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A REVIEW ON IRON DEFICIENCY ANEMIA IN ADOLESCENT GIRLS

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ABSTRACT

Introduction: Anaemia is one of the common nutritional deficiency disorders globally that is affecting both developed and developing nations. This has larger implications not only on the health but also reflects the social-economic development of the country. Iron deficiency anaemia can appear in any stage of life but is more common in young children or pregnant females. Adolescent especially girls are vulnerable to iron deficiency anaemia. Girls from age group 12 to 17 are prone to be affected and are considered as a high-risk group.

Objective: To develop a literature review on iron deficiency anaemia in young girls. This has been a major public health issue in many countries. This has been implicated as the risk factor for the developmental and growth in a particular age group. The review includes the pathophysiology, cause, clinical characteristics, differential diagnosis, prevention and treatment.

Methodology: The peer-reviewed article has been taken onto the account for the formation of a literature review. Most portals on the cyberspace are searched for the review, these may include PubMed, Google Scholar and NCBI. Scientific reaches that have been published in English has been considered. With initial 55 paper, 25 were considered after analysis as per the inclusion and exclusion criterion.

Result and Discussion: The result of the studies conducted revealed that adolescent girls are prone to develop iron deficiency anaemia more than 20 per cent and tend to face the ill effect of it in the form of mental or physical development.

Conclusion: We have found that preventive measures if taken at the required time may reduce the morbidity burden of anaemia in these risk groups. Healthcare professionals should especially focus on the requirement of the early diagnosis and intervention with proper prophylaxis.

INTRODUCTION

Anaemia is the term used for the pathological process in which the erythrocytes haemoglobin or Hb and the concentration of the blood cells per unit of the volume are reduced abnormally (3). In an individual with no anaemia, the levels and value of haematocrit and Hb may vary as per the stage of the life, developmental stage, environmental oxygen pressure, age and gender (1). The cut off recommended by the WHO to define iron deficiency anaemia is shown in table 1.

Iron deficiency anaemia

Iron deficiency anaemia usually arises when the balance of the iron intake, stores of the iron and the loss of the iron is not balanced (2). This leads to the insufficiency of iron in the body to support the haem production of the erythrocyte. Although iron deficiency anaemia rarely causes death it can seriously impact significantly the development and status of health. However, the diagnosis of the condition is quite assessable it is often overlooked by the physician.

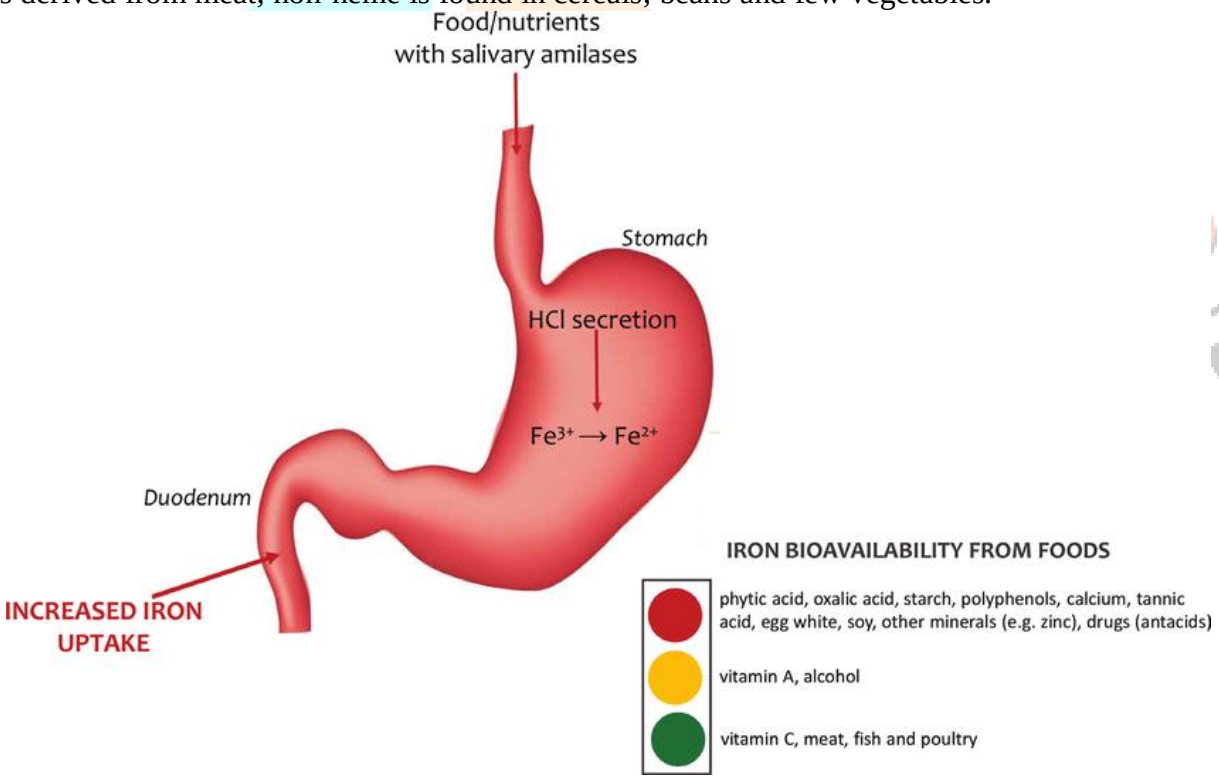
Age Group and Gender	Haemoglobin (g/dl)
6 to 59 months	11.0
5 to 11 years	11.5
12 to 14 years	12.0
Non-pregnant women	12.0
Pregnant women	11.0
Men (> 15 years)	13.00

