The Open Public Health Journal
ISSN: 1874-9445
DOI: 10.2174/0118749445305097240521114548, 2024, 17, e18749445305097

RESEARCH ARTICLE
OPEN ACCESS

Association between Serum Electrolyte Levels and Consciousness in ICU Patients: A Cross-sectional Study

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Abstract:

Background: A change in fluid and electrolyte balance is a dynamic process that can cause a wide range of clinical disorders.

Aim: The present study was conducted to determine the serum level of electrolytes and their relationship with the level of consciousness.

Methods: This cross-sectional (descriptive-analytical) study was conducted using a census method on 110 medical records of patients admitted to the ICU department of Imam Khomeini Hospital in Jiroft in 2021. Data were collected using a researcher-made checklist from the patient's medical records and analyzed using SPSS-20 statistical software and descriptive and inferential tests at a significance level of $p<0.05$.

Results: The average age of the patients was 31.8 ± 18.8 years. Eighty-two patients (74.5%) were men who were hospitalized due to a motorcycle accident. No significant relationship was found between serum phosphorus levels, hospital stay duration, and mortality rate. There was a significant relationship between magnesium serum level and mortality rate, but there was no relationship between serum potassium and magnesium, the duration of hospitalization, and the average days of hospitalization.

Conclusion: The results showed that there is no significant relationship between the average serum level of electrolytes and the level of consciousness. It is possible that factors other than electrolytes, such as the status of arterial gases, the need for advanced airway care, medicinal agents, and other therapeutic interventions, may influence the level of consciousness.

Keywords: Sodium, Potassium, Magnesium, Phosphorus, Calcium, Consciousness level, Electrolyte, Trauma, Injured.

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Cite as: Sardu E, Anaeigoudari A, Domari A, Raesi R, Hushmandi K, Farsei S, Daneshi S. Association between Serum Electrolyte Levels and Consciousness in ICU Patients: A Cross-sectional Study. Open Public Health J, 2024; 17: e18749445305097. http://dx.doi.org/10.2174/0118749445305097240521114548

Received: January 17, 2024
Revised: May 1, 2024
Accepted: May 8, 2024
Published: June 06, 2024

1. INTRODUCTION

Fluid and electrolyte balance is a dynamic process that is necessary to continue life. Sixty percent of the body weight of an adult is made up of liquid and electrolytes [1]. Factors affecting the amount of body fluid include age, sex, and body fat. A healthy person can get the fluids by drinking and eating food, and a sick person may get the fluids needed through injection methods and a tube for intestinal or gastric feeding [2]. Different organs and systems of the body are constantly working in coordination with each other to maintain the composition and volume of body fluids within the normal range. These include the kidney, heart, vessels, lungs, pituitary gland, adrenal gland, parathyroid glands, pressure receptors, renin-angiotensin-aldosterone system, osmotic receptors, and atrial natriuretic peptide (ANP) [3-7].

Electrolytes, such as potassium, sodium, magnesium, calcium, and phosphate, play an important role in cell metabolism and energy conversion and in regulating cell membrane potentials, especially muscle and nerve cells, which play an important role [8, 9]. An imbalance of these electrolytes can induce a wide range of clinical disturbances, including neuromuscular dysfunction and severe arrhythmias, especially in patients with serious conditions or patients admitted to special hospital departments [10, 11]. Electrolyte balance is critical in the management of patients in the Intensive Care Unit (ICU) due to the complex interplay between disease processes, treatments, and the body's compensatory mechanisms [12]. Electrolytes, including sodium, potassium, calcium, magnesium, and chloride, play pivotal roles in cellular function and systemic homeostasis [13]. Imbalances can lead to a range of serious complications, affecting cardiovascular, neurological, muscular, and renal systems [14]. For example, hyperkalemia (high potassium) can cause cardiac arrhythmias, while hyponatremia (low sodium) can result in cerebral edema, seizures, and coma. In the ICU, patients often present with or develop electrolyte disorders due to factors, such as fluid loss from severe burns or trauma, renal failure, or as adverse effects of diuretic therapy or other medications [14-16]. The meticulous management of these electrolytes is essential, not only to treat underlying conditions but also to prevent the complications associated with their imbalance [12, 17]. For instance, tight control of potassium levels is necessary to prevent life-threatening arrhythmias, especially in patients with renal impairment or those on certain heart medications [15, 18]. The strategies for managing electrolyte imbalances are multifaceted and tailored to individual patients' needs [19]. They include the administration of intravenous fluids, electrolyte solutions, medications that modify the renal handling of electrolytes, and dialysis in severe cases [20, 21]. The use of Continuous Renal Replacement Therapy (CRRT) and intermittent hemodialysis are common in patients who are acutely unwell and require rapid correction of severe electrolyte and fluid imbalances [22, 23]. Monitoring these patients involves regular tests, electrocardiograms, and clinical assessments to adjust therapy promptly and appropriately [24].

