e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 632-636

Original Research Article

Micronutrient Deficiency Patterns in Children with Recurrent Infections: A Prospective Observational Study

Maloth Priyanka[1], Dasari Uday Kumar[2], Kaushal Poreddy[3]

[1]Assistant Professor, Department of Paediatrics, government Medical College, Bhadradri, Kothagudem
[2]Assistant Professor, Department of Paediatrics, Kakatiya Medical College, Warangal
[3] Department of Biological Sciences, College of Science, Virginia Tech, VA, USA

Received: 12-12-2025 / Revised: 11-01-2026 / Accepted: 12-02-2026
Corresponding Author: Dr Maloth Priyanka
Conflict of interest: Nil

Abstract:

Background: Recurrent infections in children is frequent cause of healthcare visits and hospital admissions, particularly in low and middle income countries. Micronutrients such as iron, zinc, and vitamin D play a crucial role in immune function, and their deficiencies may predispose children to repeated infectious illnesses.

Aim: To assess the pattern of micronutrient deficiencies and their association with infection frequency and severity among children with recurrent infections.

Methods: This prospective observational study was conducted in the department of Pediatrics, Government Medical College, Bhadradri Kothagudem, from July to November 2025. Children aged 6 months to 12 years with recurrent infections were enrolled after obtaining informed consent. Demographic details, clinical profile, and infection characteristics were recorded. Anthropometric assessment was performed using WHO growth standards. Laboratory evaluation included hemoglobin, serum ferritin, serum zinc, and serum 25-hydroxyvitamin D levels. Data were analyzed using SPSS version 21.0.

Results: Among 120 enrolled children, 82.5% had at least one micronutrient deficiency. Iron deficiency was the most common (60%), followed by vitamin D (45%) and zinc (38.3%). Nearly half of the children had multiple deficiencies. Children with two or more deficiencies experienced significantly higher infection frequency, longer illness duration, and increased hospitalization rates.

Conclusion: Micronutrient deficiencies, particularly iron, vitamin D, and zinc, are highly prevalent among children with recurrent infections and are associated with increased morbidity. Targeted screening and correction of deficiencies may help reduce infection burden in this vulnerable group.

Keywords: Recurrent infections, Micronutrient deficiency, Iron deficiency, Zinc, Vitamin D.

DOI: 10.25258/ijcpr.18.2.101

Introduction

Recurrent infections in children are a common clinical problem and often reflect an interplay between exposure to pathogens, immature immunity, and modifiable nutritional factors. Micronutrients such as iron, zinc and vitamin D are central to both innate and adaptive immune responses, influencing epithelial barrier integrity, phagocyte function, cytokine signaling, and lymphocyte maturation [1]. Iron deficiency frequent in growing children and in inflammatory states has been linked to immune dysregulation and greater susceptibility to infections, with potential clinical consequences even before overt anemia becomes evident [2]. Zinc deficiency is also prevalent in pediatric age groups and is associated with impaired immune competence, increasing the risk and severity of respiratory and gastrointestinal infections; supplementation has therefore been explored as an adjunct preventive strategy in susceptible children [1]. Vitamin D, beyond its skeletal role, has immunomodulatory effects, and evidence from pediatric studies and meta-analyses suggests that vitamin D status and/or supplementation may influence the risk of acute respiratory tract infections in children, although benefits can vary by baseline status and population [3]. The aim of the study is to prospectively assess the pattern of key micronutrient deficiencies (iron, zinc, vitamin D and related markers) among children with recurrent infections and examine their association with infection frequency and clinical severity.

Methods

This prospective observational study was conducted in the department of Pediatrics at Government Medical College, Bhadradri Kothagudem, Telangana, over a period of five months from July to

November 2025. The study population comprised children aged 6 months to 12 years presenting to the pediatric outpatient department or admitted to the pediatric wards with a history of recurrent infections as per the institutional protocol. Children with known primary immunodeficiency disorders, chronic systemic illnesses (such as congenital heart disease, chronic kidney disease, or malignancy), long-term steroid or immunosuppressive therapy, and those already receiving micronutrient supplementation in the preceding three months were excluded. After screening for eligibility, informed written consent was obtained from parents or legal guardians, and assent was obtained from children aged ≥7 years wherever appropriate. Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to commencement.

