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Review Article

Early Childhood Anemia in Rural Bangladesh: The Role of Iron Deficiency, Infections, and Inadequate Complementary Feeding Techniques

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Abstract

Anemia and iron deficiency increased quickly until 8 to 9 months of age, while the prevalence of subclinical infections remained stable. Apart from age and male sex, iron deficiency and subclinical infections were the main risk factors for anemia. Similarly, age, male sex, and subclinical illnesses were important risk factors for iron deficiency. In early rural Bangladeshi newborns, the burden of anemia and iron deficiency is particularly severe during the key transition period of increased physiological Fe requirements corresponding to the early phase of supplementary feeding, which lasts from 6 to 11 months of age. Nutritional and infection control strategies alone are insufficient. as soon as they begin providing them with complimentary foods. The increasing prevalence of anaemia and Iron Deficiency during the first 3 months of the complementary feeding period highlights the need to support mothers to introduce Fe supplements or Fe-rich foods or products in their infants' diet as soon as they start giving them complementary foods. In order to reduce anemia and Iron Deficiency in this population, it is imperative to incorporate methods related to water, sanitation, and hygiene, as well as parasitic disease control, given the high prevalence of subclinical infections and their role in these conditions. In order to avoid anemia during infancy in Bangladesh, a multipronged approach involving both infection control techniques and dietary Fe consumption improvements is required. A person's capacity to work is restricted by anemia and iron deficiency, which can potentially have serious negative economic repercussions and impede the advancement of the country. Because of all of this, it is generally accepted that lowering the global burden of iron deficiency and iron deficiency anemia is a top priority in public health nutrition.

Keywords

Anemia, Iron Deficiency, Early Childhood Anemia, Rural Bangladesh, Inadequate Complementary Feeding Techniques

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1. Introduction

One of the most prevalent and unsolvable public health issues, especially in underdeveloped nations, is still anemia. Up to two billion people are thought to be affected by anemia globally, with pregnant women, teenage girls, and babies and small children bearing the brunt of the illness [1, 2]. Anaemia can have a variety of causes, such as blood problems, infections, and inadequate nutrition [1, 3].

Full-term, normal-birth-weight newborns are mostly self-sufficient in meeting their Fe needs throughout the first six months of life. These infants have enough iron reserves at birth to meet their requirements for iron [4]. Despite the extremely low Fe concentrations in breast milk, Fe is present in a highly accessible form. High Fe stores at birth and low, but highly bioavailable, Fe in breast milk ensure that no more Fe is needed until about 6 months of age, at which point the hepatic Fe stores that were built up during gestation are exhausted and requirements rise quickly. The 6- to 11-month age range has greater Fe requirements than any other time in life due to the baby's rapid growth and cognitive development. Infants need extra sources of Fe starting around the time they are 6 months old in order to avoid Fe deficiency and the consequences that follow. This extra iron is usually available in complementary foods that are high in iron, such as meat products or foods that have been fortified with iron. Many children in developing nations are at a higher risk of developing ID and anemia during the critical complementary feeding phase due to the low availability and lack of access to expensive animal-source foods or foods fortified with iron, as well as the low Fe bioavailability of typical cereal-based complementary foods.

Twenty-seven million women, adolescents, and children in Bangladesh are estimated to be affected by anemia, with associated economic consequences reaching up to 7 9% of GDP [5]. The current study's goals were to investigate the role that ID, infections, and feeding behaviors play in anemia in Bangladeshi infants during the crucial early complementary feeding window, which lasts from 6 to 11 months of age. The availability of several Fe status indicators and markers of subclinical infections, which enable a detailed investigation of the percentage of anemia attributable to ID, infections, and poor dietary behaviors, is a strength of the current analysis. The creation of focused treatments that can lessen the burden that anemia and ID place on newborns in rural Bangladesh can be guided by the information provided here.

2. Iron Deficiency Is the Main Basis of Early Child Hood Anemia

Fe deficiency worldwide may be responsible for up to 50% of anemia, according to a rough but frequently quoted estimate [2]. Anaemia prevalence surveys have been used to assess the global burden of Fe deficiency; despite limitations in technique, the findings are substantial and suggest a serious public health issue. According to WHO estimates, anemia caused by Fe deficiency affects 27% of preschool-aged children and 41% of women [2], with significant regional and age-group variations. Fe-deficiency anemia (IDA) has well-documented effects [1, 6-8].

IDA has been linked to delayed or impaired cognitive and physical development in children. Adults with IDA may experience a decrease in their physical work capability and productivity. During the perinatal stage, anemia increases the risk of death for both women and infants. According to estimates from 10 developing nations, the economic impact of iron deficiency (ID), which results from low labor productivity in adults and motor and mental disability in children, is 4% of gross domestic product [9].

