ORIGINAL ARTICLE

Frequency of Hyponatremia in Children with Bronchiolitis from 1 Month up to 2 Years in a Tertiary Care Hospital

Asra Hashmi[1*] and Atika Sher[1]

[1]*Department of Pediatric Medicine, Liaquat National Hospital and Medical College, Karachi, Pakistan*

Abstract

Background: Bronchiolitis is the leading cause of hospitalisation in children, typically diagnosed based on a child's symptoms and physical examination. A child shows signs like difficulty breathing, a persistent cough, trouble feeding, irritability, or episodes of apnea, along with wheezing or crackles heard during auscultation. In that case, these findings together strongly suggest a diagnosis of Bronchiolitis.

Objective: To determine the frequency of Hyponatremia in children aged 1 month to 2 years diagnosed with bronchiolitis in a tertiary care hospital.

Material and Methods: This cross-sectional study was conducted at the Department of Pediatrics Medicine, Liaquat National Hospital, Karachi, over six months from October 2024 to March 2025. The study included children aged 1 month to 2 years who were admitted to a tertiary care hospital with Bronchiolitis. A non-probability consecutive sampling method was used to select participants, and a total of 103 patients with Bronchiolitis were enrolled. Venous blood samples were collected within 24 hours of hospital admission to measure serum sodium levels. Data analysis was done using IBM SPSS Statistics version 27.

Results: The mean age of participants was 10.7 ± 6.0 months, with 60.2% being male gender. Hyponatremia was observed in 4.9% of patients, with a mean serum sodium level of 138.7 ± 3.1 mmol/L. No statistically significant associations were found between Hyponatremia and gender, age group, immunisation status, or clinical history.

Conclusion: Although the frequency of Hyponatremia in children with bronchiolitis was low in our setting, its potential complications necessitate routine electrolyte monitoring. Early detection and appropriate fluid management can help reduce the risk of adverse outcomes. Further multi-centre studies are recommended to better understand the relationship between Hyponatremia and bronchiolitis severity.

Keywords: *Hyponatremia, bronchiolitis, children, pediatrics, respiratory tract infections.*

INTRODUCTION

Bronchiolitis is the leading cause of hospitalisation in children, accounting for 18% of all infant hospitalisations. Approximately 10% to 15% of these children require intensive care management [1, 2]. Bronchiolitis is typically diagnosed based on a child's symptoms and physical examination. Suppose a child shows signs like difficulty breathing, a persistent cough, trouble feeding, irritability, or episodes of apnea, along with wheezing or crackles heard during auscultation. In that case, these findings together strongly suggest a diagnosis of bronchiolitis [3].

It has been observed that when children with bronchiolitis have low sodium levels in their blood (less than 135 mmol/L), it leads to poor outcomes and a relatively more severe course of illness. Having Hyponatremia, or low sodium, could also raise the risk of complications and even increase the rate of mortality [4].

For patients with bronchiolitis, intravenous fluids (IVF) are often given for several reasons: to address dehydration, reduce the risk of aspiration pneumonia, and ensure the stomach remains empty in case endotracheal intubation is required [5]. However, recent evidence highlights that using hypotonic IV fluids can increase the risk of Hyponatremia, particularly in hospitalised children. This condition can trigger higher levels of antidiuretic hormone (ADH) in the body, which is especially concerning for those with bronchiolitis. [2, 6, 7].

According to a study, it was concluded that the frequency of Hyponatremia in children was 78%, which is significantly high. So, whenever a child is diagnosed with bronchiolitis, it is important to check their serum sodium levels. If the levels are found to be low, correcting the sodium imbalance should be part of their treatment plan, alongside managing the bronchiolitis itself. This helps ensure the child receives comprehensive care for their condition [3].

Infections of the respiratory tract can raise the risk of Hyponatremia by 29% to 59%, particularly in patients with bronchiolitis [8]. This increased risk is often due to factors like inappropriate secretion of antidiuretic hormone (ADH), reduced fluid intake, vomiting, or improper administration of fluids [8-10].

Hyponatremia in bronchiolitis patients can occur for two main reasons: increased levels of ADH (antidiuretic

**Corresponding author: Asra Hashmi, Department of Pediatric Medicine, Liaquat National Hospital and Medical College, Karachi, Pakistan. Email: drasrahashmi05@gmail.com*
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hormone) and the administration of fluids that are too diluted [11]. Normally, ADH is released in response to changes in the body's salt concentration, but it can also be triggered by other factors unrelated to salt levels [12, 13]. One possible explanation for this is that hyperinflation of the lungs or increased pressure in the blood vessels of the lungs can reduce the filling of the heart's left atrium. This, in turn, might lead to the release of ADH and could also contribute to low oxygen levels in the blood. [6, 8, 9].