Detailed demographic and clinical data were collected prospectively using a predesigned and pretested proforma. Information regarding age, sex, socioeconomic status, nutritional history, immunization status, and environmental factors such as overcrowding and exposure to tobacco smoke was recorded. A thorough clinical examination was performed in all enrolled children, with emphasis on anthropometric measurements including weight, height/length, and body mass index, which were interpreted using WHO growth standards. The type, frequency, and severity of infections such as respiratory tract infections, gastrointestinal infections, skin and soft tissue infections, and urinary tract infections were documented based on clinical findings and available medical records. Severity was assessed using indicators such as duration of illness, need for hospitalization, and requirement for intravenous antibiotics. All children were managed as per standard institutional treatment protocols, and participation in the study did not alter routine clinical care.

Venous blood samples were collected under aseptic precautions for laboratory evaluation of micronutrient status. Hemoglobin estimation and peripheral smear examination were performed to assess anemia, and serum ferritin levels were measured to evaluate iron stores, with appropriate consideration of inflammatory status. Serum zinc levels were estimated using standard biochemical methods, and serum 25-hydroxyvitamin D levels were measured to assess vitamin D status. Additional investigations such as C-reactive protein were performed when clinically indicated to aid interpretation of micronutrient parameters. Data were entered into Microsoft Excel and analyzed using SPSS version 21. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation or median with interquartile range, as appropriate. Associations between micronutrient deficiencies and infection patterns were analyzed using suitable statistical tests, and a p-value <0.05 was considered statistically significant.

Results:

A total of 120 children with recurrent infections were enrolled during the study period. The mean age of the study participants was 4.8 ± 2.6 years, with a male predominance (Table 1). Upper respiratory tract infections were the most common presentation, followed by gastrointestinal and skin infections. Overall, 82.5% of children had at least one micronutrient deficiency, while 46.7% had two or more deficiencies (Table 3). Iron deficiency was the most frequently identified abnormality, followed by vitamin D and zinc deficiency (Table 2). Children with multiple micronutrient deficiencies experienced a significantly higher frequency of infections and longer duration of illness compared to those with normal micronutrient status. Hospitalization rates were also higher among children with combined deficiencies (Table 4), indicating a possible association between micronutrient inadequacy and infection severity.

Table 1: Demographic and clinical characteristics of the study participants (n = 120)

Variable	Number (%)
Age <5 years	68 (56.7)
Age ≥5 years	52 (43.3)
Male	70 (58.3)
Female	50 (41.7)
≥5 infections/year	78 (65.0)
Hospitalization required	42 (35.0)

Table 2: Distribution of Micronutrient deficiencies among the study participants

Micronutrient deficiency	Number (%)
Iron deficiency	72 (60.0)
Vitamin D deficiency	54 (45.0)
Zinc deficiency	46 (38.3)

Table 3: Number of Micronutrient deficiencies per child	
Number of deficiencies	**Number (%)**
None	21 (17.5)
One	43 (35.8)
Two	36 (30.0)
Three	20 (16.7)
No deficiency	21 (17.5)

Table 4: Association between Micronutrient deficiency and infection severity			
Parameter	**Micronutrient deficiency**		**Statistical analysis**
	Present	**Absent**	
≥5 infections per year	72 (72.7%)	6 (28.6%)	$\chi^2 = 14.82$; P = 0.001
Mean duration of illness (days)	7.6 ± 2.1	4.3 ± 1.5	$t = 6.84$; P < 0.001
Hospitalization required	39 (39.4%)	3 (14.3%)	$\chi^2 = 5.21$; P = 0.022

