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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Relationship Between Air Temperature and Urea, Creatin, EGFR, Sodium, Potassium Levels in Geriatric Patient Groups

Geriatrik Hasta Gruplarında Hava Sıcaklığı ile Üre, Kreatin, EGFR, Sodyum, Potasyum Düzeyleri Arasındaki İlişki

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ABSTRACT

Aim: In this study, we have aimed to investigate whether the changes in air temperature are related to electrolyte imbalance and renal dysfunction in geriatric patient population admitted to emergency departments.

Material and Methods: The study included 29,225 patients aged 65 and over, and these patients were divided into four groups based on the seasons. The patients were divided into 3 groups in terms of the age range in order to analyze whether the electrolyte imbalance would develop as a result of the increase in patients' ages.

Results: When the seasonal groups were compared in terms of urea, creatinine, and eGFR, urea and creatinine values were found to be statistically higher in summer when temperature values were high while sodium, potassium, and eGFR values were detected to be low (p <0.001). interpretation that the relationship between plasma sodium and seasons was statistically significant in the young-old, middle-old and oldest-old groups when it was evaluated according to the grouped ages (All P <0.001). In the evaluation made on the basis of monthly temperature values, it was observed that the development rate of hyponatremia was at a higher level in July (p <0.001).

Conclusions: In conclusion, we noticed in our study that electrolyte changes may occur due to temperature changes in the patients admitted to the emergency department.

Keywords: Seasonal temperatures effects, electrolyte imbalance, geriatric patient, emergency department

ÖZ

Amaç: Bu çalışmada acil servislere başvuran geriatrik hasta popülasyonunda hava sıcaklığındaki değişikliklerin elektrolit dengesizliği ve böbrek fonksiyon bozukluğu ile ilişkili olup olmadığını araştırmayı amaçladık.

Gereç ve Yöntemler: Çalışmaya 65 yaş ve üstü 29,225 hasta dahil edildi ve bu hastalar mevsimlere göre dört gruba ayrıldı. Hastaların yaşlarındaki artışa bağlı olarak elektrolit dengesizliğinin gelişip gelişmeyeceğini analiz etmek için hastalar yaş aralığı açısından 3 gruba ayrıldı.

Bulgular: Mevsimsel gruplar üre, kreatinin ve eGFR açısından karşılaştırıldığında, sıcaklık değerlerinin yüksek olduğu yaz aylarında üre ve kreatinin değerleri istatistiksel olarak daha yüksek, sodyum, potasyum ve eGFR değerlerinin düşük olduğu tespit edildi (p <0.001). genç-yaşlı, orta-yaşlı ve en yaşlı-yaşlı gruplarında plazma sodyum ile mevsimler arasındaki ilişkinin gruplandırılmış yaşlara göre değerlendirildiğinde istatistiksel olarak anlamlı olduğu yorumu (Tüm P <0,001). Aylık sıcaklık değerlerine göre yapılan değerlendirmede, hiponatremi gelişme hızının Temmuz ayında daha yüksek düzeyde olduğu görüldü (p <0,001)

Sonuçlar: Sonuç olarak, çalışmamızda acil servise başvuran hastalarda sıcaklık değişimlerine bağlı olarak elektrolit değişikliklerinin oluşabileceğini fark ettik.

Anahtar Kelimeler: Mevsimsel sıcaklık etkileri, elektrolit dengesizliği, geriatrik hasta, acil servis

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Introduction

Emergency departments (ED), which have increasing importance in terms of providing medical service, play a significant role in the geriatric patient population receiving inpatient and outpatient treatment. The term "geriatric" has different definitions in the literature while the term "oldest" it was used for describing the people aged 85 and over in 1985. World Health Organization defined the people over the age of 60 as the elderly population. Although the patient group at and over the age of 65 is defined as the geriatric population in the Geriatric Emergency Service Manual published in 2014, it has been concluded that each hospital should determine the age of the geriatric patients to be treated in the Emergency Departments (1).