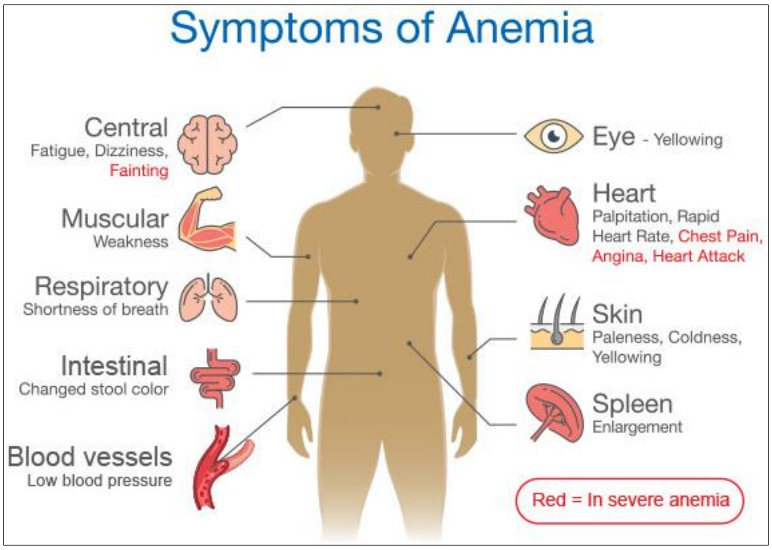

Figure 1. *Symptoms associated with Iron deficiency Anemia [27].*

The most frequent causes of IDA in children include low birth weight, fast growth, inadequate intake, and gastrointestinal losses brought on by consuming too much cow's milk. The only supply of iron throughout the intrauterine stage is iron that passes through the placenta. During the last stage of pregnancy, the fetus has 75 mg/kg of iron overall. If there is no major blood loss during the first six months of life, iron reserves are sufficient to support erythropoiesis and the development of physiological anemia occurs during the postnatal period. Because their stockpiles are smaller, low birth weight newborns and babies who have had perinatal blood loss deplete their supplies earlier. Postponing the cutting of the umbilical chord can enhance the condition of iron and lower the likelihood of iron deficiency [10]. Breastmilk's iron content peaks in the first month and then progressively declines over the next several, reaching a low point of roughly 0.3 mg/L in the fifth month [11]. However, this sum differs from person to person. Research has demonstrated that the iron content of breastmilk is unaffected by the diet of the mother [12]. Despite the fact that breastmilk normally contains very little iron, 50% of it is absorbed. It is well known that giving a baby anything other than breastmilk during the first six months of life can interfere with the way iron is absorbed from the milk. As a result, these items ought to be served during different meals. In summary, there is a high absorption rate, but it is not as high as what is needed for growth. Therefore, throughout the first six months of life, newborns use the iron in their stores until their intake of iron from food grows.

After the sixth month, solid foods should be provided that are high in nutrients, including iron, zinc, phosphorus, magnesium, calcium, and vitamin B6. Based on data from the World Health Organization, solid foods should provide 98% of an infant's iron needs between the ages of 6 and 23 months [13, 14]. To satisfy this iron requirement, a diet high in meat, fish, eggs, and vitamin C should be consumed. Overindulging infants in cow's milk too early on is another feeding error. Babies' prolonged blood loss may be linked to cow's milk's heat-sensitive proteins. Furthermore, compared to breastfeeding, cow's milk absorbs iron far less readily. Iron-rich foods can be replaced with cow's milk; however, the calcium and caseino-phosphopeptides in cow's milk may interfere with the absorption of iron. Iron deficiency is easily developed in newborns fed iron-poor meals after the sixth month, when they have nearly depleted their stores of iron.

