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Prevalence and Associated Factors of Iron Deficiency Anemia in Children Under Two Years: A Comprehensive Analysis

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Annotation: **Introduction:** Iron deficiency is the most common nutritional deficiency ailment across the world and is responsible for 90% of childhood anemia, it. Consequently, IDA etiology comprises of physiological and nutritional variables. This study also seeks to establish the frequency of IDA, its causes and methods of preventing the condition amongst children below the age of two years. **Patients and method:** This cross-sectional, non-observational study included 110 infants less than two years old presenting with IDA. Specific inclusion criteria regarded infants up to twelve months. The variables captured include; One hundred infants with normochromic normocytic mean values were used as the control group. **Results:** The study identified several clinical features of iron deficiency anemia (IDA) among participants. revealed the highest incidence of IDA in infants aged 9-12 months. **Conclusion:** Inadequate iron consumption in infants under six months, often resulting from premature weaning, precipitates iron deficiency anemia (IDA), which peaks between 9 and 12 months, occasionally requiring transfusions for certain affected infants.

Keywords: Iron Deficiency Anemia, Nutritional Deficiency, infants.

Introduction

Iron deficiency, the most prevalent nutrient deficiency globally, is responsible for 90% of anemia in children and is primarily nutritional, significantly contributing to hemorrhagic diseases in infancy and childhood, with Dietary Iron Deficiency Anemia (IDA) being more prevalent among bottle-fed infants consuming excessive cow's milk, while breast-fed infants, despite lower iron content, exhibit reduced IDA due to superior absorption (1).(2) Iron deficiency primarily stems from the disparity between a neonate's iron reserves and its growth-related demands, with prevalent etiological factors encompassing physiological, pathological, and nutritional elements (3). Growth occurs at an accelerated rate during infancy and adolescence, rendering these populations particularly susceptible to iron deficiency, with the American Academy of Pediatrics recommending an intake of 1 mg of iron per kg of body weight daily for infants, or 2 mg for pre-term infants, without exceeding 15 mg per day (4). Iron supplementation is advised to commence by 2 months for preterm infants and 4 months for term infants, as those with low birth weight are particularly susceptible to iron deficiency anemia due to diminished iron reserves; this condition is exacerbated by the interference with iron absorption from human milk, necessitating the introduction of iron-rich solid foods at 6 months when breastfeeding decreases, while cow's milk should be avoided (5).(7)(6) IDA as a chronic, slowly progressing disease, many patients may not exhibit typical symptoms; clinical presentations are often nonspecific, resembling various anemias, and can include irritability, anorexia, fatigue, gastrointestinal issues, pica, and a heightened risk of infections, with mucosal pallor being notably specific in children, while atrophic glossitis, koilonychia, and dysphagia are less frequently observed in pediatric populations compared to adults (1)(8)(9). Heart failure may arise from low hemoglobin, particularly post-acute blood loss, with possible mild splenomegaly; consequently, auscultatory findings including apical systolic soft hemic flow and alternating hair color bands necessitate intervention, while maintaining cerebral iron levels is crucial for optimal brain function, as iron deficiency anemia in infants correlates with long-term deficits in mental and psychomotor development (10)(11). Behaviorally, iron deficiency anemia (IDA) may lead to alterations such as increased withdrawal, heightened imitativeness, and diminished interest in previously enjoyed activities; additionally, affected children often present with reduced stature relative to their peers, although regular iron supplementation may ameliorate these growth deficiencies (12). Infection susceptibility is heightened in individuals with IDA due to compromised leukocyte function and diminished cell-mediated immunity, as evidenced by reduced skin test reactivity (13). this investigation assesses the co-occurrence of nutritional deficiencies, including rickets and helminthic infections, in conjunction with iron deficiency anemia (IDA), revealing that children with IDA exhibit a heightened vulnerability to these conditions, which exacerbates their overall health challenges, while also analyzing the ramifications of IDA on transfusion requirements and the increased risk of urinary tract infections in affected infants.

Patients and Methods

Study Design and Participants

This cross-sectional study conducted from March 1 to October 15, 2024, involved one hundred and ten infants under two years exhibiting pallor, with inclusion criteria restricted to those aged twelve months or younger, and data collection encompassing subject names, ages, and sex.