Geriatric patient population shows an increase all over the world, especially in developed countries. The problems that may occur in the elderly should be taken into consideration from physical, psychological and socioeconomic perspectives (2). It is known that electrolyte imbalance may occur at seasonally high temperatures due to fluid loss resulting from insufficient fluid consumption and perspiration and that deterioration may be observed in renal functions because of the activation of compensatory regulatory mechanisms (3). The risk of disease resulting from high seasonal temperature is more commonly observed in the elderly population, the patients having chronic diseases, disabled people and the individuals living alone (4,5). The studies have shown that the temperature changes have a direct impact on hospital admissions, morbidity and mortality (6).

It is observed that the air temperatures in our country and region have continued to increase over the years and more evidently in summers. In this study, we have aimed to investigate whether the changes in air temperature are related to electrolyte imbalance and renal dysfunction in geriatric patient population admitted to emergency departments.

Material and Methods

2.1. Study area and population

Diyarbakır, one of the biggest cities in the south-eastern region of Turkey, accommodates 1,699,901 inhabitants according to the records of the address-based population registration system taken by the Turkish Statistical Institute on December 31, 2017 (7). This study comprises the retrospective analysis of the patients presenting to the emergency department of Gazi Yaşargil Education and Research Hospital between 1 September 2016 and 1 September 2018. A total of 364,000 patients were admitted to the emergency department of our hospital in the above-mentioned time period. The study included 29,225 patients aged 65 and over, and these patients were divided into four groups based on the seasons: the patients admitted in spring were classified as group 1, the patients admitted in summer as group 2, the patients admitted in autumn as group 3 and the patients admitted in winter as group 4. The patients were divided into 3 groups in terms of the age range in order to analyze whether the electrolyte imbalance that develop associated to the increase in patients' ages: group 1 was defined as the young-old (65-74 years), group 2 as middle-old (75-84 years) and group 3 as oldest-old (85 years and over).

2.2. Meteorological evaluation

Seasons were defined as follows: Spring (from March 1 to May 31), Summer (from June 1 to August 31), Autumn (from September 1 to November 30), and Winter (from December 1 to February 28). Daily minimum, maximum and mean temperature changes evaluated during the study period were obtained from the data recorded by the Directorate General of Meteorology of the Turkish Ministry of Agriculture and Forestry.

2.3. Exclusion criteria

The patients who were found to be diagnosed with chronic renal failure in the data processing system at the hospital and who were included in the routine dialysis program,, While examining the laboratory values of the patients, it was checked whether the patients whose glucose values were not within the normal reference values (70-105mg/dL) were diagnosed with diabetes in the hospital information processing system. Patients diagnosed with diabetes were excluded from the study. The patients under the age of 65 and the ones suffering from trauma were excluded from the study.

2.4. Data collection and measurements

We recorded serum urea, creatinine, sodium (Na), potassium (K) and Estimated Glomerular Filtration Rate (eGFR) values, sociodemographic data such as age and gender, and the highest daily air temperature at the time of admission of the patients included in the study based on the daily temperatures. We used the data defined according to the reference range of the central laboratory at our hospital. The normal reference range was determined as 16.6-48.5 mg/dl for the urea value, 0.7-1.2 mg/dl for the creatinine value, and > 60 ml / min./1.73m^2 for the eGFR value. The normal reference range was accepted as 3.5-5.1 mmol /L for potassium and 136-145 mmol/L for sodium in terms of dyskaliemia and dysnatraemia rates. Hypernatremia was defined as a serum sodium value above 145 mmol/L while hyponatremia was explained as a serum sodium value below 136 mmol/L. The serum potassium values above 5.1 mmol/L were classified as hyperkalemia, and the values below 3.5 mmol / L were categorized as hypokalemia. The blood samples of the patients are taken through BD Vacutainer® SST ™ II Advance Tubes (BD SST™ II Advance) blood collection tubes in our emergency department. Biochemical data are determined by means of a Cobas c 501 Automated Chemistry Analyzer (in Roche Hitachi Cobas C 501 System).

