International Journal of Contemporary Pediatrics
Iram A et al. Int J Contemp Pediatr. 2026 Sep;13(9):1704-1709
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20262959

Original Research Article

Association between iron deficiency anaemia and febrile seizures in children aged 1–5 years: a case-control study

Asfiya Iram*, Naushad Malagi, Shahana Khanum, Hiba Saher

Department of Pediatrics, Al Ameen Medical College Hospital, Vijayapura, Karnataka, India

Received: 21 June 2026
Accepted: 04 August 2026

***Correspondence:**
Dr. Asfiya Iram,
E-mail: asfion26@gmail.com

ABSTRACT

Background: Febrile seizures (FS) constitute the most prevalent seizure disorder in early childhood. Iron deficiency anaemia (IDA) has been hypothesised as a modifiable neurobiological risk factor for FS, potentially mediated through altered dopaminergic and GABAergic neurotransmission. This study assesses the association between iron deficiency anaemia and febrile seizures in children aged 1–5 years.
Methods: A prospective case-control study enrolled 50 children (25 cases with febrile seizures; 25 controls with febrile illness without seizures) aged 1–5 years at Al Ameen Medical College Hospital, Vijayapura. Haematological parameters including haemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and red cell distribution width (RDW) were assessed. IDA was defined as Hb <11 g/dl with supportive red cell indices.
Results: Mean Hb was significantly lower in cases (9.2±1.4 g/dl) than in controls (10.6±1.2 g/dl) (p <0.01). IDA (Hb <11 g/dl) was present in 68% of cases versus 40% of controls. Moderate anaemia was more frequent among cases (56%) than controls (20%). MCV <70 fl was detected in 44% of cases and 32% of controls. MCH <27 pg was present in 20% of cases compared to 8% of controls. The overall association between IDA and febrile seizures was statistically significant (p<0.05).
Conclusion: Iron deficiency anaemia is significantly more prevalent among children with febrile seizures compared to febrile controls. Routine haematological screening for IDA in febrile young children may facilitate early identification and intervention to potentially reduce seizure recurrence risk.

Keywords: Febrile seizures, Iron deficiency anaemia, Haemoglobin, Children, Case-control study, Microcytic anaemia

INTRODUCTION

Febrile seizures are the most common seizure disorder of childhood, affecting approximately 2–5% of children between the ages of six months and five years in the general population.[1,2]

They are defined as seizures occurring in the context of fever (body temperature ≥38°C) lasting for a maximum of 15 minutes, and not recurrent within a 24 hours period, in the absence of intracranial infection, metabolic disturbance, or a prior history of afebrile seizures. Although the prognosis is generally favourable, the acute episode causes significant parental anxiety and healthcare resource utilisation, and a subset of affected children are at risk of recurrence or subsequent epilepsy development.

The aetiology of febrile seizures is multifactorial, encompassing genetic predisposition, viral infections, and environmental factors. Among these, nutritional deficiencies particularly iron deficiency have attracted increasing investigative interest as a potentially

modifiable risk factor.[3,4] Iron is an essential cofactor for numerous enzymatic processes in the developing brain, including synthesis of myelin, mitochondrial oxidative metabolism, and production of monoamine neurotransmitters such as dopamine, serotonin, and gamma-aminobutyric acid (GABA).[5]

Deficiency of iron during critical periods of brain development may therefore predispose the immature neural circuitry to hyperexcitability, lowering the seizure threshold during febrile states.

Iron deficiency anaemia remains the most prevalent micronutrient deficiency globally, with the highest burden in children under five years of age in low- and middle-income countries.[6]

In India, the National Family Health Survey (NFHS-5) reported that approximately 67% of children aged 6–59 months are anaemic, underscoring the public health significance of this condition. Given the temporal overlap between peak IDA prevalence and peak febrile seizure incidence, the potential causal relationship between these two entities warrants systematic investigation.

Several case-control studies and meta-analyses have reported a significant association between IDA and febrile seizures, though findings have not been entirely uniform, with variations attributable to differences in study design, diagnostic thresholds, and population demographics.[1-4]

The present study was therefore conducted to investigate the association between IDA and febrile seizures in children aged 1–5 years attending a tertiary care centre in North Karnataka, thereby contributing to the regional evidence base and informing local clinical practice.

METHODS

Study design and setting

A prospective case-control study was conducted in the Department of Paediatrics, Al Ameen Medical College Hospital, Vijayapura, Karnataka, India, a tertiary-level teaching institution serving a predominantly rural catchment area. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from parents or legal guardians of all participating children prior to enrolment.

