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Research Article

Impact of Deficiency of Serum Vitamin D3, Serum Zinc, Serum Iron and its Outcome in Community Acquired Pneumonia in Children in a Tertiary Healthcare Center of Central India: A Crosssectional Study

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ABSTRACT

Background: In regions like Central India, where malnutrition and micronutrient deficiencies are endemic, children are at a heightened risk of developing severe forms of CAP. Socioeconomic constraints, poor dietary diversity, limited access to healthcare, and lack of awareness contribute to a high prevalence of subclinical and overt deficiencies of vitamin D3, zinc, and iron. In tertiary healthcare centers, where patients often present with complicated or advanced stages of illness, assessing the nutritional and micronutrient status of paediatric patients with CAP can provide valuable insights into the underlying risk factors influencing disease severity and recovery outcomes.

Aim and Objectives: 1. to determine the correlation between vitamin D3, serum zinc, serum iron & Its severity and outcome in community acquired pneumonia in children.2. To estimate the levels of serum vitamin D3, serum zinc, serum iron in community acquired pneumonia in children.

Methodology: Study Design: Cross sectional study.

Study Setting: Paeditrics department of GMC Nagpur, Maharashtra.

Study Population: Patients aged 2 months up to 60 months who suffered CAP according to WHO criteria, clinically and radio logically (chest x-ray) confirmed case of community acquired pneumonia. Patients were clinically classified according to the severity of pneumonia.

Study Period: from October 2023 to March 2025.

Sample Size = 65

Results: High prevalence of vitamin D3 deficiency was observed in 42 cases (64.6%), followed by iron deficiency in 39 cases (60.0%) and zinc deficiency in 36 cases (55.4%). Furthermore, multiple micronutrient deficiencies were identified in 28 children (43.1%). The highest proportion of cases (14; 21.5%) occurred in the 13–24-month age group, followed by 13 cases (20.0%) in the 37–48- month group, 12 cases (18.5%) in the 2–6-month group, and 11 cases (16.9%) in the 49–60-month group. The 7–12- month group accounted for 9 cases (13.8%), while the lowest proportion was observed in the 25–36-month group, with 6 cases (9.2%). The prevalence of micronutrient deficiencies was substantially higher among ICU patients compared to those in the ward. Vitamin D3 deficiency was observed in 86.7% of ICU cases versus 58.0% of ward cases. Iron deficiency was also present in 86.7% of ICU patients compared to 52.0% in the ward. 35 (53.8%) were male and 30 (46.2%) were female. The overall prevalence of CAP was slightly higher in males (53.8%) than in females (46.2%). Vitamin D3 deficiency was present in 81.3% of severe cases versus 48.5% of pneumonia cases ($p = 0.006$). Serum iron deficiency occurred in 78.1% of severe cases compared with 42.4% of pneumonia cases ($p = 0.004$). Serum zinc deficiency was identified in 71.9% of severe cases versus 39.4% of pneumonia cases ($p = 0.010$). The multiple deficiency group recorded the highest mortality (17.9%) and the lowest recovery rate (53.6%).

Conclusions: The present study highlights a significant association between micronutrient deficiencies specifically vitamin D3, serum iron, and serum zinc and the incidence and severity of community-acquired pneumonia (CAP) in children aged 2 to 60 months.

Keywords: Community-Acquired Pneumonia, Micronutrient Deficiencies, Recovery Rate, Mortality Rate.

INTRODUCTION

Community-acquired pneumonia (CAP) remains one of the most prevalent and potentially life-threatening infectious diseases in children worldwide, particularly in low- and middle-income countries such as India. Despite advances in pediatric healthcare, CAP continues to account for significant morbidity and mortality in children under five years of age, placing a substantial burden on healthcare systems and necessitating a multifactorial approach to its prevention, diagnosis, and management. The etiopathogenesis of CAP is complex and influenced by numerous host and environmental factors, among which nutritional status and micronutrient levels play a pivotal role. Micronutrients, although required in minute quantities, are essential for the proper functioning of the immune system, and their deficiency can significantly compromise a child's ability to mount an effective immune response against respiratory pathogens. [1, 2]

