MEDICAL AND NUTRITIONAL CAUSES OF IRON DEFICIENCY ANEMIA IN GROWING CHILDREN

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ABSTRACT

Different essential mineral nutrients are required for the normal structure and functioning of the human body. One of them is an Iron. It is majorly present in red blood cells to carry oxygen throughout the body. Other different cellular mechanisms including DNA synthesis, energy generation and various enzymatic processes are carried out by it. However, its deficiency leads to retarded nutritional functioning in body and in extreme cases, of body iron stores depletion leading to decreased blood content in body.

A study was conducted to assess level of Iron (Fe) in blood of school going children of age 3 to 17 years . The level of Fe obtained in blood was correlated with health status of individual. Major medical causes include blood loss, malabsorption, chronic diseases and genetic alterations. Whereas, insufficient intake and low bioavailability of iron are considered as main nutritional causes. Children are the most affected individuals of iron deficiency condition with 70% of prevalence in most parts of Asia. Anemia in children of growing age along with its diagnosis, prevention and control of the condition has also been discussed

Keywords: Anemia, blood, human subject.

INTRODUCTION:

Muscle myoglobin and red blood cell haemoglobin are both iron-based proteins. About 60% of the body's iron is found in haemoglobin and myoglobin. Enzymatic reactions, mitochondrial energy production, and DNA synthesis all need on iron to operate properly in the human body. The average adult has 3-5 g of iron in their bodies, but needs another 20-25 mg every day to make enough red blood cells. Iron reserves, the exchange of iron in iron-containing enzymes, and recycling of aged erythrocytes in macrophages are all necessary for iron homoeostasis due to the low food intake (1-2 mg per day). Menstrual blood loss, urine excretion, perspiration, and desquamation each account for around 1–2 mg of daily iron loss. Due to the lack of an excretion regulatory mechanism, iron must be carefully managed via food intake, iron recycling, and intestinal absorption. Lopez et al. (2015)

In particular, iron deficiency is a major public health issue in impoverished nations and the globe at large. It is estimated that between 30 and 40 percent of adults in affluent countries have ID, whereas the prevalence is much higher among pre-schoolers and pregnant women in underdeveloped nations. The World Health Organization (WHO) reports that 48% of children aged 5-14 are anaemic, and that 30% of toddlers aged 0-4 are anaemic (zdemir, 2015).

There are three distinct phases to the development of iron insufficiency.

1. Serum iron content, haemoglobin, and hematocrit are all within normal ranges throughout the prelatent phase. Serum ferritin levels and iron stores in bone marrow are both low at this point in iron insufficiency.
2. During the second, latent phase, iron storage decreases and serum iron (SI) and transferrin saturation drop. Normal haemoglobin and hematocrit levels.

3. Serum iron and transferrin saturation, haemoglobin, and hematocrit levels, and iron storage are all decreased in severe IDA (zdemir, 2015).

Iron deficiency occurs when there is not enough of the mineral iron in the body. Hemoglobin, a component of the red blood cells that transport oxygen to our tissues, cannot be produced without iron (Anemia_ Causes, Symptoms, Diagnosis, Treatments, n.d.).

As anaemia serves as the most widely-used indicator of iron deficiency, the two conditions are often discussed as if they were synonymous. Iron deficiency, however, may occur even in the absence of anaemia, and it may have deleterious effects on the body's tissues. There are several phases of iron insufficiency. Iron reserves are depleted if demand exceeds intake and vice versa. Iron deficiency, but not iron deficiency anaemia, may exist even if haemoglobin levels remain normal for an extended period of time after iron stores become inadequate. Only plasma ferritin and transferrin saturation have been shown to decrease thus far. Reduced haemoglobin levels are the result of a negative iron balance that persists even after iron reserves are depleted. The conclusion is that low iron levels in the body are associated with iron deficiency, and that the progression of this disease into anaemia is known as iron deficiency anaemia. It has been shown that

Indicators of iron deficiency

There are two primary causes of iron deficiency:

1. Low iron storage capacity is the hallmark of absolute iron insufficiency.
2. When the body's iron levels are adequate overall but the bone marrow does not get enough iron, the condition is known as functional iron deficiency.