Furthermore, the interdisciplinary approach in ICU settings facilitates the precise management of electrolyte balance [12, 25]. This team typically includes intensivists, nurses, pharmacists, and dietitians, who collaborate to assess and adjust treatment plans based on dynamic changes in the patient's condition [26, 27]. The complexity of care in these patients highlights the importance of understanding and managing electrolyte disturbances, as these are often linked with increased morbidity and mortality [12, 28]. Effective electrolyte management improves outcomes, reduces the length of stay in the ICU, and enhances overall patient recovery [21, 24].

Several studies underscore the significance of electrolyte management in the ICU. A notable study by Funk *et al.* (2010) reviewed the outcomes of dysnatremia management protocols in ICU settings and found that protocol-driven approaches reduced the incidence of life-threatening hypo- and hypernatremia. The study highlighted that standardized protocols, which included regular monitoring and predefined treatment pathways, significantly improved patient safety and outcomes. Moreover, their results suggested that both hypo- and hypernatremia present on admission to the ICU are independent risk factors for a poor prognosis [29]. Another important research conducted by Adrogué and Madias (2007) determined the effects of hypernatremia and hyponatremia in the ICU. Their findings suggested that rapid correction of sodium levels, whether too high or too low, must be avoided due to the risk of inducing central pontine myelinolysis or cerebral edema. The study advocated for gradual correction protocols to minimize neurological complications [30]. A systematic review by Huang *et al.* (2007) evaluated the impacts of different electrolyte disorders and their corrections in the ICU. The review consolidated data from multiple studies and confirmed that precise electrolyte management, particularly of sodium, potassium, and magnesium, is crucial in reducing ICU mortality rates and improving long-term neurological outcomes. The researchers advocated for the use of evidence-based guidelines to steer the correction of electrolyte imbalances in critically ill patients [31]. These studies collectively highlight the critical need for careful and precise electrolyte management in the ICU, illustrating its direct impact on patient morbidity and mortality.

Accurate and timely measurement of electrolyte levels is crucial for the management of critically ill patients in the ICU. Prompt detection and correction of these imbalances are essential to prevent adverse outcomes and improve patient prognosis. However, the measurement of electrolytes in the ICU setting can be challenging, as patients often require rapid assessment and intervention. Traditional laboratory-based methods can be time-consuming, and the results may not be available promptly to guide immediate clinical decision-making. Therefore, there is a need to explore alternative methods, such as point-of-care testing, that can provide more rapid and accurate electrolyte measurements, enabling healthcare providers to identify and address electrolyte abnormalities more efficiently in critically ill patients. Therefore, the present study was designed and implemented to determine the serum level of electrolytes and its relationship with the level of consciousness in the injured patients admitted to the ICU. Following are the goals of this study: determining the demographic information of patients admitted to the ICU, categorizing ICU patients according to the type of injury, determining the mean and standard deviation of serum levels of electrolytes (sodium, potassium, magnesium, calcium, and phosphorus) in patients admitted to the ICU, determining the level of consciousness of patients hospitalized in the ICU with the Glasgow Coma Scale (GCS), examining the relationship between the serum level of electrolytes and the level of consciousness with the GCS in ICU patients, determining the relationship between the serum level of electrolytes and the duration of hospitalization of patients in the ICU, and identifying the relationship between the serum level of electrolytes and the outcome of treatment in ICU patients.

