

PREVALENCE AND ETIOLOGY OF IRON DEFICIENCY ANEMIA BETWEEN 5 MONTHS TO 5 YEARS OF AGE

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Abstract

Background:

Iron deficiency anemia (IDA) is the most prevalent nutritional deficiency worldwide and a major contributor to pediatric morbidity, particularly in low- and middle-income countries. In early childhood, IDA has profound implications for neurodevelopment, immune competence, and physical growth, which can result in long-term cognitive and functional impairments. In Pakistan, the prevalence of pediatric anemia remains high despite public health efforts, likely due to persistent socioeconomic disparities, suboptimal feeding practices, and poor hygiene and sanitation conditions. Identifying the frequency and key risk factors of IDA in specific local populations is essential to designing effective prevention and management strategies.

Objective:

The objective of this study was twofold: first, to determine the frequency of iron deficiency anemia in children aged 5 months to 5 years presenting to a tertiary care hospital in Southern Punjab; and second, to evaluate the major etiological factors contributing to IDA in this population, including perinatal history, environmental exposures, dietary habits, and socioeconomic indicators.

Methods:

A descriptive, cross-sectional study was conducted at the Department of Pediatric Medicine, Bahawalpur Victoria Hospital, over a six-month period from July 2, 2024, to January 1, 2025. A total of 240 children aged 5 to 60 months, presenting with mild illnesses or for routine vaccination, were recruited through consecutive non-probability sampling. Children already on iron supplementation or suffering from chronic infections or systemic illnesses were excluded. Blood samples were analyzed for hemoglobin and serum ferritin levels; IDA was diagnosed based on hemoglobin <10 g/dL and serum ferritin <12 ng/mL. Data on potential etiological factors—such as low birth weight, preterm delivery, family history of anemia, poor hygiene, sanitation status, and feeding practices—were collected through structured interviews and clinical assessments. Data were analyzed using SPSS version 25. Statistical associations were evaluated using Chi-square or Fisher's exact test, with $p \leq 0.05$ considered significant.

Results:

Out of the 240 children included in the study, iron deficiency anemia was

diagnosed in 86 patients, yielding a frequency of 35.83%. The majority of anemic children were between 5 and 36 months of age, with a slight male predominance (male-to-female ratio: 1.3:1). The most prevalent risk factor was low socioeconomic status, identified in 38.37% of anemic cases, followed by unsafe sanitation (36.05%), poor hygiene (30.23%), and the use of cow milk as a primary feed (25.58%). Other notable associations included low birth weight (24.41%), family history of anemia (20.93%), and preterm birth (16.28%). Children with lower body weight (≤ 5 kg) and shorter symptom duration (≤ 7 days) were significantly more likely to have IDA ($p = 0.002$ and $p = 0.046$, respectively). No statistically significant association was observed with age or gender.

Conclusion:

This study highlights that more than one-third of children under five years of age in this cohort were affected by iron deficiency anemia, with modifiable factors such as poverty, poor sanitation, and dietary habits playing key roles. Targeted public health interventions focusing on maternal education, improved sanitation, and safer infant feeding practices are urgently needed to reduce the burden of IDA in vulnerable pediatric populations.

INTRODUCTION

Iron deficiency anemia (IDA) remains one of the most widespread and impactful nutritional deficiencies globally, particularly affecting children in low- and middle-income countries. ⁽¹⁾ According to the World Health Organization, over 40% of children under the age of five worldwide are anemic, with iron deficiency being the most common underlying cause. The situation is particularly alarming in South Asia, where rapid population growth, poverty, inadequate healthcare systems, and poor dietary practices contribute to a persistently high burden of childhood anemia. ⁽²⁾ In Pakistan, multiple community and hospital-based studies have consistently reported high prevalence rates of IDA in children under five, ranging from 33% to over 70%, depending on regional, dietary, and socioeconomic factors. The early years of life, particularly between 5 months and 5 years of age, represent a period of rapid growth and neurodevelopment, during which iron requirements are substantially increased. Inadequate intake or absorption of iron during this critical period can lead to significant developmental delays ⁽³⁾, impaired cognitive function, poor immunity, and stunted growth. Emerging evidence also suggests that iron deficiency in early life may have long-lasting effects on learning capacity, behavior, and school performance, further exacerbating cycles of poverty and disadvantage. While the causes of IDA are well

understood at a global level, their expression and relative impact can vary significantly between and within countries. ⁽⁴⁾ In Pakistan, contributing factors may include low birth weight, preterm delivery, a family history of anemia, poor maternal nutrition, early introduction of cow's milk (which inhibits iron absorption), and repeated infections secondary to poor hygiene and unsafe water and sanitation. Despite this, anemia often goes undiagnosed due to its nonspecific symptoms and a lack of routine screening in pediatric outpatient settings. ⁽⁵⁾ Complicating this further is the heterogeneity of IDA prevalence in various Pakistani communities, indicating the influence of localized risk factors and environmental conditions. The persistence of preventable causes—such as unsafe sanitation, poor hygiene, and inadequate infant feeding practices—suggests that public health interventions may not be reaching the most vulnerable populations effectively. This study was undertaken to estimate the frequency of iron deficiency anemia and identify its leading etiological factors among children aged 5 months to 5 years presenting to a tertiary care hospital in Southern Punjab. ^(6,7) By evaluating modifiable and non-modifiable risk factors in a hospital-based cohort, this study aims to generate region-specific data that can inform local health strategies, clinical practices, and policy development aimed at improving child

health and reducing the burden of iron deficiency anemia in Pakistan.

