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IMPACT OF HYPERNATREMIA AND HYPONATREMIA ON THE MORTALITY RATE AND LENGTH OF STAY AMONG THE CRITICALLY ILL ADULT PATIENTS IN DUHOK CITY, IRAQ

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ABSTRACT

Background and Aims: Dysnatremia, a medical condition that frequently affects critically ill after admission to the Intensive Care Unit (ICUs) and is linked to a negative impact on prognosis, was the focus of this study. Other objectives were to ascertain the prevalence of hyponatremia and hypernatremia among severely ill individuals in Duhok City, Iraq, and also to evaluate their relationship with deaths and the duration of ICU stays. **Materials and Methods:** To accomplish the objectives of the investigation, a prospective observational study design was used. 82 patients were selected as a non-probability convenience sample. Within 24 hours of ICU admission, the critically ill were evaluated using the APACHE-II Score. All patients had their serum salt levels examined from November 2021 to February 2022, and those patients were then followed up until they knew their outcomes**. Findings:** Of eighty-two clients, 18 (22%) had eunatremia, 26 (31.7%) developed hyponatremia, and 38 (46.3%) developed hypernatremia. 54 patients (65.9%) died. When compared to hyponatremia (53.8%) and eunatremia (38.9%), hypernatremia had the highest death rate (86.8%), and this difference was statistically significant (P = 0.0006). the significant importance of the study indicated at P-Value equal to or less than 0.05. An average score of the APACHE-II was found to be a reliable indicator of higher mortality in severely ill hypernatremic individuals. **Conclusions:** Compared to hyponatremia, hypernatremia showed a higher incidence and a statistically significant connection with patient mortality. The study found no association between dysnatremia and a longer duration in the intensive care unit.

KEYWORDS: APACHE-II, Length of ICU Stay, Mortality Rate, Hyponatremia, and Hypernatremia.

1. INTRODUCTION

According to previous studies, patients who are critically ill often experience an imbalance in their body's sodium levels, which has been associated with negative outcomes. In the human body sodium is the most prevalent extracellular ion, and its levels are carefully regulated through various biological processes to maintain a range of 135 to 145 mEq/L in the bloodstream; deviations from this range are referred to as dysnatremia. [1,2]

Dysnatremia, including hyponatremia (low sodium levels) and hypernatremia (high sodium levels), is a prevalent electrolyte problem among patients admitted to the ICU due to the severity and complexity of their conditions. Boths low and high levels of serum sodium, whether present upon admission or developed while stay in ICU, have been associated with the higher rate of mortality. [3,4]

In the ICU setting, hypernatremia, characterized by blood sodium levels above 145 mEq/L, affects around 2 to 9 percent of severely ill patients and is linked to increased mortality rates compared to patients with normal sodium levels [5,6,7]. Similarly, hyponatremia, defined as a serum sodium level below 135 mEq/L, is a significant electrolyte disorder among ICU patients, affecting approximately 13.7% to 15% of admissions. Even slight decreases in serum sodium levels upon ICU admission have been found to increase the risk of mortality [8,9,10,11].

Laboratory imbalances in sodium levels are one of the most common abnormalities and concerning issues experienced by severely ill individuals in medical/surgical ICUs. These imbalances serve as crucial indicators of severely ill patient's condition and frequently lead to changes in treatment. Early detection and recognition of dysnatremia are important in minimizing potential complications and negative impacts on prognosis.[12,13].

Despite the significance of dysnatremia in critically ill patients, its prevalence and effects have not been previously investigated in severely ill patients in Iraqi Kurdistan/Duhok. Therefore, this study aims to examine the medical conditions of medical and surgical cases and their relationship with dysnatremia. Additionally, this study aims at exploring the effects of dysnatremia on the mortality rates and the duration of stay among critically ill individuals aged 18 and above.

2. MATERIALS AND METHODS

The study's design: to achieve the study objectives, a prospective observational study was conducted over a three-month period from November 2, 2021, to February 2, 2022, at Azadi

and Emergency Teaching Hospital in Duhok City. The study obtained ethical approval from the GDH of Duhok's research ethics committee (reference number 24102021-10-39).