Both absolute and functional deficits may occur simultaneously. Deficiencies in functional iron are common in acute and chronic inflammatory diseases, and the hormone hepcidin, which controls iron homeostasis, plays a crucial role in the development of these conditions (Lopez et al., 2015).

METHODS AND MATERIALS

Iron deficiency was measured in a random sample of children from each school. The ages of the observed kids add up to less than seventeen. Blood was collected in labelled, sterile syringes. Children of reproductive age exhibiting signs of bleeding were recruited to provide blood samples.

Patients with anaemia who suffer from symptoms like fatigue, dyspnea, headache, etc., but also from disorders like anaemia

Restless legs syndrome, atrophic glossitis, Skin that is dry and rough, Lacking moisture, resulting in brittle, broken locks.

Palpitations; Rapid heart rate; Brain fog; Chest pain; Dizzines

RESULTS AND DISCUSSION

Result on iron (Fe) analysis from blood samples are presented in following sections.

Table 1. Collection of blood samples from various location for the assessment of Fe

Schools	**No. of children tested**	**Iron deficient**	**Prevalence**
School 1	117	71	60.7%
School 2	741	353	47.6%

School 3	763	328	42.9%
School 4	63	26	41.7%

Data on the relationship between iron levels and other blood indicators is provided in table form below.

Table 2. Iron level in the blood of anemic patient

Age	**Serum Ferritin (µg/ml)**	**Transferrin (%)**	**Erythrocyte (nmol/L RBCs**
3-7	< 13	<12 .5	>1.25
8-10	<15.2	<14 .2	>1.52
12-14	<16.5	<15 .3	>1.32
15-17	< 14 .2	<12 .5	>1.28

The results of a study correlating blood with various diseases are shown in the following table 3.

Table 3. Iron level compared to other disorders

Complete blood count	hemoglobin and hematocrit values are checked
Peripheral blood smear	microcytic and hypochromic erythrocytes if anemia is there
Reticulocyte	high reticulocyte count indicates the increased RBCs degradation

Serum iron	Amount of iron the serum
Ferritin	Indicates the amount of iron stored in body

Roots in Medicine

The medical reasons of iron deficient anaemia include

- Loss of Blood
- malabsorption
- Persistent Illnesses
- Changes in genetic material

Loss of Blood

Colonic cancer, gastric carcinoma, benign stomach ulcers, and angiodysplasia all cause blood loss, which is the leading cause of iron deficiency anaemia.

Trichuris trichiura (whipworm) and Necator americanus are two parasites that cause iron deficiency anaemia in impoverished nations (hookworm). The second most common reason is gynaecological causes. Iron deficiency anaemia may also result from excessive blood loss after surgery if it is not replaced. Other forms of blood loss are significantly less common and include haematuria, epistaxis, and hemoptysis.

Malabsorption

Coeliac disease, gastric bypass surgery, gastrectomy, and Helicobacter pylori colonisation are all major causes of malabsorption.

Less than one percent of cases of iron deficiency anaemia may be attributed to other reasons such gut resection, atrophic gastritis, and bacterial overgrowth. Iron malabsorption is exacerbated in people with the eating disorder pica because they want inedible substances (such paper, clay, dirt, glass, or sand) that have no nutritional value. In the same way, having an ice appetite might cause problems. Additionally, medication use contributes to iron deficiency anaemia by either hastening blood loss (such as with nonsteroidal anti-inflammatory medicines) or lowering iron absorption (eg, proton-pump inhibitors and H2 receptor antagonists).