Study population and sample size

A total of 50 children aged 1–5 years were enrolled: 25 cases (children presenting with febrile seizures) and 25 controls (children with febrile illness without seizures).

The sample size was determined based on feasibility within the study period and is consistent with sample sizes reported in comparable case-control investigations from similar clinical settings.[7,8]

Inclusion and exclusion criteria

Cases were defined as children aged 1–5 years admitted with a witnessed febrile seizure, confirmed by a paediatric clinician. Controls were age- and sex-matched children of the same age group presenting with acute febrile illness without any seizure episode. Both groups were recruited from the paediatric inpatient and emergency departments during the study period.

Children with any of the following were excluded: known epilepsy or prior afebrile seizures; central nervous system infection (confirmed by cerebrospinal fluid analysis where indicated); electrolyte disturbances (hyponatraemia, hypocalcaemia, hypoglycaemia); structural brain abnormality on neuroimaging; haematological disorders other than nutritional anaemia (e.g., sickle cell disease, thalassaemia major); chronic systemic illness; recent (within four weeks) blood transfusion; or use of iron supplementation within the preceding three months.

Data collection and laboratory assessment

A structured proforma was used to record demographic information (age, sex, weight-for-age), clinical features (temperature at presentation, seizure type and duration), dietary history, and socioeconomic status.

Venous blood samples were collected under aseptic conditions within 24 hours of admission and prior to any therapeutic intervention. CBC was performed using an automated haematology analyser, yielding Hb, MCV, MCH, and red cell distribution width RDW.

Diagnostic criteria for iron deficiency anaemia

IDA was diagnosed in accordance with World Health Organization (WHO) criteria: haemoglobin concentration <11 g/dl in children aged 1–5 years, in conjunction with at least two of the following supportive red cell indices: MCV <70 fl, MCH <27 pg, and RDW >15%, indicating a microcytic, hypochromic pattern consistent with iron deficiency.[9,10]

Statistical analysis

Data were entered and analysed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation (SD) and compared between groups using the independent samples Student's t-test.

Categorical variables were expressed as frequencies and percentages and compared using the Chi-square (χ^2) test. A two-tailed p value of <0.05 was considered statistically significant.

RESULTS

Baseline characteristics

A total of 50 children were enrolled, comprising 25 cases and 25 controls. The age and sex distribution were comparable between the two groups, with no statistically significant difference in baseline demographic parameters.

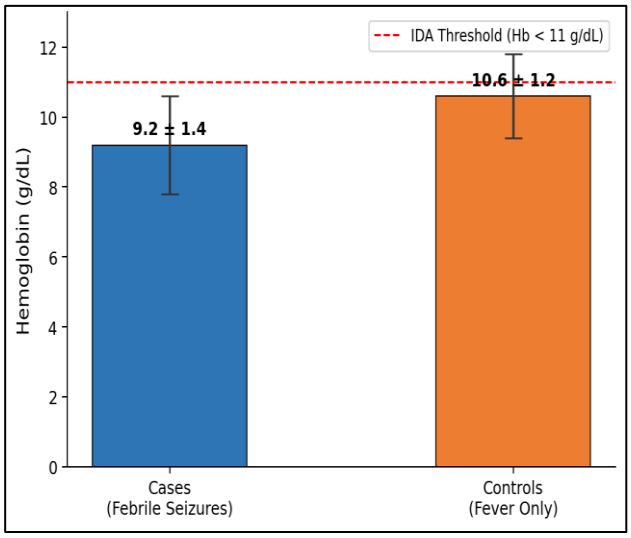

Figure 1: Mean haemoglobin levels (g/dl) in cases vs controls (mean±SD; p<0.01). The dashed red line indicates the IDA diagnostic threshold of 11 g/dl.

Table 1 summarizes the baseline characteristics and haematological findings for both groups.

Haemoglobin levels

Mean haemoglobin was significantly lower in cases (9.2±1.4 g/dl) compared to controls (10.6±1.2 g/dl) (p<0.01). The proportion of children with Hb <11 g/dl was substantially higher among cases (68%; 17/25) compared to controls (40%; 10/25) (p<0.05).

