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# Analysing Serum Sodium Levels Among Children Admitted with Lower Respiratory Tract Infections in a Tertiary Hospital Setting

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**ABSTRACT**

Respiratory infections affecting the lower respiratory tract, situated beneath the larynx, encompass various conditions such as pneumonia, wheeze-associated lower respiratory tract infection (LRTI), bronchiolitis and empyema. This study sought to ascertain the prevalence of hyponatremia in children, with a particular focus on exploring potential electrolyte imbalances in those experiencing severe pneumonia and evaluating their clinical outcomes. A retrospective descriptive enrolled children aged between 1 month and 5 years exhibiting signs and symptoms of LRTI. The severity of hyponatremia was compared across different types of pneumonia and other lower respiratory tract infections based on radiographic findings. Data collection included information on hospital stay duration in the Pediatric Intensive Care Unit (PICU) or ward, the necessity for oxygen and ventilator support, mechanical ventilation duration and the final patient outcome in terms of complications, discharge and mortality. The assessment of hyponatremia's impact on morbidity and mortality in pneumonia patients was compared to patients with normonatremia. The study revealed an equal distribution of patients between the hyponatremia and normonatremia groups, with a male predominance. Significantly higher incidence of hyponatremia was observed among patients diagnosed with pneumonia compared to those with empyema and bronchiolitis. However, the study did not identify a significant association between hyponatremia and adverse clinical outcomes. We found a higher incidence of hyponatremia in children with lower respiratory tract infections, particularly in those with pneumonia compared toDecember 19, 2023 other lower respiratory tract infections. Notably, hyponatremia did not exhibit a significant impact on patient outcomes.

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**Key Words**
Lower respiratory tract infection, hyponatremia, child, india

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## INTRODUCTION

Lower respiratory tract infection (LRTI) denotes an infection situated beneath the larynx, encompassing conditions such as pneumonia, wheeze-associated LRTI, bronchiolitis and empyema. LRTIs represent a predominant cause of morbidity and mortality globally, particularly impacting children under 5 years, with staggering statistics of 1 billion episodes annually and 703,918 deaths[1,2].

Acute lower respiratory infections (ALRI) emerge as the primary infectious cause of child mortality worldwide, contributing to 1-2 million fatalities and 12 million hospitalizations. Pneumonia, constituting 17% of all deaths in children under five in India, imposes a substantial burden, evident in a 2013 study estimating the direct cost of ALRI-related hospitalization to be 34% of the yearly per capita income. Given the profound health and economic implications, evidence-based public health interventions for ALRI prevention and treatment, including a comprehensive understanding of its etiology, are imperative. Hyponatremia, a recurrent electrolyte imbalance, emerges as a complicating factor influencing the management and outcomes of pneumonia[3-7].

Within the context of LRTI, factors such as diminished water excretion, inappropriate vasopressin secretion (SIADH), utilization of low osmolality fluids, fluid and electrolyte imbalances and various medications can contribute to the development of hyponatremia. Defined as a serum sodium level below 135 mEq L[8,9], hyponatremia may often go unnoticed, significantly contributing to morbidity and mortality independent of the primary pathology. The implications of undetected and untreated serum electrolyte abnormalities can be dire. Therefore, this study aimed to assess the prevalence of hyponatremia in children, endeavoring to establish correlations between potential electrolyte disturbances and the outcomes of severe pneumonia.

## MATERIAL AND METHODS

This retrospective descriptive investigation was conducted encompassing all patients admitted with LRTI in a tertiary care hospital in India. The study included children aged between 1 month and 5 years displaying signs and symptoms of LRTI. Exclusion criteria comprised children undergoing drug therapies potentially causing hyponatremia (e.g., diuretics), those with diagnosed tuberculosis or asthma and individuals with hyperlipidemia, hyperproteinemia, hyperglycemia.