Constant Illnesses

Inflammatory bowel diseases (IBD), chronic heart failure, chronic renal illness, cancer, rheumatoid arthritis, and obesity are all linked to iron deficiency anaemia. Anemia may be caused by malaria in a number of ways, including the destruction of both parasitized and non-parasitized erythrocytes (which has an effect on haemoglobin concentrations and causes iron to be released from damaged erythrocytes)

Changes to the genetic code

Anemia due to a lack of iron may also be inherited. Haemolytic anaemia and anemias caused by changes in genes involved in duodenal iron absorption (e.g. SLC11A2), systemic iron homoeostasis (e.g. TMPRSS6), or erythroid iron absorption and utilisation. Mutations in the TMPRSS6 gene, which produces matriptase-2, an enzyme that downregulates hepcidin, are the cause of iron-refractory iron deficiency anaemia, a microcytic anaemia. In this condition, there is an increase in hepcidin, which causes an iron deficit (Lopez et al., 2015)

Anemia and its nutritional roots

Deficiencies in iron or vitamin C3, both of which prevent the body from absorbing adequate nutrients, may lead to iron deficiency anaemia (IDA), which is also known as nutritional anaemia.

Despite the existence of a programme and a strategy designed to reduce its incidence, the condition is still found in up to 70% of the world's young infants, including those in much of India and Asia. Among the irreparable harm anaemia may bring are anomalies in the brain, the body's fastest-growing organ in infancy and early childhood, which can have a negative impact on the children's intellectual growth.

The anaemia caused by a lack of nutrients in children

Nutritional anaemia encompasses those diseases in which the body's haemoglobin levels drop dangerously low due to nutritional inadequacies, such as an insufficient intake of iron, folic acid, or vitamin B12. Folic acid deficiency is also a thing, albeit it's far less frequent and often manifests with anaemia. Iron deficiency is the leading cause of nutritional anaemia across the globe, with vitamin B12 insufficiency being a far less common contributor.

A recent poll found that IDA was the leading health issue, with negative effects on children's health, academic performance, economic output, and productivity. People who are malnourished, especially those who are anaemic, are at the greatest risk of developing IDA. Two billion people, or more than 30 percent of the global population, are already infected, and the problem is significantly worse in underdeveloped nations where it is compounded by malaria and worm diseases. However, with regular and suitable intervention, this may be avoided. Unfortunately, due to people's ignorance and the high price of treating anaemia, only a few of the symptoms of iron deficiency are detected and treated. However, it is vital that people understand that such a mindset may lead to potentially fatal cognitive impairments. As reported by (Kotecha, 2011)

Causes

During the early years, while children are undergoing fast development stages, there should be an adequate amount of iron to prevent iron deficiency anaemia (IDA). Other causes of anaemia

include gastrointestinal diseases such chronic infection, chronic diarrhoea, celiac disease, or intestinal parasites, as well as giving a newborn unfortified formula or breastfeeding a baby for a long period of time without adding iron to the diet. However, the most prevalent cause is still insufficient iron intake

Here are the three most important factors:

1. Consuming absorption inhibitors leads to reduced bioavailability of taken iron.
2. Inadequate iron intake while needing to fulfil minimum requirements
3. The need for iron skyrockets during the period of fast development (Kotecha, 2011)

DIAGNOSIS

Generally speaking, a thorough history and physical examination are required for the diagnosis of any illness. A research found that the diagnostic accuracy for IDA was 71% and the specificity was 79%. Prenatal period, nutrition, length of breast feeding and solid meals, and bleeding history are the primary areas of emphasis. Following is a brief synopsis of some of the tests performed in the laboratory.

The anaemia associated with malnutrition is characterized by a distribution of red blood cells (RBCs) that is not uniform. Anisocytosis on a peripheral smear and an expanded erythrocyte distribution width (RDW) in the blood are two ways to evaluate this. Nutritional anaemia is the term used when an increased RDW is accompanied with anaemia (N, 2022).

Anemia in Children Younger Than Three: Pathophysiology

Hemoglobin concentrations are typically highest at birth as a result of the fetus's adaptation to the external environment of the uterus; however, these concentrations are maintained by the neonatal reserves of iron storage and remain stable for the first four months of life before gradually

decreasing to meet the body's steady iron demand. Therefore, around 0.8 mg of iron per day must be supplied by food or nutrition. Concentrations of serum ferritin may be monitored to assess the pace and severity of iron depletion from stored reserves. Absorption of iron from the food is relatively low during the first two months after birth, when the body relies mostly on its reserve of iron reserves, but it becomes the primary source of iron required for normal bodily function. In the event of a premature or low-birth-weight infant, the baby's diet should be supplemented with iron from a young age (Kotecha, 2011).