The study population consisted of adult patients (18 years and older) admitted to the ICU, and convenience sampling was used to select the participants. Out of the 114 patients admitted to the ICU during the three-month period, eighty-two patients in total satisfied the requirements for the study, remaining thirty-two were disqualified due to specific reasons, such as pre-existing chronic conditions like renal failure, congestive heart failure, liver cirrhosis, short ICU stay of less than 24 hours, or being under the age of 18.

Method of Data Collection: Data collection involved obtaining a venous blood sample from each patient within the first twenty-four hours of ICU admission to measure serum sodium levels. Additional information was gathered through a questionnaire developed specifically for this study. The questionnaire took approximately five to ten minutes to complete for each patient and consisted of three sections: socio-demographic and clinical features, overall health status, and the patient's APACHE II Score, a scoring system developed by Knaus [14].

Data Collection Tool: The Score of APACHE II comprised 3 sections: the Acute Physiology Score (APS), which recorded 12 physiological characteristics of each patient with a maximum point value of 60; Age Points, weighted from 0 to 6 points; and Chronic Health Evaluation Points, weighted from 0 to 5 points. The sum of these three sections provided an overall score of APACHE II ranging from 0 to 71, with higher scores indicating a greater deviation from normal health status.

Statistical Analysis for the Study: In terms of mean (SD) or number (%), general data on critically ill individuals were reported. Both the number and percentage of deaths and cases of dysnatremia were calculated. Pearson's chi-squared test was used to look at how dysnatremia is related to medical and surgical factors as well as patient outcomes. The Wilcoxon/Kruskal-Wall analysis was done to determine how long patients stayed in the ICU when they had dysnatremia. In nominal logistic regression, the influence of APACHE II along with other variables on the deaths of severely ill individuals was investigated; when the analysis's result reached a p-value of less than or equal to 0.05, it was deemed statistically significant. Odds ratios were used to gauge the strength of this association. The statistical computations were carried out using JMP Pro 14.3.0**.**

3. RESULTS OF THE STUDY

The study indicated that the patients' average ages ranged from 18 to 92 years, with a mean age of 52.7. Most of them were in groups of age that was under 44 years old, with a percentage

of 31.7. Male participants made up (68.3%) of the study's total participants, while female participants made up 31.7%. According to **Table 1**, the majority of cases (64.6%) were medical-related. As indicated in **Figure 1**, 76 percent of critically ill patients were admitted with several comorbid diseases. Additionally, in terms of diagnosis, the majority of the admitted patients had neurological difficulties (42%), followed by respiratory issues (39%), as seen in **Figure 2**.

Table (1): General features of severely ill individuals.

Features (number=82)	**Frequency Distribution**
	Number (percentage)
Groups' age of pt., Range: (18-92 yrs.) Mean (SD)	52.7 (18.8)
≤44	26 (31.7)
45-54	13 (15.8)
55-64	18 (22.0)
65-74	14 (17.1)
≥75	11 (13.4)
Gender of patients	
Female	26 (31.7)
Male	56 (68.3)
Comorbidity of patients	
Yes	62 (75.6)
No	20 (24.4)
Case type of patients	
Surgical	29 (35.4)
Medical	53 (64.6)

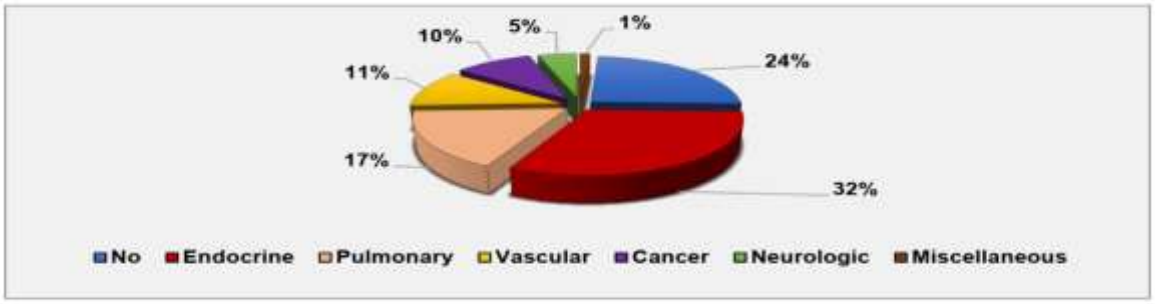

Figure (1): Comorbid illnesses were represented among critically ill patients upon ICU admission.

