

## The impact of Hypo- and Hypernatremia on Severity and Clinical Outcomes of Community Acquired Pneumonia

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### Abstract

#### *Aim*

Pneumonia is one of the leading causes of morbidity and mortality worldwide. Sodium disturbance is a common electrolyte disorder reported in patients with pneumonia. Because of pneumonia's staggering clinical and economic burden, it is important to identify and fully understand all modifiable factors that influence its clinical outcomes.

We aim to investigate the impact of hypo/hypernatremia on clinical outcome in hospitalized patients with pneumonia and help to create awareness and new strategies to further influence outcome of pneumonia patients in a favourable way.

#### *Methods*

A single center, retrospective study including all hospitalized patients who were admitted with community acquired pneumonia from January 2022 to December 2022. Patient demographics, clinical presentation, laboratory results and follow up plan were included. The clinical outcomes measured included in-hospital mortality and length of stay in ICU and hospital wards. All data will be analyzed with the latest version of SPSS.

#### *Results*

Of 420 patients with community-acquired pneumonia, 101 (24.0%) with hyponatremia were older (84.2 years  $\pm$  12.2) and highest percentage of patients scored CURB-65 of 5 (2%). Hyponatremia was associated with an increased ICU length of stay (0.2  $\pm$  0.9 vs 0.0 days,  $p = 0.008$ ). Hypernatremia was associated with a higher rate of mortality (40% vs 6%,  $p = 0.007$ ).

#### *Discussion*

Hyponatremia is common among hospitalized patients with pneumonia and hypernatremia is associated with high mortality rate. Further research is required to investigate whether promptly correcting sodium levels might have an influence on these outcomes.

## Introduction

Pneumonia is one of the leading causes of morbidity and mortality worldwide with its general incidence ranging between 1 and 25 cases per 1000 inhabitants per year.<sup>1</sup> Annually, 0.5% to 1% of adults in the UK were diagnosed with community acquired pneumonia. Among the admitted patients, 1.2% to 10% of patients were managed in an intensive care unit and, for these patients, the risk of mortality surpasses 30%. Notably, over half of the deaths linked to community acquired pneumonia occurred in individuals aged 84 years and older. This data underscores the significant impact and severity of community-acquired pneumonia within the adult population.<sup>2</sup> Due to the significant clinical and economic challenges posed by pneumonia, it is crucial to identify and thoroughly comprehend all factors that can be modified and that exert an influence on patients' progression during hospitalization. Recognizing and gaining a comprehensive understanding of these modifiable factors is essential to effectively address and manage the impact of pneumonia on both medical outcomes and financial considerations.

It has been observed by others that hyponatremia has a negative impact on clinical outcomes.<sup>3,4</sup> With respect to pneumonia, the presence of hyponatremia was associated with not only prolongation of hospitalization but also an increase in in-hospital mortality.<sup>5,6</sup> However, a study involving patients with community-acquired pneumonia, has also indicated an association between hypernatremia and increased mortality.<sup>7</sup>

To our knowledge, there is no study specifically investigating the prevalence and impact on outcomes of hypo- and hypernatremia in patients with community acquired pneumonia in the Republic of Ireland. Accordingly, we conduct a retrospective study on outcomes of sodium level at time of hospitalization and outcomes among patients. Knowledge of the prevalence and relevance of dysnatremias in patients with pneumonia could help to create awareness and new strategies to further influence outcome of pneumonia patients in a favourable way.

## Methods

### *2.1 Study design and data collection*

A single center, retrospective study of all patients who admitted with community acquired pneumonia from Jan 2022 to December 2022. All patients had to be admitted in Portiuncula University Hospital in the Republic of Ireland. Patient demographics, clinical presentation, laboratory results and follow up plan were obtained from medical record and Winpath© (Clinisys, United Kingdom) electronic laboratory record system. The clinical outcomes

measured include in-hospital mortality, length of stay in ICU, and non-ICU length of stay. All data will be analyzed with latest version of SPSS.

## 2.2 Statistical analysis

Statistical analysis were performed using Statistical Package for Social Science (SPSS) version 27 (IBM corporation, Armonk, NY).

## Results

A total of 420 patients were included in this study. Patients with CAP were 51.0% male and 49.0% female. On admission, 299 (71.2%) patients had normal sodium level, 101 (24.0%) were hyponatraemic and 20 (4.8%) had hypernatremia. Of the patients with hyponatremia, 49 (48.5%) were male and had a mean age of  $84.2 \pm 12.2$  years. Among them, 3 (3.0%) patients had CURB-65 score of 0, 84 (83.2%) had a CURB-65 score of 1, 5 (5.0%) had a CURB-65 score of 2, 7 (6.9%) had a CURB-65 score of 3 and 1 (1.0%) patient had CURB-65 score of 4 or 5. Among those with hypernatremia, none of patients had CURB-65 score more than 2. (Table 1). Patients with hypernatremia had the highest CURB-65 scores of 2 (10.0%) while patient with hyponatremia had the highest score of CURB-65 score of 5 (2.0%).

