# Prevalence of dyselectrolytaemia in children with pneumonia admitted to a tertiary care centre in Eastern India

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**Abstract**

***Introduction***: Globally, pneumonia accounts for 15% of deaths in children less than 5 years of age Electrolyte imbalance, especially hyponatraemia (serum sodium<135meq/L), has been described in a wide variety of acute infections such as pneumonia and is associated with worse outcomes leading to a poor prognosis. Hypokalaemia is the next common electrolyte imbalance associated with pneumonia.

***Objectives:*** To assess the prevalence of dyselectrolytaemia in children aged 2 months to 5 years with severe pneumonia and to find the association between it and morbidity, mortality and hospital stay in severe pneumonia.

***Method:*** In this hospital-based cross-sectional study, 107 admitted children aged 2 months to 5 years were included after clinical or radiological diagnosis from January 2019 to June 2020. Frequency of dyselectrolytaemia and associated outcome were analysed using Chi-square test.

***Results:*** A total of 107 hospitalised children was studied comprising 62 (57.9%) boys and 45 (42.1%) girls. Out of the children 55 had initial low serum sodium levels, 34.6% having mild hyponatraemia. Those children who presented with severe and very severe pneumonia with initial hyponatraemia were found to be significantly associated with mechanical ventilation, growth in blood culture, C-reactive protein, increased length of hospital stay and mortality.

***Conclusions***: Most common dyselectrolytaemia associated with pneumonia was hyponatraemia. Hyponatraemia was associated with prolonged hospital stay and with poor outcome.

(Key words: Pneumonia, Hyponatraemia, Dyselectrolytaemia)

## Introduction

Pneumonia is an acute respiratory tract infection (RTI) which is classified according to age and specific causative organism[1]. Based on source, pneumonia is classified as community acquired pneumonia (CAP) or nosocomial pneumonia and based on pathology it is classified as bronchopneumonia, lobar pneumonia or interstitial pneumonia[2]. Pneumonia can be caused by bacteria, viruses or fungi. Common bacterial agents causing pneumonia in the first 2 months of life are pneumococci and staphylococci (gram positive) or Klebsiella and *Escherichia coli* (gram negative). In age group 3 months to 3 years, the chief organisms are pneumococci, *Haemophilus influenzae* and staphylococci. After 3 years, common pathogens are pneumococci and staphylococci. Chlamydia and mycoplasma may cause CAP in adolescents[5]. Common viral aetiology accounting for pneumonia among children include respiratory syncytial virus (RSV), influenza, parainfluenza and adenovirus[3].

Globally, pneumonia accounts for 15% of deaths in children less than 5 years of age[4]. In hospitalised patients with CAP, baseline hyponatraemia prolongs hospital stay while hypernatraemia signals a worse outcome both short-term and long-term[5]. Certain central nervous system (CNS) infections and RTI e.g., pneumonia present with the syndrome of inappropriate antidiuretic hormone secretion (SIADH)[6,7]. Thus, commonest electrolyte imbalance in pneumonia is hyponatraemia, the second common being hypokalaemia[8-10].

## Objectives

- To assess the prevalence of dyselectrolytaemia in children aged 2 months to 5 years with severe pneumonia
- To find the association of dyselectrolytaemia with morbidity, mortality and hospital stay in severe pneumonia

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**Method**

A hospital-based cross-sectional study was carried out in the Department of Paediatrics, Institute of Medical Sciences (IMS) & SUM Hospital, Bhubaneswar, India from January 2019 to June 2020.

***Inclusion criteria:*** Children aged 2 months to 5 years, admitted to IMS & SUM hospital with clinically and radiologically confirmed severe and very severe pneumonia during the study period were included in the study.

***Exclusion criteria:*** Infants less than 2 months of age, children more than 5 years of age, children with renal disorders, gastroenteritis or CNS infections, children on drugs which can cause electrolyte imbalance e.g., diuretics, anticonvulsants and children with other conditions having deranged electrolytes e.g., severe acute malnutrition (SAM) were excluded from the study.

***Sample size*:** Purposive sampling technique was used. It was a hospital based cross-sectional study on a limited number of cases over a limited period of time; a sample size of 107 children was taken including all clinically and radiologically confirmed severe and very severe pneumonia cases admitted to the paediatric ward and intensive care unit.