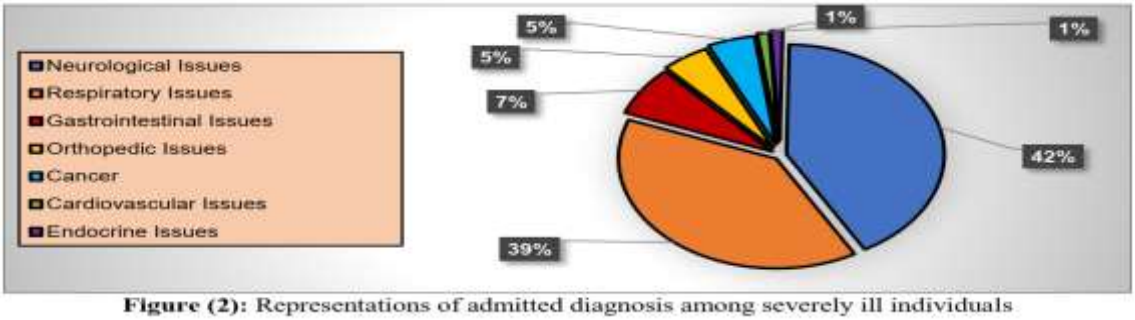

Figure (2): Representations of admitted diagnosis among severely ill individuals

According to the study, high serum sodium was found in 46.3 percent of the patients who were admitted. Additionally, 62 patients (75.6%) who were admitted to the ICU at the time needed mechanical ventilation (80.6% invasively and 19.4% non-invasively). Osmotic treatment was administered to the vast majority of patients (54.9%). Some patients, with a proportion of (35.4%) were not permitted to begin feeding during the first 24 hours after they were admitted to the ICU. In contrast, feeding was permitted in the other (64.6%) patients and administered via an enteral route (81.1%). More than half of critically ill patients (61%) received diuretic drugs, with loop diuretics being the most common type (88%) given to them. In addition, 54 (65.9%) of the patients died **(Table 2)**.

Table (2): Clinical features of severely ill adult patients and their outcome.

Features (number=82)	**Frequency Distribution**
	Mean (SD)
Systolic BP ranges;(73-200)	122.9 (24.10)
Diastolic BP ranges; (40-150)	74.6 (16.4)
$PaCO_2$ ranges; (22-114 mmHg)	38.5 (9.7)
PaO_2 ranges; (25-429 mmHg)	84.9 (43.2)
SPO_2 ranges; (49-100%)	95.7 (4.0)
Fraction of inspired O_2 ranges; (21-100 %)	63.6 (31.1)
Serum Na+ ranges; (126-165 mEq/L)	141.9 (8.6)
Actual's GCS of Patient ranges; (3-14)	6.5 (3.3)
	No. (%)

Serum sodium Levels	
Hyponatremia	26 (31.7)
Hypernatremia	38 (46.3)
Eunatremia	18 (22.0)
Mechanically ventilated	
Yes	62 (75.6)
No	20 (24.4)
Methods of mechanical ventilation	
Non-Invasively	12 (19.4)
Invasively	50 (80.6)
Osmotic therapies	
Yes	45 (54.9)
No	37 (45.1)
Feedings	
Yes	53 (64.6)
No	29 (35.4)
Feedings methods	
Orally	9 (17.0)
Enterally	43 (81.1)
Parenterally	1 (1.9)
Diuretic uses	
Yes	50 (61)
No	32 (39.0)
Diuretic Category	
Loop Diuretic	44 (88.0)
Loop and Potassium-Sparing Diuretic	6 (12.0)
Patient Outcomes	
Discharged	28 (34.1)
Died	54 (65.9)