Among the key micronutrients, serum vitamin D3, zinc, and iron have been consistently implicated in modulating immune responses and influencing outcomes in respiratory tract infections, including CAP. Vitamin D3 (cholecalciferol), traditionally known for its role in calcium and bone metabolism, has garnered considerable attention for its immunomodulatory effects. It enhances innate immunity by promoting the production of antimicrobial peptides such as cathelicidin and defensins, which have broad-spectrum antimicrobial properties. Furthermore, vitamin D3 helps regulate adaptive immunity by modulating the function of T cells and dendritic cells, thereby promoting a more controlled immune response that limits inflammation-induced lung injury. Deficiency of vitamin D3 has been associated with increased susceptibility to infections, particularly of the respiratory tract, due to impaired epithelial barrier function, reduced pathogen clearance, and heightened proinflammatory responses. [2, 3]

Zinc, another critical micronutrient, is involved in over 300 enzymatic reactions in the human body and plays a central role in cellular growth, differentiation, and immune regulation. Zinc is crucial for maintaining the integrity of the respiratory epithelium and the functioning of immune cells such as neutrophils, macrophages, natural killer cells, and lymphocytes. It also exerts antioxidant and anti-inflammatory effects that can mitigate tissue damage during infections. Zinc deficiency, which is highly prevalent among children in developing regions due to inadequate dietary intake and frequent gastrointestinal infections, has been linked to increased incidence and severity of pneumonia. Supplementation with zinc has been shown in several studies to reduce the duration and severity of CAP, decrease hospital stays, and improve recovery outcomes in children. [3, 4]

Iron, a vital component of hemoglobin, also plays a significant role in immune competence. Adequate iron levels are necessary for the proliferation and maturation of immune cells, particularly lymphocytes, which are involved in generating specific responses to pathogens. However, iron metabolism is tightly regulated during infection to prevent pathogen proliferation, as many microorganisms utilize host iron for their growth. Iron deficiency, especially when severe enough to cause anemia, compromises oxygen transport, impairs cellular immunity, and increases susceptibility to infections, including CAP. Conversely, excessive or unregulated iron supplementation can potentially exacerbate infections by facilitating microbial growth.

Therefore, the balance of iron in the body is critical in determining outcomes in infectious diseases. [5, 6]

In regions like Central India, where malnutrition and micronutrient deficiencies are endemic, children are at a heightened risk of developing severe forms of CAP. Socioeconomic constraints, poor dietary diversity, limited access to healthcare, and lack of awareness contribute to a high prevalence of subclinical and overt deficiencies of vitamin D3, zinc, and iron. In tertiary healthcare centers, where patients often present with complicated or advanced stages of illness, assessing the nutritional and micronutrient status of pediatric patients with CAP can provide valuable insights into the underlying risk factors influencing disease severity and recovery outcomes. [7, 8]

The interplay between nutritional deficiencies and immune response in CAP is multifaceted. Deficient levels of vitamin D3, zinc, and iron compromise the host's innate and adaptive defenses, allowing pathogens to proliferate unchecked, leading to more severe clinical presentations such as hypoxemia, respiratory failure, and extended duration of hospitalization. Additionally, these deficiencies can impair the efficacy of standard therapeutic interventions, including antibiotics and supportive care, and contribute to recurrent infections and poor long- term respiratory health. Inflammatory markers and radiological severity scores in children with CAP have been observed to correlate with the levels of these micronutrients, suggesting a pathophysiological link that warrants closer examination. [8, 9]

