

Research Article

Assessing Iron Intake During the Complementary Feeding Period (6 Months to 2 Years) in Bangladesh

Shamina Zaman Kajori*

Department of Food & Nutrition, Dhaka University, Dhaka, Bangladesh

Abstract

In Bangladesh, infants aged 6–23 months are particularly vulnerable to iron deficiency and anemia, driven by low dietary iron intake, high phytate diets from plant-based complementary foods, and subclinical infections. This review synthesizes evidence on iron needs, complementary feeding practices, bioavailability challenges, and the efficacy of strategies such as fortified cereals, micronutrient powders, and improved dietary diversity. We propose a multipronged approach combining dietary enhancement, infection control, food processing methods (e.g. de-phytinization and promotion of animal-source foods plus vitamin C), and behavior change communication. Improvement of iron intake during the complementary feeding window is vital to reduce anemia, support cognitive development, and enhance child well-being in Bangladesh.

Keywords

Bangladesh, Complementary Feeding, Iron Intake, Anemia, Infants, Micronutrient Powders, Iron Bioavailability

1. Introduction

Childhood anemia remains a major public health concern in Bangladesh, particularly during the critical window of infancy and early childhood. In surveys conducted in the early 2000s, nearly 92% of infants aged 6–11 months were found to be anaemic, highlighting the widespread nature of the issue. Although anemia prevalence declines somewhat with age, it still remains high, with approximately 68% of children anaemic and 56% suffering from iron deficiency by later childhood [1]. This is particularly concerning given the long-term impacts of iron deficiency on cognitive development, physical growth, and immune function.

The period from 6 to 24 months of age is particularly vulnerable, as iron requirements peak during this time due to rapid growth and increased blood volume. According to the World Health Organization (WHO), children aged 6–12

months require about 9–10 mg of iron per day, while those aged 12–24 months need about 5–7 mg per day [1]. However, breastmilk alone provides only about 0.2 mg of iron daily, which is insufficient to meet these needs. This makes appropriate complementary feeding essential during this stage.

Despite this, complementary feeding practices in Bangladesh remain suboptimal. National surveys indicate that fewer than 20–25% of children aged 6–23 months receive a minimum acceptable diet, which includes both dietary diversity and meal frequency [2, 3]. Even more concerning is the low intake of iron-rich foods—only about 10% of children meet recommended consumption levels [2, 3]. This dietary inadequacy significantly contributes to the high burden of anemia and iron deficiency.

*Corresponding author: Kajori.zaman@gmail.com (Shamina Zaman Kajori)

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Addressing childhood anemia in Bangladesh requires urgent attention to improving infant and young child feeding (IYCF) practices, ensuring access to iron-rich or fortified

foods, and scaling up interventions targeting both caregivers and health systems to support optimal nutrition during early childhood.

Term infants, 0 to 6 months

CPS [20]	AAP [8,21]	ESPGHAN [19,22]	Italian Intersociety Document
			
2019	2019	2017	2021
Exclusive breastfeeding is sufficient to meet iron requirements until 6 months of age Formula-fed infants: Iron-fortified formula	Exclusive breastfeeding is sufficient to meet iron requirements until 4 months of age Exclusively or >50% breastfed infants: 1 mg/kg/day iron supplement from 4 to 6 months Formula-fed infants: formula containing 4 mg/L to 12 mg/L of iron	Exclusive breastfeeding is sufficient to meet iron requirements until 4 to 6 months of age Formula-fed infants: formula containing 4 mg/L to 8 mg/L iron	Iron stores acquired prenatally along with a small amount of iron from breast milk are adequate to meet iron needs for most healthy full-term infants Exclusive breastfeeding is sufficient to meet iron requirements until 6 months of age Exclusively or >50% breastfed infants are not at risk for inadequate intakes Formula-fed infants: formula containing 4 mg/L to 8 mg/L iron

Figure 1. Dietary recommendations for term infants, 0 to 6 months. CPS, AAP, ESPGHAN [4].

2. Discussion

1) Dietary Iron Intake and Bioavailability

Complementary foods in Bangladesh are often plant-based and high in phytate, inhibiting iron absorption. Many foods fail to meet phytate: iron molar ratios recommended for good absorption, especially in cereal-legume staple [5]. Animal-source foods (fish/meat/eggs) are more bioavailable but infrequently fed: fish consumed by ~19% infants, plant sources by <14% [6].

2) Infection and Other Risk Factors

While iron deficiency is the leading cause of anemia in young children, subclinical infections also play a significant, often underrecognized, role—especially in low-resource settings like rural Bangladesh. These infections, which do not always present with obvious clinical symptoms, can trigger inflammation that interferes with iron metabolism and impairs

hemoglobin synthesis. Inflammatory responses reduce the body's ability to absorb and utilize iron, even when dietary intake is adequate.

