

Role of Zinc and 25(OH) D3 in Acute Bronchiolitis

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Abstract:

Background: When it comes to infections of the lower respiratory tract, acute bronchiolitis is among the most prevalent among infants less than two years old. This study aimed to investigate the correlation between the severity of acute bronchiolitis in infants and levels of zinc and vitamin D. **Methods:** One hundred children participated in this cross-sectional comparison study. The research was conducted at Benha University's Pediatrics and Neonatology Department and Benha Teaching Hospital. Two equal groups were formed from all the patients: a control group (n=50) and a patient group (n=50). **Results:** Management strategies for pediatric patients with acute bronchiolitis in relation to blood zinc and vitamin D3 levels. Patients treated at home, in a hospital ward, or in a PICU did not exhibit significant variations in blood vitamin D3 levels. Similarly, there was no statistically significant difference in serum zinc levels between the treatment groups. Although bronchiolitis patients may have vitamin D3 and zinc deficiency, these results do not appear to indicate a correlation between the severity of the condition and the need for intensive care or hospitalization. **Conclusion:** Zinc and vitamin D3 blood levels are much lower in infants with acute bronchiolitis when compared with healthy controls. Regardless of clinical severity, these abnormalities were common. Although they did not correlate with specific clinical or laboratory indicators of illness severity, their role in immune modulation suggests that they may influence susceptibility and overall immunological resistance.

Keywords: Zinc; Vitamin D3; Acute Bronchiolitis.

Introduction

When it comes to infections of the lower respiratory tract, acute bronchiolitis is among the most prevalent in infants under the age of two. Airway blockage, wheezing, and trouble breathing are common symptoms caused by inflammation, swelling, and necrosis of the epithelial cells lining the tiny airways. The most common cause is respiratory syncytial virus (RSV), but other viruses may play a role.⁽¹⁾

Both the onset and clearance of bronchiolitis are influenced by the immune response. The role of micronutrients, especially zinc and vitamin D, in immune function and vulnerability to respiratory infections has garnered increasing attention in recent years. The respiratory epithelium relies on the trace element zinc to maintain its structure and function. It strengthens mucosal defense, modifies antiviral immunity, and increases ciliary activity in the lining of the bronchi.⁽²⁾

Zinc and vitamin D3 were studied together because both are essential for immune function. Zinc supports cellular immunity, while vitamin D3 regulates both innate and adaptive responses. Their combined evaluation helps clarify whether they act synergistically or independently in the treatment of acute bronchiolitis. It was reported that vitamin D and zinc may have beneficial effects in the treatment of bronchiolitis.⁽³⁾

Vitamin D is not only an essential nutrient for bone and calcium metabolism but also an effective immunomodulator. Innate and adaptive immunity are both influenced by their ability to regulate inflammation and the production of antimicrobial peptides, such as cathelicidin. There may be a correlation between vitamin D insufficiency and the severity of bronchiolitis, as vitamin D levels fluctuate throughout the year and are highest in the winter.⁽⁴⁾

Bronchiolitis is a common and costly illness worldwide, particularly in developing nations, but little is known

about the role these micronutrients play in the development and progression of the disease.⁽⁵⁾

The objective of the current study was to investigate the correlation between zinc and vitamin D levels and their relationship to the severity of acute bronchiolitis in infants.

Patients and methods

A hundred kids were a part of this cross-sectional comparison research. From September 2023 to March 2024, researchers from Benha University's Paediatrics and Neonatology Department, in collaboration with Benha Teaching Hospital (MOH), conducted the study.

We ensured that we obtained patients' written informed consent. A secret code and an explanation of the study's goal were given to each subject. The Research Ethics Committee, Faculty of Medicine, Benha University, and the Ministry of Health all provided their approval before the commencement of the research.

Approval code: MS 4-11-2023

The inclusion criteria were that acute bronchiolitis was diagnosed in all male and female infants admitted to the Pediatric Department or Outpatient Clinic between the ages of one month and thirty months, based on their medical history, symptoms, and physical examination results.