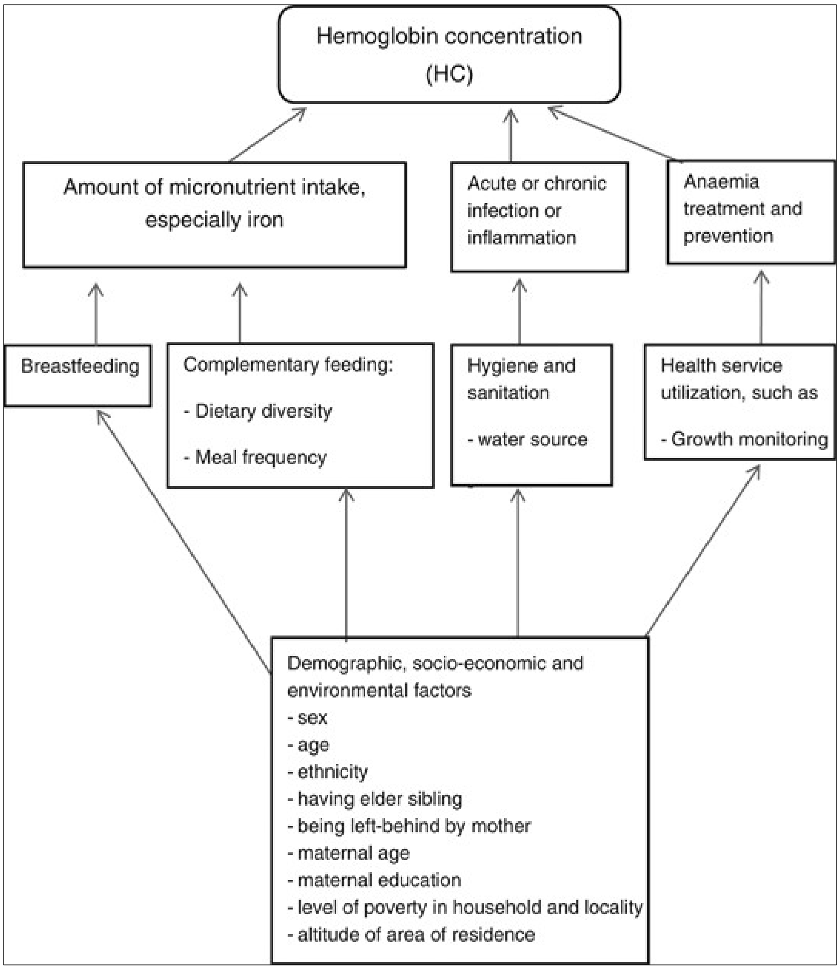

Figure 2. *Poor Complementary Feeding Practices and High Anemia [28].*

If inadequate intake cannot be ruled out or if oral iron treatment is not working as intended, blood loss should be investigated as a possible underlying cause in patients, particularly older children. Children are comparatively less likely to get chronic iron deficiency anemia, which manifests as occult bleeding. It can be brought on by gastrointestinal issues such as peptic ulcer, Meckel's diverticulum, polyp, hemangioma, or inflammatory bowel disease. Rarely, insensible blood loss can be diagnosed with celiac disease, persistent diarrhea, or pulmonary hemosiderosis using the patient's medical history. Remember that iron deficiency can also be caused by parasitosis, particularly in developing nations. 2% of teenage girls have iron deficiency anemia, which is mostly associated with growth spurts and menstrual blood loss [15]. Adolescent girls should have a thorough menstrual history taken, and girls who experience excessive bleeding should be monitored for potential bleeding disorders, such as von-Willebrand disease.

3. Various Infection Leads to Anemia in Childhood

Compared to controls, patients with viral infections had considerably greater levels of anemia. MCV, MCH, and RDW did not significantly differ, indicating that iron metabolism is not linked to anemia that follows an acute infection. Anemia related to infection is caused by an iron deficit. The anemia that accompanies an acute infection does not seem to be connected to iron metabolism, in contrast to the scenario in chronic infection where hepcidin plays a significant role in the etiology of anemia. Of course, in order to determine the validity of this idea, empirical testing is necessary. Thus, anemia is linked to acute sickness. Iron metabolism disturbance does not seem to be linked to the pathophysiology of this anemia.

4. Children Under 5 Years Are Prone to Anemia Due to Inadequate Complementary Feeding

The main public health issue is anemia, with a kid under five considered anemic if their hemoglobin (Hb) level is less than 11.0 g/dl [16]. The most frequent causes of anemia in children under five are low consumption and malabsorption of foods high in iron [17, 18]. It is common in underdeveloped nations and leads to low academic performance, poor motor and cognitive development, and exposure to comorbid disorders [19].

The worldwide health issue with the highest prevalence and severity is under-five anemia. 47.4% of the 1.6 million individuals affected by anemia worldwide were preschoolers [20]. In Bangladesh, 51% of children under five have anemia [21]. Stunting, inadequate nutritional diversity, food insecurity, deworming, wasting, educational status, mother weight, and subpar prenatal care visits were the risk factors for anemia.

5. Bangladesh's Current Public Health Initiatives in Aim to Shield Children from Iron Deficiency Anemia

Regrettably, the high prevalence estimates indicate that the present strategies used in South Asia have not been successful in lowering the incidence of pediatric anemia. There seem to be a lot of reasons. It is anticipated that even when the National Anemia Control Program is put into place, the prevalence of IDA among young children in India would remain high due to a combination of inadequate coverage and poor adherence to the intervention. According to recent research, children's iron deficiency anemia is unlikely to improve with iron drops because of low dispersion and poor compliance [22, 23].

