



## Impact of Hyponatremia Severity on In-Hospital Outcomes among Elderly Patients

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*(Received: 25 November 2025    Revised: 27 December 2025    Accepted: 11 January 2026)*

### KEYWORDS

Hyponatremia, Elderly, Severity, Hospital outcome, Length of hospital stay.

### ABSTRACT:

**Background:** Hyponatremia is common in elderly hospitalized patients and is associated with adverse clinical outcomes. The prognostic impact of hyponatremia severity in this population warrants a focused evaluation. This study aimed to assess the impact of hyponatremia severity on in-hospital outcomes in elderly patients.

**Methods:** This observational study was conducted in the Department of Internal Medicine at Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh, over 12-month period of time. Elderly patients ( $\geq 60$  years) with serum sodium levels of  $< 135$  mmol/L were included. Patients were categorized into mild, moderate and severe hyponatremia groups based on their serum sodium concentrations. Associations between severity and hospital outcomes, duration of hospital stay and age group were analyzed using SPSS version 22.0, with  $p < 0.05$  considered statistically significant.

**Results:** A total of 66 patients were analyzed. Severe hyponatremia was associated with higher in-hospital mortality and increased discharge risk compared with mild and moderate hyponatremia. Prolonged hospital stays were more common in patients with severe hyponatremia. Severe hyponatremia was also more frequently observed in patients aged  $> 70$  years.

**Conclusion:** Hyponatremia severity is strongly associated with adverse short-term hospital outcomes in older adult patients. Severity-based assessment at presentation may facilitate early risk stratification and guide management strategies to improve outcomes in this vulnerable population.

### Introduction

Hyponatremia is a common electrolyte imbalance frequently encountered in hospitalized patients, particularly prevalent among the elderly and is

associated with adverse clinical outcomes.<sup>1,2</sup> Age-related physiological changes such as impaired renal water handling, altered thirst perception and increased sensitivity to antidiuretic hormone contribute to disturbances in sodium homeostasis in older adults.<sup>3</sup> In



elderly hospitalized patients, hyponatremia often arises in the context of acute illness, chronic comorbidities, or medication use, serving both as a marker of disease severity and a contributor to clinical deterioration.<sup>4</sup>

Hyponatremia has gained considerable attention due to its prognostic significance. Numerous studies have demonstrated that lower serum sodium levels correlate with increased in-hospital mortality, longer hospital stays and higher rates of discharge with residual morbidity.<sup>5,6</sup> These adverse outcomes are particularly evident among elderly patients, who possess diminished physiological reserves and reduced capacity to adapt to osmotic stress.<sup>7</sup> Accordingly, the severity of hyponatremia at presentation has emerged as an important predictor of short-term hospital outcomes.

The classification of hyponatremia into mild, moderate and severe categories constitutes a clinically meaningful framework for risk stratification. Severe hyponatremia is strongly linked with neurological complications, prolonged hospitalization and increased mortality, whereas even mild to moderate hyponatremia is associated with subtle cognitive impairment and delayed recovery.<sup>2,3</sup> These outcomes can occur independently of the underlying etiology, emphasizing the prognostic importance of serum sodium concentration itself.

Age further modifies the link between hyponatremia severity and clinical outcomes. Older patients suffering from severe hyponatremia exhibit a higher likelihood of prolonged hospitalization, incomplete recovery, or death compared to their younger counterparts with similar sodium levels.<sup>4,8</sup> This interaction calls for outcome evaluations within an elderly-specific framework rather than extrapolating from mixed-age cohorts.

Despite the accumulating international evidence, data from South Asian countries on the impact of hyponatremia severity on in-hospital outcomes in elderly patients remain limited. Regional studies mostly focus on prevalence or etiologies rather than severity-outcome associations in older populations.<sup>9</sup> Such local evidence is crucial for guiding clinical decision-making and optimizing resource use in tertiary care settings.

Therefore, recent research underscores the imperative to assess how hyponatremia severity influences short-term hospital outcomes including mortality, length of stay and functional recovery in elderly hospitalized patients,

facilitating improved prognostication and tailored management strategies in diverse healthcare contexts.<sup>4,6</sup>

This study aimed to evaluate the impact of hyponatremia severity on short-term in-hospital outcomes among elderly patients. Specifically, the study examined the association between the severity of hyponatremia and hospital outcome, duration of hospital stays and age distribution. By focusing on these outcome measures, this study seeks to clarify the prognostic implications of hyponatremia severity in elderly hospitalized patients and contribute evidence relevant to clinical practice in similar healthcare settings.