Discussion

The present prospective study from Government Medical College, Bhadradri Kothagudem demonstrated a high burden of micronutrient deficiencies among children with recurrent infections, with nearly four out of five participants showing at least one deficiency and almost half exhibiting multiple deficiencies. Such clustering is biologically plausible because dietary inadequacy, repeated illness, and socioeconomic determinants often coexist, creating a cycle where infection worsens appetite and absorption, while deficiency impairs immune competence and mucosal barrier function [4, 5]. Indian multicentric evidence also shows that inadequate intake is strongly associated with biochemical deficiencies of key micronutrients (including iron and zinc) among school-age children, supporting the likelihood that many children entering clinical pathways already have subclinical deficits before recurrent infections become apparent [6]. Similarly, national-level datasets from other LMIC settings show ferritin and zinc deficiencies as common biochemical abnormalities in school-aged children, reinforcing that iron and zinc are frequent limiting factors during growth [7]. Our findings therefore add prospective clinical support to the broader epidemiologic picture that micronutrient insufficiency is common in pediatric populations and may be particularly concentrated in children experiencing repeated infectious morbidity [6, 7].

Iron deficiency emerged as the predominant abnormality in our cohort and was associated with higher infection frequency and markers of severity. Beyond anemia, iron deficiency can alter immune effector mechanisms, influence cytokine profiles, and reduce cellular immune responses, while inflammation can simultaneously distort biomarkers (especially ferritin), complicating interpretation unless inflammatory markers are considered [2]. Contemporary pediatric reviews emphasize that iron deficiency can exist without overt anemia and still carry functional consequences, and they stress careful diagnosis and treatment strategies, particularly in the context of infection and inflammation [2, 8]. From a clinical standpoint, the association we observed between deficiency status and higher hospitalization/longer illness duration is consistent with the concept that marginal iron status may reduce physiologic reserve during infection episodes and prolong recovery, even when standard antimicrobial management is provided [2, 9]. At the same time, evidence cautions against indiscriminate supplementation in low-risk populations, as benefits depend on baseline status and context; hence, a targeted "test-and-treat" approach is often more defensible for children with recurrent morbidity than blanket supplementation [8].

Zinc deficiency was also frequent in our study, and children with zinc deficiency particularly when combined with iron and/or vitamin D deficiency had a higher burden of infections. Zinc is central to innate and adaptive immune function (including epithelial integrity, neutrophil activity, and T-cell function) and has recognized roles in inflammatory modulation and oxidative balance [1]. Recent pediatric syntheses reiterate zinc's immunological importance and its potential relevance to infection susceptibility, especially where baseline dietary intake is inadequate [1]. However, the translation from biologic plausibility to consistent clinical benefit is not uniform across settings; a recent taskforce systematic review on nutritional interventions for pediatric acute respiratory infections highlighted that single-nutrient interventions generally have limited or inconsistent effects on key outcomes, though zinc may offer modest benefit in some contexts such as reduced length of hospital stay in pneumonia [10,11]. This nuance matters for interpreting our results: the strong association between zinc deficiency and recurrent infections does not automatically imply that routine zinc supplementation will prevent recurrence in all children; rather, it supports targeted identification of deficiency and corrective strategies integrated with broader nutritional counseling and infection-prevention measures [1, 10].

Vitamin D deficiency was the second most common deficiency in our cohort and showed a relationship with infection frequency and severity indicators. Vitamin D has immunomodulatory actions, including effects on antimicrobial peptides and regulation of inflammatory responses, which has led to extensive trials on respiratory infection prevention [12]. Updated evidence, however, suggests that the preventive effect of vitamin D supplementation against acute respiratory infections is at best modest and may depend on dosing regimen, baseline deficiency, and population characteristics [12]. Recent pediatric trials also show variability in benefit, highlighting that supplementation during high-risk seasons or in children with low baseline levels may be more relevant than universal supplementation [12]. In the context of our findings, vitamin D deficiency may be a marker of broader nutritional and lifestyle factors (limited sun exposure, suboptimal diet, recurrent illness) that collectively contribute to infection vulnerability, rather than a sole causal driver [11, 12]. Therefore, the practical implication is to interpret vitamin D as part of a composite risk profile and to prioritize correction particularly in deficient children, while avoiding overstating its independent effect in preventing all recurrent infections [10, 12].