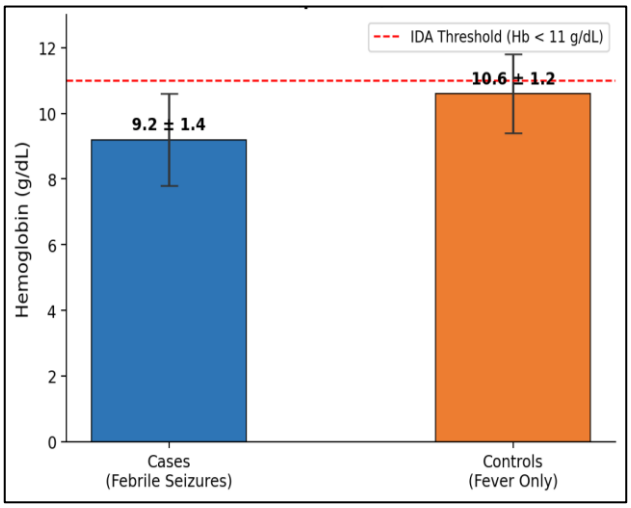

Figure 2: Proportion of children with haemoglobin <11 g/dl in cases vs controls (p<0.05).

Table 1: Comparison of haematological parameters between cases and controls.

Parameters	Cases (n=25)	Controls (n=25)	P value
Hb (mean±SD, g/dl)	9.2±1.4	10.6±1.2	<0.01*
Hb <11 g/d (%)	68 (17/25)	40 (10/25)	<0.05*
Moderate anaemia (%)	56 (14/25)	20 (5/25)	<0.05*
MCV <70 fl (%)	44 (11/25)	32 (8/25)	0.34 (NS)
MCH <27 pg (%)	20 (5/25)	8 (2/25)	0.21 (NS)
RDW >15% (%)	16 (4/25)	16 (4/25)	1.00 (NS)
IDA (composite, overall)	—	—	<0.05*

*Statistically significant (p<0.05), NS=not significant.

Table 2: Distribution of anaemia severity in cases and controls.

Anaemia category (Hb, g/dl)	Cases N (%)	Controls N (%)
No anaemia (≥11.0)	8 (32)	15 (60)
Mild (10.0–10.9)	3 (12)	5 (20)
Moderate (7.0–9.9)	14 (56)	5 (20)
Severe (<7.0)	0 (0)	0 (0)
Total	25 (100)	25 (100)

Severity of anaemia and red cell indices

Moderate anaemia was more frequent in the case group (56%; 14/25) than in the control group (20%; 5/25) (p<0.05). MCV <70 fl was identified in 44% of cases and 32% of controls; MCH <27 pg was observed in 20% of cases compared to 8% of controls. RDW >15% was equally distributed in both groups (16% each). While the individual differences in MCV, MCH, and RDW did not reach statistical significance, the composite diagnosis of

IDA (Hb <11 g/dl with supportive microcytic-hypochromic indices) was significantly associated with febrile seizures ($p<0.05$).

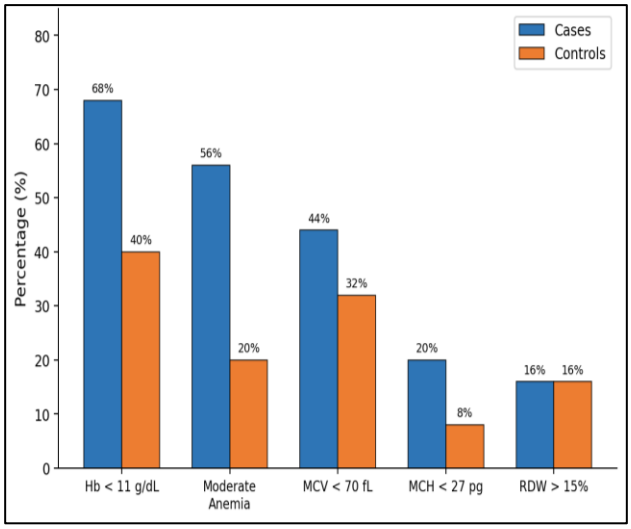

Figure 3: Grouped comparison of haematological indices (%) between cases and controls. Cases demonstrate consistently higher proportions across Hb, moderate anaemia, MCV, and MCH thresholds.

DISCUSSION

The present study demonstrated a statistically significant association between iron deficiency anaemia and febrile seizures in children aged 1–5 years. Mean haemoglobin was significantly lower in febrile seizure cases than in febrile controls (9.2±1.4 g/dl vs 10.6±1.2 g/dl; $p<0.01$), and the prevalence of IDA was nearly twice as high among cases (68%) compared to controls (40%). These findings are consistent with the broader body of published evidence.

