

Lack of Association Between Dysnatremia and Hospitalization Length in Patients with COVID-19: Evidence from a Retrospective Analysis

Running title: Sodium Disorders and COVID-19 Hospitalization Length

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Abstract

Background: COVID-19 has had a significant impact on global health, and previous studies have linked sodium abnormalities (dysnatremia), including hyponatremia and hypernatremia, to increased rates of ICU admission, mechanical ventilation, and complications that may affect recovery and prolong hospitalization. This study aimed to evaluate the association between sodium abnormalities and the length of hospitalization among patients with COVID-19.

Methods: A retrospective study was conducted on patients with PCR-confirmed COVID-19 between 2019 and 2021. Data collection involved reviewing medical records, laboratory findings, and conducting telephone interviews with patients. Data were analyzed using SPSS version 18. Descriptive statistics summarized the data, while chi-square, t-test/Mann–Whitney, and Pearson/Spearman correlations were applied as appropriate. Logistic regression assessed associations, with $P < 0.05$ considered significant.

Results: The study comprised 129 participants, with a male-to-female ratio of 54.3% to 45.7%. Hyponatremia was present in 44.2% ($n = 57$) of patients, while hypernatremia was observed in 5.4% ($n = 7$). Overall, 50.4% ($n = 65$) of patients had normal serum sodium levels. Spearman correlation showed no significant association between serum sodium levels and length of hospital stay ($P = 0.789$). Similarly, Kruskal–Wallis analyses revealed no significant differences between sodium levels and hospitalization duration across age groups, sex, diuretic use, kidney disease, type of intravenous fluid, serum magnesium, albumin, blood sugar, ICU stay, or ward stay (all $P > 0.05$). Chi-square analysis also showed no significant association between serum sodium and patient outcomes ($P = 0.342$), and stratified analyses by outcomes confirmed the absence of statistical significance (all $P > 0.05$).

Conclusion: Despite previous reports of an association between sodium disorders and morbidity/mortality in COVID-19 patients, this study did not find a significant relationship between the two variables. Further research is warranted to explore the potential impact of sodium abnormalities on COVID-19 patient outcomes.

Keywords: COVID-19, Electrolyte imbalances, Dysnatremia, Length of hospital stay, Morbidity

Introduction

The emergence of COVID-19, caused by the novel coronavirus SARS-CoV-2, has posed significant challenges to global health systems (1, 2). With a wide range of clinical presentations, from asymptomatic to severe and fatal cases, understanding the relationship between sodium disorders and disease progression in COVID-19 patients is crucial for optimizing treatment strategies and improving patient outcomes (3, 4).

Laboratory findings in hospitalized COVID-19 patients often reveal elevated leukocyte counts, inflammatory markers such as CRP and ESR, and increased D-dimer levels (1). Additionally, leukopenia may be observed in some cases. Chest imaging typically shows ground-glass opacities in the lungs, contributing to the overall clinical picture of this infectious disease (2). Given the novel nature of COVID-19, no definitive cure currently exists. Thus, preventative measures such as vaccination, home quarantine, and public health interventions have been implemented globally to control disease transmission and mitigate its impact on populations and healthcare systems (3). Electrolyte imbalances, such as hyponatremia, hypernatremia, hypokalemia, hyperkalemia, and hypocalcemia, have been associated with increased mortality rates in COVID-19 patients. These disorders complicate the treatment process and can significantly impact patients' recovery, often prolonging hospitalization and exacerbating overall disease burden (4). This study focuses on sodium disorders, specifically hyponatremia and hypernatremia. Hyponatremia is characterized by plasma sodium levels below 135 mmol/L, while hypernatremia is defined as plasma sodium levels exceeding 145 mmol/L. These imbalances can have significant implications for patient outcomes and require careful monitoring and management in clinical settings (5-7). Research shows that COVID-19 patients with hyponatremia or hypernatremia have longer hospital stays, increased ICU admissions, ventilation needs, and higher septic shock risk. These sodium imbalances also correlate with increased mortality and complications, stressing the importance of monitoring and managing electrolyte imbalances in COVID-19 care (8, 9). Recent systematic reviews and meta-analyses (10-13) have quantified the prevalence of hyponatremia in COVID-19 patients. A comprehensive meta-analysis (11) encompassing 52 studies reported a pooled prevalence of hyponatremia at 25.8% among hospitalized COVID-19 patients. This finding underscores the high incidence of sodium imbalances in this patient population. As COVID-19 remains an evolving disease with numerous unknown aspects regarding its pathogenesis and treatment, this research aims to investigate the impact of COVID-19 on sodium electrolyte balance and its relationship with disease progression. By understanding these factors, we can potentially develop strategies to maintain electrolyte homeostasis, reduce hospitalization duration, and prevent hospitalization-associated complications. Ultimately, this knowledge may contribute to lowering mortality rates and mitigating the adverse outcomes experienced by COVID-19 patients. The primary objective of this study was to evaluate the association between sodium abnormalities, including both hyponatremia and hypernatremia, and the length of hospitalization in patients with PCR-confirmed COVID-19. Additionally, the study aimed to determine the prevalence of hyponatremia and hypernatremia among hospitalized COVID-19 patients and to investigate whether the severity of these sodium abnormalities is associated with adverse clinical outcomes, such as intensive care unit admission and the need for mechanical ventilation.