Exclusion criteria included infants and toddlers, infants with certain medical conditions (such as those affecting the kidneys, liver, or gastrointestinal tract, or those with damaged immune systems), and those in critical care (such as those requiring ventilator support or those with pneumonia as a complicating factor).

Grouping:

Two equal groups were formed from all the patients: a control group (n=50) and a patient group (n=50).

All studied cases were subjected to the following: Detailed history taking, including [Information about the patient, including their age and gender, current

symptoms (cough, wheezing, and respiratory distress), length of time symptoms have persisted, how they have progressed (worsening, plateauing, or improving), past medical history (including previous episodes of wheezing or respiratory illnesses), prematurity, neonatal history (including admission to the neonatal intensive care unit (NICU), intubation, or oxygen therapy, medications, birth and developmental history (including mode of delivery, birth weight, and milestones), and Family history (including asthma, allergies, or atopy in parents or siblings) are all required. **Full clinical examination:** **General examination including** [Overall health status, including alertness, signs of respiratory distress, signs of dehydration, vital signs, temperature, respiration rate, heart rate (tachycardia), oxygen saturation (SpO₂), blood pressure, palpation (chest expansion, tracheal position), percussion (hyper-resonance, dullness), auscultation, cardiovascular (heart sounds), gastrointestinal (abdominal distension, signs of feeding intolerance or vomiting), neurological (mental status, tone, and skin colour), indications of dehydration, and

Laboratory investigations

Automated haematology analyzers, such as Sysmex or Coulter, process samples for complete blood counts (CBCs) in as little as two to four hours. Several important parameters were measured, including red blood cells (RBCs), haemoglobin (Hb), haematocrit (a measure of the percentage of haemoglobin in the blood), white blood cells (WBCs), and platelets (measured by impedance, fluorescence, or both).

C-Reactive Protein (CRP) in Serum as Detected by ELISA: The electrochemical immunosorbent assay (ELISA) method requires the addition of CRP-specific antibodies to a microplate, along with controls, standards, and serum samples. After that, we added an enzyme-linked secondary antibody, incubated the mixture, and washed it to eliminate any unattached substances. The addition of a chromogenic

substrate, such as TMB, caused a colour response that was directly proportional to the concentration of CRP. A dependable evaluation of systemic inflammation was achieved by measuring the colour intensity at 450 nm using an ELISA reader.

Using a chemiluminescent immunoassay, the vitamin 25(OH)D level was measured. An enzyme-labelled antibody produced a chemiluminescent signal after incubating serum samples with antibodies specific to 25(OH)D. A luminometer was used to detect the signal after washing to eliminate unbound compounds.

Using atomic absorption spectrophotometry, the serum zinc level was determined. After preparing the standards, controls, and serum samples, the aspirated samples were fed into the zinc detection apparatus. Accurate measurement of serum zinc levels was achieved by measuring absorbance at a wavelength that is unique to zinc, which is 213.9 nm.

The purpose of the Arterial Blood Gas (ABG) test was to measure the patient's acid-base balance, ventilation, and oxygenation. Using aseptic methods, 0.5-1 mL of arterial blood was drawn, usually from the radial artery. It was ensured that there was sufficient collateral circulation before the sample by performing Allen's test. To keep the results accurate, the sample was analyzed immediately after being treated with heparin to prevent clotting. Using an automated ABG analyzer, the blood was processed. Some of the parameters evaluated were pH, used to assess acid-base balance, PaCO₂ and PaO₂, bicarbonate, and base excess.

Imaging

To begin imaging the heart, lungs, and surrounding areas, a chest X-ray was taken. If there were any anomalies, such as pleural effusion, consolidation, or lung enlargement, it provided important information. For better diagnosis, we got the standard lateral and posterior-anterior (PA) images.

