Iron Deficiency Anaemia in Children

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ABSTRACT

Two-thirds of anemia in children worldwide, of which IDA accounts for 20 to 25% of cases, are caused by iron deficiency, which is a significant global health burden. Despite treatment, unfortunately, IDA can have neuropsychiatric effects and is strongly associated with cognitive decline throughout childhood and adolescence 60% of African children under 5 years of age are anemic, of which IDA accounts for 50% of the burden. However, iron salt supplementation has a significant impact on preventing or reducing anemia. It is estimated that since the late 1990s, about 2 billion people worldwide have ID disease, which causes half of all anemia cases. The majority of people with iron deficiency who do not have anemia have no symptoms and can only be identified by a screening test. The most common symptom of iron deficiency anemia is pallor, also commonly seen in the nail bed, conjunctiva, palmar crease, and nail bed. In the absence of iron and ferritin studies, haemoglobin can be a sensitive test to distinguish IDA from other forms of microcytic anemia.

Keywords: Children, Iron, Iron Deficiency Anaemia, Nutrients.

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Introduction

The fourth most abundant element and material on Earth, iron, is found in both the outer and inner cores of the planet.[1-4]

By Lemmery and Geofgroy, the elemental iron was first identified in the human body in 1713. Iron blood is concentrated in red corpuscles, according to Vincenzo Menghini (1704–1759).[5]

With paediatrics as a field of study, research on the prevention of hypochromic microcytic anemia dates back to 1920. The normal Hb values for infants at various developmental stages were studied by paediatrician Helen Mackay in Vienna in the 1920s. She noticed a drop in Hb at 2 months, a plateau at 6 months, and then a further decline from 2 years onward, with a particularly severe drop in Hb among infants who weren't breastfed and had low birth weights. However, supplementing with iron salts had a significant impact on preventing or reducing anemia. She came to the conclusion that iron deficiency in the diet caused late-infancy anemia and that iron therapy could help to alleviate the issue.[6,7]

Modern knowledge of iron deficiency and iron deficiency anemia (IDA) is based on Helen's research findings and recommendations. Even today, Helen still advises giving iron supplements to non-breastfed infants after one month. All infant formulas must comply with European Union 14 directives requiring the addition of vitamins and iron. Even today, little is understood about how iron deficiency contributes to anemia in children, despite the fact that it has long been a major health concern.[8–11]

Deficiency in iron

According to the World Health Organization (WHO), ID affects about 2/3 of all children worldwide (42%) and is more likely to affect children under the age of two. It is the most prevalent micronutrient deficiency and can occur in both developed and developing countries. Around the world, 20–25% of all preschoolers have IDA.[12]

According to estimates from the late 1990s, an estimated 2 billion people worldwide were affected by ID, which was responsible for half of all cases of anemia. However, a recent global systematic analysis of anaemia data establishing anaemia cause-specific attribution for 17 anemia-related conditions ranked ID as the most anaemia cause globally.[13]

Contrarily, an iron deficiency is a condition in which the body's total iron levels are insufficient to support normal physiologic processes. Serum ferritin is another indicator of it.[14]

Clinical manifestation of iron deficiency

The majority of people with iron deficiency without anemia are asymptomatic, and only screening tests can identify them. Despite treatment, it has been shown to impair neuropsychological functions, resulting in behavioral disorder, a decline in perception functions, motor and mental developmental retardation, and cognitive impairment through childhood and into adolescence.[15-18] Due to iron's role in basal ganglia and myelination, these processes are facilitated. Strokes, febrile seizures, and breath-holding episodes have also been linked to an elevated risk.[19]

The most common symptom of iron deficiency anaemia is pallor, which is also frequently found in the nail beds, conjunctivae, palmar creases, and nail beds. Exercise-induced dyspnea, fatigue, cold intolerance, or decreased mental acuity are symptoms of mild to moderate IDA. When iron and ferritin studies are not available, Hb14) can be a sensitive test to distinguish IDA from other forms of microcytic anaemia.[20,21]

The early diagnosis of iron deficiency anemia with RDW has been made possible by studies using a highly sensitive and efficient tool. Studies have reported sensitivity ranges between 81 and 94 percent, specificities between 50 and 90 percent, and high positive and negative predictive values between 64 and 100 percent. However, a study in India found that combining Hb and RDW increased test accuracy, with sensitivity of 98%, specificity of 90%, PPV of 90%, and NPV of 98%.[22]

Mentzer index (MCV/RBC) > 13

Mentzer's index is the Mean Corpuscular Volume per Red Cell Count calculated as Mentzer index = Mean corpuscular volume (in FL)/RBC count (in Millions per microlitre). A value of < 13 is suggestive for β-thalassemia trait while a value >13 is for iron deficiency anaemia.[23]

A study in Indonesia, established a sensitivity of 93% and specificity of 84% among children aged 6 to 12 years. This is a good validated and inexpensive test for screening for iron deficiency anaemia especially in the developing countries.[24]

Demographic factors

Age and sex have been documented in various studies having strong association with IDA, in Pakistani (AOR 1.40, 95% CI 1.18–1.55 p <0.05,) North East Ethiopia (AOR = 9.6, 95% CI: 3.61–25.47) Namutumba in eastern Uganda 6-11 months and 12-23 months with AOR = 1.12; 95% CI: 1.05–1.19 and AOR = 1.12; 95% CI: 1.00–1.24 respectively.