The research protocol was reviewed and approved on 18.09.2018 with the assignment of number 139 by the Clinical Research Ethics Committee of Gazi Yaşargil Training and Research Hospital at the University of Health Sciences. The study was conducted according to the Declaration of Helsinki.

2.5. statistical methods

SPSS 25.0 (IBM Corporation, Armonk, New York, United States) program was used for the analysis of the variables. The conformity of the data to normal distribution was evaluated by means of Shapiro-Wilk test. One-Way ANOVA, a parametric method, was used for the comparison of independent multiple groups according to the quantitative data. Test Tukey HSD and Games-Howell tests were preferred for post hoc analysis while the Kruskal-Wallis H test was used with the results of Monte Carlo simulation technique and Dunn's Test was utilized for Post Hoc analysis. A partial Correlation test was used for the examination of the correlations among the variables after their year and day factors were taken under control. The comparison of the categorical variables was tested through Chi-Square Monte Carlo Simulation technique. The column ratios were compared with each other and they were registered according to the results of Benjamini-Hochberg corrected p values. Quantitative variables were shown as mean ± SD (Standard Deviation) and median (Minimum) values in the tables while categorical variables were demonstrated with n (%). The variables were examined at 95% confidence level and the p values below 0.05 were accepted to be significant.

Results

29,225 patients were included in the study and they were defined according to the seasons. The patients in spring season were classified as group1 (n=7060), the ones in summer as group2 (n=7095), the patients in autumn as group3 (n = 6075), and the ones in winter as group4(n=8995). When we evaluated the groups in terms of increase and decrease in plasma sodium and potassium values according to seasonal changes, we found a statistically significant relationship between the conditions (p<0.001). The development rate of hyponatremia was higher in summer (17,3%),than in spring (12,3%), autumn (14,3%) and winter (10,7%) .While the rate of hypernatremia was higher in winter (15%) compared to summer (8,8%), which indicates a statistical significance in both cases (p<0.05). Similarly, it was observed that the elevated level of potassium (Hyperpotassemia) was higher in winter (16.6%) than in summer (14.3%). When we compared the genders, age and age groups of the patients according to the seasons, we did not find a statistical significance (p; 0.079, 0.065 and 0.172, respectively) Table 1.

When the seasonal groups were compared, urea and creatinine values were found to be statistically higher in summer when temperature values were high while sodium (Na), potassium (K), and eGFR values were detected to be low (p <0.001). The measured values were in the normal reference range. Considering the whole patient population, patients presenting to the ED in summer months had slightly higher values of urea and creatinine and lower value of eGFR on the average in comparison with the patients admitted to the service in the winter season. Table 2 shows the median values of urea, creatinine and eGFR and the averages of Sodium, Potassium and maximum temperature values according to seasonal temperature changes.

Spearman's rho correlation analysis was performed in order to assess whether there was a correlation between the change of daily temperature and urea, creatinine, sodium, potassium and eGFR values. When we evaluated the results, we found that there was a positive correlation between temperature changes and urea and creatinine while a negative correlation was detected between the aforesaid changes and sodium, potassium and eGFR levels. This correlation was recorded to be quite weak although there a statistical significance was observed (p<0.001). Table 3 illustrates the correlation between the change of daily temperature at the time of admission and eGFR values, and urea, creatinine, Na and K values.