When a chest X-ray did not provide a complete picture, such as in instances of emphysema, pneumothorax, or other structural abnormalities, a computed tomography (CT) scan of the chest was ordered. The pleura, mediastinum, and lung parenchyma can be examined in detail using CT imaging's high-resolution, cross-sectional images of the chest cavity. Using a multi-detector CT system, thin-slice reconstruction and contrast enhancement were used as necessary to conduct CT scans.

Sample size calculation:

The sample size was calculated according to the O₂ saturation, which increased in the vitamin D group from $89.7 \pm 9.5\%$ on the 1st day, reaching $94 \pm 3.5\%$ on the 3rd day, according to a previous study (3). Based on the following considerations: 0.05 α error and 80% power of the study. Ten cases were added to overcome dropout. Therefore, 100 patients were allocated (50 patients in each group).

Statistical analysis

With the help of IBM's Statistical Package for the Social Sciences (2017, Released), we coded, tabulated, and transferred the data we gathered to a computer. Armonk, New York: IBM Corp., (IBM SPSS Statistics for Windows, Version 25.0). The data type of each parameter informed the presentation and analysis of the resulting data. Validity of data, including Kolmogorov-Smirnov evaluation. Numbers that describe something: Parametric numerical data is represented by the mean and standard deviation ($\pm$ SD), while the median and range represent non-parametric numerical data. Frequency and proportion of non-numerical data. Statistical analysis, including the following: the student's t-Test, the Mann-Whitney test, the Kruskal-Wallis's test, the chi-square test, the receiver operating characteristic curve, regression analysis, and connection analysis. The application of generalized linear models in linear regression analysis allowed for the prediction of risk variables. The likelihood

of the outcomes was determined, and an odds ratio and 95% confidence interval were computed. With a 95% confidence interval, a p-value is deemed significant if it is less than or equal to 0.05. ⁽⁶⁾.

Results

Table 1 shows a statistically significant age difference ($p < 0.05$) between the control and sick groups, but no significant difference in sex distribution. There were statistically significant variations in the symptoms reported by the control group and the pediatric patients with acute bronchiolitis ($p = 0.000$). These findings emphasize the importance of a fever, cough, and difficulty breathing as distinct symptoms in children suffering from acute bronchiolitis. Acute bronchiolitis in children was significantly different from the control group in terms of vital signs. The heart rate (HR) and respiratory rate (RR) of the sick group were noticeably higher than those of the control group ($p < 0.05$). O₂ Sat RA, the oxygen saturation level in room air, was significantly lower in the control group compared to the patients ($p = 0.000$). These results indicate that children with acute bronchiolitis frequently exhibit a rapid heartbeat, shallow breathing, and low oxygen saturation. There was a statistically significant difference in blood zinc and vitamin D3 levels between the control group and children with acute bronchiolitis. The levels of blood zinc and vitamin D3 were significantly decreased in the sick group compared to the control group ($p < 0.05$).

Table 2 displays the patient group's medical history, physical exam, CBC and CRP results, ABG data, treatment plan, and serum vitamin D3 and zinc levels.

Table 3 examines the relationship between vitamin D3 levels in blood and several laboratory variables in children with acute bronchiolitis. Vit D3 and arterial blood gas indicators, such as pH, PCO₂, and HCO₃, did not correlate significantly with haemoglobin (Hb), total leukocyte count

(TLC), platelet count, C-reactive protein, or serum vitamin D3. These findings suggest that there is no direct correlation between blood vitamin D3 levels and specific haematological or respiratory indicators in children with acute bronchiolitis. There were no significant correlations found between serum zinc and HB, TLC, platelet count, or C-reactive protein in paediatric patients with acute bronchiolitis. There were, however, correlations between serum zinc and arterial blood gas parameters, including pH, PCO₂, and HCO₂, as well as haematological or respiratory markers—the relationship between zinc and vitamin D3 levels in the blood of children suffering from acute bronchiolitis. According to the study, there was a slight positive association ($r = 0.12$) that was not statistically significant. These data suggest

a lack of direct correlation between zinc levels and blood vitamin D3 levels in this patient category.