## Materials & Methods

This observational study was conducted in the Department of Internal Medicine at Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh, over twelve months. The study included 66 elderly patients aged 60 years and above who were admitted to the medical wards and diagnosed with hyponatremia, defined as a serum sodium concentration below 135 mmol/L. Patients of either sex who met the inclusion criteria were enrolled consecutively. Exclusion criteria included pseudohyponatremia, patients receiving mannitol therapy and critically ill patients requiring intensive care support. After obtaining informed written consent, demographic information, including age, was recorded and serum sodium levels were measured using standard ion-selective electrode techniques. Based on serum sodium concentration at presentation, patients were classified into mild, moderate, or severe hyponatremia categories according to established clinical definitions. Hospital outcomes were documented for all patients, including improvement and discharge, discharge on risk bond and in-hospital mortality. The duration of hospital stay was recorded and categorized for analysis. Data were collected using a structured case record form to ensure accuracy, consistency and completeness. Ethical approval for the study was obtained from the Ethical Review Committee of Sir Salimullah Medical College and patient confidentiality was strictly maintained throughout the study. Statistical analysis was performed using SPSS version 22.0 for Windows. Categorical variables were expressed as frequencies and percentages. Associations between the severity of hyponatremia and in-hospital outcome, duration of hospital stay and age group were assessed



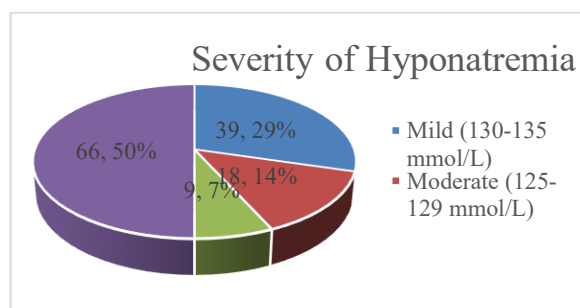
using the Chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant.

## Results

**Table 1. Age distribution of the patients (n = 66)**

Age group (years)	Frequency (n)	Percentage (%)
65–70	28	42.4
71–75	15	22.7
>75	23	34.8
Total	66	100

Table 1 presents the age distribution of the study population (n=66). The majority of patients (42.4%) were in the 65–70 year age group, followed by those above 75 years (34.8%) and the 71–75 year group (22.7%).



**Figure 1: Distribution of the patients by severity of Hyponatremia (n=66)**

Mild hyponatremia was found in 59.1% cases, followed by 27.3% had moderate and 13.6% had severe hyponatremia.

**Table 2: Association of In-Hospital Outcome with Severity of Hyponatremia (n=66)**

In-Hospital Outcome	Mild (n=39)	Moderate (n=18)	Severe (n=9)	p value
	n (%)	n (%)	n (%)	
Improved	36 (92.3)	15 (83.3)	0 (0)	<0.01

DORB	3 (7.7)	3 (16.7)	4 (44.4)
Died	0 (0)	0 (0)	5 (55.6)

Table 2 shows the association between hyponatremia severity and in-hospital outcome. A statistically significant relationship was observed ( $p < 0.01$ ). The proportion of patients who improved decreased markedly with increasing severity, from 92.3% in the mild group to 0% in the severe group. Conversely, mortality was exclusive to the severe hyponatremia group, occurring in 55.6% of these patients. Discharge on risk bond (DORB) was more frequent in the moderate (16.7%) and severe (44.4%) categories.

**Table 3: Association of Hospital stay with Severity of Hyponatremia (n=66)**

Duration of Hospital stay	Mild (n=39)	Moderate (n=18)	Severe (n=9)	p value
	n (%)	n (%)	n (%)	
7-10	37 (94.9)	14 (77.8)	6 (66.7)	0.011
Above	2 (5.1)	4 (22.2)	3 (33.3)	

Table 3 describes the association between hyponatremia severity and duration of hospital stay. A significant association was found ( $p = 0.011$ ). The proportion of patients with a hospital stay exceeding 10 days increased with severity: 5.1% in the mild group, 22.2% in the moderate group and 33.3% in the severe group.

**Table 4: Association of Age group with Severity of Hyponatremia (n=66)**

Age group in years	Mild (n=39)	Moderate (n=18)	Severe (n=9)	p value
	n (%)	n (%)	n (%)	
65 to 70	22 (56.4)	6 (33.3)	0 (0)	0.011



71 to 75	9 (23.1)	4 (22.2)	2 (22.2)
Above 75	8 (20.5)	8 (44.5)	7 (77.8)

Table 4 presents the association between patient age group and hyponatremia severity. The association was statistically significant ( $p=0.011$ ). No patients aged 65-70 years had severe hyponatremia. The proportion of patients above 75 years increased with severity, comprising 20.5% of the mild group, 44.5% of the moderate group and 77.8% of the severe group.