Table 1: Haemoglobin cut-off levels for diagnosing anaemia
Source: 2001 World Health Organization Report

Iron comprises 5 per cent of the earth crust, yet iron deficiency anaemia is not uncommon among the population. The amount of iron within the body may be different as per the age and the sex. Iron deficiency is simply defined as the reduced ferritin level which is resulted directly either by inadequate dietary intake or faulty processing of iron in the body. The decrease in the ferritin level is due to either of the cause: excessive blood loss, any of haemorrhagic condition, occult bleeding or any of the inflammatory processes as a result of chronic disease. Iron is an important component of haemoglobin, myoglobin and other haem proteins. Commonly on an average 10 per cent of the dietary haemoglobin is absorbed. The use of iron in early developmental stages may include psychomotor functions and intellectual developments.

Iron Metabolism

Iron is an essential element required for the metabolic function of several cellular components. As the element have few toxic affects regulations needs to be maintained. Deficiency or abundance of the element may lead to pathological implications. The human diet has two forms of elements: Haem and non-Haem (4). On one hand, haem is derived from meat, non-heme is found in cereals, beans and few vegetables.



The stomach gastric juices are known to increase the absorption of the iron. This increases the bioavailability. After the entry of ferric iron onto the large intestine it is reduced to ferrous by duodenal cytochrome b before its absorption (5). Once reduced it moves from small intestine to apical membrane of the electrolyte. After this, it enters the cell as ferroprotein facilitating the re-oxidation of ferrous iron to ferric iron. Then the iron is transported into the bone marrow for the synthesis of the haemoglobin and further incorporated into erythrocyte. Almost 70 per cent of the iron inside the human body is in the form of haem compounds example haemoglobin and myoglobin. 29 per cent is stored in the form of ferritin and hemosiderin (6).

CURRENT DISEASE LOAD- EPIDEMIOLOGY

Among the cases of iron deficiency anaemia, 95 per cent is accounted for disturbed intake of diet. Poor or unbalanced diet intake may cause iron deficiency anaemia in young girls and pregnant females. The world health organisation has estimated that more than 2 billion people worldwide that is a total of 30 per cent world population is affected by disease (8). When it comes to a developing nation, the range may be from 4.3 per cent to 30 per cent of

the total population. Many data available on the iron efficiency anaemia prevalence among young girls of age 12 to 17 depict the need for early interventions.

Published articles have shown that iron deficiency anaemia has prevailed in girls ranging from 9 percent in young girls of 12 to 15 age to 16 per cent of girl ageing 16 to19 years. This has been presented with lower ranges in boys. In developing countries, the condition is more serious where the prevalence of anaemia in the general population was as high as 40 per cent among girls (9).

Another study reports that anaemia affects approximately 50 per cent of the Indian population (7). Women are affected more, and the implications are serious with 20-40 per cent maternal death due to it. Several government schemes are currently working to combat the condition and India became the first country to launch the National Nutritional Anaemia Prophylaxis Program. This involves the initiative for weekly supplements of iron and folic acid. Yet the national health family survey conducted in 2016 reported that 50 per cent of the pregnant females were anaemic and 35 of the young girls' were facing lower haemoglobin values (10).

RISK FACTORS

Adolescence is a crucial stage for any individual in terms of development. In this stage, the iron requirement is high due to body development (13). An important factor that causes the iron deficiency at this point of life may be attributed to changing dietary choices with the increasing demand for muscular development. There are social, economic influences on the choices made by them. In adolescence the eating disorder is common including refusal to eat food, constant issues with body image and weight loss, skipping meals. All this collectively forces toward faulty dietary intakes.

Another issue that influences iron outcomes is a lifestyle. Intake of fast food by young adults may make them nutritionally deprived of essential micronutrients and elements of food. Food rich in sodium, fats, sugar with poor fibres, nutrients, calcium and vitamin is referred by young girls once under the influence of peers.