A systematic review and meta-analysis by Sulviani et al confirmed that poor iron indices are significantly associated with susceptibility to febrile seizures in children, with pooled analyses across multiple case-control studies demonstrating substantially lower haemoglobin levels in seizure-affected children.[1] Similarly, Bakkannavar et al conducted a comprehensive systematic review across the 5–60-month age group and reported a consistent pattern of IDA predominance in febrile seizure populations.[2] Kwak et al in a meta-analysis of 14 studies found a significant association between IDA and the occurrence of febrile seizures, reporting an odds ratio of 2.31, suggesting that iron-deficient children face more than twice the risk of febrile seizures compared to iron-replete peers.[3]

Earlier meta-analytic work by Gan et al and Alipour et al. also demonstrated comparable findings: IDA was significantly more prevalent among febrile seizure cases than controls, with the association remaining robust after adjustment for confounders in several of the constituent studies.[4,5]

The biological plausibility of this association is well-established. Iron is critical for the function of iron-dependent enzymes involved in neurotransmitter synthesis, including tyrosine hydroxylase (dopamine and norepinephrine) and tryptophan hydroxylase (serotonin). Dopaminergic dysregulation in iron-deficient states may reduce the seizure threshold, particularly during fever-induced metabolic stress.[10]

At the individual study level, Hena et al reported a significantly higher prevalence of IDA in children with a first episode of febrile seizure in a Pakistani cohort, consistent with the findings.[6] Chaudhary et al similarly demonstrated a higher rate of IDA in febrile seizure cases compared to controls in a Nepalese tertiary hospital setting, with mean haemoglobin values comparable to those reported in the present study.[7] Sharifi et al reported analogous findings in an Iranian case-control study across a similar age range (6 months to 5 years), further corroborating the universality of this association across diverse geographic and ethnic contexts.[8]

Daoud et al published one of the earlier case-control studies establishing iron status as a possible risk factor for first febrile seizure, noting significantly lower serum ferritin and haemoglobin in the seizure group.[10] The present study, while limited to CBC-based haematological indices owing to resource constraints, corroborates these findings in a comparable clinical framework. Saleem and Siddique found IDA to be an independent risk factor for the first episode of febrile seizures, reinforcing the clinical relevance of haematological screening in at-risk children.[13]

Fallah et al specifically evaluated the utility of RDW as a marker of iron deficiency in children with febrile seizures and found significantly elevated RDW values in the seizure group.14 In the present study, RDW >15% was equally distributed between groups (16% each), which may reflect the small sample size limiting statistical power for this individual parameter. The composite diagnosis of IDA, however, remained significantly associated with febrile seizures overall. Sadeghzadeh et al documented significantly lower haemoglobin, serum ferritin, and serum iron in febrile seizure cases in children under three years, and posited that iron supplementation may reduce seizure recurrence by restoring normal brain iron homeostasis.[17]

Ahmed et al examined multiple risk factors for febrile seizures and identified iron deficiency as a significant independent contributor in a Pakistani paediatric cohort.[18] Iragamreddy et al and Bijje et al demonstrated a significant association between iron deficiency and febrile seizures in an Indian tertiary care setting, consistent with the present findings.[19]

Most recently, Kago-Tague et al conducted a study in Yaounde involving children aged 6–60 months and found IDA to be significantly associated with febrile seizures, lending cross-continental support to this well-established association.[20] Abd El-Raziq et al specifically investigated serum ferritin levels and demonstrated significantly lower values in febrile seizure cases, providing biochemical corroboration of iron deficiency beyond haematological parameters alone.[12]

Taken together, the findings of the present study are in alignment with the predominant literature, contributing regional data from a high-burden Indian setting. Several limitations warrant acknowledgement: the relatively small sample size (n=50) limits statistical power for subgroup analyses; the absence of serum ferritin measurement precludes confirmation of true iron store depletion; and the cross-sectional nature of blood sampling at presentation does not allow causal inferences to be drawn.

Future studies with larger sample sizes, inclusion of ferritin and transferrin saturation, and follow-up data on seizure recurrence after iron supplementation would further clarify the clinical importance of this association.

CONCLUSION

Iron deficiency anaemia is significantly more prevalent among children aged 1–5 years presenting with febrile seizures compared to age-matched febrile controls without seizures. Mean haemoglobin was significantly lower in cases, and moderate anaemia was disproportionately represented in the seizure group. Routine haematological screening for IDA in young febrile children presenting to paediatric services may be a clinically prudent and cost-effective strategy to identify at-risk individuals and guide timely iron supplementation, with the potential to reduce febrile seizure recurrence.

