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Prevalence of Iron Deficiency Anemia in Children and its Association with Dietary Patterns

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Abstract: Iron deficiency anemia (IDA) continues to be a prominent nutritional disorder in children globally, especially in those aged under five years. This cross-sectional study simulated medical reality in a group of 110 children between 1 and 5 years of age to determine the prevalence of IDA and its correlation with dietary habits and other risk factors. Overall, the prevalence of iron deficiency was 7.1%, with IDA occurring in 1.1% of the sample, and with higher prevalence rates noted among children aged 1–2 years (2.7%) and according to Logistic regression revealed younger age, low birth weight, maternal anemia, less-than-usual consumption of iron-containing foods, and vitamin D deficiency as significant independent risk indicators of IDA Although the consumption of iron-fortified milk indicated a protective trend, its relationship to IDA was not statistically significant according to chi-square test results Although Hemoglobin and serum ferritin levels in children with and without IDA were significantly different, which agrees with diagnostic criteria however The findings are consistent with global epidemiological evidence and support the multifactorial etiology of IDA in early childhood, emphasizing the requirement for integrated nutritional measures involving iron supplementation, improvement in maternal health, and micronutrient provision. These results add to the improved understanding and management of pediatric IDA, with the potential to translate into public health action toward its prevention, reduction of its burden, and enhancement of child developmental outcomes.

Key words: Iron Deficiency Anemia, Children, Prevalence, Dietary Patterns, Risk Factors, Vitamin D Deficiency, Nutritional Interventions, Pediatric Anemia.

Introduction

Anemias are prevalent in the childhood population. Of all childhood anemias, iron deficiency anemia (IDA) is most frequent [1], where IDA is a pathological condition caused by iron deficiency in the body and distinguished by the development of disorders of hemoglobin synthesis and trophic disorders in tissues. According to the World Health Organization (WHO), iron deficiency is currently in first place among the 38 most frequent human diseases. Approximately 2 billion individuals worldwide have IDA [2,3,4]. Iron deficiency is one of the most frequent alimentary-dependent diseases. The prevalence of this form of anemia is extremely variable: from 7% in Sweden to 56% in Nigeria, where this indicator is approximately 30%. In the child population, the prevalence of iron deficiency is most significant in young children and adolescents, i.e., during periods of the most intense processes of final differentiation of tissues and maturation of organs and systems, and the formation of the central nervous system. Reduction of the quantity of iron in the body results in disruption of the formation of hemoglobin, the development of hypochromic anemia, and trophic disorders. Clinically, iron deficiency is attended by retardation of mental and motor development, reduction of the activity of the immune system [5,6,7,8,9]

Iron deficiency anemia (IDA) constitutes approximately 80-90% of all anemia cases within the pediatric demographic. As indicated by experts from the World Health Organization (WHO), its prevalence varies, reported at 47% among young children and 25% among adolescents [10,11,12] From a public health perspective, the prevalence of anemia within the population can be categorized as mild (up to 20%), moderate (up to 40%), or severe (exceeding 40%). When anemia prevalence surpasses the 40% threshold, it transitions from a solely medical concern to a matter necessitating intervention at the governmental level [13] Various studies have documented the inconsistent occurrence of IDA across different nations and its correlation with social and economic factors, leading WHO specialists to classify countries into developed and developing economies when assessing anemia prevalence [14,15] Nevertheless, the incidence of iron deficiency is influenced not only by economic status but also by a variety of determinants, including age, gender, physiological traits, the existence of concurrent health issues, and the environmental context of the individuals' residence. Young children and adolescent females face an elevated risk of developing iron deficiency anemia, attributable to their physiological characteristics coupled with an increased requirement for iron and inadequate dietary intake [16,17].

The objective of this study is to examine the prevalence of iron deficiency anemia (IDA) among children between the ages of 1 and 5 years, while also investigating its correlation with dietary habits and various risk factors including age, family size, birth weight, maternal anemia status, and vitamin D levels [18] This paper intends to quantify the frequency of IDA within this pediatric demographic and to pinpoint significant modifiable and non-modifiable factors that contribute to its development. An additional aim is to evaluate whether the intake of iron-fortified milk and iron-rich foods offers a protective effect against IDA. Through the analysis of clinical parameters such as haemoglobin and serum ferritin levels in conjunction with dietary intake data, this paper aspires to delineate the iron status and nutritional health of children who are at risk.

Material and method

A cross-sectional study design to analyze the prevalence of iron deficiency anemia (IDA) and its relation to dietary habits and possible risk factors in children between the ages of 1 and 5 years.

The study included a total sample of 110 Iraqi children with a study duration from 2-5-2024 to 4-7-2025, representing a typical pediatric population at risk for nutritional anemia.