Demographic information, including patient's names, ages, genders and addresses, was collected. Anthropometric data, such as height and weight, were also recorded. Symptoms (cough, fever, breathlessness, wheeze, stridor or grunting and chest indrawing) and signs (tachypnea, chest indrawing, audible wheeze) were systematically documented and analysed. Systemic findings, vital signs and laboratory results, including complete blood count (CBC) and serum electrolytes, were retrieved from case records. Radiological investigations, particularly chest x-rays, were meticulously noted. Relevant details regarding the management, encompassing mechanical ventilation, fluids and inotropes, blood products, antibiotics and other prescribed medications, were included. The study concluded by noting the outcomes for subsequent analysis.

The severity of hyponatremia was assessed in relation to pneumonia types and other lower respiratory tract infections based on x-ray findings. Data regarding the duration of hospital stay in the PICU or ward the necessity for oxygen, ventilator support, and the duration of mechanical ventilation were collected. The final outcomes, comprising complications, discharge and mortality, were evaluated. Hyponatremia's impact on morbidity and mortality in pneumonia patients was compared to patients with normonatremia.

Statistical analysis involved inputting data into Microsoft Excel, and SPSS version 22.0 was utilized for comprehensive analysis. Results were presented in terms of frequency and percentage for categorical variables and mean with standard deviation for continuous variables. A $p<0.05$ was considered statistically significant.

## Results

The current investigation recorded a cohort of patients presenting with hyponatremia (n = 48) alongside a normonatremia group (n = 48), revealing a male predominance as detailed in Table 1. Upon evaluating symptoms, no statistically significant differences were observed between the groups concerning fever, breathlessness, wheeze, stridor, grunting and chest indrawing among the patients. The distribution of patients displaying pallor and requiring oxygen saturation was equally distributed across the groups. An examination of the respiratory system indicated consistent findings between the two groups concerning chest symmetry, percussion and auscultation results among the patients, as outlined in Table 2.

In the scrutiny of blood parameters in the context of hyponatremia, a noteworthy correlation emerged, showing a significantly higher Total Leukocyte Count (TLC) among hyponatremic patients compared to their normonatremic counterparts (refer to Table 3). Regarding the classification of Lower Respiratory Tract

Table 1: Demographic parameters of study participants

| | Hyponatremia | | Normonatremia | | |
|---|---|---|---|---|---|
| Variable | n | % | n | % | p-value |
| Sex | | | | | |
| Female | 7 | 14.58 | 10 | 20.83 | 0.56 |
| Male | 18 | 37.50 | 13 | 27.08 | |
| Age | | | | | |
| 1m-1yr | 11 | 22.92 | 14 | 29.17 | 0.61 |
| 1-5yr | 14 | 29.17 | 9 | 18.75 | |

Table 2: Symptoms and Signs comparison in study participants

| | Hyponatremia | | Normonatremia | | |
|---|---|---|---|---|---|
| Symptoms | n | % | n | % | p-value |
| Fever | | | | | |
| Absent | 6 | 12.50 | 4 | 8.33 | 0.45 |
| Present | 19 | 39.58 | 19 | 39.58 | |
| Cough | | | | | |
| Absent | 3 | 6.25 | 2 | 4.17 | 0.38 |
| Present | 22 | 45.83 | 21 | 43.75 | |
| Breathlessness | | | | | |
| Absent | 5 | 10.42 | 11 | 22.92 | 0.28 |
| Present | 21 | 43.75 | 11 | 22.92 | |
| Stridor | | | | | |
| Absent | 11 | 22.92 | 14 | 29.17 | 0.26 |
| Present | 14 | 29.17 | 9 | 18.75 | |
| Wheezing | | | | | |
| Absent | 10 | 20.83 | 16 | 33.33 | 0.45 |
| Present | 16 | 33.33 | 6 | 12.50 | |
| Chest indrawing | | | | | |
| Absent | 3 | 6.25 | 10 | 20.83 | 0.52 |
| Present | 22 | 45.83 | 13 | 27.08 | |
| Grunting | | | | | |
| Absent | 13 | 27.08 | 16 | 33.33 | 0.43 |
| Present | 13 | 27.08 | 6 | 12.50 | |
| Pallor | | | | | |
| Present | 5 | 10.42 | 6 | 12.50 | 0.67 |
| Absent | 19 | 39.58 | 18 | 37.50 | |
| Oxygensaturation | | | | | |
| < 95 | 4 | 8.33 | 7 | 14.58 | 0.58 |
| > 95 | 21 | 43.75 | 16 | 33.33 | |
| Chest-symmetrical | | | | | |
| No | 5 | 10.42 | 6 | 12.50 | 0.72 |
| Yes | 18 | 37.50 | 19 | 39.58 | |
| Auscultation | | | | | |
| Creps | 8 | 16.67 | 3 | 6.25 | 0.84 |
| Rhonchi | 3 | 6.25 | 2 | 4.17 | |
| Creps+rhonchi | 8 | 16.67 | 6 | 12.50 | |
| Normal | 8 | 16.67 | 10 | 20.83 | |