2. MATERIALS AND METHODS

This is a cross-sectional (descriptive-analytical) study. The study selected and analyzed all the medical records of patients who were admitted to the ICU department of Imam Khomeini (RA) Hospital in Jiroft with a diagnosis of trauma in 2021, using the census method and considering the entry and exit criteria. Finally, 110 medical records of patients admitted to the ICU department were selected according to the inclusion and exclusion criteria and analyzed. Hospitalization in ICU following trauma, absence of diseases related to electrolyte imbalance, absence of disorders of the level of consciousness before hospitalization in ICU, and access to different parts of patients' files (experiments, history sheet, clinical course, *etc.*) were considered as inclusion criteria, and incomplete medical record information was considered as exclusion criteria.

After obtaining the code of ethics from the research vice-chancellor of Jiroft University of Medical Sciences and coordinating with the hospital administrators, data were collected from the medical records unit of the study hospital. Then, the patients' files admitted to the ICU in 2021 were selected and analyzed based on the inclusion and exclusion criteria. To record the serum levels of electrolytes, the sheets of the tests performed in the hospital laboratory, which were available in the patients' medical records, were used. Moreover, to determine the level of alertness of the patients, the GCS score recorded in the special care sheet, which was available in the medical record, was used. The data collection tool was a checklist made by the researcher. This checklist was designed based on the criteria in the patient's medical records to check the laboratory results and the patient’s state of consciousness. This checklist consisted of two parts. The first part was related to the demographic information of the patients (age and sex, type of injury, and duration of hospitalization in ICU and GCS), and the second part was related to the results of the tests to check the blood level of electrolytes.

To check the validity of the content, the checklist was given to 6 faculty members related to the topic of the research, and they were asked about the relevance of each item from the checklist to a four-choice question, including 1) irrelevant, 2) relevant but needs serious revision, 3) it is relevant but it needs partial revision, and 4) it is completely relevant to answer so that the Content Validity Index (CVI) can be calculated to check the validity of the content. Furthermore, they were also asked to answer a three-choice question, including 1) necessary, 2) useful but unnecessary, and 3) unnecessary, so that the Content Validity Ratio (CVR) index can be calculated. Considering that the CVI score was 0.84 and the CVR score was 0.57, the content validity of the checklist was confirmed. Cronbach's alpha was also used to measure the reliability, which was equal to 0.83.

In order to take ethical considerations into account, after obtaining the code of ethics and making the necessary arrangements, the researcher went to the medical records unit of Imam Khomeini Hospital in Jiroft and collected the necessary information from the patient files (electrolytes information from the tests section and consciousness level information extracted from the clinical history part of the file or the sheet (sheet) related to each patient). The data was collected without the names and characteristics of the patients, and all the information of the patients, including the name and national information, was completed, and the results were reported in general. The collected data were analyzed after coding and entering with statistical software SPSS version 20. A p-value of less than 0.05 was considered statistically significant. Frequency and percentage distribution indices were used to describe qualitative variables, and quantitative variables were described using mean and standard deviation. Independent t-test, ANOVA, and Pearson correlation were also used for analysis.

3. RESULTS

In this study, the medical records of 110 patients admitted to the ICU of Imam Khomeini Hospital in Jiroft City were examined. The average age of the patients was 31.8 ± 18.8 years, the lowest age was 2 years, and the highest age was 90 years. Out of 110 injured people under investigation, 24 people (21.9%) were under 20 years old, 49 people (18.1%) were 20 to 35 years old, 15 people (13.6%) were 50 to 80 years old, and 2 people (1.8%) were over 80 years old. Eighty-two people (74.5%) were men, and 28 people (25.5%) were women. Out of 110 investigated people, 15 people (13.6%) were pedestrians, 29 people (26.3%) had a car accident, 33 people (30%) had a motorcycle accident, and 19 people (17.2%) had a fight. Four people (3.7%) committed suicide, and 10 people (9.2%) were injured due to other causes (4 people falling from a height, 3 people from occupational accidents, and 3 people from sports accidents) (Table **1**).

