

Climatic Effect on Rheumatoid Arthritis

Romatoid Artrite İklimin Etkisi

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ABSTRACT Objective: We aimed to investigate the relationship between climatic changes and hospital admissions that are registered as rheumatoid arthritis according to ICD-10 coding registry at the Atatürk University Hospital, located in Erzurum city center. **Material and Methods:** The study included 3 033 193 patients presenting to the Atatürk University Hospital outpatient clinics, including emergency admissions between January 2008 and December 2011. Data from 2 151 952 cases (70.9% of total applications) aged between 18-105 years were included in the study. A total of 29 966 patients who were registered as RA (ICD 10 code M06) or seropositive RA (ICD 10 code M05), according to the ICD-10 coding registry system, were selected. Statistical analyses were run to find out a possible relationship between daily number of hospital admissions due to RA or seropositive RA and studied climatic parameters. **Results:** The mean age was 47.06±16.3 years. Yearly mean relative humidity and mean atmospheric pressure was 68.1±13.96 %, and 822.73±5.97 hPa respectively. Yearly median temperature, precipitation, and wind speed was 5.88 (-27.9-24.9; 6.9)°C, 3.90 (0.1-28.0; 1.0) kg/m², and 3.73 (0.3-12.5; 2.7) m/sec, respectively. Pearson's correlation analysis showed a significant but weak positive correlation between the number of admissions and precipitation, as well as wind speed, and a weak negative correlation with atmospheric pressure (r and p; 0.161 and <0.001; 0.122 and 0.011; -0.065 and 0.040, respectively). There was no correlation between the number of RA patients and temperature, relative humidity, and wind directions (p>0.05). In linear regression analysis, wind speed was a significant independent variable affecting the daily number of admissions of RA patients (p<0.001). **Conclusion:** The relationship between meteorological variables and daily admissions to hospital outpatient clinics due to RA is weak.

Key Words: Climate; temperature; atmospheric pressure; humidity; wind; arthritis, rheumatoid

ÖZET Amaç: Erzurum şehir merkezindeki Atatürk Üniversitesi Hastanesi polikliniklerine başvuranlarda ICD-10 kodlama sistemine göre romatoid artrit (RA) olarak kaydedilen günlük hasta sayıları ile iklim değişiklikleri arasındaki ilişkiyi araştırmayı amaçladık. **Gereç ve Yöntemler:** Ocak 2008 ile Aralık 2011 tarihleri arasında toplam 3 033 193 hasta Atatürk Üniversitesi Hastanesi polikliniklerine başvurdu (acil başvurular dâhil). Yaş aralığı 18-105 olan 2 151 952 hastanın (toplam başvuruların %70,9'u) verileri çalışmaya dahil edildi. Bunlardan ICD-10 kodlama sistemine göre romatoid artrit (ICD kodu M06) veya seropozitif romatoid artrit (ICD kodu M05) olarak kaydedilmiş olan toplam 29 966 RA'lı hastanın verisi çalışmaya alındı. RA nedeniyle hastaneye başvuran günlük hasta sayısı ile iklimsel değişkenler arasındaki ilişkiyi değerlendirmek için analizler yapıldı. **Bulgular:** Ortalama yaş 47,06±16,3 yıldır. Yıllık ortalama nem ve atmosfer basıncı sırasıyla %68,1±13,96 ve 822,73±5,97 hPa idi. Yıllık ortalama sıcaklık, yağış miktarı ve rüzgâr hızı sırasıyla 5,88 (-27,9-24,9; 6,9) °C, 3,90 (0,1-28,0; 1,0) kg/m² ve 3,73 (0,3-12,5; 2,7) m/saniye idi. Pearson korelasyon analizinde RA nedeniyle hastaneye başvuru sayısı ile yağış ve rüzgâr yönü arasında zayıf pozitif korelasyon, atmosfer basıncı ile zayıf negatif korelasyon olduğu görüldü (r ve p sırası ile; 0,161 ve <0,001; 0,122 ve 0,011; -0,065 ve 0,040). RA nedeniyle günlük başvuru sayısı ile sıcaklık, nem ve rüzgâr yönü arasında ilişki yoktu (p>0,05). Lineer regresyon analizinde rüzgâr hızının, RA nedeniyle başvuru sayısını etkileyen bağımsız bir değişken olduğu görüldü (p<0,001). **Sonuç:** İklimsel değişkenler ile RA nedeniyle hastane polikliniklerine başvuru sayısı arasında zayıf bir ilişki vardır.