Anaemia was more predominant in Males with increased odds. The observed sex difference is because of a higher pre- and post-natal growth rate in male infants, low iron storage state due to an increased foetal erythropoietic activity, larger intestinal iron loss, lower iron absorption, and more frequent infections in boys. However, with iron fortification in staples, these gender- based differences are leveled.[25]

Low family income and maternal education increases the likelihood of developing anaemia while increasing maternal age decreased the likelihood among children less than 5 years. This is attributable to provision of better nutrition, education and life and the ease to comprehend and apply medical and nutritional counsel to the children.[26] Mothers aged <20 years and between 30- 39 years were 4.69 and 2.55 times, likely to have anaemia in a Kenyan survey respectively.[27]

Perinatal factors

As seen in a retrospective cohort in Korea OR 6.49, low birth weight and prematurity are regarded as risky groups for IDA because of the low iron stores at birth. This happens because the third trimester of pregnancy, when the maximum amount of iron is transferred to the fetus, is shorter. Thus, they quickly deplete their smaller stores. Due to their need for catch-up growth, premature babies have a higher iron requirement and start receiving supplemental elemental iron at two weeks of age.[28]

Dietary elements

Children's rapid growth, reduced absorption, and gastrointestinal losses brought on by an excessive intake of unprocessed cow's milk are some of the most frequently observed IDA etiologies.[29] Because of poor dietary sources and poor absorption, there is insufficient intake of iron. In comparison to haem sources found in meat diets (meat, liver, and offal, among others), non-haem sources from plant-based diets have poor absorption (25%).[30] On the other hand, cow's milk contains calcium and casein phosphopeptides that interfere with the absorption of iron and also cause protein-induced enterocolitis, which results in blood loss and ID.[31]

Transplacental iron is the only source of iron for a developing fetus and reaches its maximum level during the last trimester of pregnancy, when the fetus has a total iron content of 75 mg/kg.[32] Up to the first six months of life, this iron is enough for erythropoiesis. Breastmilk iron levels are high in the first month and gradually decline until they are approximately 0 mg/l at 5 months. Iron is typically only received in small amounts, but it is absorbed very well (50 percent). The goal of supplementation is to meet the recommended dietary allowances for infants: full-term: 1 mg/kg daily (maximum 15 mg); premature: 2 to 4 mg/kg daily (maximum 15 mg); and children: 1 to 3 years old: 7 mg daily. Complementary foods should contain vitamin C, fish, eggs, and foods high in meat in order to accomplish this. due to the low bioavailability and consequently poor absorption of iron in a plant-based diet.[33]

Comorbidities

There are many comorbidities associated with IDA, such as acute lower respiratory tract infection (ALRTI), malnutrition, intestinal parasites, malaria, diarrhea, and HIV.[34]

Iron deficiency anaemia and underweight and stunting are significantly related.[35] Epidemiological studies first looked into the link between obesity and ID in the 1960s and discovered that obese children and adolescents had lower serum iron concentrations and had a double the chance of being diagnosed with IDA.[36] Children in Saudi Arabia with high body mass index (BMI) experienced an anaemia prevalence of 60%, with ID being responsible for 79.2% of cases.[37] This is a result of the poor diet that has been observed, with a focus on high- calorie foods that are deficient in vitamins and iron.[38]

As a common haematological symptom linked to the progression of the disease, pediatric HIV infection is linked to anemia.[39] The multi-factorial aetiology of HIV-associated anemia includes opportunistic infections, drug-related side effects, iron deficiency, anemia of chronic disease associated with HIV infection, and drug-related side effects.[40]

In third world nations, malaria significantly worsens anemia.[41] Although haemolytic anemia is the main cause of anemia in the context of malaria, inflammation-related anemia also has a significant impact on how iron is distributed because it regulates iron absorption.[42]

ID and malaria interact in a complicated way. While iron supplementation increases the risk of developing severe malaria, iron deficiency appears to protect against both the liver and erythrocytic phases of the parasite's life cycle, which both require iron for growth.[43] The distribution and metabolism of iron are both hampered by malaria in various ways.[44] They include hemolysis, heme release, impaired erythropoiesis, elevated macrophage iron, and up-regulation of hepcidin, which reduces iron absorption and contributes to IDA. The loss of iron and reduced nutrient absorption required to maintain normal Hb are associated with diarrheal illness.[45]

Early infants exposure to microbial pathogens in complementary foods (before six months of age) increases the risk of infection for diarrheal disease, which then results in malabsorption.[46] Shigella and enteroinvasive E also cause bloody diarrhea. Dysentery caused by coli may increase the risk of iron deficiency anemia (IDA) in infants, particularly in developing nations.[2]

Conclusion

Two-thirds of anemia in children worldwide, of which IDA accounts for 20 to 25% of cases, are caused by iron deficiency, which is a significant global health burden. It is estimated that since the late 1990s, about 2 billion people worldwide have ID disease, which causes half of all anemia cases. The majority of people with iron deficiency who do not have anemia have no symptoms and can only be identified by a screening test. The most common symptom of iron deficiency anemia is pallor, also commonly seen in the nail bed, conjunctiva, palmar crease, and nail bed.

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