The most clinically meaningful pattern in our results was the gradient of morbidity with the number of deficiencies: children with two or more micronutrient deficiencies had the highest infection frequency, longer illness duration, and greater hospitalization requirement. This supports a "multiple-hit" model where combined deficits in iron, zinc, and vitamin D may synergistically impair barrier function and immune responses, increasing both susceptibility and severity [1, 2]. Broader pediatric nutrition literature also emphasizes that micronutrient deficits often occur together especially during early life and periods of rapid growth and recommends systematic attention to vulnerable groups where restricted diets, food insecurity, or chronic inflammatory states may coexist [4]. Our study's strengths included prospective recruitment and standardized biochemical assessment; nevertheless, limitations include the single-center design, absence of a healthy control group, potential confounding by socioeconomic/environmental factors, and biomarker interpretation challenges in the setting of inflammation (particularly ferritin) [2]. Despite these limitations, the findings provide actionable direction: children presenting with recurrent infections represent a high-yield group for targeted micronutrient evaluation (iron indices with inflammation context, serum zinc, and vitamin D) and integrated interventions (dietary optimization, evidence-based supplementation for confirmed deficiency, deworming/parasite control where indicated, and reinforcement of immunization and hygiene practices) [2, 6].

Conclusion

This prospective study found a high prevalence of micronutrient deficiencies among children with recurrent infections, with iron deficiency being most common, followed by vitamin D and zinc deficiency. Children with multiple deficiencies experienced more frequent infections, longer illness duration, and higher hospitalization rates, suggesting a dose–response relationship between nutritional inadequacy and infectious morbidity. These findings support targeted screening for key micronutrients in children presenting with recurrent infections, with careful interpretation of iron markers in inflammatory states. Correcting confirmed deficiencies through dietary counseling and evidence-based supplementation, alongside routine infection-prevention strategies, may help reduce recurrence and severity.

References

1. Padoan F, Piccoli E, Pietrobelli A, Moreno LA, Piacentini G, Pecoraro L. The Role of Zinc in Developed Countries in Pediatric Patients: A 360-Degree View. Biomolecules. 2024; 14(6): 718.
2. Lee NH. Iron deficiency in children with a focus on inflammatory conditions. Clin Exp Pediatr. 2024; 67(6): 283 – 93.
3. Fang Q, Wu Y, Lu J, Zheng H. A meta-analysis of the association between vitamin D supplementation and the risk of acute respiratory tract infection in the healthy pediatric group. Front Nutr. 2023; 10: 1188958.
4. Panzeri C, Pecoraro L, Dianin A, et al. Potential Micronutrient Deficiencies in the First 1000 Days of Life: The Pediatrician on the Side of the Weakest. Curr Obes Rep. 2024; 13(2): 338 – 51.
5. Ernawati F, Efriwati, Nurjanah N, et al. Micronutrients and Nutrition Status of School-Aged Children in Indonesia. J Nutr Metab. 2023; 2023: 4610038.
6. Awasthi S, Kumar D, Dixit S, et al. Association of dietary intake with micronutrient deficiency in Indian school children: a cross-sectional study. J Nutr Sci. 2023; 12: e104.
7. Ernawati F, Efriwati, Nurjanah N, et al. Micronutrients and Nutrition Status of School-Aged Children in Indonesia. J Nutr Metab. 2023; 2023: 4610038.
8. Chmielewska A, Domellöf M. Iron deficiency in infants and children - the current research challenges. Curr Opin Clin Nutr Metab Care. 2025; 28(3): 284 – 8.
9. Leung AKC, Lam JM, Wong AHC, Hon KL, Li X. Iron Deficiency Anemia: An Updated Review. Curr Pediatr Rev. 2024; 20(3): 339 – 56.

10. Milani GP, Alberti I, Abodi M, et al. A systematic review and meta-analysis on nutritional and dietary interventions for the treatment of acute respiratory infection in pediatric patients: An EAACI taskforce. Allergy. 2024; 79(7): 1687 – 1707.
11. Clerico JW, Thams L, Stounbjerg NG, et al. Effects of vitamin D supplementation on acute respiratory tract infections in 6-8-year-old children: a randomized clinical trial. Eur J Nutr. 2025; 64(4): 170.
12. Jolliffe DA, Camargo CA Jr, Sluyter JD, et al. Vitamin D supplementation to prevent acute respiratory infections: systematic review and meta-analysis of stratified aggregate data. Lancet Diabetes Endocrinol. 2025; 13(4): 307 – 20.