Table 3: Comparison of Laboratory Parameters in study participants

| Parameter | Hyponatremia | Normonatremia | p-value |
|---|---|---|---|
| Total leukocyte count | 14.5±7.2 | 12.8±10.0 | 0.027 |
| Haemoglobin | 11.3±2.1 | 10.1±1.8 | 0.486 |
| Neutrophil count | 44±20 | 34±14 | 0.121 |
| Lymphocyte count | 44±18 | 50.2±18.0 | 0.168 |
| Platelet count | 360.5±145.8 | 287.5±160.3 | 0.297 |
| ESR | 32±19 | 26.5±22.8 | 0.458 |

Table 4: Comparison of diagnosis and outcome in study participants

| | Hyponatremia | | Normonatremia | | |
|---|---|---|---|---|---|
| Parameter | n | % | n | % | p-value |
| Diagnosis | | | | | |
| Pneumonia | 16 | 33.33 | 10 | 20.83 | 0.03 |
| Empyema | 3 | 6.25 | 0 | 0.00 | |
| Bronchiolitis | 6 | 12.50 | 13 | 27.08 | |
| Outcome | | | | | |
| Complications | 0 | 0.00 | 0 | 0.00 | 0.3 |
| Death | 0 | 0.00 | 2 | 4.17 | |
| Discharge | 24 | 50.00 | 21 | 43.75 | |

Infections (LRTI) in association with hyponatremia, a markedly higher incidence of hyponatremia was observed in patients diagnosed with pneumonia compared to those diagnosed with empyema and bronchiolitis. The present study did not identify any significant association between hyponatremia and

adverse outcomes. Notably, all patients in the hyponatremia group were discharged during their admission, as depicted in Table 4.

## DISCUSSIONS

The foremost electrolyte imbalance encountered is hyponatremia, which may stem from endogenous sodium dysregulation, iatrogenic causes, a combination of both, particularly in critically unwell children. Those admitted to critical care units due to respiratory insufficiency or failure arising from lower respiratory tract infections face an elevated risk of hyponatremia. This risk may be attributed to dysregulation of arginine vasopressin, antidiuretic hormone, excessive administration of free water or sodium deficiency. Hyponatremia significantly amplifies morbidity and mortality rates in children with lower respiratory tract diseases[6,10].

The present study unveiled a notably higher incidence of hyponatremia among patients diagnosed with pneumonia compared to those with empyema and bronchiolitis. In concurrence, a study by Chaitra et al. noted hyponatremia in 46.7% of children with bronchopneumonia. Predominantly, cases exhibited mild hyponatremia (71%), with 21.4% classified as moderate and only 7% as severe. Moderate hyponatremia was generally asymptomatic. Lobar pneumonia the second most prevalent respiratory infection in the sample, showed hyponatremia in 50% of cases, with 5 having moderate hyponatremia and 1 severe hyponatremia[2]. In alignment with our findings, Mhatre *et al*. reported a prevalence of 42.3% for hyponatremia in pediatric patients with lower respiratory tract infection. The pneumonia group exhibited a higher prevalence of hyponatremia (91.66%) compared to the non-pneumonia group (8.33%). Severity of pneumonia correlated with a higher frequency of severe hyponatremia, emphasizing the significance of early detection and appropriate intervention for the prognosis of children with pneumonia[11].