The study found an important relationship between high serum sodium and the patient's age, as demonstrated by a p-value of 0.0425. Furthermore, the study found a substantial relationship between medical cases and hypernatremia, with a p-value of (= 0.0236). At a p-value of (= 0.0008), the study discovered a significantly important connection between urine output and high serum sodium. Additionally, the study revealed a substantial relationship between hypernatremia and low SPO2, with a p-value of (= 0.0014). The duration of stay among the dysnatremic patients did not differ significantly, as indicated in **Table 3**.

Table (3): Association between dysnatremia and the surgical and medical features of severely ill adult individuals

Features (number=82)	Dysnatremia among ICU Patients			P-value (Two-tailed)
	Hypernatremia	Hyponatremia	Eunatremia	
Groups' age of pt. no (%) ≤44 45-54 55-64 65-74 ≥75	 7 (26.92) 7 (53.85) 7 (38.89) 9 (64.29) 8 (72.73)	 10 (38.46) 3 (23.08) 9 (50.00) 1 (7.14) 3 (27.27)	 9 (34.62) 3 (23.08) 2 (11.11) 4 (28.57) 0 (0.00)	**0.0425[b]**
Gender of pt. no (%) Female Male	 13 (50.00) 25 (44.64)	 6 (23.08) 20 (35.71)	 7 (26.92) 11 (19.64)	0.4885[b]
Comorbidities no (%) Yes No	 32 (51.61) 6 (30.00)	 18 (29.03) 8 (40.00)	 12 (19.35) 6 (30.00)	0.2371[b]
Types of cases no (%) Surgical Medical	 9 (31.03) 29 (54.72)	 9 (31.03) 17 (32.08)	 11 (37.93) 7 (13.21)	**0.0236[b]**
Volume of prescribed Fluid Mean (SD)	1462.9 (576.4)	1813.1 (2133.5)	2052.4 (1144.5)	0.2914[a]
Urine Output ml/24hrs. Mean (SD)	3718.7 (2634.6)	2020.8 (1432.9)	2020.8 (1432.9)	**0.0008[a]**
Systolic BP Mean (SD)	121.0 (26.0)	127.0 (24.3)	120.7 (19.3)	0.5803[a]
Diastolic BP Mean (SD)	77.6 (21.8)	74.8 (15.7)	74.2 (13.5)	0.7665[a]
$PaCO_2$ (mmHg) Mean (SD)	44.0 (18.0)	40.5 (9.7)	35.4 (6.5)	**0.0014[a]**
PaO_2 (mmHg Mean (SD)	79.2 (40.3)	91.6 (43.6)	106.3 (72.8)	0.1719[a]
SPO_2 (%) Mean (SD)	93.4 (5.6)	96.5 (3.5)	98.1 (2.0)	0.1576[a]
Fraction of Inspired O_2 (%) Mean (SD)	69 (30.5)	57.0 (32.3)	61.8 (30.2)	0.3115[a]
Length of stay in ICU Median (IQR)	3.5 (5.75)	4 (10.5)	5.5 (7.75)	0.5919[c]

[a] One-way ANOVA, [b] Pearson chi-squared, [c] Wilcoxon/Kruskal-Wallis, for statistical analyses, tests were run.
Significant deviations are indicated by red bold numbers.

With the exception of patient death, where hypernatremic patients had a higher mortality rate of 86.8%, the study discovered a statistically very important link between elevated sodium levels and patient death at a p-value of (= 0.0006), as shown in Table 4. The study also found no significant association between dysnatremia and the patients' Glasgow coma scale levels, osmotic treatment, mechanical ventilation, feeding, or the use of diuretics.