The following factors can affect a child's adherence to iron drop use: confusing dispensing instructions, unpleasant and strong metallic taste, staining of the child's teeth if not wiped off right away, and gastrointestinal side effects. Additional technical drawbacks of using liquid iron preparations include a limited shelf life and costly delivery due to the weight of the bottles. Other South Asian therapies have a different focus and are food-based, encouraging better eating habits and weaning methods such as introducing food at the appropriate time and consuming supplementary meals in moderation in addition to a varied diet to improve the consumption of breast milk. Foods high in nutrients are used, accessible, and widely available. Micronutrients are abundant and highly bioavailable.

In Bangladesh, the incidence of anemia in newborns, young children, and mothers is reduced by delaying the cutting of the cord, sleeping with a bed net, nursing exclusively, spacing out deliveries, and cleaning your hands. Pregnancy-related anemia can be prevented by iron-folic supplementation [24]. iron-ferric acid (IFA) supplements, a more diverse diet, sleeping under a bed net, getting intermittent preventative therapy (IPTp) for malaria, often washing your hands, and taking deworming drugs were all recommended. By continuing to breastfeed, giving enough supplemental food (including micronutrients), treating and avoiding malaria, washing hands often, and using deworming drugs, anemia can be prevented and good growth can be fostered in early newborns. Adolescents can prevent anemia with the use of IFA supplements, deworming medicine, and hand washing. Parental planning facilitates delaying childbearing.

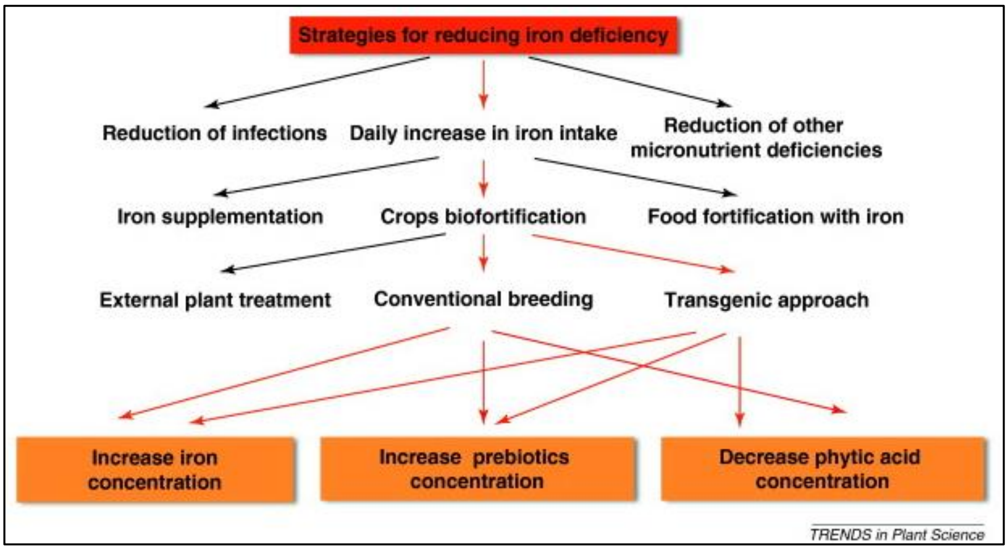

Figure 3. *Strategies for reducing Iron deficiency [29].*

There are new iron fortifiers in development. Nanotechnology engineering is used to generate iron that is easily absorbed by physiological routes and is nanosized. However, since too much free iron in biological systems can be hazardous, industrial manufacture must be done under the tightest safety regulations. We found that Fe (III) oxide nanoparticles were absorbed via the ferric route and had no adverse effects on organ or hematological functions in an animal model. This implies that the goal of lowering iron solubility and absorption may be achieved by creating tailored iron forms and fractions [25].

Another option with great potential is biofortification, which is cultivating and genetically modifying plants to produce a final plant meal with a greater iron content. Micronutrient biofortification in staple foods has been attempted, but the ultimate goals are still far off, and all safety, cost-benefit, and low environmental impact requirements must be met before deployment.

