therapy is effective in raising the hemoglobin level and replacing iron stores [95,96]. According to the CDC recommendation for IDA patients should consume a dosage of 60 mg/day elemental iron [97]. For the preparation of iron most commonly Ferrous sulfate is used as its least expensive. Examples of Supplements and their elemental iron content are included in Table -12

**Table 12: Iron Supplements and their elemental iron content**

Supplement	Total Iron (mg)	Elemental Iron (mg)
Ferrous gluconate	325	35
Ferrous sulfate	324	66
Feostat chewable	100	33
Ferrous liquid	100	33/mL
Fe 50 extended release	160	50
Slow Fe	160	50
Feosol caplets	50	50
Ferro Sequels timed release	50	50

**Source:** Drug facts and comparisons. St. Louis, MO: Facts and Comparison

## 7. THE CONTROL OF INFECTION

When it comes to parasite infestation, it is very important to educate the family about good feeding practices during the infective illness especially when young children concerned. In the case of an infant, continued breastfeeding prevents many infectious diseases [98,99,100]. When it comes to hookworm infestation play a role in causing anemia by chronic blood loss. From a health point of view, to deal with parasitic infection deworming should be done routinely [101,102,103].

## 8. FOOD FORTIFICATION

To enhances the nutritive value of foods, food fortification is the most effective and has an important part in meeting the needs of folate, iodine, and iron. In the developing world, food fortification recommended when dietary iron intake is not sufficient to fulfill iron demand. [104,105].

Globally traditionally eaten basic foods are considering to be a magnificent source for iron fortification. There are many examples of fortified foods such as salt, sugar, cornmeal, wheat and rice flour, cookies, soya sauce infant formula, curry powder. For the fortification, proper industrial infrastructure is required in developed countries which do not exist in some countries [106,107,108,109].

## 9. CONCLUSION

Even though iron deficiency is a preventable condition, it is highly prevalent among the adolescent women because of nutrient lacking or not enough and of poor quality, in all over India as less attention has been paid toward iron-rich nutrition. By promoting the initiative to produce crops to increase iron concentration for enriching human nutrition. Effective biofortification strategy can be adopted in relieving iron deficiency anemia and improving general health. From these initiatives, it is concluded that overall socio-economic development, nutrient intake, and education will surely help in reducing the anemia in women & children.

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