Predisposing factors

Iron deficiency anaemia is the result of an imbalance in the intake and metabolism circulation of iron in the body. This imbalance is present in later stages of life in individual who are not exclusively breastfeed until easily six months of their early life. Many studies have shown the correlation between breastfeeding and the development of anaemia in later life years. Frequent tea, coffee, alcohol consumption also reduced the absorption of iron in the body. Early pregnancy, poor socioeconomic status, lower educational background, poor sanitation may predispose girls to develop iron deficiency anaemia (12).

DETERMINANTS OF IRON DEFICIENCY ANAEMIA

Major determinants are depicted in brief in table 2

A) **Faulty diet:** Diet with poor iron stores, insufficient iron supplementation, folic acid, vitamin C, Vitamin B12, and Vitamin D increases the chances of developing iron-deficiency anaemia.

B) **Medications**: There are certain medications which directly or indirectly interferes with the metabolism of iron within the body, hence altering its absorption. For example, few medicines like antacid reduce the acidity of the stomach juices hence reducing the absorption of iron-reducing its bioavailability (14).

C) **Obesity**: Obesity in children and adolescence is the causative agent of multiple other diseases like juvenile diabetes. High calories diet and poor iron absorption cycle are responsible for lower iron reservoirs in these individuals.

D) **Malnutrition:** This is associated with secondary disorder other than a dietary deficiency. These are the presence of malabsorption syndrome, excessive iron loss, intestinal villi atrophy. All these conditions hamper the absorption of micronutrients from the body to be utilized for various purposes.

E) **Due to Gastro-intestinal issues**: In India, the most common cause of iron deficiency anaemia in young girls and children is Ascaris Lumbricoides manifestation. This is a parasite which is commonly predominant in the poor sanitation and is known to cause malnutrition in young adults and children. This can be easily diagnosed through stool test (11). Other gastrointestinal causes of iron deficiency anaemia are H. Pyroli infection, atrophic gastritis, inflammatory bowel disease etc.

F) **Menstrual Abnormalities**: Menarche and menstrual disturbance along with dietary faults are the biggest cause of anaemia in young girls.

Findings	Cause
1. Iron-poor diet	Not taking appropriate diet
2. Secondary to Medication	Some medications inhibit the absorption
3. Overweight or obesity	High calories food intake deficient in iron
4. Malnutrition disorders	Lesion of the intestine
5. Iron in Athletes	Also known as Sports anaemia, secondary to sports activities
6. Acute or chronic blood loss	Depletion of iron caused by blood loss example, injury, blood donation
7. Gastrointestinal tract disorders	peptic disease, inflammatory bowel disease, coeliac disease, haemorrhoids, H. pylori infection and diverticulitis
8. Reproductive Issues	Menarche and menstrual abnormalities like Metrorrhagia Pregnancy, childbirth and intrauterine diseases

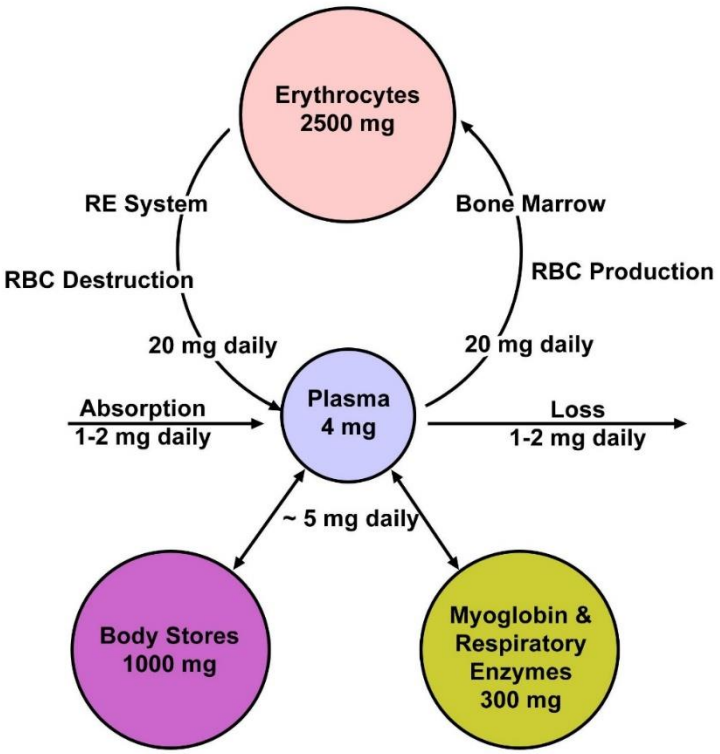
Table 2: Important factors causing iron deficiency anaemia in adolescents

PATHOPHYSIOLOGY

Principle organ in the body in terms of iron reserves and metabolism are spleen, liver and bone marrow. Serum ferritin is the indicator of the iron stores in the body. Plasma ferritin is the primary indication of the iron-deficiency anaemia. Reduction in the ferritin level occurs in the body before the reduced haemoglobin levels or serum iron level in the body.