Cohort Selection and Data Gathering

In a focused analysis of rickets and UTIs, as well as a gender comparison, 100 randomly selected specimens were examined, revealing that the control group exhibited a normochromic

normocytic blood profile characterized by normal hemoglobin and hematocrit levels, while structured parental interviews provided comprehensive insights related to the underlying key formulae detailed at the conclusion of this report.

Treatment Response

The investigation revealed that five patients unresponsive to iron therapy within a month were diagnosed with thalassemia via hemoglobin electrophoresis and subsequently excluded, alongside five additional patients with normochromic normocytic anemia, while some individuals with iron deficiency anemia received blood transfusions.

Results

Age Distribution

Figure 1 illustrates that the peak occurrence of iron deficiency anemia (IDA) in children is between nine to twelve months, with prevalence rates of 4% for those retaining to Promise for 1 to 8 months, 17% for 13 to 16 months, 25% for 17 to 21 months, and 13% for 22 to 24 months.

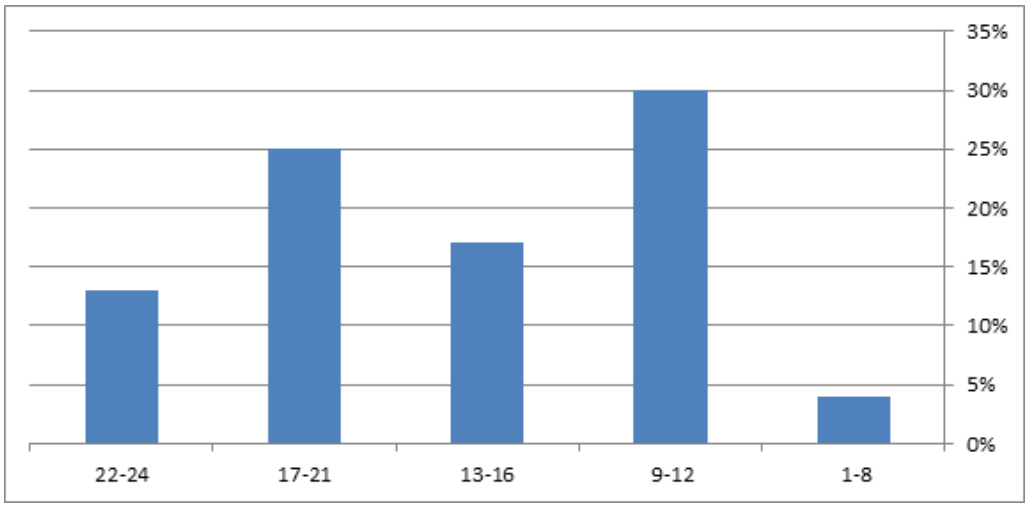

Figure (1): Age Distribution of Iron Deficiency Anemia (IDA) in Children Below 2 Years

Hemoglobin Level

Figure 2 demonstrates that a considerable percentage of patients present with hemoglobin levels under 6 gm/dl, with 37% of Iron Deficiency Anemia (IDA) patients at 5 gm/dl, 19% at 6 gm/dl, 17% at 7 gm/dl, 10% at 8 gm/dl, 15% at 9 gm/dl, and 2% at 10 gm/dl.

