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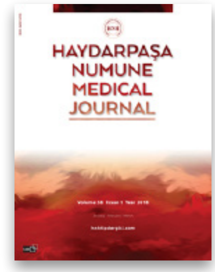


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ORIGINAL ARTICLE

# Correlation of Renal Colic Incidences with Season, Gender and Age: Cross Sectional Study

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## Abstract

**Introduction:** In this study we researched whether meteorological changes have an effect on the number of renal colic patients admitted to the hospital emergency department and moreover, whether this effect varies with gender and age.

**Methods:** 5661 patients admitted to the emergency medicine clinic of Fatih Sultan Mehmet Training and Research Hospital between the dates of January 2017 and December 2017 with renal colic complaints were retrospectively scanned with International Classification for Diseases- 10 (ICD 10) N23 (renal colic) code. Renal colic was diagnosed and treated by emergency medicine physicians. Average temperature and humidity values according to months were acquired from the Republic of Turkey Ministry of Forestry and Water Affairs General Directorate of Meteorology.

**Results:** The study was conducted with a total number of 5661 cases between the ages of 2 and 91. 3344 (59.1%) of the patients were male and 2317 (40.9%) were female. Average examination age of the cases was 41.58±14.63. There is a statistically significant difference between the seasons in terms of the examination ages of the cases (p=0.001). As a result of the dual comparisons, the average examination age of the cases in the summer season was found to be lower at a statistically significant level than the averages of the cases in Winter (p=0.001), Spring (p=0.001) and Fall (p=0.045) seasons (p<0.05).

**Discussion and Conclusion:** In our study, we detected that meteorological parameters have an effect on renal colic development and this effect varies according to the age and gender of the patient. Especially in the warmer months, male patients are more sensitive towards dehydration than female patients probably due to the hormonal mechanisms and thus the renal colic incidence is higher in these patients. Therefore, the suggestion is to increase fluid intake and not to stay dehydrated.

**Keywords:** Age; gender; meteorological parameters; renal colic; season.

Renal colic is a frequently encountered urologic emergency condition which frequently develops related to kidney stone disease, is diagnosed and treated in emergency departments and which emerges with severe pain. It frequently begins as a sudden pain that doesn't go away without treatment due to the obstruction of the upper urinary system. The cause is urolithiasis in 85% of the cases [1]. Approximately 600.000 patients are admitted to Emergency Services Departments annually in the USA [2].

The risk of a person going through a renal colic attack throughout their entire life is between 1-10% [3]. Stone disease incidence rate is approximately 15% in Turkey [4]. Male

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to female ratio is approximately 3-4:1 [5]. It usually peaks around the age of 30 in men and at the ages of 35 and 55 in women [6]. 5-12% of the population has the chance of experiencing renal colic due to stone in some period of their lives [7]. If untreated, its relapse rate can go up to 30%-40% while reoccurrence can be reduced with diet and appropriate pharmacologic treatments at rates reaching 50% [8, 9]. Costovertebral angle sensitivity is an important symptom in renal colic during the physical examination. Usually, microscopic hematuria, nausea and vomiting accompany colic pain. There is pressure increase in the urinary tract due to the stone preventing the urine flow. Edema and inflammation occur around the stone causing obstruction. Diuresis increases because of the prostaglandin excretion and it increases the spasmodic effect on ureteral smooth muscle and increases the severity of renal colic [10, 11].

Stone formation is a complex process which begins with crystallization and goes on to crystal formation with crystal growth, aggression and adhesion. This process continues with the addition of some chemical and environmental factors which have stimulant or repressive effects. Climate and temperature are also among the environmental factors which have stimulant effects on stone formation. A relationship between renal colic frequency and temperature increase is stated in many studies [13-16], but in some studies there wasn't a statistically significant relationship detected between this couple [17, 18]. In this study we researched whether meteorological changes have an effect on the number of renal colic patients admitted to the emergency departments and also whether this effect varies between genders and among years of age.

## Materials and Methods

5661 patients admitted to the Fatih Sultan Mehmet Training and Research Hospital emergency medicine clinic between the dates of January 2017 and December 2017 with renal colic complaints were retrospectively scanned with International Classification for Diseases- 10 (ICD 10) N23 (renal colic) code. Patients who were admitted with abdominal-flank pain complaints but were later diagnosed with diseases outside of the urinary tract stone disease such as acute appendicitis, ovarian torsion, pelvic inflammatory disease were excluded from the study. Renal colic was diagnosed and treated by emergency medicine physicians. Patients with repeated hospital visits were included in the study. Temperature and humidity values according to months were acquired from the Republic of Turkey Ministry of Forestry and Water Affairs General Directorate of Meteorology.

