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Original Research Article

Study of risk factors associated with anaemia in children admitted to a subdistrict hospital

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ABSTRACT

Background: Anaemia remains a significant public health problem among children, particularly in developing countries, leading to impaired growth, cognitive delay, and increased morbidity. Identifying the underlying risk factors is essential for effective prevention and management. Objectives were to study the prevalence and risk factors associated with Anaemia among children admitted to a subdistrict hospital.
Methods: A cross-sectional observational study was conducted among 100 children admitted to the paediatric ward of a subdistrict hospital from April to September 2025. Detailed demographic data, dietary history, socioeconomic status (SES), clinical findings, and relevant laboratory investigations were recorded. Haemoglobin estimation was performed, and anaemia was classified as per WHO criteria. The association between potential risk factors and anaemia was analysed using appropriate statistical tests.
Results: Overall, 65% of children were anaemic, with moderate anaemia observed in 55% and severe anaemia in 10%. Anaemia was significantly more prevalent among children with low birth weight (<2.5 kg) (81.0% vs 42.9%; OR=5.70; p<0.001). Children of mothers with low educational status had higher odds of anaemia (84.7% vs 36.6%; OR=9.63; p<0.001). Lower SES was also significantly associated with anaemia (81.1% vs 46.8%; OR=4.89; p<0.001). The prevalence and severity of anaemia increased with worsening nutritional status. Exclusive breastfeeding showed no statistically significant association with anaemia (p=0.23).
Conclusions: Anaemia is highly prevalent among hospitalized under-five children and is strongly associated with low birth weight, poor maternal education, low SES, and malnutrition. Early screening and targeted nutritional and maternal interventions are essential to reduce the burden of childhood anaemia.

Keywords: Anaemia, Children, Risk factors, Nutritional deficiency, Subdistrict hospital

INTRODUCTION

Anaemia remains one of the most prevalent nutritional disorders affecting children worldwide and continues to pose a major public health challenge, particularly in low- and middle-income countries.[1-4] Globally, a substantial proportion of children under five years of age are affected, with the highest burden concentrated in South Asia and Sub-Saharan Africa.[2-4] Despite the implementation of large-scale nutrition and supplementation programs, childhood anaemia remains highly prevalent in India, reflecting persistent challenges related to maternal nutrition, infant feeding practices, and socioeconomic inequities.[3-5]

The aetiology of childhood anaemia is multifactorial. Iron deficiency is the predominant cause; however, other contributing factors include low birth weight, poor dietary intake, recurrent infections, and deficiencies of essential micronutrients.[4,5] Anaemia during early childhood has been consistently associated with adverse health outcomes, including impaired physical growth, weakened immunity, and delayed cognitive and neurodevelopmental performance.[6,7] These effects may

persist into later childhood and adulthood, underscoring the importance of early identification and prevention.

Children born with low birth weight are particularly vulnerable due to reduced iron stores at birth and increased iron requirements during early infancy and periods of rapid growth.[8-10] Premature babies with no iron supplementation in infancy also have higher chances of developing anaemia in early childhood.

Hospitalized children represent a particularly high-risk group for anaemia due to underlying illnesses, increased metabolic demands, and compromised nutritional status.[13] However, evidence examining the prevalence and determinants of anaemia among hospitalized children in subdistrict hospital settings remains limited.

The present study was therefore undertaken to assess the prevalence of anaemia and to identify associated risk factors among children aged 6 months to 5 years admitted to a subdistrict hospital.

METHODS

Study design and setting

This observational cross-sectional study was conducted in the department of paediatrics at Rukshamaniben general hospital, Khokhara, a subdistrict hospital catering to urban and semi-urban populations. The study was carried out over a period of six months, from April to September 2025.

Study population

The study population consisted of children aged 6 months to 5 years admitted to the paediatric ward of a subdistrict hospital during the study period. All eligible children fulfilling the inclusion criteria were enrolled after obtaining written informed consent from their parents or legal guardians. The study population included children from varied demographic and socioeconomic backgrounds, providing a representative hospital-based sample for assessing the prevalence of anaemia and its associated risk factors.

Inclusion and exclusion criteria

Children aged 6 months to 5 years admitted to the hospital during the study period were considered eligible for inclusion in the study. Participation was entirely voluntary, and written informed consent was obtained from the parents or legal guardians of all eligible children prior to enrolment.

Children were excluded from the study if they had any previously diagnosed haematological disorders, including thalassemia or sickle cell disease, as these conditions could independently influence haemoglobin levels. Those who had received a blood transfusion within the preceding three months were also excluded to avoid confounding of haematological parameters. Children whose parents or legal guardians declined to provide consent were also excluded from participation.