Attri *et al*. conducted a study where clinical indicators in hyponatremic vs. isonatremic groups were evaluated across different age groups. The investigation revealed that clinical signs of respiratory distress were more prevalent in the hyponatremic group than the isonatremic group, though the difference was not statistically significant[12]. This finding resonates with our present study. A study by Channawar K S identified moderate hyponatremia in 18.5% and severe hyponatremia in 5.5% out of 54 cases. Similar findings have been reported by Singhi *et al*., associating severe hyponatremia with a threefold increase in the risk of mortality. Another prospective study by Dhawan and colleagues revealed a 3.5-fold increase in mortality in hyponatremic patients compared to normonatremic patients, aligning with our present study[13-15].

## CONCLUSION

The present study recorded an increased frequency of hyponatremia in individuals with lower respiratory tract infection. Specifically, hyponatremia was more prevalent in children with pneumonia compared to those with other lower respiratory tract infections examined in the study. Importantly, the research did not identify a significant influence on patient outcomes. Diligent fluid management, especially employing fluid restriction therapy, in conjunction with tailored interventions addressing the underlying cause, proves to be a beneficial strategy in minimizing the risk of morbidity and related consequences in these paediatric cases.

## REFERENCES


1. Otters, H.B., J.C.V. Wouden, F.G. Schellevis, L.W. van Suijlekom-Smit and B.W. Koes, 2005. Changing morbidity patterns in children in dutch general practice: 1987–2001. Eur. J. Gen. Pract., 11: 17-22.
2. C.M., M.N. and S. G, 2016. Hyponatremia in lower respiratory tract infections. Int. J. Contemp. Pediatr.s, 3: 381-384.
3. Krishnan, A., R. Kumar, S. Broor, G. Gopal and S. Saha et al., 2019. Epidemiology of viral acute lower respiratory infections in a community-based cohort of rural north Indian children. J. Global Health., 9: 1-10433.
4. Liu, L., S. Oza, D. Hogan, J. Perin and I. Rudan *et al.*, 2015. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: An updated systematic analysis. Lancet., 385: 430-440.
5. Peasah, S.K., D.R. Purakayastha, P.A. Koul, F.S. Dawood and S. Saha et al., 2015. The cost of acute respiratory infections in northern India: A multi-site study. BMC Public Health, 15: 1-330.
6. Sakellaropoulou, A., M. Hatzistilianou, M. Eboriadou and F. Athanasiadou-Piperopoulou, 2010. Hyponatraemia in cases of children with pneumonia. Arch. Med. Sci., 4: 578-583.
7. Nair, H., E.A. Simões, I. Rudan, B.D. Gessner and E. Azziz-Baumgartner et al., 2013. Global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010: A systematic analysis. Lancet., 381: 1380-1390/
8. Gilbert, E.S., 2009. Ionising radiation and cancer risks: What have we learned from epidemiology? Int. J. Radiat. Biol., 85: 467-482.
9. Ahamed, A. and S. Sudhir, 2023. Ahamed A, Sudhir S. Assessment of serum sodium levels in children admitted with lower respiratory tract infections (LRTI) in a tertiary care hospital. Eur. J. Mol. Clin. Med., 10: 322-327.

10. Nair, V., M.S. Niederman, N. Masani and S. Fishbane, 2007. Hyponatremia in community-acquired pneumonia. Am. J. Nephrology, 27: 184-190.
11. Mhatre, S.S,S.G. and Kumbhar 2019. Study of hyponatremia in paediatric patients with acute lower respiratory tract infection. J. Evol. Med. Dent. Sci., 7: 1704-1708.
12. Attri, H.T. Singh, S.G. Vandana. and K. Kumar, 2019. Impact of hyponatremia on clinical presentation and management in pediatric patients with lower respiratory infections. JMSCR2., 7: 21-28.
13. Singhi, S, A. Dhawan, 1995. Frequency and significance of electrolyte abnormalities in pneumonia. Indian. Pediatr., 29: 735-740.
14. Carter, E.J., S.M. Pouch and E.L. Larson, 2013. The relationship between emergency department crowding and patient outcomes: A systematic review. J. Nurs. Scholarship, 46: 106-115.
15. O'Laughlin, D.T., and J.L. Hick, 2008. Ethical issues in resource triage. Respir. Care., 53: 197-200