### Discussion

The present study evaluated the impact of hyponatremia severity on short-term in-hospital outcomes among elderly patients, with particular emphasis on hospital outcomes, duration of hospital stays and age-related severity distribution. The findings demonstrate that increasing severity of hyponatremia is associated with poorer in-hospital outcomes, prolonged hospitalization and a higher burden of severe disease among older age groups, underscoring the prognostic significance of serum sodium levels in elderly hospitalized patients.

In this cohort, most patients experienced clinical improvement and were discharged, while a smaller proportion were discharged on risk bond or died during hospitalization. However, adverse outcomes were disproportionately concentrated among patients with severe hyponatremia. This observation is consistent with previous studies that have identified severe hyponatremia as an independent predictor of in-hospital mortality and unfavorable outcomes.<sup>10,11</sup> Wald et al. reported that lower serum sodium levels at admission were associated with increased mortality and prolonged hospitalization, even after adjustment for comorbid conditions.<sup>10</sup> Similar findings have been reported in elderly-specific cohorts, highlighting the vulnerability of this population to the consequences of severe electrolyte imbalance.<sup>12</sup>

The association between the severity of hyponatremia and hospital outcome observed in this study may be explained by several mechanisms. Severe hyponatremia is more likely to produce neurological complications such as cerebral edema, altered mental status and

seizures, which can precipitate rapid clinical deterioration and complicate management. Elderly patients, in particular, have reduced cerebral adaptive capacity, making them more susceptible to neurological injury at lower sodium thresholds compared with younger individuals. This physiological limitation may account for the higher rates of mortality and discharge on risk bond observed among severely hyponatremic patients in the present study.<sup>13,14</sup>

Duration of hospital stay is an important indicator of disease burden and healthcare resource utilization. In this study, prolonged hospitalization was more frequently observed among patients with severe hyponatremia. This finding aligns with multiple reports demonstrating that hyponatremia, particularly in its severe form, is associated with extended hospital stay.<sup>15</sup> Prolonged hospitalization may reflect the need for close monitoring of sodium correction, management of neurological complications and treatment of underlying conditions contributing to hyponatremia. Corona et al. emphasized that even moderate hyponatremia can delay recovery and discharge, while severe hyponatremia substantially amplifies this effect.<sup>16</sup>

The relationship between age and severity of hyponatremia observed in this study further highlights the compounded risk faced by older patients. Severe hyponatremia was more commonly observed among patients aged above 70 years. Age-related changes in renal function, impaired free water excretion, altered thirst perception and increased sensitivity to antidiuretic hormone may all contribute to this pattern.<sup>17</sup> Additionally, older patients are more likely to present late in the course of illness or have atypical symptoms, leading to delayed diagnosis and more severe biochemical derangement at admission. Similar age-severity associations have been reported by Filippatos et al. and Soiza et al., who noted that advancing age is a key determinant of both severity and adverse outcomes in hyponatremia.<sup>18,19</sup>

Importantly, the findings of this study reinforce the clinical value of severity-based classification of hyponatremia. While etiology remains important for guiding treatment, serum sodium concentration at presentation provides immediate prognostic information and may help identify patients at high risk for poor outcomes. Early recognition of severe hyponatremia and



prompt, carefully monitored correction may therefore reduce morbidity and mortality in this vulnerable group.

Overall, the present study contributes to the growing body of evidence that hyponatremia severity is a critical determinant of short-term hospital outcomes in elderly patients. By demonstrating clear associations between severity, hospital outcome, length of stay and age, this study provides clinically relevant insights that may aid risk stratification and management in routine inpatient practice.

### Limitations of the Study

This study has several limitations. It was conducted at a single tertiary care center with a relatively small sample size, which may limit external validity. The observational design precludes causal inference and potential confounding factors such as comorbidities and treatment variations were not adjusted for in multivariable analysis. Long-term outcomes following discharge were not assessed.

### Conclusion

Hyponatremia severity is a key determinant of short-term in-hospital outcomes in elderly patients. Severe hyponatremia is associated with higher mortality, prolonged hospital stays and greater disease burden, particularly in patients aged > 70 years. Early identification of severe hyponatremia and timely, appropriate management may improve clinical outcomes and reduce hospitalization-related complications in this high-risk population.

**Conflicts of interest:** None.

**Ethical approval:** The study was approved by the Institutional Ethical Review Committee.

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