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Frequency of Hyponatremia in Children Admitted with Pneumonia

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ABSTRACT

Objectives: The purpose of this study was to establish the prevalence of hyponatremia among children of 2 months to 5 years of age admitted at Ayub Teaching Hospital, Abbottabad, with pneumonia and factors related to it. **Materials and Methods:** An analytical cross-sectional study was conducted in the pediatric department on 135 children with pneumonia. The level of hyponatremia was determined by the patient's serum sodium concentration <135mEq/L, moderate 131-134mEq/L, severe 126-130mEq/L, and severe 125mEq/L. The socio-demographic profile of the children, the severity of pneumonia, and data on socio-economic status were obtained. All statistical analyses were done using the statistical package SPSS. **Results:** In this study, 28% of the children had hyponatremia, 14% mild, 9% moderate, and 5% severe hyponatremia. In general, a higher incidence was reported in severe pneumonia (40%) among children 2-3 years old and low economic status. There were few differences between males and females. **Conclusion:** A recent study shows that hyponatremia is highly prevalent in childhood pneumonia and that the prevalence is related to illness severity, age, and socio-economic status. More awareness, earlier presentation, and proper management would significantly enhance the outlook.

INTRODUCTION

Although hyponatremia may often be a pathological process that accompanies various severe forms of diseases in children, it is most common in children admitted to hospital care due to pneumonia (1). Pneumonia, responsible for causing the most significant number of child morbidity and mortality, is defined as an infection of the alveolar space, and the clinical features as fever, cough with or without sputum production, fast breathing, and chest indrawing (2). Children with a fever with cough, quick breath, and chest indrawing are categorized as mild to moderate pneumonia, while severe pneumonia has other signs of danger, including the inability to drink (3).

Numerous research studies have associated pneumonia with hyponatremia, with the authors stating that hyponatremia is common in children admitted to hospitals with pneumonia (4). For example, low blood sodium levels (hyponatremia) in children with pneumonia also affect the severity of the disease. Hypothetically, the lower the sodium levels measured, the poorer the state of the child (5). Additionally, specific investigations indicate that by identifying hyponatremia as a predictor of pneumonia severity and the risk of complications (6). These patients should also be closely monitored for the development of hyponatremia, which, apart from being dangerous in general, may worsen other secondary conditions, such as the development of respiratory failure, and may also hinder the treatment plan (7).

Hyponatremia is common in children with pneumonia, though not all data presented the same occurrence. Various authors from different parts of the world have documented different prevalences. For example, a cross-sectional survey carried out at a tertiary care hospital in Pakistan showed that acute severe pneumonia in children was independently associated with hyponatremia in 22% of cases, as noted earlier by studies in other geographical areas (8). Equally, Indian

and other SA research has suggested that hyponatremia is not an uncommon finding in children with pneumonia, especially in severe cases of the disease (9).

Hence, the pathology underlying hyponatremia in pneumonia continued receiving a multifactor approach. These patients develop hyponatremia due to many reasons, such as higher secretion of ADH in response to infection, fluid overload, and inflammation (10). In some occasions, hyponatremia also arises from irrational fluid balance during hospitalization because intravenous liquids have a high water content and can, therefore, reduce sodium levels in the serum (11). Therefore, healthcare providers should closely follow up on the fluid and electrolyte balance of a child with pneumonia to prevent the occurrence and complications of hyponatremia (12).

Mortality rates due to pneumonia, their association with nutritional status, and hyponatremia in children have also been dealt with in different studies. Establishing a link between malnutrition and electrolyte imbalance is justified since it is well-documented that any disturbances in the total body sodium and water content could result from the altered solute-sodium balance (13). In addition, the correlation between age, gender, and differential socioeconomic status with hyponatremia in children with pneumonia has been investigated. Pneumonia and hyponatremia are prevalent in younger children under the age of five and are less common in boys than girls (14).

The severity of the disease also determines the percentage of hyponatremia concussion in children with pneumonia. Some literature has confirmed that whereas hyponatremia was a trend with mild to moderate pneumonia patients, the increased severity associated with the inflammation of the respiratory system in this disease leads to fluid impairment in severe cases (15). Therefore, it is paramount to work on strategies for early identification of hyponatremia and early treatment, especially in these patients.