### Statistical Analyses

IBM SPSS Statistics 22 program was used in the evaluation of the results acquired in the study. Compatibility of the parameters with normal distribution was evaluated with Shapiro Wilks test in the evaluation of the study data. During the evaluation of the study data, on top of the descriptive statistical methods (Mean, Standard deviation, frequency), in the comparison of quantitative data; One-Way Anova test was used in the comparison of parameters showing normal distribution between the groups and Tamhane's T2 test was used in the detection of the group causing the difference. Kruskal Wallis test was used in the comparison of the parameters not showing normal distribution between the groups and Mann Whitney U test was used in the detection of the group causing the difference. Chi Square test was used in the comparison of qualitative values. Significance was evaluated at p<0.05 level.

## Results

The study was conducted on a total of 5661 cases with examination ages between 2 and 91 between the dates of January 1st, 2017 and December 31st, 2017. 3344 (59.1%) of the cases were male and 2317 (40.9%) were female. Average examination age of the cases was 41.58±14.63. There was a statistically significant difference in terms of the gender distribution rates of the cases admitted to the emergency department between the seasons (p=0.044; p<0.05) (Table 1). As a result of the paired comparisons carried out for the detection of the difference, it was found that the ratio of men admitted to the emergency department in fall (61.3%) was higher than the ratio of men admitted in the seasons of 1Winter (57.3%) and 2Spring (56.3%) while the ratio of women admitted to the emergency department during fall (38.7%) was found lower at a statistically significant level than the ratios of 1Winter (42.7%) and 2Spring (43.1%) seasons (p1=0.032, p2=0.020; p<0.05). There was no statistically significant difference found between other seasons in terms of gender distributions (p>0.05).

There was no statistically significant difference found between the months in terms of the gender distribution ratios of the cases admitted to the emergency department (p>0.05). There was a statistically significant difference between the seasons in terms of the average examination age of the cases (p=0.001; p<0.05). As a result of the paired comparisons carried out for the detection of the difference, it was found that the average examination age of the cases in the summer season was lower at a statistically significant level compared to the averages of the cases in Winter (p=0.001), Spring (p=0.001) and Fall (p=0.045) seasons (p<0.05). There is no statistically significant difference be-

**Table 1.** Evaluation of genders according to Months and Seasons

| | Gender | |
|---|---|---|
| | Male n (%) | Female n (%) |
| Season | | |
| Winter | 771 (57.3) | 574 (42.7) |
| Spring | 739 (56.9) | 559 (43.1) |
| Summer | 936 (60.3) | 617 (39.7) |
| Fall | 898 (61.3) | 567 (38.7) |
| p | 0.044* | |
| Month | | |
| January | 248 (56.8) | 189 (43.2) |
| February | 249 (57) | 188 (43) |
| March | 242 (57.6) | 178 (42.4) |
| April | 288 (59.1) | 199 (40.9) |
| May | 209 (53.5) | 182 (46.5) |
| June | 324 (60.9) | 208 (39.1) |
| July | 272 (58.6) | 192 (41.4) |
| August | 340 (61) | 217 (39) |
| September | 295 (65.1) | 158 (34.9) |
| October | 297 (60.7) | 192 (39.3) |
| November | 306 (58.5) | 217 (41.5) |
| December | 274 (58.2) | 197 (41.8) |
| p | 0.122 | |

Chi Square Test; *p<0.05.

tween other seasons in terms of the average examination age of the cases (p>0.05) (Table 2).

There was a statistically significant difference between the months in terms of the average examination age of the cases (p=0.001; p<0.05). As a result of the double comparisons carried out for the detection of the difference, it was found that the average examination age of the cases admitted in the month of August was lower at a statistically significant level (p<0.05) than the averages of the months of January (p=0.002), February (p=0.001), March (p=0.001), April (p=0.001), May (p=0.001), July (p=0.001), September (p=0.041), October (p=0.016), November (p=0.001) and December (p=0.001). There was no statistically significant difference found between the other months in terms of average examination age of the cases (p>0.05)

**Table 2.** Evaluation of examination age, temperature and humidity parameters between seasons

| Season | Examination age Mean±SD | Temperature Mean±SD (median) | Humidity % Mean±SD (median) |
|---|---|---|---|
| Winter | 42.4±15.22 | 6.8±1.03 (6.1) | 78.05±1.64 (78) |
| Spring | 42.69±14.67 | 12.05±3.6 (12) | 72.42±1.64 (73) |
| Summer | 40.06±14.05 | 22.98±1.14 (23.8) | 69.78±1.71 (69) |
| Fall | 41.45±14.51 | 15.63±3.42 (15.7) | 76.17±2.91 (77) |
| p | [1]0.001* | [1]0.001* | [2]0.001* |

[1]One-Way Anova Test; [2]Kruskal Wallis Test; *p<0.05.