All information collected during the study was treated with strict confidentiality in accordance with the Indian council of medical research (ICMR) ethical guidelines. Participant identity was anonymized using unique identification codes, and the data were used solely for research purposes.

Access to study data was restricted to the investigators, and no personal identifying information was disclosed at any stage of the study.

Data collection

After obtaining informed consent from parents or guardians, detailed information was collected using a pre-structured questionnaire. The data included demographic details, dietary history, socioeconomic background, birth history, and clinical symptoms. A thorough clinical examination was conducted to assess nutritional status and signs suggestive of anaemia.

Laboratory investigations

Blood samples were collected under aseptic precautions for haemoglobin estimation and peripheral smear examination. Anaemia was classified based on world health organization (WHO) criteria according to age-specific haemoglobin cut-off values.

Statistical analysis

Collected data were tabulated and analysed using appropriate statistical methods. Descriptive statistics were used to summarize baseline characteristics, while inferential statistics were applied to determine associations between various risk factors and anaemia. A $p<0.05$ was considered statistically significant.

RESULTS

Demographic characteristics

Among the total 100 children assessed, 10% were severely anemic, 55% were moderately anemic, and 35% had Hb levels more than 9 gm/dl.

Thus, 35% of the children were in the normal-mild anaemia range, while 65% showed moderate to severe degree of anemia by hemoglobin level.

For statistical analysis purpose children with haemoglobin levels more than 9 gm/dl (mild anaemia) have been categorised in single group with children having no anaemia.

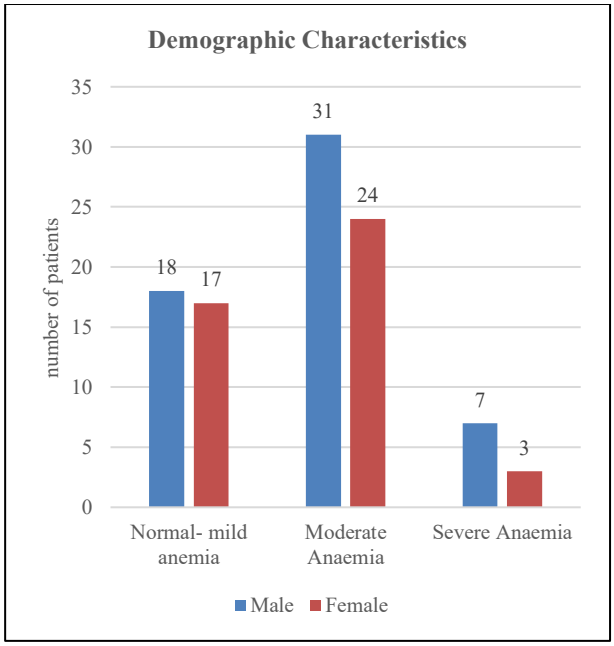

Figure 1: Demographic characteristics.

Association between low birth weight and anemia

Table 1 shows total of 100 children were included in the study, of whom 65 were anaemic and 35 had normal haemoglobin levels. Among children with low birth weight (LBW<2.5 kg), 47 (81.0%) were anaemic, while 11 (19.0%) had normal haemoglobin levels. In contrast, among children with a birth weight >2.5 kg, 18 (42.9%) were anaemic and 24 (57.1%) had normal haemoglobin levels.

Statistical analysis demonstrated a significant association between low birth weight and anaemia. The chi-square value was χ^2=15.60 with 1 degree of freedom, and the association was highly statistically significant (p=0.000078). The odds of anaemia among children with low birth weight were approximately 5.7 times higher compared to children with birth weight greater than 2.5 kg (OR=5.70), indicating a strong positive association between low birth weight and childhood anaemia.

Table 1: Association between low birth weight and anemia.

Variables	Anaemia	Normal	Total
LBW (<2.5 kg) at birth	47	11	58
>2.5 kg at birth	18	24	42
Total	65	35	100

*χ2=15.60, df=1, p=0.000078

Association between exclusive breastfeeding and anemia

Table 2 shows that out of 51 the children who were EBF, 36 (70.6%) were anaemic and 15 (29.4%) had normal haemoglobin levels. Among 49 top-fed children, 29 (59.2%) were anaemic, while 20 (40.8%) had normal haemoglobin levels.

Statistical analysis showed no significant association between feeding practice and anaemia. The chi-square value was χ^2=1.42 with 1 degree of freedom, and the result was not statistically significant (p=0.2319).