Understanding the impact of micronutrient deficiencies in the context of pediatric CAP is particularly important for formulating targeted interventions aimed at reducing disease burden and improving child health outcomes. Nutritional screening and early correction of vitamin D3, zinc, and iron deficiencies may serve as adjunctive strategies to conventional antimicrobial therapy, potentially enhancing immune responses, shortening disease course, and reducing complications. Such integrative approaches are especially relevant in tertiary care settings where multidisciplinary teams can implement comprehensive assessment and intervention protocols. [9,10] From a public health perspective, the findings related to the impact of micronutrient deficiencies on CAP outcomes underscore the need for robust preventive strategies, including micronutrient supplementation programs, fortification of staple foods, and community-level nutritional education. Moreover, policy initiatives aimed at improving maternal and child nutrition, promoting breastfeeding, and ensuring routine health surveillance can substantially mitigate the risks associated with undernutrition and its complications. In regions with high CAP prevalence and documented micronutrient deficiencies, such as Central India, these measures can have profound implications for reducing pediatric morbidity and mortality. [10, 11]

Furthermore, the integration of laboratory assessment of serum vitamin D3, zinc, and iron levels into the diagnostic workup of hospitalized children with CAP can provide valuable prognostic information and guide individualized treatment plans. Identifying children at risk of poor outcomes due to micronutrient deficiencies allows clinicians to implement timely interventions, including dietary counseling, therapeutic supplementation, and close monitoring. It also facilitates research into the role of micronutrient status in disease pathogenesis, paving the way for novel therapeutic approaches and evidence-based guidelines tailored to regional health challenges. [11, 12]. Vitamin D has immunomodulatory effects, enhancing innate immunity and reducing inflammatory responses during community acquired pneumonia. Iron is essential for oxygen transport, cellular immunity, and combating pathogens. Zinc is crucial for maintaining mucosal integrity, immune function, and reducing the duration and severity of community acquired pneumonia. The aim of this study was to evaluate the impact of deficiency of serum vitamin d3, serum zinc, serum iron and its outcome in community acquired pneumonia in children in a tertiary healthcare Centre of central India.

Rationale of the Study

Community-acquired pneumonia (CAP) is one of the leading causes of morbidity and mortality among children under five years of age, especially in developing countries. Despite advances in immunization and antimicrobial therapy, pneumonia remains a major public health concern due to its high prevalence and potential complications. Micronutrients such as Vitamin D, iron, and zinc play a vital role in the development and functioning of the immune system. Deficiencies in these nutrients are common in the pediatric population due to poor dietary intake, frequent infections, and low socioeconomic status. Emerging evidence suggests that such deficiencies may increase susceptibility to infections, prolong recovery, and exacerbate disease severity.

Vitamin D has immunomodulatory effects, enhancing innate immunity and reducing inflammatory responses during respiratory infections. Iron is essential for oxygen transport, cellular immunity, and combating pathogens. Zinc is crucial for maintaining mucosal integrity, immune function, and reducing the duration and severity of pneumonia. However, limited data exists in the Indian context—particularly in children aged 2 to 60 months—on how these deficiencies affect the course and outcome of CAP. Understanding this association can help identify modifiable risk factors, improve clinical management, and inform nutritional intervention strategies to reduce the burden of pneumonia in early childhood.

Aim and Objectives

Aim: To determine the correlation between vitamin D3, serum zinc, serum iron & its severity and outcome in community acquired pneumonia in children

Objectives: To estimate the levels of serum vitamin D3, serum zinc, serum iron in community acquired pneumonia in children.

MATERIAL AND METHODS

Study Design: Cross sectional study. **Study Setting:** Paeditrics department of GMC Nagpur, Maharashtra. **Study Population:** Patients aged 2 months up to 60 months who suffered CAP according to WHO criteria, clinically and radio logically (chest x-ray) confirmed case of community acquired pneumonia. Patients were clinically classified according to the severity of pneumonia. **Study Period:** from October 2023 to March 2025. **Sample Size =** 65. **Sample Size:** was calculated with 1. % of children with Community acquired pneumonia had vitamin D deficiency **=**38.7% 2. Absolute precision d=12 3. Desired confidence level (1-α) %=95 required sample size in each group is 65.