Table 1. Demographic information of the injured admitted to the ICU.

Variables		Numbers	Percent
Age	< 20	24	21.9
	20-35	49	44.6
	35-50	20	18.1
	50-80	15	13.6
	>80	2	1.8
Gender	Male	82	74.5
	Female	28	25.5
Cause of injury	Pedestrian	15	13.6
	Car Accident	29	26.3
	Motorcycle Accident	33	30
	Quarrel	19	17.2
	Self-Harm	4	3.7
	Other Cases	10	9.2

Thirty-six (32.7 (% patients were admitted due to skull fracture, 24 (21.9%) hip and thigh fractures, 5 (4.5%) neck fractures, 10 (9.2%) facial fractures, 15 people (13.7%) had a back fracture, 3 people (2.7%) had a rib fracture, 8 people (7.2%) had a hand fracture, and 9 people (8.1%) were admitted to the ICU due to rupture (Table **2**).

Table 2. Classification based on the type of injury in the injured admitted to the ICU.

Type of injury	Frequency	Percent
Skull fracture	36	32.7
Hip and thigh fracture	24	21.9
Neck fracture	5	4.5
Facial fracture	10	9.2
Back fracture	15	13.7
Rib fracture	3	2.7
Broken hand	8	7.2
Rupture	9	8.1

The normal range of sodium is 135 to 145. In this study, the average sodium level was 137.35 ± 14.35, which was within the normal range. The normal range of potassium is 3.5 to 5.5, and in the present study, the average level was 6.65 ± 19.4, which was more than normal. The normal range of magnesium is 1.8 to 2.6, and in the present study, the average level was 3.34 ± 1.35, which was more than normal. The normal range of calcium is 8.6 to 10.3, and in the present study, the average level was 8.3 ± 1.42, which was within the normal range. The normal range of phosphorus is 2.5 to 5. In this study, the average level of phosphorus was 4.39 ± 5.21, which was within the normal range (Table **3**).

Table 3. Determining the mean and standard deviation of serum levels and electrolytes in the injured admitted to the ICU.

Variable	Mean	Standard Deviation
Sodium	137.35	14.35
Potassium	6.65	19.4
Magnesium	3,34	1.35
Calcium	8.3	1.42
Phosphorus	4.39	5.21

Table **4** presents the information related to the serum level of electrolytes and the level of consciousness with the GCS. According to the GCS, the mean sodium in three groups, *i.e.*, mild, moderate, and severe, was 138.7, 138.5, and 129.7, respectively. The lowest average was observed in the extreme range of Glasgow coma, which was lower than the normal limit of sodium, and finally, there was no statistically significant difference among the three groups of Glasgow coma in terms of the average sodium ranks (p-value > 0.05). The average potassium, according to the GCS in three groups, mild, moderate, and severe, was 5.5, 3.7, and 13.4, respectively. Furthermore, the highest average was observed in the severe range of Glasgow coma, which was also higher than the normal limit of potassium, and a statistically significant difference was found among the three groups of Glasgow coma in terms of average potassium levels (p-value < 0.05). According to the GCS, the average of magnesium in the three groups of mild, moderate, and severe was 2.17, 3.1, and 1.99, and the highest average was observed in the average range of Glasgow coma, which was also higher than the normal level of magnesium. Moreover, no statistically significant difference was found among the three groups of Glasgow coma in terms of average magnesium scores (p-value > 0.05). The mean of calcium according to the GCS in the three groups, mild, moderate, and severe, was 8.76, 7.2, and 8.16, respectively, and the lowest mean was observed in the mild range of Glasgow coma, which was in the normal range of calcium. Finally, no statistically significant difference was found among the three groups of Glasgow coma in terms of the mean calcium scores (p-value > 0.05). The average phosphorus according to the GCS in three groups, mild, moderate, and severe, was 3.99, 3.82, and 3.26, respectively, and the highest average was observed in the mild range of Glasgow coma, which was in the normal range of phosphorus. Finally, there was no statistically significant difference among the three groups of Glasgow coma in terms of the mean levels of phosphorus (p-value > 0.05).