The odds of anaemia among EBF children were 1.65 times higher compared to top-fed children (OR=1.66). However, this difference did not reach statistical significance, indicating that exclusive breastfeeding was not significantly associated with anaemia in the present study population.

Table 2: Association between exclusive breastfeeding and anemia.

Variables	Anaemia	Normal	Total
EBF	36	15	51
Top fed	29	20	49
Total	65	35	100

*χ2=1.42, df=1, p=0.2319

Association between low maternal education and anemia

Table 3 shows that out of 59 children whose mothers were uneducated or had basic school-level education, 50 (84.7%) were anaemic and 9 (15.3%) had normal haemoglobin levels. In contrast, among children whose mothers had high school or graduate-level education, only 15 (36.6%) were anaemic, while 26 (63.4%) had normal haemoglobin levels.

Statistical analysis demonstrated a strong and statistically significant association between maternal education status and childhood anaemia. The chi-square value was 24.66 and the association was highly significant (p=0.00001).

The odds of anaemia among children of mothers with uneducated or basic schooling were approximately 9.6 times higher compared to children of mothers with high school or graduate education (OR=9.63), indicating a strong influence of maternal educational status on the occurrence of anaemia in children.

Table 3: Association between low maternal education and anemia.

Maternal education status	Anaemia	Normal	Total
Uneducated/ basic school	50	9	59
High school/ graduate	15	26	41
Total	65	35	100

*χ2=24.66, df=1, p=0.00001

Association between SES of family and anemia

Families were classified based on modified Kuppuswamy scale. Based on total score families were classified as upper class, upper middle class, lower middle class, upper lower class and lower class.

Table 4 shows out of 53 children belonging to upper lower and lower SES, 43 (81.1%) were anaemic and 10 (18.9%) had normal haemoglobin levels. In contrast, among children from upper middle and lower middle SES, 22 (46.8%) were anaemic, while 25 (53.2%) had normal haemoglobin levels.

Statistical analysis revealed a statistically significant association between SES and anaemia. The chi-square value was χ^2=12.89 with 1 degree of freedom, and the association was highly significant (p=0.000329). The odds of anaemia among children belonging to upper lower and lower socioeconomic strata were approximately 4.9 times higher compared to those from upper middle and lower middle socioeconomic groups (OR=4.89), indicating a strong relationship between lower SES and the prevalence of childhood anaemia.

Table 4: Association between SES of family and anemia.

SES	Anaemia	Normal	Total
Upper lower and lower SES	43	10	53
Upper middle and lower middle SES	22	25	47
Total	65	35	100

*χ2=12.89, df=1, p=0.000329

Association of malnutrition with anemia

Haemoglobin (Hb) level was considered a categorical variable and classified into four categories based on concentration: severe anaemia (<7 g/dl), moderate anaemia (7-9 g/dl), mild anaemia (9-11 g/dl), and normal haemoglobin (≥11 g/dl).

Mid-upper arm circumference (MUAC) was treated as a categorical variable to assess nutritional status and was classified into three categories: severe acute malnutrition (SAM), moderate acute malnutrition (MAM), and normal nutritional status, as per standard WHO criteria.

The total study sample consisted of 100 participants (n=100).

Table 5 demonstrates the distribution of haemoglobin levels across different categories of nutritional status. Among children with normal nutritional status, 14 (22.2%) had normal haemoglobin levels (>11 g/dl), while the majority exhibited anaemia, including 11 (17.5%) with mild anaemia (Hb 10-10.9 g/dl), 35 (55.6%) with moderate anaemia (Hb 7-9.9 g/dl), and 3 (4.7%) with severe anaemia (Hb<7 g/dl).

In children with MAM, only 2 (9.1%) had normal haemoglobin levels. Mild anaemia was observed in 3 (13.6%), moderate anaemia in 12 (54.5%), and severe anaemia in 5 (22.7%) children, indicating a higher proportion of severe anaemia compared to children with normal nutritional status.

Among children with SAM, 2 (13.3%) had normal haemoglobin levels, while 3 (20.0%) had mild anaemia, 8 (53.3%) had moderate anaemia, and 2 (13.3%) had severe anaemia.

Overall, moderate anaemia was the most prevalent category, affecting 55% of the study population, followed by severe anaemia in 10%. The proportion and severity of anaemia increased with worsening nutritional status, with both MAM and SAM groups showing a higher burden of moderate and severe anaemia compared to children with normal nutritional status. This trend highlights a strong association between malnutrition and reduced haemoglobin levels.

Table 5: Association of malnutrition with anaemia.