Methods

This retrospective cohort study analyzed patients with PCR-confirmed COVID-19 who were admitted to Sayad Shirazi Hospital in Gorgan, Iran. All patients included in the study tested positive for SARS-CoV-2 using a Real-Time PCR assay. The retrospective cohort design allowed

for the evaluation of clinical and laboratory data, including sodium levels, and their association with hospitalization outcomes.

Data were collected retrospectively through review of hospital medical records for all eligible patients diagnosed between 2019 and 2021. This study was designed as a retrospective cohort study, in which patients were classified according to serum sodium status into dysnatremia (hyponatremia or hypernatremia) and normonatremia groups. Clinical outcomes, including mortality, length of hospital stay, and disease course, were compared between the two groups. To minimize confounding, the groups were frequency-matched for age and sex. In addition to medical record review, telephone interviews were conducted when necessary to gather additional clinical information, including disease symptoms, treatment adherence, and post-discharge outcomes. All participants were informed about the study objectives, and written informed consent was obtained. Participants were assured of the confidentiality of their personal information throughout the study. Each patient was assigned a unique code number to ensure anonymity, and no personal identifiers were recorded in the dataset. Confidentiality was strictly maintained during data collection, analysis, and publication.

Inclusion criteria comprised patients with PCR-confirmed COVID-19. Exclusion criteria included patients with heart failure, hypothyroidism, or chronic kidney disease diagnosed within the 12 months prior to admission. Additionally, patients who had used thiazide diuretics within the three months prior to hospitalization were also excluded. Patients were divided based on laboratory data. Both case and control groups were matched by age and gender to assess mortality rate, hospitalization duration, and disease progression.

Statistical analysis

Data were analyzed using SPSS version 18. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize continuous and categorical variables. The Chi-square test was applied to compare categorical variables between groups, while the independent t-test or Mann–Whitney U test was used for continuous variables depending on data normality. Pearson or Spearman correlation coefficients were employed to evaluate the relationships between continuous variables. Logistic regression analysis was conducted to assess associations between sodium abnormalities and clinical outcomes, adjusting for potential confounders such as age, sex, and comorbidities. A *p*-value of less than 0.05 was considered statistically significant. The choice of statistical tests was based on data type, distribution, and the need to control for confounding factors to ensure accurate interpretation of the results.

Results

A total of 129 patients with PCR-confirmed COVID-19 were included in the study. Among them, 57 patients (44.2%) had hyponatremia, 7 patients (5.4%) had hypernatremia, and 65 patients (50.4%) had normal serum sodium levels. Serum sodium measurements were obtained on admission and periodically during hospitalization, allowing accurate classification of patients into the respective groups.

Table 1 presents the association between sodium disorders and hospitalization duration, along with demographic and clinical variables. Spearman correlation analysis showed no significant relationship between serum sodium levels and length of hospital stay ($P = 0.789$). Kruskal–Wallis analyses indicated no significant differences in hospitalization duration across age groups, gender, diuretic use, renal disease, type of intravenous fluid, magnesium levels, albumin levels, or blood sugar levels (all $P > 0.05$).