A drop in sodium levels can cause brain edema, increased intracranial pressure, and lead to fluid buildup in the lungs [14]. It can also trigger serious neurological issues like difficulty breathing, seizures, and extreme tiredness or sluggishness [15].

Medical health professionals should be aware of the signs and symptoms that indicate involvement of other organs caused by RSV infection, other than the lungs [16]. They should consider RSV as a possible cause in all premature babies, particularly those who did not receive palivizumab to help prevent it [17].

In a study, the incidence of Hyponatremia in children with LRTI was 66% and was associated with worse outcomes and prolonged hospital stay [18].

Early detection of Hyponatremia in bronchiolitis can reduce the adverse clinical outcomes such as seizures, dehydration, mechanical ventilation, and hyponatremic encephalopathy [19], which will eventually decrease the length of PICU hospital stay in order to reduce the unusual burden on the health sector and the patient's family [20].

To the best of our knowledge, there have been very few local studies on the frequency of Hyponatremia in children with bronchiolitis. But in our clinical setup, no one has attempted this study in the region of Sindh province.

The objective of our study is to determine the frequency of Hyponatremia in children with bronchiolitis. This study allows us to quickly identify patients with low sodium levels, enabling us to provide timely and appropriate care. Also, it will improve the clinical outcome of the patient by early and accurate management and will also prevent long-term consequences.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Pediatrics Medicine, Liaquat National Hospital, Karachi, over six months from October 2024 to March 2025. The study included children aged 1 month to 2 years who were admitted to a tertiary care hospital with bronchiolitis. Both boys and girls were eligible for participation. However, children were excluded if they had certain pre-existing conditions, such as congenital lung abnormalities, heart defects, central nervous system infections, neuromuscular disorders, or if they were experiencing diarrheal illness at the same time. Before enrolling the children, their parents or guardians provided informed consent. Once consent was obtained, the researchers collected important demographic and clinical details about the patients.

The sample size was determined using the WHO sample size calculator, taking into account the frequency of Hyponatremia (low sodium levels) in children with bronchiolitis, which was estimated at 78% based on previous research [3]. The calculation was made with a 95% confidence level and an 8% margin of error, resulting in a required sample size of 103 patients. A non-probability consecutive sampling method was used to select participants.

Before starting the study, we obtained clearance from the ethical committee of Liaquat National Hospital (1062-2024-LNH-ERC). Once these approvals were secured, we approached the parents or guardians of patients admitted to the Pediatric Medicine Department at Liaquat National Hospital, explained the purpose of the study in detail, and obtained their informed consent before proceeding. For each participant, we recorded basic information such as age, sex, height, and weight. Within 24 hours of admission, we collected blood samples to measure serum sodium levels. Any deviations from the normal sodium range, specifically cases of Hyponatremia, were identified and documented. The frequency of Hyponatremia was recorded by the researcher within the first 24 hours of admission, and all data were systematically collected using a structured proforma.

Venous blood samples were collected within 24 hours of hospital admission to measure serum sodium levels. Hyponatremia was operationally defined as a serum sodium concentration less than 135 mmol/L. All serum sodium measurements were performed using a standardised hospital laboratory analyser.

Data analysis was done using IBM SPSS Statistics version 27. For numerical variables, the mean and standard deviation were calculated and reported. For categorical variables, frequency counts and percentages were provided. To assess relationships between categorical variables, either the Chi-square test or Fisher's exact test was used, depending on the context. Binary logistic regression was employed to calculate

odds ratios. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 103 children aged between 1 month and 24 months with bronchiolitis were included in the study. The mean age of the participants was 10.70 ± 6.04 months, and the mean weight was 7.95 ± 1.94 kg. The average hospital stay was 3.21 ± 1.12 days.