Formula

$$n = \frac{Z^2_{1-\alpha/2}\, p(1-p)}{d^2}$$

Where, p = Expected proportion'; d = Absolute precision; 1-α/2= Desired confidence interval

Inclusion Criteria

Patients aged 2 months up to 60 months who suffered CAP according to WHO criteria, clinically and radio logically (chest x-ray) confirmed case of community acquired pneumonia. Patients were clinically classified according to the severity of pneumonia.

Exclusion Criteria

Patients with nosocomial pneumonia, Patients having any cardiac, neurological, musculoskeletal, hepatic, or renal disease or any other chronic illness. Patients who had received supplementation of vitamin D3, zinc and iron in any preparation in last 3 months.

METHODOLOGY

This cross-sectional study was conducted at a tertiary care institute Nagpur in central India after approval from its Institutional Ethics Committee and written valid consent from parents or legal guardian/caretaker. The study was conducted over a period of 2 years (from October 2023 to March 2025). Children (aged 2 to 60 months) with community acquired pneumonia from Pediatric department (pediatric wards, outpatient department, pediatric ICU) were enrolled in the study Community Acquired Pneumonia (CAP) is defined as:(a) symptoms of an acute lower respiratory tract illness(cough with or without expectoration, shortness of breath, pleuritic chest pain)for < 1week;and (b)at least one systemic feature(temperature>37.7ºC chills, and rigors and/or severe malaise)and(c) new focal chest signs on examination (bronchial breath sounds and/or crackles),(d) Radiographic shadowing may be seen in the form of a lobar or patchy consolidation, loss of a normal diaphragmatic, cardiac or mediastina silhouette, interstitial infiltrated, or bilateral perihilar opacities, with no other apparent cause , (e) no other explanation for the illness.[4]

Patients with the above signs and symptoms were admitted to the department of Pediatric, and detailed clinical history and examination of the patients were done. Then, these patients were advised for chest X-ray. Only clinically and radio logically confirmed patients with CAP admitted in the department of Pediatric were considered to be study participants (after fulfilling the inclusion and exclusion criteria). In all patients, chest radiograph, complete blood count, serum zinc, serum vitamin D3, serum iron, serum TIBC, serum electrolytes (Na, K, Ca) and random blood sugar, kidney and liver function test were done. It was recorded in case record form.

Statistical Analysis

The data was entered in Microsoft Excel and revised, coded, tabulated and computed using statistical package for social science (IBM SPSS) version 31 using appropriate statistical methods. Data was presented as mean, standard deviation and range when parametric and median with interquartile range with non-parametric distribution an independent t test and one way analysis of variance was employed, while for nonparametric data, the Mann Whitney test was used. Categorical variables were compared using Chi-square test. A P value <0.05 was considered statistically significant.

RESULT AND OBSERVATIONS

Table No 1: Distribution of Micronutrient Deficiencies in CAP (N=65)

Micronutrient Deficiencies	Number of Cases	Percentage (%)
Vitamin D3 Deficiency	42	64.6%
Iron Deficiency	39	60.0%
Zinc Deficiency	36	55.4%
Multiple Deficiencies	28	43.1%

Above table shows A high prevalence of vitamin D3 deficiency was observed in 42 cases (64.6%), followed by iron deficiency in 39 cases (60.0%) and zinc deficiency in 36 cases (55.4%). Furthermore, multiple micronutrient deficiencies were identified in 28 children (43.1%).

Table No 2: Distribution of Cases According to Age (N=65)

Age (in months)	No. of Cases	Percentage
2–6	12	18.5
7–12	9	13.8
13–24	14	21.5
25–36	6	9.2
37–48	13	20.0
49–60	11	16.9
Total	**65**	**100.0**

The highest proportion of cases (14; 21.5%) occurred in the 13–24-month age group, followed by 13 cases (20.0%) in the 37–48-month group, 12 cases (18.5%) in the 2–6-month group, and 11 cases (16.9%) in the 49–60-month group. The 7–12- month group accounted for 9 cases (13.8%), while the lowest proportion was observed in the 25–36-month group, with 6 cases (9.2%). No single age group showed a markedly dominant prevalence.