Table 2 summarizes the correlation of sodium disorders with patient outcomes. Chi-square analysis revealed no significant association between serum sodium levels and outcomes, including recovery, death, transfer to another center, or personal satisfaction ($P = 0.342$). Stratified analyses by outcome categories confirmed the absence of statistically significant differences across sodium status groups (all $P > 0.05$).

Regarding ICU stay, 98 patients (76%) were admitted for less than 4 days, while 31 patients (24%) stayed 4 days or more; no significant association was found between serum sodium levels and ICU stay duration ($P = 0.508$). Similarly, ward hospitalization duration did not differ significantly according to sodium status, with 95 patients (73.6%) staying less than 7 days and 34 patients (26.4%) staying 7 days or more ($P = 0.278$).

Overall, these findings indicate that sodium abnormalities were not significantly associated with prolonged hospitalization or adverse clinical outcomes in this cohort of COVID-19 patients.

Discussion

COVID-19 has burdened healthcare systems globally, with over one million lives lost since its emergence. Electrolyte imbalances, including sodium disorders like hyponatremia and hypernatremia, have been associated with increased disease mortality and complications, necessitating close monitoring and management (9, 14). This retrospective study investigated the impact of sodium disorders on hospitalization duration in COVID-19 patients at Sayad Shirazi Hospital, Gorgan, from 2019 to 2021. The analysis involved 129 hospitalized patients and aimed to contribute to understanding the connection between electrolyte imbalances and patient outcomes in COVID-19.

The results of this study indicated no statistically significant relationship between serum sodium levels and hospitalization duration in COVID-19 patients ($P = 0.789$). Similarly, no significant association was observed between the qualitative level of serum sodium (normal, hyponatremia, hypernatremia) and hospitalization duration ($P = 0.854$). Conversely, a 2021 Italian study by Andrea Berni et al. found that hyponatremia at admission was associated with increased requirements for non-invasive ventilation and ICU transfer ($P = 0.001$ and $P = 0.007$). Furthermore, hyponatremia patients were 2.7 times more likely to experience mortality compared to those with normal sodium levels or hypernatremia (15). These contrasting findings highlight the need for further research to clarify the relationship between sodium imbalances and COVID-19 disease progression and outcomes.

In our study, 41 of the 57 patients with hyponatremia (71.9%) died during hospitalization, accounting for 48.8% of all deaths. However, although mortality was numerically higher among patients with hyponatremia, the association between hyponatremia and mortality was not statistically significant ($P = 0.342$). Therefore, these findings should be interpreted with caution, and larger prospective studies are warranted to further clarify the relationship between hyponatremia and mortality in COVID-19 patients. These findings align with a 2021 Italian study by Martino et al., which reported worse prognoses for patients with combined serum sodium abnormalities compared to those with only hyponatremia or hypernatremia. This cohort also experienced longer hospital stays ($P = 0.031$), increased need for mechanical ventilation ($P = 0.028$), and higher rates of ICU transfer ($P = 0.001$) (16). Similarly, a 2020 Turkish study by Tezkan et al. found that electrolyte disturbances, particularly hyponatremia, are linked to poor outcomes in COVID-19 patients. Hyponatremia was present in 35.8% of participants, with no cases of hypernatremia. This contrasts with the present study, where hyponatremia was found in 44.18% of patients and hypernatremia in 5.42%. Tezkan's study also revealed that electrolyte

disorders, including hyponatremia, calcium, potassium, and chlorine imbalances, were associated with greater ICU admissions, increased need for mechanical ventilation, and longer hospitalization durations ($P < 0.001$) (17). These studies collectively suggest that electrolyte imbalances, especially sodium disorders, are potentially significant predictors of adverse outcomes in COVID-19 patients.