The relationship between the seasonal changes, plasma sodium and age groups are demonstrated in Table 4. When we examine the horizontal and vertical interpretations of this table, we see in the vertical interpretation that the relationship between plasma sodium and seasons was statistically significant in the young-old, middle-old and oldest-old groups when it was evaluated according to the grouped ages (All P values; <0.001). The most obvious differences were examined in detail. Accordingly, the incidence of hypernatremia in the young, middle and oldest groups was at the highest level in winter months (p <0.05), while hyponatremia was higher in the young-old, middle-old and oldest-old groups in summer (p <0.05). When the relationship between plasma sodium and age were evaluated according to the seasons in horizontal interpretation, spring was not found to be statistically significant while a statistically significant relationship was detected in summer, autumn and winter seasons (P; 0.253, 0.001, 0.003 and 0.003, respectively). The most obvious differences were examined in detail and hyponatremia was seen to be more common in young-old and middle-old groups in autumn (p <0.05) while the incidence of hypernatremia was higher in middle-old and oldest-old groups in summer and winter months (p <0.05).

The relationship between seasonal changes, serum potassium and age groups are given in Table 5. When we examine the horizontal and vertical interpretations of this table, we see in the vertical interpretation that the relationship between serum potassium and seasons was statistically significant in the middle-old group while it was not statistically significant in the young-old and oldest-old groups when this relationship was evaluated according to the grouped ages (P-values; 0.114, 0.062 and <0.001, respectively). The most obvious differences were examined in detail. Accordingly, the incidence of hyperpotassemia in the middle-old group was at the highest level in winter months (p <0.05) whereas hypopotassemia was higher in

	Spring (A) (n=7060) Mean±SD	Summer (B) (n=7095) Mean±SD	Autumn (C) (n=6075) Mean±SD	Winter (D) (n=9885) Mean±SD	P
Age	76.11±7.37	76.21±7.52	75.88±7.39	76.15±7.41	0.065 [2]
	n (%)	**n (%)**	**n (%)**	**n (%)**	
Gender					
Female	3958 (56.1)	3882 (54.7)	3404 (56.0)	5103 (56.7)	0.079 [1]
Male	3102 (43.9)	3213 (45.3)	2671 (44.0)	3892 (43.3)	
Age groups					
Young-Old	3254 (46.1)	3229 (45.5)	2899 (47.7)	4136 (46.0)	0.172 [1]
Middle-Old	2765 (39.2)	2757 (38.9)	2293 (37.7)	3501 (38.9)	
Oldest-Old	1041 (14.7)	1109 (15.6)	883 (14.5)	1358 (15.1)	
Plasma sodium					
Hypernatremia	541 (7.7)	624 (8.8) [A]	489 (8.0)	1353 (15.0) [ABC]	**<0.001 [2]**
Hyponatremia	865 (12.3) [D]	1225 (17.3) [ACD]	870 (14.3) [AD]	962 (10.7)	
Normonatremia	5654 (80.1) [BCD]	5246 (73.9) [BD]	4716 (77.6)	6680 (74.3)	
Serum potassium					
Hyperpotassemia	1093 (15.5)	1017 (14.3)	954 (15.7)	1494 (16.6) [B]	**<0.001 [2]**
Hypopotassemia	263 (3.7) [D]	312 (4.4) [CD]	196 (3.2)	271 (3.0)	
Normokalemia	5704 (80.8)	5766 (81.3)	4925 (81.1)	7230 (80.4)	

Table 1. Electrolyte changes by season, age groups, and gender

summer (p <0.05). When the relationship between serum potassium and age were evaluated according to the seasons in horizontal interpretation, a statistically significant relationship was detected in spring, summer, autumn and winter seasons (P; 0.004, <0.001, 0.022 and <0.001, respectively). The most obvious differences were examined in detail and hyperpotassemia was seen to be at the highest rate in the oldest-old group in summer months and in middle-old and oldest-old groups in summer, autumn and winter months (p <0.05) while hypopotassemia was not found to be significant according to the age groups (p>0.05).