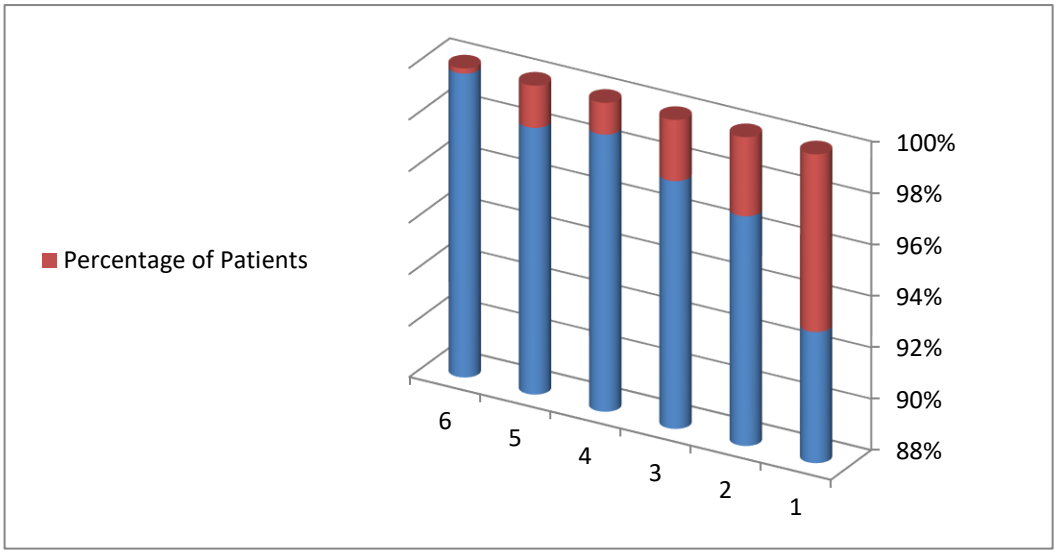

Figure (2): Distribution of Patients by Hemoglobin Levels

Serum iron Level

Figure 3 demonstrates that a substantial percentage of patients have serum iron concentrations lower than 6 µmol/L, with 39% at 5 µmol/L, 37% at 6 µmol/L, 9% at 9 µmol/L, 6% at 8 µmol/L, 5% at 10 µmol/L, and 4% at 7 µmol/L.

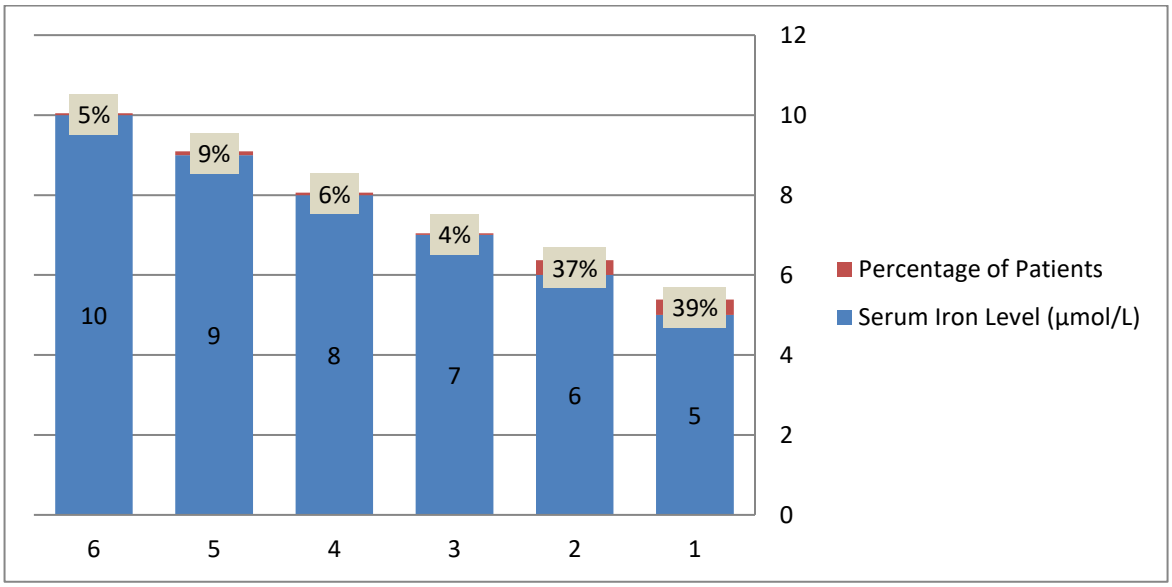

Figure (3): Distribution of Patients by Serum Iron Levels

Table 1 illustrates that patients with iron deficiency anemia (IDA) exhibit a statistically significant higher prevalence of concurrent nutritional deficiencies such as rickets, with 36% affected by rickets compared to 64% without, while a control group shows only 14% with rickets and 86% without.

Table 1: Prevalence of Rickets in Patients with Iron Deficiency Anemia (IDA) vs. Control Group

Group	Affected by Rickets (%)	Not Affected by Rickets (%)
Patients with IDA	36%	64%
Control Group	14%	86%

Z = 7.19 P<0.002 (very highly significant)

Table 2 reveals that 26% of patients exhibited worm infestation (Ancylostomiasis), while 74 % were devoid of such infestation in of Iron Deficiency Anemia.