The present study aims to determine the prevalence of hyponatremia in children presenting with pneumonia in the pediatric ward of Ayub Teaching Hospital Abbottabad, Pakistan. While the incidence and association between hyponatremia and clinical and demographic data have already been examined, this paper gives valuable information on how hyponatremia interferes with pneumonia care and pediatric outcomes. This work may also help clinicians improve the management of children with pneumonia, particularly in low-income settings like Pakistan, because pneumonia remains a leading reason for admissions of children.

Objective: The frequency of hyponatremia in children in the age group of 2 months to 5 years with pneumonia who are admitted to the pediatric department of Ayub Teaching Hospital Abbottabad has been established in this study.

MATERIALS AND METHODS

Study Design: This work is a cross-sectional descriptive study that sought to establish the prevalence of hyponatremia among children admitted with pneumonia to a pediatric department in Pakistan.

Study setting: The study was conducted at the Pediatric Department of Ayub Teaching Hospital (ATH) Abbottabad, Pakistan. ATH is one of the largest tertiary care organizations in the region and offers crucial specialized health care for children at times of need.

Duration of the study: The study was done during the period 14th June 2024 to 13th November 2024, starting when the synopsis was approved.

Inclusion Criteria

Children aged 2 months to 5 years with pneumonia, according to the operational case definition, defined as fever, cough, fast breathing, and chest in-drawing, were included in the study. Patients of both genders were allowed in the study.

Exclusion Criteria

Children with any other illnesses at the time of sampling other than pneumonia were not sampled. Furthermore, children with a diagnosis of gastroenteritis and those who were enrolled on intravenous fluids on admission were also excluded. These exclusion factors were set in place to eliminate any interference in the outcomes of the study by any other factors apart from the disease of interest, namely children with pneumonia.

METHODS

This cross-sectional study involves children 2 months to 5 years of age receiving pneumonia supplies in the Pediatric Department of Ayub Teaching Hospital, Abbottabad. The study was conducted after the consent of the hospital's ethics committee was obtained. Patients' age, gender, weight, mother's education level, family monthly income, and socioeconomic and residential status were elicited from the parents after explaining the study to them. Peripheral blood samples were obtained using appropriate sterilization procedure to determine the serum sodium concentration of the patient, and the results were divided into mild hyponatremia (131-134m Eq/L), moderate hyponatremia (126-130 mEq/L), severe hyponatremia (≤125 mEq/L). The information would be documented on a pro forma given in the annexure titled Annexure-I. The patient's right to privacy was respected throughout the study, following universal ethical procedures. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 22. Student's t-test, Chi-square, and Fisher exact test were used to determine frequencies, percentages, and associations for categorical variables, respectively.

RESULTS

In the present study, participants were 135 children who came under the inclusion criteria of this study conducted at Ayub Teaching Hospital, Abbottabad. The demographic and clinical features of the participants and the frequency of hyponatremia are summarized below.

Demographic Characteristics

Of the participants, 60% were aged between 2 to 3 years, 30% between 3 to 4 years, and 10% between 4 to 5 years. There were 70 male and 65 female participants, with a man-to-woman ratio of 1.08:1. Socio-economically, 50% of the children belonged to families having monthly income below PKR 30,000, 30% from families having income ranging from 30,000 PKR to 60,000 PKR, and 20% from families having monthly income above 60,000 PKR. Regarding the location of residence, the majority of children, 60%, were from rural settings, while 40% were from urban settings.

Frequency of Hyponatremia

A total of 28% of children experienced hyponatremia, which was classified as mild in 4% of patients and moderate/severe in 24%. The distribution of hyponatremia is as follows: hypoxemia for mild was at 14%, moderate at 9%, and severe at 5%. Details of the severity of hyponatremia classified by age group are shown in Table 1 below.

Table 1

Severity of Hyponatremia by Age Group

Age Group (Years)	Mild Hyponatremia (%)	Moderate Hyponatremia (%)	Severe Hyponatremia (%)
2-3	16	7	4
3-4	12	6	3
4-5	8	5	2

Hyponatremia by Gender

By gender grouping, the incidence was slightly higher among males at 30% compared to females at 25%. This difference was also insignificant based on the test conducted, with a p-value greater than 0.05. The following table illustrates the frequency of hyponatremia by gender in detail.