As illustrated in Table **1**, out of 103 children, 62 (60.2%) were male, and 41 (39.8%) were female. The majority of patients, 61 (59.2%), were under 12 months of age, while 42 (40.8%) were 12 months or older. Regarding hospital stay, 68 (66%) patients were admitted for ≤3 Days, and 35 (34%) stayed for >3 days. Immunisation status was complete in 84 (81.6%) children, while 19 (18.4%) had not been immunised. Of those who were immunised, 46 (54.8%) had complete immunisation, and 38 (45.2%) had partial immunisation. A positive family history of partial chest infection was reported in 43 (41.7%) cases, while 60 (58.3%) had no such history. A history of previous hospital admission was present in 27 (26.2%) children, while 76 (73.8%) were not previously admitted. The mean serum sodium level was 138.73 ± 3.13 mmol/L, ranging from 127 to 148 mmol/L. Hyponatremia was observed in 5 (4.9%) of the children with Bronchiolitis within 24 hours of admission.

As illustrated in Table **2**, among the 5 patients with Hyponatremia, 2 (40%) were male, and 3 (60%) were female, with no statistically significant association between gender and Hyponatremia, p-value = 0.384. 4 out of 5 children with Hyponatremia (80%) were under 12 months of age, compared to 1 (20%) aged ≥12 months, but this was not statistically significant (p=0.646). Among all 5 children with Hyponatremia, 4 (80%) had hospital stays of ≤3 Days *versus* 1 (20%) with >3 days (p= 0.659). Regarding immunisation, 3 (60%) of hyponatremic patients were not immunised, and only 2 (40%) were immunised. This association was found to be statistically significant (p=0.042). Family history of chest infection (p=1.000) and previous admission

Table 1: Demographic and clinical profile of study participants.

Variables	Frequency (%)	Min to max
Gender		
Male	62(60.2)	-
Female	41(39.8)	-
Age (months)ǂ	10.70±6.04	2 to 24
Age groups		
<12 months	61(59.2)	-
≥12 months	42(40.8)	-
Weight (kg)ǂ	7.95±1.94	3.50 to 12
Hospital Stay (days)ǂ	3.21±1.12	2 to 7
Hospital stay		
≤3 days	68(66)	-
>3 days	35(34)	-
Immunization		
Done	84(81.6)	-
Not Done	19(18.4)	-
Immunisation status (n=84)		
Complete	46(54.8)	-
Partial	38(45.2)	-
Family history of partial chest infection		
Yes	43(41.7)	-
No	60(58.3)	-
Previous admission		
Yes	27(26.2)	-
No	76(73.8)	-
Serum Sodium(mmol/L)ǂ	138.73±3.13	127 to 148
Hyponatremia		
Yes	5(4.9)	-
No	98(95.1)	-

ǂ*Continuous variables are expressed as mean ± standard deviation*

Table 2: Association of hyponatremia with demographic and clinical profile.

Variables	Hyponatremia n (%)		p-value
	Yes	No	
Gender			
Male	2(40)	60(61.2)	0.384
Female	3(60)	38(38.8)	
Age group			
≤12 months	4(80)	57(58.2)	0.646
>12 months	1(20)	41(41.8)	
Hospital stay			
≤3 days	4(80)	64(65.3)	0.659
>3 days	1(20)	34(34.7)	
Immunization			
Done	2(40)	82(83.7)	0.042*
Not done	3(60)	16(16.3)	
Family history of partial chest infection			
Yes	2(40)	41(41.8)	1.000
No	3(60)	57(58.2)	
Previous admission			
Yes	3(60)	24(24.5)	0.111
No	2(40)	74(75.5)	

**Significant at 0.05 levels*.

were not significantly associated with Hyponatremia (p=0.111).

According to Table **3**, Male gender had an odds ratio (OR) of 0.422 (p=0.357), indicating a non-significant reduced risk compared to females. Children ≤12 months had a higher OR of 2.877 (p=0.352). Shorter hospital stays (≤3 days) showed an OR of 2.125 (p=0.508), which was also not significant. The most significant association was found with immunisation status: children who were immunised had significantly lower odds of Hyponatremia, OR of 0.130 (p=0.032), indicating a protective effect of immunisation.

Table 3: Odds ratio for children with hyponatremia in bronchiolitis.

Variables	Odds ratio (95% CI)	p-value
Gender		
Male	0.422(0.067-2.645)	0.357
Female	Reference category	
Age group		
≤12 months	2.877(0.310-26.698)	0.352
>12 months	Reference category	
Hospital stay		
≤3 days	2.125(0.228-19.771)	0.508
>3 days	Reference category	
Immunization		
Done	0.130(0.020-0.842)	0.032*
Not done	Reference category	
Family history of partial chest infection		
Yes	0.927(0.148-5.799)	0.935
No	Reference category	
Previous admission		
Yes	4.625(0.729-29.340)	0.104
No	Reference category	

*CI: Confidence Interval, *Significant at 0.05 levels.*

DISCUSSION

This study investigated the frequency of Hyponatremia within 24 hours of admission in children from age 1 month to 2 years hospitalised with bronchiolitis and found a relatively low incidence of 4.9%, with a mean serum sodium level of 138.7 ± 3.1 mmol/L. This frequency is significantly lower than reported in prior studies, suggesting possible differences in patient characteristics, clinical management, and institutional protocols.