Table 2: Prevalence of Worm Infestation (Ancylostomiasis) in Patients with Iron Deficiency Anemia

Group	Affected by Worm Infestation (%)	Not Affected by Worm Infestation (%)
Patients with IDA	26%	74%

Table 3 showed that 24% of patients of have had blood transfusion. Patients without blood transfusion 76% of iron Deficiency Anemia.

Table 3: Distribution of Blood Transfusion Status Among Patients with Iron Deficiency Anemia

Group	Patients who had blood transfusion (%)	Patients without blood transfusion (%)
Patients with IDA	24%	76%

Table 4 illustrated the increased susceptibly of infants with Iron Deficiency Anemia to Urinary Tract Infections. A prevalence of 54% of patients exhibited urinary tract infections (UTIs), whereas 46% did not, with control cases showing 12% with UTIs and 88% without.

Table 4: Susceptibly to UTI in Iron Deficiency Anemia patients

Group	Patient with UTI	Patient without UTI
Patients with IDA	54%	64%
Control Group	12%	88%

$Z = 7.25$ $P<0.002$ (very highly significant)

Discussion

In this study, among the one hundred patients diagnosed with iron-deficiency anemia (IDA), 57% were male and 43% female, indicating a slightly higher prevalence in males, contrasting with Demir and Gurler, 2022 , who reported a higher incidence of IDA in females in their Turkish study (14).

The current investigation reveals that 9-12 months is the most pivotal period for the onset of iron deficiency anemia (IDA), which is often overlooked in the initial five months due to infants' residual iron reserves, with occurrences noted in other age groups within the first two years, corroborated by Ringoringo, 2022 whose cross-sectional study in Indonesia indicated that 32% of infants aged 9-11 months were affected by IDA (15). In concurrence with Shao *et al.*, 2021 a cohort study from China revealed that 19.6% of infants were diagnosed with iron deficiency anemia at the age of 9 months. (16). Al-Faloji and Senior, 2022 observed a 24.2% prevalence of iron deficiency anemia among infants aged 6 to 12 months (17).

The present study revealed that the highest hemoglobin levels among patients were between 4-6 gm/dl, in contrast to the 8-9 gm/dl reported by Shareef, Abdulkareem, and Azeez (2020), while serum iron concentrations peaked at 4-6 µMole/L, differing from their findings of 7-8 µmol/L, attributed to the familial neglect experienced by hospitalized patients, with total iron binding capacity peaking at 170 µmol/L (18), while other potential causes of hypochromic microcytic red cells, such as occult stool blood loss, lead poisoning, B6 deficiency, sideroblastic anemia, and pulmonary hemosiderosis, remained statistically insignificant due to their rarity and limited laboratory resources(19).

Fifty four percent of our patients were susceptible to UTI. This results agree with Jayamanna and Jayaweera, 2023 found anemia, particularly iron deficiency anemia, is prevalent among children under two years, making them more vulnerable to infections, including UTIs (20). Also consistent with Yauba *et al.*, 2014 children with sickle cell anemia are at a higher risk of developing UTIs, with studies showing significant bacteriuria in these patients, especially during crises Most of our patients, their GUE showed pus cells, bacteria and granular casts which indicate upper UTI (21).

Thirty-six percent of our anemic children have rickets. This findings agree with Elidrissy, Zolali and Hawsawi, 2012 and Pettifor, Thandrayen and Thacher, 2018 reported that the most common form of anemia associated with rickets. It arises due to shared nutritional deficiencies, such as inadequate intake of iron and vitamin D, which are prevalent in children with rickets (22)(23).

Twenty-four percent of our patients received blood transfusions, as Ikhurionan, Bell, and Ofovwe (2024) suggested that a hemoglobin level below 3 g/dl with signs of impending heart failure may necessitate transfusion (24), while Pelkonen et al. (2023) indicated that transfusion is warranted when hemoglobin drops below 4 g/dl (24).

A notable 33% of our patients exhibited Ancylostomiasis, corroborating findings by LealemGedefaw, GetnetTesfawa and NetsanetFentahun, 2015 (25). Iron supplementation is advocated in the management of Ancylostomiasis due to the mature worm's blood-sucking

activity on intestinal walls, leading to iron deficiency anemia(26).

Conclusion

Inadequate iron intake in infants prior to six months, due to premature weaning, leads to iron deficiency anemia (IDA), with peak incidence observed between 9 and 12 months, necessitating transfusions for some affected infants.

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