	Spring (A) (n=7060) Median (Min./Max.)	Summer (B) (n=7095) Median (Min./Max.)	Autumn (C) (n=6075) Median (Min./Max.)	Winter (D) (n=9885) Median (Min./Max.)	P
Urea (mg/dl)	43 (10 / 433)	45 (10 / 316)	44 (10 / 424)	42 (10 / 423)	**<0.001 [5]**
Creatinine (mg/dl)	0.93 (0.24 / 4.97)	0.98 (0.21 / 4.98)	0.94 (0.26 / 7.74)	0.92 (0.03 / 7.76)	**<0.001 [5]**
eGFR (CKD EPI) (ml/min/1.73m^2)	77 (7 / 90)	67 (7 / 90)	73 (5 / 90)	70 (5 / 90)	**<0.001 [5]**
	Mean±SD.	**Mean±SD.**	**Mean±SD.**	**Mean±SD.**	
Sodium (mmol/L)	140.04±4.54 [BCD]	139.64±5.46 [D]	139.76±4.78 [D]	140.72±4.87	**<0.001 [2 3]**
Potassium (mmol/L)	4.51±0.64 [D]	4.49±0.65 [CD]	4.53±0.63 [D]	4.56±0.63	**<0.001 [2 4]**
Maximum temperature ^{0} C	22.30±5.31 [BCD]	38.12±3.08 [CD]	25.12±8.30 [D]	10.05±4.02	**<0.001 [2 3]**

[2] OneWay ANOVA (Robuts Statistic: Brown-Forsythe); Post Hoc Test: [3] Games Howell, [4] Tukey HSD, [5] Kruskal Wallis Test (Monte Carlo); Post Hoc Test: Dunn's Test, SD: Standard Deviation, Min.: Minimum, Max.: Maximum

A Significant with respect to the spring season, B Significant with respect to the summer season, C Significant with respect to the autumn season, D Significant with respect to the winter season.

Table 2. Evaluation of the mean/median values of Urea, Creatinine, Sodium, Potassium, and eGFR by seasons

In the evaluation made on the basis of monthly temperature values, it was observed that the development rate of hyponatremia was at a higher level in July (p <0.001) when the highest temperatures were recorded throughout the year (Mean±SD. 39.69±1.81 C0). It was seen that the rate of hyperpotassemia was higher in January when the coldest values were recorded in terms of mean temperature in the year (Mean±SD.9.44±3.14 C^0) compared to other months and that the development rate of hypopotassemia was higher in July when the highest temperatures were recorded (Mean±SD. 39.69±1.81 C^0).

Discussion

As a result of the investigations we carried out in the planning phase of this study, we observed that there was limited evidence on the temperature changes and

	Maximum temperature degrees Celsius		**Sodium**		**Potassium**	
	r	**P**	**r**	**P**	**r**	**PA**
Sodium (mmol/L)	-0,101	<0.001	-	-	-	-
Potassium (mmol/L)	-0,034	<0.001	-0,074	<0.001	-	-
Urea (mg/dl)	0,024	<0.001	-0,047	<0.001	0,241	<0.001
Creatinine (mg/dl)	0,028	<0.001	-0,078	<0.001	0,221	<0.001
eGFR (CKD EPI) (ml/min/1.73m^2)	-0.029	<0.001	0,097	<0.001	-0,225	<0.001

Year and day effects of Partial Correlation Test have been kept under control, r: Correlation Coefficient

Table 3. spearman's rho correlation analysis

electrolyte imbalances in literature. Therefore, we believe that our study has provided significant results in terms of demonstrating the relationship between electrolyte imbalances due to seasonal temperature changes and renal dysfunction in the patients presenting to the emergency department in Diyarbakır, a city located in the southeastern region of Turkey where the continental climate is dominantly observed. It is a well-known fact that global warming has increasingly become an important cause of pathology over the years and that heat-related diseases affect many people every year. Diseases developing due to the increase in temperature are of great importance since they may vary from the conditions that can be treated with simple medical interventions such as sunburn, redness, edema, syncope, and cramps to the potentially life-threatening forms such as heat stroke and heat exhaustion resulting from the deterioration of thermoregulation mechanisms. It is known that there is a linear decrease in glomerular filtration rate (GFR) at a rate of 8 ml /min/1.73 m2/year on average in most of the patients at and over the age of 40 with or without kidney disease (8).