The clinical outcomes by sodium status are shown in Table 2. The mean length of stay, either in ICU or wards, were longer in the group with hyponatremia. Hospital mortality was greater among the patients with hypernatremia (40%) which is statistically significant. 30-day-readmission rates to hospital with CAP was observed and patients with hyponatremia had higher incidences (11.9% vs 10.0%).

*Table 1: Demographic data and baseline characteristic*

	CAP with hyponatremia	CAP with normonatremia	CAP with hypernatremia
Patients n (%)	101 (24.0%)	299 (71.2%)	20 (4.8)
Mean age years (SD)	$84.2 \pm 12.2$	$79.2 \pm 12.1$	$80.9 \pm 15.11$
Gender n (%)			
Male	49 (48.5)	157 (52.5)	9 (45)
Female	52 (51.5)	142 (47.5)	11 (55)
CURB-65 n (%)			
0	3 (3.0)	10 (3.3)	1 (5.0)
1	84 (83.2)	231 (77.3)	17 (85.0)
2	5 (5.0)	24 (8.0)	2 (10.0)
3	6 (5.9)	27 (9.0)	0 (0)

4	1 (1.0)	4 (1.3)	0 (0)
5	2 (2.0)	3 (1.0)	0 (0)

*Table 2: Hospital Outcomes of patients*

	CAP with hyponatremia	CAP with hypernatremia	P value
Mean ICU length of stay (days)	0.2 (0.9)	0.0	0.008
Mean Length of stay (days)	9.1 (8.6)	8.5 (4.7)	0.633
Mortality (%)	6.0	40.0	0.007
30 day readmission (%)	11.9	10.0	0.806

## Discussion

Prevalence of disorders of serum sodium was significantly increased in patients with CAP, with a described incidence of up to 30%.<sup>8,9</sup> These incidences were similar to our study findings (24.0%). The mechanism of hyponatremia in pneumonia is incompletely understood. Syndrome of inappropriate antidiuretic hormone secretion (SIADH) is one of the common causes believed to play a role in patients with CAP.<sup>10</sup> Individuals diagnosed with CAP frequently exhibit multiple factors that contribute to the nonosmotic activation of antidiuretic hormone (ADH). Notably, these factors include inflammatory cytokines like interleukin 6, which are associated with the body's immune response to infection. Moreover, the presence of stress, nausea, and inadequate oxygen supply also contribute to the activation of ADH. These combined factors contribute to fluid retention and the electrolyte imbalances often seen.<sup>11-13</sup> Patients might concurrently experience hypovolemia which can occur due to various factors. Firstly, inadequate oral intake, often associated with reduced appetite can lead to decreased fluid levels in the body. Additionally, systemic vasodilation, a widening of blood vessels throughout the body, can contribute to hypovolemia. Extrarenal sodium losses can also further exacerbate hypovolemia.<sup>14</sup>

Several risk stratification algorithms have been created to assist in categorizing patients based on their risk of experiencing complications related to community-acquired pneumonia (CAP). Notably, two widely used algorithms are CURB-65 and the Pneumonia Severity Index (PSI). CURB-65 score evaluates several factors including confusion, blood urea nitrogen (BUN) level, respiratory rate, blood pressure, and patients aged 65 or older.<sup>15-17</sup> In our study, there was an association between severity of CAP as determined by CURB-65 score, and the level of hyponatremia. Patients with hyponatremia were older and had higher CURB-65 scores. Mean

ICU lengths of stay were found to be increased, with higher percentage of increasing CURB-65 score (3.0%). The results were almost in accordance with some of the previous studies.<sup>18</sup>

In view of our results, low sodium levels upon admission were found to be independently linked with a longer duration of hospitalization ( $p=0.633$ ). This observation aligns with findings from prior research conducted in this field.<sup>19</sup> On the other hand, these findings stand in contrast to a previously conducted study on sodium level in patients with community acquired pneumonia, where an association was found between hyponatremia and increased mortality but not prolonged length of stay.<sup>20</sup>

Limitations of this study include the retrospective design and lack of information on factors affecting sodium balance including hyperglycemia, patients' comorbidities, and pre-admission medication. Another limitation is causative organisms of community acquired pneumonia was not collected and association between certain pathogens and sodium level could not be assessed.

Hyponatremia is common among hospitalized patients with pneumonia, and hypernatremia is associated with high mortality rate. Further research is required to investigate whether promptly correcting sodium levels might have an influence on these outcomes.

**Declaration of Conflict of Interest:**

None declared.

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