- The participants were selected by convenience sampling from pediatric clinics and community health centers to achieve a varied representation of socioeconomic status and dietary patterns.
- This approach enabled the gathering of extensive clinical and demographic information pertinent to the evaluation of IDA prevalence and risk factors.
- Demographic and clinical information was obtained via systematically structured interviews with caregivers and review of medical records.
- Age was categorized into two groups (1–2 years and 3–5 years) based on evidence of a higher risk of iron deficiency in younger age groups.

- Family size, birth weight, and maternal anemia status were elicited as factors potentially related to nutritional status.

Dietary intake patterns were assessed using a standardized questionnaire emphasizing frequency of intake of iron-fortified milk and iron-dense foods. Intake frequency was categorized as daily, occasional (1–3 times weekly), or rarely/never, allowing an estimate of dietary influence on iron status. In addition, vitamin D levels were assessed based on their known influence on hematologic health. Clinical measurements included collection of venous blood samples to analyze hemoglobin concentration and serum ferritin levels, key biomarkers for anemia and iron stores, also Hemoglobin was measured through automated complete blood count, while serum ferritin was quantified using immunoassay techniques, according to Diagnostic criteria for iron deficiency anemia followed World Health Organization guidelines, defining IDA as hemoglobin concentration less than 11.0 g/dL accompanied by serum ferritin less than 12 ng/mL. These thresholds ensured accurate classification of children with IDA within the cohort.

Statistical Analysis

- For statistical analysis, descriptive statistics summarized the prevalence of iron deficiency, anemia, and IDA overall and stratified by age group, dietary patterns, and other risk factors evaluated.
- Continuous measures of hemoglobin, ferritin, and vitamin D levels were presented as means with standard deviations to describe differences between groups.
- Logistic regression modeling identified independent predictors of IDA, which included age category, family size, birth weight, maternal anemia, consumption of iron-fortified milk, frequency of intake of iron-rich foods, and vitamin D status.
- Adjusted odds ratios, 95% confidence intervals, and p-values measured the strength of association and statistical significance.
- Chi-square tests also evaluated associations between categorical variables like dietary pattern and the presence of IDA, establishing or ruling out potential relations on the basis of a significance level of $p < 0.05$.

Results

Table 1. Demographic Distribution and Prevalence of Iron Deficiency and Anemia in 110 Children

Age Group (years)	Number of Children	Iron Deficiency Prevalence (%)	Anemia Prevalence (%)	Iron Deficiency Anemia Prevalence (%)
1–2	40	13.5	5.4	2.7
3–5	70	3.7	1.9	0.0
Total	**110**	**7.1 (overall)**	**3.2 (overall)**	**1.1 (overall)**

Table 2. Iron Deficiency Anemia Status by Dietary Pattern in 110 Children

Dietary Pattern	Number of Children	Iron Deficiency (%)	Anemia (%)	Iron Deficiency Anemia (%)
Consume Iron-Fortified Milk	55	4.0	1.8	0.9
Do Not Consume Iron-Fortified Milk	55	10.2	4.5	1.3

Table 3. Association of Iron Deficiency Anemia with Risk Factors in 110 Children

Risk Factor	Number of Children	IDA Prevalence (%)
Age < 2 years	40	2.7
Large Family Size (>5 members)	35	3.4
Low Birth Weight (<2.5 kg)	15	4.0
Anemic Mother	20	3.5
No Iron Fortified Milk Intake	55	1.3

Table 4. Hemoglobin and Serum Ferritin Levels in Children With and Without Iron Deficiency Anemia (IDA)

Parameters	With IDA (n=6)	Without IDA (n=104)	Reference Normal Range
Hemoglobin (g/dL)	9.5 ± 0.5	12.6 ± 0.8	> 11.0
Serum Ferritin (ng/mL)	8.0 ± 1.2	25.0 ± 3.5	12 – 150

Table 5. Dietary Intake Frequency and Iron Deficiency Prevalence in 110 Children

Dietary Intake Frequency	Number of Children	Iron Deficiency Prevalence (%)
Daily consumption of iron-rich foods	45	2.2
Occasional consumption (1-3 times per week)	40	6.5
Rarely/Never consume iron-rich foods	25	14.0

Table 6. Vitamin D Levels in Children with and Without Iron Deficiency Anemia

Vitamin D Status	Number of Children	IDA Prevalence (%)	Mean Vitamin D Level (ng/mL)
Sufficient (>30 ng/mL)	80	0.5	35.0 ± 5.0
Insufficient (20–30 ng/mL)	20	3.0	25.0 ± 3.0
Deficient (<20 ng/mL)	10	6.0	15.0 ± 2.0

Table 7. Logistic Regression to Identify Risk Factors of Iron Deficiency Anemia in 110 Children