Anahtar Kelimeler: İklim; ısı; atmosfer basıncı; rutubet; rüzgâr; artrit, romatoid

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Environmental factors play important roles on health.^{1,2} There is a common belief that arthritis pain is influenced by the weather. Several studies investigated the effect of climatic changes on diseases and chronic pain conditions.³⁻⁵ Since the time of Hippocrates it is believed that climatic conditions have some effects on chronic pain conditions.⁶ Analysis of the relationship between climatic conditions and human health and interpreting the results with regard to healthcare might be useful. There are only limited studies from Turkey addressing this issue.⁷⁻⁹

This study aimed to investigate the relation between climatic changes and hospital admissions due to rheumatoid arthritis in Erzurum, which is a city with 700 000 inhabitants, located in Eastern Turkey, with an altitude of approximately 1900 meters showing a typical continental climate. It is one of the unique cities in the world with such a population at the given altitude.

We decided to review the hospital admissions to a tertiary hospital in Erzurum within 4 years and to look for any relationship between sex, age, and climatic variables. The primary aim was to investigate the correlation between hospital admissions due to rheumatoid arthritis and aforementioned climatic changes.

We aimed to find out if there was a correlation between daily hospital visits due to RA and daily mean climatological parameters, such as temperature, relative humidity, precipitation, atmospheric pressure, wind speed, and wind direction. The data on climatic variables were obtained from the Turkish State Meteorological Service.

MATERIAL AND METHODS

STUDY DESIGN

This is an observational cross-sectional ecological study.

SETTING AND SAMPLE SIZE

The study was conducted in Erzurum, a city with 700 000 inhabitants located at an altitude of around 1900 meters in the northeastern part of Turkey. Atatürk University Hospital is the only tertiary

hospital in the region with 1341 bed capacity. Between January 2008 and December 2011, 3 033 193 patients presented to the Atatürk University Hospital outpatient clinics, including the emergency units. After exclusion of patients below 18 years of age, the data of 2 151 952 cases (70.9% of total applications) at an age range of 18-105 years were included in the study.

Patient data were obtained from the main hospital registry. According to the International Classification of Diseases (ICD-10) patients with "Rheumatoid arthritis (M06)" and "Seropositive rheumatoid arthritis (M05)" were selected; 23 859 patients were coded as M06 and 6 107 patients were coded as M05, which made a total of 29 966 patients (1.39% of the included sample) with rheumatoid arthritis (RA).

Daily mean climatological parameters of temperature, relative humidity, atmospheric pressure, wind speed and daily average wind direction were obtained from the Turkish State Meteorological Service. Analyses were done to determine the correlation between the daily number of diagnoses and studied meteorological parameters.

STATISTICAL ANALYSIS

Data were given as mean, standard deviation (SD), median, minimum and maximum. Statistical analyses were done using the SPSS version 20 software. One-way analysis of variance (ANOVA), Chi Square test, independent samples t test, correlation analyses and linear regression analyses were performed. Pearson's correlation coefficient was given. Statistical significance level p was set as 0.05.

POWER ANALYSIS

The post-hoc sample size calculation was based on the main outcome "number of daily applications" and its correlation with climatic variables.

A sample size of 29 966 achieves 99.6% power to detect a difference of 0.01 between the null hypothesis correlation of 0.8 and the alternative hypothesis correlation of 0.79 using a two-sided hypothesis test with a significance level of 0.05.¹⁰

RESULTS

Data of 29 966 patients who were between the ages of 18 and 105 years were analyzed (Figure 1). Mean age \pm SD was 47.06 \pm 16.3 years. Of the included patients, 9296 (31.0%) were males and 20 670 (69.0%) were females. Female to male ratio was 2.2.

Prevalence of RA was 1.39% in patients over 18 years who presented to a tertiary hospital. There was no significant difference between the ICD-10 coding registry system diagnosis and gender or age (Table 1).