Table (4): Association between dysnatremia and the condition of a critically ill adult patient's mental state, their therapeutic approach, and prognosis (outcomes)

Outcomes (patient's Prognosis), number=82	Dysnatremia among ICU Patients			P-value (Two-tailed)
	Hypernatremia, n=38	Hyponatremia, n=26	Eunatremia. n=18	
Patient's GCS Levels no (%)				
Mild (13-15)	0 (0.00)	4 (15.39)	2 (11.11)	0.1051
Moderate (9-12)	6 (15.79)	5 (19.23)	1 (5.56)	
Severe (1-8)	32 (84.21)	17 (65.38)	15 (83.33)	
Mechanical ventilation no (%)				
Yes	30 (78.95)	17 (65.38)	15 (83.33)	0.3189
No	8 (21.05)	9 (34.62)	3 (16.67)	
Osmotical therapies no (%)				
Yes	20 (52.63)	14 (53.85)	11 (61.11)	0.8307
No	18 (47.37)	12 (46.15)	7 (38.89)	
Feeding no (%)				
Yes	23 (60.53)	16 (61.54)	14 (77.78)	0.4169
No	15 (39.47)	10 (38.46)	4 (22.22)	
Diuretic use no (%)				
Yes	24 (63.16)	14 (53.85)	12 (66.67)	0.6452
No	14 (36.84)	12 (46.15)	6 (33.33)	
Patient's Outcome no (%)				
Discharged	5 (13.2)	12 (46.2)	11 (61.1)	**0.0006[b]**
Died	33 (86.8)	14 (53.8)	7 (38.9)	

For statistical analysis, Pearson chi-squared tests were used.
Significant deviations are indicated by red bold numbers.

As indicated in **Table 5,** hypernatremia exhibited a strong correlation with patient death, with P-values of 0.0011 and 0.0002 for the total APACHE II and predicting mortality, respectively. Additionally, **Figure 3** describes the APACHE II Total score ranges for eunatremic, hypernatremic, and hyponatremic patients who were discharged and died.

Table (5): Clinical Outcomes in critically ill adult patients and the association between dysnatremia and medical issues

Factors, (number=82)	Dysnatremia (Outcomes) no (%)			P-value (two-tailed)
	Hypernatremia number=38	Hyponatremia number=26	Eunatremia number=18	
Overall Score of APACHE II Mean (SD)	27.1 (4.3)	22.2 (9.4)	20.3 (6.3)	**0.0011[a]**
Patient's Temperatures				
Hyperthermia	7 (44.44)	8 (44.44)	2 (11.11)	0.4559[b]
Hypothermia	3 (37.50)	2 (25.00)	3 (37.50)	
Normothermia	28 (48.21)	16 (28.57)	13 (23.21)	