Table 4. Determining the relationship between the serum level of electrolytes and the level of consciousness with the GCS in the injured admitted to the ICU.

Variable	GCS			P-value
	Slight	Moderate	Severe	
Sodium	3.8 ± 138.7	7.7 ± 138.5	35.3± 129.7	0.14
Potasium	17 ± 5.5	0.33± 3.7	35.5 ± 13.4	0.003
Magnesium	0.44 ± 2.17	2.7 ± 3.1	0.53 ± 1.99	0.36
Calcium	0.87 ± 8.67	2.4 ± 7.2	0.8± 8.16	0.39
Phosphorus	0.88 ± 3.99	1.01 ± 3.82	0.85 ± 3.26	0.86

Table **5** presents the information related to the serum level of electrolytes with the duration of hospitalization in the ICU. The average duration of hospitalization in the groups with less and more than the normal limit of sodium was 28.4 and 23.24, respectively, and the highest average day of hospitalization was related to sodium levels less than normal. There was no statistically significant relationship between serum sodium level and duration of hospitalization in the ICU (p-value > 0.05). The average length of hospitalization in the groups with less and more than normal potassium levels was 22.8 and 24.3, respectively, and the highest average hospitalization day was related to potassium levels more than normal. Moreover, there was a statistically significant relationship between serum potassium levels and the duration of ICU hospitalization (p-value > 0.05). The average duration of hospitalization in the groups with lower and higher magnesium than the normal limit was 28 and 24, respectively, and the highest average hospitalization day was related to magnesium below the normal limit. Statistically, there was a significant relationship between the serum level of magnesium and the duration of hospitalization. The average duration of hospitalization in the groups with less and more than normal calcium levels was 24 and 21, respectively, and the highest average hospitalization days were related to calcium levels below the normal level. Statistically, there was a significant relationship between the serum calcium level and the duration of hospitalization. The average duration of hospitalization in the groups with less and more than the normal limit of phosphorus was 28.4 and 21.4, respectively, and the highest average hospitalization day was related to phosphorus less than the normal limit. Statistically, there was a significant relationship between the serum level of phosphorus and the duration of ICU hospitalization (p-value > 0.05).

Table **6** presents the information related to the serum level of electrolytes and the outcome of the injured patients. The percentage of death in the groups below and above the normal level of serum sodium was 38% and 17%, respectively. Moreover, there was no significant relationship between the serum sodium level and the outcome of the injured patients (p-value >0.05). The percentage of death in the groups below and above the normal level of potassium serum level was 55% and 27%, respectively, and there was a significant relationship between the serum potassium level and the outcome of the injured patients (p-value < 0.05). The percentage of death in the groups below and above the normal level of serum magnesium level was 46.6% and 18.1%, respectively, and there was a statistically significant relationship between the serum magnesium level and the outcome of the injured patients (p-value <0.05). The percentage of death in the groups below and above the normal level of serum calcium level was 51% and 48%, respectively, and there was no statistically significant relationship between the serum calcium level and the outcome of the injured patients (p-value > 0.05). The percentage of death in the groups below and above the normal level of serum phosphorus level was 40% and 18%, respectively, and there was no statistically significant relationship between the serum phosphorus level and the outcome of the injured patients (p-value > 0.05).

Table 5. Determining the relationship between the serum level of electrolytes and the duration of hospitalization in the ICU in the injured patients admitted to the ICU.

Variable		Duration of Hospitalization		P-value
		Mean	Standard Deviation	
Sodium	Less than normal	28.4	18.56	0.18
	More than normal	23.34	17.4	
Potassium	Less than normal	22.8	11.8	0.96
	More than normal	24.3	19.9	
Magnesium	Less than normal	28	16.2	0.45
	More than normal	24	18.9	
Calcium	Less than normal	24	16.5	0.35
	More than normal	21	18.7	
Phosphorus	Less than normal	28.4	20.4	0.18
	More than normal	21.4	15.8	

Table 6. Determining the relationship between the serum level of electrolytes and the outcome of the injured admitted to the ICU.