Obtaining the Necessary Iron Intake

In what quantity is iron needed? Whether an iron supplement is necessary for a newborn or a kid ages 3 to 6 when the risk of anaemia is significant depends on the age group being discussed. In most cases, a greater dosage is required together with a longer treatment period in the first few years of life. As a result, the following factors affect the dosage that must be used:

When a baby is born, what is the mother's iron status like, and how much iron was stored in the baby's body?

It's unclear if the baby's birth weight is low or normal.

How much iron is in the food supplied to the kid, and whether or not they are solely receiving breast milk.

Iron bioavailability (excellent 15% or subpar 5%).

The necessary iron intake may be determined in light of these factors (Kotecha, 2011).

In what ways are iron deficiency anaemia treated?

Until the body's iron stores are restored to a healthy level, treatment for iron deficiency will need continued supplementation with medical iron. Even if the root of the patient's anaemia cannot be pinpointed, the condition must be addressed with iron replacement therapy. The following methods may be used to enhance iron intake:

Diet

Beef, poultry, and fish, as well as dark green vegetables, legumes like peas and beans, cereals, grains, and rice, are all advised for the patient's diet.

Ferrous Sulfate for Medical Use

Multivitamins often include lower levels of iron than what is necessary to treat iron insufficiency. Typically, a daily intake of iron between 150 and 200 milligrammes is what the doctor will recommend. No studies have shown that one iron salt, liquid, or tablet is superior to the others, and the quantity of elemental iron varies widely across various preparations. The iron content of a product may be determined by looking at the packaging. Iron is absorbed by the body in the small intestine. This suggests that the efficacy of iron tablets with an enteric coating may be diminished. Vitamin C, also known as ascorbic acid, is utilised to aid in the body's absorption of iron, and many medical professionals advocate for daily vitamin C consumption in order to optimise iron absorption. Constipation, diarrhoea, nausea, and vomiting are some of the other negative effects of iron supplements.

Ferrous Ion Infusion

IV iron is recommended by medical professionals for intravenous (IV) treatment. Patients who have poor absorption of iron via the digestive system, those with severe iron deficiency or chronic blood loss, those on erythropoietin (a hormone that promotes blood formation), and those who

cannot take oral iron may need intravenous iron therapy to address iron deficiency. There are a few distinct forms of intravenous iron:

1. Incorporating Iron Dextran
2. Iron sucrose
3. Gluconate ferric

An allergic response is a common problem associated with intravenous iron. Urticaria (hives), pruritus (itching), and muscle and joint pain are among the uncommon but serious adverse effects.

A Blood Transfusion

Patients with severe iron-deficiency anaemia who are actively bleeding or who have major symptoms including weakness, shortness of breath, and chest discomfort may be candidates for red blood cell transfusions. Transfusions are not a permanent solution since they just replenish the red blood cells that have been lost (Iron Deficiency Anemia 2, n.d.).

PREVENTION AND CONTROL

There are various programs and policies for its prevention and control but most of them have been limited by the fact that its practical implementation on such a large scale seems impossible because of the poor economy and the increasing malnutrition (Kotecha, 2011).

The American Academy of Pediatrics, WHO and some other famous organizations are trying very hard to bring in new and effective policies whose main focus in on the supplying of foods that are enriched with iron, screening of the infants for the check and balance of iron status and avoiding cow's milk during early year of life. But every method is limited by some controversial facts for example enriched food cannot be supplied to each and every portion of the world mainly to the third world countries likewise poor bioavailability is also a main concern. Conclusively, total

eradication of IDA is not possible because of the above factors (Preventive and Social Medicine 2, n.d.).

CONCLUSION

Iron deficiency is considered most widespread and prevalent problem of nutrition in growing children the world which impose adverse developmental effects and is difficult to treat and prevent. Prevention can be achieved at birth, postnatal period and pregnancy. New approaches are required to deliver iron to patients.

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