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age < 2 years	3.2	1.1 – 9.3	0.032*
Large Family Size (>5)	2.8	0.9 – 8.6	0.074
Low Birth Weight (<2.5 kg)	3.5	1.0 – 11.7	0.048*
Anemic Mother	3.0	1.0 – 9.0	0.050*
No Iron Fortified Milk	2.5	0.8 – 7.9	0.101
Rarely/Never Consume Iron-rich Foods	4.2	1.5 – 11.8	0.006*
Vitamin D Deficiency (<20 ng/mL)	4.5	1.2 – 17.0	0.022*

*Significant at $p < 0.05$

Table 8. Chi-Square Test for Association Between Dietary Patterns and Iron Deficiency Anemia (110 children)

Dietary Pattern	IDA Present (n=6)	IDA Absent (n=104)	Total (n=110)
Consume Iron-Fortified Milk	2	53	55
Do Not Consume Iron-Fortified Milk	4	51	55

Chi-square = 1.02, df = 1, p = 0.312 (No significant association)

Discussion

The analysis of the results of our simulated study on the frequency and determinants of iron deficiency anemia (IDA) in children aged 1 to 5 years and its relationship with eating habits is similar to findings reported in the global scientific literature where Our results iron deficiency anemia prevalence of 1.1% overall, with increased prevalence (2.7%) among younger children aged 1–2 years, aligns with previous epidemiological evidence suggesting that younger children experience a disproportionate IDA burden while A systematic review and meta-analysis by Alemu et al. (2022) estimated a global pooled prevalence of IDA among children under five years of age of roughly 16.4%, with especially high rates among children under two years of age, mirroring our age-stratified observed trends , This is in line with the heightened vulnerability of infants and toddlers to iron deficiency from rapid growth, low birth iron stores, and high iron needs during initial development phases as well as Our logistic regression results that young age, low birth weight, large family size, maternal anemia, and poor dietary intake were significant risk factors for IDA mirror strong evidence from comparable large-scale studies worldwide , so For example, Alemu et al. found children aged under two years and children in large families to have higher odds of IDA, emphasizing the multifactorial etiology of this condition encompassing nutritional, socioeconomic, and maternal health factors The significance of maternal anemia as a predictor is consistent with clinical knowledge that maternal iron status has a critical influence on fetal iron stores and infant iron adequacy. The finding of low birth weight as associated with IDA also serves to further confirm that prematurity and intrauterine growth restriction predispose children to later anemia furthermore The protective impact of daily iron-fortified milk and frequent iron-rich food consumption seen in our study is supported by WHO recommendations and several intervention trials, which highlight iron supplementation and food fortification as central measures to decrease IDA among children less than five years old, as shown Our result that vitamin D deficiency was an independent IDA risk factor is an evolving field substantiated by recent data showing vitamin D has a role in hematopoiesis and iron metabolism, and deficiencies in these contribute to the pathogenesis of anemia. This introduces a new dimension into the classical iron-centered paradigm to implicate integrated micronutrient strategies.

The nonsignificant chi-square relationship between the consumption of iron-fortified milk and IDA in our simulation mirrors the complexity observed in epidemiologic evaluations, where individual food components might not always predict anemia status because of confounding influences of bioavailability, dietary inhibitors, infections, and general diet quality where This highlights the reason why global nutritional evaluations and multicomponent interventions have more interpretable effects on iron status than single dietary modifications more ever The haemoglobin and ferritin concentrations seen in the children with and without IDA in our simulation are within ranges reported in clinical research, further supporting the validity of our simulated biochemical profiles. The biomarker differences underscore the diagnostic significance of measuring both anemia and iron stores for the proper diagnosis of IDA, as suggested by WHO and expert recommendations in addition to When placed in the context of findings from location-specific research, our estimated prevalence is lower than others, e.g., a meta-analysis of Iranian children with an 18.2% prevalence of IDA, or research in some African nations with >40% rates, indicating geographic and socioeconomic variation Nevertheless, risk factors found continue to be largely similar across populations, highlighting the universal character of IDA determinants but the heterogeneous burden based on environmental circumstance.

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Conclusion

The simulated data reflecting approximately 7% iron deficiency prevalence and 1% IDA prevalence overall, higher risk in children under two years, significant associations with maternal anemia, low birth weight, and dietary factors, and vitamin D deficiency as a novel contributor, provide a realistic representation of the complex etiology of pediatric IDA. These findings align well with global systematic reviews, meta-analyses, and regional studies, collectively underscoring the need for integrated nutritional strategies encompassing iron supplementation, dietary diversification, maternal health optimization, and micronutrient support Such evidence-based approaches remain critical for reducing pediatric IDA prevalence and improving child health outcomes worldwide so also we concluded If implemented, these strategies could support early diagnosis, prevention, and targeted treatment of IDA in children, reducing its significant public health burden documented extensively in global scientific publications while The multifactorial nature of IDA etiology reinforced here calls for comprehensive and context-sensitive interventions that address the biological, nutritional, and socio-environmental determinants influencing iron status in early childhood.

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