A detailed history was elicited from parents/ guardians and a detailed clinical examination was done. All children were screened for dyselectrolytaemia and complete blood count, C-reactive protein (CRP), blood culture and radiological evaluations were done at the time of hospitalization.

Serum sodium and serum potassium levels were determined using indirect Ion-Selective Electrode (ISE) method. Hyponatraemia was defined as serum sodium <135mEq/L and hypernatraemia as serum sodium >145mEq/L. Similarly, a serum potassium value <3.5mEq/L was considered as hypokalaemia and >5.5mEq/L as hyperkalaemia.

Patients were classified as severe and very severe pneumonia as per WHO criteria (2005);

*Severe pneumonia* was defined as fever, cough and tachypnoea (respiratory rate ≥50 breaths/min) in infants from 2 months to 1 year and as a respiratory rate ≥40 breaths/min with chest recession in children 1 to 5 years.

*Very severe pneumonia* was defined as tachypnoea with chest recession, nasal flaring, cyanosis, intermittent apnoea, grunting respiration and refusal of feeds in infants from 2 month to 1 year of age and tachypnoea with chest recession, nasal flaring, cyanosis and grunting respiration in children 1 to 5 years of age

***Ethical issues:*** The study was approved by the Institutional Ethics Committee of the Institute of Medical Sciences (IMS) & SUM Hospital, Bhubaneswar, India (Ref. No. / DMR/ IMS.SH/ SOA/180135). Informed written consent was obtained from the parents and confidentiality of the data was maintained throughout the study

***Statistical analysis:*** All data were entered in the Microsoft Excel spread sheet and analysed using SPSS software version 20.0**.** The primary outcome was expressed in percentage. Chi square test was used to determine the association between the outcome variable and dependent variable. $p<0.05$ was taken as statistically significant,

**Results**

A total of 107 hospitalized children was studied which included 62 (57.9%) boys and 45 (42.1%) girls. Among them 52 (48.6%) belonged to age group 2 months to 1 year, 32 (29.9%) belonged to age group 1 to 3 years and 23 (21.5%) belonged to age group 3 to 5 years.

Most common dyselectrolytaemia found in our study was hyponatraemia. Out of 107 children 55 (51.4%) had hypernatremia at the time of presentation to the hospital.

Figure 1 shows the percentage distribution of serum sodium in the study population,

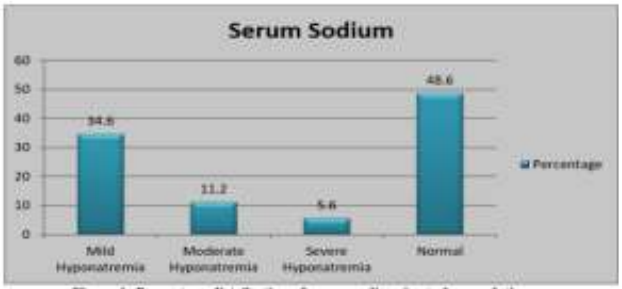


**Figure 1: Percentage distribution of serum sodium in study population**

*Mild hyponatraemia 130-134 mEq/L, moderate hyponatraemia 125-129 mEq/L, severe hyponatraemia <125mEq/L*

Among the study population 37 (34.6%) children had mild hyponatraemia, 12 (11.2%) had moderate hyponatraemia and 6 (5.6%) had severe hyponatraemia. Fifty-two (48.6%) children had normal serum sodium values at the time of admission (Figure 1).

Among the study population 26 (24.3%) children had hypokalaemia, 2 (1.9%) had hyperkalaemia and 79 (73.8%) had normal serum potassium at the time of admission. Ninety-six (89.7%) children had normal serum chloride, 11 (10.3%) had hypochloraemia and none had hyperchloraemia at the time of admission.

The association of different variables with the serum sodium is shown in Table 1.

**Table 1:** ***Association of different variables with serum sodium***

| Variables | Hyponatraemia | | p-value |
|---|---|---|---|
| | Present | Absent | |
| *Initial temperature* | | | |
| Raised (>38.5°C) | 39 | 35 | 0.686 |
| Normal | 16 | 17 | Odds Ratio 1.2 |
| *Mechanical ventilation* With | | | |
| Without | 11 | 02 | 0.01* |
| | 44 | 50 | Odds Ratio 6.2 |
| *C-reactive protein* | | | |
| Positive (>1mg/L) | 50 | 34 | 0.001* |
| Negative(<1mg/L) | 05 | 18 | Odds Ratio 5.2 |
| *Total Leucocyte count* | | | |
| Positive | 38 | 41 | 0.25 |
| Negative | 17 | 11 | Odds Ratio-0.6 |
| *Blood culture* | | | |
| Growth | 18 | 02 | 0.001* |
| No growth | 37 | 50 | Odds Ratio-12 |
| *Hospital stay* | | | |
| 7 or more days | 32 | 11 | 0.001* |
| <7 days | 16 | 41 | Odds Ratio 7 |