Although no significant association between serum sodium levels and hospitalization duration was found in the current study, hyponatremia's substantial impact on patient prognosis and outcomes is evident. These findings are consistent with a 2019 study by Frontera et al. in New York, which demonstrated that patients with moderate to severe hyponatremia (sodium levels below 130) had a higher likelihood of requiring mechanical ventilation ($P = 0.001$). Additionally, the risk of encephalopathy was estimated to be eight times greater in hyponatremia patients compared to those with hypernatremia. The study also reported a 38% increase in mortality rates associated with increased hyponatremia severity. However, the duration of hospitalization did not significantly correlate with hyponatremia severity ($P = 0.381$), a finding consistent with the present study (18). In this study, no significant association was observed between serum sodium levels and the length of hospital stay or other clinical outcomes in patients with COVID-19. These findings contrast with several previous reports that identified hyponatremia as a common electrolyte disturbance in COVID-19 patients and linked it to increased risk of ICU admission, mechanical ventilation, and mortality. The absence of a significant relationship in our cohort may be due to differences in patient characteristics, sample size, or the management protocols implemented at our center. Additionally, strict exclusion criteria, such as pre-existing heart failure, kidney disease, hypothyroidism, and recent thiazide use, may have limited the variability in sodium disturbances and mitigated their impact on outcomes. Our results suggest that, while sodium abnormalities are clinically important, their effect on hospitalization duration and immediate patient outcomes may be less pronounced in certain patient populations or under specific clinical management strategies. Further multicenter studies with larger sample sizes are warranted to clarify the prognostic significance of sodium disorders in COVID-19 and to reconcile these discrepancies with prior literature.

These results underscore the importance of closely monitoring and managing sodium imbalances in COVID-19 patients to improve outcomes and reduce mortality. Further research is essential to develop targeted interventions and establish optimal electrolyte management strategies in this patient population. A systematic review and meta-analysis study by Rizki Akbar et al. (10) further supports the significant impact of hyponatremia on COVID-19 patient outcomes, concluding that hyponatremia is associated with poor prognoses. This finding aligns with the present study, where a considerable proportion of patients with hyponatremia (71.92%) experienced mortality. The relationship between hyponatremia and adverse outcomes in COVID-19 patients highlights the importance of electrolyte monitoring and management in this population. Further research is essential to elucidate the underlying mechanisms and develop targeted interventions to improve outcomes and reduce mortality.

Additional factors contributing to electrolyte imbalances in COVID-19 patients include: malnutrition and inadequate oral intake, medication side effects, endocrine dysfunction induced by inflammation or direct viral effects, and impaired renal function, such as acute kidney injury. Comprehensive monitoring and management strategies are essential to address these multifactorial disturbances.

Several limitations should be acknowledged when interpreting the findings of this study. First, the retrospective design may introduce biases and confounding factors that could affect the observed

associations between sodium disorders and COVID-19 outcomes. Second, the relatively small sample size may limit the generalizability of the results and reduce the statistical power to detect subtle but potentially important associations. Third, as a single-center study, the patient population may not reflect broader demographic or clinical diversity, and site-specific practices could influence the findings. Additionally, unmeasured or unadjusted confounders, including disease severity and specific treatments received, may have impacted the observed relationships between sodium abnormalities and patient outcomes. Finally, although this study focused specifically on sodium disorders, other electrolyte imbalances may also play a role in COVID-19 progression and outcomes. Future research with larger, multicenter cohorts and comprehensive assessment of electrolyte disturbances is warranted to address these limitations and provide more robust evidence regarding the clinical significance of sodium disorders in COVID-19 patients.

Future research should involve multicenter studies to include patients from diverse backgrounds, which would make the findings more widely applicable. Studies with larger sample sizes are needed to improve statistical reliability and uncover subtle relationships between sodium disorders and COVID-19 outcomes. It would also be valuable to look beyond sodium alone and consider other electrolytes, such as potassium, magnesium, and calcium, to better understand how these imbalances together may affect disease progression. Prospective studies would help track patients over time, reduce potential biases, and evaluate how correcting these imbalances could improve recovery and overall outcomes.

Despite the lack of a significant association between sodium abnormalities and short-term hospitalization outcomes in this study, continuous monitoring of electrolyte levels in COVID-19 patients remains crucial. Prompt identification and management of sodium and other electrolyte imbalances can help prevent complications, support optimal recovery, and ensure patient safety. Clinicians should remain vigilant, especially in patients with severe disease or multiple comorbidities, and adopt individualized strategies to correct electrolyte disturbances when necessary.