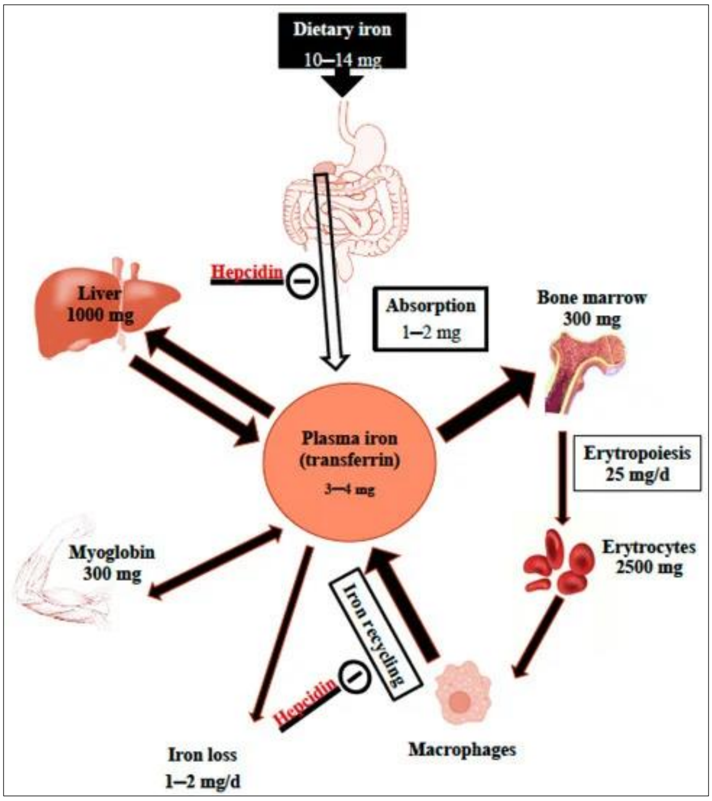

Figure 4. *Dietary Approached to Iron deficiency Prevention in Childhood [30].*

6. Executing a Comprehensive Approach for Anemia in Children

We think that implementing creative, alternative strategies into supplemental feeding programs to reduce the high frequency of iron deficiency among preterm newborns is one strategy to quickly address this significant public health issue. To boost the overall nutritional content of weaning meals, "Micronutrient Sprinkles" should be added to their supplemental feeding regimens. Sprinkles can raise the iron content of supplemented meals when paired with other important micronutrients [26].

Because the sachets are easy to use and distribute, they may be included in any program designed to improve South Asian weaning practices. Preventing infantile diabetes will help achieve at least four of the eight Millennium Development Goals: Increasing adult productivity to end extreme poverty and hunger; Increasing childhood learning to achieve universal primary education; promoting gender equality and empowering women through knowledge of proper weaning practices; and promoting gender equality and empowering women through knowledge of proper weaning practices.

7. Conclusions

To avoid iron deficiency in neonates and early childhood, it is critical to encourage appropriate weaning practices and the consumption of low-cost, nutritionally sufficient supplementary meals in developing nations such as South Asia. Sprinkles can be introduced to the present supplemental feeding programs to improve the nutritional value of extra meals delivered at home or at school while also supporting the health and well-being of youngsters. They are inexpensive, easy to use, and come with clear instructions. Sprinkles may also provide other essential micronutrients based on the needs of the intended audience. Several nutritional studies have demonstrated that, particularly for children between the ages of 6 and 12, the amount of iron consumed from traditional supplemented meals in developing nations is frequently insufficient. Conventional food processing methods such as soaking, fermentation, and germination may increase iron intake somewhat, but they don't seem to increase iron bioavailability to the same degree. Dietary diversity and enrichment of additional meals (e.g., with fish powder) are good for the child's overall nutritional intake, but they frequently don't close the iron deficiency. Due to these factors, the majority of people will require iron supplementation in one form or another, whether through home-made fortification products or commercially available supplemental meals. Iron deficiency and anemia rates may be decreased by commercially supplemented complimentary meals, provided that the iron dosage and chemical type are both appropriate. On the other hand, a baby formulation meant for older children will give older children more iron than they need, and a child formulation meant for younger children—ages 6 to 12 months—will give younger children less iron than they need. Thus, even in the unlikely event that commercially fortified supplemental meals were widely available and reasonably priced, another method would very certainly be needed to raise babies' iron intake to the necessary level. In contrast to the situation with iron supplements, no study that was part of this evaluation found any negative effects from increasing iron consumption or strengthening supplementary meals at home. Large-scale studies with a significant number of iron-deficient kids are yet required. Research comparing the physiological effects of iron administered between meals with those of iron supplied with food might also be beneficial. Iron-fortified foods will likely result in little amounts of iron being ingested at each meal; but, with home fortification, the daily dosage of iron may be absorbed in a single meal. As a result, researching the effects of ingesting iron at different meals may be beneficial.

Conflicts of Interest

The authors declare no conflicts of interest.

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