Ferritin may be increased in the conditions of infection on the body and leukaemia. Other diseases like renal disorders, rheumatoid disorder, lymphomas, breast cancer may also result in increased ferritin levels.

Although standing alone ferritin is not an actual indicator of iron deficiency anaemia but is a contributory clinical presentation in most cases. As the measurement of ferritin does not shows the prevalence do eth disease within the body. Iron haemostasis is regulated by the absorption of iron in the various parts of the gut. Hence measurement of iron at various forms indict the perfect balance between consumption and utilization.



Source: Medscape

If we take an example of a man 70-kg the total iron quantity inside the body is about 4 g. This is further constantly maintained by a cyclic balance of absorption and loss from the body. However, the demand for the body for iron is 20-25 mg it only absorbs 1 Mg from the diet. At a lifespan of 120 days of an erythrocyte, 0.8% of red blood cells tend to get destroyed and replaced each day. A man with 5 L of blood volume has 2.5 g of iron incorporated into the haemoglobin, with a daily turnover of 20 mg for haemoglobin synthesis and degradation and another 5 mg for other requirements. Most of this iron passes through the plasma for re-utilization. Iron over these requirements is deposited in body stores as ferritin or hemosiderin

DIAGNOSIS

For the diagnosis of iron deficiency anaemia, a full blood scanning is advisable. This may include complete blood count, ferritin levels, haematocrit values. Diagnosis is based on three different aspects:

A) History taking of the patient with the presentation of sign and symptoms
B) Focussing on the sign and symptoms for the differential diagnosis
C) Detailed physical examination with lab reports

Serum iron level decreases, serum transferrin is decreased with high iron-binding capacity in cases of anaemia (25). In most cases, the onset of the cases is slow and insidious with appearances of symptoms usually slow. The principle symptoms in iron deficiency anaemia are paleness, fatigue, dyspnoea, debility, irritability, headache, paraesthesia, mood changes etc

While on examination physician may find signs of tachycardia, atrophy of the tongue, retarded growth, koilonychia, swollen limbs. In cases of anaemia, the physician should be attentive for early diagnosis and may find co-relations between the menarche and other menstrual disturbances, attention to the presence of ringworms should be kept. Nutritional assessment completely based on their BMI should be done. This must be followed by a complete blood count and reticulocyte count. An erythrocyte count of < 3.9 million/ml, along with haemoglobin levels < 12 g/dl in adolescent with haematocrit value $< 33\%$, confirms presence of anaemia (24).

DIFFERENTIAL DIAGNOSIS

Lead poisoning
Microcytic anaemia
Autoimmune Hemolytic anaemia
Thalassemia

COMPLICATIONS

Increased risk of infections
Reduced immunity
Stunned growth

PREVENTION

There are certain approaches which should be focussed for prevention of anaemic in young girls.

A) Counselling for them which is aimed at improving the quality of lifestyle and more encouragement for the intake of a balanced diet.
B) Providing iron supplementation for young girls targeting their needs and requirements
C) Providing fortified food supplements to lower socio-economic population
D) Control of infection with better sanitation maintenance.
E) The decision in the individual case should be taken as per the individual requirements. As adolescent age require widespread mental support focus should also be maintained in such direction.
F) Early assessment and interventions should be focussed targeting the risk population.

TREATMENTS

Supplementary therapy

An iron supplement should be the choice of treatment in individual diagnosis with anaemia. In 90 percent of the cases, the choice is oral supplementations. Parenteral supplements should be reserved for an individual having a low tolerance for oral tablets. Iron salts including ferrous sulphate, gluconate and fumarate are highly effective to their bioavailability and rapid speed of absorption.

Ferrous salts are more preferred mode of therapy as they have few side effects. Their absorption is also unaffected by the intake of food therefore they can be easily taken before or after the meals. The ideal dose in adolescents is 60 mg of elemental iron twice a day in the case of moderate anaemia. Treatment should be capable of increasing the haemoglobin levels by one g/dl. The government in India under several initiatives providing fortified food to protect the broader population from anaemia.

CONCLUSION

Many population-based studies have shown a deep analysis regarding dietary pattern and iron deficiency anaemia. Many other factors associated are secondary to socio-economic conditions of the individual. Research studies have shown the efficacy for early preventive measure such as iron-fortified food, health promotions, counselling etc in preventing iron deficiency anaemia. Hence a strong policy is required at the mass level to combat easily treatable and preventable diseases yet affecting 50 per cent of the population.

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