Conclusion

In this study, sodium abnormalities were not significantly associated with the length of hospital stay or key clinical outcomes in patients with COVID-19. While dysnatremia has been linked to adverse outcomes in previous studies, our findings suggest that, under the management protocols applied in this cohort, sodium imbalances may have a limited impact on immediate hospitalization outcomes. These results highlight the importance of individualized patient monitoring and suggest that routine correction of mild sodium disturbances may not substantially alter short-term clinical outcomes. Further multicenter studies with larger and more diverse populations are needed to clarify the prognostic role of sodium disorders in COVID-19 and guide evidence-based management strategies.

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Authors Contribution

Conceptualization: Amirhossein Parmah, Taraneh Esmaeili, Majid Dastorani, Saeid Amirkhanlou. Data curation: Amirhossein Parmah. Formal analysis: Taraneh Esmaeili, Majid Dastorani. Investigation: Amirhossein Parmah. Methodology: Saeid Amirkhanlou. Project administration:

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Ethical Statement

The research followed the ten of the Declaration of Helsinki. The institutional ethical committee at Golestan University of Medical Sciences approved all study protocols. All issues have been in accordance with the standards of Golestan University of Medical Sciences. The study was approved by the ethical committee guidelines in the Faculty of Medicine, Golestan University (IR.GOUMS.REC.1400.419).

Conflicts of Interest

The authors declare that they have no competing interests.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, in accordance with ethical guidelines.

References

1. Tjendra Y, Al Mana AF, Espejo AP, Akgun Y, Millan NC, Gomez-Fernandez C, et al. Predicting disease severity and outcome in COVID-19 patients: a review of multiple biomarkers. *Archives of pathology & laboratory medicine*. 2020;144(12):1465-74.
2. Ponti G, Maccaferri M, Ruini C, Tomasi A, Ozben T. Biomarkers associated with COVID-19 disease progression. *Critical reviews in clinical laboratory sciences*. 2020;57(6):389-99.
3. Pourbagheri-Sigaroodi A, Bashash D, Fateh F, Abolghasemi H. Laboratory findings in COVID-19 diagnosis and prognosis. *Clinica chimica acta*. 2020;510:475-82.
4. Ciaccio M, Agnello L. Biochemical biomarkers alterations in Coronavirus Disease 2019 (COVID-19). *Diagnosis*. 2020;7(4):365-72.
5. Abduljabbar T, Alhamdan RS, Al Deeb M, AlAali KA, Vohra F. Association of salivary content alteration and early ageusia symptoms in COVID-19 infections: A systematic review. *European Journal of Dentistry*. 2020;14:S152-S8.
6. Al Yaqoubi IH, Al-Maqbali JS, Al Farsi AA, Al Jabri RK, Khan SA, Al Alawi AM. Prevalence of hyponatremia among medically hospitalized patients and associated outcomes: a retrospective cohort study. *Annals of Saudi Medicine*. 2024;44(5):339-48.
7. Gul Khan F, Sattar S, Yaqoob MM, Vallani N, Asad M. Frequency of dysnatremia in patients admitted with COVID-19 infection and its prognostic implication. *Journal of International Medical Research*. 2023;51(11):03000605231202180.