Yearly mean relative humidity and mean atmospheric pressure was 68.1 \pm 13.96% and 822.73 \pm 5.97 hPa. Yearly median temperature, precipitation and wind speed was 5.88 (-27.9-24.9; 6.9) °C, 3.90 (0.1-28.0; 1.0) kg/m² and 3.73 (0.3-12.5; 2.7) m/sec, respectively.

Pearson's correlation analyses showed a weak positive correlation between the number of hospital admissions and precipitation as well as wind speed and a weak negative correlation with atmospheric pressure (r and p ; 0.161 and <0.001; 0.122 and 0.011; -0.065 and 0.040, respectively, Figure 2). There was no significant correlation between the number of patients presenting to the hospital and

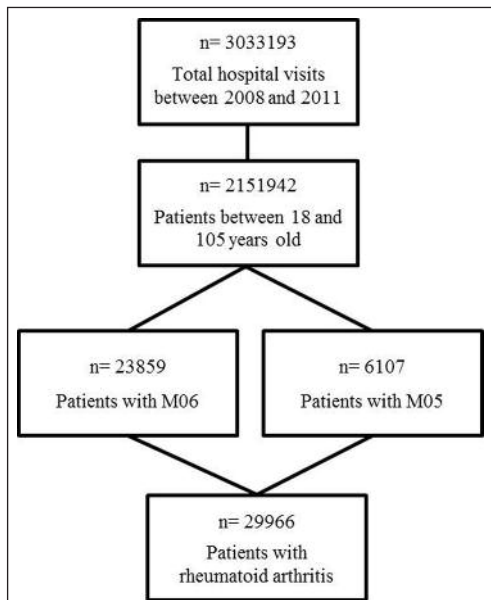


FIGURE 1: Study flow diagram.

TABLE 1: Distribution of gender and age according the ICD-10 coding registry system diagnosis.

	M05	M06	p value
Gender [n/(%)]			
Male	1883/(30.8)	7413/(31.0)	0.721
Female	4224/(69.1)	16446/(68.9)	
Age [mean \pm SD]	47.30 \pm 16.17	46.93 \pm 16.42	0.095

M05: Rheumatoid arthritis; M06: Seropositive rheumatoid arthritis; SD, standart deviation.

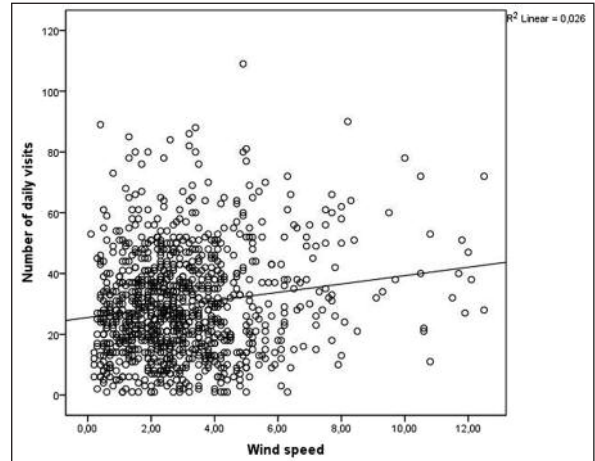


FIGURE 2: The correlation between the number of daily visits due to rheumatoid arthritis and wind speed.

temperature or relative humidity ($p=0.907$ and $p=0.933$, respectively).

There was no significant correlation with the mean number of patients presenting to the hospital and wind directions ($p=0.303$, Table 2).

We established a linear regression model to check for factors independently affecting the number of daily admissions ($p<0.001$). Temperature, relative humidity, atmospheric pressure, wind speed, and precipitation were used as independent variables [Number of daily admissions= $77.50-0.106*(\text{temperature})-0.096*(\text{relative humidity})-0.067*(\text{atmospheric pressure})+1.816*(\text{wind speed})+0.367*(\text{precipitation})$] (p values 0.397, 0.297, 0.772, <0.001 and 0.069, respectively). Among the factors studied, wind speed was associated with a significantly increased number of admissions with RA ($p<0.001$).