In our study, the absence of any significant association between Hyponatremia and age, gender, or hospital stay, along with a higher mean sodium level, may reflect effective fluid management strategies, particularly the use of isotonic IV fluids. This is supported by Shein *et al*. [2], who demonstrated that serum Na+ levels negatively correlated with length of stay in hospital ($r = -0.477$, $P < 0.0001$). They further showed that children who received <70 mL/kg/day of intravenous fluids had a significantly higher risk of developing Hyponatremia during the following day (50.0% *vs*. 26.9%, $P < 0.001$) and experienced longer hospitalisation compared to those who received ≥70 mL/kg/day.

Rashid *et al*. [3] reported a 78% frequency of Hyponatremia in children with bronchiolitis, with a mean sodium level of 130.86 ± 6.61 mmol/L, highlighting a significant electrolyte disturbance. Similarly, Milani *et al*. [4] found 57% of infants with bronchiolitis to be hyponatremic, with the condition occurring significantly more in those aged ≤6 months ($P < 0.005$). These findings emphasise the need for age-specific vigilance and suggest that younger infants may be more vulnerable to sodium imbalances.

Our study's lower Hyponatremia frequency may thus be attributed to the proactive use of isotonic fluids and careful monitoring, in contrast to earlier or more traditional practices involving hypotonic solutions. These findings underscore the clinical value of implementing updated fluid therapy guidelines and support recommendations for routine serum sodium monitoring, especially during the first few days of hospitalisation when the risk of Hyponatremia peaks.

Furthermore, the lack of significant correlation between Hyponatremia and clinical history variables such as previous admissions or family history of chest infections indicates that in-hospital practices may play a larger role in influencing sodium balance than background patient factors alone.

Despite the low frequency of Hyponatremia observed in this study, routine monitoring of serum electrolytes remains essential. Even mild Hyponatremia in pediatric patients can lead to serious complications such as seizures, cerebral edema, and prolonged hospitalisation, particularly if overlooked. This is especially critical in settings where IV fluid administration practices may vary.

Another important observation is that while immunisation status was not significantly associated with Hyponatremia in our study, the two patients who had complete immunisation and were hyponatremic highlight that other pathophysiological mechanisms, particularly inappropriate ADH secretion and pulmonary hyperinflation, play a more central role.

Keeping in view the above-mentioned discussion, it is imperative to advocate for cautious and individualised fluid management, especially in infants

and younger children who are more susceptible to fluid imbalances. While our data suggests a low prevalence of Hyponatremia, this does not diminish the clinical relevance of early recognition and prevention strategies, particularly in resource-limited settings where laboratory testing may be delayed.

LIMITATIONS

Single-centre study design limits the generalizability of findings across different regions and healthcare settings. The relatively small sample size reduces the statistical power to detect associations with less common variables.

Disease severity was not graded, and follow-up post-discharge was not performed, which could have provided additional insights into clinical outcomes. The study did not assess the impact of nutritional status or comorbidities on Hyponatremia risk, which may be relevant in broader populations.

CONCLUSION

This study demonstrates that while Hyponatremia is relatively uncommon in children hospitalised with bronchiolitis in our setting, it remains a clinically important electrolyte disturbance. The 4.9% frequency highlights a potentially preventable complication that can have serious consequences if left unrecognised. Our findings underscore the value of early serum sodium monitoring and the implementation of safe fluid management protocols, especially the use of isotonic IV fluids. Given the known risks associated with Hyponatremia, even at mild levels, vigilance in monitoring and individualised patient care are essential components of bronchiolitis management. Further large-scale, multi-centre studies are recommended to explore long-term outcomes and refine guidelines for fluid therapy in this vulnerable population.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Review Committee of Liaquat National Hospital, Karachi (REF letter No. 1062-2024-LNH-ERC). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Before enrolling the children, their parents or guardians provided informed consent.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

AH did literature research, data collection, and preparation of the manuscript. The manuscript was critically reviewed by AS.

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