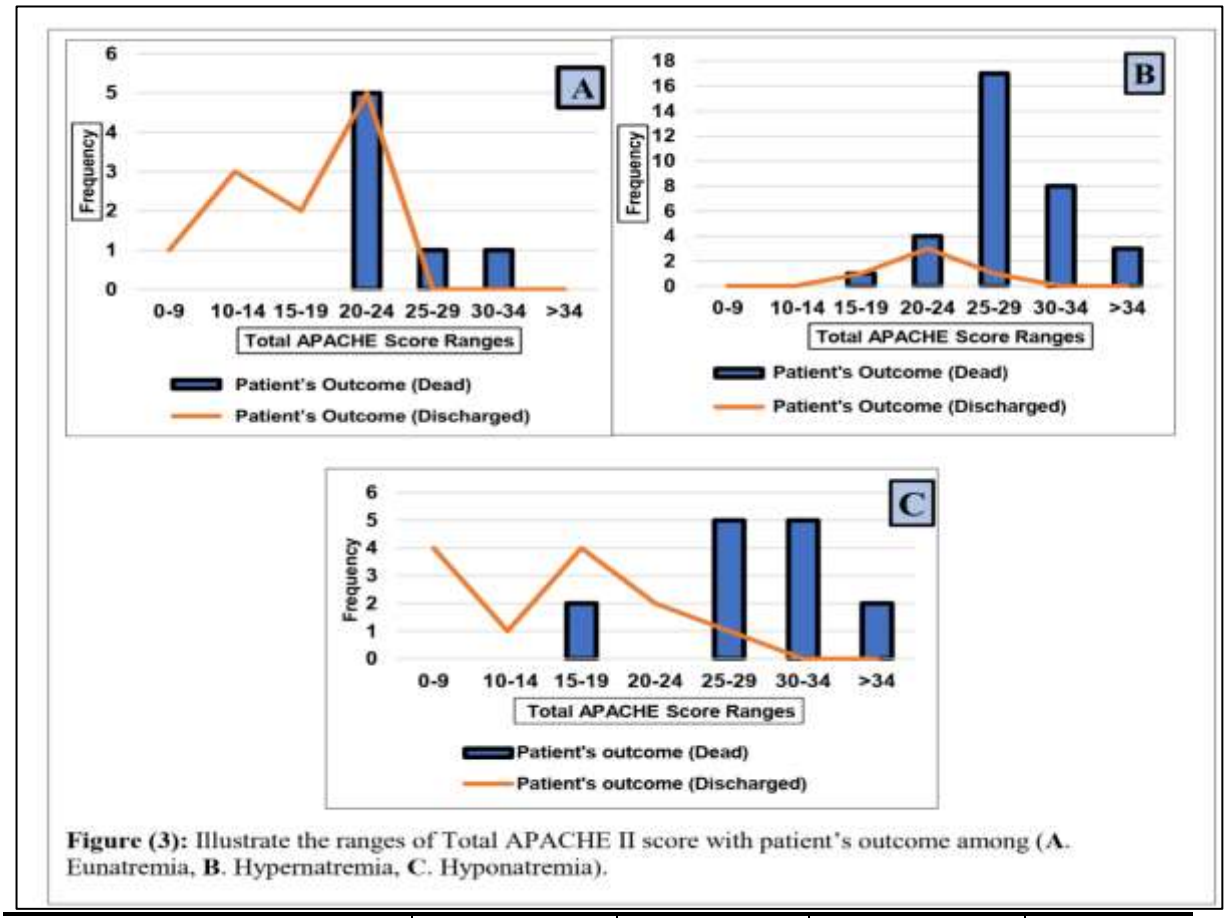

Figure (3): Illustrate the ranges of Total APACHE II score with patient's outcome among (**A**. Eunatremia, **B**. Hypernatremia, **C**. Hyponatremia).

Oxygenation types for patient $FIO_2 \geq 50\%$ ($AaDO_2$) $FIO_2 < 50\%$ (PaO_2)	 27 (51.92) 11 (36.67)	 13 (25.00) 13 (43.33)	 12 (23.08) 6 (20.00)	 0.2172[b]
PH categories for patients Normal Alkalosis Acidosis	 21 (42.86) 2 (18.18) 15 (68.18)	 16 (32.65) 5 (45.45) 5 (22.73)	 12 (24.49) 4 (36.36) 2 (9.09)	 0.0797[b]
Predicted Mortality Rate Mean (SD)	57.2 (15.7	43.7 (27.1	32.6 (13.5	**0.0002** [a]

For statistical analysis, b Pearson chi-squared tests and a one-way ANOVA were both used.
Significant deviations are indicated by red bold numbers

A higher overall APACHE II score was also found to be a predictor of greater mortality in severely ill dysnatremic individuals (P = 0.00001). Additionally, compared to patients who consumed the food on their own, receiving the food enterally was associated with a greater risk of mortality **(**the table is not included)

4. DISCUSSION

Eighty-two critically ill adult patients from the ICU of 2 government teaching hospitals in Duhok City were enrolled in this study. The majority of the patients were young males with various comorbidities. Hypernatremia was more common than hyponatremia and eunatremia at the time of admission. Patients with hypernatremia had higher APACHE-II scores and mortality rates compared to those with hyponatremia and eunatremia, indicating a significant association between these variables.