Table 4 examines the correlation between zinc and vitamin D3 levels in blood and the treatment strategy for children with acute bronchiolitis. Serum vitamin D3 levels were not significantly different among children treated in the paediatric intensive care unit (PICU), the hospital ward, or both. Similarly, there was no statistically significant difference in serum zinc levels between the treatment groups. Although bronchiolitis patients may have vitamin D3 and zinc deficiency, these results do not appear to indicate a correlation between the severity of the condition and the need for intensive care or hospitalization.

Table 1: Personal history, symptoms of disease, vital signs among the studied groups

Variable			Patient group (N=50)	Control group (N=50)	t-test	P- value
Personal history	Age (m)	Mean $\pm$ SD	9.6 $\pm$ 6.7	12.4 $\pm$ 6.8	-2.1	0.038*
		Median	8	11	(MW)	
		Range	1-26	1-28		
Symptoms	Sex	Maleh	27 (54%)	34 (68%)	$\chi^2 = 2.1$	0.218
		Female	23 (46%)	16 (32%)		
Vital signs	Temperature (m)	Mean $\pm$ SD	38.2 $\pm$ 0.55	36.8 $\pm$ 0.2		0.000*
		Range	36.9-39.1	36.5-37.1	-16.9	
Vital signs	Cough		50 (100%)	0 (0%)	Fisher	0.000*
		Difficult of breath	50 (100%)	0 (0%)	Fisher	
	HR	Mean $\pm$ SD	117.7 $\pm$ 21.6	108.1 $\pm$ 11.8	2.8	0.007*
		Range	82-152	92-138		
	RR	Mean $\pm$ SD	46.1 $\pm$ 12.9	29.5 $\pm$ 6.9	7.9	0.000*
		Range	25-70	20-46		
	O ₂ Sat RA	Mean $\pm$ SD	94.9 $\pm$ 4.5	98.9 $\pm$ 1.1	-6.04	0.000*
		Range	84-100	97-100		
	S. Vit D3	Mean $\pm$ SD	19 $\pm$ 16.4	30.7 $\pm$ 9.6		0.000*
		Median	11.5	29	-4.4	
		Range	7.1-78	16-55		
S. Zinc		Mean $\pm$ SD	45.1 $\pm$ 20.9	84.1 $\pm$ 11.5	-11.6	0.000*
		Median	38	83		
		Range	22-112	68-112		

Data represents as frequency (percentage) or mean $\pm$ standard deviation. Chi-square (χ^2) and t- tests were used. S: significant, MW: Mann Whitney. HR: heart rate, RR: respiratory rate. RD: Respiratory distress. O₂ Sat RA: oxygen saturation in room air. Bold values are statistically significant at $p < 0.05$.

Table 2: History, examination, CBC & CRP, ABG data, plan of management, S. Vit D3 & S. Zinc among the patient group

Variable		N (50)	%
Previous admission	PICU	3	6
	NICU	6	12
	Word	12	24
Examination	Wheezy	50	100
	Coarse crepitation	23	46
	Air entry	35	70
	Fair	15	30
	D	28	56
	RD grade	14	28
Plan of management	1	8	16
	2	28	56
	3	14	28
	Home TTT	8	16
CBC	Ward	28	56
	PICU	14	28
	Mean $\pm$ SD	8	16
	Range		
ABG data	HB (g/dl)	10.5 $\pm$ 0.79	9.4-13
	TLC (10 ⁹ /ul)	8.9 $\pm$ 2.6	5-14.1
	PLT (1000/ul)	187 $\pm$ 55	111-316
	CRP (mg/l)	7.8 $\pm$ 3.6	1-19
ABG data	PH	7.3 $\pm$ 0.07	7.19-7.44
	PCO ₂	40.2 $\pm$ 6.2	23-57
	HCO ₃	21.8 $\pm$ 2.5	15.6-26.1

Data represented as frequency (percentage) or mean $\pm$ standard deviation. PICU: paediatric intensive care unit, NICU: neonatal intensive care unit, TTT: treatment, HB: haemoglobin, TLC: total leucocyte count, PLT: platelets, CBC: complete blood count, CRP: C-reactive protein, ABG: Arterial Blood Gas.