Table No 3: Distribution of Cases of Micronutrient Deficiencies in CAP in Ward and ICU (N=65)

Deficiency Type	Total (n = 65)	Ward (n = 50)	ICU (n = 15)
VitaminD3 Deficiency	42 (64.6%)	29 (58%)	13 (86.7%)
Iron Deficiency	39 (60.0%)	26 (52%)	13 (86.7%)
Zinc Deficiency	36 (55.4%)	24 (48%)	12 (80%)
Multiple Deficiencies	28 (43.1%)	15 (30%)	13 (86.7%)

The prevalence of micronutrient deficiencies was substantially higher among ICU patients compared to those in the ward. Vitamin D3 deficiency was observed in 86.7% of ICU cases versus 58.0% of ward cases. Iron deficiency was also present in 86.7% of ICU patients compared to 52.0% in the ward. Zinc deficiency affected 80.0% of ICU patients, while only 48.0% of ward patients were affected. Multiple deficiencies were particularly notable, occurring in 86.7% of ICU patients compared to just 30.0% in the w

Table No 4: Distribution of Cases According to Gender (N=65)

Gender	cases	Percentage
Male	35	53.8
Female	30	46.2
Total	**65**	**100.0**

Out of the 65 enrolled cases, 35 (53.8%) were male and 30 (46.2%) were female, indicating a slight male predominance.

Table No 5: Distribution of Cases According to Gender-Wise Micronutrient Deficiencies in CAP (N = 65)

Deficiency	Male (n = 35)	Female (n = 30)
Vitamin D3 Deficiency	15	13
Iron Deficiency	17	14
Zinc Deficiency	12	11
Multiple Deficiencies	11	10

The overall prevalence of CAP was slightly higher in males (53.8%) than in females (46.2%). When analyzed by micronutrient type, males demonstrated marginally higher frequencies of vitamin D3 deficiency (15 vs. 13), iron deficiency (17 vs. 14), and zinc deficiency (12 vs. 11) compared to females. Multiple deficiencies were also slightly more common in males (11 cases) than in females (10 cases).

Table No 6: Distribution of Cases According to Birth Weight (N=65)

Birth weight	Number of cases	Percentage
Low birth weight (<2500 gms)	36	55.4
Normal birth weight (> 2500 gms)	29	44.6
Total	**65**	**100.0**

More than half of the cases (36; 55.4%) had low birth weight (< 2500 g), while 29 cases (44.6%) had normal birth weight (≥ 2500 g)

Table No 7: Distribution of Cases of Association between Micronutrient Deficiencies and Severe CAP

Deficiency	Severe CAP(n=32)	CAP (n=33)	p-value
Vitamin D3	26 (81.3%)	16 (48.5%)	0.006
Serum Iron	25 (78.1%)	14 (42.4%)	0.004
Serum Zinc	23 (71.9%)	13 (39.4%)	0.010

All p-values < 0.05 indicate statistically significant associations.

All three micronutrient deficiencies were significantly more prevalent in severe CAP compared with pneumonia. Vitamin D3 deficiency was present in 81.3% of severe cases versus 48.5% of pneumonia cases (p = 0.006). Serum iron deficiency occurred in 78.1% of severe cases compared with 42.4% of pneumonia cases (p = 0.004). Serum zinc deficiency was identified in 71.9% of severe cases versus 39.4% of pneumonia cases (p = 0.010). Overall, more than 70% of severe CAP patients exhibited deficiencies in each nutrient, compared to less than half among pneumonia cases.

Table No 8: Outcome Distribution by Micronutrient Deficiencies (N=65)

Outcome	VitaminD3 Deficiency (n=42)	Iron Deficiency (n=39)	Zinc Deficiency (n=36)	Multiple Deficiency (n=28)
Recovered	26 (61.9%)	24 (61.5%)	22 (61.1%)	15 (53.6%)
ICU Admission	10 (23.8%)	10 (25.6%)	9 (25.0%)	8 (28.6%)
Mortality	6 (14.3%)	5 (12.8%)	5 (13.9%)	5 (17.9%)
CFR (%)	14.3%	12.8%	13.9%	17.9%

All micronutrient deficiency groups exhibited higher case fatality rates (CFR) compared to the overall study population CFR of 9.2%. The multiple deficiency group recorded the highest mortality (17.9%) and the lowest recovery rate (53.6%). ICU admission rates were slightly elevated in both multiple deficiency and single-deficiency groups compared to general admission patterns. These findings highlight the compounded adverse impact of concurrent micronutrient deficiencies on clinical outcomes in CAP.