Table 2

Frequency of Hyponatremia by Gender

Gender	Hyponatremia (%)	No Hyponatremia (%)
Male	30	70
Female	25	75

Hyponatremia and Socioeconomic Status

Socioeconomic status did reveal a conspicuous correlation with the incidence of hyponatremia. Four hundred thirty-four children with a low monthly family income of less than PKR 30000 had hyponatremia 35%, children from the family earning PKR 30000 to PKR 60000 had 20%, and more than PKR 60000 had only 10%. This implies that socioeconomic status, which can be associated with the child's nutritional status, may predispose children with pneumonia to develop hyponatremia, as highlighted in Table 3.

Table 3

Hyponatremia by Socioeconomic Status

Monthly Family Income	Hyponatremia (%)	No Hyponatremia (%)
< PKR 30,000	35	65
PKR 30,000–60,000	20	80
> PKR 60,000	10	90

Severity of Pneumonia and Hyponatremia

It also agreed with other findings that the severity of pneumonia is directly related to cases of hyponatremia. Among children with severe pneumonia, hyponatremia was observed in 40 percent, while in children with mild to moderate pneumonia, hypernatremia was seen in only 22 percent. This indicates that despite the types of pneumonia, severe pneumonia may cause the patient to develop hyponatremia. However, it is important to go further in the analysis of these results to specify if this relationship is, from a statistical point of view, significant.

Finally, hyponatremia was reported in 28% of the children with pneumonia, more frequently in male children, in the younger age group, in children from lower socioeconomic classes, and in those with severe pneumonia. These findings also underscore the need to screen serum sodium in children with pneumonia and those in the identified high-risk groups.

DISCUSSION

Pneumonia is a frequent cause of hospitalization in children, and hyponatremia is reported to be a common electrolyte disorder in pediatric pneumonia, wherein it is associated with severity of clinical manifestations and more significant morbidity. In this study, the female researcher aimed to find out the prevalence of hyponatremia in children between 2 months and 5 years of age admitted to Ayub Teaching Hospital Abbottabad with pneumonia. Regarding hyponatremia, 28% of the children had varying severity of this condition, with 14% of the children having mild hyponatremia, 9% with moderate hyponatremia, and 5% of the children having severe hyponatremia. This group's overall prevalence of hyponatremia also corroborates with previous pediatric pneumonia studies (1, 2, 5). A relationship between hyponatremia and severity of illness and pneumonia, in particular, has been reported in various reports, which makes it essential as both the severity of illness indicator and potentially a predictor of outcome (3, 7).

This high prevalence of hyponatremia is in consonant with what other international and regional studies have shown, especially where the prevalence of

childhood pneumonia is very high. Another survey by Mehmood et al. (5) revealed high comparative incidence of hyponatremia, at 30%, among children suffering from community-acquired pneumonia. Other cross-sectional studies have produced almost equivalent results, including that by Natarajan et al. (2), who established a hyponatremia rate of 26% in children admitted for pneumonia. These outcomes indicate that hyponatremia, compared to other electrolyte abnormalities, is relatively significant in children affected by pneumonia, including those requiring hospitalization. The electrolyte disturbance is common because, during inflammation, there is an elevated production of antidiuretic hormone (ADH) that leads to water retention and dilution of sodium (6).

Age was also considered another variable in the study to analyze its impact on the development of hyponatremia. The results also revealed that the most vulnerable age group was children 2-3 years old. This concurs with earlier evidence suggesting that younger children are more likely to develop electrolyte imbalances. Mishra et al. (4) noted that children who attend care less than 3 years of age had a high risk of hyponatremia in severe pneumonia cases. Younger children are perhaps at a higher risk because their renal function may not be as advanced, and their fluid turnover rates may be higher, making it difficult for the child's body to maintain adequate sodium balance during times of illness.

The other study finding that we noted was that hyponatremia was more prevalent in male patients compared to female patients. Even though this finding was non-significant, it corroborates such findings of other studies, which have reported a higher rate of hyponatremia in male children with pneumonia. For example, Yadav et al. (6) and Zaheer et al. (10) reported a higher frequency of hyponatremia in males, but this was not significantly different from females. Possible reasons for these differences are unclear and might be hormonal or other socio-demographic factors not considered in these investigations.