Table 3: Correlation between S. Vit D3 and other variables, between S. Zinc and other variables and between S. Vit D3 and S. Zinc among patient groups

Variable	S. Vit 3 D3		S. Zinc	
	r	p-value	r	p-value
HB	-0.015	0.916	0.088	0.545
TLC	0.177	0.218	-0.191	0.185
PLT	-0.051	0.707	0.106	0.464
CRP	0.006	0.966	-0.208	0.147
PH	0.028	0.426	-0.074	0.610
PCO ₂	0.006	0.969	0.112	0.438
HCO ₃	0.133	0.358	0.049	0.737
S. Zinc	0.102	0.480	--	--

Data represented as numbers. HB: haemoglobin, TLC: total leucocyte count, PLT: platelets, CRP: C-reactive protein, S. Zinc: serum zinc.

Table 4: Association between S. Vit D3, S. Zinc and Plan of management among patient groups

Variable		Plan of management			K-Test	P-value
		Home TTT (N=28)	Ward (N=14)	PICU (8)		
S. Vit D3	Mean $\pm$ SD	20.7 $\pm$ 18.9	19 $\pm$ 15.1	13.2 $\pm$ 5.3	0.642	0.531
	Median	11.5	12.7	12.1		
	Range	7.1-78	8.5-64	7.8-23		
S. Zinc	Mean $\pm$ SD	41.4 $\pm$ 17.8	52.1 $\pm$ 25	45.6 $\pm$ 22.9	1.3	0.294
	Median	36.5	43.5	40		
	Range	23-89	28-112	22-90		

Data represented as Mean $\pm$ SD, Median or Range. TTT: Treatment, PICU: Paediatric intensive care unit.

Discussion

Acute bronchiolitis is one of the most common acute lower respiratory infections in infants. Bronchiolitis is a common presentation to emergency departments, following a seasonal pattern. It is common under the age of two years, with most outbreaks seen at 2 - 8 months. Acute bronchiolitis is a viral disease caused by the respiratory syncytial virus (RSV) in more than 50% of cases ⁽⁷⁾.

The present study compared 50 children with acute bronchiolitis to 50 healthy controls, revealing key demographic and clinical differences. The bronchiolitis group was slightly younger, consistent with prior research showing that infants under 12 months are at higher risk due to immature immune systems and narrower airway ⁽⁸⁾.

In the current study, management strategies varied by severity: 56% of cases were mild (outpatient), 28% required general ward admission, and 16% needed PICU care. This distribution reflects the natural spectrum of bronchiolitis, where most cases are self-limiting but a subset progress to respiratory failure. Similar findings were reported by Hasegawa et al. (2014), who noted that 20–30% of hospitalized infants required ICU admission, often due to hypoxemia or apnea. The high outpatient rate in our study suggests effective triage, though the 44% hospitalization rate underscores the disease's potential severity. ⁽⁹⁾

Patients in our group were also identified by their vital signs, which included a rapid heart rate, tachypnea, and low oxygen saturation. These align with the work of Destino et al. ⁽¹⁰⁾ who determined that tachypnea and SpO₂ <92% were indicators of the need for hospitalization. The obstructive pathophysiology of bronchiolitis, in which mucus and airway oedema block ventilation, is mirrored by the substantial respiratory rate rise. ⁽¹¹⁾ Studies have shown a correlation between hypoxemia, a critical severity measure, and longer hospitalization when SpO₂ <95%. ⁽¹²⁾

According to the participants' medical histories, 42% of those with bronchiolitis had been hospitalized in the past, whereas 58% had never been. The newborn intensive care unit (NICU) had 12% of the patients, while the pediatric intensive care unit (PICU) had 6%

According to previous research, severe bronchiolitis is more likely among infants who are born prematurely, have a low birth weight, or have been admitted to the neonatal intensive care unit (NICU) or pediatric intensive care unit (PICU) before ^(11, 13).