**p -value <0.05 is considered statistically significant*

Table 1 suggests that those children having hyponatraemia at the time of admission have a 6.2 times higher risk of requiring mechanical ventilation which is statistically significant ($p<0.05$). Patients with positive C-reactive protein have a 5.2 times higher risk of developing hyponatraemia which is statistically significant ($p<0.05$). Patients with growth in blood culture have 12 times higher risk of developing hyponatraemia which is statistically significant ($p<0.05$). Hyponatraemia at the time of admission is associated with increased length of hospital stay.

Table 2 shows the association of outcome with serum sodium.

**Table 2:** ***Association of outcome with serum sodium***

| Outcome | Hyponatraemia | | p-value |
|---|---|---|---|
| | Mild / Moderate | Severe | |
| Death | 02 | 05 | 0.00001* |
| Improved | 47 | 01 | |

**p value <0.05 is considered as statistically significant*

Table 2 suggests that severe hyponatraemia has more adverse outcomes than mild to moderate hyponatraemia.

**Discussion**

The study was done to find out the prevalence of dyselectrolytaemia in children who presented to the hospital with severe and very severe pneumonia and to find the association of dyselectrolytaemia with morbidity, mortality and hospital stay. The study population is representative of children with severe and very severe pneumonia admitted in a tertiary care centre in East India. In this study a total of 107 children participated of which 52 (48.6%) are in age group 2 months to 1 year, 32 (29.9%) are in age group 1 to 3 years and 23 (21.5%) are in age group 3 to 5 years. Studies by Jha CB, *et al*[11] and Das M, *et al*[12] found that the 2

months to 1 year age group was involved in 60% and 64.7% respectively. However, a study by Praneetha DCK, *et al*[13] found that the most common age group of presentation was 2 to 5 years (46%).

Out of 107 children 55 (51.4%) had hyponatraemia, 37 (34.6%) having mild hyponatraemia, 12 (11.2%) having moderate hyponatraemia and 6 (5.6%) having severe hyponatraemia. In a similar study by Mandal PP, *et al*[14], 42% of the study population had hyponatraemia and among them 81% had mild hyponatraemia, 14% had moderate hyponatraemia and 5% had severe hyponatraemia. A study by Singhi S, *et al*[15] concluded that 27% presented with hyponatraemia. Nair V, *et al*[16] found that most of the patients with hyponatraemia had mild hyponatraemia, 3% had moderate hyponatraemia and only one had severe hyponatraemia.

In this study, patients with initial raised body temperature had hyponatraemia similar to studies by Mandal PP, *et al*[14] and Don M, *et al*[17]. Patients with hyponatremia at the time of admission had 6.2 times more risk for requirement of mechanical ventilation and the association of hyponatremia with requirement of mechanical ventilation was statistically significant similar to a study by Praneetha DCK, *et al*[13] and a study by Agarwal P et al[18]. In this study, it was concluded that positive CRP had increased risk with developing hyponatremia and the relationship of hyponatraemia with positive CRP was statistically significant similar to a study by Don M, *et al*[17] but it was unlike a study by Jha CB, *et al*[11]. There was no association of hyponatraemia with the leucocyte count though higher number of children with hyponatremia (69%) had leucocytosis similar to studies done by Jha CB, *et al*[11] and Nair V, *et al*[16]. Those children with growth in blood culture showed statistically significant association with hyponatraemia. Hyponatraemia caused a 7-fold increase in length of hospital stay and increased mortality rate. This may be due to time taken for correction of dyselectrolytaemia and the further complications which occurred due to dyselectrolytaemia. Similar analysis was done in studies by Singhi S, *et al*[15] and Tierney WM *et al*[19].

**Conclusions**

Most common dyselectrolytaemia found in our study was hyponatraemia. At the time of presentation to the hospital 51.4% of the children had hyponatraemia. Mechanical ventilation, CRP, growth in blood culture and length of hospital stay were significantly associated with hyponatraemia.

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