Similarly, the second factor that came up with a statistically significant association with the development of hyponatremia in this study was the SES. Hyponatremia was substantially higher in children from families with an income below PKR 30,000 per month (35% vs. 7%). This finding is consistent with the study by Rabha and Dhungel (3) that indicated that hyponatremia was common in children from low-socioeconomic status families because they were more likely to miss meals, delay when seeking health care, and be prone to infections. Structural weaknesses in food systems may lead to deficits in micronutrients, especially among low-income households, and the effects of such deficiencies on children are widely described in the medical literature (8). Moreover, either timely or inadequate or insufficient health care in such families might have enhanced the severity of pneumonia in these children, making them more vulnerable to complications such as hyponatremia (9).

Speaking of clinical implications, the severity of pneumonia was identified in this work as one of the most significant indicators influencing the presence of hyponatremia. The analysis also showed that hyponatremia was more frequent among children with severe pneumonia than among children with mild and moderate pneumonia: 40% versus 22%, respectively. This finding aligns with other works conducted by Zeeshan et al. (8) and Rabha and Dhungel (3) that we gathered during the literature review process, which linked severe pneumonia with a high likelihood of electrolyte imbalances. In these cases, inflammation is increased, and therefore, the levels of ADH will be raised, which results in water retention and dilutional hyponatremia. In addition, severe pneumonia is more likely to require extended hospitalization and aggressive treatment, adding more stress to the body's ability to sustain electrolyte homeostasis (10).

However, antecedent hyponatremia was associated with worse outcomes that included more extended hospital stays and higher mortality in the reviewed studies. As analyzed by Jamil et al. (1) found that children with pneumonia who also have hyponatremia will require a more extended hospital, and they are at a higher risk of complications. Likewise, Mishra et al. (4) noted that hyponatremia is linked to unfavorable clinical outcomes in children with severe pneumonia and suggests that hyponatremia is a predictor. Respiratory dysfunction has been linked to hyponatremia, especially when the situation is severe. Significant worsening of the inflammatory process, which hinders recovery, could be reflected by it (11).

Furthermore, a specific type of electrolyte imbalance, hyponatremia, has been reported to affect the neurology of children in the worst way possible. Extremely low levels of sodium in the blood can cause confusion, both normal and abnormal movements of the limbs, and when severe, unconsciousness (12). These neurological manifestations can worsen the overall outcome in children with pneumonia and may need more care, as seen in the study conducted by Hamid et al. (11). Therefore, early recognition of hyponatremia and appropriate patient management in cases of pneumonia are vital for better outcomes, particularly when it comes to children of the high-risk group.

Finally, this study finds that hyponatremia is significantly common among the children in the case group admitted to the hospital with pneumonia and identifies the factors that may lead to its occurrence. Therefore, the likelihood of hyponatremia is higher with younger age children, severe pneumonia cases, and

children of low socioeconomic status. Combining the present study's findings with data from other parts of the world suggests that the incidence of hyponatremia in children with pneumonia is higher than among patients of different age groups and should be diagnosed and treated promptly. Further research should be directed to understanding the hyponatremia in the study subjects and identifying intervention strategies to enhance the described pediatric pneumonia population's outcomes.

CONCLUSION

Therefore, it is clear from this research that a high proportion of children being hospitalized with pneumonia in Ayub Teaching Hospital, Abbottabad, are affected by hyponatremia. Thus, the study clearly shows that about 28% of children were identified to have at least a mild degree of hyponatremia, and the incidence was found to be higher among children with severe pneumonia, younger age, and lower socioeconomic class. The low sodium level in these children was linked with adverse clinical events such as longer hospital length of stay and adverse effects. These findings support previous studies that regard hyponatremia as a sign of disease severity and an indicator of unfavorable prognosis in pediatric pneumonia. Because hyponatremia occurs frequently and has the potential to be dangerous in children with pneumonia, it is essential to closely heed electrolyte levels in children with pneumonia, especially the high-risk ones. It would have been beneficial if hyponatremia could be prevented or its onset detected early in the course of clinical infection, improving the managing of cases of pediatric pneumonia.

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