	Plasma sodium	**Young-Old n (%)**	**Middle-O n (%)**	**Oldest-old n (%)**	**P (age * plasma sodium)**
Spring					
	Hypernatremia	233 (7.2)	212 (7.7)	96 (9.2)	0.253
	Hyponatremia	395 (12.1) [II, III]	349 (12.6) [II, III, IV]	121 (11.6)	
	Normonatremia	2626 (80.7) [II, III, IV]	2204 (79.7) [II, III, IV]	824 (79.2)	
Summer					
	Hypernatremia	240 (7.4)	259 (9.4) [A]	125 (11.3) [A]	**0.001**
	Hyponatremia	552 (17.1)	486 (17.6) [IV]	187 (16.9) [I, III, IV]	
	Normonatremia	2437 (75.5) [BC]	2012 (73.0)	797 (71.9) [I, III]	
Autumn					
	Hypernatremia	215 (7.4)	196 (8.5)	78 (8.8)	**0.003**
	Hyponatremia	427 (14.7) [C]	350 (15.3) [C]	93 (10.5)	
	Normonatremia	2257 (77.9)	1747 (76.2)	712 (80.6) [B]	
Winter					
	Hypernatremia	558 (13.5) [I, II, III]	576 (16.5) [A I, II, III]	219 (16.1) [A I, II, III]	**0.003**
	Hyponatremia	444 (10.7) [II, III]	364 (10.4) [III]	154 (11.3)	
	Normonatremia	3134 (75.8) [BC]	2561 (73.2)	985 (72.5) [I, III]	
P (Seasons * Plasma sodium)		**<0.001**	**<0.001**	**<0.001**	

Pearson Chi-Square Test (Monte Carlo)

(A significant with respect to the young-old group, B significant with respect to the middle-old group, C significant with respect to the oldest-old group) when the relationship between plasma sodium and age was analyzed by being stratified according to seasons

(I significant with respect to spring group, II significant with respect to summer group, III significant with respect with autumn group, IV significant with respect to winter group) when the relationship between plasma sodium and seasons was stratified according to age.

Table 4. Relationship between plasma sodium and age groups according to seasonal changes

The studies in the literature have shown that the renal function and physiological changes in water and electrolyte homeostasis of elderly population may be mostly related to the mortality in elderly patients and that there is a decrease in renal tubular involvement of sodium and water in dehydration periods of elderly patients (9). The physiological mechanisms of the body strive to regulate the electrolyte and water balance in the event of hyperthermia and dehydration. Renal failure may occur as the glomerular filtration rate decreases. Elderly people are more vulnerable to the development of kidney disease related to increased heat due to decreased thermotolerance and weakened thirst (10). Studies conducted by Hansen et al. (11) have shown that the patients at or over the age of 85 constitute the highest risk group in terms of the electrolyte and renal dysfunctions, which may be the result of heat fluctuations, when compared to the patients at the age of 15-64. When we evaluated the increase and decrease in plasma sodium and potassium values due to seasonal temperature changes within the scope of our study, we found that the development rate of hyponatremia was higher in summer when the temperature values were high in terms of plasma sodium levels compared to winter and that the development rate of hypernatremia was at a higher level in winter, which indicates a statistical significance in both cases. Similarly, it was observed that the elevated level of potassium was higher in winter than in summer and these results were consistent with the literature. When the season groups were compared to each other in terms of urea, creatinine, and eGFR, urea and creatinine values were found to be statistically higher in summer when temperature values were high while sodium, potassium and eGFR values were calculated to be lower. Although this difference was statistically significant, no clinical significance was observed, and the measured values were in the normal reference range. This outcome was important for us since it demonstrated that the temperature increase could lead to electrolyte imbalance.