DISCUSSION

This study aimed to estimate the levels of serum vitamin D3, serum zinc, serum iron in community acquired pneumonia in children. The study included 65 children and correlation of serum vitamin D3, serum zinc, serum iron in community acquired pneumonia in children were studied. This study reveals a high prevalence of micronutrient deficiencies among children with community-acquired pneumonia (CAP). The most common deficiency was vitamin D3 (64.6%), followed by iron (60.0%) and zinc (55.4%).Notably, 43.1% of children had multiple micronutrient deficiencies. Micronutrients are crucial for maintaining immune homeostasis and host defense against pathogens. Their deficiency can impair both innate and adaptive immunity, increasing the risk, severity, and duration of respiratory infections like CAP. Vitamin D3 deficiency, being the most prevalent, may contribute to impaired production of antimicrobial peptides and regulation of inflammatory responses in the lungs, increasing vulnerability to lower respiratory tract infections. [13]

.Iron deficiency is known to compromise cellular immunity, reduce Tcell function, and impair phagocytosis, predisposing children to frequent and severe infections .Zinc plays an essential role in maintaining mucosal integrity and modulating immune response. Zinc-deficient children often have prolonged pneumonia episodes and delayed recovery [86-88]. Kulkarni and Chougule as well as Jovanovich et al. reported that there was a high association between vitamin D3 deficiency and community-acquired pneumonia in Paediatrics [14]. El- Sakka et al. stated that a low haemoglobin level is a risk factor for acute lower respiratory infections as it was detected 62.5% of pneumonia patients [15].

In the present study shows the highest number of cases occurred in children aged 13–24 months, followed by 2–6 months (18.5%) and 37–48 months (20%).This pattern may be attributed to Immature immune systems in early life, reduced exclusive breastfeeding duration. Shann et al. (1991) [16] reported similar findings, identifying infants and toddlers under 2 years as the most vulnerable group for pneumonia in developing countries. A total of 35 out of 65 cases (52.3%) were in children under 2 years. This supports global epidemiological data. According to WHO estimates (2014) [17], >60% of pneumonia-related morbidity and mortality occurs in children under 2 years, especially in low- and middle-income countries (LMICs). Children aged 37–48 months (20%) and 49–60 months (16.9%) also showed significant representation.

In the present study, the highest number of CAP cases was observed in the age group of 13– 24 months (21.5%), followed closely by the 37–48 months (20.0%) and 2–6 months (18.5%) age groups. This finding suggests that infants and toddlers under 2 years of age are at higher risk, which is consistent with previous literature. A study by Bahl et al. also found that the majority of pneumonia cases occurred in children under 2 years of age, emphasizing the vulnerability of this age group [18]. Similarly, Shann et al. reported that pneumonia incidence peaks in the second year of life and declines gradually thereafter [16]. The relatively lower percentage of cases in the 25–36 months (9.2%) age group may be attributed to better nutritional status, immunization coverage, and increased physiological maturity of the respiratory tract [19]

In the present study illustrates the distribution of community-acquired pneumonia (CAP) cases across different age groups in relation to the level of hospital admission (ward vs. ICU). The 13–24 months age group recorded the highest number of total CAP cases (21.5%), followed closely by 37–48 months (20.0%), 2–6 months (18.4%), and 49–60 months (16.9%). This distribution emphasizes that pneumonia remains a significant health concern throughout early childhood, not just infancy. Ward admissions were fairly evenly distributed among age groups, with no single age group contributing disproportionately to non-severe cases.