TABLE 2: Daily number of patients according to wind directions.

Wind direction (n=number of the total days)	Daily number of patients	
	Mean	SD
East (n=316)	27.90	16.81
East North East (n=222)	35.35	17.57
East South East (n=18)	25.43	13.72
North (n=76)	22.00	13.92
North East (n=177)	30.53	18.27
North North East (n=23)	34.20	19.34
North North West (n=23)	31.71	17.75
North West (n=52)	23.09	14.02
South (n=83)	27.22	19.12
South East (n=34)	31.17	18.48
South South East (n=14)	28.77	15.71
South South West (n=86)	28.75	19.00
South West (n=214)	29.42	12.42
West (n=220)	29.89	17.13
West North West (n=56)	26.20	18.15
West South West (n=212)	30.47	17.19

SD: Standard deviation.

DISCUSSION

This study revealed a weak relationship between meteorological parameters and the frequency of daily admissions with the diagnosis of RA. Results of the linear regression model support the relation between wind speed and precipitation to some extent.

In the literature, there is no consensus on the effects of climatic parameters on RA. Although the effect of temperature, relative humidity and atmospheric pressure on RA have been studied extensively the number of reports on wind speed and wind direction are limited.¹¹ Our study revealed a significantly correlation between the daily number of hospital visits with RA and wind speed, and a weak negative correlation with atmospheric pressure but there was no significant correlation with temperature, humidity, precipitation and wind directions.

Gorin et al. reported that pain levels were highest on cold, overcast days and the days with high barometric pressure.¹² In contrast, Wilder et al. suggested that pain and weather conditions had no correlation.¹³ In a much recent study, Macfar-

lane et al. studied the effect of weather on reported pain and concluded that weather influenced reported pain; however, they suggested that the relation might be at least partly mediated by lifestyle factors such as cooler and cloudy days being associated with less exercise, poorer sleep, and higher reported boredom.¹⁴ Brennan found that pain level increased as a function of absolute change in atmospheric pressure from one day to the next. Precipitation and temperature were not shown to influence pain severity.¹⁵ Gorin et al. suggested that although weather sensitivity was shown to affect pain, the effect sizes were not clinically significant.¹² Cold and damp conditions were considered to influence pain the most. However, the perceived effect of weather on pain was not related to regional climate. Thus, the belief that pain is worsened by living in a colder climate was not confirmed.¹⁶ It was shown previously that in contrast to classical knowledge, daily number of admissions due to "Pain in joint" had a negative correlation with relative humidity and a positive correlation with atmospheric pressure in Erzurum.¹⁷

Lack of a correlation between hospital visit, and temperature and relative humidity is consistent with the data in other reports.¹¹ We observed no correlation between the number of hospital visits and relative humidity and wind direction. According to classical knowledge, rheumatic symptoms worsen in response to falling barometric pressure.¹⁸ Our results support the relation between hospital visits and barometric pressure.

An interesting finding of our study was the correlation between the number of daily hospital visits due to RA with wind speed. The correlation of hospital admissions due to RA with wind speed were questionable and showed no clear relation, which was consistent with the literature.¹⁹ A number of studies investigated the effects of wind speed on diseases.^{20,21} Therefore, the impact of meteorological factors on health needs further evaluation.

STUDY LIMITATIONS

The most important limitation of this study may be the coding errors. Generally coding of the illnesses

is made by the department secretaries who might not be precise about the codes. One other limitation of this study is patients coming from other neighboring cities where the altitude and other climatic parameters differ. Erzurum is the only tertiary hospital in the Northeastern region of Turkey, and receives many patients from other cities in this region.

CONCLUSION

After overall analyses of our data, we conclude that there are weak associations between hospital visits due to RA and the climatic parameters. Although there are some controversies, this conclusion is consistent with the general literature.

When compared with therapeutic medicine, prevention is even a greater task for health professionals. Possible new findings on the relationship between climate and health may guide the development of new preventive strategies.

There is a significant body of research on climatic effects on health. Unfortunately, until now the effects of climate on patients with RA could not be clearly demonstrated. Investigating the effects of additional climatic parameters on patients with RA without the limitations mentioned in this study will aid the development of new preventive strategies.

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