8. Tzoulis P, Grossman AB, Baldeweg SE, Bouloux P, Kaltsas G. Management of Endocrine Disease: Dysnatraemia in COVID-19: prevalence, prognostic impact, pathophysiology, and management. *European Journal of Endocrinology*. 2021;185(4):R103-R11.
9. Tzoulis P. Prevalence, prognostic value, pathophysiology, and management of hyponatraemia in children and adolescents with COVID-19. *Acta Bio Medica: Atenei Parmensis*. 2021;92(5).
10. Akbar MR, Pranata R, Wibowo A, Irvan, Sihite TA, Martha JW. The prognostic value of hyponatremia for predicting poor outcome in patients with COVID-19: a systematic review and meta-analysis. *Frontiers in Medicine*. 2021;8:666949.
11. Khidir RJY, Ibrahim BAY, Adam MHM, Hassan RME, Fedail ASS, Abdulhamid RO, et al. Prevalence and outcomes of hyponatremia among COVID-19 patients: a systematic review and meta-analysis. *International Journal of Health Sciences*. 2022;16(5):69.
12. Shrestha AB, Sapkota UH, Shrestha S, Aryal M, Chand S, Thapa S, et al. Association of hypernatremia with outcomes of COVID-19 patients: A systematic review and meta-analysis. *Medicine*. 2022;101(51):e32535.
13. Song H, Chia A, Tan B, Teo C, Lim V, Chua H, et al. Electrolyte imbalances as poor prognostic markers in COVID-19: a systemic review and meta-analysis. *Journal of endocrinological investigation*. 2023;46(2):235-59.
14. Alfano G, Ferrari A, Fontana F, Perrone R, Mori G, Ascione E, et al. Hypokalemia in Patients with COVID-19. *Clinical and Experimental Nephrology*. 2021;25(4):401-9.
15. Berni A, Malandrino D, Corona G, Maggi M, Parenti G, Fibbi B, et al. Serum sodium alterations in SARS CoV-2 (COVID-19) infection: impact on patient outcome. *European Journal of Endocrinology*. 2021;185(1):137-44.
16. Martino M, Falcioni P, Giancola G, Ciarloni A, Salvio G, Silvetti F, et al. Sodium alterations impair the prognosis of hospitalized patients with COVID-19 pneumonia. *Endocrine Connections*. 2021;10(10):1344-51.
17. Tezcan ME, Gokce GD, Sen N, Kaymak NZ, Ozer R. Baseline electrolyte abnormalities would be related to poor prognosis in hospitalized coronavirus disease 2019 patients. *New microbes and new infections*. 2020;37:100753.
18. Frontera JA, Valdes E, Huang J, Lewis A, Lord AS, Zhou T, et al. Prevalence and impact of hyponatremia in patients with coronavirus disease 2019 in New York City. *Critical care medicine*. 2020.

Table 1. Association between Sodium Disorders and Hospitalization Duration in COVID-19 Patients

Variables	Frequency	Percentage (%)	P-value
Serum sodium level			
Normal	65	50.4	0.854
Hyponatremia	57	44.2	
Hypernatremia	7	5.4	
Age group			
Under 45 years	22	17.1	0.697
45-74 years	75	58.1	0.566
More than or equal to 75 years	32	24.8	0.705
Gender			
Male	70	54.3	0.885
Female	59	45.7	0.447
Diuretic use			
Yes	12	9.3	0.733
No	117	90.7	0.777
Renal disease			
Yes	16	12.4	0.668
No	113	87.6	0.928
Type of serum			
Normal Saline	60	46.5	0.707
Half Saline	64	49.6	0.839
Ringer's solution	5	3.9	0.374
Magnesium level			
Normal	124	96.1	0.157
Abnormal	5	3.9	0.903
Albumin level			
Normal	92	71.3	0.545
Abnormal	37	28.7	0.753
Blood sugar level			
Normal	111	86	0.978
Abnormal	18	14	0.209
Length of stay in ICU			
Less than 4 days	98	76	0.508
4 days or more	31	24	0.611
Length of hospitalization in the ward			
Less than 7 days	95	73.6	0.278
7 days or more	34	26.4	0.931
Outcome of patients			
Recovery	37	28.68	0.315
Death	84	65.11	0.662
Transfer to another center	5	3.87	0.949
Personal satisfaction	3	2.32	-

Table 2. Correlation of sodium disorders with patient outcomes

	Serum Sodium Level						<i>P</i> -Value
	Normal		Hyponatremia		Hypernatremia		
Outcome of patients	Frequency	Percent	Frequency	Percent	Frequency	Percent	
Recovery	21	16.27	14	10.85	2	1.55	0.342
Death	39	30.23	41	31.78	4	3.10	
Transfer to another center	2	1.55	2	1.55	1	0.77	
Personal satisfaction	3	2.32	-	-	-	-	