Evidence from studies in rural Bangladeshi infants shows that subclinical infections independently increase the risk of anemia. Adjusted odds ratios (ORs) for anemia associated with such infections range from approximately 1.4 to 1.5, indicating a substantial risk even when accounting for other factors [7]. In population-attributable terms, subclinical infections accounted for around 16% of anemia cases in infants—while iron deficiency was responsible for about 67% [7]. These findings highlight the multifactorial nature of anemia and the need for integrated approaches that go beyond just iron supplementation.

Addressing infection-related anemia requires strategies such as improving sanitation and hygiene, promoting exclusive breastfeeding during the first six months, timely immunization, and managing infections through primary

healthcare services. Monitoring inflammation biomarkers, such as C-reactive protein (CRP) or alpha-1-acid glycoprotein (AGP), may also help better assess the true burden of iron deficiency by accounting for inflammation's confounding effects on iron status indicators.

To effectively reduce childhood anemia, it is essential to consider both nutritional and non-nutritional factors, including the underlying burden of infections and inflammation.

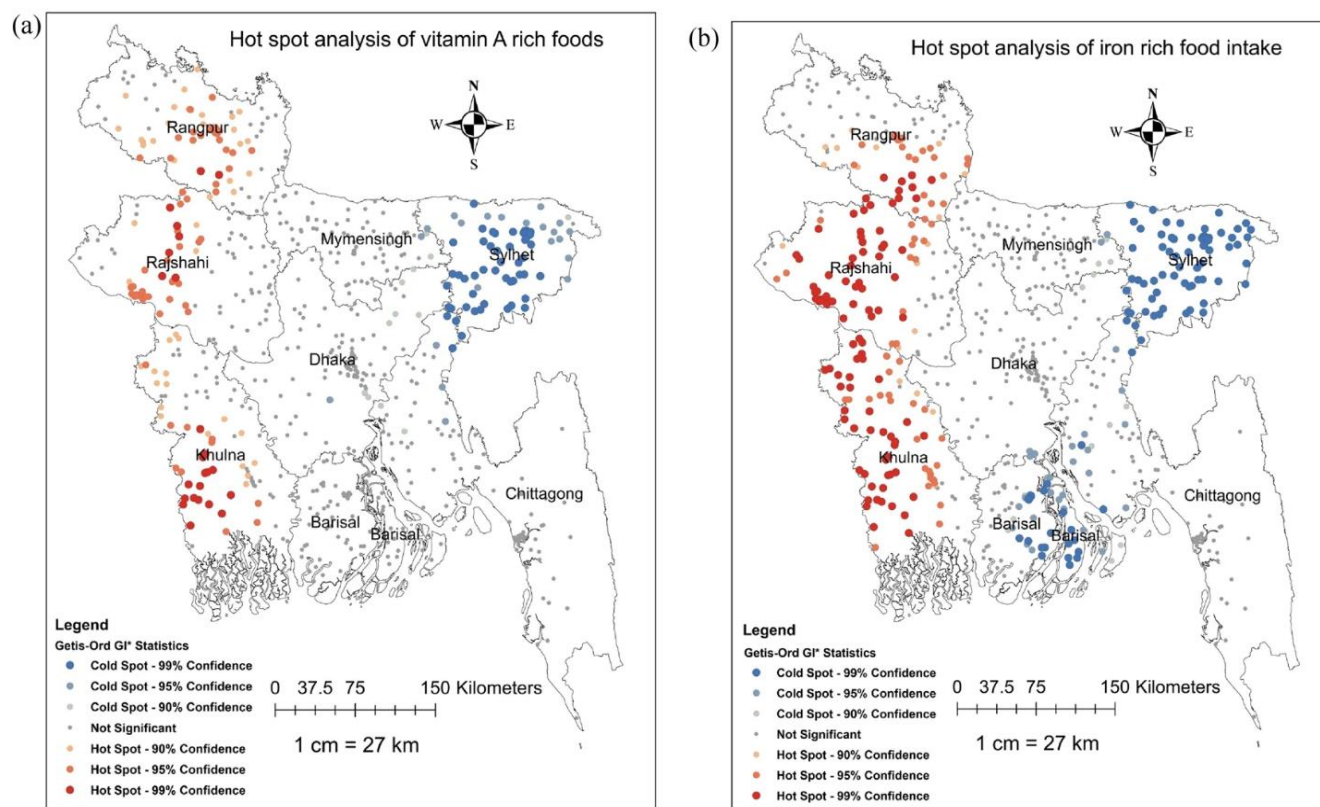


Figure 2. Spatial variations and determinants of vitamin A and iron rich food consumption among Bangladeshi children aged 6–23 months [8].

3) Fortification and Micronutrient Powders (MNPs)

Systematic reviews demonstrate that micronutrient powders (MNPs) are effective in reducing childhood anemia and iron deficiency globally. Among children under two years of age, MNPs have been shown to reduce anemia by approximately 18% and iron deficiency by around 53% [5]. They also significantly increase hemoglobin and serum ferritin levels, key biomarkers for iron status. These findings highlight the potential of home fortification strategies using MNPs as a practical and scalable intervention in low-resource settings.