In addition, 24% had been admitted to the general ward before, which lends credence to the idea that a history of respiratory infections increases vulnerability, possibly as a result of stunted lung development or chronic inflammation of the airways ⁽¹⁴⁾. A study by Garcia-Garcia et al. (15) reported that babies who had been hospitalized

before were 2.5 times more likely to have severe bronchiolitis, which backed our results.

All patients in our cohort presented with wheezing. The American Academy of Pediatrics and other international diagnostic standards agree that wheezing and respiratory distress are the primary symptoms of bronchiolitis in children under two years old.⁽¹³⁾ While wheezing is diagnostically useful, it is not pathognomonic since other illnesses (such as asthma or foreign body aspiration) might also manifest similarly in all individuals.⁽¹⁶⁾

46% of our cases had coarse crepitations. This suggests the possibility of inflammation in the smaller airways and alveoli occurring simultaneously, most likely due to cellular debris and mucus clogging. This finding is consistent with studies by Hasegawa et al.⁽⁹⁾ who discovered that crackles in bronchiolitis patients are associated with inflammatory exudate and virus-induced damage to the epithelium. The fact that 54% of patients do not exhibit crepitus suggests that there is variation in the clinical presentation, which may be influenced by factors such as disease severity or the type of virus (e.g., RSV vs. rhinovirus).⁽⁸⁾

The present study revealed no significant correlations between serum vitamin D3 or zinc levels and common clinical or laboratory markers in bronchiolitis patients. Vitamin D3 showed no meaningful association with blood counts, CRP, or arterial blood gases, while zinc had only weak, non-significant trends. The two micronutrients were also not correlated with each other.

The slightly acidic mean pH in our study suggests metabolic responses to respiratory acidosis in severe cases. This matches data from McKiernan et al. (17) where pH < 7.3 predicted ICU admission. The wide PCO₂ range (23–57 mmHg) reflects variable respiratory compensation, consistent with Javouhey et al. (18), who

found hypercapnia in 20% of hospitalized bronchiolitis patients.

This study demonstrated that children with acute bronchiolitis had significantly lower serum levels of both vitamin D3 and zinc compared to healthy controls ($p < 0.001$). Deficiency states were evident for both micronutrients in the patient group, whereas the control group maintained consistently normal levels. Notably, bronchiolitis patients exhibited wide variability in vitamin D3 and zinc concentrations, indicating differing degrees of deficiency that may contribute to variations in disease susceptibility and severity among children.

Vitamin D plays a pivotal role in modulating the innate immune system, particularly by inducing antimicrobial peptides such as cathelicidin and defensins, which are crucial for defending against respiratory pathogens (19). These peptides enhance the activity of neutrophils and macrophages (20), thereby boosting mucosal immunity in the respiratory tract. UV-induced synthesis of vitamin D in the skin leads to increased cathelicidin levels; conversely, reduced UV exposure during winter lowers vitamin D levels and may account for the higher incidence of bronchiolitis during colder months (21).

Multiple studies support the association between vitamin D deficiency and bronchiolitis. Belderbos et al. (22), Kawashima et al. (23), and Mohamed & Al-Shehri (24) all reported significantly lower serum vitamin D levels in children with bronchiolitis. Similarly, Golan-Tripto et al. (19) found lower vitamin D levels in bronchiolitis cases compared to children with non-respiratory febrile illnesses. Vo et al. (25) further demonstrated that reduced vitamin D levels were linked to an increased risk of hospitalization in bronchiolitis.