With an average age of 52.7 years, ranging from Eighteen to Ninety-two years, most of the admitted patients were aged equal to or less than Forty-four years. The findings of the present study were inconsistent with those of the Homoky [15] study, which looked at the relationship between sodium levels and the death rate, and the duration of ICU stay among severely ill individuals. Homoky's study found that the critically ill individual's mean ages were higher than those of the current study, at 64 yrs., ranging from less than or equal to 28 years to more than or equal to 85 years, with the majority of patients over the age of Sixty-one years. In two more studies, Padhi [16] examined hyponatremia in 699 patients, while Kiaei [17] looked into the connections between serum sodium and death rate in 178 ICU patients, both of which found that the subjects' mean ages were higher. The findings of two previous studies by Kolmodin [18] and Sheyo [19] found that the average ages of the severely ill patients were lower than those of the current study.

It is interesting to note that Basile-Filho [20], who investigated whether disturbances in sodium levels could pose a long-term hazard to critically ill individuals, found that the mean score for patients'age was 51.8 yrs, which is in line with the current finding. Differences in sample size and the age of the patient group could be the reason for this variance in the average age between the current study and the previous studies.

The majority of the severely ill had a higher proportion of multipe disorders **Figure 1**, with endocrine and respiratory issues being the most common multiple illnesses. The findings of this investigation did not agree with those of Homoky [15], who discovered that coronary artery disease and dyslipidemia were the most common comorbidities among critically ill patients. This discrepancy in multiple illnesses between the present study and the prior investigation was caused by the different ages of the participants; in Homoky's research the majority of patients were old, which made them more prone to developing those kinds of disorders.

At the time of admission to the ICU, there were 82 patients, of whom 22% were eunatremic and high serum sodium was found at a higher occurrence than low serum sodium (46.3% vs. 31.7%). The severity of the diseases, multiple illnesses, severe fluid loss, and usage of diuretics to manage patient's condition could all be contributing factors to a higher prevalence of hypernatremia. Regardless of sample size, Tinawi's [21] study on 410 dysnatremic patients found that hypernatremia was more common than hyponatremia, with respective prevalence rates of 25.8% and 22.43%. Although eunatremia was admitted at higher rates than dysnatremia, their findings showed that hypernatremia was more common than hyponatremia. Similarly, Patel [22] found that hypernatremia was more common than hyponatremia in their research of 798 dysnatremic individuals in the medical intensive care unit. While the results were at odds with those of studies by Funk [10], Sakr [3], and Mohamed G. Zakaria [23], which were carried out on various sample sizes and populations, it was found that hyponatremia was more common than hypernatremia, with respective incidences of (81.9% vs. 18.6%), (17.7% vs. 6.9%), and (42.5% vs. 10.83%).

The majority of hypernatremic patients were in the group age that was higher than or equal to Seventy-five years, indicated at 72.73 percent, in this study, which found a statistically significant association between hypernatremia and an old patient. This indicates that among severely ill patients, growing older was thought to be a risk factor for rising serum sodium levels. The most vital defenses against high serum sodium are thirst and easy access to water. Inadequate kidney function, defects in the thirst mechanism, and hyperthermia with excessive urination all of which were present in the critically ill elderly patients in the current study could all be attributed to the many biological and physiological changes that occur in their body systems as a result of the severity of their illnesses and aging. The current result was consistent with observations made by Alparslan and Sümeyye [24], Stelfox [25], and Lindner [26] that older age was associated with a higher risk of developing hypernatremia. On the other hand, according to Funk [10], hypernatremia can affect both young and old critically ill patients, with the former group being more severely affected.

Additionally, the study's findings indicated a significant relationship between hypernatremia, low SPO2 levels, and certain medical case types. Since most hypernatremic patients had respiratory issues, low oxygen saturation was likely a contributing factor. In addition, the reason for developing hypernatremia in medical cases may be related to the severity of the diagnosis that was admitted, which worsens the level of consciousness in 84.21% of hypernatremic patients. The results were inconsistent with a study by Funk [10] that

found surgical problems were more common in hypernatremic patients and had a stronger link with hypernatremia than medical issues. The study's result that there is a strong association between urine output and hypernatremia may be explained by the fact that a large number of hypernatremic patients were treated with osmotic therapy and diuretic medicines at their initial admission to the intensive care unit, as was the severity of their conditions.