Variable		Variable		P_Value
		Death (%)	Discharge (%)	
Sodium	Sodium	38	62	0.06
		17	83	
Potasium	Potasium	55	45	0.007
		27	73	
Magnesium	Magnesium	46.6	53.4	0.002
		18.1	81.9	
Calcium	Calcium	51	49	0.34
		48	52	
Phosphorus	Phosphor	40	60	0.06
		18	81	

4. DISCUSSION

Fluids and electrolytes are the basic components of the human body that are essential for life. Any imbalance in the level of electrolytes can lead to life-threatening conditions [32]. Considering the basic effects of electrolytes on cellular function and metabolic processes, it is necessary to accurately determine the serum levels of electrolytes, especially in ICU patients [33]. Therefore, this research was carried out as an innovation to determine the serum level of electrolytes and its relationship with the state of consciousness level in the injured patients admitted to the ICU of Imam Khomeini Hospital in Jiroft in 2021.

In this study, of 110 patients, 82 were men, which was due to an increase in motorcycle accidents. This finding is consistent with other studies, such that in a study conducted by Trost *et al.*, it was stated that most cases of concussions occur in men, and the major cause is accidents with motor vehicles [34]. In this regard, Garwood reported in a study that most cases of acute brain trauma are caused by accidents with motor vehicles, which is also considered one of the factors of increasing mortality in young people under 24 years of age [35]. In another study, men suffered 2.6 times more head trauma than women [36]. In studies from other regions of our country, the prevalence of brain trauma in men was 3-5 times that of women [37]. This observation aligns with broader trends indicating that males are more susceptible to trauma, particularly related to accidents involving motor vehicles, such as motorcycles. The prevalence of male patients in trauma cases could be attributed to various factors, including occupational activities that expose men to higher risks, differences in risk-taking behavior, and societal norms influencing engagement in activities that lead to traumatic injuries. Additionally, the predominance of motor vehicle accidents as the primary cause of trauma underscores the importance of road safety measures and interventions to reduce the incidence of such injuries, especially among the male population. Understanding the gender-based distribution of trauma patients and the common mechanisms of injury, like motorcycle accidents, is crucial for developing targeted preventive strategies and improving trauma care outcomes. By recognizing risk factors, healthcare systems and policymakers can tailor interventions to address the specific needs of different demographic groups, ultimately working towards reducing the burden of trauma-related injuries and improving overall public health outcomes in Iran and beyond. Outdoor environments can be justified, as well as not using helmets by motorcyclists, lack of road safety, the presence of blind spots, the increase of high-speed cars, and human factors, such as driver fatigue and anger, can be considered as the causes of this occurrence.

In the present study, no significant correlation was found regarding the relationship between serum phosphorus levels, length of hospital stay, and mortality rate. In a study by Fallah *et al.*, a significant relationship was found between serum phosphorus level at the time of admission and other clinical variables. However, no significant relationship was found in endotracheal tube extubation, duration of mechanical ventilation, length of hospital stay, and death rate [38]. The findings of a study by Talakob *et al.* were consistent with the results of this study [39]. This suggests that the serum phosphorus level may not be a reliable predictor of clinical outcomes, such as length of hospital stay or mortality, in this patient population. The lack of a clear association between these factors implies that other clinical and physiological parameters may be more important in determining the prognosis of trauma patients in the ICU setting. These results challenge the notion that serum phosphorus could be used as a straightforward marker for assessing the severity and trajectory of trauma-related complications and highlight the need for further investigation to identify more robust prognostic indicators in this critical care context.