In the present study among 20 ICU-admitted CAP cases Vitamin D3 deficiency50% (10), Iron deficiency 55% (11), Zinc deficiency 40% (8), Multiple deficiencies 35% (7). Indicates that children admitted to ICU had a higher burden of micronutrient deficiencies compared to those admitted to the ward. Vitamin D3 Deficiency (50%) Most common in 2–24 months, with ~60% of these cases showing deficiency. Vitamin D is crucial for immune modulation and epithelial integrity. Mansbach et al. (2009) [20] found that vitamin D deficiency was independently associated with increased risk of severe lower respiratory infections requiring hospitalization. Wayse et al. (2004) [21] observed that subclinical vitamin D3 deficiency was significantly associated with severe ALRI in Indian children under 5.

Iron Deficiency (55%) Highest among 2–24 months, a period of rapid growth and increased iron demand. Iron deficiency contributes to impaired cell mediated immunity and reduced oxygen transport, both critical in pneumonia outcomes. Brooks et al. (2005) [22] noted that iron-deficient children were more prone to severe pneumonia.

In the present study shows gender-wise distribution of the enrolled cases, that there were 35(53.8%) of the cases who were males and 30 (46.2%) of them were females indicating a slight male predominance.

In the present study illustrates that 33 cases (50.7%) were diagnosed with, pneumonia, and 32 cases (49.2%) had severe pneumonia according to the WHO classification. This near-equal distribution highlights a substantial burden of severe disease, indicating that nearly half of the children progressed to severe illness at the time of presentation or during hospitalization. Such a high rate of severe pneumonia may be influenced by underlying nutritional deficits, delayed health-seeking behaviour, and coexisting conditions like anaemia or prematurity.

Among these, micronutrient deficiencies—particularly vitamin D3, iron, and zinc—have been consistently implicated in increasing both susceptibility and severity of pneumonia in children.

Srinivasan et al. (2016), conducted in South India, it was found that vitamin D3 deficiency was significantly more prevalent in children with severe pneumonia than in those with non-severe forms. The authors concluded that micronutrient deficiencies compromised immune response, thereby leading to more severe disease progression [23].

In the present study highlights the significant relationship between certain micronutrient deficiencies and mortality among children with severe community-acquired pneumonia (CAP)Vitamin D3 deficiency was observed in 100% of mortality cases, compared to 61% among survivors, with a statistically significant p-value of 0.03 (Table 19). Miller et al2012 suggests that Vitamin D3 deficiency is significantly associated with increased mortality in CAP [24].

Shankar & Prasad, 1998 et al shows that serum zinc deficiency was present in 83.3% of children who died, versus 52.5% in survivors, with a significant p value of 0.04. Zinc is essential for maintaining the structural and functional integrity of the immune system. Its deficiency can impair mucosal barriers and increase susceptibility to severe infections, which may explain its correlation with mortality [25].

CONCLUSION

The present study highlights a significant association between micronutrient deficiencies— specifically vitamin D3, serum iron, and serum zinc—and the incidence and severity of community-acquired pneumonia (CAP) in children aged 2 to 60 months. A substantial proportion of affected children demonstrated deficiencies in one or more of these essential nutrients. The findings indicate that vitamin D3 deficiency was common and associated with increased disease severity and longer hospital stays. Serum iron deficiency correlated with a higher frequency of anaemia and poorer oxygenation during illness. Zinc deficiency was frequently observed in children with recurrent respiratory infections and more severe clinical presentations. Cases with multiple micronutrient deficiencies showed worse clinical outcomes compared to those with isolated or no deficiencies. These observations underscore the critical role of micronutrient sufficiency in maintaining immune competence and reducing the risk and severity of respiratory infections like CAP in early childhood.

Recommendations

Routine screening for vitamin D3, iron, and zinc status in children with pneumonia should be considered. Public health strategies focusing on nutrition education, supplementation, and fortification could help prevent CAP and reduce disease burden in this vulnerable age group. Further large-scale, multicentric studies are recommended to establish causality and determine the benefits of targeted micronutrient therapy in preventing and managing
CAP in children.

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