Larger, multi-centre prospective studies incorporating biochemical markers of iron status are recommended to further delineate this association and evaluate the impact of iron repletion on seizure outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Sulviani R, Kamarullah W, Dermawan S, Susanto H. Anemia and poor iron indices are associated with susceptibility to febrile seizures in children: A systematic review and meta-analysis. J Child Neurol. 2023;38(3–4):186–97.
2. Bakkannavar S, Faheem Y, Jaiswal A. Associative patterns between iron deficiency anemia and febrile seizures in the five to 60 months age group: A comprehensive systematic review. Cureus. 2024;16(3):56470.
3. Kwak BO, Kim K, Kim SN, Lee R. Relationship between iron deficiency anemia and febrile seizures in children: A systematic review and meta-analysis. Seizure. 2017;52:27–34.
4. Gan Y, Yu J, Fan J. Association between febrile seizures and iron deficiency anemia in infants and preschool children: A meta-analysis. Chin J Obstet Gynecol Pediatr. 2019;5(1):18.
5. Alipour A, Rezaianzadeh A, Habibian N. Association between iron deficiency anemia and febrile convulsion in 3- to 60-month-old children: A systematic review and meta-analysis. Iran J Child Neurol. 2013.
6. Hena SA, Zafar SM, Mahmood A. Association of iron deficiency anaemia with the first episode of febrile seizure in children: A case-control study. Cureus. 2024;16(11):74129.
7. Chaudhary BR. Association of iron deficiency anemia with febrile seizure in children in a tertiary care hospital. J Nepal Health Res Counc. 2021;19(1):66–70.
8. Sharifi P, Koohsorkhi MB, Moghtaderi M. Association between iron-deficiency anemia and febrile convulsion in children aged 6 months to 5 years. Alex J Pediatr. 2021;34(2):144–8.
9. Chen M, Li L. Relationship between iron deficiency anemia and febrile seizures in children. Int J Pediatr. 2020;47(3):187–90.
10. Daoud AS, Batieha A, Abu-Ekteish F. Iron status: A possible risk factor for the first febrile seizure. Epilepsia. 2002;43(7):740–3.
11. Khan SA, Khan J, Gul MS, Akbar K, Farid A, Adnan M. Iron deficiency associated with febrile seizures. Rawal Med J. 2021;46(3):530–2.
12. Abd El-Raziq AEES, Abd El-Maksod BAA, Mabrouk MI, KhairAllah MAA. The association between serum ferritin and febrile seizure in children. Asian J Med Sci. 2025;16(11):739.
13. Saleem MA, Siddique AA. Iron deficiency anemia as a risk factor for the first episode of febrile seizure. Int J Pediatr Res. 2020;6(2):922.
14. Fallah R, Tirandazi B, Akhavan Karbasi S, Golestan M. Iron deficiency and iron deficiency anemia in children with febrile seizure. Iran J Pediatr Hematol Oncol. 2013;3(1):200–3.
15. A comprehensive analysis of iron deficiency as a risk factor for febrile seizures in children aged 6 months to 5 years: A retrospective case-control study. J Family Med Prim Care. 2024;13(12):5562–9.
16. Kumar VN, Hassan F, Jha L, Kumar A, Bandopadhyay C, Choudhury I. Iron deficiency in febrile seizures: A prospective case control study. Int J Contemp Pediatr. 2020;7(12):2267–70.
17. Sadeghzadeh M. Iron status and febrile seizure: A case control study in children less than 3 years. Iran J Child Neurol. 2012;6(4):27–31.

18. Ahmed BW. Risk factors in children with febrile seizures and their iron status. J Pak Med Assoc. 2019;69(3):22–5.
19. Iragamreddy VR, Bijje RB. A study of association between iron deficiency and febrile seizures. Int J Contemp Pediatr. 2023;10(6):912–5.
20. Kago-Tague DA. Iron deficiency anemia and febrile seizures in children aged 6 to 60 months in Yaounde. Health Res Afr. 2024;2(8):97.

Cite this article as: Iram A, Malagi N, Khanum S, Saher H. A cross-sectional study of awareness regarding dog bite and its management in rural community of Maharashtra, India. Int J Contemp Pediatr 2026;13:1704-9.