According to the study's findings, hypernatremic patients had a higher average score of total APACHE-II compared to hyponatremia and those patients with normal levels of sodium, and this variance was statistically important; regarding the mortality, the investigation discovered that a higher score of APACHE-II was a predictive of increased deaths among the severely ill dysnatremic adult individuals. Furthermore, a higher percentage of observed and anticipated deaths occurred in the hypernatremic group, which was statistically significant. The majority of the hypernatremic patients in this study were elderly and had lower mean SPO2 levels and higher mean urine output values, which led to excessive fluid loss. These factors contributed to higher mortality among hypernatremic patients. These results corroborated those of Maganyane [7], who found that among severely ill dysnatremic patients, any increase in the average APACHE-II score was associated with a higher risk for death.

Although Baruah [27] noticed that elevated sodium levels and low sodium levels were both distinct warning signs for death and that the mortality rate for those with hypernatremia was marginally greater than for those with hyponatremia, and this finding was statistically significant, indicating that elevated sodium levels had a stronger relationship with mortality than hyponatremia, as it did in the current study. Similar findings were made by Kiaei [17] and Mokhtari [11], who found that hypernatremia significantly increased mortality risk compared to hyponatremia. Contrarily, studies by Stieglmair [9], Hoorn and Zietse [28], and Uddin [29] stated that any reduction in serum sodium was linked to higher mortality. This may be because their study involved critically ill cardiothoracic surgical ICU patients who had acute kidney injuries.

Despite the fact that Patel [22] and Funk [10] found a link between dysnatremia and mortality among patients admitted to the intensive care unit , their data was not show any appreciable differences between low or and high serum sodium in terms of mortality. Surprisingly, the Homoky [15] findings revealed that neither hyponatremia nor hypernatremia was associated with patient mortality, with an overall survival rate of 98% and just two deaths among individuals with normal levels of serum sodium.

In the current study, severely ill patients spent an average of four days in the ICU, ranging from one to seventy-one days. Because there were no differences in the length of stay at the

ICU, it is noteworthy that the present study found no association between hyponatremia or hypernatremia and the length of ICU stay. Previous studies had found that dysnatremia at ICU admission was associated with a longer stay. Rosner and Ronco [30] and Patel [22] reported that patients with high serum sodium were linked with a longer stay in ICU than those with hyponatremia. In contrast, Sakr [3] and Padhi [16] found in their research that hyponatremia was linked to a longer length of stay in an ICUs.

The finding of this study was consistent with those of [15], who came to the conclusion that there were no variances in intensive care unit stays between patients who had high or low serum sodium levels. The minor size of the sample and the seiousness of illnesses among the patients with disturbed sodium's level , which required them to remain in the intensive care for an equal lengths of time, are likely the reasons for the disparities between the results of the present study and those of the earlier studies on ICU stays. The study's main limitation was the small sample size due to the following factors: first, the fact that there were only two government teaching hospitals in Duhok city, with a maximum of ten ICU beds; second, the patients' ages and medical conditions; and third, the short time frames for data collection and follow-up.

CONCLUSIONS: The current investigation came to the conclusion that disruption of serum sodium level was the common electrolyte that became unbalanced among severely ill initially admitted to an ICUs. In contrast to hyponatremia and eunatremia, hypernatremia was observed in 46.3% of the patients. Hypernatremia and patient death were significantly correlated because more deaths and higher overall APACHE-II mean scores were accounted for and noticed among hypernatremic individuals. According to the study, individuals with dysnatremic conditions had similar lengths of stay in the ICU.

RECOMMENDATIONS: To save a patient's life and improve the intensive care unit's electrolyte management strategy, sodium levels must be corrected promptly and effectively. This will enable prompt identification and treatment of any electrolyte abnormalities that are found. Fluid pumps must be properly installed in the Critical Care Unit to refill the proper quantity and kinds of fluids for the patients. A larger sample size should be used in future research on a similar study to examine serum sodium levels in the first 24 hours of admission to the ICU in order to present the results more precisely.

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