For men;

There was a statistically significant difference between the age groups in terms of the distribution ratios of the months (p=0.001; p<0.05). As a result of the paired comparisons carried out for the detection of the difference, August distribution ratio of the cases between the ages of 15 and 39 (12.4%) was found higher at a statistically significant level than the ratios of cases between the ages of 40-59 (8.5%) and cases at the age of 60 and above (3.6%) (p=0.001; p<0.05). August distribution ratio of the cases between the ages of 40 and 59 (8.5%) was found higher at a statistically significant level than the ratio of the cases at the age of 60 and above (3.6%) (p=0.002; p<0.05). There was no statistically significant difference between other age groups in terms of the distribution ratios of the months (p>0.05) (Table 3).

**Table 3.** Evaluation of months between separate age groups in males and females

| Gender/Month | Age | | | | p |
|---|---|---|---|---|---|
| | <15 n (%) | 15-39 n (%) | 40-59 n (%) | ≥60 n (%) | |
| Male | | | | | |
| January | 1 (7.7) | 133 (7.3) | 90 (7.7) | 24 (7.1) | 0.001* |
| February | 1 (7.7) | 136 (7.5) | 80 (6.8) | 32 (9.5) | |
| March | 0 (0) | 129 (7.1) | 81 (6.9) | 32 (9.5) | |
| April | 0 (0) | 135 (7.4) | 118 (10.1) | 35 (10.4) | |
| May | 1 (7.7) | 110 (6) | 67 (5.7) | 31 (9.2) | |
| June | 2 (15.4) | 194 (10.7) | 99 (8.5) | 29 (8.6) | |
| July | 1 (7.7) | 158 (8.7) | 84 (7.2) | 29 (8.6) | |
| August | 1 (7.7) | 226 (12.4) | 100 (8.5) | 12 (3.6) | |
| September | 1 (7.7) | 146 (8) | 125 (10.7) | 23 (6.8) | |
| October | 1 (7.7) | 153 (8.4) | 120 (10.2) | 23 (6.8) | |
| November | 2 (15.4) | 157 (8.6) | 116 (9.9) | 30 (8.9) | |
| December | 2 (15.4) | 143 (7.9) | 91 (7.8) | 37 (11) | |
| Female | | | | | |
| January | 0 (0) | 78 (8.1) | 77 (8.4) | 34 (7.9) | 0.021* |
| February | 0 (0) | 75 (7.8) | 68 (7.4) | 45 (10.5) | |
| March | 0 (0) | 68 (7.1) | 82 (9) | 28 (6.5) | |
| April | 0 (0) | 81 (8.5) | 85 (9.3) | 33 (7.7) | |
| May | 0 (0) | 69 (7.2) | 76 (8.3) | 37 (8.6) | |
| June | 0 (0) | 91 (9.5) | 73 (8) | 44 (10.3) | |
| July | 2 (18.2) | 74 (7.7) | 75 (8.2) | 41 (9.6) | |
| August | 2 (18.2) | 114 (11.9) | 71 (7.8) | 28 (6.5) | |
| September | 2 (18.2) | 70 (7.3) | 60 (6.6) | 24 (5.6) | |
| October | 4 (36.4) | 84 (8.8) | 71 (7.8) | 33 (7.7) | |
| November | 0 (0) | 81 (8.5) | 94 (10.3) | 42 (9.8) | |
| December | 1 (9.1) | 73 (7.6) | 84 (9.2) | 39 (9.1) | |

Chi Square Test; *p<0.05.