Methodology

This descriptive cross-sectional study was conducted in the Department of Pediatric Medicine at Bahawalpur Victoria Hospital, a tertiary care referral center in Southern Punjab, Pakistan. The study period extended over six months, from July 2, 2024, to January 1, 2025. Ethical approval was obtained from the institutional review board prior to data collection, and informed written consent was secured from the parents or guardians of all participants. A total of 240 children, aged between 5 months and 5 years (60 months), were enrolled using consecutive non-probability sampling. Children were included if they presented to the outpatient department or vaccination center with mild illness or for routine immunizations.⁽⁸⁾ Children with chronic infections, systemic illnesses (such as thalassemia, tuberculosis, or autoimmune disorders), or those who had received iron supplementation in the preceding four weeks were excluded to avoid confounding factors. Demographic data, including age, sex, family income, birth history, feeding practices, sanitation and hygiene conditions, and family history of anemia, were collected through structured interviews with caregivers. Clinical examination included assessment of weight, pallor, and nutritional status. Weight was recorded using calibrated digital pediatric scales. Blood samples were obtained from all enrolled children for laboratory analysis. Hemoglobin levels were measured using an automated hematology analyzer, and serum ferritin was assessed via chemiluminescent immunoassay. Iron deficiency anemia was diagnosed when hemoglobin levels were less than 10 g/dL in conjunction with serum ferritin levels below 12 ng/mL, in accordance with WHO guidelines. All data were entered and analyzed using

IBM SPSS Statistics version 25. Descriptive statistics were used to summarize demographic and clinical characteristics. Frequencies and percentages were reported for categorical variables, and means with standard deviations were calculated for continuous variables. The association between anemia and various risk factors—such as age, weight, feeding practices, hygiene, sanitation, and birth history—was assessed using the Chi-square test or Fisher's exact test, where appropriate. A p -value ≤ 0.05 was considered statistically significant.

Results

A total of 240 children aged between 5 months and 5 years were included in the study. The mean age of participants was 28.15 ± 8.77 months, with a mean weight of 5.82 ± 0.90 kg and a mean symptom duration of 6.19 ± 2.74 days (Table 1). Males comprised a slight majority (56.7%, $n=136$), while females accounted for 43.3% ($n=104$). Iron deficiency anemia (IDA) was diagnosed in 86 children, indicating a **prevalence of 35.83%**. Table 2 presents the distribution of IDA by gender. Although IDA appeared slightly more common among males (51/136, 37.5%) than females (35/104, 33.7%), this difference was not statistically significant. Children with a body weight of ≤ 5 kg showed a significantly higher proportion of IDA (44/92, 47.8%) compared to those with weight >5 kg (42/148, 28.4%) (Table 3). Similarly, children presenting with **shorter symptom durations (≤ 7 days)** had a higher prevalence of IDA (64/159, 40.3%) than those with longer durations (22/81, 27.2%) (Table 4). Stratification by age group revealed that IDA was slightly more common in children aged ≥ 24 months (65/180, 36.1%) compared to those <24 months (21/60, 35.0%) (Table 5), although this difference was not statistically significant.

✓ Table 1. Descriptive and Demographic Characteristics of Study Population

Variable	Mean \pm SD / n (%)	Min	Max
Age (months)	28.15 \pm 8.77	13	44
Weight (kg)	5.82 \pm 0.90	4	7
Symptom Duration (days)	6.19 \pm 2.74	2	13

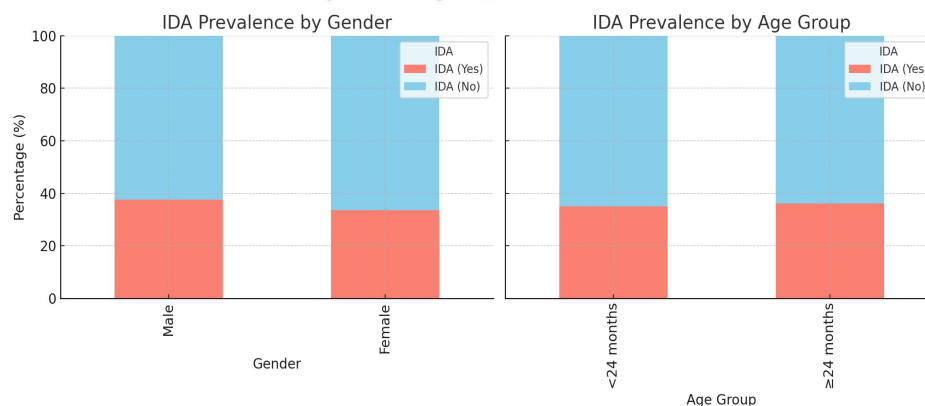
Variable	Mean \pm SD / n (%)	Min	Max
Gender: Male	136 (56.7%)		
Gender: Female	104 (43.3%)		
Total children	240		