Nutritional status	Hb>11 g/dl	Hb 10-10.9 g/dl	Hb 7-9.9 g/dl	Hb<7 g/dl	Total
Normal	14	11	35	3	63
Mam	2	3	12	5	22
Sam	2	3	8	2	15
Total	18	17	55	10	100

DISCUSSION

The present study demonstrates a high prevalence of anaemia (65%) among hospitalized children aged 6 months to 5 years, with moderate anaemia constituting the largest proportion. Similar prevalence rates have been reported in hospital-based studies from India and other resource-limited settings, suggesting that hospitalization often reflects an underlying vulnerability to nutritional deficiencies and illness.[3,5,13]

Low birth weight emerged as a significant risk factor for childhood anaemia in the present study. Children born weighing less than 2.5 kg had substantially higher odds of anaemia compared to those with normal birth weight. This finding is consistent with previous evidence indicating that impaired intrauterine nutrition leads to reduced foetal iron accretion and early depletion of iron stores during infancy.[8-10]

Although a higher proportion of anaemia was observed among exclusively breastfed children, the association was not statistically significant. Previous studies have shown that while exclusive breastfeeding is optimal during early

infancy, breast milk alone may not meet iron requirements beyond six months of age unless complemented with timely introduction of iron-rich complementary foods.[11,12] This highlights the importance of appropriate complementary feeding practices rather than discouraging exclusive breastfeeding.

Maternal education demonstrated a strong association with childhood anaemia in the present study. Children of mothers with lower educational attainment were significantly more likely to be anaemic. Maternal education influences child health through its impact on dietary diversity, healthcare utilization, hygiene practices, and health-seeking behaviour.[14,15] These findings reinforce the importance of female education as a long-term strategy for improving child nutritional outcomes.

SES was another important determinant of childhood anaemia, with significantly higher prevalence observed among children from lower socioeconomic strata. Poverty-related factors such as food insecurity, poor dietary quality, inadequate sanitation, and limited access to healthcare services contribute substantially to nutritional deficiencies and recurrent infections.[16,17]

A clear association between malnutrition and anaemia severity was observed in this study. Children with moderate and SAM exhibited a higher prevalence of moderate and severe anaemia. Malnutrition impairs erythropoiesis through deficiencies of iron, protein, and essential micronutrients and is further exacerbated by infection-related inflammation.[18,19] This bidirectional relationship highlights the need for integrated nutritional rehabilitation strategies.

Moderate anaemia was the most common category identified in this study. Although often overlooked, moderate anaemia can adversely affect immune function, physical endurance, and neurodevelopment.[6,7,20] Hospitalization therefore provides a critical opportunity for early detection and timely intervention to prevent long-term adverse outcomes.

Overall, the findings of the present study indicate that childhood anaemia among hospitalized children is influenced by a complex interplay of perinatal factors, maternal characteristics, nutritional status, and socioeconomic conditions. Comprehensive strategies encompassing maternal education, antenatal care, nutritional supplementation, and socioeconomic support are essential to effectively reduce the burden of childhood anaemia.

CONCLUSION

Childhood anaemia remains highly prevalent (65%) among hospitalized children aged 6 months to 5 years, with moderate anaemia being the most common form. Low birth weight, poor maternal education, low SES, and malnutrition emerged as significant risk factors, highlighting the multifactorial nature of anaemia in early childhood. These findings emphasize the need for early screening, targeted nutritional interventions, and maternal education programs, alongside strengthening ongoing initiatives such as the national iron plus initiative. Addressing these risk factors through integrated hospital- and community-based strategies can help reduce the burden of anaemia, improve growth and cognitive outcomes, and break the intergenerational cycle of malnutrition.

The study was hospital-based, limiting generalizability to the community. Its cross-sectional design prevents establishing causality. Detailed dietary assessments and advanced laboratory tests (e.g., serum ferritin) were not performed, and some information relied on caregiver recall, which may introduce bias.

Recommendations

Based on the study findings, it is recommended that early screening and timely intervention be implemented for high-risk children, particularly those with low birth weight, malnutrition, or from lower socioeconomic backgrounds. Maternal education and nutrition programs should be strengthened to improve awareness about complementary feeding, iron-rich diets, and anaemia prevention. Existing national initiatives, such as the National Iron Plus Initiative, should be effectively implemented, with emphasis on hospital-based nutrition counselling and supplementation. Additionally, community-based strategies targeting vulnerable populations are essential to enhance access to nutritious foods, preventive healthcare, and regular monitoring, thereby reducing the burden of childhood anaemia and improving growth and developmental outcomes.

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