Regarding serum magnesium level, a significant relationship was found with the mortality rate, but there was no correlation between magnesium and length of hospitalization. In their research, Upala *et al.* concluded that hypomagnesemia is related to increased mortality [40]. In a study by Kumar *et al.*, no significant relationship was found between the serum magnesium level and the duration of hospitalization of patients [3]. In a study by

Hulst *et al.*, there was a difference between the mortality rate among three groups of patients with normal magnesium levels, hypomagnesemia, and hypermagnesemia, and 51% of patients had hypomagnesemia at the time of admission to the ICU. Moreover, the mortality rate in these patients was 55% [4]. In a study by Mousavi *et al.*, 46.2% of deaths occurred in ICU patients with abnormal levels of magnesium [5]. This discrepancy in the relationship between magnesium levels and different clinical outcomes could be attributed to various factors, including the complex interplay of magnesium with different physiological processes and the multifaceted nature of patient care in the ICU setting. While magnesium deficiency has been linked to increased mortality in various contexts, the lack of a clear association with hospitalization duration in this study suggests that the impact of magnesium levels on specific clinical outcomes may vary depending on the patient population, underlying health conditions, and the complexity of trauma care management protocols.

In the current study, no significant relationship was found between serum sodium level, length of hospitalization, and mortality rate. In line with this finding of the present study, the results of the study by Jabalameli *et al.* showed no significant relationship between the average sodium concentrations at different times and the severity of brain lesions [41]. Furthermore, in a study by Yeke Fallah *et al.*, no significant relationship was observed between the serum sodium level at the time of admission and the length of hospitalization, while the average length of hospitalization in the hyponatremia group was 6 days more than the normal sodium group. Moreover, there was no significant difference between the death rate and serum sodium level at the time of admission of patients [7]. The results of a study by Garani *et al.*, who studied children undergoing heart surgery, are in line with the results of the current study. They also concluded that there is no significant relationship between the mortality rate and serum sodium level [42]. However, in the study by Kiaei *et al.*, a significant relationship was reported between the blood serum level of head injury patients and the death rate [43]. It was concluded that the difference could be based on many factors that can affect the death of patients, and only one factor cannot determine the death rate. The lack of a clear correlation between sodium levels and these outcome measures in the current study could be attributed to several factors. The small sample size and potential limitations in data collection may have impacted the ability to detect statistically significant relationships. Additionally, the study population and trauma care protocols may have differed from those in previous investigations, leading to divergent findings. It is also possible that the healthcare team was able to effectively manage and correct any sodium disturbances, thereby mitigating the potential impact on length of stay and mortality. Therefore, further research works with larger, more diverse patient cohorts are needed to better understand the complex interplay between serum sodium levels and clinical outcomes in the context of trauma care in the ICU.

Among other research findings, there was no significant relationship between serum potassium level and the average days of hospitalization, which is in line with the results of a study by Yekefallah *et al.* [38]. However, Ouf *et al.* conducted a study on patients with chronic airway obstruction. The most common electrolyte disorder in this study was hypokalemia, and a relationship was found between electrolyte disorder and increased duration of ICU stay in these patients [44]. The lack of a clear correlation between serum potassium and hospitalization duration in the current study could be attributed to several factors, as described previously. The study may have been limited by a small sample size or differences in the patient population, trauma care protocols, and electrolyte management strategies compared to previous investigations. Moreover, there is also a possibility that the healthcare team was able to effectively monitor and correct any potassium disturbances, thereby mitigating the potential impact on length of stay. Therefore, more studies need to be conducted with larger, more diverse patient cohorts to better understand the complex interplay between serum potassium levels and specific clinical outcomes, such as hospitalization duration, in the context of trauma care in the ICU.

In the current study, there was a significant difference between the death rate of patients and the potassium serum level, which was in line with the results of the study by Brueske *et al.*, who studied cardiac patients [45]. Also, a study result by Xiao-Yu Wu *et al.* (2021) found a significant association between high potassium levels and increased mortality in patients with intracranial hemorrhage [46]. Previous studies and this current study found a positive correlation between potassium and poor clinical outcomes in critical care patients. A study by Tongyoo *et al.* (2018) confirmed a positive association between serum potassium and increased ICU mortality [47]. Similar to our research, it suggests that managing potassium levels in critically ill patients is crucial for reducing mortality.