Malisova.O et al. (12) have illustrated in their study that the water demand is higher in summer months than in winter and that the loss of fluid due to sweating was about 1000 ml more in summer than in winter. Pfortmueller et al. (13) conducted a study in 2014 on the effect of excessive temperatures on the prevalence of electrolyte failure in the patients admitted to the ED, and they found out that the prevalence of hyponatremia was significantly elevated during the periods of high temperature and that there was a weak inverse correlation between daily maximum temperature changes and serum sodium and potassium. When we investigated whether there was a correlation between daily temperature changes and the values of urea, creatinine, eGFR, sodium, and potassium, we detected that there was a positive correlation between daily temperature changes and urea and creatinine levels and that the negative correlation between daily temperature changes and sodium, potassium and eGFR was statistically significant but very weak, which is compatible with the literature. We believe that this situation is caused by the increase in water and salt loss due to sweating at high temperatures, the decrease in fluid intake, and the inadequacy of regulatory mechanisms resulting from the increasing age. Older people have an increased risk of hyperkalemia, even in the absence of kidney disease. There are many factors contributing to this situation, including a decrease in the levels of plasma renin and aldosterone and a decrease in the GFR due to increasing age. Studies have shown that plasma aldosterone levels are lower in healthy elderly individuals than in young individuals. Relative hypoaldosteronism may cause the development of hyperkalemia in response to the basal potassium value with increasing age. If other potassium regulatory systems fail, this may contribute to increased susceptibility to hyperkalemia (14). In a 10-year retrospective study carried out by Zhao et al. (15) in 2013, sodium levels were found to be significantly lower in August than in the rest of the year. In another study conducted by Mauro G. et al. (16), it was observed that the prevalence of hyponatremia increased in the elderly patients admitted to the ED and that there was an important increase in the prevalence of hyponatremia in the old group in summer months when compared to the adult group. In our study, it was observed that the development rate of hyponatremia was higher in July when the highest temperature values were recorded, as seen in the evaluation based on the monthly temperature rates. However, in January, when the coldest values were recorded in terms of average temperature in the year, the rate of hyperpotassemia was observed to be higher than in other months, and it was seen that the development rate of hypopotassemia was higher in July, when the temperature values were at the highest level than in other months. This outcome is compatible with the literature and it demonstrates how significant the temperature changes are in terms of sodium and potassium alterations. Many studies have illustrated that older individuals have a higher risk of morbidity and mortality due to temperature changes than the young population. On the other hand, it has been concluded that there is a need for further research on the field of high temperature-related extreme death rates in the elderly population that is increasing worldwide (17). In the study carried out by Katherine G. Arbuthnott and Shakoor Hajat (18) in England on the impacts of temperature increases on the health under different climate change scenarios due to global warming in the future, it have been found out that hot summers and heat fluctuations had negative effects on health. By using different climate change scenarios, they have mentioned in all of the evaluations on heat-related effects that the temperature-related deaths would increase and that the increase in elderly population would contribute to the elevation of these rates, as seen in other studies.

In conclusion, we noticed in our study that electrolyte changes correlate with weather temperature changes in the patients admitted to the emergency department. For this reason, we aimed to draw the attention of the physicians to the high-temperature fluctuations in summer months due to the global warming and climate change, which have become increasingly important in recent years, and the heat-related diseases that may develop because of this situation. We believe that it is necessary to take precautions and raise the awareness of the society in order to protect the individuals and especially the elderly patient group from long term exposure to heat during the summer months.

Limitations

Our research is a single-centered study. We could not perform the long-term follow-up of the patients since the study was carried out on the blood tests of the patients at the time of admission in the emergency department. Therefore, we cannot make an explanation of the growing mortality rate related to the weather temperature increase. We do not have a detailed history on how long the patients have been exposed to heat, what the rates of their daily fluid intake are, whether they use diuretics or another medication resulting in a fluid loss, and whether there is an air conditioning system in their houses.

Conflict of Interest: The authors declare no any conflict of interest regarding this study.

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Authors' Contribution: The authors confirm sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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All authors declared that they follow the rules of Research and Publication Ethics.

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