In addition to MNPs, fortified infant cereals have shown promising results, particularly in low- and middle-income countries (LMICs). Evidence from multiple studies indicates that consumption of fortified cereals can reduce anemia prevalence by about 43% and increase hemoglobin concentrations with a mean difference of approximately 3.4 g/dL. These products offer a nutrient-dense

complementary food option that can fill the iron gap during the critical 6–24-month window, especially in contexts where dietary diversity is limited.

Bangladesh-specific evidence supports these global findings. A recent randomized controlled trial conducted in the country confirmed that iron fortification of complementary foods significantly reduced anemia prevalence among infants [9]. This underscores the importance of integrating fortified foods into national infant and young child feeding (IYCF) programs, particularly where traditional diets fall short in providing essential micronutrients.

Together, MNPs and fortified complementary foods represent cost-effective, evidence-based strategies for addressing iron deficiency and anemia in early childhood. Scaling up these interventions could play a vital role in reducing the high burden of anemia among Bangladeshi children.



Figure 3. Iron Fortified Feeding Components [9].

4) Food Processing and Dietary Strategies

Improving iron bioavailability from complementary foods is essential in reducing childhood anemia, especially in settings like Bangladesh where plant-based diets are common. One key barrier to iron absorption is the presence of phytates—naturally occurring compounds in cereals and legumes that inhibit mineral absorption. Techniques such as dephytinization, including soaking, fermentation, and sprouting of grains and pulses, can significantly reduce phytate content and modestly enhance the bioavailability of iron and other minerals [10]. These traditional food preparation methods are low-cost and culturally acceptable, making them practical interventions for improving nutritional quality at the household level.

In addition to processing methods, dietary combinations play a crucial role in enhancing iron absorption. Consuming plant-based meals alongside vitamin C-rich foods—such as citrus fruits, tomatoes, or green leafy vegetables—can significantly improve non-heme iron absorption. Vitamin C acts as a reducing agent, converting iron into a more absorbable form. Furthermore, the inclusion of even small amounts of animal-source foods, such as meat, fish, or eggs, can enhance overall iron bioavailability due to the presence of heme iron and certain peptides that promote iron uptake.

Integrating these strategies into infant and young child feeding practices can help address micronutrient deficiencies and support healthier growth and development in young children.

Table 1. Recommended Iron Intake vs. Typical Intake.

Age group	WHO/FAO recommended intake (bioavailable)	Typical intake in Bangladesh	Notes
6–12 months	~9–10 mg/day	Frequently <5 mg/day	Breastmilk ≈0.2 mg/day; plant-based diet
12–24 months	~5–7 mg/day	Often <3 mg/day	Complementary feeding remains largely cereal/lentil based

(Based on WHO and modeling data) [11]

Table 2. Key Strategies to Improve Iron Intake and Status [12, 13].

Strategy	Evidence Summary
Micronutrient powders	RCT meta-analysis: ↓ anemia ~18%, ↓ iron deficiency ~53%; improved Hb, ferritin

Strategy	Evidence Summary
(MNPs)	
Fortified complementary cereals	Reduced anemia ~43%, increased hemoglobin in LMIC trials
Dietary diversification	Inclusion of animal-source foods (fish, meat, eggs) improves heme-iron intake; low baseline consumption (<20%) in Bangladesh
Food processing techniques	De-phytinization improves bioavailability when combined with vitamin C or animal foods
Infection control and WASH	Reducing subclinical infections critical; contributes ~16% of anemia burden [10]

3. Conclusion

To effectively combat iron deficiency and anemia among Bangladeshi infants aged 6 to 24 months, a comprehensive and coordinated strategy is urgently needed. Expanding the availability and use of iron-fortified complementary foods and micronutrient powders can directly address nutritional shortfalls, while promoting dietary diversity—especially the inclusion of locally available animal-source foods and vitamin C-rich fruits and vegetables—can significantly improve iron absorption. Enhancing food preparation practices, such as soaking, fermenting, and germinating grains and legumes, further increases nutrient bioavailability by reducing antinutritional factors like phytates. Equally critical is the integration of nutrition interventions with infection prevention, hygiene promotion, and sanitation programs, recognizing the significant role of illness in impairing iron status. Lasting impact will depend on effective behavior change communication that empowers caregivers with knowledge and practical skills, supported by enabling policies, community-based delivery platforms, and strong supply chain systems. A unified effort across health, agriculture, and education sectors can substantially reduce the burden of childhood anemia, unlocking the full developmental potential of millions of children and strengthening the nation's future workforce and wellbeing.

Abbreviations

MNP	Multiple Micronutrient Powder
LMICs	Low- and Middle-Income Countries

Conflicts of Interest

Author has no conflict of interest.

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