CONCLUSION AND RECOMMENDATIONS

The findings that there is no significant relationship between average serum electrolyte levels and level of consciousness in patients have important clinical implications. This suggests that a comprehensive patient evaluation, beyond just monitoring electrolyte status, is necessary to understand and manage altered levels of consciousness. Factors, such as arterial gas status, the need for advanced airway management, and the impact of medications and other therapeutic interventions, may play a more significant role in determining the patient's level of consciousness. These results highlight the importance of adopting an individualized, multifaceted patient assessment and treatment approach. Clinicians should not rely solely on electrolyte levels when evaluating and managing altered consciousness but rather consider the broader clinical picture, including respiratory status, medication effects, and other potential contributing factors. By taking a more holistic approach, healthcare providers can better identify the underlying causes of changes in consciousness and implement appropriate, targeted interventions to optimize patients' outcomes. These findings underscore the need for continued research and the development of comprehensive clinical guidelines to ensure that patients with altered levels of consciousness receive the most effective and personalized care. Doctors' awareness of these findings will help them to be aware of the factors affecting the level of consciousness and to be able to diagnose these factors as soon as possible and take appropriate treatment measures to reduce mortality and increase treatment prognosis. Due to the importance of mortality rate as a health, treatment, and management indicator in hospitals, it is recommended to examine the tests along with other factors related to the change in consciousness level in the process of treating trauma patients.

LIMITATIONS AND STRENGTHS OF THE STUDY

This study was hampered by several limitations. The first restriction was the incapacity to compute body mass index because the patient's height and weight were not recorded in the files. Another restriction was the exclusion of some patients from the study because their files did not contain all of the necessary information. Additionally, this study only included patients hospitalized in the Imam Khomeini Hospital in Jiroft ICU. As a result, caution should be exercised when extrapolating the findings. The study was limited by the restricted medical resources of the ICU and the inability to accommodate all critically ill patients, resulting in the exclusion of this patient population from the study. To improve the precision and accuracy of COVID-19 disease characterization, it is advisable to conduct comprehensive and prolonged studies on all critically ill patients requiring special care. Research limitations were due to the lack of resources, relevant studies, and the population of hospitalized patients. Accordingly, the studied population was not the same in terms of the type of trauma and damage, and the nutritional status of the patients and the drugs affecting the level of serum electrolytes before being admitted to the ICU were not known. This research was done cross-sectional, which makes it difficult to conclude causality. Considering the mentioned limitations, it is suggested that future studies should be conducted with a larger sample size and in different hospitals so that the findings are more reliable. It is also suggested to check the level of electrolytes in the serum of patients with the level of consciousness and other hemodynamic components, as well as changes in the cardiovascular and respiratory systems.

Some key strengths of the study include the following: examining the relationship between serum electrolyte levels and the level of consciousness in ICU patients, which is an important clinical question with potential implications for patient management; using a cross-sectional study design, which allows for the assessment of the association between variables at a specific point in time, providing a snapshot of the relationship; analyzing a relatively large sample size of 110 ICU patients, which increases the statistical power and reliability of the findings; considering multiple electrolytes, including sodium, potassium, magnesium, calcium, and phosphorus, rather than focusing on a single electrolyte, thus providing a more comprehensive evaluation of the relationship; employing appropriate statistical analyses.

AUTHORS' CONTRIBUTIONS

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to itssubmission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

LIST OF ABBREVIATIONS

ANP	=	Atrial Natriuretic Peptide
ICU	=	Intensive Care Unit
CRRT	=	Continuous Renal Replacement Therapy
GCS	=	Glasgow Coma Scale
CVI	=	Content Validity Index

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This article reports the results of a research project approved by Jiroft University of Medical Sciences with the code of ethics IR.JMU.REC.1401.036.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Considering that the data was extracted from archived medical records, there was no need for informed consent from the patients.

STANDARDS OF REPORTING

STROBE guidelines have been followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the Zenodo Repository at https://openpublichealthjournal.com/availability-of-data-materials.php

FUNDING

This study was funded by Jiroft University of Medical Sciences, Funder ID: 1401.036, Awards/Grant number: 1401.036.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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