However, not all studies have found consistent associations. Beigelman et al. (26), Roth et al. (27), and McNally et al. (28) did not observe significant

correlations between vitamin D status and severity of bronchiolitis. These discrepancies may be attributed to geographic and seasonal differences in sunlight exposure, variations in vitamin D supplementation practices, and population-based genetic differences such as vitamin D receptor polymorphisms (29).

Despite conflicting findings in the literature, some intervention studies offer promising insights. Saad et al. (20) reported that vitamin D supplementation significantly improved clinical outcomes and reduced the duration of hospitalization in infants with bronchiolitis. Khoshnevisasl et al. (3) observed reductions in respiratory rate and hospital stay in vitamin D-treated groups, although these differences did not reach statistical significance.

In the present study, while vitamin D3 levels were slightly higher in outpatient-managed children and lower in PICU patients, the differences were not statistically significant. Additionally, there was no significant correlation between vitamin D3 levels and laboratory or clinical markers, suggesting that its immunological role in bronchiolitis may not be directly reflected through acute-phase indicators and require further immunological exploration.

Zinc is another essential micronutrient involved in maintaining respiratory tract immunity. It supports epithelial barrier function, enhances antiviral defense, and regulates immune cell function. In our study, serum zinc levels were also significantly lower in bronchiolitis patients than in controls ($p < 0.001$). However, no significant association was found between zinc levels and clinical severity or lab markers ($p = 0.294$), indicating that its role may be more subtle and not readily observable through conventional parameters.

Several previous studies were in agree with our findings. Ibraheem et al. (30) in Nigeria and Brooks et al. (31) reported that children with acute lower respiratory

infections had low serum zinc levels. Zinc supplementation has shown more pronounced benefits in bacterial pneumonia, especially when infants with viral bronchiolitis were excluded, suggesting that zinc's protective effects may be pathogen specific.

Interventional studies on zinc in bronchiolitis have produced variable results. Heidarian et al. (32) and Malik et al. (33) found no significant differences in clinical improvement or prevention of respiratory infections with zinc supplementation. Similarly, Coles et al. (34) and Somé et al. (35) concluded that zinc's prophylactic efficacy may vary depending on the etiology of the infection. Moreover, studies by Srinivasan et al. (36) and Fataki et al. (37) showed no reduction in hospital stay or improvement in clinical outcomes with zinc therapy in pneumonia patients.

In this cohort, zinc levels did not vary significantly across different treatment settings (home management, ward admission, PICU), and no strong correlations were observed with inflammatory or hematological markers. This suggests that, like vitamin D, zinc's impact may lie more in modulating host defense mechanisms rather than influencing acute clinical manifestations.

Our study had limitations as the relatively small sample size, Lack of Longitudinal Data, No Assessment of Dietary Intake, Seasonal and Sunlight Exposure Variability and the study did not include detailed immunologic profiling (e.g., cathelicidin levels, cytokine profiles) to explore the mechanistic roles of these micronutrients.

Conclusion

Vitamin D3 and zinc blood levels are much lower in children with acute bronchiolitis as compared to healthy controls, according to this research. These deficiencies were prevalent regardless of clinical severity, and while they did not significantly correlate with specific

clinical or laboratory markers of disease severity, their role in immune modulation suggests a potential influence on susceptibility and overall immune resilience. The findings support existing evidence that nutritional status, particularly micronutrient levels, may play a role in the host's response to respiratory infections like bronchiolitis, even if not directly reflected in acute-phase clinical parameters.

Therefore, future trials are needed to evaluate the potential benefits of zinc and vitamin D supplementation as adjunctive therapy in the treatment or prevention of bronchiolitis. Promote adequate maternal and infant nutrition, including appropriate vitamin D and zinc intake through diet or supplementation, particularly in vulnerable populations. Routine screening: to evaluate vitamin D3 and zinc levels in infants at high risk for respiratory infections, especially during bronchiolitis seasons.

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Conflicts of interest

No conflicts of interest

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