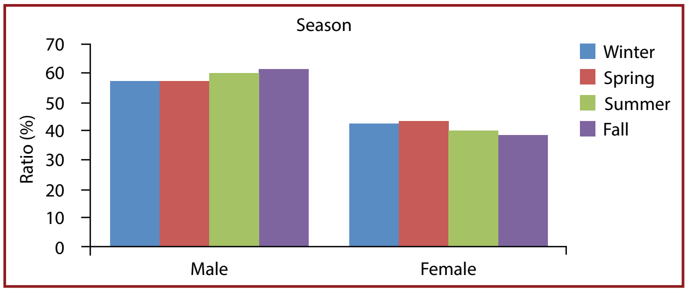


**Figure 1.** Renal colic incidences according to the seasons between male and female patients.

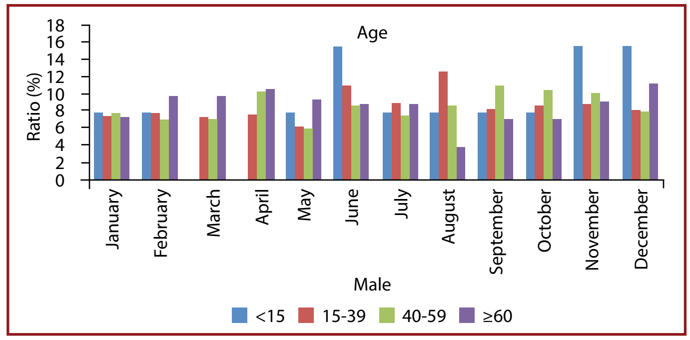


**Figure 2.** Renal colic incidences according to the months between age groups of <15, 15-39, 40-59, and >60 years.

## Discussion

Renal colic is a disease frequently observed in emergency departments and it is characterized with colic type pain. Effects of climate changes on renal colic attacks were researched in countries with different geographical characteristics and different results were achieved. In most of the studies, it is stated that there is an increase in the frequency of renal colic with the increase of the temperature [13-16, 19].

There have been some theories derived to explain the relationship between temperature increase and renal colic frequency. One of these is the increase of vitamin D synthesis and the other is the dehydration theory [14-16-20].

In the vitamin D synthesis theory, the formation of kidney stone is linked to the increase of vitamin D synthesis which increases with sunlight [20]. In the dehydration theory, stone formation occurs in the urinary system because of the decreased urine volume and increasing crystallization due to inadequate fluid intake and perspiration in hot climates [13-21].

In a study conducted in the USA, Tom H. Brikowski et al. reported that the number of patients who had RC was influenced by the temperature and that the rates in the north, south and intercontinental regions were different [22]. A study conducted in Italy by Gervellin et al.[21] using 7-year data of patients determined a strong positive correlation between the number of RC patients in the emergency department and air temperature.

The results of this study show that there is a clear absolute increase in the renal colic incidence during the summer months (27.4%). This is probably related to the increased average monthly temperatures during the summer. Indeed, this is supported by the important correlation between the number of renal colic patients and monthly average maximum temperature. Moreover, August had the highest average temperature (23.8 C) and number of renal colic patients (557-9.8%).

In some studies, it has been stated that gender and age affect renal colic incidences seasonally while in different studies it has been stated that there is no such effect. For example, in a study conducted by Pincus et al. [16] in Melbourne, Australia, it was stated that age and gender do not have a clear effect on renal colic incidence seasonally. On the contrary to this, in the New Jersey study, the effect increased with increasing age and was greater in males. In our study, August distribution rate (12.4%) of the male patients between the ages of 15 and 39 were found higher at a statistically significant level (p=0001) than the cases between the ages of 40 and 59 (8.5%) and cases at the age of 60 and above (p=0.001; p<0.05) In a study on US troops in a region with high possibility of renal stones, Evans et al. [23] found that the estimated average duration between formation of kidney stone and symptoms was 93 days. This supports the increased renal colic incidences with the temperature increases starting in the months of May and June and especially in the month of August in our study. It is believed that the renal colic incidences are more frequent especially in the 15-39 age group male patients who are more active in the daily life due to more fluid loss with perspiration and more exposure to the solar rays.

A negative correlation was determined between daily relative humidity and the number of female RC patients. However, the increase in the number of patients along with temperature increase was found not to be related to gender [24]. In our study, there was no statistically significant correlation observed between humidity and seasonal renal colic incidences.

There are several limitations to this study. Cases were selected on their discharge diagnostic code. As this was sometimes based on clinical criteria, rather than examination results, a small number of cases may not have been renal colic. The retrospective nature of the study did not allow determination of whether the cases were presentations caused by a new stone or recurrent presentations because of a stone that remains unpassed. There may be a delay between renal stone formation and clinical manifestation. In this study, patients were identified by the use of International Classification of Diseases 10th (ICD-10) revision discharge codes. These codes are assigned based on the discharge diagnosis of the emergency department staff and there may be some variability in how staffs identify renal colic patients. Although there are guidelines on the diagnosis and management of renal colic that are followed by most staff, some patients may have been misclassified.

## Conclusion

While the effects of meteorological parameters on the number of renal colic patients admitted to the emergency departments vary in different studies, in our study we detected that the meteorological parameters have effects on renal colic development and this shows variability according to the age and gender of the patients. Although it cannot be more than a comment, since the number of renal colic incidences increases in male patients as they are more sensitive towards dehydration especially in the warmer months compared to female patients possibly due to hormonal mechanisms, it is suggested to increase liquid intake and to not stay dehydrated.

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**Authorship Contributions:** Concept: A.Ş., A.Ü.; Design: A.Ş., Ç.Y., S.A.; Data Collection or Processing: A.Ş., Ç.Y., S.A.; Analysis or Interpretation: A.S., D.G., Ö.H.Y.; Literature Search: A.Ü., D.G., Ö.H.Y.; Writing: A.Ş., A.Ü., S.A., Ç.Y.

**Conflict of Interest:** None declared.

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