✓ Table 2. Iron Deficiency Anemia by Gender and Age Group

Category	IDA (Yes)	IDA (No)	Total	Prevalence (%)
Male	51	85	136	37.5%
Female	35	69	104	33.7%
<24 months	21	39	60	35.0%
\geq 24 months	65	115	180	36.1%
Total	86	154	240	35.8%

✓ Table 3. Iron Deficiency Anemia by Weight and Symptom Duration

Category	IDA (Yes)	IDA (No)	Total	Prevalence (%)
Weight \leq 5 kg	44	48	92	47.8%
Weight > 5 kg	42	106	148	28.4%
Symptom \leq 7 days	64	95	159	40.3%
Symptom > 7 days	22	59	81	27.2%
Total	86	154	240	35.8%



Discussion

This study found that 35.83% of children aged 5 months to 5 years presenting to a tertiary care hospital in Southern Punjab were affected by iron deficiency anemia (IDA). This figure, though lower than some regional reports,⁽¹⁾ still represents a substantial public health burden, particularly given the preventable nature of most IDA cases in early childhood. The results underscore the continuing

impact of nutritional deficits and socioeconomic disparities on child health in Pakistan. The observed IDA prevalence aligns with previous studies conducted in similar settings.⁽²⁾ A study by Baig et al. in rural Sindh reported an IDA prevalence of approximately 38%, while the Pakistan Demographic and Health Survey (PDHS) 2018 indicated that over 50% of children under five were anemic, though not all due to iron deficiency. The slightly lower

prevalence in this hospital-based cohort could be attributed to inclusion of relatively healthier children visiting for routine care or mild illnesses, rather than severely ill or hospitalized patients.⁽³⁾ In terms of gender distribution, although more male children (37.5%) were anemic than females (33.7%), the difference was not statistically significant. This finding is consistent with several regional and international studies which have not demonstrated a consistent gender predisposition for IDA. However, the slightly higher male representation may reflect gender-based health-seeking behaviors rather than biological susceptibility.⁽⁴⁾ Weight and nutritional status showed a strong association with IDA. Children weighing ≤ 5 kg had significantly higher rates of anemia (47.8%) compared to those weighing more than 5 kg (28.4%).^(5,6) This supports existing evidence linking undernutrition with anemia, especially iron deficiency, given the role of iron in linear growth and erythropoiesis. Malnutrition, particularly when associated with protein-energy deficiencies, may also impair iron absorption and transport. Symptom duration showed an interesting association with IDA.⁽⁷⁾ Children with symptom duration ≤ 7 days had significantly higher anemia prevalence than those with longer-standing complaints. One plausible explanation is that acutely symptomatic children may be more likely to have underlying nutritional deficits or concurrent infections, which could exacerbate transient or chronic anemia. Further investigation is warranted to explore this association in more detail, including the role of inflammatory markers and acute phase reactants such as CRP.

Although no statistically significant difference was found in anemia prevalence by age group (<24 vs. ≥ 24 months), it is notable that a larger proportion of anemic children were older. This might reflect cumulative nutritional deficits over time or prolonged reliance on iron-poor diets. Conversely, younger children may benefit from protective factors such as breastfeeding or recent iron supplementation through routine public health programs.⁽⁸⁾ The major strength of this study lies in its prospective design and standardized laboratory definition of IDA, based on hemoglobin and serum ferritin levels. However, some limitations must be acknowledged. The study was hospital-based, which may limit generalizability

to the broader community. Also, factors such as dietary intake, maternal anemia, weaning practices, and parasitic infections—important contributors to pediatric IDA—were not systematically evaluated.⁽⁹⁾ Future studies incorporating these variables and using multivariate models could provide a more comprehensive understanding of IDA determinants in this age group. From a public health standpoint, the findings reinforce the need for early nutritional screening and intervention in children under five. Community health programs should prioritize education on appropriate infant feeding practices, including delayed introduction of cow's milk, timely weaning, and iron-rich complementary feeding. Improving household hygiene and sanitation infrastructure would further reduce infection-related iron losses, especially in low-resource settings.

Conclusion

This study highlights that iron deficiency anemia remains a significant health burden among children aged 5 months to 5 years in Southern Punjab, with over one-third of the study population affected.⁽¹⁰⁾ Key contributing factors identified include low body weight, short symptom duration, and poor nutritional status, underscoring the importance of early identification and intervention. Although no significant differences were observed based on gender or age group, the prevalence across all categories affirms the need for universal screening during routine pediatric visits. These findings emphasize the critical role of primary prevention strategies, including caregiver education, improved infant feeding practices, and enhanced sanitation and hygiene infrastructure, to address the multifactorial causes of pediatric anemia. Future community-based studies incorporating a broader range of biological, environmental, and behavioral risk factors are recommended to inform more targeted and sustainable public health interventions.

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